



**MISA LUMINOUS SPARK  
2021**



**PROCEEDINGS  
OF FIRST  
INDIAN CONFERENCE  
ON  
CONVERGENCE IN  
TECHNOLOGY  
2021**

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**Dr. Kavita Aggarwal**



**‘Educators have three loves: love of learning, love of learners, and the love of bringing the first two loves together.’**

With a career spanning over four decades in the field of education, I feel honored to have had such a rich, diverse and significant experience in the various dimensions of teaching and contribute effectively towards building a brighter future generation.

Doctorate in Education Management and a rich experience of 40 years in the Education Industry as a leader and an educator has allowed me to share my expertise and knowledge at the national and international educational platform. Since then the face of education has changed significantly and it feels great to be a part of driving this positive change!

I have been the Principal of leading National and International schools and have set up systems, policies, and procedures; procured affiliations, trained and mentored teachers including Vice-Principals / Principals and administrative staff.

My expertise lies in setting up new schools affiliated with Cambridge International Examinations (CAIE), Cambridge, UK, and CISCE curricula owing to which I have consulted on various projects for new schools right from inception to complete functioning.

I am also heading as Chairperson of ‘**Members of International Schools Association**’ (MISA), a prestigious organization of 110 Cambridge schools in the country affiliated to CAIE.

**MISA ( Members of International Schools Association )** was initiated by me in 2007 with few like-minded people to empower teachers and help schools to overcome the academic & administrative hurdles of the Cambridge curriculum. The main objective of MISA is to empower the teachers and school leaders in managing the international curriculum.

Currently, I am associated as Director/Head of School with D. G. Khetan International School, Malad West. Being the Founder Principal of this school right from its inception in 2006 affiliated with Cambridge International U.K.

I have attended various conferences as a Speaker and Moderator at National and International platforms. My views and opinions with regards to the education sector have been published in various newspapers and magazines. I'm also humbled to be a recipient of many awards for my outstanding efforts and contribution to the field of education.

I have always believed that the all-around development of the students means their development in **IQ, SQ, EQ & AQ** along with their physical development I truly believe that if our words and actions inspire our students to dream more, learn more, do more, and become more, then we are on the path to creating responsible future leaders.

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- **Dr.Hari Krishna Maram, Digital Brand Ambassador and Chairman of Vision Digital India & Vice Chancellor Global Digital University USA , Director - Stayfit Pvt Ltd**
- He has an illustrious career in education and has served as the Governing Council Member at AIMA (All India Management Association), Managing Committee Member CII , Chairperson - International Facility Management Association (IFMA ) ,Vice President at AIMS (Association of Indian Management Schools).
- Additionally, he was Honorable Secretary-BMA (Bangalore Management Association), Treasurer-Education Promotion Society for India (EPSI) South India, Executive Board Member at NIPM and Chairperson Higher Education Forum – Karnataka.
- His efforts in management education have been recognized on numerous occasions by the Government of India. He is also a part of the UGC Committee.
- Throughout his lifetime, he has received various awards like Prestigious Knighthood Award from UK, MTC Global Top 10 Thinkers, "

## Speaker 2: Dr Tamasi Kar



- PhD in Experimental Particle Physics, Physikalisches Institute University of Heidelberg, Germany
- Thesis: “A Triplet Track Trigger for Future High Rate Collider Experiments” | Advisor: Prof. Dr André Schöning
- Postdoctoral Scholar at Physikalisches Institute, University of – present Heidelberg, Germany
- Project Description: “Detailed and realistic Geant4 simulations and
- Triplet Track Trigger studies for Future Circular Collider Experiments”
- Summer Intern at the Visiting Student Research Program, TIFR, Mumbai  
Project Title: “A study of the statistics involved during the microseconds of the Universe (the Quark Gluon plasma state) using Boltzman
- Transport Equation” | Supervisor: Prof. Sourendu Gupta

## **Speaker 3 : APMJ.SHEIK DAWOOD**



- Grand Nephew of Dr. APJ Abdul Kalam
- Managing Trustee of Dr. APJ Abdul Kalam International Foundation
- Sheikh Dawood holds a M Tech Degree in the field of computer Science from SASTRA Deemed University
- He has worked in IIT Bangalore with Prof Dr. Sadagopan for Various IT related projects.
- Sheikh was employed in Archive.org, Sanfrancisco, USA as a Research fellow with its founder Brewster Kahle, for the Internet Archive.
- His current role involves partnering with Microsoft India as a Cloud Evangelist and spreading the cloud Adaptation in India

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9. Ms Nitu Singh : APS School
10. Professor Chaudhary Vivek : DG Khetan International School
11. Ms Kovita Gupta : DG Khetan International School



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## PNEUMONIA DETECTION USING TRANSFER LEARNING AND CONVOLUTIONAL NEURAL NETWORKS

**Aarav Jain**

Prabhavati Padamshi Soni  
International Junior College  
aarav8304@gmail.com

### Abstract

This paper outlines the advantages of using transfer learning on pre-trained convolutional neural networks and the problems transfer learning solves for Pneumonia detection. Seven pre-trained models are used for Pneumonia detection along with one convolutional neural network trained from scratch. This paper also concludes why ResNet-50 [1] performs best for detecting pneumonia given an x-ray scan, and the reasons why this particular model works best with respect to its architecture, data it was initially trained with and the number of parameters the pretrained model has among many other things. ResNet-50 [1] achieves the highest validation accuracy of 93.27% with just 5216 files of image training data.

**Keywords-***Transfer learning, Pneumonia, Convolutional Neural Networks, Image Classification, Resnet-50, Supervised Learning*

### Introduction

Pneumonia killed more than 800,000 children in 2017 [2] who were under the age of 5. Pneumonia also accounts for 15% of all deaths of children under 5 years. It transmits in many ways, air-borne droplets from coughing and inhalation of bacteria found commonly on one's throat are just a few ways Pneumonia can spread. Additionally, Pneumonia is one of the most misdiagnosed conditions.

Given the high number of covid-19 cases, Pneumonia being caused due to covid-19 have also seen an alarming rise in recent times. To detect Pneumonia given an x-ray scan of the patient's lungs, radiologists search for white spots near the lungs which are called infiltrates. However, to speed up this process of searching for these infiltrates while reducing the error rate in detecting them, an image classifier made using convolutional neural networks could be trained to detect these infiltrates instead.

However, few problems arise. Often enough data is not available, especially tasks related to medical and healthcare. This lack of data, could lead to unacceptable accuracies and overfitting of the training dataset for detecting pneumonia using convolutional neural networks. Also, when high accuracies are needed, it is common to increase the total number of layers and hidden units of a neural network. This increases computational costs and time taken to train the neural network significantly. Hence, a solution to this problem is a technique called "transfer learning". A pretrained model is taken with its weights already set according to a dataset with a



large number of image files, such as the ImageNet dataset [3], and then training on our personalized dataset takes place on the last few layers of the neural network, which help classify the given input image into different classes. Of course, this idea of transfer learning could be applied to different problems in this domain apart from image classification too, such as image segmentation and object detection.

This method of diagnosis of Pneumonia can replace the need for patients to undergo several tests, such as Blood tests, Pulse oximetry, Sputum test, CT scans and Pleural fluid culture. Additionally, as these tests may not be needed to diagnose Pneumonia, this will speed up the diagnosis process, hence reducing the strain on hospital resources.

### Theory

A convolutional neural network used for classification of an input image to a particular class can be thought of by dividing the neural network into two different sections: Feature learning and Classification. A convolutional neural network is used to respect the spatiotemporal features of an image, as flattening the image into a vector in the first layer itself, without performing convolutions, will lead to the loss of the spatiotemporal features.

One of the main problems with medical imaging analysis is the lack of data available. However, due to the lack of data it could be difficult to train the data without overfitting. Overfitting leads to low validation accuracy as it memorizes specific attributes from the training dataset which do not generalize well to the rest of the data. However, transfer learning avoids the problem of overfitting by training a network on a very large dataset, one which generalizes very well. Hence, we can use these layers which do not overfit for predictions for another dataset, leading to higher validation accuracies. This can be done as the first few layers of the neural network learn generic features which are commonly required by the network to detect and perform tasks. These generic features, for example, are lines, colours, edges and shapes amongst many others.

Using such a method has multiple benefits, such as faster training times, higher validation accuracies with a low data size and lower computational costs.

Firstly, using transfer learning, the model can be trained faster. The first few layers of the neural network do not require to be trained as they are pre-trained to recognize lower level generic features of an image like edges, curves and lines. Hence backpropagation computations do not need to be done on these layers of the neural network and hence as a result of smaller number of computations, the training time reduces.

Additionally, we can get very accurate results even if small amounts of data is available. Transfer learning reduces the problem of overfitting as it has already learnt to recognize generic features of an image such as lines, curves and edges and depending on the data the pretrained model was trained with, it would also have learnt to recognize higher level features of an image, such as being able to detect colours, shapes, patterns, sizes and even objects. This happens as the pretrained weights used to recognize these generic features are a lot more accurate in doing so due to the high dataset size which prevents from overfitting. Thus, by using these pretrained weights, we can customize the last few layers to our data as those layers usually learn features which are a lot more specific to a particular dataset and hence get more accurate results.



Lastly, convolutional neural networks can have many parameters that need to be trained, as a result, the computational costs are quite high. Transfer learning reduces the computational costs due as the pretrained parameters do not need to be trained. Typically, only the last layer of the neural network, which is used to generate a probability distribution for the possible classes that the input image could belong to, needs to be trained when we use transfer learning, hence avoiding the need to train multiple hidden convolutional and fully connected layers.

### Experimental

Binary cross entropy was selected as the appropriate loss function for this task as there are only two class labels: Pneumonia and no Pneumonia.

The Adam optimization algorithm was used for the training of the neural networks due to the faster convergence of the neural network especially after the loss becomes lower compared to the results obtained using Stochastic Gradient Descent.

Eight different models were trained for this task, seven pretrained models (DenseNet [4], EfficientNet [5], InceptionNet [6], MobileNet [7], ResNet-50 [1], VGG16 [8] and Xception [9]) used by transfer learning whose weights were pre-trained on ImageNet [3] and one Convolutional Neural Network trained from scratch. The results below show which models give the most accurate results. The models were trained on one GPU on Google Colaboratory.

The dataset used was “Labeled Optical Coherence Tomography (OCT) and Chest X-Ray Images for Classification” distributed by Mendeley Data [10]. The training dataset consists of 5216 files belonging to 2 classes (pneumonia and no pneumonia), while the validation dataset consists of 624 files belonging to 2 classes (pneumonia and no pneumonia). The neural networks were trained for 10 epochs. A batch size of 32 was selected. Additionally, all images were resized into 250 \* 250 size with 3 channels.

However, due to the low amount of image files available, the model started to overfit very quickly, both for the pre-trained neural networks as well as the one trained from scratch. Hence, data augmentation was used to generate additional data which were modified using random rotation, width shift, brightness change, zoom, shear and vertical and horizontal flips. Also regularization such as Dropout with a rate of 0.4 and Batch Normalization was used.

### Results

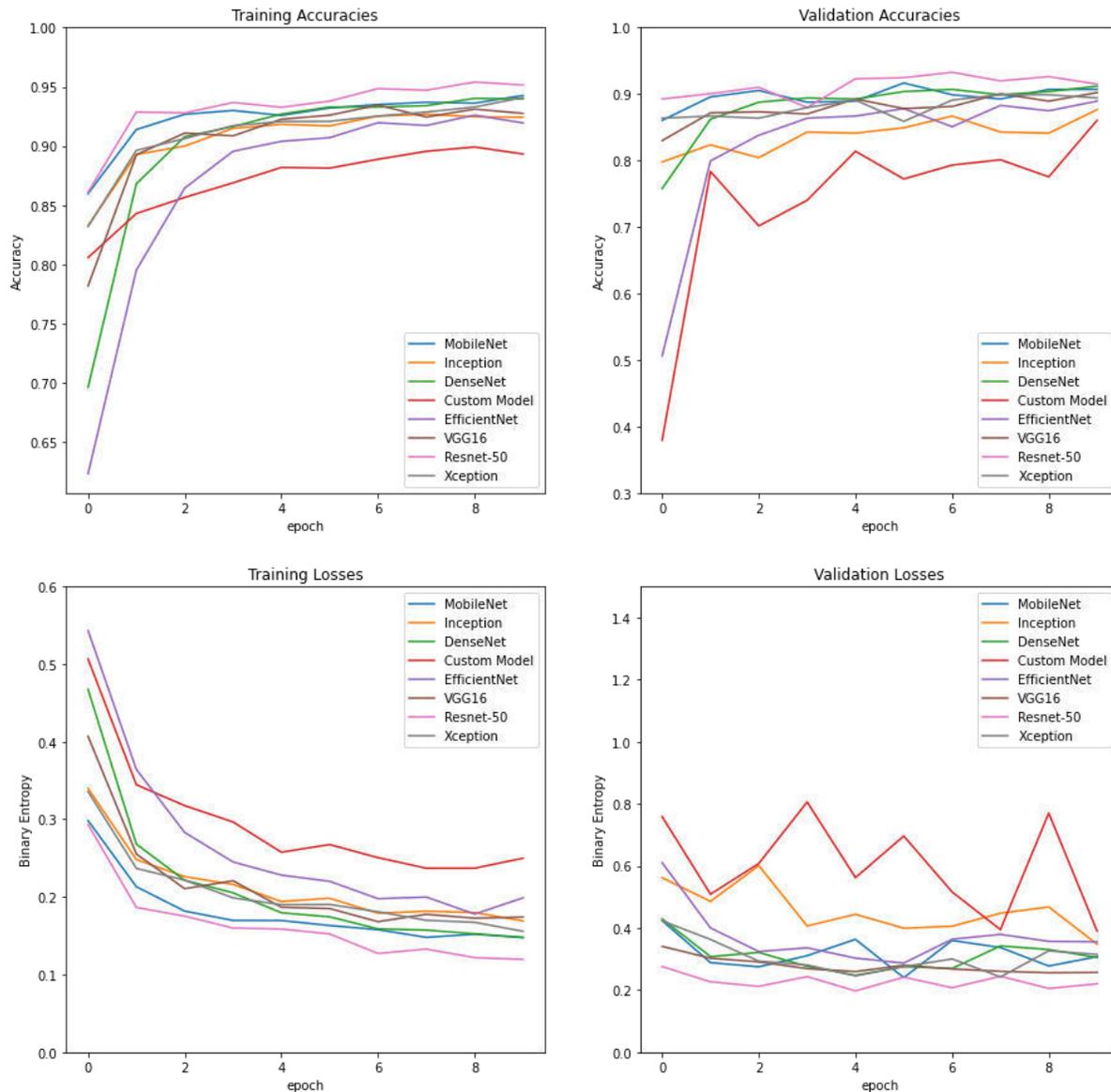
Training and validation loss along with training and validation accuracy for each of the eight neural networks were computed.

The results obtained clearly showed a vast improvement in detecting Pneumonia when transfer learning is used. After training the eight different neural networks, the best performance for neural networks trained using transfer learning have a validation accuracy on average 4.35% better than the neural network trained from scratch. It can also be observed using the help of the graphs below that the training of the neural network trained from scratch is a lot more unstable due to the high fluctuations of the validation loss.

The best performing neural network, Resnet-50 [1], had a validation accuracy of 93.27%, which is 7.21% higher than the neural network trained from scratch, which had a validation accuracy of 86.06%.

### Discussion

The results below are of image classification models which detects if a given x-ray scan has Pneumonia or does not have Pneumonia.

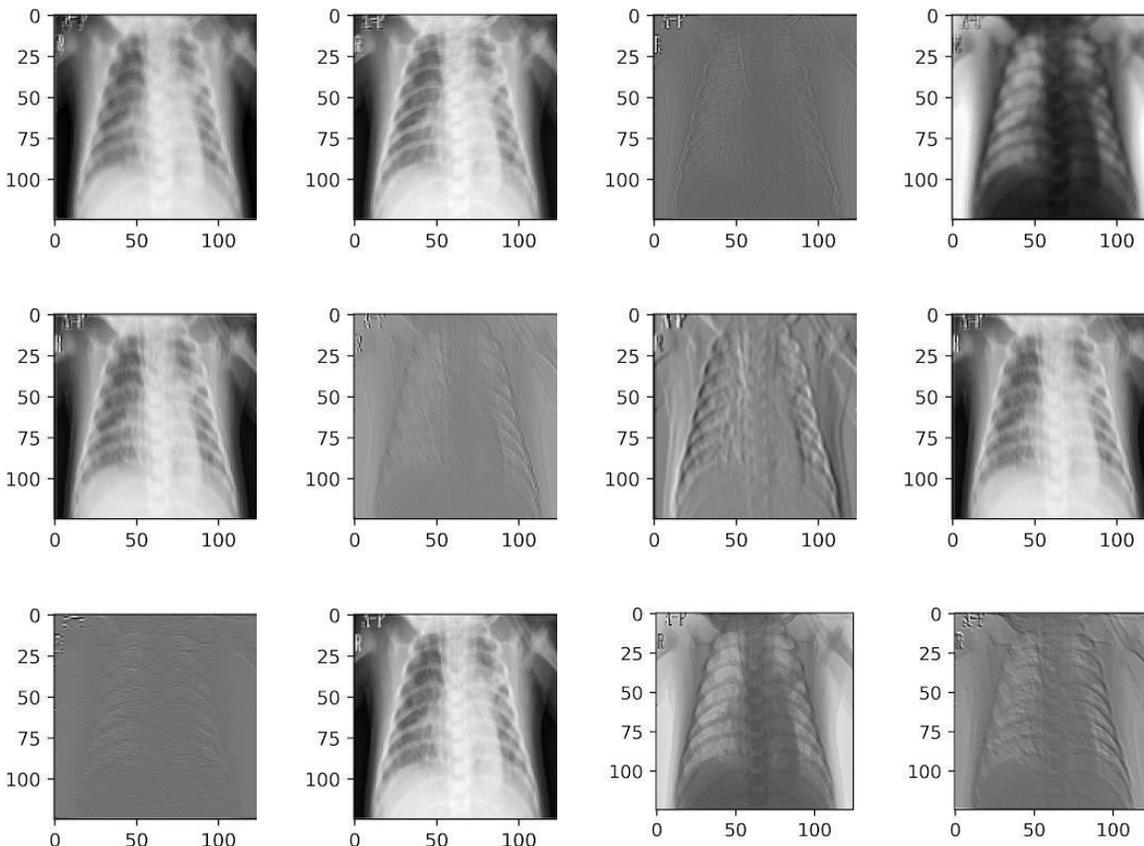


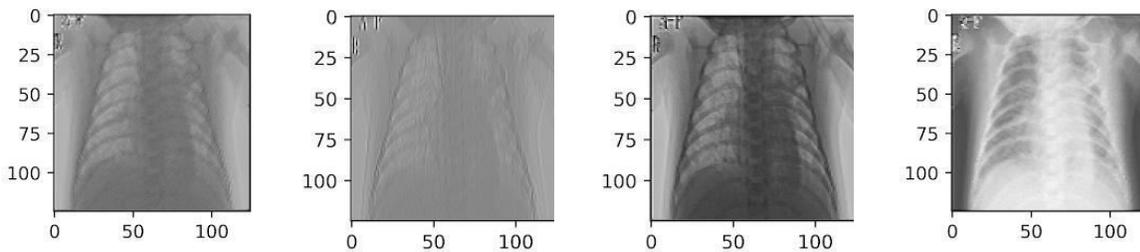
**Fig. 1** Shows the results of training the eight different convolutional neural networks. The lower the (validation and training) losses, the better. Higher the (validation and training accuracies) the better.

From the results above, it is clear to see that models trained using transfer learning have much better performance compared to a convolutional neural network trained from scratch. The neural network trained from scratch seems to start overfitting very quickly as well, as the validation accuracy is a lot lower than the training accuracy.

However, amongst all of the models, the ResNet-50 [1] model performs the best, achieving a validation accuracy of 93.27% on the 7th epoch. The MobileNet [7] model comes a close second, achieving a validation accuracy of 89.58% on the 10th epoch.

One of the main reasons that Resnet-50 [1] performs so well on the dataset is due to the number of parameters it has in its network. For example, Resnet-50 [1] comprises a total of 23,587,712 parameters, whereas EfficientNet [5] comprises a total of 17,673,823 parameters. A higher number of parameters that are pretrained leads to the neural network having learnt more features to detect in an image. Hence, Resnet-50 [1] learns features to detect the small infiltrates and increase in white density around the lungs of the x-ray scan image to classify whether a patient has Pneumonia or does not have Pneumonia. Additionally, due to the use of transfer learning using Resnet-50 [1], the neural network does not need to relearn all of its parameters, which not only would take a lot of time and be computationally expensive, but also would overfit due to the limited data. However, as the weights have been pre trained on a much larger dataset such as ImageNet [3], which has more than 14 million images, hence the neural network had not overfit on that.





**Fig. 2** Shows a visualization of what different convolutional layers in the neural network in Resnet-50 [1] learnt after training.

The pictures above show how the convolutional layers learn the different features needed to detect if the given x-ray scan has pneumonia or does not have pneumonia. As we can see, these are a few visualizations of the original image after the convolutional operations.

### Conclusion

The use of transfer learning was critical in achieving such high validation accuracies with only 5216 images of x-ray scans available. With a small dataset, a neural network trained from scratch would overfit very quickly, and hence not allow it to converge to the global minima and keep a low training loss whilst maintaining a high validation accuracy. Additionally, as the weights from the pretrained network are frozen apart and training is carried out on the classification head, computational costs reduce as the trainable parameters have reduced in number. However, these results could further be improved by using a technique called “finetuning”, where along with training the custom feedforward neural networks the layers of the original pre-trained neural network undergo training as well. Additionally, more data could be collected to gain higher validation accuracy. In the future, I plan to use transfer learning to achieve high accuracy and make it usable in the real world for instance segmentation on x-ray scans. This will help give doctors exact locations where the neural network predicts infiltrates are present that suggest Pneumonia.

### Acknowledgements

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### References

1. K. He, X. Zhang, S. Ren and J. Sun, "Deep Residual Learning for Image Recognition," presented at the 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Las Vegas, NV, USA, June 27-30, 2016
2. "Pneumonia." World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/pneumonia> (accessed July. 1, 2021)



3. J. Deng, W. Dong, R. Socher, L. Li, K. Li, L. Fei-Fei. "ImageNet: A large-scale hierarchical image database" August 18, 2009. Distributed by IEEE. [10.1109/CVPR.2009.5206848](https://doi.org/10.1109/CVPR.2009.5206848) .
4. G. Huang, Z. Liu, L. Van Der Maaten and K. Q. Weinberger, "Densely Connected Convolutional Networks," presented at the 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Honolulu, HI, USA, July 21-26, 2017
5. M. Tan, Q. V. Le. "EfficientNet: Rethinking Model Scaling for Convolutional Neural Networks". Arxiv. [arXiv:1905.11946](https://arxiv.org/abs/1905.11946) (accessed June. 19, 2021)
6. C. Szegedy, W. Liu, Y. Jia, P. Sermanet, S. Reed, D. Anguelov, D. Erhan, V. Vanhoucke, A. Rabinovich, "Going deeper with convolutions," presented at the 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Boston, MA, USA, June 7-12, 2015
7. G. Howard, M. Zhu, B. Chen, D. Kalenichenko, W. Wang, T. Weyand, M. Andreetto, H. Adam. "MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications". Arxiv. [arXiv:1704.04861](https://arxiv.org/abs/1704.04861) (accessed June. 20, 2021)
8. K. Simonyan, A. Zisserman. "Very Deep Convolutional Networks for Large-Scale Image Recognition". Arxiv. [arXiv:1409.1556](https://arxiv.org/abs/1409.1556) (accessed June. 29, 2021)
9. F. Chollet, "Xception: Deep Learning with Depthwise Separable Convolutions," presented at the 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Honolulu, HI, USA, July 21-26, 2017
10. D. Kermany, K. Zhang, M. Goldbaum. "Labeled Optical Coherence Tomography (OCT) and Chest X-Ray Images for Classification." January 06, 2018. Distributed by Mendeley Data, v2. [http://dx.doi.org/10.17632/rscbjbr9sj.2](https://dx.doi.org/10.17632/rscbjbr9sj.2)

## A COMPUTATIONAL ANALYSIS OF SCHOOL FACTORS FOR REDUCING DROP-OUTS IN MUMBAI'S MUNICIPAL SCHOOLS

**Aria Gupta**  
Aditya Birla World Academy



Municipal school children holding a piece of writing chalk in their hands



## An International Multidisciplinary Research e-Journal

### Abstract

Dropping out of the educational system can cause serious individual, familial, educational, and social difficulties. This is influenced by a variety of factors, but it is mainly at the school level where students drop out. Mumbai's municipal schools are facing a problem of high dropout rates. Nearly 49% of these dropouts are due to child-centric school factors.

Currently, government funds for aided schools are allocated without any detailed analysis of school factors. The government should compare schools across various parameters and correlate them with the schools' student strength, to identify specific areas of improvement.

To investigate and identify key school factors related to drop-outs for a predictive analysis, I have collected standardized school report cards of over 1600 Mumbai municipal schools comprising information about various schools' facilities, students and teachers.

Following an analysis using machine learning algorithms, several school factors directly impacting drop-outs were highlighted: *digital learning, English medium of instruction, high female-to-male teacher ratio, and free textbooks*. Rather than sanitation in toilets and mid-day meals, government resources should be redirected towards these factors for a quality education.

**Keywords:** *Drop-outs, school factors, machine learning, municipal schools, education*

### Introduction:

Education serves as a vital component for the socioeconomic development of the individual, community, and the country. The emphasis on education as a central piece of growth (both at an individual and societal scale) - "education for development" does not have an unfamiliar ring to it. In order to truly tap and reap the benefits of human potential, it is essential that everyone has the correct access to education. It is not just education, but the relevance of education to development that brings the larger picture into perspective.

Primary education holds utmost importance due to the impressionable minds of students at that age. The foundational skills acquired early in childhood make a lifetime of learning possible, due to the early exposure and encouragement both inside and outside of the formal schooling system, according to the science of brain development. This education stimulates and integrates core values and skills: social, cognitive, cultural, emotional, and physical, which are much needed in the future.

These students represent the youth of India, where their growth runs parallel to that of the nation and is reflected through the learning and experience imbibed and stimulated over the years. The thread of the growth of society depends upon the quality of education that is being imparted, and the extent of its reach.

India has one of the lowest literacy rates, of merely 74.37%, despite having a largely young population. Leaving school, or "dropping out", at an early stage makes it hard for a large part of India's population to improve their living conditions and break the cycle of poverty that currently chains down the weaker socio-economic classes.

Even though school drop-out rates have improved in recent years, it remains a major cause for concern when it comes to the overall development of the country. For every 100 children enrolled in school, only 70 manage to complete their studies. So that implies a 30% drop-out rate!

Based on rich empirical data, most researchers agree that school drop-outs are influenced not by a single factor, but rather by a combination of factors (*Janosz et al., 2000; Lamot et al., 2013; Lyche, 2010; Rumberger, 2011*). Although school is not solely responsible for drop-outs, it



is at the school level *de facto* where dropping out takes place. Members of the school staff are the ones with a direct contact with children and, as such, they are the first to notice the risk of a child dropping out of school. Factors such as a parent's wish to educate their child and a child's willingness to learn are also affected by the facilities provided at school, such as playgrounds, digital facilities. Social and household factors such as income, family problems are only controllable by the government up to a certain extent, and not much can be done on an individual level on a large scale.

Therefore, we deemed it relevant to explore all the factors at school level related to early school leaving. These school factors can be categorized under:

- learning resources (such as free textbooks and uniforms)
- school infrastructure (availability of laptops, projectors, ICT labs, playgrounds, laboratories etc.)
- health and hygiene (includes meals, drinking water availability and toilets)
- safety (such as distance of schools from home, female-to-male teacher ratio)

The Municipal Corporation of Greater Mumbai (MCGM), the central administrative body in Mumbai, does not have any predictive model that analyses each school's individual needs before allocating aid to the respective schools. When funds are allocated without research on an individual level, this may lead to a sub-optimal use of funds.

### Scope:

This research paper conducts an in-depth analysis of school-based parameters to highlight determinants of potential risk or protective factors. This project focuses only on the **primary** sections of Mumbai's Municipal schools.

### Methodology:

Data collection:

Before starting the research, it was necessary to understand different perspectives about the current scenario of the education system.

**Experts** such as Mrs. Swapna Agarwal (Founder of *Yogdaan*, a street school), Mrs. Nikita Ketkar (CEO of *Masoom*, a night school), and the school principal of *Global Talent International School*, Mrs. Kajal Chattija, agreed that drop-outs are a major problem, and pointed us towards specific factors in each of their organizations and schools.

We also did a **survey** via Google Form to students' parents and teachers to understand which factors they believed were causing drop-outs. This was a simple multiple choice question survey, which addressed the different barriers to education.

Since much primary data collection was not possible, we collected **data for each school from the government website**. Information for each school (regarding students, teachers, facilities available, school background, etc.) is collected and uploaded regularly by the



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government in the form of a school report card. This is authentic data in a standardized format and can be used for analysis every two years when data is collected. Each school has a unique UDISE code. When the code is entered into the website, a school report card is generated for the respective school. Since the school report cards were available in a PDF format, we used a Robotic Process Automation (RPA) Path to convert it into an excel sheet. The excel sheet contained data of over 1600 schools (935 primary and upper primary schools, 722 secondary schools) with the following parameters: *school district, school type, classes taught, medium of instruction, building status, availability of ramps and handrails, mid-day meals, availability of roads, number of toilets for girls and boys, library, drinking water availability, playground, furniture, electricity, medical checkup facility, internet, ICT lab, desktops, printers, projectors, laptops, free textbooks, number of male and female teachers, number of girls and boys, and total strength.*

Since certain factors such as the age of the building, and solar panels seemed relatively irrelevant, we chose to **clean and segregate the data** - keeping only the factors mentioned above. We also organized the data class-wise, to assess factors causing drop-outs for primary and secondary sections separately.

SCHOOL REPORT CARD												
(as on 30th September 2018)												
UDISE Code	27 22 02 00 289			School Name	BAIAJ MR SCHOOL			Block	URC-2 (KANDIVALI)			
State	Maharashtra			District	MUMBAI (SUBURBAN)			Block	URC-2 (KANDIVALI)			
Rural / Urban	2-Urban			Cluster	BAIAJ ROAD MUN MAR			Pincode	400067			
Ward	R/S-WARD			Mohalla				Municipality	MUMBAI			
Panchayat	NA			City	Mumbai							
Assembly Const.				Parl. Constituency								
School Category	1 - Primary			Medium of Instruction	Medium 1			Visit of school for / by	Acad. Inspections			
School Management	3-Municipal Corporations (MNC)			Medium 2	Medium 3			Acad. Inspections	3			
School Type	3-Co-educational			Medium 4				CRC Coordinator	0			
Lowest & Highest Class	1 - 5							Block Level Officers	0			
Pre Primary	2-No							State/District Officers	0			
Year of Establishment	1973			Is this a Shift School?	2-No			Anganwadi At Premises	2-No			
Year of Recognition-Pri.				Building Status	3-Government			Anganwadi Boys	0			
Year of Recognition-Upr Pri.				Boundary wall	1-Pucca			Anganwadi Girls	0			
Year of Recognition-Sec.				No. of Building Blocks	1			Anganwadi Worker	NA			
Year of Recognition-Higher Sec.				Pucca Building Blocks	1			Residential School	2-No			
Affiliation Board-Sec.				Is Special School for CWSN?	1-Yes			Residential Type				
Affiliation Board-HSec.				Availability of Ramps	1-Yes			Minority School	2-No			
Toilets	Boys	Girls	Total Class Rooms	Availability of Handrails	1-Yes			Approachable By All Weather Road	1-Yes			
Total	4	4	In Good condition	6	6			Drinking Water Available	1-Yes			
Functional	3	3	Needs Minor Repair	6	6			Drinking Water Functional	Yes			
Func. CWSN Friendly	1	1	Needs Major Repair	0	0			Rain Water Harvesting	2-No			
Urinal	5	1	Other Rooms	0	0			Playground Available	1-Yes			
Handwash Near Toilet	1-Yes		Library Availability	1-Yes	1-Yes			Furniture Availability	58			
Handwash Facility for Meal	1-Yes		Separate Room for HM	1-Yes	1-Yes			Electricity Availability	1-Yes			
Digital Facilities (Functional)	2-No Internet			1-Yes Desktop	1			Solar Panel	2-No			
ICT Lab	0 Tablet			0 Printer	0			Medical checkups	1-Yes			
Laptop	0 DTH			2-No DigiBoard	0			No. of Students Received (DCF 5.1, 5.2)	Primary			
Projector				0 Free uniform	0			Up Primary	0			
RTE Information & Management												
SMC Exists	1-Yes SMC & SMDC Same			NA SMDC Constituted				RTE Information	Pri.	Up.Pri	Sec.	H.Sec
Text Books Received	1-Yes Special Training			1-Yes Material for Training	1-Yes			Instructional days	215	0	0	0
Grants Received	10000.0			Grants Expenditure	10000.0			Avg School hrs.Std.	5.3	0.0	0.0	0.0
								Avg School hrs.Tch.	6.0	0.0	0.0	0.0
								CCE	1-Yes			
Total no. of Students Enrolled Under Section 12 of the RTE Act in Private Unaided and Specified Category Schools (DCF Sl. No. 1.42(a))												
Pre-Pri.	Class I	Class II	Class III	Class IV	Class V	Class VI	Class VII	Class VIII	Class IX	Class X	Class XI	Class XII
B	G	B	G	B	G	B	G	B	G	B	G	B
-	-	-	-	-	-	-	-	-	-	-	-	-
Total no. of Economically Weaker Section (EWS) students Enrolled in Schools (DCF Sl. No. 1.42(b))												
Pre-Pri.	Class I	Class II	Class III	Class IV	Class V	Class VI	Class VII	Class VIII	Class IX	Class X	Class XI	Class XII
B	G	B	G	B	G	B	G	B	G	B	G	B
-	-	-	-	-	-	-	-	-	-	-	-	-
Teachers												
Classes Taught						Total						
1-Primary	6					2-Up.Pr.	0					
3-Pri. & Up.Pr.	0					5-Sec. only	0					
6-H Sec only.	0					7-Up pri and Sec.	0					
8-Sec and H Sec	0					10- Pre-Primary Only.	0					
11-Pre- Pri & Pri	0											
Teachers Aged above 55						Academic Qualification						
0						Below Graduate	0					
0						Post Graduate and Above	5					
0						Total Teacher Trained in Computer	6					
Teacher With Professional Qualification												
Diploma or Certificate in basic teachers' training						2 Bachelor of Elementary Education (B.El.Ed.)						
0						0						
B.Ed. or Equivalent						1 M.Ed. or Equivalent						
0						0						
Other						0 None						
0						0						
Diploma/degree in special Education						3 Pursuing any Relevant Professional Course						
0						0						

A sample school report card

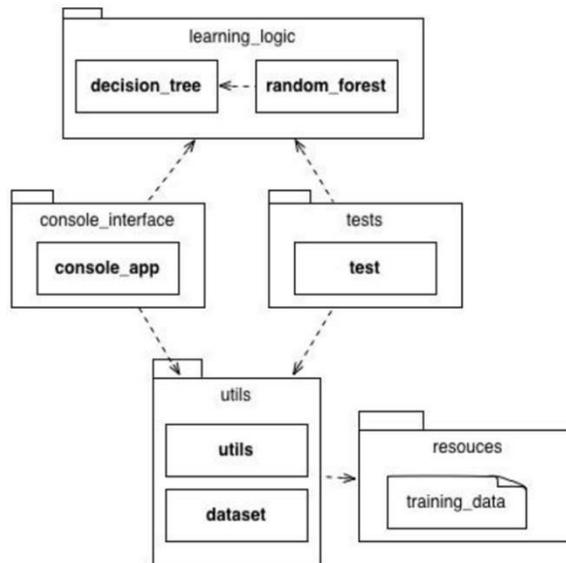


A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
UDISE Code	School Name	State	District	School Cate	School Mana	School Type	Lowest & Hg	Pre primary	Medium Of I	Is This a shif	Building Stat	Boundary W/	No of Buildir	Availability o	Availability o	Meals	Road Availa
2.7221E+10	LORD HARRI	Maharashtra	Mumbai	2- Primary w	Municipal Coi	Co-educator	Jr.Kg. to VIII	no	Marathi	No	government	pucca	3	yes	Yes	no	Yes
2.7221E+10	COLABA MAI	Maharashtra	Mumbai(SUI 1	-primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	Marathi	No	government	pucca	3	yes	Yes	no	Yes
2.7221E+10	COLABA MU	Maharashtra	Mumbai(SUI 1	-primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	Marathi	Yes	government	pucca	1	yes	Yes	no	Yes
2.7221E+10	COLABA MU	Maharashtra	Mumbai(SUI 1	-primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	Marathi	Yes	government	pucca	1	yes	Yes	no	Yes
2.7221E+10	COLABA MU	Maharashtra	Mumbai(SUI 1	-Primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	Hindi	Yes	government	pucca	1	yes	Yes	no	Yes
2.7221E+10	COLABA MU	Maharashtra	Mumbai(SUI 1	- Primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	Hindi	Yes	government	pucca	1	yes	Yes	no	Yes
2.7221E+10	COLABA LP L	Maharashtra	Mumbai(SUI 1	- Primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	Urdu	Yes	government	pucca	1	yes	Yes	yes	Yes
2.7221E+10	COLABA MU	Maharashtra	Mumbai(SUI 1	- Primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	kannada	Yes	government	pucca	1	yes	Yes	no	Yes
2.7221E+10	COLABA MU	Maharashtra	Mumbai(SUI 2	- Primary v	Municipal Coi	Co-educator	Jr.Kg. to VIII	no	English	Yes	government	pucca	1	yes	Yes	yes	Yes
2.7221E+10	MANOHARD	Maharashtra	Mumbai(SUI 2	- Primary v	Municipal Coi	Co-educator	Jr.Kg. to VIII	no	Marathi	No	government	pucca	1	yes	Yes	no	Yes
2.7221E+10	BORABAZAR	Maharashtra	Mumbai(SUI 2	- Primary v	Municipal Coi	Co-educator	Jr.Kg. to VIII	no	Hindi	No	government	pucca	1	yes	Yes	no	Yes
2.7221E+10	NEW KADY	Maharashtra	Mumbai(SUI 2	- Primary v	Municipal Coi	Co-educator	Jr.Kg. to VIII	yes	English	No	government	pucca	1	yes	Yes	yes	Yes
2.7221E+10	DONGRI MU	Maharashtra	Mumbai(SUI 1	- Primary	Municipal Coi	Co-educator	Jr.Kg. to V	yes	Marathi	Yes	government	pucca	1	yes	Yes	yes	Yes
2.7221E+10	BANGALPUJ	Maharashtra	Mumbai(SUI 1	- Primary	Municipal Coi	Co-educator	Jr.Kg. to V	no	Urdu	Yes	government	pucca	1	yes	Yes	yes	Yes

Toilets Boys	Toilets Girls	Total Class r	Library	Drinking Waf	Rain Water I	Play ground	Furniture	Electricity	Medical Chei	Internet	ICT lab	Desktops	Printer	Projector	Laptop	
8	8	8	Yes	Yes	Yes	Yes	95	Yes	Yes	yes		2	10	1	1	0
3	3	4	Yes	Yes	no	Yes	73	Yes	Yes	yes	no	1	1	1	0	
5	5	8	Yes	Yes	Yes	Yes	218	Yes	Yes	yes	no	4	1	2	0	
5	5	9	Yes	Yes	Yes	Yes	244	Yes	Yes	yes	no	1	0	1	0	
5	5	14	Yes	Yes	Yes	Yes	447	Yes	Yes	yes	no	1	1	1	0	
4	6	8	Yes	Yes	Yes	Yes	227	Yes	Yes	yes		2	1	1	0	
3	6	2	Yes	Yes	no	Yes	59	Yes	Yes	yes		2	0	1	0	
5	5	2	Yes	Yes	no	Yes	18	Yes	Yes	yes	no	1	1	1	0	
4	5	32	Yes	Yes	Yes	Yes	1346	Yes	Yes	yes	no	15	1	1	0	
2	2	4	Yes	Yes	no	Yes	40	Yes	Yes	yes		0	1	1	0	
2	2	4	Yes	Yes	no	Yes	43	Yes	Yes	yes		0	1	1	0	
6	6	6	Yes	Yes	no	Yes	169	Yes	Yes	yes		0	1	1	0	
4	3	9	Yes	Yes	no	Yes	186	Yes	Yes	yes		0	1	1	0	
2	3	2	Yes	Yes	no	Yes	35	yes	Yes	no		0	0	1	0	
5	7	8	Yes	Yes	Yes	Yes	214	Yes	Yes	yes	no	20	1	1	0	
4	3	8	Yes	Yes	no	Yes	198	Yes	Yes	yes		0	4	0	1	
5	5	4	Yes	Yes	no	Yes	99	Yes	Yes	yes		0	1	1	0	

### AI Model Training:

In the first step, a prediction model is developed using the training data. The aim of the model is to identify the potential dropouts as early as possible by classifying student observations as dropouts or not and then checking the accuracy of the prediction by displaying the confusion matrix of each algorithm.





The methods used for the classification are **Logistic Regression, SVM (Support Vector Machine), Decision Tree, and Random Forest**. All these classification algorithms use supervised techniques.

Step 1: Dividing the data into primary and secondary data

Step 2: The data was divided into training sets (to train the model) and testing sets (to evaluate the results). The training part comprised of 70% of the subjects, chosen at random and the testing part of 30%.

Step 3: The training algorithm we used is random forest. It should be noted that the base methodology to build decision trees we use is called CART (Classification and regression trees). CART uses a recursive partitioning method for building decision trees for classification and regression. To make the implementation generic to any dataset, a normalization function which deletes the dataset's incomplete entries was implemented.

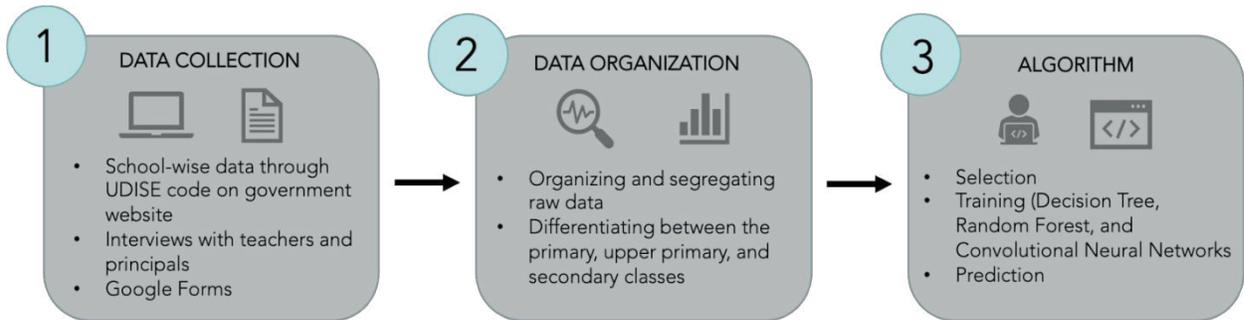
As our dataset was based on theory, we classified the different schools with respect to their parameters by a ' YES 'or' NO'. This helped understand which factors children look for in schools and reduce drop-out rates.

```
#output
{'min_samples_split': 12, 'splitter': 'random', 'max_depth': 1}
Made predictions in 0.0005 seconds.
Tuned model has a training F1 score of 0.8000.
Made predictions in 0.0002 seconds.
Tuned model has a testing F1 score of 0.7273.
Made predictions in 0.0002 seconds.
Tuned decision tree model has a training F1 score of 0.8098.
Made predictions in 0.0001 seconds.
Tuned decision tree model has a testing F1 score of 0.8129.
```

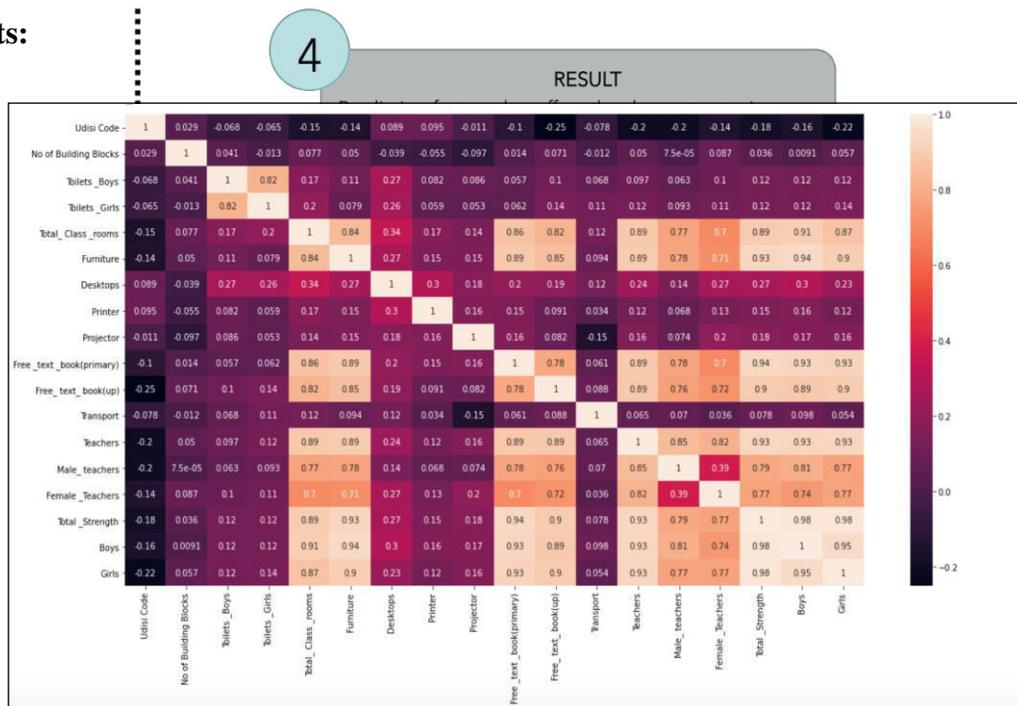
The results of the different models are summarized below:

	Decision Tree	Random Forest	Convolutional Neural Networks
Precision	98.69	90.51	96.65
Recall	99.34	86.65	96.87
F1-score	99.34	96.27	97.77

Ultimately, the Decision Tree model gave us optimum results, with a precision of 98.69%. The overall methodology can be summarized as seen in the flowchart below:



## Results:



Heat map: correlation between different school-based parameters

First, we analyze the heat map that correlates the different school parameters, where the lighter shades represent a high correlation, and the darker shades represent no correlation.

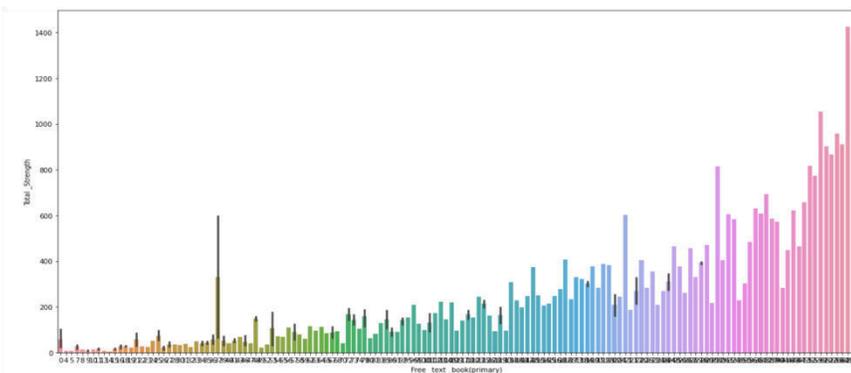
Here are a few important things to note:

1. The correlation between free textbooks and number of students is very high (0.94), which shows that as number of free textbooks provided increases, the number of students is likely to increase too.

2. The correlation between number of female teachers and number of students is also very high (0.79), which suggests that the number of students is likely to increase when there are more female teachers, maybe because of an ease of safety concerns
3. The correlation between number of desktops and students is also relatively high compared to other values, which explains the current importance of digital learning, as well as the curiosity of students to engage more in a technological education.
4. Surprisingly, the correlation between total number of students and no. of toilets is not very high, which puts up a further question whether the fund allocation towards sanitation is really needed.

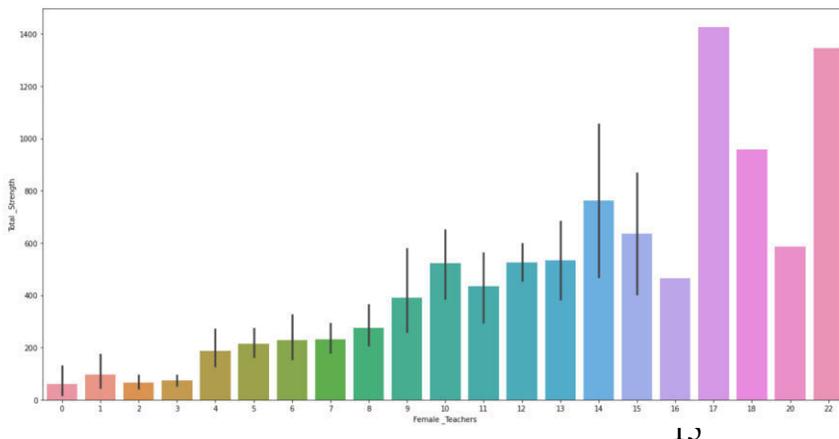
We now study a few of our parameters in detail.

### 1. Free Textbooks



As can be seen in the graph above, as number of free textbooks provided in school increases, the number of students (total strength) increases too. The provision of free textbooks reduces the burden of the cost of education on the parents by a large amount. Students can have access to necessary course materials required for classes, providing them with better chances of success. Without these free textbooks, students may have to pay for them, making them take up part-time jobs at a young age, or they may not buy textbooks at all. This leads to a lack of understanding, and hence, interest in studies which further causes them to drop out of school.

### 2. Female Teachers



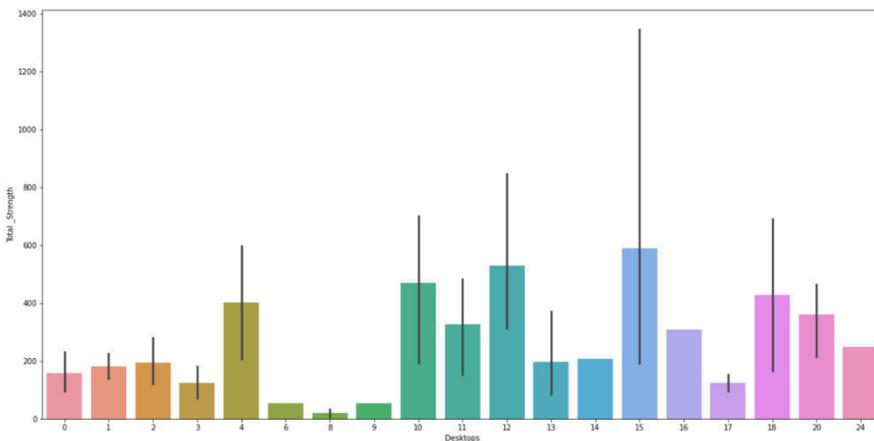


The general trend of the graph shows that as number of female teachers increases, the total strength also increases. Evidence suggests that female teachers are likely to increase the likelihood that girls remain in school and ease any safety concerns that students or parents may have.

Additionally, it is very important to expose students (especially girls) to look up to accomplished female role models as much as possible. Women, as teachers, can raise gender awareness and the sensitivity of male teachers, while also helping to promote important behavioral patterns in students. Female empowerment in the education sector can create a school environment that can makes girls feel comfortable to learn and grow.

### 3. Desktops

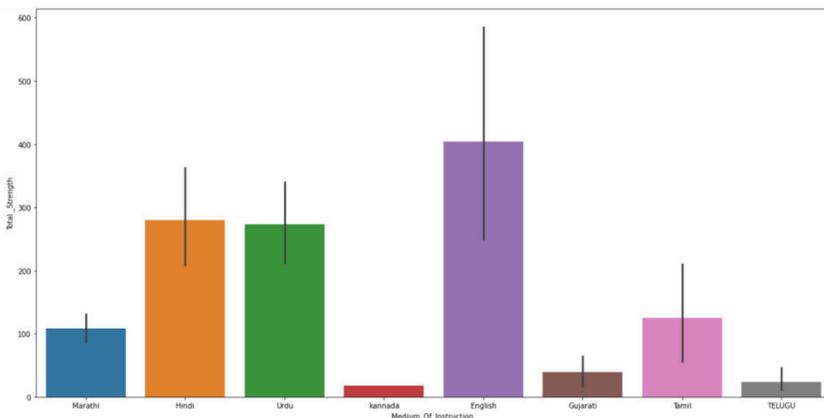
Trends show that for more desktops provided in a school, there tend to be more students (with a



few exceptions). Digital learning has become a very usual occurrence in the modern world and is even replacing most traditional educational procedures. It has not only made learning mobile, but also interactive and engaging, which motivates students to maintain interest.

Furthermore, digital learning tools, and technology sharpen critical thinking skills which are the basis for the growth of systematic reasoning. Nearly every employment opportunity nowadays involves some degree of technological proficiency. Providing and teaching students how to use desktops, tablets, and phones has made education available to all by addressing the constraints of traditional models of learning.

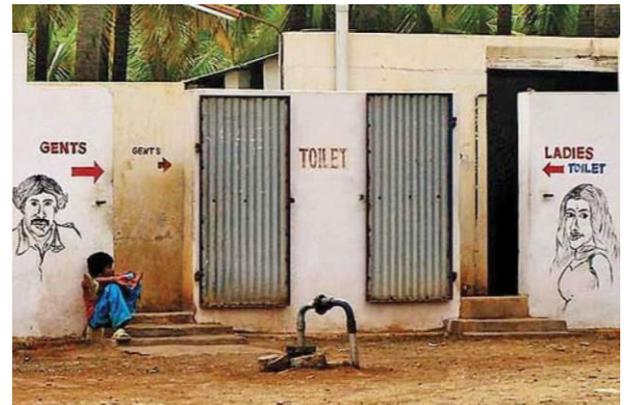
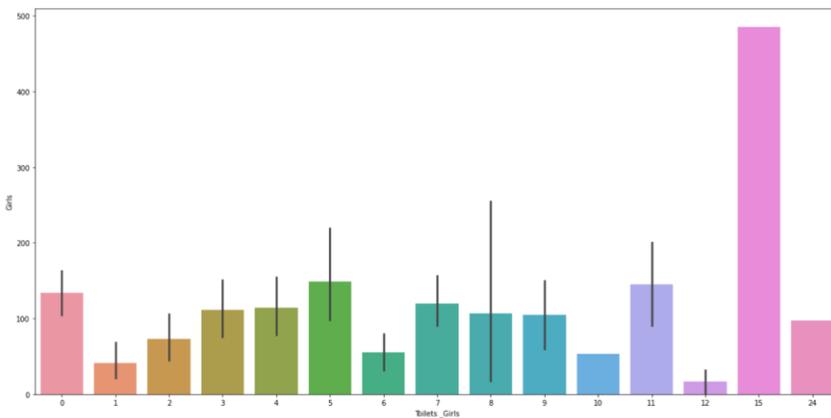
### 4. Medium of Instruction



This parameter can be overlooked easily, but we see an interesting observation. Schools with an English and Hindi medium of instruction see a higher number of students, despite being in the state of Maharashtra, where the language spoken is Marathi.

This shows that students are now showing a preference for primary and mainstream languages such as Hindi and English, which can help them with a wider variety of employment opportunities in the future and does not restrict them to a relatively uncommon language such as Telugu or Kannada.

### 5. Toilets

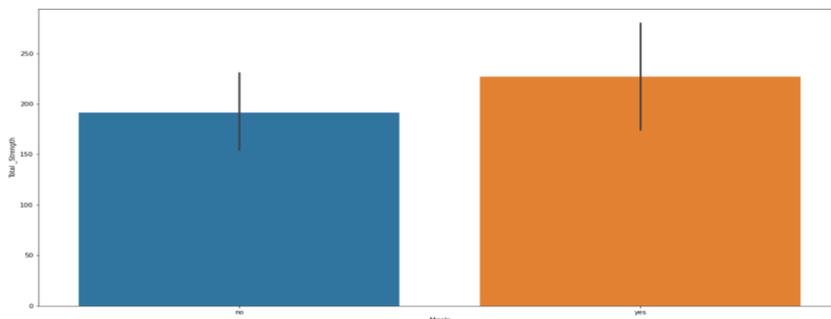


Toilets are considered an important factor when it comes to school facilities. Previous research shows that a large number, nearly 23% of girls, drop out of schools in India because of the lack of sanitation facilities when they reach puberty, due to menstruation.

However, the uniform distribution of our data shows us that toilets are not a very important factor when it comes to girls' education in Mumbai's Municipal Schools. This is possibly because in the short schooling hours, students do not feel the need to utilize the toilet facilities.

Additionally, a lot of funds have been directed towards sanitation programs in such schools, which is why most schools have an adequate number of health and hygiene facilities with respect to the number of students. This does not bring out a need for focus on sanitation facilities in toilets in these schools.

### 6. Mid-day Meals





Previously, during field surveys it was learned that in some schools, children come to school only to have the lunch provided by the school since most of them belong to socially and economically weaker sections of the society.

However, our data suggests otherwise. Schools providing and not providing meals have approximately the same number of students. This is possibly because the government has a lot of schemes in place to provide the families with food grains, and the students no longer feel the need to drop out of school on the basis of whether meals are provided or not.

### Conclusion:

The table below summarizes a few of the government schemes that provide aid to municipal schools.

Table 2: Summary of Major Government Schemes

Sarva Shiksha Abhiyan	Mid-day Meal Scheme	Swachh Vidyalaya Abhiyan	Samagra Shiksha Abhiyan
Aim: to open new schools in those habitations which do not have schooling facilities and strengthen existing school infrastructure through provision of additional class rooms, toilets, drinking water, maintenance grant and school improvement grants	Aim: provide cooked mid-day meals with 300 calories and 8-12 grams of protein to all children studying in Government and aided schools and EGS/ AIE centres, with a view to enhance enrolment, retention and attendance and while simultaneously improving nutritional levels among children	Aim: to ensure that every school in India has a set of functioning and well maintained water, sanitation, and hygiene facilities (a combination of technical and human development components that are necessary to produce a healthy school environment and to develop or support appropriate health and hygiene behaviours)	Aim: to improve school effectiveness measured in terms of equal opportunities for schooling and equitable learning outcomes. It subsumes the three Schemes of Sarva Shiksha Abhiyan (SSA), Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and Teacher Education (TE). Provides children with free textbooks and digital learning and teachers with training
Budget: ₹26,129 crore	Budget: ₹11,500 crore	Budget: ₹620 billion	Budget: ₹27,957 crore

A large part of government aid towards schools is directed towards sanitation and mid-day meals, with special schemes for the same. The important factors, such as the provision of digital education and female teachers, have relatively smaller schemes with a smaller budget.

Conventionally, one would expect the drop-outs to be caused due to lack of sanitation facilities, or mid-day meals. This was the need till a few years ago, and to some extent, is still needed in



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some schools. **However, our circumstances have changed, and so the focus of our resources needs to change too.**

Previously, a majority parents looked at municipal schools as mere caregiving centres with such facilities, where they would send their children to eat and play when they would go out for work. However, our research suggests that now there is a major shift in parents' perspectives of school. While previously, schools were looked at as merely a centre where parents could send their children while they worked, now they are looked at as education hubs. Students, as well as parents are gradually understanding the importance and seriousness of education that, in today's age, is a necessity to break out of the cycle of poverty for weaker socio-economic sections.

Now, field conversations with a few parents have told us that in some cases, the students are pulled out of school as they do not learn much and only go to play, which serves as a waste of money. In order to reduce these drop-outs, the government must adapt to this shift in perspective, from emphasis on school facilities, to a progressive education. Students are no longer looking at school facilities, but those school factors that enable and provide opportunities for employability. This education includes digital learning through laptops, tablets, and desktops and encourages students to study in schools with English as the medium of instruction.

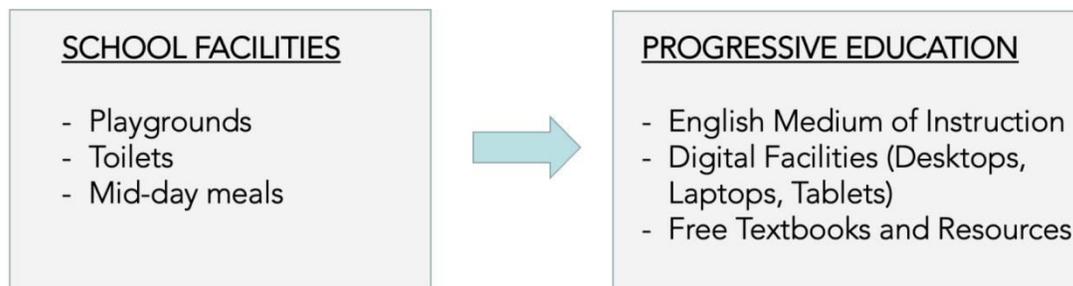
Furthermore, the need for free textbooks has risen. Students are becoming serious about their studies, and these textbooks provide them with the means to achieve their academic goals without having to worry about the burden of the cost of education. Female teachers serve as an additional factor that help prevent dropouts, especially for girls, due to the school environment they create that makes students feel comfortable to learn and grow.

Now, the proposed government schemes should be directed towards a primarily progressive education. In order to reduce drop-outs effectively, it is essential to direct resources towards the quality education of these students.

Here are a few takeaways:

- 1. Provide progressive learning through the digital medium (desktops, projectors etc.)**
- 2. Focus more on English medium schools**
- 3. Provide free textbooks and uniforms**
- 4. Train more female teachers to reduce safety concerns**

By reducing drop-out rates effectively, the impact is an improved employment rate due to a quality education where municipal schools are looked at as education hubs rather than mere caregiving facilities. This breaks the cycle of poverty for first generation learners and leads to equality in education. These students represent the youth of our nation. Effective steps taken to reduce such drop-outs will reap the benefits of India's human potential - leading to greater growth and development.





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### Author Profile:

Completed the Indian Certificate of Secondary Education from The Cathedral and John Connon School (2020) Currently studying under the A-Levels Curriculum at Aditya Birla World Academy (2022)  
Mumbai, India. Email ID: ariagupta16@gmail.com

### References:

- <https://portal.mcgm.gov.in/irj/portal/anonymous/qlBMCScl123>  
<https://src.udiseplus.gov.in/hom>  
<https://timesofindia.indiatimes.com/city/pune/marathi-to-be-must-till-class-10-in-all-maharashtra-schools/articleshow/74328309.cms>  
<https://mumbaimirror.indiatimes.com/mumbai/other/will-students-in-bmc-run-schools-soon-get-to-learn-a-foreign-language/articleshow/70464088.cms>  
<https://www.mdpi.com/2079-9292/9/10/1613/htm>  
<http://14.139.60.153/bitstream/123456789/8835/1/A%20Study%20of%20the%20extent%20and%20causes%20of%20droopouts%20in%20primary%20schools%20in%20rural%20maharashtra%20with%20special%20ref%20to%20firl%20dropouts.pdf>  
<http://schooldropoutprevention.com/country-data-activities/india/>  
<http://iosrjournals.org/iosr-jrme/papers/Vol-4%20Issue-6/Version-3/K04637583.pdf>  
<https://files.eric.ed.gov/fulltext/ED587683.pdf>  
[https://www.researchgate.net/publication/314077615\\_DECREASING\\_SCHOOL\\_DROPOUT\\_RATE\\_AS\\_A\\_FACTOR\\_OF\\_ECONOMIC\\_GROWTH\\_AND\\_SOCIAL\\_EMPOWERMENT\\_THEORETICAL\\_INSIGHTS](https://www.researchgate.net/publication/314077615_DECREASING_SCHOOL_DROPOUT_RATE_AS_A_FACTOR_OF_ECONOMIC_GROWTH_AND_SOCIAL_EMPOWERMENT_THEORETICAL_INSIGHTS)  
[https://www.researchgate.net/publication/342833162\\_PREDICTION\\_OF\\_SCHOOL\\_DROP\\_OUTS\\_WITH\\_THE\\_HELP\\_OF\\_MACHINE\\_LEARNING\\_ALGORITHMS](https://www.researchgate.net/publication/342833162_PREDICTION_OF_SCHOOL_DROP_OUTS_WITH_THE_HELP_OF_MACHINE_LEARNING_ALGORITHMS)  
[https://www.researchgate.net/publication/333016151\\_Machine\\_Learning\\_Approach\\_for\\_Reducing\\_Students\\_Dropout\\_Rates](https://www.researchgate.net/publication/333016151_Machine_Learning_Approach_for_Reducing_Students_Dropout_Rates)  
<https://er.educause.edu/articles/2019/12/predictive-analytics-for-student-dropout-reduction-at-pontificia-universidad-javeriana-cali>  
<https://www.indiaspend.com/budget/budget-explainer-how-india-funds-public-school-education-718488>  
<https://www.oecd-ilibrary.org/docserver/9789264276147-4-en.pdf?expires=1620655339&id=id&accname=guest&checksum=D23318A4B9477D02CE5608095D04CB63>  
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### 3D PRINTING - THE NEW STAR IN HUMANITARIAN TECHNOLOGY?

**Dhruv Jain**

Prabhavati Padamshi Soni  
International Junior College

#### Abstract

The main objective of this paper is to prove why 3D printing is a potential candidate to be the upcoming humanitarian technology and its impact on the world and on the different sectors of human welfare. The conclusions were reached by statistics, ongoing projects and a survey conducted by me asking people opinions on this agenda. As this is a topic that is quite new and fresh, I have adapted to use the style of numbers, data, and logical reasoning to back my hypothesis and also prefaced a bit on how this technology works and its astounding process.

**Keywords:** 3D Printing, Education, Healthcare, Housing

#### INTRODUCTION

Humanitarian technology can be thought of as two words. 'Humanitarian' has been defined as concerned with or seeking to promote human welfare[14]. 'Technology' is often thought of simply as a 'tool' that extends human capability for example, from hammers to the internet). So it can simply be thought of as innovations and creations that benefit human well-being. It involves projects that improve water and sanitation facilities, healthcare, education and off-grid electricity generation.

3D printing can reproduce physical objects from a geometrical representation by continuous, sequential addition of material [1]. It was first used in the commercial sector by Charles Hull in the year 1980 [2]. It is an application of additive manufacturing which can be defined as the process of producing parts through the deposition of material in a layer-by-layer fashion[15]. It uses raw materials like plastic, metal, ceramics, and resins and uses them to produce an array of three dimensional objects.

The obvious reasons for this technology to be chosen are it saves time, conserves money, and preserves the environment. These three constraints are what human life revolves around. It saves time as the internal process is quite fast. Now, if we save time, productivity increases, pressure reduces and there is time to explore more opportunities. It reduces costs as there is no need for labour at factories and less machines are needed as it can handle the entire job. By conserving money, it produces more funds to be invested in other areas of interest and research, businesses don't face losses, no loss of employment, more income generated. The environment is protected as it makes use of recycled waste materials and If the environment is not harmed, then sustainability is achieved, better air and water quality and cleaner earth and better space for us to live.



Now as we 3D printing has the ability to print anything which has its dark side as well. There are security implications with 3D printing like production of illegal weapons and loss of intellectual property. However, there have been introduction of policies and standards by the EU (European Union), China and USA. Also, high capital investment is another downside of it. However, in the long run they can cut down a huge amount of costs and be more profitable compared to traditional methods.

### Theory

So how does 3D Printing work?

3D Printing is a four step process. Firstly, you have to design the digital representation object you want to 3D print in CAD software like AutoCad, TinkerCad, etc. An electronic version can also be created by 3D scanning the real world object by a specialised software which precisely scans the object and produces a digital copy of it. The second step involves converting the digitised version from design software into STL file format which has an extension of .STL. .STL stands for stereolithography which uses tessellations wherein the whole model is represented and recreated by small triangles which stores information about the model in a language which 3D printers can understand. The third step includes slicing the model where the object is chopped, segmented into numerous horizontal layers. Now, after this process a unique file format called G-code is produced which contains each and every step and instructions for the machine as to how to print the 3D model and finally the model is printed using raw materials provided. The fourth step involves post processing wherein the model is enhanced in its quality, appearance by use of special techniques like polishing.

There are various technologies used in 3D printing:

#### Fused Deposition Modeling (FDM)

Here a plastic filament material which has thermal properties is heated at its melting point and released out of nozzle and model is built layer by layer.

#### Stereolithography (SLA)

It uses ultraviolet light to produce layers of 3D model. A pool of photoreactive resin has light emitted on its surface which causes resin to turn into solid thereby producing a shape.

#### Selective Laser Sintering (SLS)

This technology uses a high powered laser which is struck over a layer of fine powder which causes the particles in powder to bind and fuse together to create a thin solidified layer. Then, another layer of powder is placed over the top of the previous layer and reiterates the process.

### Materials used in 3D printing

#### Plastics

This is one of the most popular materials used for 3D Printing. Mainly, because it is very affordable, provides strong flexibility, has great smoothness and firmness. In plastic there are various types like Polylactic acid (PLA) which is made from sugarcane and corn starch and therefore makes it biodegradable and environmentally friendly. Acrylonitrile butadiene styrene (ABS) is another material which is very strong in terms of strength and is often used to make toys like LEGO blocks.



### Metal

Used by direct metal laser sintering or DMLS technology of 3D printing, it is often used to make parts of aeroplanes in the aviation industry, make utensils, ornaments made of gold. It is often utilised in the form of metal dust. Properties which make it quite useful are high melting point, ductility, good corrosion, oxidation resistance and high specific stiffness [4].

### Impact of 3D Printing on humans

### Healthcare

- ***Prosthetics:*** It is an artificial, man-made human body part made mostly from ABS, plastics, metals that is to be fitted whenever a person loses any of its body parts or when they become non functional. There are about 1.7 million people in the United States living with limb loss, and 50,000 to 100,000 new amputations occur per year[3]. 3D Printing has made great advancements in this area as it is considerably cheaper which is truly evident as reports by American Orthotics and Prosthetics Association suggest that an average traditional prosthetic costs between \$1,500 to \$8,000 while a 3D printed prosthetic is available for a price as cheap as \$50! Nevertheless, it can be customised as per the person needs which makes them more comfortable wearing it. It can be developed within a timespan of 24 hours [5] which makes them easily accessible in emergency and increases production rate. This emerging technology has allowed disabled or severely injured athletes to continue their desire to play sports in competitions like Paralympics which otherwise sports persons couldn't even play.
- ***Artificial organs and Tissues:*** The bioprinting of tissue involves the use of silicone mold where living tissues are placed on a chip. Later, a grid of living cells are printed layer by layer followed by insertion of stem cells via a specialised ink into the mesh of cells. An additional microgel involving a lot of nutrients is supplied via a single inlet and outlet. With this, patients do not have to wait for the donors and are also saved from the risk of cell rejection. They also make it possible for people to get organ transplants for which there are no compatible donors, open room for more research to be conducted and devise solutions to health problems that couldn't be solved before.
- ***Personalised and new medical equipment:*** Right from printed glasses, surgical tools to stethoscope, thermometers everything can be 3D printed. They allow the creation of personalised designed medicines as per the patient's needs. A girl born in 2011 named KaibaGionfriddo was born with tracheobronchomalacia, a disease in which windpipe collapses causing breathing and heart rate to stop often during the day. Her doctors 3D printed bioresorbable device that instantly aided Kaiba breathe. Later, after the operation her trachea rebuilt itself and she was able to breathe properly again [6]. Now, local hospitals and pharmacies can manufacture medicines as per patient's problem leading to more effective and faster treatment. This is the power of 3D Printing!

### Education

- ***Virtual Training and Planning:*** Usually when CT scan is performed on a patient, a digitized version of the required body part is produced. However, much cannot be done with this digitized version of this part. So with the help of 3D Printing, we can reproduce the digital version into a three dimensional, real model. Now the doctors can train themselves for the actual, real life surgery by first rehearsing the entire process on the 3D



model. This will help acquire more precision, accuracy and lower surgery times. It can help trainee doctors to understand how each part of the body functions and appears in real life and visualize them even more effectively[7]. Real hands on practice of surgeries is no longer a dream now! Shah and Ahmed, two undergraduate medical students conducted a survey on the importance of the variation in teaching for undergraduate dental education and found that the majority of students had a preference for kinesthetic learning ie. tactile learning [8]. Those physical interactions or activities are the reasons why 3D printed models are essential in the training of medical professionals.

- ***Boosts Maker Culture:*** It is simply a replica of DIY( Do-It-Yourself) culture wherein people use their ideas and creativity to fabricate things. It draws and attracts people, communities into creating something unique and new. With the advent of 3D Printing, students are not limiting their imaginations as anything they want to build can be immediately available in 3D version. No need to produce presentations, pitch to manufacturers, spend time travelling and waiting. All you need is a 3D printer. It will increase the number of freelancing designers as they manufacture designs easily with open source community softwares. The students can experience hands-on, practical learning which will help them further deepen the level of interest with the touch and feel of objects. Innovation will reach new heights as ideas are transformed to reality with this amazing invention.
- ***STEM Education and R&D:*** 3D Printing has helped students especially in field science and technology to improve their skills like spatial, problem solving skills. They can foster their creativity and imagination by building prototypes. Learners make designs in software, test their designs, encounter issues, solve them and they keep trying which helps them build problem solving. With 3D printing, there are a plethora of avenues that are unexplored like they can be used to print laptops, furniture, gadgets, so these areas need research which young enthusiasts would be willing to perform.

### **Disaster Relief**

Whenever natural disasters hit us, they come with massive amounts of destruction and economic loss. They destroy homes, buildings, transport systems, shops and literally anything that comes their way. After the storm of demolition passes away, there is an urgent need for reconstruction of damaged infrastructure. There are things that need quick fixes and 3D printers have the ability to produce objects instaneously and with a limited amount of resources. They provide immediate solutions like production of medical equipments, newly built homes. What we need after a disaster is shelter which is facilitated by use of 3D printers as they build small, sturdy houses from eco-friendly materials. Another immediate requirement is electricity which can be attained by printing new wires to replace damaged ones , solar panels to generate electricity and even fabricate generators.

In 2015, an earthquake of magnitude 7.8 hit Nepal and tore the whole nation into pieces. An organization named Field Ready went to a place in Nepal, named Bahrabise, where a huge number of families were affected by the natural phenomenon. Later, when they viewed and inspected the area they found out that there were multiple pipe breakages, leaks coupled with missing bath fittings. The designer, immediately within a small span of time designed a CAD drawing of a water fitting model and fabricated a three dimensional model of it. They fixed it in



the pipe and it worked perfectly alright. This was the first time that bath fitting for pipes had ever been 3D printed [9]. Now, if the process was done traditionally, firstly, it would have taken a couple of days to import materials required from different countries, then manufacturing it. It would have taken a great ordeal of time and money. With 3D printing, both of these assets are saved as well as people are able to restore water supply immediately for their use. Enormous volumes of water were conserved, people continued their household chores and so many things improved in such a small matter of time.

Another amazing project by Field Ready was implemented by the local manufacturing of rescue airbags and medical equipment in Syria. As it is known, Syria has been a country that has been severely affected by war and conflict. Rubble, collapsed buildings, gigantic rocks have covered the entire country. These bags produced from recycled materials are a cheap effective solution that has allowed lifting of debris, ruins that weigh up to tons. Due to constant bombings, people often get stuck under the rubble and can face severe injuries due to the heavy amount of pressure. With this new invention people can easily be rescued and so many lives are saved. If there were no 3D printed airbags, so many people would have died by now [10].

### Housing and Shelter

- In today's world, 29.245 percent of urban population live in slums [11]. This huge number shows the global housing crisis the world is facing right now. This calls for an immediate solution to produce cost effective houses to accommodate these people. 3D Printing with its amazing innovation is able to build homes from concrete and recycled materials. The quality of homes is excellent and provides protection against natural disasters like floods, earthquakes. As natural disasters occur, there are millions of people who are left homeless and there is an urgent need for cheap and sustainable homes like these which makes the implementation of this technology even more significant.

### Projects

- New Story, a non-profitable housing organisation in collaboration with ICON are constructing the world's first ever 3D printed community in a remote location in Mexico. Their aim is to create 50 homes with an area of 500 sq.ft for families that live on less than \$3 per day. Providing 2 bedrooms, bathrooms, kitchen and protection against seismic activity this community will take just a couple of days to be ready. This shows that the world is moving towards this technology. Here are some pictures of the project.



- Tvasta Manufacturing Solutions, a startup by three IIT alumni has built India's first ever 3D printed house with area of approximately 600 sq.ft in Chennai and 1BHK style home. The house can adjust itself according to climatic conditions. Built within 5 days, it is supported by the Ministry of Housing and Urban Affairs. Finance minister feels this would be an important step to complete the mission of 'Housing for All by 2022'.
- Dubai has built the world's largest 3D printed building with help of ApisCor, a construction firm based in the US. It possesses an immense height of 6900 square feet with an astounding height of 31 Feet. Built from recycled and waste materials mixed with concrete, this building was just built from a single 3D printer. Check out some amazing photographs here.



### Experimental

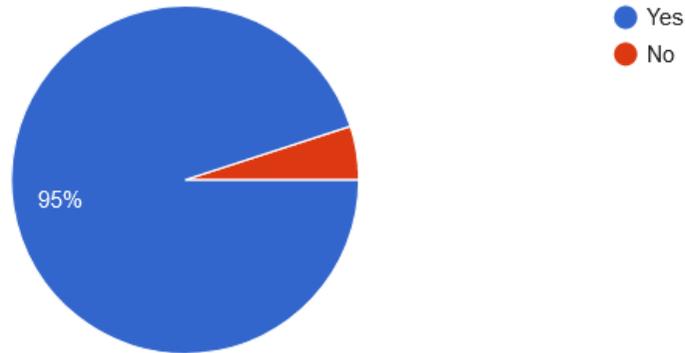
I conducted a survey to test my hypothesis of whether 3D printing will be the next face of humanitarian technology. For this, I made use of google forms to get people's opinions on whether they think that this technology will create an impact on human welfare and which sector it would affect the most. It was a multiple choice based questionnaire to make sure results can be easily quantified and inputs can be collected accurately. 60 respondents participated in the survey conducted online and here are the results.



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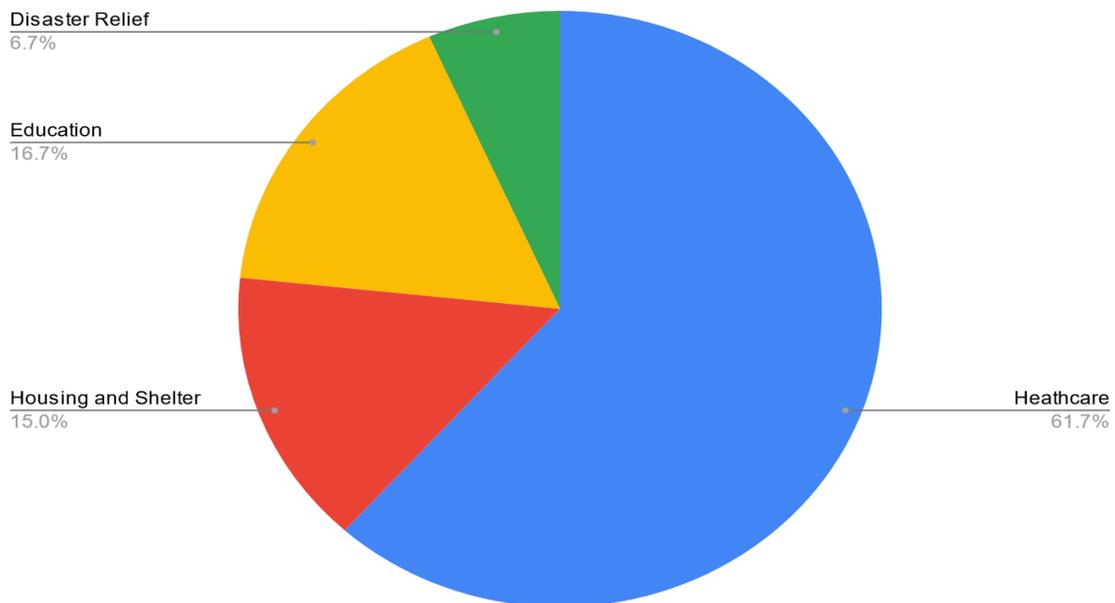
Do you think 3D Printing will improve human welfare and quality of life?

60 responses



According to the respondents, they definitely think 3D Printing will be the next upcoming humanitarian technology. As the results state, out of 60 respondents, 57 believe it has the potential accounting for 95 percent and only 3 feel it is a creation that will not benefit humans. As this technology is dependent solely on human well being so if we ourselves feel it might create a change then there's no stronger evidence needed.

### Which avenue do you think it will impact the most?

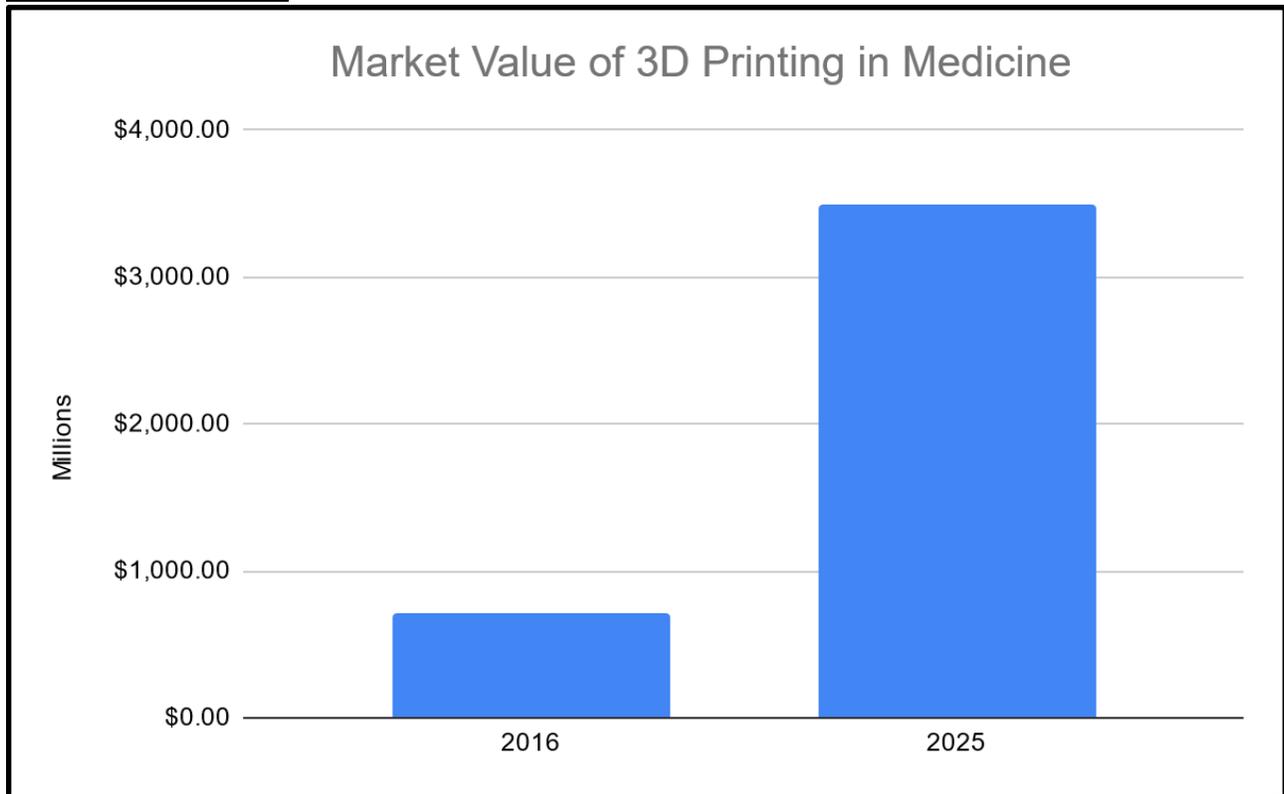




### Discussion/Result

Out of 60 surveyors, about a majority 37 candidates felt 3D Printing might affect healthcare the most, followed by 10 respondents in favour of education, 9 in housing and sector and disaster relief being the avenue being least impacted according to them. This is true as maximum research findings have been developed in the medical sector and these healthcare projects are noticeable in people's eyes and spreading in the news.

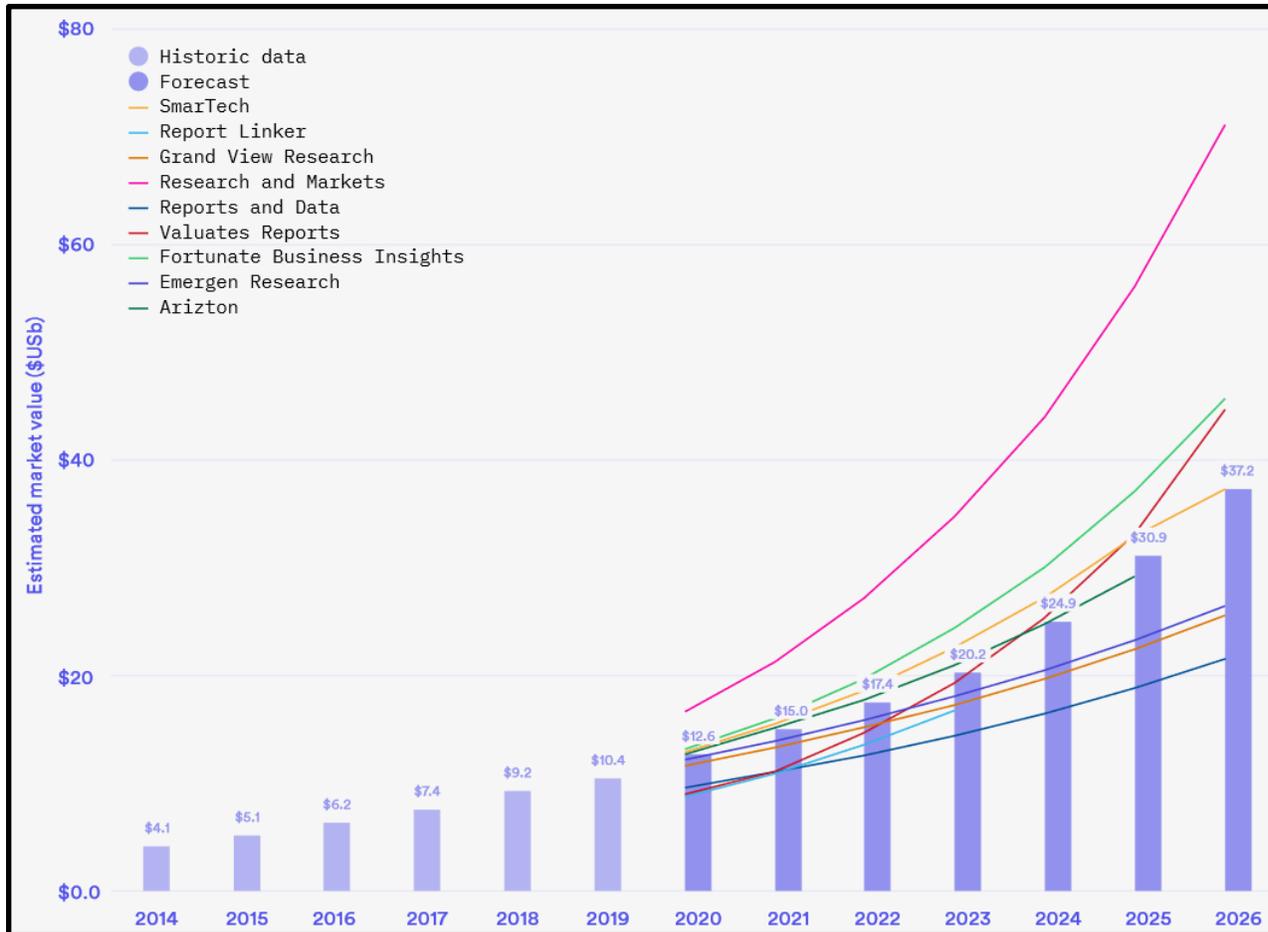
### Medical & Healthcare



It has been forecast that 3D printing in the medical field will be worth \$3.5bn by 2025, compared to \$713.3m in 2016. The industry's compound annual growth rate is supposed to reach 17.7% between 2017 and 2025. 3D printing has a strong future in the market and the supply chain is about to boost to great extent as this creation has created a strong impact in every small area in the medical field. A survey conducted by the WHO states that 40 million people require prosthetic and orthotic devices. Still out of those large numbers, only 5 to 15 percent of those have access to these equipment. This is an awakening call for humans to implement large scale 3D printing and manufacturing of prosthetics to produce large quantities of these devices to help the pain in agony and suffering. The demand is so huge in the market and it's time supply gets the upper hand. The reason why 3D printing is the best fit solution here is as its less production time, less processing overall costs and environmental friendly. Around 600000 implants have been performed in 2019 by the use of 3D printing and it is estimated that number might reach 4 million.[12] which again emphasizes on the wide scale adoption of the technology.



## Economic use and Implementation



As the report as per data collected by Wohler Associates [11], it shows the market value of 3D printing is constantly rising and is expected to grow exponentially in the future. This is clearly an indication that the world has started accepting the importance of this technology and is being used all over the world. In 2014, the market value stood at \$4.1 billion and from experts prediction it may scale up to \$37.2 billion. Of course, as this technology is now mainly utilized in the medical and housing sector, it will indirectly affect human welfare and aid humans.

## Other Sectors

An approximate 3 billion people will require adequate and affordable housing by 2030. The prime minister of Dubai has aimed to achieve the goal of 3D printing 25% of all buildings by 2030 in Dubai. This shows the level of trust and faith the government and nations have in this innovation and large sums of money they are ready to invest to ensure homes for everyone. There are 100+ projects working under the branch of construction 3D printing all with the same aim to provide housing to all and make houses affordable and sustainable. A survey conducted by Dimensional research in November 2016 on 3D printing in Education showed that 77 percent



of educators were interested in buying these printers for teaching. 45% of survey respondents said that they let their students utilize the technology in other areas as well. Also 23% of educators surveyed said they do introduce the technology in elementary schools [13]. Well, this clearly proves that teachers are ready to teach students the new and effective way of learning-active and hands-on learning. 3D printers itself is a huge subject that can be explored, learnt and its applications in education are just a bonus.

### Life-Saver

The air rescuer built by the Field Ready organisation has saved 5 precious lives in its first implementation. Now, as we know the enormous amount of medical equipment, organs and tissues that have been already fabricated and implemented coupled with so many disaster relief solutions that were designed using this innovation would have definitely saved at least millions of lives by now.

### **CONCLUSION**

As human welfare consists of three major sectors- education, healthcare and shelter and with 3D printing it has produced a profound impact on all avenues as we have seen throughout the entire paper. Hence, this qualifies as the perfect humanitarian technology. With this invention being novel and possessing a strong prospect, it needs support from society in forms of capital, time, resources to perform more research and experimentation to enhance its impact on all possible sectors. We being youth of the community are responsible to make sure technologies reach out to maximum people out there by raising necessary awareness and helping people out. Since 3D printing can lead to a lot of dangerous activities, governments need to introduce stricter policies and standards to ensure safe usage of it. As humans, it's important for us. Also, it is crucial for human beings to be sensible enough to use this technology as every coin has two sides and it's upon us to focus on the bright side and harness the maximum potential out of it.

### **REFERENCES**

1. ISO/PRF 17296-1,"Additive manufacturing -- General principles -- Part 1: Terminology", 2015.
2. P. Holzmann, J. Robert, A. AqeelBreitenecker, Soomro, & J. S. Erich, "User entrepreneur business models in 3D printing," Journal of Manufacturing Technology Management, Vol. 28, No. 1, pp. 75-94, 2017.
3. Matthew P. Fahrenkopf, Nicholas S. Adams, John P. Kelpin, and Viet H. Do, "Hand Amputations", NCBI.
4. N. Shahrubudina,T.C. Leea, R. Ramlana, "An Overview on 3D Printing Technology: Technological, Materials, and Applications, 2nd International Conference on Sustainable Materials Processing and Manufacturing (SMPM 2019), Sun City, South Africa,8-10 March 2019.
5. C.Lewis. "3D Printed Prosthetics in the Developing World".borgenproject.org.  
<https://borgenproject.org/3d-printed-prosthetics-in-the-developing-world/>
6. "3D Printing in Medicine And Healthcare – The Ultimate List In 2021".  
<https://medicalfuturist.com/3d-printing-in-medicine-and-healthcare/>



## An International Multidisciplinary Research e-Journal

7. H. Dodziuk, “Applications of 3D printing in healthcare”, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5071603/>
8. J. Garcia, Z. Yang, R. Mongrain, R. Leask and K. Lachapelle, “3D printing materials and their use in medical education: a review of current technology and trends for the future”,
9. S.Jones. “When disaster strikes, it's time to fly in the 3D printers”.[theguardian.com](http://theguardian.com). <https://www.theguardian.com/global-development/2015/dec/30/disaster-emergency-3d-printing-humanitarian-relief-nepal-earthquake>
10. “Syria”. [fieldready.org](http://fieldready.org). <https://www.fieldready.org/syria>
11. Wohlers Report 2021 . Wohlers Associates, March 16, 2021.
12. “3D Printing In Healthcare: Where Are We In 2021? (Updated)”. [amfg.ai](http://amfg.ai). <https://amfg.ai/2019/08/30/3d-printing-in-healthcare-where-are-we-in-2019/>
13. S.Saunders. “Y Soft’s International Education Survey Finds That Majority of Schools Limit Student Access to 3D Printing”. [3dprint.com](http://3dprint.com). <https://3dprint.com/162719/y-soft-3d-print-education-survey/>
14. “What is Humanitarian Engineering?”. [osu.edu](http://osu.edu). <https://hecouse.engineering.osu.edu/what-humanitarian-engineering>
15. O. Abdulhameed, A.Al-Ahmari, W.Ameen, S.Mian, “Additive manufacturing: Challenges, trends, and applications” , February 24, 2019



## TREND IN SCREEN TIME RELATED HEADACHES AND MIGRAINES DUETO COVID 19 PANDEMIC

Alexia J. D'souza

Billabong High International School Malad

[alexiadsouza777@gmail.com](mailto:alexiadsouza777@gmail.com)

### Abstract

Given the present day scenario of the COVID 19 Pandemic, there has been an unprecedented increase in our use of screen time and electronic device usage, along with a surge in reports of increased Head aches and Migraines, and poor Ocular Health. This leads us to ask the question; Is our screen use related to, or influencing the occurrence of Headaches or Migraines? This research paper scrutinized and investigated this hypothesis by exploring links between the two and assessing the situation by data collected through a survey across 115 people. An analysis concluded that a rise in screen time increases the frequency, and intensity of neurological symptoms experienced by children and adults alike.

**Keywords:** *Screen time, Migraine disorders, Headaches, Mental health, Ocular health*

### INTRODUCTION

In this current circumstance of the COVID 19 Pandemic we find ourselves even more connected and reliant on technology in the form of the Internet, Electronic Devices, and even Software; they have become a crucial and integral part of our lives. Their applications range from Communication to Employment, to Academics and even Entertainment. In consequence to their widespread use, our Screen Time: The amount of time a person spends watching or interacting with content on the screen of a computer, phone, TV, gaming console, etc.[1] has increased exponentially. In accordance to this action, come a few unavoidable impacts; namely Neurological symptoms such as Migraines and Headaches amongst others such as deterioration in Ocular Health and frequent Body Pain. This paper aims explore the influence of the COVID 19 Pandemic on trends in this data while examining and identifying possible links between Screen Time and Neurological symptoms, through the use of Biotechnology and Computer analysis.

### Theory

Eye Strain is a condition wherein your eyes become fatigued or exhausted after intense use and being exposed to a screen for prolonged durations of time. Studies have shown that a mere two hours of continuous use is enough for symptoms to set in, beginning with-



- Blurred Vision
- Dry eyes
- Redness in Eyes
- Itching in eyes
- Tearing up
- Double vision

As you look at a screen, you're exposed to a constant glare, you blink lesser, this can have far ranging consequences such as your eyes drying out, your eyes not receiving the required nutrients and oxygen for the cornea, as well as an increased risk of infection. In addition, the conditions in which we use our screens aren't often ideal; improper postures, poor lighting and intense focus which can worsen the situation. As a result of this, people can suffer from a variety of issues, such as-

- Lower attention span
- Sore body; specifically the neck, shoulder and upper back pain
- Disturbed sleep cycle
- Mood affected
- Head aches and Migraines
- Light sensitivity(2)

The collection of these problems, stemming from excessive screen use is termed as Computer Vision Syndrome (CVS). Studies have shown that more than 90% of computer users are affected by CVS, and that 19% to 53% of people having extended screen usage have reported suffering from headaches and migraines as a consistent impact. 46% of school going students experience migraines due to computer use. Factors which specifically play a critical role in exacerbating headaches are-

Screen Brightness; the intensity of the light and the light/ dark contrast, people with existing neurological deficits often have a lower tolerance for bright light.

Duration of Exposure; exhaustive viewing for as little as 30 minutes can trigger CVS symptoms, and prolonged use for 2 hours a day can increase the frequency of headaches. Daily exposure can magnify the problem. Flicker Frequency; abnormal flickering from screens can intensify headaches.

Blue light; the blue spectrum of light is known to be an aggravator for headaches and migraines, and is a vital part of visible light. It is also known to impact sleep patterns.[3]

This detrimental correlation between extended exposure to screens was seen in a 2015 study by students of INSERM Research Centre of Epidemiology and Biostatistics U897 and the University of Bordeaux investigating the association between excessive screen time exposure and non-migraine headache and migraine in young adults. Out of 4927 responding French students, 75.5% were female, and the mean age of participants was 20.8 years. "Students in the highest screen time exposure quintile had an increased risk for headache. The odds ratio (OR) (95% confidence interval (CI)) was 1.37 (1.14 to 1.66) for migraine when compared with



students without headache and with low screen time exposure. This association was somewhat stronger for migraine without aura (OR = 1.50, 95% CI 1.19 to 1.89)". This result concluded that the high times of screen exposure were related with migraine in young adults, but no significant association with non-migraine headache was found.[4]

Screen time can be especially hazardous for a person suffering from migraine; early studies have indicated that computer screens can worsen symptoms in 1/3rd of patients; more so if light is a trigger.

Some studies suggest that the onset of an attack activate certain neural pathway to the brain while others suggest that there are specific cells in the eye that are extremely sensitive to certain wavelengths of light[5]. For those light sensitive, there are a few characteristics of lighting that must be paid attention to carefully to be safer; such as Fluorescent Light Pulsing which is flickering of fluorescent lighting that is unnoticeable by the human eye but detected by the brain[6], and Flashing, Contrasting and other light patterns are frequent stimulants as well, encompassing namely bright reflected light, flashing strobe lights and flickering lights in repetitive and contrasting patterns[7].

Since people suffering from migraines have a lower threshold for bright light, the screen brightness could pose as a threat for an attack. Extensive use increases the risk for ocular complications and streaming video content can aggravate those with motion sensitivities, as well as affect migraine and vestibular conditions. In patients affected by post-concussion syndrome and traumatic brain injury, there is lesser clinical evidence to support the impact of computer screens, however they have been astoundingly vocal in expressing that screens were vexatious to their condition. LCD

Screens have been shown to slow the recovery time for post-concussive individuals, and treatments involving mandatory computer use are significantly less effective in keeping headache symptoms at bay[8].

In addition to triggering or exacerbating headaches and migraines, Screen time can go as far as disturbing a person's mental health. The use of social media in particular is known to aggravate stress, anxiety and even depression; with us relying on these applications for our recreation and communication more than ever in today's times, increased screen time contributes heavily to these problems. It can even cause addiction and reward seeking behaviour in humans following the release of Dopamine, the hormone responsible for feelings of pleasure that is replicated every time someone 'likes' our posts, it is a fleeting rush of joy and our minds go in search of that feeling, this propelling that kind of seeking behaviour[9]. A 2017 study[10] showed that adults who used their computer or watch television for more than 6 hours/ day were more at a risk to suffer from moderate to severe depression, especially because screen time is a sedentary behaviour and high sedentary levels are linked to depression.

The impacts of extensive screen time are particularly magnified on the brains and development of children. Increased screen time use through engaging in digital devices lessens the time spent engaged in non-electronic activities, such as exploring the outdoors, and playing with other children and physical toys. These activities are vital to foster creativity, imagination, develop motor skills, hand eye coordination, muscle use and social skills during interactions, compromising on this will leave them with less developed skills. Often children are seen learning from videos and television, while this is captivating, studies have shown that they are hindered in



communication and language skills, and that they perform less well on reading tests and may show deficits in attention[11].

In teens, screen use was linked to compromises in emotive ability and personality; “Studies in young men show that playing violent video games is linked to more aggression and less sensitivity to others. Also, imaging studies have found that internet addiction and game addiction can shrink the brain regions responsible for planning and executive functions, empathy, compassion, and impulse control.”

The use of digital devices soon before bed can cause disturbed and irregular sleeping patterns; the blue lights from screens inhibits the secretion of melatonin, the sleep promoting hormone, keeping you from having a restful sleep. Since we usually use our screens while sitting down and in a stationary position, the lack of activity and movement can promote a risk of weight gain leading to diabetes and heart disease in adults[12].

Too much screen time can also have dangerous and direct impacts on the human brain, even going as far as altering its structure. The Adolescent Brain Cognitive Development study[13][14]took brain scans to compare any visible impacts on the brains of children ages 9 and 10 who used digital devices for more than 7 hours a day. Scans revealed that the brain’s cortex; a layer responsible to process information stimuli from the five sense showed premature thinning in these kids than in those who did not use their screens for such prolonged times[15].

The existence of these harmful implications makes it important for us to take certain steps in reducing our screen time and giving our eyes and minds a break. Screen time can be tracked using applications on your phone to make a conscious change towards lowering screen use. Blue light blocking glasses can be used while working on digital devices. Changing your light bulbs to warm, white LEDs that emit lesser blue light can help people who’re light sensitive and triggering to migraines[16]. Lighting can be adjusted to be positioned behind and not directly aligned to your face, close attention should be paid to ergonomics to ensure good posture and keeping devices a good distance away from your face; you can also invest in equipment that is tailored with ergonomics in mind. Dry eye can be eased with the use of prescribed eye drops [2].

### **Experimental**

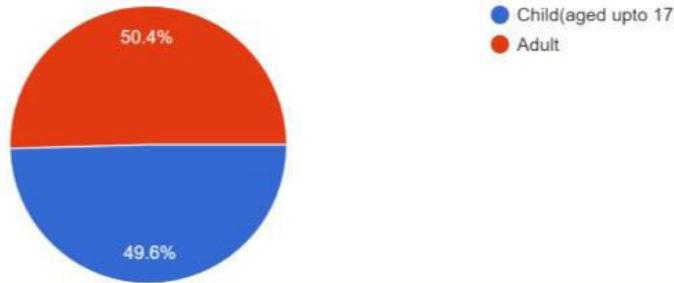
To explore and document information and statistics about the trend in screen time related headaches and migraines I collected first hand data through a questionnaire on Google forms. The 115 people who answered the survey were majorly self-diagnosed and 50.4% were adults aging 18 and above, the rest youth between the ages of 10 and under 17.



### Result

What do you identify as?

115 responses



CHILD

How old are you?

57 responses

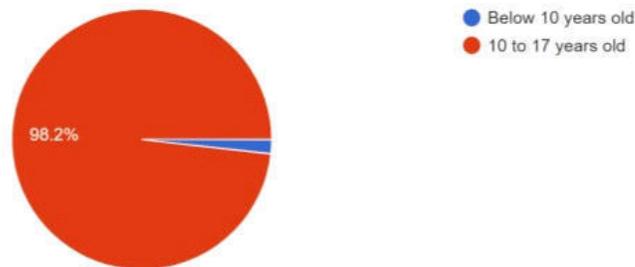


Fig. 1



What do you usually use your device for? Tick all that apply.

57 responses

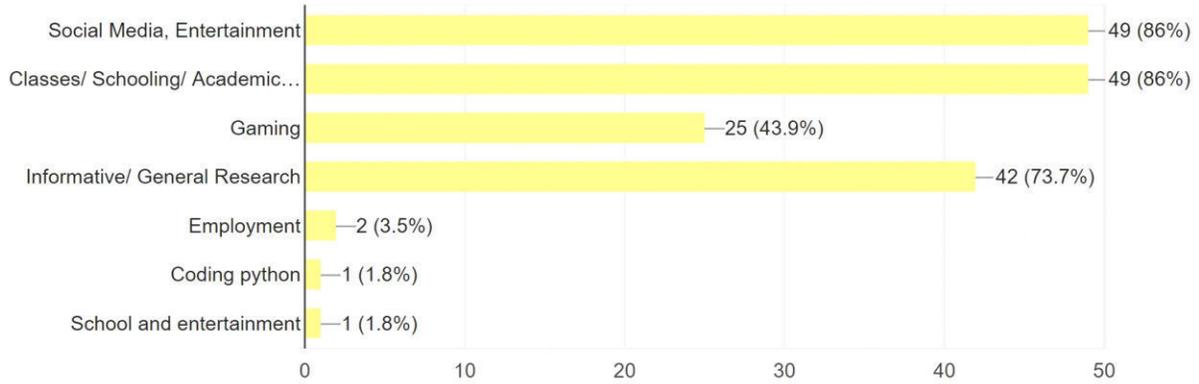
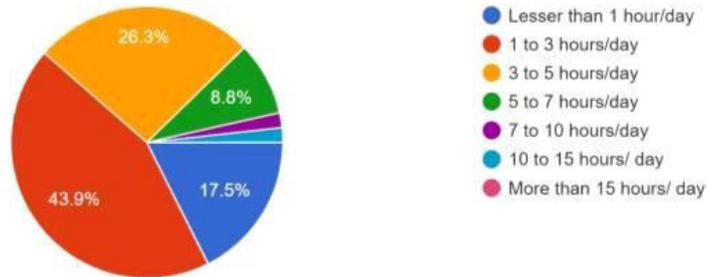


Fig. 2.1 Fig. 2.2

Before the pandemic, what was your Screen time in hours every day?

57 responses



Did you suffer from Migraines before the Pandemic began?

57 responses

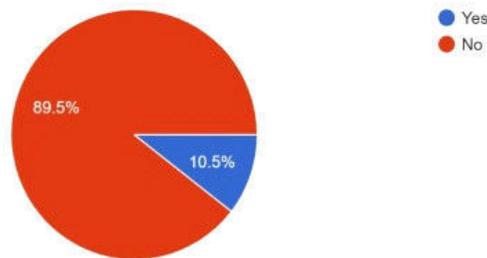
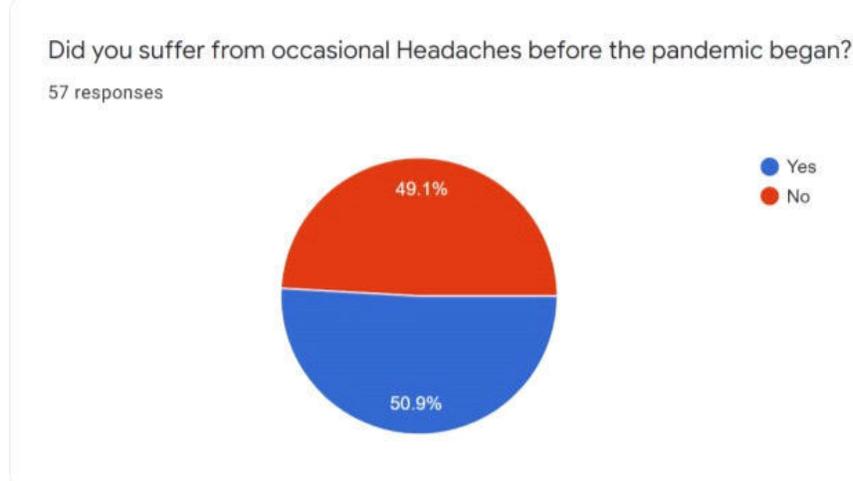


Fig. 2.3

Fig. 2.4



How often did these Migraines and Headaches occur?((please answer this only if you have experienced headaches and migraines))

39 responses

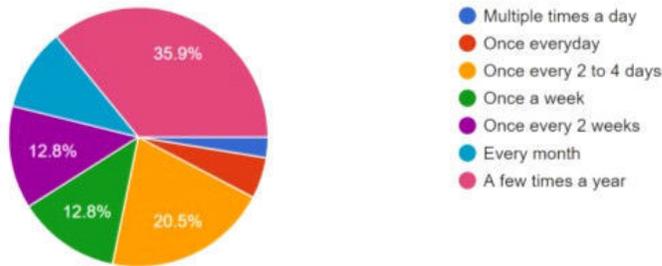


Fig.2.5

Fig.2.6

After/ during the pandemic, what is your Screen time?

57 responses

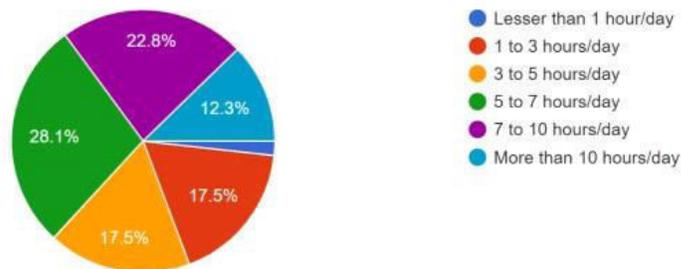


Fig. 2.7

Do you think your Screen Time has increased since the Pandemic began?

57 responses

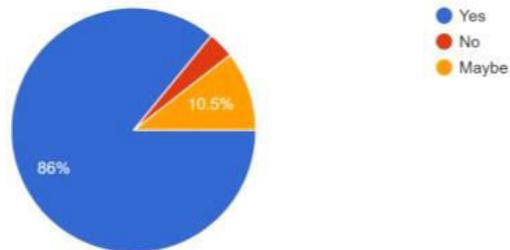
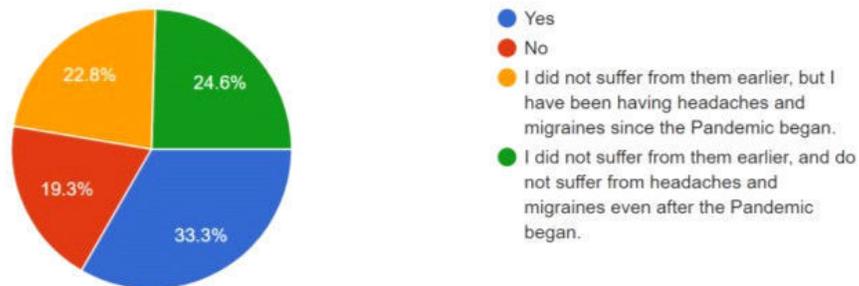


Fig. 2.8

Do you believe your headaches and migraines have increased since the Pandemic began?  
(Increased or even begun to occur since the Pandemic Began))

57 responses



If YES, how frequently do they occur now?

34 responses

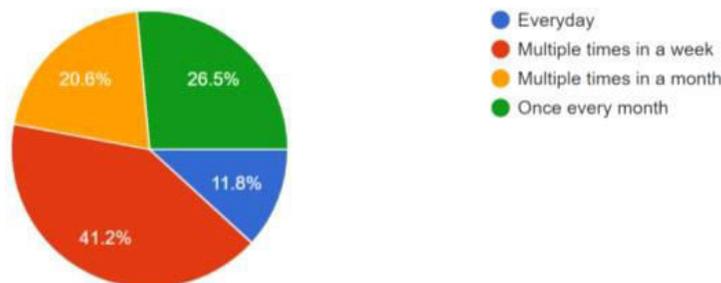


Fig. 2.9

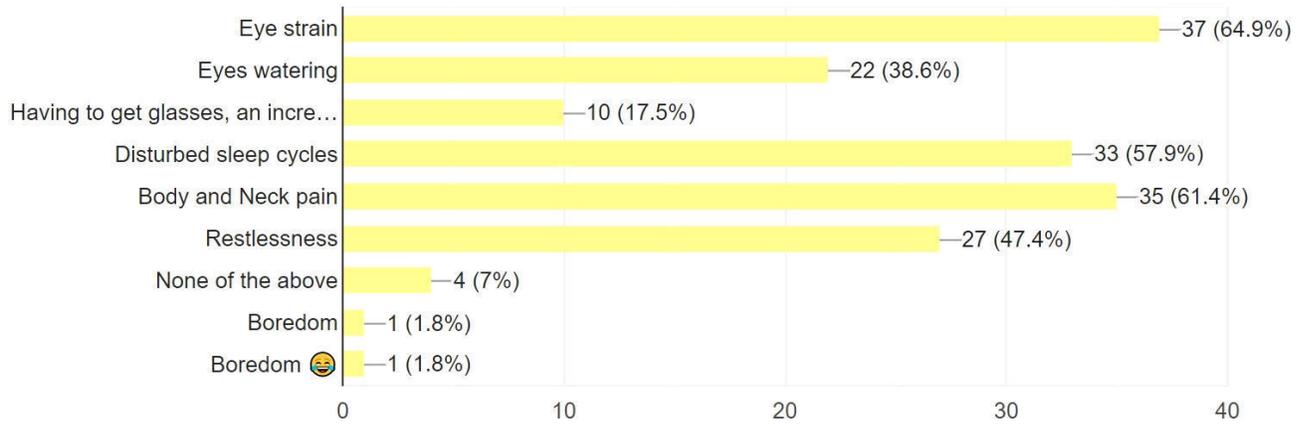


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Fig. 2.10

Have you experienced any of these other issues since the Pandemic began? Tick all that apply.

57 responses



### ADULT

How old are you?

58 responses

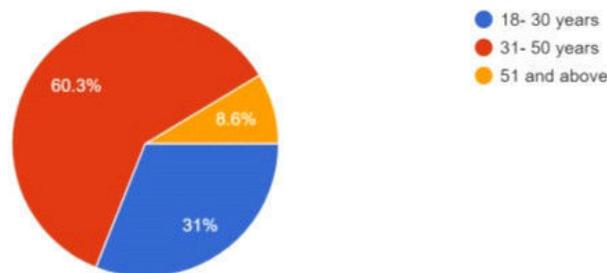


Fig. 2. 11

Fig. 3.1



Before the pandemic, what was your Screen time in hours every day?

58 responses

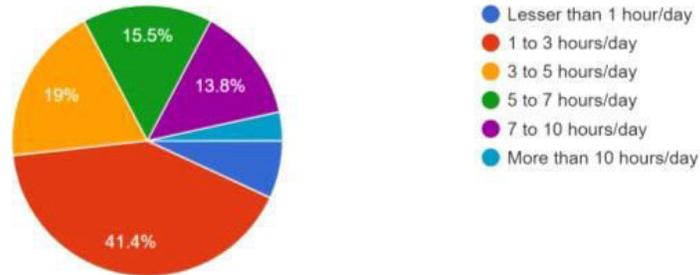


Fig. 3.2

Fig. 3.3

Did you suffer from Migraines before the Pandemic began?

58 responses

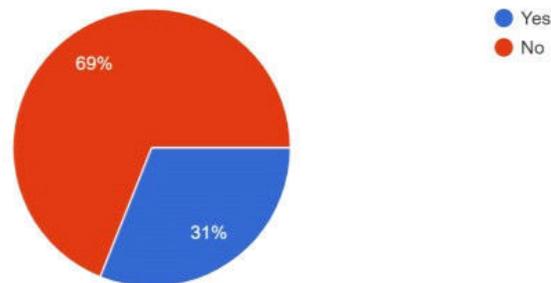
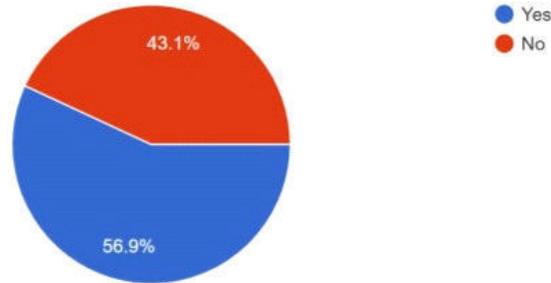


Fig. 3.4



Did you suffer from occasional Headaches before the pandemic began?

58 responses



How often did these Migraines and Headaches occur?((please answer this only if you have experienced headaches and migraines before the Pandemic began))

45 responses

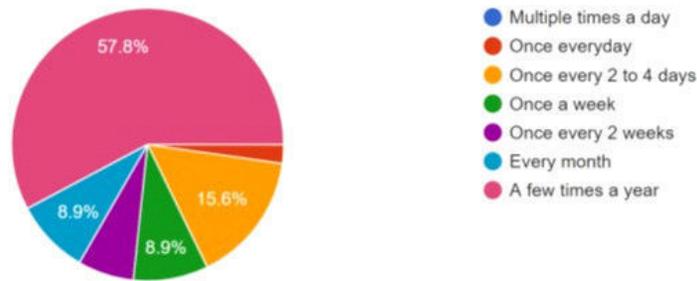


Fig. 3.6

Fig. 3.5

After/ during the pandemic, what is your Screen time?

58 responses

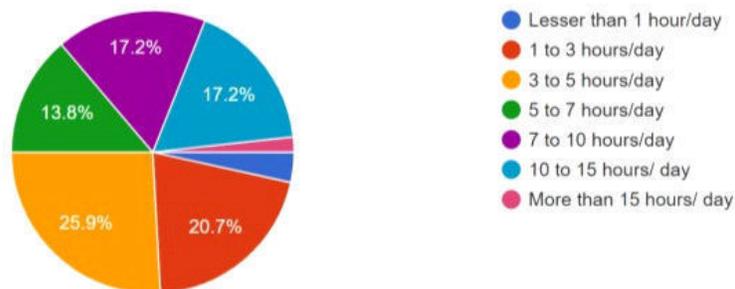


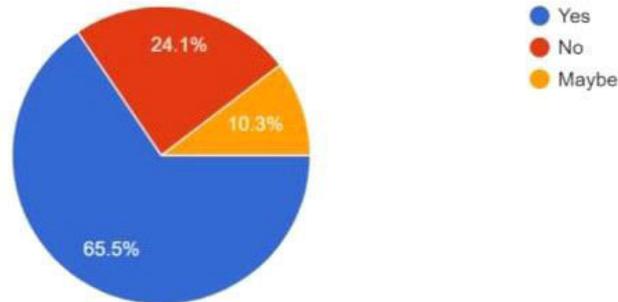
Fig. 3.7



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Do you think your Screen Time has increased since the Pandemic began?

58 responses



Do you believe your headaches and migraines have increased since the Pandemic began?  
(Increased or even begun to occur since the Pandemic Began)

58 responses

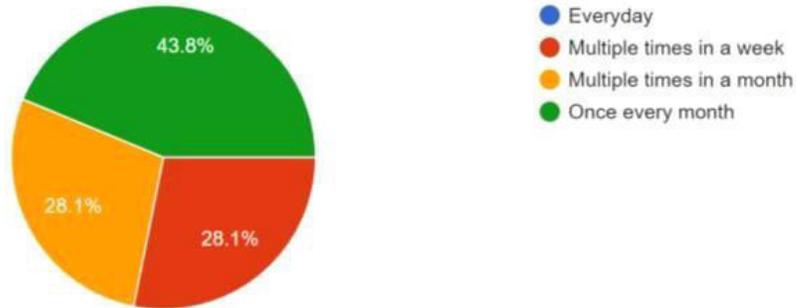


Fig. 3.8

Fig. 3.9

If YES, how frequently do they occur now?

32 responses



Have you experienced any of these other issues since the Pandemic began? Tick all that apply.

58 responses

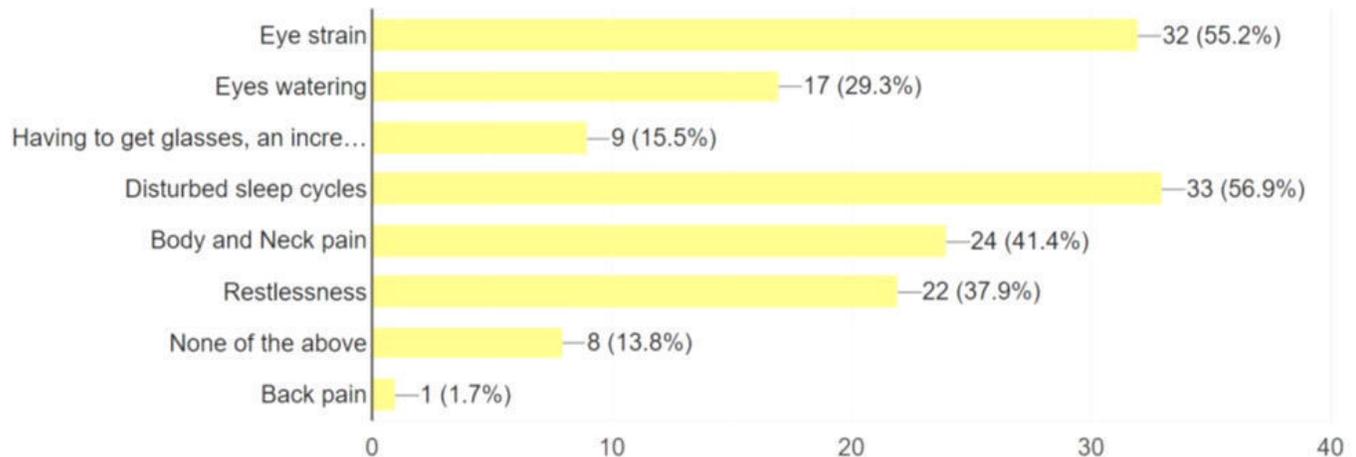


Fig. 3.10



### Discussion

The survey was differentiated by age with individuals below 17 years of age considered as Children, and those 18 and above were adults.

49.6% of the total people asked(115) were children, 98.2% of which were 10 to 17 years old. When asked what they used their devices for 49%(of 57) replied for “Social Media & Entertainment” and “Classes/ Schooling/ Academic purposes”, 42.5% said they used it for “Information/ General Research”.

A majority; 43.9% (of 57) admitted that their screen time was for “1 to 3 hours/ day” with 26.3% using it for “3 to 5 hours/ day” and 17.7% had a screen time of “Lesser than 1 hour/ day”. 89.5%(of 57) of the responders attested to not suffering from migraines before the Pandemic began, and 50.9%(of 57) said they did suffer from occasional headaches before the Pandemic began. 35.9% of the people who had experienced headaches or migraines before suffered from them “A few times a year”, while 20.3% bore them every “2 to 4 days”. After asking what their screen time was after or during the Pandemic, 28.1%(of 57) affirmed it was now “5 to 7 hours/ day”, and 22.8% said it was “7 to 10 hours/ day”. 86% of people(of 57) agreed that their screen time had increased since the pandemic began, with 33.3%(of 57) acknowledged that their headaches and migraines had begun to occur as well increased in frequency since the Pandemic began. Notably, 24.6% (of 57) answered that they had never suffered from headaches and migraines before the Pandemic and neither did they now. Of those who replied positively to having seen an increase in the recurrence of these neurological symptoms(34), 41.2% said they occurred “Multiple times a week.” While asked to cite some other issues faced by them since the Pandemic began (57), most complained of Eye strain, Body & Neck pain, Disturbed sleep cycles and Increased Restlessness.

50.4% of the total people asked(115) were adults, Primarily constituting of 60% between the ages “31 to 50”, 31% between “18 to 30 years”, and the remaining 8.6% aged “51 and above”. When asked what they use their devices for(58), usage for “Social Media & Entertainment”, “Informative/ General Research and “Employment” were common. 41.4% of people asked(58) agreed to using their screens and devices for a screen time of “1 to 3 hours/ day”, and 19% for “3 to 5 hours/ day”. 69%(of 58) professed to suffering from migraines before the Pandemic began, and 56.9%(of 58) had occasional headaches. Out of those having experienced migraines and headaches, 57.8% succumbed to them “A few times a year”. When asked what their screen time was during or after the Pandemic(of 58), 25.9% said it was “3 to 5 hours/ day” and 20.7% admitted to “1 to 3

hours a day”. 65.5% of people(of 58) recognised that their screen time had increased since the Pandemic. 34.5%(of 58) believed that their headaches and migraines had increased since the Pandemic began, with 43.8% of those attesting to having suffered from them(of 32) recently saying they occur “Once a month”. When asked about which issues they noticed they suffered from since the Pandemic began, Eye strain, Disturbed sleep cycles, Body and Neck pain and Restlessness were prevalent.

The data collected was analysed through the use of computers and the following statistics were found.



In Children(aged 17 and below), the average time spent on their screens and devices was 2.91 hours/ day; during and after the Pandemic, this rose to 6.22 hours/ day which is an alarming increase of 213.75%. When asked if they had begun experiencing increased head aches and migraines, most children replied “Yes”, they had heightened bouts of these neurological disorders and had even started to experience them when they hadn’t previously. From 30% of them suffering, the number escalated to 56% after the Pandemic, a rise of 26% seen. The frequency of these headaches and migraines were intensified too, occurring at an average of “Every 2 weeks” earlier, but now more persistent in happening “Multiple times a week”.

In Adults (aged 18 and above) the mean time of screen use had increased drastically by 74.27%. Atfirst it was 4.16 hours/ day, however it had increased to 7.25 hours/ day post Pandemic. The majority of adults acknowledged that they had endured more headaches and migraines after and during the Pandemic. This was a significant augmentation of 7.57% on the previously 37.07% sufferers pre-pandemic. Their frequency was strengthened too, occurring more often at “Multiple times a month” when compared to the “Few times a year” before the Pandemic.

### Conclusion

The results of my survey showed that the screen time in these 115 adults and children had increased by 90.52%. Screen use was previously 3.54 hours/ day, but since or during the COVID 19 Pandemic had increased to 6.74 hours/ day. The number of people suffering from headaches and migraines had increased too, but this rise was more significant in children as compared to adults; a surge from 33.54% of people afflicted by headaches and migraines had increased to 50.41% after the COVID 19 Pandemic, which was a hike by 16.87%.

This concludes that the Trend in Screen time related Headaches and Migraines was an Increase as compared to earlier, due to the COVID 19 Pandemic.

### Acknowledgements

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### References

- No Name. “Screen time”. “Dictionary.com”. <https://www.dictionary.com/browse/screen-time> (accessed Jun. 15, 2021)
- K. McCallum. “Is Excess Screen Time Causing Your Headaches?”. “Houstonmethodontist.org”. <https://www.houstonmethodist.org/blog/articles/2020/apr/is-extra-screen-time-causing-your-headaches/> (Jun. 15, 2021)
- G. Bullock. “Computer Screens: The Effect on Headaches, Migraines and Concussions”. “Theraspecs.org”. <<https://www.theraspecs.com/blog/computer-screens-headaches-migraines-and-concussions/>>(accessed Jun. 15,2021)



## An International Multidisciplinary Research e-Journal

- I. Montagni, E. Guichard, C. Carpenet, C. Tzourio and T. Kurth. "Screen time exposure and reporting of headaches in young adults A cross-sectional study". "Journals.sagepub.com". <<https://journals.sagepub.com/doi/10.1177/0333102415620286>>(accessed Jun. 26, 2021)
- R. Nosedá, V. Kainz, M. Jakubowski, J. J. Gooley, C. B. Saper, K. Digre and R. Burstein. "A neural mechanism for exacerbation of headache by light". "PubMed.org". <<https://pubmed.ncbi.nlm.nih.gov/20062053/>>(accessed Jul. 18, 2021)
- A. Wilkins, J. Veitch and B. Lehman, "LED lighting flicker and potential health concerns: IEEE standard PAR1789 update," 2010 IEEE Energy Conversion Congress and Exposition. "ieeexplore.ieee.org" <<https://ieeexplore.ieee.org/document/5618050>>(accessed Jun. 27, 2021)
- A. J. Shepherd. "Visual Stimuli, Light and Lighting are Common Triggers of Migraine and Headache". "Journal of Light & Visual Environment". Vol. 34 (2010) No. 2 P 94-100. <[https://www.jstage.jst.go.jp/article/jlve/34/2/34\\_2\\_94/article](https://www.jstage.jst.go.jp/article/jlve/34/2/34_2_94/article)>(accessed Jun. 27, 2021)
- S. N. Gray. "An Overview of the Use of Neurofeedback Biofeedback for the Treatment of Symptoms of Traumatic Brain Injury in Military and Civilian Populations". Medical Acupuncture. "ncbi.nlm.nih.gov". <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5580369/>>(accessed Jun. 27, 2021)
- M. Pandika. "The Unexpected Effects of All That Screen Time". "RallyHealth.com". <<https://www.rallyhealth.com/health/unexpected-effects-screen-time>>(Jun. 15, 2021)
- B. Stubbs, D. Vancampfort, J. Firth, F. B. Schuch, M. Hallgren, L. Smith, B. Gardner, K. G. Kahl, N. Veronese, M. Solmi, A. F. Carvalho and A. Koyanagi. "Relationship between sedentary behaviour and depression: A mediation analysis of influential factors across the lifespan among 42,469 people in low- and middle- income countries". "PubMed.gov". <<https://pubmed.ncbi.nlm.nih.gov/29329054/>>(accessed Jun. 27, 2021)
- No name. "What does too much screen time do to Children's Brains?". "Healthmatter.nyp.org". <<https://healthmatters.nyp.org/what-does-too-much-screen-time-do-to-childrens-brains/>>(accessed Jun. 18, 2021)
- May Research Content Team. "The negative impact of too much screen time". "maycreation.org". <<https://info.mayrecreation.com/blog/the-negative-impact-of-too-much-screen-time>>(accessed Jun. 18, 2021)
- No name. <<https://abcdstudy.org/>>(accessed Jun. 27, 2021)
- No name. "Landmark study of adolescent brain development renews for additional seven years". "drugabuse.gov" <<https://www.drugabuse.gov/news-events/news-releases/2020/04/landmark-study-of-adolescent-brain-development-renews-for-additional-seven-years>>(accessed Jun. 27, 2021)
- M. P. Paulus, L. M. Sequeglia, K. Bagot, J. Jacobus, R. Kuplicki, F. J. Breslin, J. Bordurka, A. S. Morris, W.
- K. Thompson, H. Bartsch and S. F. Tapert. "Screen media activity and brain structure in youth: evidence for diverse structural correlation networks from the ABCD study". "ncbi.nlm.nih.gov". <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6487868/>>(accessed Jun. 30, 2021)



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K. Smyres. “What light bulbs are best for someone who is sensitive to light”. “TheraSpecs.com”.  
<https://www.theraspecs.com/blog/light-bulbs-best-someone-sensitive-light/>



## DEPLOYING DEEP NEURAL NETWORKS TO PREDICT GREENHOUSE GAS EMISSION OUTPUT

**Ninoushka Grover**

JBCN International School, Borivali  
[grover.ninoushka@gmail.com](mailto:grover.ninoushka@gmail.com)

### Abstract

Tackling the global climate crisis is a daunting task. Excessive greenhouse gas emissions lead to rising temperatures and sea levels, stratospheric ozone depletion and a greater occurrence of intense, sporadic natural disasters. As such, it is of utmost importance to understand anthropogenic activity—namely, energy production, agricultural cultivation and transportation adopted worldwide, which perpetuate this phenomenon. The following paper uses machine learning, specifically, deep learning models, to predict future greenhouse gas emission trajectories, considering the top contributing countries and key sectors worldwide. The model incorporates additional correlated factors, such as gross domestic product (GDP) growth per capita and population growth rate to prepare a comprehensive predictive tool. To facilitate emission prediction, raw data was procured of the top 20 emitters worldwide, covering a sample period of 28 years from 1990 - 2018. Results indicate high predictive accuracy of the model, with a coefficient of determination ( $r^2$ ) of 98.7%, implying a high degree of explainability regarding variability in the data.

**Keywords:** Global warming, Greenhouse gas emissions, Deep learning, Artificial Neural Network (ANN).

### Introduction

Mitigating the effects of the eminent global climate crisis is arguably the greatest challenge humanity is facing today. A disproportionate amount of greenhouse gas emissions expelled into the atmosphere are the product of intemperate human activity. This rapid increase in environmental degradation has been accelerated by the unforeseen expansion of the global population within the last 50 years. Increasing consumption, in conjunction with the proliferation of industrialization to meet insatiable consumer demand has culminated into the acceleration of greenhouse gas emissions—agriculture, transport and energy, the key contributors to this spike. Implications of climate change include rising temperatures and sea levels, stratospheric ozone depletion, changes in precipitation patterns and a greater occurrence of intense, sporadic natural disasters.



Scholars worldwide have adopted various methods of forecasting greenhouse gas emissions. One such method, applied in a recent study conducted by Appiah et al. utilized ‘Artificial Neural Networks’ (ANNs), in a fully connected two-layer feed-forward configuration. The data, constricted to that of developing economies, assessed overarching, generalized economic variables, such as the valuation of imports and exports, as contributing factors to carbon dioxide emissions. Conversely, a study by Wang et al. proposed a hybrid model consisting of the metabolic nonlinear grey model (MNGM) and an autoregressive integrated moving average (ARIMA) to forecast emission trajectories in which cumulative carbon emission values were considered exclusively. Another study, conducted by Radojević et al. developed an ANN model to forecast greenhouse gas emissions in Serbia, focussing primarily on economic and energy-centric data from 1999-2001—such as gross energy consumption and share of renewable energy, pertaining to countries across the European Union; it’s validation frame comprising emission data from 2002-2007. A differing technique was adopted by Miranda et al. concerning the prediction of greenhouse gas emissions in tropical reservoirs. The developed model, which coupled both statistical and ANN models to facilitate classification and prediction, respectively, used factor analysis to condense input variables to evoke greater prediction accuracy. The aforementioned works examines primarily industry specific variables (singular, sectoral-centric analysis), with data pertaining to a constricted sample size for limited countries and skewed time periods; the aforementioned study exclusively examined a confined selection from the entire range of contributing gasses to the climate crisis.

In order to forecast anthropogenic trends accurately and predict future greenhouse gas (GHG) emission output, the current study considered distinct, non-cumulative variables of differing contribution to aggregate emissions. The top 20 emitters, which contribute over 78% of global GHG emissions, were examined as representative of the global climate crisis. Key indicators, derived from the World Bank of Open Data, were used alongside fluctuations in economic activity and population growth, as determinants of the emission output of particular countries and economic sectors.

By developing an advanced deep learning model, the current study aims to minimize the deleterious effects of the superfluous greenhouse gas emission output worldwide. The predictive model provides insights to inform and facilitate sustainable economic growth, investment into the development of remedial technologies and incentivisation of public/private participation in deployed carbon neutral processes, in order to curtail the global climate crisis.

### Background

Climate change is largely the product of the ‘greenhouse effect’, a phenomenon which is composite of the properties of greenhouse gasses in relation to atmospheric conditions. Increasing concentrations of such gasses—namely carbon dioxide (CO<sub>2</sub>), methane gas (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O), amongst other artificial chemicals—absorb transmitted solar energy and re-radiate its heat towards Earth’s surface. Human activity accounts for the majority of this greenhouse gas emission output, with over 47552.14 million metric tons of CO<sub>2</sub> equivalent gasses (MtCO<sub>2</sub>e) expelled in 2018. A World Resources Institute (WRI) report published in 2020, emphatically attributes global emission output to three multifarious sectors: energy, agriculture and industrial processes. Energy consumption accounts for over 73% of global GHG emissions.



This sector comprises electricity and heat generation, transportation, manufacturing and construction, bunker fuel usage, fugitive emission output and other fuel consumption. Fugitive emissions, or fluorinated gas emissions, arise from industrial gas production processes, electrical component and appliance manufacturing, as well as the the extraction and refinement of aluminium and magnesium. These processes emit high concentrations of heat-trapping chemicals, (possessing a warming effect of up to 23000 times greater than that of carbon dioxide), such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>), thus contributing significantly towards the net greenhouse gas emission output. Further, bunker fuel emissions refer to the pollution caused by fuels used aboard ships, notably amassed fleets of cargo vessels transporting manufactured goods. Bunker fuels are a key disaggregated contributor to total emissions, owing to their composition of largely hydrocarbon molecule chains.

Further, agricultural subsectors of which include emissions generated by the cultivation of livestock and crops, are cited as the second greatest contributor to climate change (12%). Primary activities, including cattle belching and fertilizer usage, emit methane gas (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) respectively, representing the greatest proportion of agriculturally affiliated emissions, at upto 65%. Another crucial contributor to climate change are industrial processes, a sector which has expanded by 174% since 1990, the fastest growing source of greenhouse gas emissions worldwide. The increased manufacture and usage of appliances such as air conditioning and refrigerators are responsible for this uptake, as large quantities of potent hydrofluorocarbons are expelled as a product of industrial activity.

### **Theoretical: Deep Learning**

Deep learning is a machine learning mechanism derived from artificial neural network (ANN) algorithms. Deep learning models comprise a multi-layer feedforward ANN which is trained with stochastic gradient descent using back-propagation. The current study's model, a deep neural network (DNN)—or multi-layer perceptron (MLP), consists of four hidden layers of neurons with a rectifier activation function (ReLU). In order to train DNNs using stochastic gradient descent with backpropagation of errors, a nonlinear function, which appears and behaves like a linear function is required. This particular characteristic of the ReLU activation function allows increasingly complex relationships in the data to be comprehensively understood and consequently generate accurate predictions.

### **Experimental Design**

To predict greenhouse gas emission output of the top 20 emitters worldwide, raw data was procured from creditable World Bank and World Resources Institute database covering a sample period of 28 years (1990 - 2018) to account for long term variations. To develop an accurate, representative model, key contributors to greenhouse gas emissions were input into the deep neural network framework. Table 1 features the variables examined and their units of measurement, alongside the variable type as regressors input into the DNN. Further demographic statistics and economic metrics, namely population growth rate and gross domestic product (GDP) growth per capita, respectively, were factored into the model, as both inputs demonstrated a distinct correlation and direct contribution to forecasted emission values.

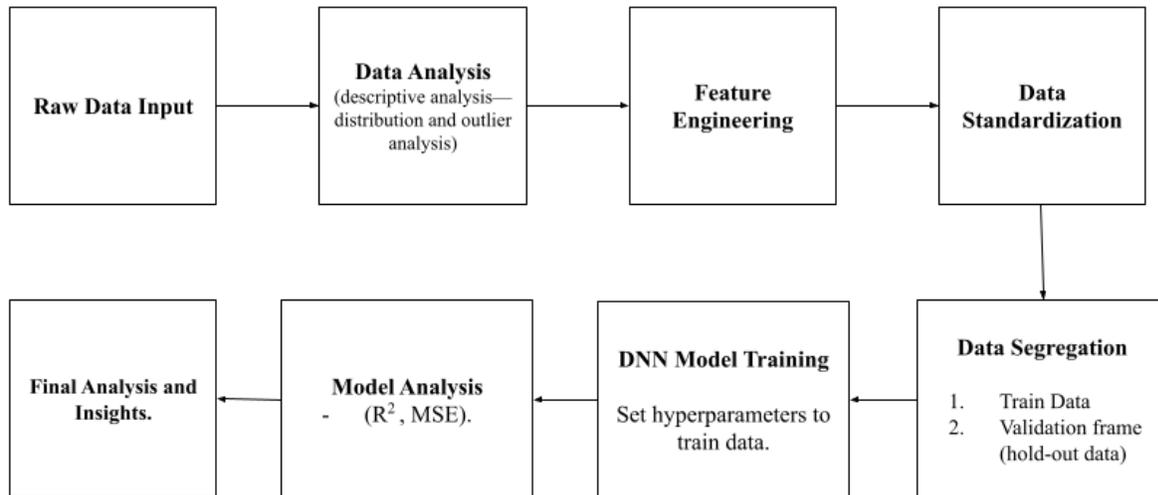
**Table 1** Data and variable definition

Variable	Unit	Variable Type
Year	Time (YYYY)	Time
Country	Factor	Enum
Agriculture	MtCO <sub>2e</sub>	Numeric
Building	MtCO <sub>2e</sub>	Numeric
Bunker Fuels	MtCO <sub>2e</sub>	Numeric
Electricity/Heat	MtCO <sub>2e</sub>	Numeric
Energy	MtCO <sub>2e</sub>	Numeric
Fugitive Emissions	MtCO <sub>2e</sub>	Numeric
Industrial Processes	MtCO <sub>2e</sub>	Numeric
Manufacturing/Construction	MtCO <sub>2e</sub>	Numeric
Other Fuel Combustion	MtCO <sub>2e</sub>	Numeric
Transportation	MtCO <sub>2e</sub>	Numeric
Waste	MtCO <sub>2e</sub>	Numeric
GDP Growth Rate Per Capita	Percentage (%)	Numeric
Population Growth Rate	Percentage (%)	Numeric

Both Supervised and Unsupervised techniques were used to identify distinct patterns in the data using advanced H2o distributed computing, For instance, K-mean clustering algorithm was applied to identify distinct groups within the dataset. The method did not produce cohesive clusters, resulting in high in-group variations. The study was extended by applying Random Forest to produce relevant classifications, however, the results were of little use.

For the regression problem, experiments with developing Deep Learning models produced excellent results. Fig. 1 specifies the process.

**Fig. 1** Framework of the study

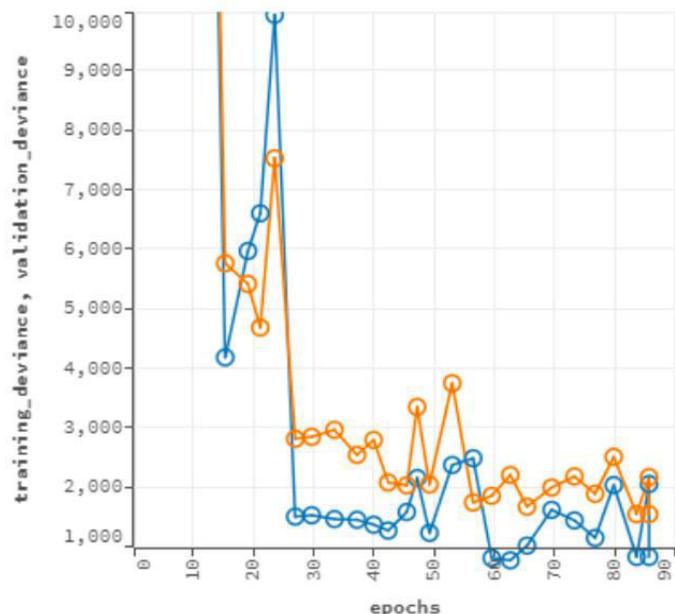


In order to ensure appropriate data fit and predictive accuracy of the model, the study applied a fully connected five-layer feed-forward deep learning neural network with rectifier (ReLU) activation function.

Hyperparameters, including nfolds for validation (5), epochs (25)/iterations and hidden layer sizes, were optimized in order to generate a model with the highest  $r^2$  value (minimizing the cost function), possessing a high degree of explainability regarding variability in the data. The model training process (number of epochs) persisted until the cost-function (evaluated in this case by RMSE/ $r^2$ ) was minimized using a stopping metric—as reflected in the exemplar scoring history from the experiment (Fig. 2).

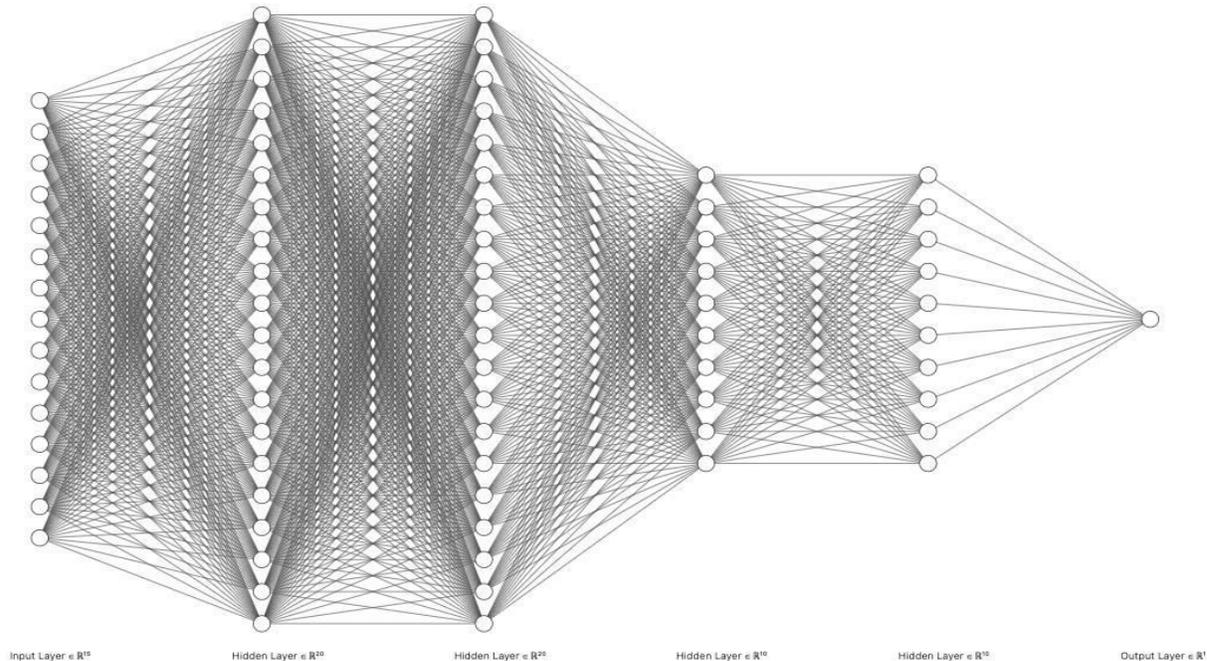
The rectifier activation function (applied to the deep learning model), unlike sigmoidal and hyperbolic tangent functions, does not completely saturate; when processed, values, if  $> 0$ , remain as the original input, whilst all else values ( $< 0$ ) snap to 0. Therefore, this function is able to accurately comprehend complex relationships within the data and compute variable importances for factor analysis. The model

**Fig. 2** Sample scoring history with training and validation data.



was trained using a deep learning algorithm with backpropagation, in conjunction with an adaptive learning rate algorithm (ADADELTA).

**Fig. 3** Architecture of the deep neural network.



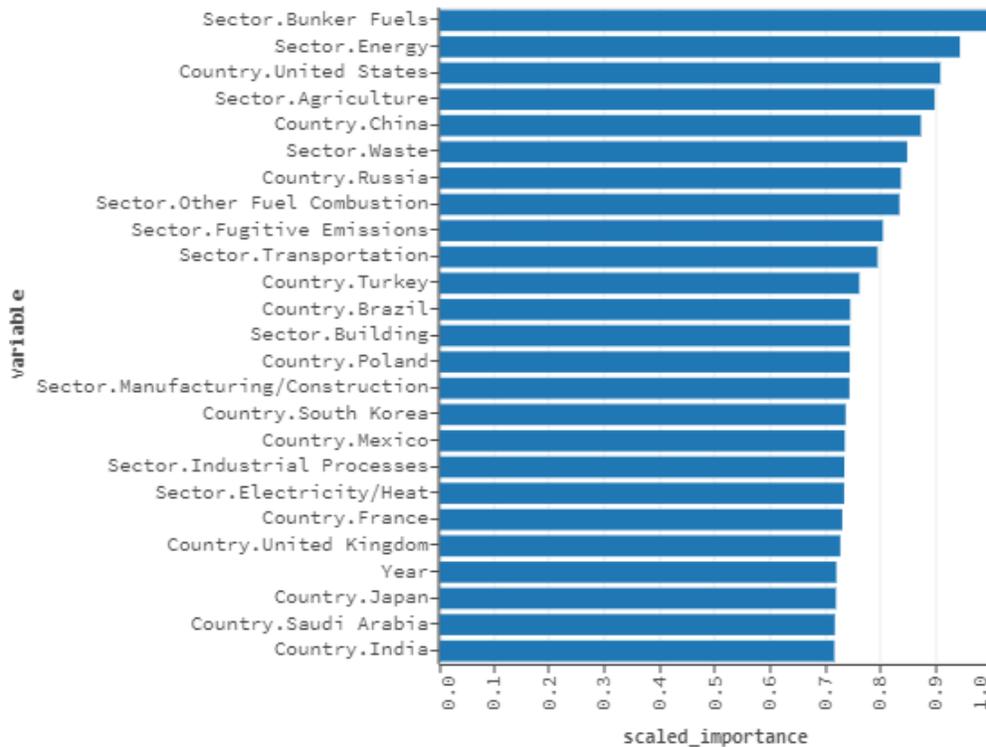
**Note:** intermediary layers are scaled down by a factor of 10 for representation purposes.

As depicted in the architecture of the deep neural network (Fig. 3), the study employed fifteen variables at the input layer, of numeric, time and enum type (Table 1). Variables were subject to processing through the hidden layers using the ReLU activation function. Configuration of the hidden layer magnitudes (200, 200, 100, 100) were derived and optimized for accuracy, during the experimentation process, using a deep learning grid search. The model, once developed, postulated the variable importance of inputs, as well as a basis for prediction. Five fold cross validation using hold-out data, was then executed to test for accuracy in the model.

### Results and Discussion

The factors analysis, (as depicted in Fig. 4) produced a scaled variable importance of the inputs assessed, in relation to the outcome variable. The DNN indicates that bunker fuels are the chief contributor to global greenhouse gas emission output. This result corroborates the theoretical research conducted, which clearly indicates the potency of hydrofluorocarbons and CO<sub>2</sub> emissions used to fuel increasing volumes of global trade.

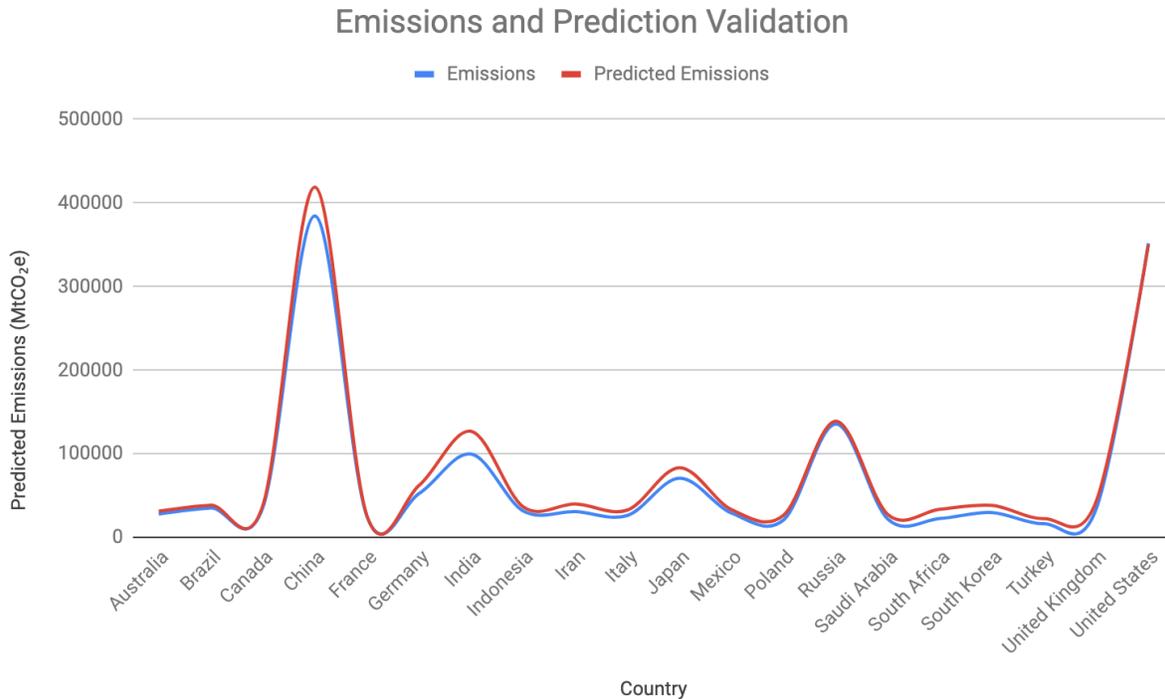
**Fig. 4** Factor analysis (scaled variable importance)



Energy is cited as the second largest sectorial contributor, followed by agriculture, which further consolidates real-world emission trends. Results indicate that the model is highly sensitive to fluctuations in the emission outputs of the United States, China and Russia. The DNN model appears relatively unchanged by the electricity/heat and industrial processes sector, as well as the aggregate emission output of India, which is justified by the training and validation metrics obtained. Assessed metrics for determining model accuracy include root mean square error (RMSE) and coefficient of determination ( $r^2$ ). Training metrics indicate a RMSE of 79.5 and  $r^2$  of 98.7%, whilst validation metrics indicate a RMSE of 125 and  $r^2$  of 96.7%.



**Fig 5.** Predicted emissions versus actual emission output



In order to evaluate the accuracy of the developed model, predicted emission values were compared with historical emission output. As evidenced in Fig. 5, the DNN predicts emissions with great precision. In most instances of diversion from veritable values, minor overestimation occurs in countries with generally volatile GHG emission output; as per historical data which was input during the training phase.

The present DNN model, possessing the same degree of accuracy as presented in Fig. 5, was used to predict exact emission output values for 2019 - 2023. Fig. 6 depicts the predictions, alongside historical emission data (2014 - 2018) which was input during the development of the DNN. As per the model, considering demographic and economic variances, emissions will increase to an aggregate of 81.25 billion metric tons in 2023 (at the current rate), within the top 20 greatest emitting countries. The model accounts for the expected increase in greenhouse gas emission output, increasing at a rate of 5 - 6% annually.

**Table 2** Historical versus predicted emissions

Country/Year	Emission Data (MtCO <sub>2</sub> e — millions) - Source: World Resources Institute					Deep Learning Model - Predicted Emissions (MtCO <sub>2</sub> e — millions)				
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
<b>Australia</b>	1011.6	1021.4	1010.4	1061.4	1057.6	1203.9	1176	1205.6	1292.6	1319.1
<b>Brazil</b>	1633.0	1588.2	1519.1	1541.4	1486.7	1679	1735.1	1705.9	1746.6	1801.6



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<b>Canada</b>	1334.0	1324.1	1298.6	1325.3	1355.1	1205.5	1167.8	1199.5	1343.6	1693.6
<b>China</b>	21796.4	21802.7	21763.5	22157.3	22737.6	17284.2	24638.3	29129.9	29746.9	30098.2
<b>France</b>	750.2	763	764.5	771.4	757	1039.7	1055	1013.8	1015.5	1047.4
<b>Germany</b>	1617.0	1626.9	1637.2	1605.1	1554.8	1915.8	1835.4	1876.2	1825.5	2063.1
<b>India</b>	5207.9	5232.5	5307.4	5554.8	5818.1	6207.7	6047.1	6550.6	7237	7912
<b>Indonesia</b>	1359.1	1368.1	1383.2	1466.6	1573.5	1760.2	1783.4	1805.5	1883.5	2119.9
<b>Iran</b>	1493.0	1481.9	1491	1526.1	1551.5	1750.5	1641.8	1908.3	1932.7	2157.7
<b>Italy</b>	752.7	774.1	766.3	757	749	2442.7	2863.3	1186.8	1247.5	1266.7
<b>Japan</b>	2536.1	2464.2	2448	2405.6	2313.4	3004.8	2986.8	2967.1	2907.4	3237.3
<b>Mexico</b>	1142.5	1180.1	1200.1	1188.1	1191.4	1864.6	1910.8	1368.4	1427.3	1633.9
<b>Poland</b>	668.4	676.8	698.8	725.2	725.3	826.7s	819.6	819.9	818.9	883.6
<b>Russia</b>	4839.0	4744.6	4721.1	4774.3	4872.8	3669.1	3082.8	3739.2	3834	4158.5
<b>Saudi Arabia</b>	1168.2	1225.1	1226.5	1208.4	1167.1	986.7	1032.7	1085.4	1128.9	1178.8
<b>South Africa</b>	990.7	943.2	942.5	962.2	961.9	2508.6	2737.1	1199.3	1176.7	1179.5
<b>South Korea</b>	1278.4	1322.6	1346.2	1369.7	1382.8	1728.4	1595.3	1356.9	1309	1467.8
<b>Turkey</b>	761.4	777.1	826.8	908.7	905.1	1100.8	846.4	939.8	1143.3	911.1
<b>UK</b>	977.2	945.7	900.9	875.6	859.7	1607.2	1617.5	1645.9	1658.2	1723.7
<b>United States</b>	11650.8	11405.3	11216.9	11091.8	11439.7	11470.7	11026.8	10495.5	11968.1	13396.9
<b>Grand Total</b>	62967.3	62667.2	62468.9	63276	64460.1	65256.6	71599.1	73199.3	76643.3	81250.3

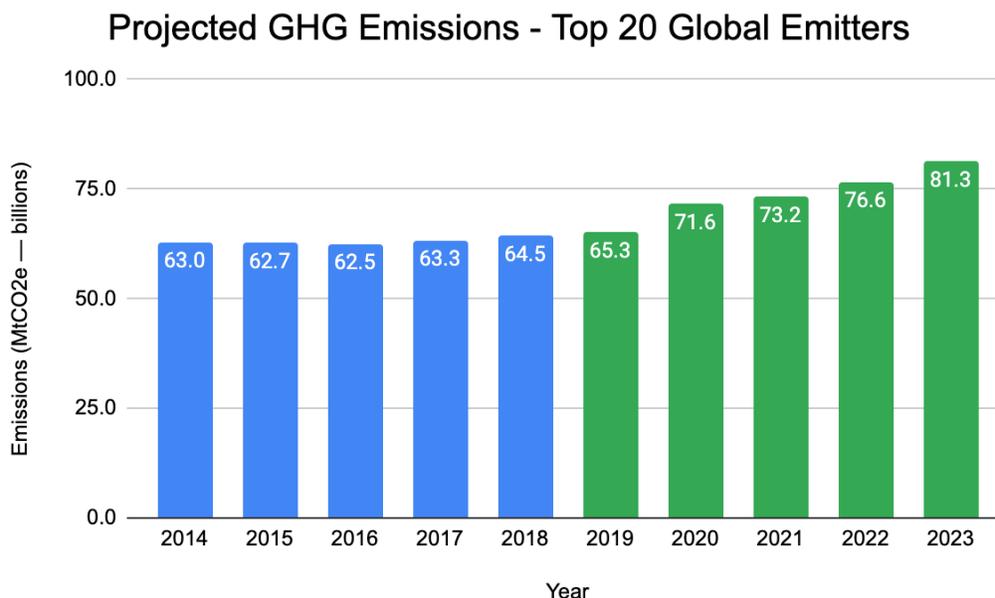
### Conclusion

The intensification of the global climate crisis necessitates combative action against factors of imperative contribution to rising greenhouse gas emissions worldwide. Machine learning mechanisms—particularly deep learning—are widely regarded as the most accurate and intuitive predictive model for computing complex relationships within raw data.

As evident from the highly complex model presented, considering key contributing sectors and accounting for fluctuations in gross domestic product and population growth, results emphasize the necessity for immediate action to curtail the acceleration in emission output of all greenhouse gasses (comprehensive of nitrous oxide, methane gas and artificial chemical emissions, as well as carbon dioxide). The projection indicates a massive increase of GHG to 81.3 billion metric

tonnes at the existing rate of growth. Global mitigation initiatives should be directed towards sectors concerning energy and agricultural production and consumption, as well as industrial processes, as indicated by the DNN and corroborated by external research.

**Fig 6.** Predicted emission trajectories (green) versus historical emissions (blue) in billions.



One such solution, the development of remedial technologies, should be accelerated, accounting for economic welfare and sector dependency. The developed deep learning model is robust towards changes in input data, evidenced by the predictive accuracy in relation to veritable emission output values. However, the model does not account for potential drastic changes in economic conditions, such as the suppressed economic activity caused by the COVID-19 pandemic. Future studies should focus on the widespread adoption of alternate technologies which are environmentally sustainable and perpetuate economic development. In order to avert this environmental disaster, collaborative global effort must be initiated on an urgent basis.

### References

- “Climate Watch Historical GHG Emissions.” 2021. Distributed by: World Resources Institute. <https://www.climatewatchdata.org/ghg-emissions>
- D. Radojević , V. Pocajt , I. Popović , A. Perić-Grujić & M. Ristić, “Forecasting of Greenhouse Gas Emissions in Serbia Using Artificial Neural Networks”, 2013. Accessed: Jun. 17, 2021 [Online]. Available: <http://dx.doi.org/10.1080/15567036.2010.514597>
- Davor Z. Antanasijević, Mirjana Đ. Ristić, Aleksandra A. Peri-Grujić, Viktor V. Pocajt. “Forecasting GHG emissions using an optimized artificial neural network model based on correlation and principal component analysis”. Elsevier, International Journal of Greenhouse Gas Control 20, Rep. 244–253, May 2013.
- “Deep Learning (Neural Networks)” H2O.ai. <https://docs.h2o.ai/h2o/latest-stable/h2o-docs/data-science/deep-learning.html> (accessed Jun. 3, 2021)



## An International Multidisciplinary Research e-Journal

- “Each Country's Share of CO<sub>2</sub> Emissions”. Union of Concerned Scientists. <https://www.ucsusa.org/resources/each-countrys-share-co2-emissions> (accessed Jun. 24, 2021)
- Gómez Miranda, I.N., Fernández Jaramillo, J.M. & Peñuela M, G.A. “Hybrid Multivariate Statistical and Neural Network Model to Predict Greenhouse Gas Emissions”. Arab J Sci Eng (2021). February 2021. Accessed Jun. 18, 2021. [Online]. Available: <https://doi.org/10.1007/s13369-020-05226-7>
- Johannes Friedrich, Mengpin Ge, Andrew Pickens. “This Interactive Chart Shows Changes in the World's Top 10 Emitters”. World Resources Institute. <https://www.wri.org/insights/interactive-chart-shows-changes-worlds-top-10-emitters>. (accessed Jul. 1, 2021)
- Kingsley Appiah, Jianguo Du, Rhoda Appah and Daniel Quacoe, “Prediction of Potential Carbon Dioxide Emissions of Selected Emerging Economies Using Artificial Neural Network”, August 2018. Accessed Jun. 1, 2021. [Online]. Available: <https://www.researchgate.net/publication/331710993>
- National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. “Population Growth, Resource Consumption, and The Environment” in *Population Summit of the World's Scientific Academies*. Washington, DC, USA: The National Academies Press, 1993, pp. 5-7.
- Qiang Wang, Shuyu Li and Zhanna Pisarenko. “Modeling carbon emission trajectory of China, US and India” Elsevier, Journal of Cleaner Production 258 120723. Jan. 2020.
- “The Effects of Climate Change.” Nasa.gov. <https://climate.nasa.gov/effects/> (accessed Jun. 5, 2021)
- World Bank Open Data, “GDP per capita growth (annual %)” (2020). Distributed by: World Bank national accounts data, and OECD National Accounts data files. [https://data.worldbank.org/indicator/NY.GDP.PCAP.KD.ZG?name\\_desc=false](https://data.worldbank.org/indicator/NY.GDP.PCAP.KD.ZG?name_desc=false)
- World Bank Open Data, “Population, total”, (2020). Distributed by: World Bank national accounts data, and OECD National Accounts data files. <https://data.worldbank.org/indicator/SP.POP.TOTL>



## THE USE OF IOT IN SMART HEALTHCARE OF PATIENTS AND ASSISTED LIVING OF PEOPLE WITH SPECIAL NEEDS

**Vansh Sonani**

Utpal Shanghvi Global School  
v3sonani@gmail.com

### Abstract

With advancements in technology, medicine has reached great heights and now health can be monitored just sitting at home. In the past few years, there has been a significant increase in the usage of these technologies in our day to day lives which is aimed to improve the standard of living and quality of life among people of all kinds. This research paper consists of several developments, detailed researches and data representation of the use of IoT in healthcare and assisted living, showing how and why there has been a boost in this field.

**Keywords:** Internet of Things, Smart Healthcare, Assisted Living, use of devices, actuators and sensors.

### INTRODUCTION

IoT so called Internet of things is the new technology that has been very popular recently because of its uses in numerous areas including in Healthcare, thus becoming a very essential part of our daily lives. It is a network that consists of physical objects connected to each other (as the name suggests). Using sensors like pulse sensors, oxygen sensors make it so easy to monitor health that there would be no need to visit a doctor for this. It would save on travelling time and most importantly the enormous bills that are needed to be paid to the doctor. During emergency situations, till the patient reaches the hospital, some treatment could be started with the help of such IoT devices. IoT is very robust and reliable, which has certainly made it the need of the hour. But is the increase in use of smart IoT devices greatly responsible in saving lives of patients and increasing life expectancy rates? Let's find out.

### Theory

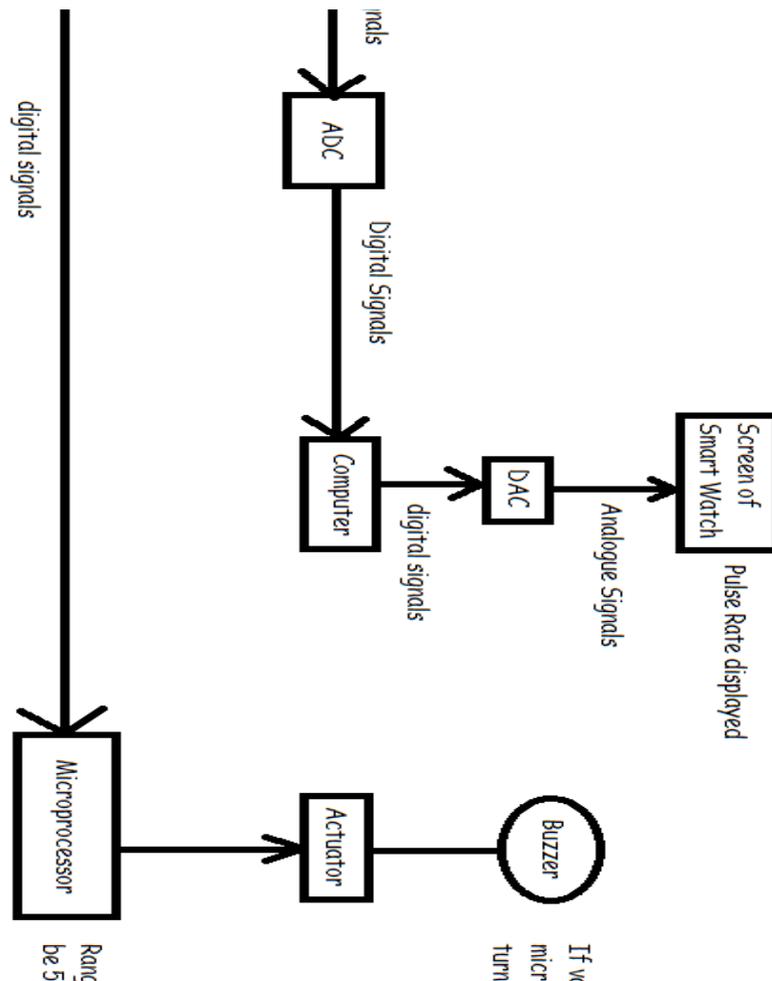
Devices have been specially designed to read the human body with the sensors and actuators they contain, enabling them to recognize their function, share data the obtained and communicating with other devices connected to them. Smart Watches, Fitness bands, Smart Shoes, Artificial Intelligence Devices and several mobile phone applications help to monitor health data and at the same time, they can remind and assist the user to follow the workout routine, exercise regularly, give warnings etc. In these devices, the sensors take in the particular readings and information from the human body like the pulse sensor will take readings of the



pulse rate of that person. This data reading is received in the form of analogue signals and is converted into digital signals by an Analogue to Digital Converter (ADC). These digital signals are understood by the computer as it consists of binary 0s and 1s. The computer processes the data and displays it on a screen like a Smart Watch would display pulse rate on its screen. Devices also use a microprocessor which has been fed with a range of values. If the data read does not fit

within the range then an actuator is instructed to take the digital signals, convert them into analogue and send some kind of alert like a buzzer or a notification to the user to take appropriate precautions. Like an oximeter, the microprocessor is fed with a range of 90 to 99 %. If the oxygen concentration goes above or below the same, the user is notified to visit a doctor or take care of themselves. [1]

Not only simple devices but more complex equipment used in hospitals including ventilators also use IoT. The process is similar to that described above but only that the actuators can perform much more jobs like increasing oxygen supply if low or turning on electric cardioversion if heart beat becomes irregular or slow. Ventilators are connected to a Local Area Network within the hospital along with some automation that allows them to be controlled remotely which is important in cases of emergency, the patient may die until the doctor reaches to his/her ward but controlling the ventilator from far away may help the patient survive until the doctor reaches to continue further treatment. These are just some examples where IoT is used in the field of medicine, the list goes endless and more developments are being continuously made to make these systems more reliable.



[2]

### Experimental

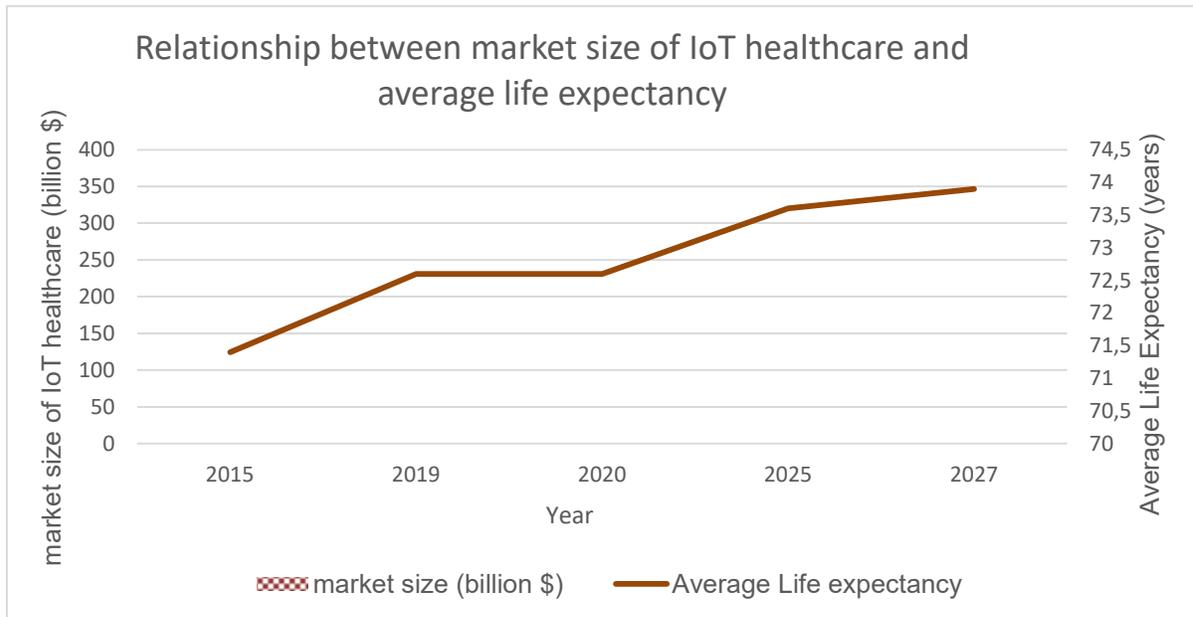
The use of IoT in this field has seen a rise since the past few years. The amount of money spent by organisations to invest in building such devices and the amount spent by people to these devices has also increased. The most likely reasons are the usefulness and need of such technology. Increase in production of these products and increase in income of people has made it possible for people to afford them and ensure their safety. Several surveys and researches were carried out regarding the increase of the use of IoT and increase in sales. The Institute of Electrical and Electronics Engineers (IEEE) [3] has scheduled many conferences and undertaken surveys in the last 3 years to discuss on this topic. The online survey cloud based software, Survey Monkey [4], had conducted an e-survey form based on the increase in use of IoT Healthcare devices. It includes questions that will help to know how much common people are aware of this kind of technology and how often they use them in their daily lives. (The link of the survey is mentioned in references)[5] This will help collect information related to the demand of such devices in the market. The data set collected showcases that the market size of IoT in healthcare has increased from USD 57.62 billion in the year 2019 to USD 72.5 billion in 2020. It is expected to grow at an even higher rate and will probably reach \$188.2 billion in 2025 and \$352.8 billion in 2027. [6]



### RESULT

From these surveys it has been known that the market size and usage of IoT in healthcare will continue to grow rapidly. However, it is also seen that over the last few years, the average life expectancy of people has seen a rising trend and is predicted to rise even more in the future. Worldwide life expectancy has increased from 71.4 years in 2015 to 72.6 years in 2019 and is projected to go up to 74 by 2030. [7] After many researches took place, it is now understood that the advancements in IoT are leading to people living longer lives. The Survey Monkey survey form indeed concluded to show that people are becoming more aware and dependent on such medical devices. Trends show that people who filled the form during the Covid-19 pandemic had more knowledge about smart devices than those who filled the form before the pandemic. Staying healthy and immune to keep away from catching the virus forced people to gain knowledge and invest in health monitoring equipment. Increase of the use of IoT in healthcare has indeed helped save lives of critical patients and made people more careful for their health.

### DISCUSSION



[8]

This graph above clearly shows the relationship between the market size of the use of IoT in healthcare and the average life expectancy of the world. As the investment amount increases,



more people are benefitted from the same and it helps them to stay fit and healthy for longer. Detailed relationship is maintained which is evident between the years 2019 and 2020. Because of the Covid-19 pandemic, there were great increase in the number of deaths worldwide, which did not allow the life expectancy to rise. It was a period of global recession and so major investments could not be made into the field of IoT even though healthcare was required during this tough time.

### CONCLUSION

To sum up, the use of IoT in healthcare allows fast, efficient and reliable health monitoring that saves doctor visits and expenses of the same. In hospitals, patients can be given remote and personalised treatments. However, some of the disadvantages are too important to be ignored. One of the most dangerous of them is privacy and security of the user. These devices can collect or steal user data and leak it to their company or sell it to someone else. Another major factor affecting the use of IoT is internet connection. Devices need to be connected to the internet or Bluetooth at all times and poor connection would lead to inaccurate results. Bugs or Viruses into the system will make it potentially corrupt and unable to track the patient's health. Moreover, making the user or hospital staff computer literate and teaching them to use the equipment properly would be both time consuming and expensive. Like there are two sides of a coin, IoT healthcare also has several advantages and disadvantages. There are continuous approaches being made in order to minimise the effects of these drawbacks. User privacy controls are being initiated, devices made more user friendly and that work effectively even with low connection. Internet of Things is a vast field and is expanding at a tremendous rate. The near future will be dependent on IoT for all kinds of tasks it can perform. Everyone should use IoT for the benefits it offers to its users but at the same time, taking care that appropriate measures are taken to avoid the negative impacts caused while using these devices.

### Acknowledgements

*Vansh Sonani*

### REFERENCES

- [1] Picture obtained from- N Patel. "Build your own offshore remote team" [www.peerbits.com](http://www.peerbits.com) (accessed 15<sup>th</sup> April 2021)
- [2] Diagram Made By: Vansh Sonani (myself)
- [3] Institute of Electrical and Electronics Engineers (IEEE) – Z. Zhu, R. Bajcsy and C. Chow. "Advancing Technology for Humanity" <https://ieeexplore.ieee.org> (accessed 17<sup>th</sup> April 2021)
- [4] Survey Monkey – R. Finley and J. Finley "Secure what Matters" [www.surveymonkey.com](http://www.surveymonkey.com) (accessed 27<sup>th</sup> May 2021)
- [5] Link for IoT Healthcare survey – R. Ducot. "IoT Healthcare Survey" [SurveyMonkey.com https://www.surveymonkey.com/r/FSSP9MG](https://www.surveymonkey.com/r/FSSP9MG) (accessed 27<sup>th</sup> May 2021)



## An International Multidisciplinary Research e-Journal

[6] Market share statistics –

A.Keshwani. “One stop research for all Market Research and Consulting needs.”  
[www.marketsandmarkets.com](http://www.marketsandmarkets.com) (accessed 17<sup>th</sup> April 2021)

[7] Life expectancy statistics –

M. Roser. “Research and data to make progress against the world’s largest problems”  
[www.ourworldindata.org](http://www.ourworldindata.org) (accessed 17<sup>th</sup> April 2021)

[8] Graph Made By: Vansh Sonani (myself)



### SMART HOMES AND CITIES

**Sahil Gada**

Utpal Sanghvi Global School  
sahil.gada2006@gmail.com

#### **Abstract**

In this modern world, lies a piece of technological brilliance called Internet of things. This research paper will tell you how IoT can help connect homes and cities to the very minutest appliance and in turn create a smart world where everything is interconnected to each other making it far more convenient to do everything from controlling the thermostat to reporting medical or criminal emergencies.

**Keywords:** *Internet of things, Smart Home, Actuators, Temperature/ Humidity/Motion ,Sensors, Smart City*

#### **INTRODUCTION**

A fairly newfound section of technology, the Internet of things often said as Iot has the basic principle of connecting all the electronic things together in a hub and let them communicate to each other. As the name suggests it is an Internet for physical electronic objects and a platform for them to share and transfer data. It is recently getting popular in new modern houses where it is being used to make household chores, security, emergencies and many more things very convenient for us to do and also reduce the burden and stress by running on pre-set commands where there is no need for us to manually start all the appliances. This smart home is a base for a smart city and smart country and eventually a smart world.

### Theory

The smart home will make every chore and work very quick and easy but it does take a significant amount of time and money to set up. The basic principle will work on scanners, actuators and microprocessors in very device or even non electrical things. It will mainly help us to get different aspects of a home like the door management system, security management system, water management system, light management system, temperature control, power consumption, healthcare and many more things, to a very advance and extremely simple to control. It will be a very modern and futuristic environment for the residents. It will make life so easy that without breaking a single drop of sweat you can do all your jobs from washing your clothes to charge your electric car and that too without any sort of manual input.

Fig: 1

Imagine waking up one day and getting out of bed, then an AI voice greets you good morning. You command to open the curtains and they open without even moving a finger. You go to take a bath and that AI voice informs your that the water heater has been set to your last desired



temperature. Once you get out of the shower and get dressed you command to have a sandwich for breakfast, the AI voice informs you that you have bread, lettuce, ranch, meat, tomatoes ready in the refrigerator

and you were running low on cheese so the voice had already placed an order for you a day ago. Then the doorbell rings and the AI voice informs you it's the cheese delivery man. You receive it and then ask for the recipe for the sandwich, and the AI voice sends a video to your tablet which shows you how to make the sandwich. You have a nice breakfast and run for work. You realise you forgot to charge your car last night but the AI voice informs that the car has been charged overnight. As soon as you leave your house all the unnecessary appliances and the robot vacuum

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cleaner starts up. During work you get a notification on your mobile saying that there is a delivery for you on the door and then send a message on your outdoor screen asking to leave the package with your neighbour across the street since you weren't at home. You leave from work and when you get about 100 meters from your house your appliances start. When you are in your driveway your garage door automatically opens. When you enter your house the lights start, then when you are sitting on your couch your AI helper to reduce the thermostat temperature. The voice says, "Sure, I suggest you turn on the air purifier since the AQI levels are higher than usual." And then you command to switch on the air purifier and it starts up. You go to your laundry room and say out loud, "how to wash wine stains off shirts." The AI voice replies, "I have set the washing machine settings to removing wine stains." You dump your stained shirt in the washer and when you check the dryer the same settings have been applied there.

Fig: 2

Now, this was just one small piece of life with a completely connected house, there are many more aspects to this house like an automatic voice command television and many more. Now I am about to list some of the aspects and benefits of a smart home:

1) Reduced power consumption – Since the entire system is connected, you can easily monitor which appliance or task is using a lot of energy and find ways to reduce the power and therefore saving money on electricity bills.

2) Enhanced control – With a totally connected house you can control any of your appliance by just a click from your phone or a simple voice command. This can help to keep track and control all the tasks in the household chores without even moving.



Fig: 3





- 3) High comfort levels – A connected hub offers you the opportunity to relax while being stress-free about your household chores. One can receive a lot of free time because all your problems can be solved automatically with the connected hub.
- 4) Personalisation – The entire function could be programmed to each and everyone's personal needs and, with good coding there is nothing you couldn't personalise.

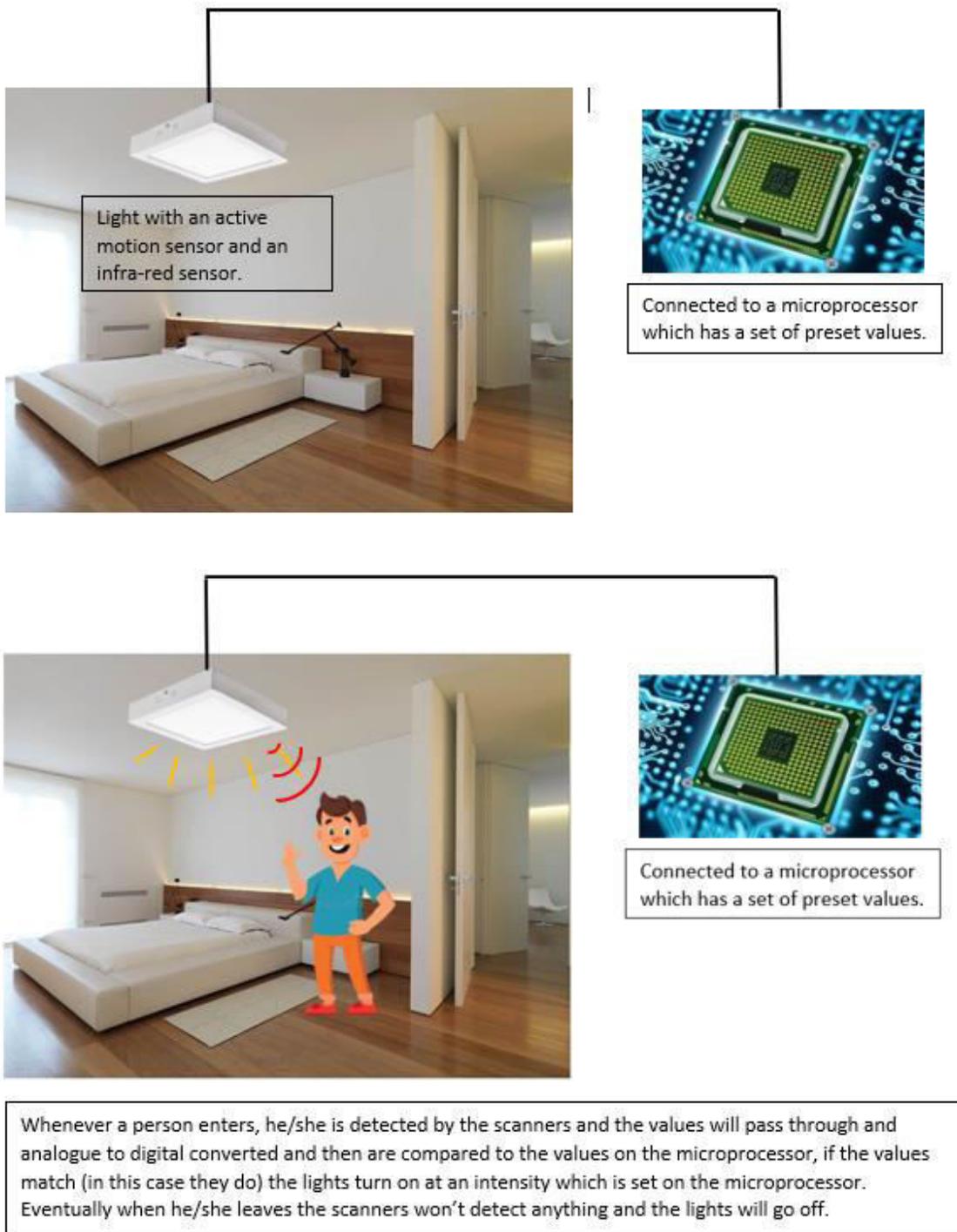
Here is a list of some aspects which be a lot more convenient to use once you have a smart home:

- Smart Lights – Lights can turn on as soon as someone enters the room after dawn and switch off as soon as there is nobody in your room just by the use of motion and infrared sensors. Whenever motion or a high temperature like the human body (37 degree Celsius) the lights will switch on and as soon as this motion or temperature is out of range the lights will switch off on their own
- Thermostat – Controlling the entire house temperature by just a simple command can be convenient but the constant change of surrounding temperature make the thermostat control tedious but the microprocessor will keep the temperature maintained on the values that last suited you in those conditions. Plus, it can also give suggestions to either increase or decrease the thermostat according to changes in the environmental conditions like the humidity.
- Smart Door Lock – The door has been locked using the same old-fashioned keys for the past generations, but now a new era called for smarter locks. Unlocking doors using fingerprints, iris scanners and face recognition are a lot more secure and convenient to use and no issue of losing or forgetting your keys.
- Smart Cooking –Cooking can be very easy with the use of internet of things. Due to the feature of remembering your previous chooses and, the things that you like you can get varied recipe suggestions from all over the internet and it also checks the all the items present in the fridge and checks recipes than can be made using those.
- Smart Appliances – Connecting appliances to each other make them really easy to use. For example, your washing machine will know how to wash each cloth and your air conditioner will know what temperature suits you the most and your speaker will know what level do you prefer the most which helps you reduce your stress cause due to small everyday things and make life so much better.
- Smart Garden –A smart garden can help you take care of your plants and lawn much more efficiently. The pH and moisture sensors in the soil can be connected to a microprocessor and the sprinklers which will activate them as soon at its too dry. This will help you maintain your lawn and you can have an automatic lawn mower which can start trimming the grass if it overgrows above a certain limit.

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Now for a brief example this diagram will help you understand how one of the aspects (smart lights) of a smart house will work.

Fig: 4



Now there is an important use of ADCs and DACs in this hub. ADCs are Analogue to Digital converters which convert analogue signals from appliances to digital messages to be read by the microprocess and DACs change digital signals to analogue message so that the appliances can communicate to and fro the microprocessor. One more device to name which helps this system is an actuator. It is a part of a device or machine that helps it to achieve physical movements by converting energy, often electrical, air, or hydraulic, into mechanical force.

Now a smart home is just a small step to create a smart city which will make a city completely connected. Every single building or structure connected to each other. The house connected to the hospitals, police stations, fire stations, banks, supermarkets and all the other structures in a city. I realise this is a really big project but it can be easily accomplished if there are many smart homes which could be connected to a central city hub.



Fig: 5

A smart city will be a new futuristic advancement to a settlement. It will provide us with features that would make our lives about 50% easier and a lot more convenient. For example:

- Enhanced Security–If your house might be getting robbed or infiltrated the Iot sensors can detect the presence of somebody unknown outside of active hours and give a straight message to the police or send a CCTV footage. Even you will get a message saying something fishy is going on at your place and you might want to check it.
- Health Care – There might be elderly people who may be living alone or with family and suffer with health issues who need to be under surveillance every time. This smart home



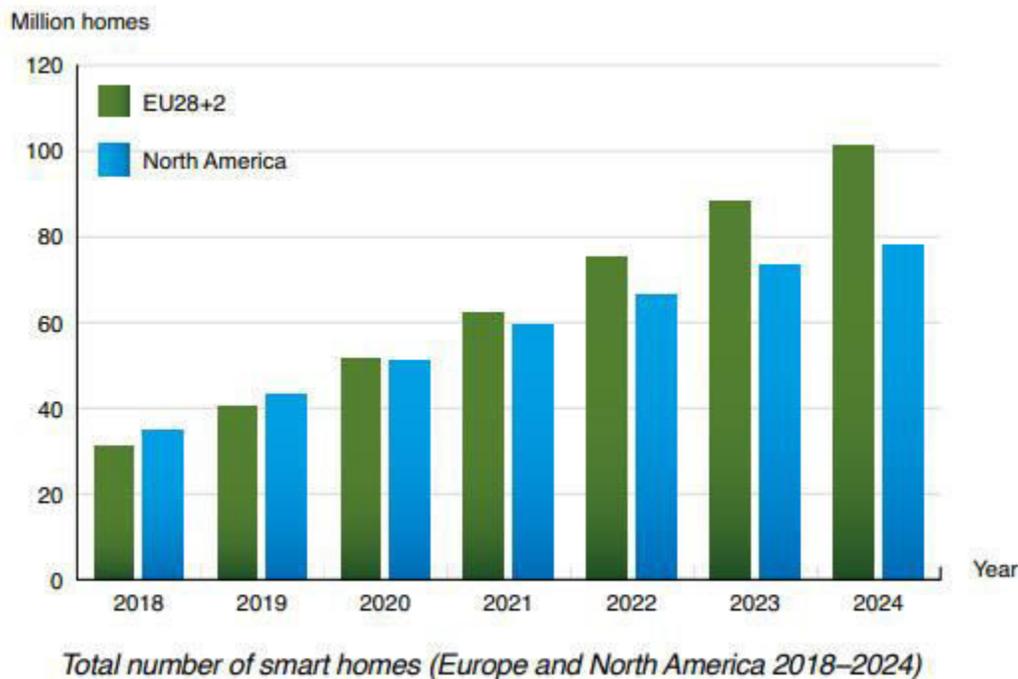
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and city can make emergencies situations a lot less stressful. There can be a smart watch or another device with the sick person and his heart rate, oxygen levels and more health features can be recorded every 30 mins and sent to the doctor and the head family member. If the value gets highly abnormal an ambulance will automatically be called to take the patient in.

- Fire security – A fire in an empty house or even a filled one can be nasty and life threatening but a smart home can easily detect sources of a possible fire and inform you. In any case you don't get informed or it gets too late the smart city feature will have already informed the fire station and they would be there for your rescue. It will reduce the amount of destruction cause by everyday fires to life and property.
- Emergencies – There can be times when the entire city may be affected by some mass emergency and here being a smart city will be a huge advantage due to having everything connected and coordination between emergencies services will go extremely smoothly and all the procedures can be carried out smoothly.

### DISCUSSION

The main idea to talk about here is the number of rising smart homes in this world and the numbers are represented by the following graph.



Graph: 1

This graph shows in the last 3 years the number of smart homes is increasing by a rapid amount and the trend predicts that by 2024 there would be around 180 million households which operate with the use of Internet of things.

Another argument suggests that a smart home will have a huge risk of cybercrime and since our private data is being transferred between appliances wirelessly can be stolen and the victim will be in a massive trouble. To settle this argument of potentially threatening yourself and your data I will say that Internet of things has also had an impact on cybersecurity and many tests have been conducted along with safety features like multiple firewalls have been equipped to the entire personalized hub. Any new device entering the hub will be thoroughly checked and only after the owner's permission will be allowed to access the personal data.

### CONCLUSION

In a nutshell, Internet of things is the general tool that everybody needs for a smart life and assisted living. In times like these where a pandemic has affected our world, we get to know the true value of our home, it's a place which gives us comfort and a sense of protection and stuck in our houses for such a long time we have developed an emotional connect to it and turning it into a smart home can elevate this connect and make our homes an even more welcoming place. To end this paper, I would like to quote Arthur C. Clarke – 'Any sufficiently advanced technology is indistinguishable from magic.' This quote really connects to me saying that about 20 years ago we made science fiction and magical movies which exactly portrayed the current technology we have so rather than wasting such a genius idea, we should all implement it and live the life we were always dreaming of.



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### REFERENCES

- [1] [www.javatpoint.com](http://www.javatpoint.com). 2021. *IoT | Smart Home and Smart City - Javatpoint*. [online] Available at: <<https://www.javatpoint.com/iot-smart-home-and-smart-city>> [Accessed 17 July 2021].
- [2] STMicroelectronics. 2021. *IoT for Smart Home and City - STMicroelectronics*. [online] Available at: <<https://www.st.com/en/applications/iot-for-smart-home-and-city.html>> [Accessed 17 July 2021].
- [3] Toptal Design Blog. 2021. *Home Smart IoT Home: Domesticating IoT*. [online] Available at: <<https://www.toptal.com/designers/interactive/smart-home-domestic-internet-of-things>> [Accessed 17 July 2021].
- [4] Domb, M. (2019, February 28). Smart Home Systems Based on Internet of Things. Retrieved July 17, 2021, from <https://www.intechopen.com/books/internet-of-things-iot-for-automated-and-smart-applications/smart-home-systems-based-on-internet-of-things>
- [5] Digiteum. 2021. *Smart Homes: The Internet of Things (IoT) Home Automation | Digiteum*. [online] Available at: <<https://www.digiteum.com/iot-smart-home-automation/>> [Accessed 17 July 2021].
- [6] IoT Now News - How to run an IoT enabled business. 2021. *IoT and home automation: What does the future hold? - IoT Now News - How to run an IoT enabled business*. [online] Available at: <<https://www.iot-now.com/2020/06/10/98753-iot-home-automation-future-holds/>> [Accessed 17 July 2021].
- [7] IoT Business News. 2021. *IoT News - The number of smart homes in Europe and North America will reach 179 million in 2024 - IoT Business News*. [online] Available at: <<https://iotbusinessnews.com/2021/02/11/06951-the-number-of-smart-homes-in-europe-and-north-america-will-reach-179-million-in-2024/>> [Accessed 17 July 2021].
- [8] Forcepoint. 2021. *IoT Cybersecurity*. [online] Available at: <<https://www.forcepoint.com/cyber-edu/iot-cybersecurity#:~:text=What%20is%20IoT%20Cybersecurity%3F,all%20types%20over%20the%20internet.&text=Benefits%20aside%2C%20connecting%20to%20the,connecting%20to%20potential%20cyber%20threats.>>> [Accessed 17 July 2021].
- [9] Typeset.io Formats. 2021. *IEEE format - For Authors*. [online] Available at: <<https://typeset.io/formats/ieee/default-template-for-ieee-journals/7571580208800f8572b783b996ff7646?source=ieee-resp-ad-1&key=z0fi9pl4zz4a8bwe3iyfstwpq0rxndnmzjktnecknf079ctdf7dr8eoaws92h2n5v>> [Accessed 17 July 2021].
- [10] Image1 - Static.javatpoint.com. 2021. [online] Available at: <<https://static.javatpoint.com/tutorial/iot/images/iot-in-smart-home-and-smart-city-application.png>> [Accessed 17 July 2021].
- [11] Image2 - Bs-uploads.toptal.io. 2021. [online] Available at: <[https://bs-uploads.toptal.io/blackfish-uploads/uploaded\\_file/file/39332/image-1566402184774-80ed60aba9fd255bac32ecc38c477780.jpg](https://bs-uploads.toptal.io/blackfish-uploads/uploaded_file/file/39332/image-1566402184774-80ed60aba9fd255bac32ecc38c477780.jpg)> [Accessed 17 July 2021].



[12]Image3 - Iot-now.com. 2021. [online] Available at: <[https://www.iot-now.com/wp-content/uploads/2019/09/image2\\_compliance-300x251.jpg](https://www.iot-now.com/wp-content/uploads/2019/09/image2_compliance-300x251.jpg)> [Accessed 17 July 2021].

[13]Image4– Created by myself.

[14]Image5 - Static.javatpoint.com. 2021. [online] Available at: <<https://static.javatpoint.com/tutorial/iot/images/iot-in-smart-home-and-smart-city-application2.png>> [Accessed 17 July 2021].

[15]Image6 - I1.wp.com. 2021. [online] Available at: <<https://i1.wp.com/bquestfoundation.org/wp-content/uploads/2020/05/iStock-944453634-1.jpg?fit=5000%2C2771&ssl=1>> [Accessed 17 July 2021].

[16]Graph1 - Iotbusinessnews.com. 2021. [online] Available at: <<https://iotbusinessnews.com/WordPress/wp-content/uploads/total-number-smart-homes-EU-NAM-2018-2024.jpg>> [Accessed 17 July 2021].



### HAS THE CONCEPT OF ONLINE EDUCATION SHIFTED IT'S PARADIGM FROM IMPROV COMEDY TO A STREAMLINED PROGRAM DURING THE PANDEMIC?

**Niyati Deora**

D. G. Khetan. International. School  
[niyatideora3108@gmail.com](mailto:niyatideora3108@gmail.com)

#### **Abstract**

During the COVID-19 pandemic the World had adapted the technique of online education and learning. This research paper is going to talk about how technology and students have made their way out to adapt this new not so popular culture of distance/online learning and education. In addition, the surveyor is going to use a method of primary research to prove her stance over the topic. Moreover, this research paper is going to act as a timeline to explain the technicalities and technological advancements faced and adapted.

**Keywords:**-Online Learning ,Technological advancements ,Trying times, Distance learning, Improv Comedy (comic improvisations)

#### **Introduction**

While the world has grown it has brought to us several inventions one of them being 'technology'. The way it has and is evolving nothing can be said till where it can go, technology has proved this statement to be the life saver of everyone , during trying times.

Towards the end of 2019, the Chinese capital: city of Wuhan had its first ever CoronaVirus patient on the 31 of December,2019 [1]. This one case, one patient and one life had further resulted in a nationwide lockdown, after which on 30 January 2020 it was announced as an emergency, further a pandemic on 11 March 2020 by the World Health Organisation[1]. This one date was started to try everyone's patience. It completely changed the definition of education, education has become just an online meet to everyone. This concept was once improv has been improvised today to a limitless extent, but how? This research paper is going to be all about how and what technological improvements have been brought to online education during these trying times.

#### **Theory**

When at the start of this pandemic the concept of online education was new to everyone, it was an experimental phase for everyone, students, teachers, everyone.

March-April 2020, This was the time when everything was new, a worldwide lockdown, work from home, School from home everything was just new. It can also be called as an experimental phase of the entire situation.

### Adapting the change

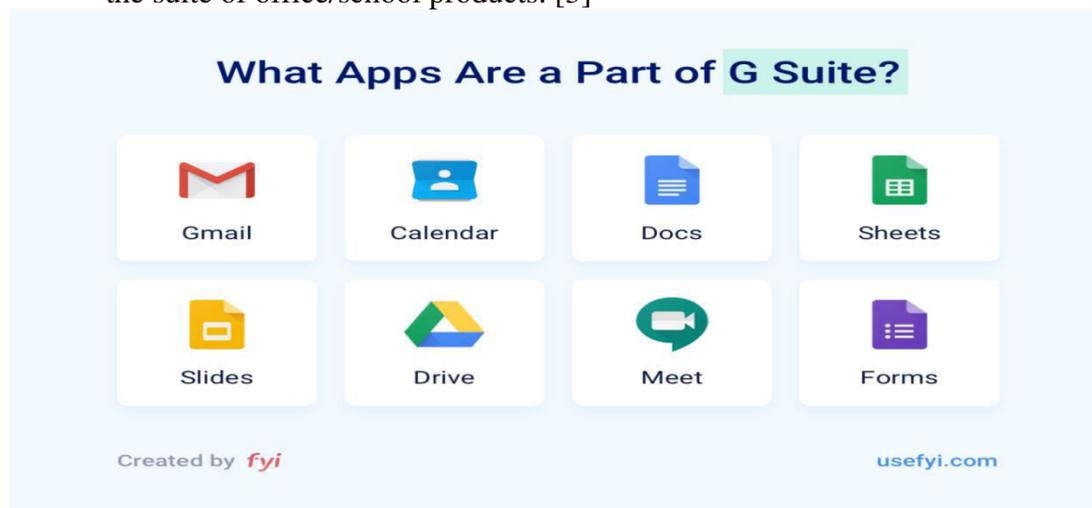
At the start, things were difficult. Finding an alternative to the traditional way of learning seemed a bit impossible once. However when technology had its hands folded in front of the world, the question of what had got its answer but how was still struggling to find its answer.

Then after video conferencing apps like Zoom & WebX came to existence, they played their magic over everyone.

But this wasn't enough, companies like Google & Microsoft came up with a compilation of softwares and apps. The following are these and software's mentioned in detail.

### Google

- Google Classroom: Google Classroom is a free application designed to help students and teachers communicate, collaborate, organize and manage assignments. [2]
- Google Meet: An app for HD video conferencing app.
- G-Suite: G Suite gives your entire company/Organisation access to Gmail accounts and the suite of office/school products. [3]



**Fig.1** Google apps inclusive in G Suite [ 3 ]

### Microsoft:-

This company had created an entire new world, it had created its software in a way that in software you can run the entire school. Whether it was calls, chats, sharing of docs etc. Microsoft teams allowed the user to do everything at one place. [4]

Nevertheless, not all the apps and softwares mentioned above were launched during the pandemic, some of them were launched long back however it has gained popularity now.

For example- Google Classroom was launched on 12 August, 2014. At first in 2015 the classroom had 10 million students and teachers using it [5] whereas, now almost all the schools are using google classroom as a platform between a student and a teacher. The popularity of this



app has increased to an extent where only in the state of Maharashtra ( A state in India) there are 23 million students using Google Classroom[6].

This wasn't enough later in the month of August-September 2021, there arose a need for much stronger apps and softwares to conduct online examinations.

For which a few schools/colleges instructed students to set up 360\* set ups using the same google and Microsoft apps. Whereas, the others opted for advanced technology.

The following are the examples of the same:-[7]

- ExamOnline
- Speed exam
- PSI Bridge
- Examity
- ExamSoft

These softwares had features like:- [7]

- Auto authorisation of students using facial recognition.
- Object trackers
- Student verification
- Set time limits
- Auto & Live proctoring
- AI-based software
- Personalised assessments
- Automated exam security
- Multi-user collaborations
- Smart onboarding

These softwares were used all across the world by institutions to conduct online examinations however these came with its own inbuilt pros and cons. These gave the ensurity to teachers that the exams were attempted without any malpractices, however some of these softwares were restricted to browsers like and so on and so forth.

Now later when around the start of 2021 there was a sense of hope between world citizens that schools and colleges would start but it was melancholy that they couldn't as the situation had worsened and even in July 2021 still online education is the apple of everyone's eye.

Over the span of these one and a half year technology has grown, it has grown like never before.

### Experimental

{ For reference to this entire section kindly refer to [10] , [11]. }

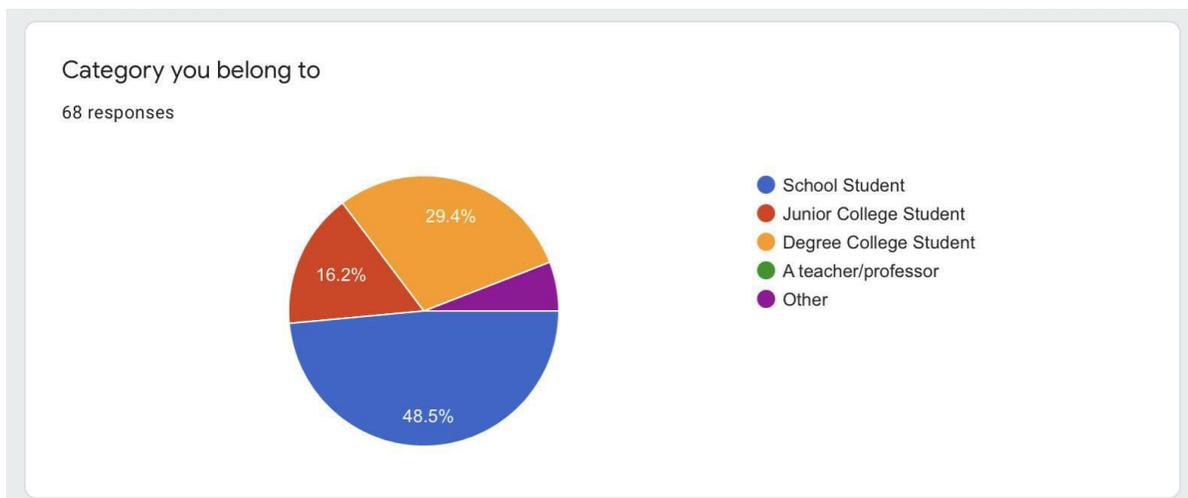
To understand the genzie religion of online education, conducting some primary research was as necessary as brushing teeth everyday.

After seeing a few pieces of evidence and understanding the genzie religion of online education better. A survey was conducted which asked questions as the following:

1. Were you at the start comfortable with online education? And if not then why.
2. What ways were adapted by your teacher in order to improve the quality of online education and if you are a teacher, what had you or your institution done for the same?

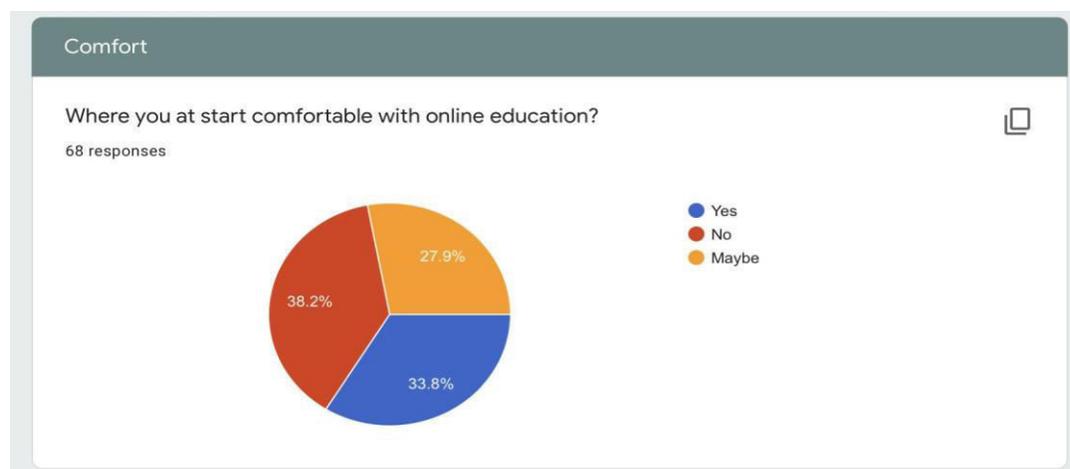
3. According to you, has online education improved the problem solving skills of an individual?
4. In your opinion, what more technology related ways can be adapted to improve online education?

These were questions asked and the set of people who participated are as the following shown in pie chart below.



**Fig.1.1** Pie chart of profession percentage.

68 people participated of different different professions and students of school, degree and junior college. Mainly school students participated more as compared to others. The college students who participated had strong and factual opinions as compared to others. However, this form wasn't in favour of collecting gender data. Though there were less adults who participated there was still a lot of reality in the data collected.



**Fig.1.2** Pie chart of comfort.



Now when the participants were asked about “why weren’t they comfortable at the start with online education. It was justified as:-

Some answers were-

”It was a bit difficult to adapt to it all of a sudden as we're used to sitting in the class and studying. The online method was way different to what we were adapted to”

One also said-

“Quality education isn't gained,that could have in physical schools surely.”

This certainly proves that the lack students were feeling was of adaptation and quality.

Further, when they were asked “What ways were adapted by your teacher in order to improve the quality of online education and if you are a teacher, what had you or your institution done for the same?”

Students said:-

- “Compulsory keeping your videos on and frequently asking questions by picking random students on related topics in progress.”
- They made use of ppts, even for math instead of using whiteboard and showing it on camera, in this was we could have a clear view of what we were being taught
- Teaching with the help of videos
- Our teachers started making creative power point presentation to teach us but it isn't that effective to be very honest.
- We were given online textbooks to begin with and gradually were asked to wear school uniform and we're slowly phased into a actual class room like environment

Whereas at first when these above mentioned ways were adapted students also had to face its cons which were

- When online classes started teachers didn't use Google Meet/Zoom for classes and they sent the lectures . But the then student complained that they started facing storage problems because of the video so after first term teachers started using apps like google meet and zoom for classes.
- Our teachers started making creative powerpoint presentations to teach us but it isn't that effective to be very honest.

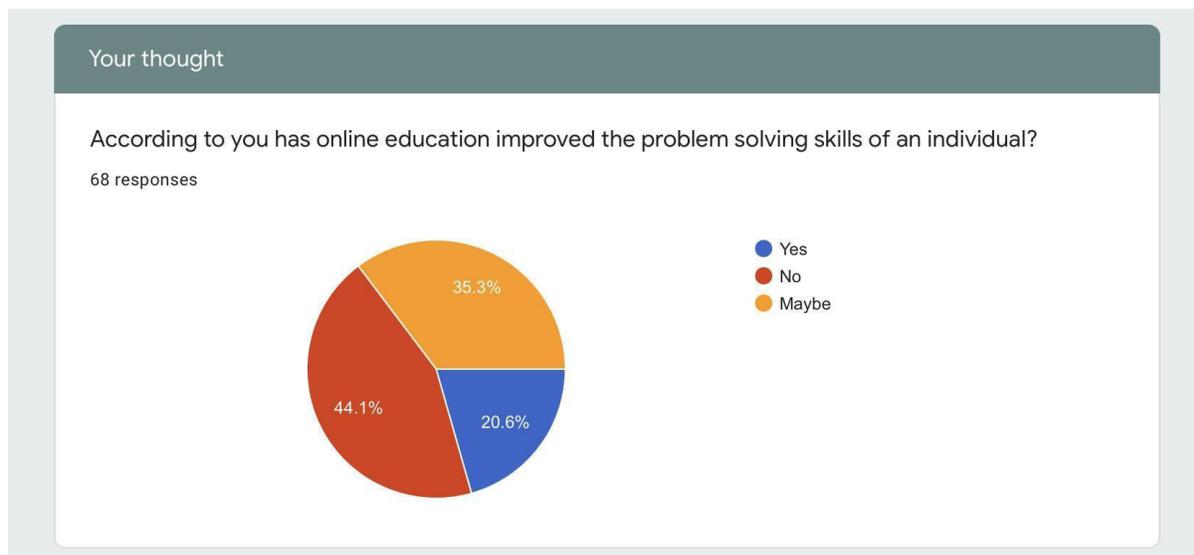
In addition students also had experiences like

- I think building a personal relationship with the teacher really helped me in improving the overall experience of online learning.
- Keeping the session interactive with students and the camera on so the students be attentive.

This part of the survey truly proved that PowerPoint Presentations and Recorded lectures helped students. Nevertheless, there were even students who found building bonds and interacting made their experience of online learning better.

Further ahead,the participants were asked that till what extent do they think “online education improved the problem solving skills of an individual?”

The poll was:-



**Fig.1.3** Pie chart of thoughts.

This question was asked following the thought “Every learning has its own teaching”. This question remained important as these technological advancements often tend to give a problem or per say you take time to understand. As everything has its learning the surveyer thought this culture had the ability to teach and improve problem solving skills of an individual henceforth, 20.6% people even agreed with her. However 44.1% didn’t and 35.3% people weren’t sure about their thought upon the same.

Moving ahead, the last structured question was “ In your opinion, what more technology related ways can be adapted to improve online education?”

Answers were as follows:-

A 2nd year B.Com student “the use of discord servers.”

A 5th year 5th architecture student said “Consolidated platform (For Eg. Microsoft Teams) instead of places like Google Meet and Zoom where the link comes on the mail, submissions are in a second place and notes are in a third place, its very complicated and scattered and unnecessary effort, basically a flexible user interface”

A partial degree college student said “More Security and surveillance in online exams”

A chartered accountant said “AR and VR technology will be more helpful in online education.”

A student of Bachelors in Accounting and Finance told “Slideshow presentation with multimedia video feedback quiz and survey corporate training can help improve online education”

A 10th grader said “Educational apps in the classroom like Kahoot can be used to review information after a lesson or unit. Teachers can create and share Kahoots with one another while students can create anonymous user names to participate in the game. This allows for whole-class participation from students who may usually be reluctant to participate in class. Teachers can determine if they want students to work independently or be assigned to teams.”

Where as students also thought that there enough technological advancements now they need:-



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A 12th grader “no more new tech is needed in my opinion if we use the prevailing tech wisely I guess it would be more effective. Teachers need to make class effective for the students then only they will show interest.”

A 10th grader “more activities and interesting ways can be introduced to make the student more interactive and also this will make their mindset more positive towards online education, which will help them understand better”

A 12th grade humanities student said “Ig , it should be more interactive, and hence must include activities that would enhance problem solving capability of students “

### Result

By this survey it can be understood that with trying times in front of students, they adjusted themselves to online learning and education whether they were happy about the fact or sad about the same. It also showed school students were better adapters than college students.

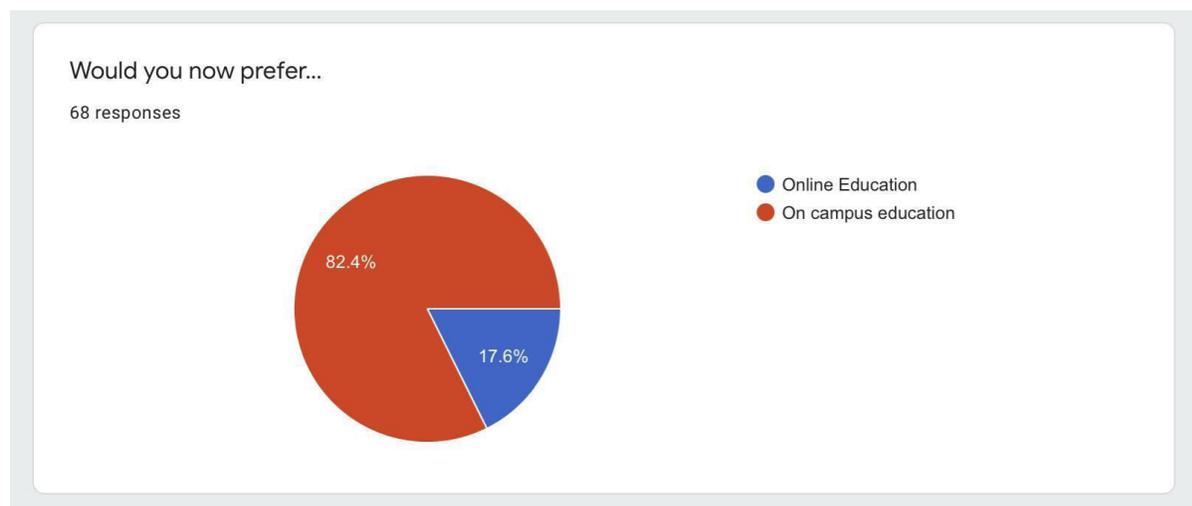
Having said that, some students were happy about the technology used but they weren't able to adapt the psychological aspect of the same.

Moreover, it can be truly said Google and Microsoft have played a very vital role in this phase. It has ensured to make online education fun for children.

Lastly, this survey has shown on a national level what students think about online learning and education.

### Discussion

The outcome had to have a preference, so for that the surveyees were asked that “Now after so long what would they prefer”



**Fig.1.4** Pie chart of preference.

82.4% of people still believed on campus education is the way. However, now 17.6% people out of 68 think online education has won their hearts.

The survey is the clear proof of how menials think and how a pandemic, made technology work it's way out and spread its magic across the globe.

### Conclusion

Education is that part of our life which is completely non-ignorable, even during these trying times. Education is the way to face the world ahead. However, on campus education was the way but now online. At the start to end it has changed, experimented and innovated with its one motive of educating students in the best possible ways.

Truly, The concept of Online education which was improv comedy at once to everyone has become an improvisation today.

As they say "It's just the beginning" now there is way more which is going in everyone's way in respect to technological advancements.

### Acknowledgments

#### Fig.2 Ms. Zinkle Dharod



Ms. Zinkle Dharod is a passionate and hard working person. With her Bachelor's degree in Psychology and Education, she has aced herself in the field of teaching social science and global perspectives. Ms. Dharod has played the role of a mentor all the while in the making of this research paper.

### References & Citation

1. World Health Organisation Regional Office Of Europe  
<https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/novel-coronavirus-2019-ncov#:~:text=On%2031%20December%202019%2C,2019%2DnCoV>"
2. Izenstark, A., & Leahy, K. L. Online Tools for Teaching & Learning  
<https://blogs.umass.edu/onlinetools/community-centered-tools/google-classroom/> ( accessed 2015 )
3. Marie Prokopets, Co-founder of Nira, niro blog  
<https://nira.com/what-is-g-suite/> ( accessed unknown )
4. Author unknown, Microsoft Official website  
<https://www.microsoft.com/en-in/microsoft-teams/group-chat-software> ( accessed continuous )
5. Antoinette Siu, Edsurge  
<https://www.edsurge.com/news/2016-09-27-a-timeline-of-google-classroom-s-march-to-replace-learning-management-systems> ( accessed Sep 16, 2017 )
6. Sarah Perez, TC  
<https://techcrunch.com/2021/02/17/google-to-roll-out-slate-of-over-50-updates-for-classroom-meet-and-other-online-education-tools/> ( accessed Feb 18, 2021 )
7. Joydeep Das, Software Suggest



<https://www.softwaresuggest.com/blog/best-online-exam-proctoring-software/> (June 4, 2021)

Other links

8. Unknown, My apps

<https://sites.google.com/a/georgiasouthern.edu/google-apps-fac-staff/getting-started/why-google>  
( accessed unknown)

JULIA LIBERMANVICTORIA LEVINDIEGO LUNA-BAZALDUAMICHELLE HARNISCH  
, world bank blogs

9. <https://blogs.worldbank.org/education/high-stakes-school-exams-during-covid-19-coronavirus-what-best-approach> ( April 1, 2020 )

Link to the primary research google form

10. <https://forms.gle/CdpPAXq3QMfmCeer7>

Link to the response' excel sheet of the form

11. [https://docs.google.com/spreadsheets/d/1IRyn-jP-DM5Y-J8CB7Fmb\\_YVPmE5KoIW\\_iXpiXJiauI/edit](https://docs.google.com/spreadsheets/d/1IRyn-jP-DM5Y-J8CB7Fmb_YVPmE5KoIW_iXpiXJiauI/edit)

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# Indian Scholar

An International Multidisciplinary Research e-Journal





### GREEN COMMUNICATION

Poorvi Tavanappa Rokhade, Hitasvi Kiran Vora  
Prithviraj Arvind Patel, Aditya Kakade  
Sanjay Ghodawat International School  
Indrajeet.Thorat@Sgishool.In

#### Abstract

**GREEN COMMUNICATION** is a practice of using efficient energy or less energy and networking technology (the technology which is used in exchanging of data digitally with the help of information systems) and products .and it reduces the use of resources whenever we communicate possibly in all branches of communication like:

- Verbal Communication
- Non-verbal communication
- Interpersonal communication
- Organizational Communication etc.

The main purpose of **GREEN COMMUNICATION** is to reduce the level of Green house gas ,and to protect the Environment from EM radiation .Our research paper is all about the upgradation in the **GREEN COMMUNICATION** , and the overview of the topic tells us the significance of **GREEN COMMUNUNICATION** in this 21<sup>st</sup> century, and structure .

**Keywords:** Green communication, Green house gas, EM radiation.

#### INTRODUCTION:

In respect to 21<sup>st</sup> century ,the world of technology and communications are facing a very big challenge, due to the total energy consumption by the communication and networking devices, which has caused in the increasing levels of Green house gas. The UNFCCC (United Nations Framework Convention On Climate Change) established in 1997 tells us that mainly the developed countries are responsible for the current levels of green house gases, and increase in the temperature has caused Global warming.

Many scientists have raised their concerns towards these problems, in the conference of parties 17 climate change, which took place at Durban, 2011. **Do we have solution for this ?** the answer to this question is, yes, we are dealing to look at sustainability regarding environmental condition, efficient energy .

That is Green Cmmunication which we have adopted, in the world of technology and communications ,which minimizes the use of energy consumption in networking devices, and the resources. The paper tries to attempt to even look at the contradictory part of **GREEN COMMUNICATION**.



### **THEORY:**

Green communication is sustainable development of energy aware networking. This promotes new technologies, concepts, and innovation. It helps in business and individuals in Power consumption. Moreover, green communication is energy monitoring. This allows visualisation of Power to choose the level of energy savings and calculation of proper saving. It is easy to deploy and affordable. It helps in business and power consumption at the cost of one organization. This, of course, is no easy undertaking. It has ICT energy establishing a approach around the world. So we have to change the way of optimising internet. Green communication is a new innovation and some examples of the companies which are using this networking are EMC corporation, Sprint, Dell, Intel etc.

### **METHODOLOGY**

**A lot of terms are used when discussing the using and misusing of green technologies.**

#### ❖ TYPES OF ENVIRONMENTAL IMPACT

- I. Carbon emissions are currently receiving the most attention due to the problem of global warming and climate change.
- II. When considering environmentally friendly solutions, air pollution, pollution and soil quality, ozone layer protection, use of natural resources, waste reduction, etc., it will have significant effects.
- III. Telecommunications equipment usually contains large amounts of rare earths and heavy metals.

#### ❖ DIRECT AND INDIRECT METHODS

- I. The existence of e-mail replaced letter writing, issues of transportation, paper usage etc.
- II. Indirect impact reduction usually limits environmental issues.
- III. The case shows that initiating indirect environmental impact of a solution is a difficult task that needs to be done very carefully.

#### ❖ ENERGY EFFICIENCY NEWS

- I. Energy efficiency measurement provides information that can be used to estimate and compare the energy consumption of different components of the cellular network and the entire network as a whole.
- II. This matrix also helps us set long-term research goals to reduce energy consumption. Due to the increase in research activities related to green communication and internal differences and the compatibility of different communication systems and performance measures, it is difficult to have enough for a single metric.

#### ❖ MOBILE DEVICES

- I. At present, numerous mobile communication devices such as smartphones, healthcare devices and smart glasses have taken us into the era of smart society.
- II. Green communication between mobile and networks enables potential benefits to improve and balance the use of information sharing, spectrum energy awareness, routing adaptation



and data caching resources and enables full mobile and wireless networks. Saves energy, so green communication is vital and promises a research topic for future mobile networks.

### ❖ RADIOACTIVE DEVICES

I. Site manufacturing and construction carbon footprint structures for radio access networks rely on a complete lifecycle analysis of network equipment. In 2007, the amount of RAN electricity consumed was about 20 kW. Recent research gives us an idea of how to build new sites and remove old site tools

II. We predict that by 2021 this trend will continue at 8% per annum during the study period and will be referred to as continuous progress.

✚ Although the definitions of measuring energy efficiency at the level of components and devices are quite straightforward, it is more difficult to define the measurement of energy efficiency at the system or network level.

### ➤ The goals with green Cellular Networks are:

- To improve energy efficiency through trade-offs between energy consumption and external conditions.
- Integration of network infrastructure and network services to enable the network to become more responsive and require less power to operate.

### Result

It minimizes the degradation of the environment;

It promotes the use of renewable resources.

It's a friendly network. It's a renewable energy branch of the environment technology and can't be ignored. To enhance the growth of energy for economic development.

- To facilitate the growth of the Green Technology industry and enhance its contribution to the national economy;
- It preserve environment for future generations.

### ADVANTAGES:

Does not emit anything harmful into the air Can bring economic benefits to certain areas.

It has less maintenance and shell out a lot of money to operate it.

### DISADVANTAGES:

- High implementing costs.
- Lack of information.
- There's no alternative raw material input.
- No known alternative process technology

### Discussion

This research paper presents a synopsis of energy consumption problems in green communication networks and illustrates network energy saving techniques. It is clasified that the common energy consumption problem green communication networks and describes the



techniques that have been used to improve the energy efficiency of these networks. This problem can find out solutions from the time and frequency domains. The energy preserving problem cross multiple systems or networks is less inferred. More efforts are in need from the modeling to particular solutions.

### CONCLUSION

While doing this project we acquired plenty of knowledge about green communication. So, according to various surveys and reports it is observed that the *Information Communication Technology (ICT)* market contributes 2% of global greenhouse gas (CO<sub>2</sub>) emissions. IT WAS UNDERSTOOD THAT A UNIQUE mobile phone network in the United Kingdom consumes about 40-50 MW. A service provider such as VI uses more than 1 million of gallons of diesel per day to power up its networks but instead of that they would have used other energy source. This amplifies those wireless communications can create a significant proportion of the total energy consumption by the ICT infrastructure. In order to save energy and the natural environment of earth we have to look into two major issues which have to be considered in Green Communications:

1. To reduce the energy consumption this can cause damage to the environment like the energy created by the burning fossil fuels.
2. To create a more energy resources which are friendly to the natural environment of earth like using Solar or Wind energy and also using the energy obtain by running turbines on water means the kinetic energy produced due to the movement of water on turbines which can produce energy and also by minimizing the use of carbon compounds or emissions. Therefore, it is THE NEED OF HOUR to develop NOVICE algorithms so as to MINIMISE the total energy required for the operation of wireless access networks.

In addition it is also important to address the relevant escalation of energy usage in wireless networks causes serious greenhouse gas that can be a major threat to the environment and sustainable development. IN ORDER TO tackle this issue, one CONSTRUCTIVE way is to implement more energy efficient wireless networks. INDEED several International research projects COMMITTED to energy efficient wireless communications include the GR (grant, 2010), Energy Aware Radio and Network Technologies (EARTH, 2010), Optimizing power Efficiency in Mobile Radio Networks (OPERA Net, 2010) and others, etc. So at last we can say that Green Communications aims at addressing the quest for sustainability regarding power resources and environmental conditions and also motivates the people to save the non-renewable resources and also to reduce the use of the resources which cause damage to environment.

### REFERENCES

[https://www.academia.edu/Documents/in/Green\\_Communications](https://www.academia.edu/Documents/in/Green_Communications)  
<https://www.ijert.org/research/a-review-on-green-communications-IJERTCONV6IS13053.pdf>  
[https://www.researchgate.net/publication/320293847\\_Green\\_Communications\\_Techniques\\_and\\_Challenges](https://www.researchgate.net/publication/320293847_Green_Communications_Techniques_and_Challenges)

Green Communications Principles, Concepts and Practice Edited by Konstantinos Samdanis, Peter Rost, Andreas Maeder, Michela Meo and Christos Verikoukis first published 2015 John Wiley & Sons, Ltd



# Indian Scholar

**An International Multidisciplinary Research e-Journal**



Survey of Green Radio Communications Networks: Techniques and Recent Advances  
Mohammed H. Alsharif, Rosdiadee Nordin, and Mahamod Ismail Department of Electrical,  
Electronics and Systems Engineering, Faculty of Engineering and Built Environment, Universiti  
Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.  
International Journal of Engineering Research & Technology (IJERT)

### "WHY-RUSH" DURING "VIRUS": POSSIBILITIES TO COMBAT PANDEMICS AND EPIDEMICS

Sparsh Bhimrajka  
BHIS Malad  
bhimrajkasparsh@gmail.com

#### Abstract

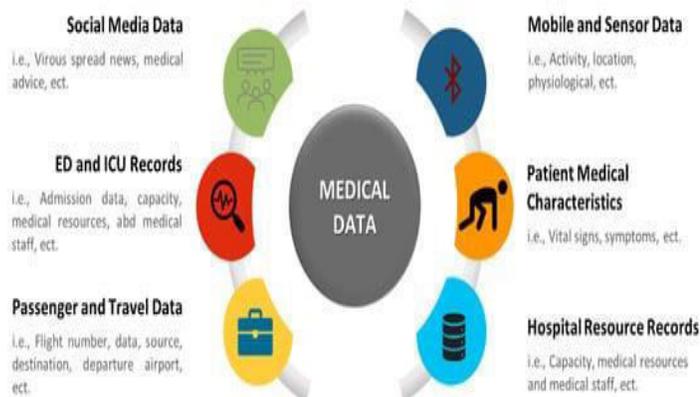
Steve Jobs once said, “The biggest innovation is the intersection of biology and technology.” He never knew that this will be proven by the COVID-19. ‘Data Science Techniques’ include a dynamic approach of data collection, analysis, and forecasting combating techniques. In this paper, I conduct a literature review, presenting a taxonomy application used to control the pandemic. The findings of this paper suggest valuable future directions used to combat COVID-19. Vaccines wastage is a major issue even after the invention of the vaccine. Storage under required temperature using data science and solar technology is the key finding of this paper.

**Keywords** :Solar technology; vaccine storage; data science techniques; COVID-19 (2019 novel coronavirus disease).

#### INTRODUCTION

❖ Introducing the topic

Data science is the field of education that merges programming skills, domain expertise, and knowledge of mathematics and statistics to mine significant understandings from certain data given. It can provide necessary information that can fix delays in existing processes. Collecting, reporting, accumulating, analyzing, and then using the data to overcome the problems of the ongoing COVID-19 Pandemic is the forte of data science. Plentiful data can be applied in the therapeutic health sector. As shown in the Figure below (Figure 1), medical data can be pigeonholed into half a dozen categories depending on their type and source. Examining this data will facilitate in foreseeing upcoming procedures, grasping the existing state of affairs, and making numerous decisions. The remedial data can be obtained from several sources, because it can be amassed using sensors of mobile/wearable appliances or medical device, virtual





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surveys, websites or cellular apps, infirmary records, local and intercontinental health systems, consultations and case study mockups, and data on open databanks or social media.

### ❖ Fundamentals of the application

Since the commencement of COVID-19, there has been a plethora of data available. This data is exponentially increasing every single day. The biggest challenge besides fighting COVID-19 has been correctly using this data for estimation, predicting risks score, and decision-making to combat the COVID-19 Pandemic. Using data science, researchers have found alternatives for the COVID-19 tests and cures.

Using AI and data science, 63% of COVID-19 cases can be detected before any symptoms appear. Activity tracking and health monitoring of respiratory infections can be found out in an early stage. Usage of more data analysis techniques has helped the coders and researchers to propose many websites and apps to distinguish the symptoms, find a bed in the hospital, or to combat COVID-19 at home.

Nevertheless, the biggest challenge lies in the storage of the already invented vaccines. Using data science techniques, the wastage can be reduced. The problems underlying will be discussed further in detail- in the next section.

### ❖ Problems regarding the vaccines

According to the strategies dispensed by the Ministry of Health and Family Welfare (MoHFW), only in January 2021, at least 10 percent of COVID-19 vaccines acquired by the Centre faced "programmatic wastage".

As per MoHFW's guideline, WMF which is an abbreviation of Wastage Multiplication Factor = 1.11 for COVID-19 vaccine, estimating a permissible programmatic wastage of 10% [WMF =  $100 / (100 - \text{wastage}) = 100 / (100 - 10) = 100 / 90 = 1.11$ ].

Vaccine wastage can take place while transportation, during storage, and even at vaccination bases/centers. The COVID-19 vaccines are also given in multi-dose vessels, with each vial containing at least a dozen doses of vaccine. There are even accidents such as vessels shattering into pieces or getting spoiled during its transportation. The COVID-19 vaccine also needs to be stored in a specific temperature extent. There have been numerous failures to preserve the vaccine in the required temperature during its transportation, or its storage, and even at the vaccination points which resulted in it getting wasted. Moreover, pilfering cannot be ignored. The robbery of COVID-19 vaccine ampoules from the larder of an infirmary located in Haryana's Jind district which took place very recently is an example. Adulteration of vaccine after opening it is an additional way in which vaccines are becoming useless and are being thrown away.

### ❖ Latest Publications

Authorized resources in the literature have examined the usage of data science in reducing vaccine wastage. In this paper, I focus on the challenges that prevail. Publications like the "Economic Times" that supported my paper, claimed fractal analytics and used data modeling to answer vaccine concerns.

The New York Times suggested recommendations and guidelines supporting AI and data analysis techniques to combat the COVID-19 Pandemic.



### ❖ Objectives

The rest of this paper is organized systematically to summarize the usage of data science techniques, to portray my experiments, emphasize on the result that may lead to the interpretations, and finally to conclude our future predictions in terms of using big data in the health care field.

### Theory

#### ➤ How do vaccines help?

A paper published on ORF by Krishnan and her team at CPC compares several data models adopted by the Government, in the past, to come up with parameters that should be considered for a data-driven approach to prioritising the allocation process of the vaccine. But before starting, one needs to know more about vaccines, and how they help. The vaccines have enfeebled parts of a specific living being (antigen) which activates an immune response within the organism's body itself. The latest vaccines carry the blueprint for creating antigens instead of making the antigen itself. Irrespective of whether the vaccine is fabricated of the antigen only or the blueprint so that the organism's body will create the antigen, this debilitated version will not lead to the causing of the disease in the being who is getting the vaccine, but it will accelerate their immune system to reply much as it would have on its primary response to the genuine pathogen. India's vaccine organization is maintained by the electronic Vaccine Intelligence Network (eVIN) executed in 32 states presently. Even though it has upgraded the supply chain, the state-of-the-art accessible inspection of eVIN shows particular blockages. Hence, not just data science, but also IoT can be assistance to eVIN for classifying and resolving tailbacks to guarantee an unceasing vaccine stock. Internet of Technology can even be operated to observe towage temperatures and alert ambiguities, as a growth in temperature can make the serum ineffective and direct to the vaccine's wastage. Furthermore, statistics can even be managed in logistics administration to enhanced is attribution paths and vehicles. The amount of events has oscillated significantly and is reliant on numerous issues other than the compactness. Seeing that its demand is not one-dimensional, request predicting methods can aid in ensuring the necessity for immunization shots in specific parts beforehand.

### Experimental

Trying to experiment, I, Sparsh Bhimrajka, thought about combining two ideas- cold storage, and groundfridges. For starters, groundfridge is basically an underground icebox that permits you to pile and preserve food fresh deprived of the necessity for electricity. Prepared with the help of laminated polyester, the underground- refrigerator is calculated to be positioned exactly a hundred centimeters underground, where, using the ground as a cloistering shielding cover and taking the benefit of the natural cooling of groundwater, it manages to maintain, without the need for other sources of energy, an internal temperature between 10°C and 12°C (perfect for stowing food- fruits and vegetables.. Even some types of alcohol like wine, and cheese). The construction —of whose regular volume is two dozen times greater than that of your standard refrigerator— does not necessitate any specific structure license and is even obtainable in a high-tech form (with LED lights, solar panels, and air circulation pump). According to me, after some

tweaks using AI and ML, putting the fridge a little more deep- at 200 centimeters to be exact, can store vaccines.

### RESULT

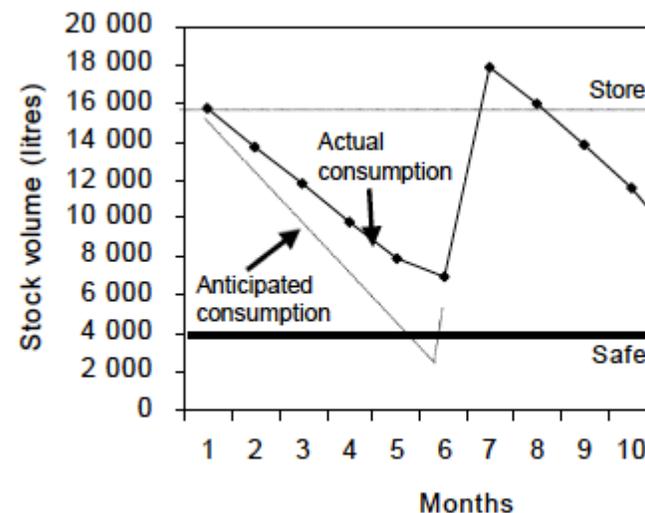
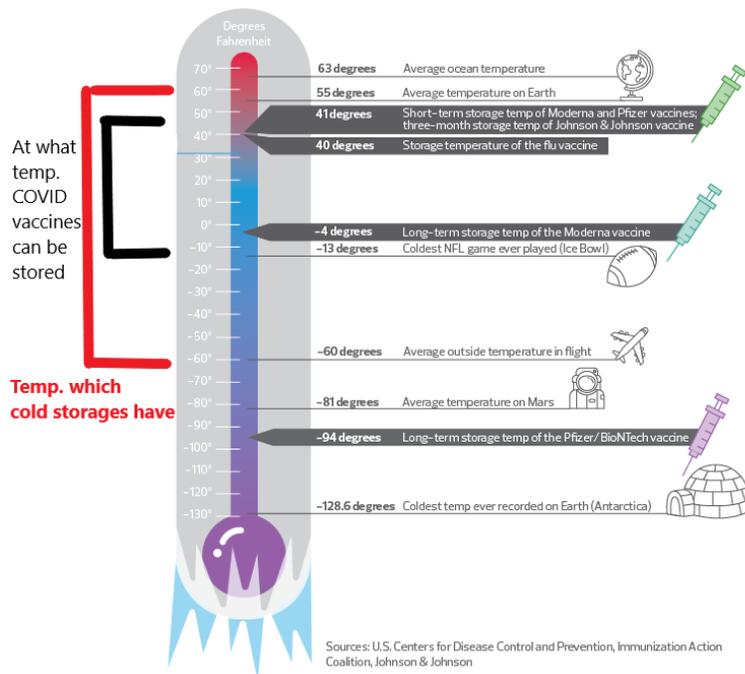
#### ➤ Storage of Vaccines

A groundfridge cold chain is a temperature-regulated supply chain that contains all vaccine-associated apparatuses and processes. The groundfridge cold chain starts with the cold storage component at the manufacturing site, ranges to the transport and conveyance of the serum and precise storage at the distributor provision, and finishes with the administration of the vaccine to the unhealthy being. Just in case the groundfridge cold chain is not appropriately sustained, the vaccine effectiveness will be lost, leading to a useless vaccine distribution. These vaccines shall be bestowed from the hour in which they are made and manufactured to the time they are processed. The vaccine effectiveness is subtracted every single time when a vaccine is exposed to an indecorous place. These unsuitable conditions include overexposure to sunlight or anything that produces heat, freeze, or light at any step in the cold chain. Once the vaccine potency is lost, it just cannot be restored, no matter what is done. Exposure to any unfitting conditions can highly demolish the potency of any refrigerated injection, but even a solitary exposure to cold temperatures (like: 0° C [32° F] or colder) can actually abolish its influence. Some liquid vaccines having a subservient can eternally become ineffective when exposed to freezing temperatures.

### DISCUSSION

Some self-explanatory statistical tools have been attached below.

How cold is cold? Putting storage temperatures of COVID-19 vaccines into perspective



This graph tells about how the consumption of vaccines will



increase if ground fridge cold storage is used.

### CONCLUSION

The capacity of data upsurges intensely over a period of time, especially data produced on the worldwide contagion triggered by the novel Corona Virus disease 2019. Such bulk of statistic necessitates applying vast data analytics apparatuses along with Artificial Intelligence methods to create sense of the plague and its spread can be controlled in an appropriate method. In this paper presentation, I exhibited an evaluation of numerous data examination claims for the COVID-19, offering a taxonomy construction that categorized the possible claims of the novel COVID-19.

### Acknowledgements

I would like to dedicate my study to the pandemic/epidemic survivors, to the patients that have been affected, and also to the homo-sapiens who unfortunately lost their lives to the COVID-19 pandemic. I would even like to devote it to all the frontline workers who have bravely brawled to save individuals and sacrificed great portions of their daily lives for others. I also acknowledge MISA Members of International Schools' Association, as well as Indian Scholar- an International Multidisciplinary Research e-Journal, for providing the topic annexure, and steps. Finally, I would like to thank Billabong High International School, and its teachers, without whom I would not be participating in this wonderful platform.

### REFERENCES

- <https://ischoolonline.berkeley.edu/data-science/what-is-data-science/>
- <https://www.groundfridge.com/groundfridge/product/>
- [https://apic.org/monthly\\_alerts/outbreaks-epidemics-and-pandemics-what-you-need-to-know/](https://apic.org/monthly_alerts/outbreaks-epidemics-and-pandemics-what-you-need-to-know/)
- <https://www.sciencedirect.com/science/article/abs/pii/S0925753520300539?via%3Dihub>

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### FIGHTING EPIDEMICS AND PANDEMICS WITH DATA

**Shllok Tahiliani**

Trinity International School

[pes.trinityis@gmail.com](mailto:pes.trinityis@gmail.com)

#### Abstract

The world was completely unprepared when the COVID-19 pandemic struck, which is why the world was in chaos. We certainly hadn't learnt anything from the previous epidemics or pandemics, but now is the time to change that - to stack up our data science ammunition, and be prepared. This research paper aims to suggest a methodology for such times using the techniques - clustering and classification. The experiment was uniquely conducted to test the mentioned methodology with a well-rounded data set, which proved fruitful. In conclusion, 'Trial and Error' is the only process that works in handling epidemics or pandemics.

**Keywords:** *Clustering, Classification, Epidemics, Pandemics*

#### INTRODUCTION

Data science is the field of study that combines domain expertise, programming skills, and knowledge of mathematics and statistics to extract meaningful insights from data. Data science practitioners apply machine learning algorithms to numbers, text, images, video, audio, and more to produce artificial intelligence (AI) systems to perform tasks that ordinarily require human intelligence. In turn, these systems generate insights that analysts and business users can translate into tangible business value [1].

Currently, data science is already being used to tackle epidemics and pandemics, such as the COVID-19 Pandemic. One example would be the apps that have been developed to monitor the spread of the disease. These generate ID on your phone and save the ID of the people you have been in contact with. If anyone tests positive, the app reviews the contact data history generated in the last few days and alerts you, to stop the spread of the disease. This way, the app predicts the spread of the disease and produces statistics of the same. There are many more such examples, like telemedicine, which are used to control to spread of the virus [2].

The problem is, data science mostly being used to control the spread of the disease, not to help the patients and/or healthcare system. The objective of this paper is to suggest data science techniques that can be used to guide the patient once they are tested positive and thus reducing the burden on the healthcare system.

#### Techniques:

These are the suggested techniques to be used to guide patients.



### Clustering

Clustering is the task of dividing the population or data points into several groups such that data points in the same groups are more similar to other data points in the same group and dissimilar to the data points in other groups. It is a collection of objects based on similarity and dissimilarity between them [3].

The following points show why clustering is required in data science –

1. Scalability – We need highly scalable clustering algorithms to deal with large databases.
2. Ability to deal with different kinds of attributes – Algorithms should be capable to be applied to any kind of data such as interval-based (numerical) data, categorical, and binary data.
3. Discovery of clusters with attribute shape – The clustering algorithm should be capable of detecting clusters of arbitrary shapes. They should not be bounded to only distance measures that tend to find a spherical cluster of small sizes.
4. High dimensionality – The clustering algorithm should not only be able to handle low-dimensional data but also the high dimensional space.
5. Ability to deal with noisy data – Databases contain noisy, missing or erroneous data. Some algorithms are sensitive to such data and may lead to poor quality clusters.
6. Interpretability – The clustering results should be interpretable, comprehensible, and usable [4].

In an epidemic/pandemic scenario, clustering will be of great use as it will help group and organize the data that is available and identify the trends, which then can be used in the next technique i.e., Classification.

### Classification

Classification analysis is a data analysis task within datascience, that identifies and assigns categories to a collection of data to allow for more accurate analysis. It can be used to question, make a decision, or predict behavior through the use of an algorithm. It works by developing a set of training data that contains a certain set of attributes as well as the likely outcome. The job of the classification algorithm is to discover how that set of attributes reaches its conclusion [5].

Classification cuts down the data set into manageable groups with similarities and assists the decision-making process. Classification is of particular importance in the healthcare industry as it makes essential data easy to find and retrieve by tagging the classified groups with commonalities which in turn assist the decision-making algorithm.

Classification helps predict the outcome of a patient in an epidemic/pandemic scenario, using the data that was clustered, which will be of great help, which will help patients make decisions and reduce the burden on doctors.

### Methodology:

This is the suggested methodology to be followed when using data science to fight micro pandemic-causing enemies.

1. Data collection of previous records

The first and the most important step in data science is to collect as much data as possible. Data forms the foundation of all the other steps. That's why adequate data must be available. An epidemic or pandemic is declared after the disease has spread to most



parts of the world. So as soon as it is declared, sufficient data to work on is already available. But equally important is to make sure that the data available is accurate and relevant. For example, data collected from hospitals and/or the government will be more accurate than data collected directly from patients, as most of the times patients fail to remember the exact details, while the former have written records of all the data. John Turkey, an American statistician, once said, “The data may not contain the answer. The combination of some data and an aching desire for an answer does not ensure that a reasonable answer can be extracted from a given body of data.” [6] That’s why data must be relevant.

### 2. Clustering

After data collection, the next step is clustering. For that, the data needs to be represented in chart form (preferably, scatter chart) so that clusters can be seen clearly and marked. But for that, a lot of data is needed, which needs to be made sure of in the previous step. After that’s done, just by a look at the chart, trends can be identified – the severity of the disease increases with age, most of the patients above the age of 60 were hospitalized and so on. Identifying these trends is important for the next step.

### 3. Creating an algorithm

Using the trends identified, an algorithm should be created, which takes basic details of the patient, such as, age, health condition, and will guide them on what medicine to take and whether or not they need to get themselves admitted. After a few tests, this algorithm can then be expanded to an application, linked to the dataset, which itself identifies trends and suggests patients. This application can be launched to the general public, widening the scope of the project and tackling epidemics and pandemics better. Please note, the scope of this algorithm/application is not to replace doctors and/or medical professionals, but to help them by reducing the burden on them and to prevent the healthcare system from collapsing.

### 4. Classification

After the algorithm/application is ready and tested, it should collect basic details about the patient and classify them into the clusters made, and, in the process, guide them. This step has to be repeated for every patient multiple times. These suggestions from the algorithm/application will certainly help reduce the burden on doctors, and they can just check the suggestions and modify them if needed.

### 5. Repetition

All of these steps will have to be repeated multiple times during an epidemic or pandemic. This needs to be done as the pathogen causing the disease is mostly a new one, so scientists are still finding information about it. Various treatments and vaccines are invented, which call for the repetition of these steps. Also, it is possible the pathogen mutates, changing everything, right from symptoms to treatments.

### Experiment:

To check the credibility of the above techniques and methodology, an experiment was carried out. To check how well the methodology fares in an epidemic/pandemic scenario, the experiment was based on the ongoing COVID-19 pandemic. The following is a timeline:



**Table 1** Experiment Timeline

Event	Period
Deciding data be gathered	9 <sup>th</sup> to 11 <sup>th</sup> May 2021
Creating a form	15 <sup>th</sup> May 2021
Distributing the form & collecting data	16 <sup>th</sup> to 20 <sup>th</sup> May 2021
Extracting data & clustering	21 <sup>st</sup> to 23 <sup>rd</sup> May 2021
Creating an algorithm	26 <sup>th</sup> and 27 <sup>th</sup> May 2021
Testing & Classification	28 <sup>th</sup> May 2021

1. Deciding data be gathered

First of all, it was to be decided what data needs to be collected. The following was decided to be collected:

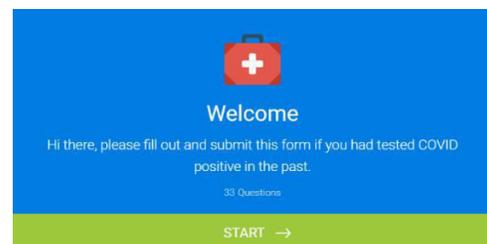
- a. Age – To check if COVID-19 affects people of different ages differently
- b. Gender – To check if COVID-19 affects people of different genders differently
- c. The density of an area – To find out how many people in the same area tested positive before the patient
- d. Availability of a toilet – To check if the patient has more than one toilet available at their house (decides between quarantine center and home quarantine)
- e. Precautionary measures – To find out how well these measures prevent COVID-19 infection
- f. Number of people in a family – Potential spreaders or catchers
- g. Number of people met daily – Potential spreaders or catchers
- h. Current health condition – To check if it affects the severity of the infection
- i. Family history – To check if it affects the severity of the infection
- j. Diet – To check if it affects the severity of the infection
- k. Drug intake (including alcohol & tobacco) – To check if it affects the severity of the infection
- l. Whether they exercise – To check if it affects the severity of the infection
- m. Occupation – To check if it affects the severity of the infection
- n. Mode of transport – To check if it affects the severity of the infection
- o. Travel – To check if it affects the severity of the infection
- p. COVID-19 variant/mutation – To check if it affects the severity of the infection
- q. Number of times infected earlier by COVID-19 – To check if it affects the severity of the infection
- r. Season – To check if it affects the severity of the infection
- s. Festivals/Celebrations/Events – To check if it affects the severity of the infection
- t. Reports of COVID-19 related tests (HRCT, CRP, CBC etc.) – Measure of severity
- u. COVID-19 vaccination – To check if it affects the severity of the infection
- v. Other vaccination – To check if it affects the severity of the infection
- w. COVID-19 treatment/medication – A result
- x. Healthcare in that area – To check if it affects the severity of the infection
- y. Number of days infected – Measure of severity
- z. Final Outcome – A result

It is also possible to collect more data, such as doses of the medicine, to expand this experiment.

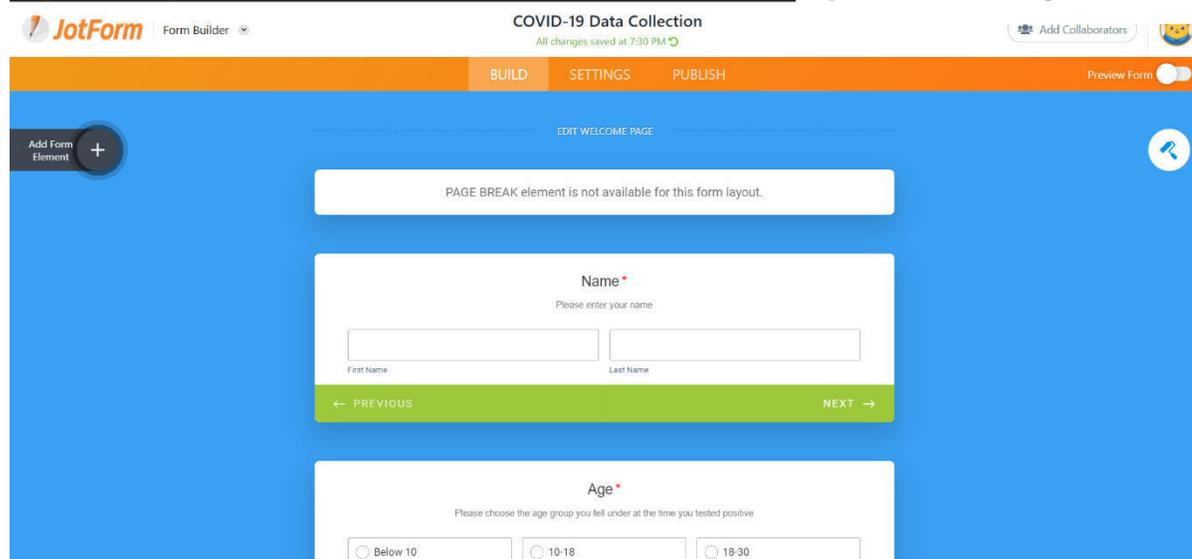
### 2. Creating a form

After the data to be collected was finalized, an online form was made to simplify the process of collecting the data. JotForm, an online form builder, was used to create the form. The form contained 33 questions and a welcome and thank you page.

The link for viewing and/or filling the form is <https://form.jotform.com/211304594729054>.



**Fig. 1** Welcome Page of the form



**Fig.2** Form in editing mode

### 3. Distributing the form & collecting data

After the form was ready, the form was sent out to people who had tested positive. The people also gave feedback. Most of them appreciated the form, while some had complaints about the form's length. After everybody had filled the form, it had 57 submissions. These were saved in a JotForm table, the link for which is: <https://www.jotform.com/tables/211304594729054>.

**Fig. 3** The JotForm table

### 4. Extracting data & creating charts

The data was then extracted from the JotForm table into a Google Sheet, for making charts. Care was taken so that the data doesn't get manipulated. After that, data was organized into charts (*refer to Discussion*) to cluster it. Trends were identified and noted (*refer to Results*).

### 5. Creating an algorithm

Using the trends identified and some general background information, an algorithm was made in Python language (using Tkinter). This algorithm would ask for the patient's age, health condition, more than one toilet availability, vaccination, oxygen level, and temperature, and give them advice on the next steps. More conditions can be added to this algorithm, to accommodate more data points. It can also be expanded to an application, connected to the source table, which can be used by anyone.

```

COVID-19 Help - Notepad
File Edit Format View Help
from tkinter import *

m = Tk()
m.title("COVID-19 Help")

a = 0
age = 0
health = 0
toilet = 0
vaccine = 0
temperature = 0
oxygen = 0

outcome = 0
disclaimer = "These are just suggestions. Please inform the patient's doctor about these suggestions and consult them for further details."
Hospital = "Please get the patient admitted to a nearby hospital. To see the suggested medications, click on Medicines. " + disclaimer
Home = "Please isolate and quarantine the patient at home. To see the suggested medications, click on Medicines. " + disclaimer
Centre = "Please admit the patient to a quarantine centre. To see the suggested medications, click on Medicines. " + disclaimer
d = "These are the suggested medicines. " + disclaimer

q = ["What is the patient's age?", "What is the patient's health condition: Blood Pressure, Diabetes, Cardiovascular Diseases or None?", "Is more than one toilet available at the patients house?", "Has the patient completed their vaccination fully?", "Is the temperature reading of the patient going above 99.5°F?", "Is the oxygen level of the patient going below 92%?"]

details = 0

def med():
    global outcome, temperature, health
    lbl.config(text = d)
    med_button.pack_forget()
    sup_lbl.pack()
    if (outcome == "Hospital"):
        rem_lbl.pack()
    elif (outcome == "Home" or "Centre"):
        fab_lbl.pack()
    if (temperature.lower() == "yes"):
        dolo_lbl.pack()
    if (health.lower() != "none"):
        blood_lbl.pack()
    exit_button.pack()

def go():
    global q, a, age, health, toilet, vaccine, temperature, oxygen, details
    welcome.pack_forget()
    if (a == 0):
        age = e.get()
        e.delete(0, END)
        a = a+1
        lbl.config(text = (q[a]))
    elif (a == 1):
        health = e.get()
        e.delete(0, END)
        a = a+1
        lbl.config(text = (q[a]))
    elif (a == 2):
        toilet = e.get()
        e.delete(0, END)

```

**Fig. 4a** The algorithm



```

a = a+1
lbl.config(text = (q[a]))
elif (a == 3):
    vaccine = e.get()
    e.delete(0, END)
    a = a+1
    lbl.config(text = (q[a]))
elif (a == 4):
    temperature = e.get()
    e.delete(0, END)
    a = a+1
    lbl.config(text = (q[a]))
elif (a == 5):
    oxygen = e.get()
    e.delete(0, END)
    a = a+1

if (a == 6):
    e.pack_forget()
    welcome.config(text = "Please check these details. If they are incorrect please retry.")
    welcome.pack()
    details = "Age - " + str(age) + " Health Condition - " + str(health) + " Availability of more than one Toilet - " + str(toilet) + " Vaccination completed - " + str(vaccine)
    + " Temperature above 99.5° F - " + str(temperature) + " Oxygen below 92% - " + str(oxygen)
    lbl.config(text = details)
    a = a+1
if (a == 7):
    welcome.pack_forget()
    next_button.pack_forget()
    finish_button.pack()

def finish():
    global Hospital, Home, Centre, outcome, age, health, toilet, vaccine, temperature, oxygen, medicines
    e.pack_forget()
    next_button.pack_forget()
    finish_button.pack_forget()
    med_button.pack()

if (int(age) < 60):
    if (health.lower() == "none"):
        if (oxygen.lower() == "no"):
            if (toilet.lower() == "yes"):
                outcome = "Home"
            elif (toilet.lower() == "no"):
                outcome = "Centre"
            else:
                outcome = "Error"
        elif (oxygen.lower() == "yes"):
            outcome = "Hospital"
        else:
            outcome = "Error"
    elif (health.lower() != "none"):
        outcome = "Hospital"
    else:
        outcome = "Error"
elif (int(age) >= 60):
    if (vaccine.lower() == "yes"):
        if (toilet.lower() == "yes"):
            outcome = "Home"
        elif (toilet.lower() == "no"):
            outcome = "Centre"
        else:
            outcome = "Error"
    elif (vaccine.lower() == "no"):
        outcome = "Hospital"
    else:
        outcome = "Error"
else:
    outcome = "Error"

if (outcome == "Hospital"):
    lbl.config(text = Hospital)
elif (outcome == "Centre"):
    lbl.config(text = Centre)
elif (outcome == "Home"):
    lbl.config(text = Home)
else:
    lbl.config(text = "Error. Please retry.")

welcome = Label(m, text = "Welcome to COVID-19 help. This module will suggest a possible line of treatment for a COVID-19 positive patient. Please click finish only after answering the sixth question.")
welcome.pack()

lbl = Label(m, text = (q[a]))
lbl.pack()

```

**Fig. 4b** The algorithm



```

sup_lbl = Label(m, text = "Vitamins and Minerals Supplements")
rem_lbl = Label(m, text = "Remdesivir")
fab_lbl = Label(m, text = "Fabiflu")
dolo_lbl = Label(m, text = "Dolo")
blood_lbl = Label(m, text = "Blood Thinners")

e = Entry(m)
e.pack()

next_button = Button(m, text = "Next", fg = "black", bg = "white", height = 1, width = 7, command = lambda:go())
next_button.pack()

finish_button = Button(m, text = "Finish", fg = "black", bg = "white", height = 1, width = 7, command = lambda:finish())

med_button = Button(m, text = "Medicines", fg = "black", bg = "white", height = 1, width = 7, command = lambda:damed())

exit_button = Button(m, text = "Exit", fg = "black", bg = "white", height = 1, width = 7, command = m.destroy)

m.mainloop()

```

**Fig. 4c** The algorithm

### 6. Testing & Classification

The algorithm was tested and run. Dummy patient details were entered as a test. The algorithm gave the correct suggestion.

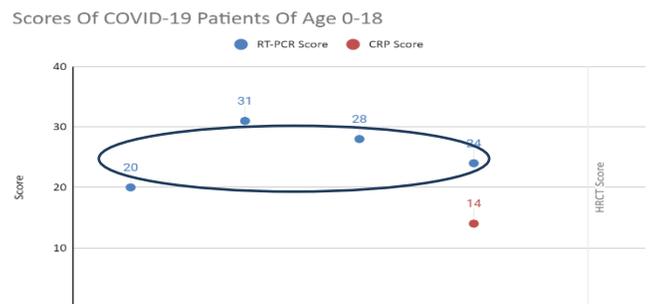
## RESULT

The experiment was carried out to check the credibility of the suggested methodology. The experiment was successful and proved the methodology credible. This methodology can very well be carried out by data scientists in an epidemic/pandemic. A little help from doctors/medical staff will increase the quality of the results.

## DISCUSSION

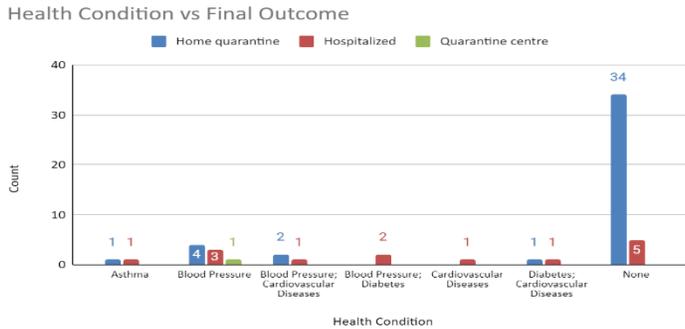
The following charts (Fig. 5a – 5f) show how scores of COVID-19 related tests change with age. Clusters of RT-PCR scores are falling as age increases which denote the severity of infections are rising. Clusters of CRP and HRCT scores are rising with age, which also denotes the same.

Fig. 6 shows how health condition affects your final

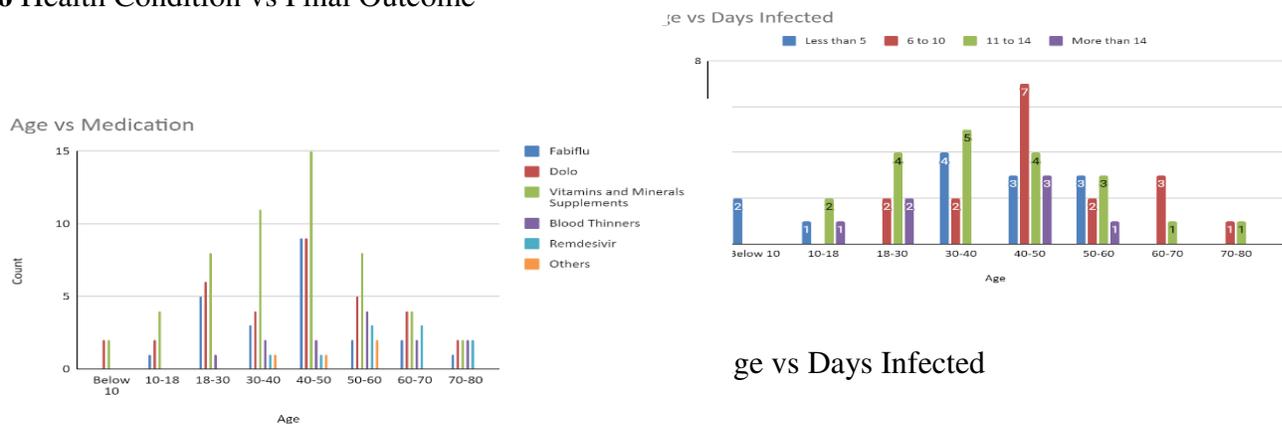


**Fig. 5a** Age vs Scores





**Fig. 6** Health Condition vs Final Outcome



**Fig. 9** Age vs Medication

## CONCLUSION

In conclusion, an experiment conducted on a small dataset of patients who recently contracted COVID-19 resulted in interesting findings. We were able to identify high-risk groups and their possible treatment methods all by clustering and classifying their symptoms, medication and test result values. Although, it has to be noted that every technique applied in Data Science requires constant and repetitive trials to attain a data set that could factually result in conclusions. ‘Trial and Error’ are probably the primary keywords of achieving any sort of success in the methods applied to gathering, filtering and making sense of the vast data in any industry. Gathering a vast number of structured data points on initial symptoms, test results, treatment plans and results of any epidemic and clustering and thereby classifying patients into various buckets of categories could turn out to be a game-changer in solving a future health crisis of epic proportions. We could use machines to do what they do best – learn through piles of health data and help conclude to solve humanity’s medical problems.

## Acknowledgements

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### REFERENCES

1. “Data Science.” Data Robot.<https://www.datarobot.com/wiki/data-science/>(accessed Jun. 1, 2021).
2. M. Cárdenas “How Data Science can help in a pandemic situation?” Sopra Steria.  
<https://www.soprasteria.com/insights/details/how-can-data-science-help-in-a-pandemic-situation>(accessed Jun. 1, 2021).
3. “Clustering in MachineLearning.” Geeks For Geeks.  
<https://www.geeksforgeeks.org/clustering-in-machine-learning/>(accessed Jun. 1, 2021).
4. “Data Mining - Cluster Analysis” Tutorialspoint  
[https://www.tutorialspoint.com/data\\_mining/dm\\_cluster\\_analysis.htm](https://www.tutorialspoint.com/data_mining/dm_cluster_analysis.htm)(accessed Jun. 1, 2021).
5. C. Davidson. “What Is Classification Analysis?” Indicative.  
<https://www.indicative.com/data-defined/classification-analysis/>(accessed Jun. 1, 2021).
6. J. Smith. “Quotes of the Week: John Tukey.” DATA SCIENTIST INSIGHTS.<https://datascientistinsights.com/2013/01/29/quotes-of-the-week-john-tukey/> (accessed Jun. 1, 2021)



### INTRODUCTION TO DIFFERENT IOT DEVICES AND POTENTIAL CYBER ATTACK THREATS

**Manyaa Doshi**

Utpal Sanghvi Global School  
manyaaaddoshi@gmail.com

#### Abstract

With the ever-growing advancements in technology come a new feature in devices and they are known as IoT devices. Smart, cunning, efficient and dangerous at the same time, these devices are now widely used in every possible industry in the world be it healthcare (restocking medicines, pharmaceutical markets, remote patient care, etc.), environment management (devices used to test quality of air, soil and water), retail stores (reordering inventory, electronic transfer of payments, etc.) and so much more. This paper describes the different kinds of IoT devices most common today, different cyberattacks and how they affect the devices and to what extent and finally an experiment to predict attacks on the mentioned devices from the various cyberattacks possible. In the end it will be very easy to draw cohesive conclusions and observe the trends in the cyberattacks posed on different devices.

**Keywords:** remote patient care; affect the devices and to what extent; draw cohesive conclusions

#### Introduction

The Internet of Things is a broad terminology which is crucial to be understood when living in a generation where robots are the new humans. Together with understanding where and for what these devices would be used, it is also important to take note of specific attacks that could be posed and to protect ourselves, our wealth and our loved ones from being held hostage. The main aim of this paper is to explain, in detail, the meaning of IoT devices, where they are used most commonly today and what are the threats posed to them. It also puts light on the subject of different cyberattacks that most of us didn't know about. There isn't only one cyberattack; there are a number of them under the term 'cyberattack' so it is extremely necessary that each one of us is well equipped with knowledge about how and which kinds of devices would be attacked with which cyberattack type. Isn't it interesting to know terms like the Mirai, Distributed-denial-of-service attack, Man-in-the-middle, Botnet and Advanced persistent threats?

It's actually even more interesting to know how they work and how hackers seem to find a way into the most complexly coded software and websites. Explore with this paper, the different threats and possible outcomes of a cyberattack on IoT devices.



### Theory

#### Stage 1: Understanding IoT devices

What exactly are IoT devices? IoT devices are hardware objects that are virtually connected to other devices and are programmed to transfer information to other devices wirelessly over internet. These devices do need human intervention but only till a certain extent. Think about it this way; you need to reach office in 20 minutes and the drive there is 30 minutes long. You still need to finish breakfast and remove the car from your garage. How about if you could just, with a click of a button on your phone, could ask your car to come outside the garage which saves you time and energy?

Especially with the growing car industry currently exceeding technological expectations, it is now humanly possible to ask your car to come out of your garage. Car companies such as Tesla by Elon Musk has come up with an electronic car that responds to commands which are given out by you from your phone. However, why don't we look at the potential threats and attacks that could be planned out which amplifies into a very big potential threat to you and your device? IoT isn't as simple as it seems. With the technology growing so rapidly it is impossible to stop and understand where many of us, either in producing or using the device, might go wrong. Some of the leading industries where IoT devices are used to most are home, agriculture, banking, offices, schools and much more. There are so many varieties of IoT devices from Autonomous mobile bots, Asset management, Environmental monitoring, IoT run supermarkets to supply chain management, etc. these particular industries use a lot of IoT devices especially now where all communication, reordering inventory, purchasing and selling happens through internet.

#### Autonomous mobile bots:

Automated robots are devices and robots that are programmed to transfer and transport a large quantity of goods during in-house tasks. These are required and used by many leading companies in order to more efficiently allocate their employees and make use of modern technology to perform and duplicate human behavior without having to be constantly monitored. How do they work? These devices have a light sensing method that detects and understands the surroundings in light in the form of a pulsed laser to measure ranges on Earth. This is known as the LIDAR which stands for Light Detection and Ranging. The LIDAR bounces laser light off surroundings for the device to understand them and detect any set obstacles that might come in the way from getting to where they are required. This is because there are inputted maps of the work environment which guides them to their destination.[1] Amazon for one is using AMR to transport its inventory from one shelf to another. Not only that but these robots made by Kiva systems actually could hold up to 450 kgs and pick out the desired quantity of goods and bring it to the desired person of authority. [2] However, still not experienced by Amazon, many believe that in the future there are likely to be a number of possible threats to the subordinates.

#### Asset management:

IoT helps asset management become more precise and detailed and allows consumers and businesses to see the flow of their assets- from whom to whom they are going. Asset management is the tracking of assets to see whether they are working based on their expected



key performance indicators. It also allows firms to get real time data and observe and predict movements and provides interpretation for e.g., to see how much the price of one stock in the stock exchange would change. [3]

### **Environmental monitoring**

Environmental monitoring is using tools and devices to improve the quality of the surroundings, it consists of three parts; air, water and soil. It is setting parameters to enable the environment become more cleaner and have sustainable growth. IoT plays a big role in this new system. With the help of iot the government can make decisions easily as real time data is given about the air filtrationsystem, fertility of soil, garbage dumped in water, etc. nowadays IoT uses frequent sampling methods to test the air and water regularly and detect any infection. Much of the farming is done by manual labor and IoT lets farmers water, fertilize and improve the condition of soil and much more by using a much more uniform and consistent technique. [4]

### **Supply Chain Management**

Supply chain management is the distribution and keeping track of goods going from one supplier to another. It is closely observing the cycle of products from the time they are raw materials till they are distributed to consumers. How does IoT help?

With speculating close onto each and every stage of production, IoT softwares allow producers to predict fluctuations in demand and understand where when and in which conditions the goods are in. This is mostly done when products are attached with a GPS system that tracks goods from one place to another. This also carries on until the supplier has restocked the inventory. It is not only manufacturers. Retailers and big superstores like Walmart use JIT which is just-in-time inventory control that restocks the products by ordering it on their own once it reaches a particular 'reorder' point. However, such devices won't work in areas with too much radio or internet traffic thus making it easier for a third party to get access to information using a number of attacks.

### **IoT run Supermarkets**

With everything around, us industrializing, it is not a shock that supermarkets too now are run and operated by scanning of barcodes and cashless transactions. The new Amazon Go is a supermarket that uses computer vision and deeper AI systems to track how much a person has bought and automatically add it to their online cart. The process begins when a consumer scans their way through Amazon Go's entry bar and starts picking out whatever they were looking for. There are no humans or employees in Amazon Go making it a completely AI operated store. Then with the use of sensors the products are added to the bag with the quantity purchased too. There are even cameras that track he number of items one has bought and a 'facial recognition' software that generates a biography of the customer; they have a filed patent to support this too. IoT keeps the products fresh and clean. The consumer then just walks out and pays the amount through Amazon Wallet. As easy as that.

There are however manual errors and obstacles that could arise such as a glitch in the system or access to the server could change room temperature settings and spoil the stock or may add too many products in the bag. This way Amazon makes use of its 'Just Walk Out' technique.



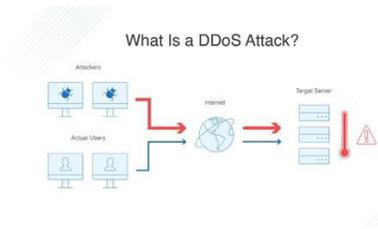
These stores operate using the same technology used by self-driven cars which is deep learning and computer vision. [5]

### Stage 2: understanding different kinds of cyberattacks on IoT devices

What are cyberattacks? The word is split into two: cyber as in internet, computers, technological appliances; and attack is to ambush a particular thing. Cyberattacks are carried out by cybercriminals, they launch an attack on computers, softwares, mobiles, etc. to hack, steal, exploit or destroy data on one's device. Cybercrime costs are expected to rise another 15% to \$10.5 trillion USD in 2025 from \$3 trillion in 2015. [6] This just shows how much harm is posed to consumers using computers and those who rely on technology to store their data. Now within the rising solutions to protect data is Cloud. Cloud or Apple's iCloud stores data on the internet and can remotely be accessed by anyone who has the necessary credentials to login. In cloud data is stored in the servers instead of the hardware or desktop and is supposedly invented to make life easier. Comparatively, now it has become much easier to hack into a system that depends on cloud because anyone from anywhere can hack the device's server. These cyberattacks on the cloud are called APT's (advanced persistent threats [explained below]) There a number of cyberattacks that have started taking place on a variety of devices. In fact, most of the devices mentioned above could be hacked using different tools and mechanisms.

Mirai Malware attacks- the Mirai attacks are very common and very known to a lot of firms, consumers and potential users by now. A Mirai attack is when devices are turned into controlled bots that will respond to the commands given by the hacker. It is mainly used in large scale attacks and mostly to hack home appliances. It primarily targets smart home appliances such as IP cameras and smart TVs, etc. So how does it work? Mirai is very similar to a contagious virus. These are infected within computers and they replicate themselves, making it only worse. it is not only an appliance attack but recently also started being called as a botnet attack. This is because the vulnerable IoT devices are connected to other command and control devices, thus becoming a large-scale hack and has affected millions of devices and kept security professionals busy. [7]

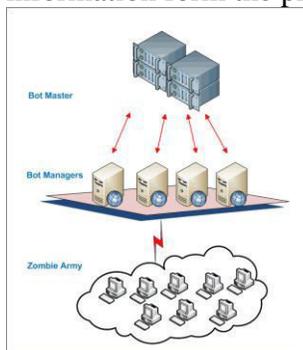
Ddos attacks- Ddos (Distributed Denial-of-service attacks) are when the hackers temporarily programme the device to not be able to respond to the host's commands and this gives the hacker enough time to divert the customer traffic to other platforms. Ddos attacks' main purpose isn't to collect or hack information but to make the server overwhelmed with too much traffic so that they give up the IP address of much larger connected devices. Attackers do this by performing a botnet attack wherein a lot of bots request for passwords and the traffic on the software/ website may reach an optimum level and this was the website or platform becomes unavailable to consumers. There have been so many real life incidents that have been Ddos attacks and those who have harmed and destroyed days' worth of business of many service companies.[8] A recent February 2020 attack is the Amazon Web Services attack where an unidentified customer was attacked where all information was available on cloud. It used a technique known as the *Connectionless Lightweight Directory Access Protocol (CLDAP) Reflection which depends on third party customers and amplifies the data sent to the victim's IP address by 70 times.* [9]



Advanced Persistent Threats- are some threats that have been constant for the cloud network. This is when the system has been attacked a particularly long time which given plenty of time to attackers to potentially damage the platform. These attacks compared to others are much more sophisticated and during this period of time the victims are unaware of this. These attacks take a lot of time to prepare and come at final conclusions; every single detail is planned and that's what makes them so successful and silent at the same time. Compared to Ddos these attacks' main aim is to collect information over a long time which means it is not just a 'dip in' attack. These contain three stages:

- 1) infiltration which is getting into the system and installing a malware software that basically spreads and infects the device
- 2) expansion- this is when hackers broaden their base and may decide to go after more confidential information and hack into employee's system as well with the help of employee codes
- 3) extraction- after the data has been moved up to a secure place then the main aim is to get out of the system without getting detected. The main task since the beginning was the extraction because this is when most of the hackers get identified and caught. [10]

Botnet attacks- a very simple term to understand in the botnet attack. Botnet attacks have become increasingly popular with the growing number of firms using robots and capital-intensive production. Botnet attacks are when a group of bots perform a Ddos attack, steal, spam or disrupt information form the production process. These are a part of Ddos attacks.



The Mirai Botnet attack of 2016 was when the bots conducted a Ddos attack and infected over 600,000 devices. Interestingly it was the first botnet attack to hack into weak IoT devices.



Man-In-The-Middle attack- personally, MITM attacks are the most intriguing. These attacks aren't very common such as malware and ransomware however they are equally (or more) dangerous.

There are 5 types of MITM attacks:

- 1) ARP cache poisoning- the Address Resolution Protocol allows hackers to intercept the conversations between two network providers. They either continue listening to
- 2) the conversation and interpreting the communication, hijack the system, alter communication (malicious failure) or conduct a Ddos attack.
- 3) DNS cache poisoning- this is where the hacker might send the customers a fake website and baits the customer into visiting them to then send out a phishing mail
- 4) HTTPS spoofing – is where the hacker's website looks very similar to the original except there is a minute change not very visible clearly. Now that the website is saved/bookmarked the hacker can successfully tap your conversations without having put himself in danger.
- 5) WIFI eavesdropping- allows hackers to eavesdrop and listen to the traffic through tricking people to connect to unsecured/ public networks
- 6) Session hijacking- this hacking is a very interesting approach. The hacker specifically waits for the victim for e.g., to log into their bank account and then uses the smart cookie and logs into the same account from their own browser.

### Experiment:

Usually, it isn't possible to carry out iot device hack experiments however this section talks more about whether or not all possible devices could be hacked or not.

many devices however with the growing number of legal websites and tools could be used to hack and break into systems. As seen above there are so many types of cyberattacks, and those were only the most common ones. Under some specific circumstances, such as under extreme security and protection protocols, it might not be impossible but possibly difficult to hack into a system as such. One of such is the IoT run supermarket: Amazon Go. Just launched in 2018, the supermarket doesn't till date have any problems or hacks, or atleast they are unknown. This is a significantly big achievement because it is very easy to think of ways hackers could earn a good amount of profit just by virtually looting a supermarket.

These are a few hypothetical ways, when iot categories are grouped with possible hacks, systems could be damaged.

1. Autonomous Mobile bots with botnet attacks- the most common way to think about a hack on the warehouse bots is ofcourse the botnet attack. Botnet attacks are programmed when a large number of bots are attacked together to disrupt either the production process or more. It's usually the large-scale businesses who use AMBs so it is rather expected there will be a number of them. This clearly gives an explanation why it would hypothetically mean that warehouses could be attacked on a very large scale. All of the devices could be programmed to hack into the system or steal data. A large number would cause enough traffic do initiate a Ddos attack also. Instead of moving traffic form one website to another, it could be programmed to obey commands.



The impact and its significance: if any botnet attacks do take place it is likely to cause so much harm to the firm and consumers. However, compared with other kinds of potential threats in different categories, this one might be less jeopardizing. If for eg amazon's fulfillment service is hacked, it would mean many of the consumers may be given damaged, wrong or may even have to wait long periods for their products to arrive. This would infact cause a system failure especially for a big brand like amazon and may even destroy their reputation. Less harm to consumers, comparatively more to producers Real life example: The Level One Robotics and Control Inc attack in 2018 had resulted in 100 company's sensitive data to be leaked online on a platform that contained confidential information, VPN addresses and customer as well as employee data. This company gave automation solutions to more than 100 automation companies including Tesla, Toyota, Ford, etc. this used Rsync as a platform to transfer data from within the company. IP addresses should be made available to only the designated managers and supervisors to avoid future ransomware attacks. [11]

### 2. Asset management clubbed with MITM

Asset management is all about securing and protecting assets and wealth. Hackers, once they know this, can very easily access the places one's invested, bought stocks in and secured their wealth. However not all MITM techniques could be used here. Some of the ones that would be spot-on would-be session hijacking and DNS cache poisoning. Why session hijacking? This is because when a user might try to login in to check the current values of their stocks or might login online to check on their wealth, hackers could access the cookie and information and could login from their own browser. DNS cache poisoning can bait the visiting into logging into a fake account just very easily giving access details to the hacker.

The impact and its significance: asset management attacks could deeply harm the consumer, their possessions and their money at risk. Consumers could lose a lot of money if the attackers have access to sensitive information. Not only that but if the banks do not know about it soon, the virus could spread, hackers could expand their framework and even leak passwords of other users. If the attack becomes a long drawn one even government attack could be hacked into affecting a much larger proportion of the economy

Real life example: the atm banks in Kolkata, India were hacked through an MITM attack where hackers physically entered the atm to insert stolen cards of fake cards and before which they entered a black box to activate a proxy server. This way when money is withdrawn, banking details wouldn't be asked for as the proxy server wouldn't need them to access the money form the atm. [12]

### 3. Environmental monitoring hacked through Mirai

Mirai attacks on smart home appliances are quite famous. The environment management systems could very easily be controlled and hacked using Mirai and it could legitimately destroy the environment and the precision of the work. It is very much



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possible that the system could be hampered with and one virus in one system could ruin all programmed in connecting computers as well.

The impact and its significance- one of the most detrimental impacts of hampering with the environment management is it affects not only the national industries but if the country is specializing then it affects the world's output of agricultural produce as well.

Real life example: the 2019 attack on the Post Rock Water District had shut down the disinfectors and water purifier machine which resulted in polluted water being circulated. This hacker previously worked in the organization but had recently resigned, allowing him access to routers which hadn't signed him off yet. In February 2021, a hacker had tried to leak large amounts of sodium hydroxide into the Florida water plant which in large amounts can lead to death but purifies water if smaller quantities are used. [13]

#### 4. Supply chain management with Ddos attacks

Ddos would be a very scary attack on the supply chain if it had to be done. It is not only going to be robots of the same kind on the same level but bots in other parts of the supply chain. If the Ddos attack is cast on the manufacturers then if the customers or retailer's attention is diverted because of excess traffic then probably the sales would be lost.

Impact and significance: if the sales are lost on an international basis there could be recession as well as lower GDP. If the hackers work for another country or may want to drive other businesses out of the market, Ddos attack on the supply chain devices would cause a significant harm to the competitor.

Real life example: a recent case of the REvil ransomware attack has spread over the internet. This attack was conducted through a group known as REvil who targeted the Kaseya VSA which is a software used by many leading companies- especially in the digital industry- and this REvil attack locks up the computers who provide and manage software updates until a fee is paid to them. This way they threaten the consumers too, by giving them a warning. The Kaseya VSA attack locked up to 40,000 computers worldwide from which it made a profit of \$11 million. [14]

#### 5.

IoT run supermarkets baited through MITM-

MITM has various kinds of hacking techniques but one could be used to change how IoT supermarkets work. Online grocery shopping could actually have lots of potential threats. A hacker for e.g., could change the website and tweak the URL. During checkout the banking information could be accessed without the consumer even knowing.

The impact and its significance: an attack in the supermarket would usually harm mostly the consumers and the company. Amazon go which operates only on IoT would be harmed till a great extent too.



Real life example: the Kaseya VSA REvil ransomware attack had also hacked one of the supermarkets in Sweden who was very dependent on IoT and technology for all its inventory and checkouts. Consumers however were brutally attacked, financially. Most of the customers using their own servers to place orders were attacked, not the ones who were using the Kaseya server. This harmed the company badly as they had to stop selling through e-commerce temporarily and keep all its cloud-based softwares offline until further notice. [15]

### Result

The result as clearly observed above is that all kinds of IoT devices can be hacked using different methods. Even if they are secure and safe there are always going to be loopholes in the system. If carefully mismatched with, the systems could be hacked, information could be taken a then some more.

However, there might be some devices that might be very safe. As safe as online banking sounds, there are banks also that could be hacked and actually have been. However, one pattern we say all around is that all of these categories have IoT devices that have been connected on a large scale and it is very possible that all devices could be attacked from all mediums but it is important to predict certain types that would be used for certain devices, so that firms and consumers do have a slight bit of background knowledge in order to prepare accordingly.

### Discussion

There are main results obtained in the experiments and some of them are genuinely predictable however currently all hypothetical. The discussion gives a brief on what the results are and what they indicate. There are clearly a bunch of trends and patterns observed from the experiments:

- 1) All kinds of IoT devices could be hacked
- 2) Much more complex methods of hacking could be used when deciding to access bank and asset details
- 3) Usually more detailed and planned research could help in getting more results but that also means that the harm could be much more.

Most of the attacks are attacking on a large scale since the size of the attacks is large and hence most Ddos attacks could potentially harm an entire company. With growing technology, the categories of IoT devices becomes much more detailed thus having many more substitutes. This just gives attackers the very intention to attack and harm the business. Also, attacks are increasing so rapidly that firms actually have to now start giving more importance to cybersecurity and security procedures because none of the firms can afford to lose or become vulnerable to any more attacks.

### Conclusion

With an increasing variety of IoT devices there have also been an increasing rate of cyberattacks. IoT devices are becoming weaker and more vulnerable every day and it just jeopardizes the lives of many victims more than it already has. Although there is



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very little, we as consumers could do, but there are few precautions one could take to avoid getting trapped by the hackers.

1) First and foremost is to start updating devices. Software updates really do help and prevent viruses and help fix bug problems.

2) end to end encryption- devices that are bought have a long history behind them especially second-hand device. It is really important to secure the devices in a way that prevents hackers from getting data from the past. Probably to wipe off or erase backup data.

3) IoT network monitoring- it is also very important to make sure that all the third party or unidentified officials have been removed or blocked

There are a lot of more precautions one could take but they might never be enough. If only all manufacturers, retailers, consumers and everyone in the supply chain takes good care so that security is embedded into the product from the beginning only then will it be possible to unite us against them.[16]

### References

- [1] NextShift Robotics. 2021. *The Basics of Autonomous Mobile Robots | NextShift Robotics*. [online] Available at: <<https://nextshiftrobotics.com/podcast/basics/>> [Accessed 5 July 2021].
- [2] Youtube.com. 2021. *Before you continue to YouTube*. [online] Available at: <<https://www.youtube.com/watch?v=IMPbKVb8y8s>> [Accessed 5 July 2021].
- [3] Asset Infinity Blog. 2021. *What Is IoT and How Is It Helpful in Asset Management? - Asset Infinity*. [online] Available at: <<https://www.assetinfinity.com/blog/what-is-iot-and-how-is-it-helpful-in-asset-management>> [Accessed 5 July 2021].
- [4] Tutorialspoint.com. 2021. *IoT - Environmental Monitoring - Tutorialspoint*. [online] Available at: <[https://www.tutorialspoint.com/internet\\_of\\_things/internet\\_of\\_things\\_environmental\\_monitoring.htm](https://www.tutorialspoint.com/internet_of_things/internet_of_things_environmental_monitoring.htm)> [Accessed 5 July 2021].
- [5] Pocket-lint. 2021. *Amazon Go and Amazon Fresh: How the 'Just walk out' tech works*. [online] Available at: <<https://www.pocket-lint.com/gadgets/news/amazon/139650-what-is-amazon-go-where-is-it-and-how-does-it-work>> [Accessed 5 July 2021].
- [6] Cybercrime Magazine. 2021. *Cybercrime To Cost The World \$10.5 Trillion Annually By 2025*. [online] Available at: <<https://cybersecurityventures.com/hackerpocalypse-cybercrime-report-2016/#:~:text=Cybersecurity%20Ventures%20expects%20global%20cybercrime,%243%20trillion%20USD%20in%202015.>> [Accessed 5 July 2021].
- [7] 2021. [online] Available at: <<https://blog.cloudflare.com/>> [Accessed 5 July 2021].
- [8] 2021. [online] Available at: <<https://www.cloudflare.com/en-in/learning/ddos/what-is-a-ddos-attack/>> [Accessed 5 July 2021].
- [9] A10 Networks. 2021. *Five Most Famous DDoS Attacks and Then Some | A10 Networks*. [online] Available at: <<https://www.a10networks.com/blog/5-most-famous-ddos-attacks/>> [Accessed 5 July 2021].



- [10] Learning Center. 2021. *What is APT (Advanced Persistent Threat) | APT Security | Imperva*. [online] Available at: <<https://www.imperva.com/learn/application-security/apt-advanced-persistent-threat/>> [Accessed 5 July 2021].
- [11] <https://www.miningreview.com/gold/emerging-cyber-threats-in-the-manufacturing-and-mining-sectors/>. 2021. [online] Available at: <<https://www.miningreview.com/gold/emerging-cyber-threats-in-the-manufacturing-and-mining-sectors/>> [Accessed 5 July 2021].
- [12] News, C., News, k. and attack, K., 2021. *Kolkata ATMs under sophisticated hacking attack | Kolkata News - Times of India*. [online] The Times of India. Available at: <<https://timesofindia.indiatimes.com/city/kolkata/kol-atms-under-sophisticated-hacking-attack/articleshow/83096894.cms>> [Accessed 5 July 2021].
- [13] Cyber Security Hub. 2021. *Another Cyber Attack Affecting Water Supply*. [online] Available at: <<https://www.cshub.com/attacks/articles/another-cyber-attack-affecting-water-supply>> [Accessed 5 July 2021].
- [14] 2021. [online] Available at: <<https://www.livemint.com/news/world/ransomware-hits-hundreds-of-us-companies-security-firm-says-11625273463663.html>> [Accessed 5 July 2021].
- [15] mint, 2021. REvil ransomware strike may have hit more targets. p.single page.
- [16] Ziniosedge.com. 2021. [online] Available at: <<https://ziniosedge.com/iot-security-threats-in-retail-how-do-we-eliminate-them/>> [Accessed 5 July 2021].



### DATA COLLECTION METHODS IN THE SPHERE OF HEALTHCARE

**Kanak Bhawmik**

Bombay Cambridge International School Andheri (E)  
[kanakbhawmik@gmail.com](mailto:kanakbhawmik@gmail.com)

#### Abstract

The research paper explains about the necessity of machines for data collection in the area of healthcare. The theory introduces the uses of several data collection devices. Survey of medical workers was conducted as an experiment. About all of the surveyed individuals selected, computerized data collection is important. The achieved results show that usage of mechanization for data collection in medical science is crucial.

*Keywords -data collection, pandemic, clinical measurements, data scientist, virtual treatment*

#### INTRODUCTION

Data science plays a vital role in the field of healthcare. It allows professionals to perform medical imaging, predictive analysis to prevent from potential disease complications/epidemic/pandemic and providing virtual assistance for patients. Collecting reliable and relevant data is a core step in the field of data science. Data scientists spend 60% of their time on cleaning and organizing data. Collecting data consumes around 19% of their time, meaning data scientists spend around 80% of their time on preparing and managing data for analysis. However, several interventions have brought an elementary procedure for data collection in the sphere of healthcare.

#### Theory

The following are a few examples of techniques and devices that simplify data collection in healthcare:

- Digital contact tracing - Contact tracking method that relies on tracking system, examples of apps include TraceTogether (Singapore), HaMagen (Israel) and Aarogya Setu (India); this technology which has come into prominence during COVID -19 pandemic.
- Radio Frequency Identification (RFID) Tags - These contain microprocessors track a large amount of data wirelessly. It is broadly used in hospitals for patient tracking, medical equipment management and also for identification of drug supplies.
- Medical Artificial Intelligence (AI) - These machines are a stimulation of human intelligence, they can help process a diagnosis, monitor patients, provide personalized medicines, and moreover with the help of electronic medical records they can also interpret bulk data and prevent disease..



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- Automated data collection system - This technology captures data of paper documents into electronic files. It is useful for updating patient details.
- Remote health monitoring system - The following is used to monitor patients out of clinical services, a monitoring device is provided to the patient that collects vitals and shares it to the physician and software that provides alerts based upon patient's health.
- Real Time locating system (RTLS) - This is used to contact a person in case of an emergency. A tag that has a button, as soon as the user presses the button an alert rings, providing the location of the individual that has pressed the button.

Devices emerging in future:

Smart beds - New smart beds measures up to 35 various readings that includes patient's weight, body temperature, heartbeat, blood pressure and also the number of times the patient has left or turned in bed. The beds electronically update patient's data. Some smart beds also have the ability to give verbal alerts and provide usb ports for charging.

Unique Device Identification (UDI)- It's a unique alphabetical or numerical code that can be read by both humans and machines, it contains information such as expiry, manufacture date. This will help improve patient safety and facilitate more production of medical equipment.

Oura ring- Wearable fitness tracker that keeps a track on physical activity and provides daily reports.

### Experiment

Survey of medical workers on data collection devices for their views and experience. Table 1.0 shows the questions and response options the survey consisted of. The link of the survey:

[https://docs.google.com/forms/d/1S1ILH3EuGRU\\_q4OXvLcduR6Tr2rJ\\_77dIBSRm-RLjc/edit](https://docs.google.com/forms/d/1S1ILH3EuGRU_q4OXvLcduR6Tr2rJ_77dIBSRm-RLjc/edit)

**Table 1.0 (The questions and the answers options that the survey contained)**

Question number	Question	Answer options
1	Name	-
2	Gender	-
3	Occupation	-
4	Select, the data collection method you think is better	Normal survey/ Online survey
5	Has data collection through the use of technology saved your time	Yes/No/Maybe
6	Which method is more likely to PRODUCE ERRORS while collecting clinical measurements of the patient	Smart beds/ Manual readings with the help of several devices
7	Data collection methods - Digital contact tracing RFID Tags  Artificial Intelligence (AI) Automated data collection system  Remote health monitoring system  Real Time locating system (RTLS)	Yes/No



	If these data collection methods are fully implemented world-wide, then can times of pandemic and epidemic be EASILY CONTROLLED	
8	From your experience, rate the IMPORTANCE OF TECHNOLOGY FOR DATA COLLECTION -	Not at all important/ Slightly important/Important/ Fairly important/ Very important

### RESULTS

The results are displayed in table 1.1 moreover for authentication the link of the results:

[https://docs.google.com/forms/d/1S1ILH3EuGRU\\_q4OXvLcduR6Ttr2rJ\\_77dIBSRm-RLjc/edit#responses](https://docs.google.com/forms/d/1S1ILH3EuGRU_q4OXvLcduR6Ttr2rJ_77dIBSRm-RLjc/edit#responses)

**Table 1.1 (The responses by the healthcare workers)**

Response	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8
1	Rahul rathod	Male	BAMS	Online Survey	Maybe	Manual readings	Yes	Important
2	Shweta Saini	Female	Floor Executive	Normal Survey	Yes	Smart beds	Yes	Very important
3	Anuradha Raut	Female	Service	Online Survey	Yes	Manual readings	Yes	Very important
4	Kinnari kanade	Female	Service	Online Survey	Yes	Smart beds	Yes	Fairly important
5	Kalpna Acharya	Female	Hospital employee	Online Survey	Yes	Manual readings	Yes	Very important
6	Nikita Mahindrakar	Female	Executive assistant	Online Survey	Yes	Manual readings	Yes	Very important
7	Dr sabiha syed	Female	Family physician	Online Survey	Yes	Manual readings	Yes	Very important
8	Sanika kadam	Female	Cardiac sonographer	Online Survey	Yes	Manual readings	Yes	Important
9	Namrata Channal	Female	Salaried	Online Survey	Yes	Manual readings	Yes	Fairly important
10	Smita Nair	Female	Service	Online Survey	Maybe	Smart beds	Yes	Important
11	S Nalawade	Female	Service	Online Survey	Maybe	Smart beds	Yes	Important
12	Mayank Singh	Male	Employee	Normal Survey	Maybe	Manual readings	Yes	Important

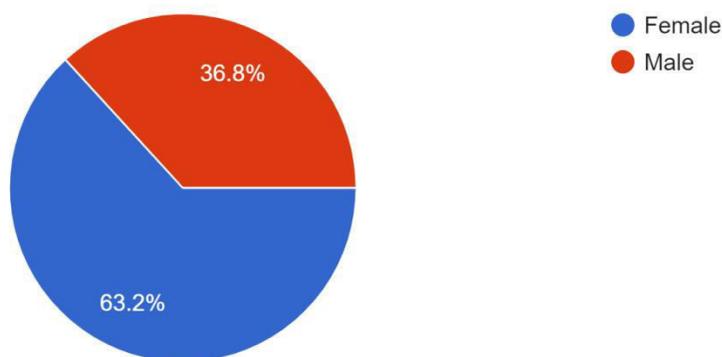


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13	Deepak Singh	Male	Healthcare professionals	Online Survey	Yes	Smart beds	Yes	Fairly important
14	Pratik Parekh	Male	Administration	Online Survey	Yes	Smart beds	Yes	Important
15	Amal	Male	Service	Online Survey	Yes	Manual readings	No	Fairly important
16	Charuta	Female	Service	Online Survey	Yes	Manual readings	Yes	Very important
17	Dr Jeetendra Bardolia	Male	Doctor	Normal Survey	Yes	Smart beds	Yes	Important
18	Arti Jadhav	Female	Service	Online Survey	Yes	Smart beds	Yes	Important
19	Pratik sharma	Male	Floor executive	Normal Survey	Yes	Smart beds	Yes	Important

### DISCUSSION

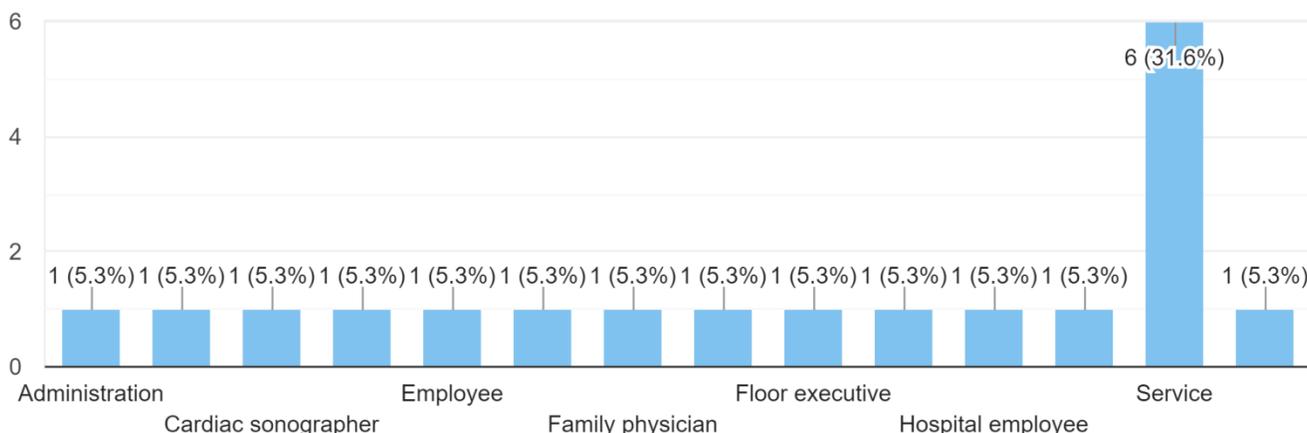
Gender  
 19 responses





### Occupation

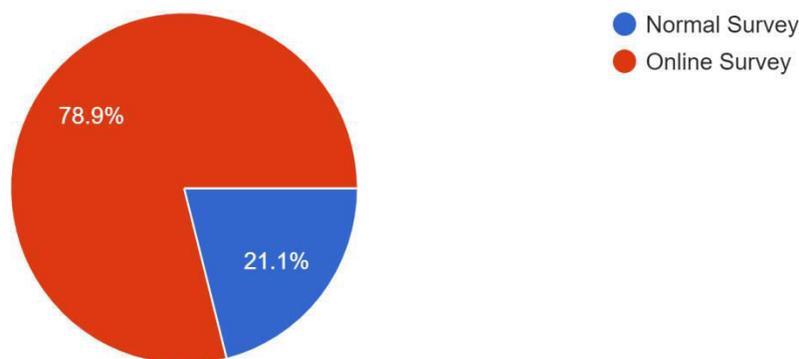
19 responses



The results show that more than 30% are occupied in service : Staff from medical companies, while other occupations include cardiac sonographer, hospital employee, family physician and floor executive.

### Select, the data collection method you think is better -

19 responses



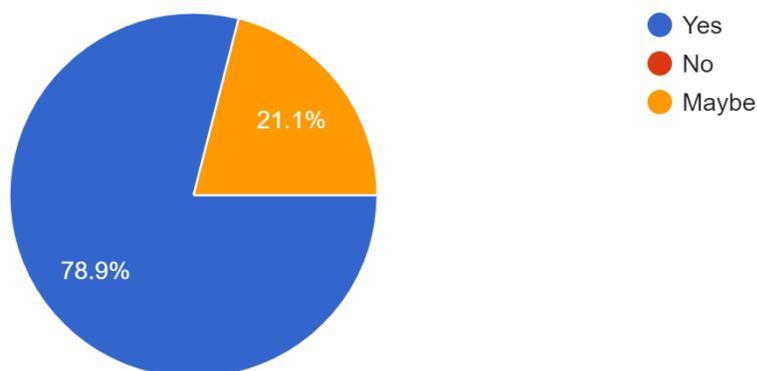


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More than 70% in healthcare prefer online surveys for hospitals and clinics, as it avoids contact and decreases the chance of infectious diseases spreading. The survey can be taken over a distance also, it can also be useful for observing patients outside medical buildings in Remote Health Monitoring System.

Has data collection through the use of technology saved your time -

19 responses



Which method is more likely to PRODUCE ERRORS while collecting clinical measurements of the patient :

19 responses

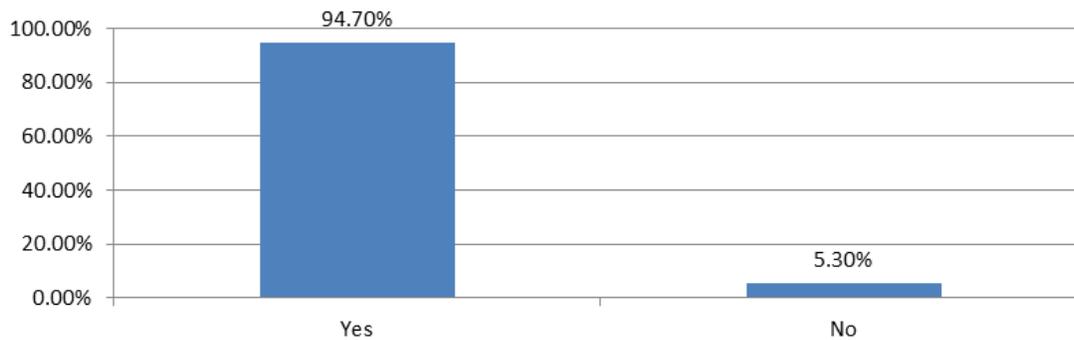




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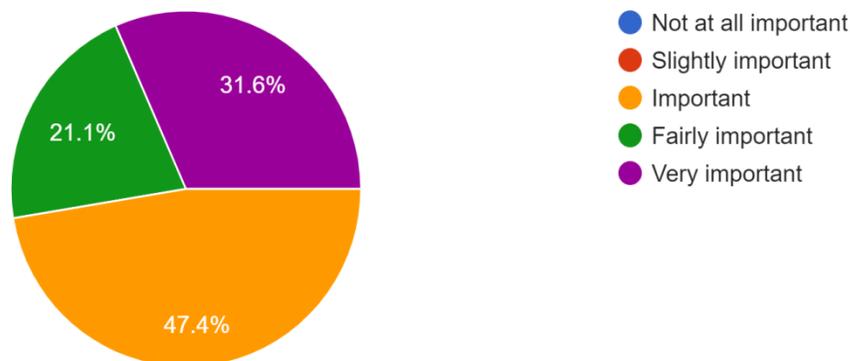
More than 50% stated that measuring clinical values manually is more error prone than smart beds as several clinical readings has to be taken through diverse devices, however smart beds provide these values altogether, in just a few seconds.

Data collection methods - Digital contact tracing| RFID Tags| Artificial Intelligence (AI)|Automated data collection system |Remote health monitoring system| Real Time locating system (RTLS)|  
If these data collection methods are fully implemented world-wide, then can times of pandemic and epidemic be EASILY CONTROLLED  
19 responses



94.7% state that total execution of the mentioned technologies can help control times of pandemic and epidemic as the devices can help trace infected citizens, medical equipment and patients count. Moreover, it can also provide distanced medical services. Implementation of such devices has broadly increased in the pandemic of COVID-19.

From your experience, rate the IMPORTANCE OF TECHNOLOGY FOR DATA COLLECTION -  
19 responses



I would like to express my gratitude towards Mrs. Anuradha Raut for guiding me throughout the project. I would also like to acknowledge My Teachers that provided me with technical support.

### REFERENCES

1. “Data collection” QuestionPro. <https://www.questionpro.com/blog/data-collection/> (accessed July, 2, 2021)
2. “Data Science in Healthcare – 7 Applications No one will tell you “Data Flair. <https://data-flair.training/blogs/data-science-in-healthcare/#:~:text=Data%20Science%20plays%20a%20pivotal,diseases%20at%20an%20early%20level.> (accessed July, 2, 2021)
3. Gil Press. “Cleaning big data: Most Time-Consuming, Least Enjoyable Data Science Task, Survey Says ” Forbes. <https://www.forbes.com/sites/gilpress/2016/03/23/data-preparation-most-time-consuming-least-enjoyable-data-science-task-survey-says/?sh=7cb6c1566f63> (accessed July, 2, 2021)
4. “Digital contact tracing” Wikipedia. [https://en.wikipedia.org/wiki/Digital\\_contact\\_tracing](https://en.wikipedia.org/wiki/Digital_contact_tracing) (accessed July, 2, 2021)
5. “Covid-19 contact tracing apps” JMIR Publications. <https://mhealth.jmir.org/2020/11/e23194/> (accessed July, 2, 2021)
6. Charlotte Seckman, Ashleigh Bauer, Tonianne Moser and Stephanie Paaske “The Benefits and Barriers to RFID Technology in Healthcare” HIMSS. <https://www.himss.org/resources/benefits-and-barriers-rfid-technology-healthcare> (accessed July, 2, 2021)
7. “Artificial intelligence in healthcare” Wikipedia. [https://en.wikipedia.org/wiki/Artificial\\_intelligence\\_in\\_healthcare](https://en.wikipedia.org/wiki/Artificial_intelligence_in_healthcare) (accessed July, 2, 2021)
8. Brinna Hanson “Automated Data Collection: Methods & Benefits” SMARTDATA SOLUTIONS. <https://sdata.us/2020/12/22/automated-data-collection-methods-benefits/> (accessed July, 2, 2021)
9. Charlotte Edwards “ Remote health monitoring: the benefits of keeping in touch” MEDICAL DEVICE NETWORK <https://www.medicaldevice-network.com/features/remote-health-monitoring-benefits/> (accessed July, 2, 2021)
10. Maged N Kamel Boulos and Geoff Berry “Real-time locating systems (RTLS) in healthcare: a condensed primer” NCBI. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3408320/> (accessed July, 2, 2021)
11. “IoT in Healthcare : Smart Beds” wyebot. <https://wyebot.com/2020/03/02/iot-in-healthcare-smart-beds/#:~:text=New%20smart%20beds%20monitor%20up,%2C%20oxygen%2C%20and%20pressure%20sensors.> (accessed July, 6, 2021)
12. “Unique Device Identification System (UDI System)” FDA. <https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/unique-device-identification-system-udi-system> (accessed July, 6, 2021)
13. Danielle Dresden “Oura Ring review: What to know” Medical News Today. <https://www.medicalnewstoday.com/articles/oura-ring-review-brand-and-product> (accessed July, 6, 2021)



### A SELF-AWARE A.I: EMULATING THE HUMAN BRAIN

**Aditya Singh**

B.K Gadia 'A' Level Junior College  
dgk04819@dgkhetan.edu.in

#### Abstract

In this paper I have compiled a possible method to emulate the functioning of the human brain in a tangible A.I model using the fields of Machine Learning, Deep Learning, neuromorphic computing, and neural networks. The conclusion this investigation suggests that it is possible to create A.I models that mimic specific functions of the brain, but due to the biological barriers faced by machines, we currently cannot create one such model that can harness the total magnitude of computing that the brain can do. All current models of A.I are based on one single scientific method whereas in my method; I have designed an amalgamation of systems that behaves like one single entity.

**Keywords:** *Machine Learning, Deep Learning, Neural Networks, Neuromorphic Computing, Mind-uploading*

#### INTRODUCTION

This paper aims to discuss the theory for creating a true A.I model that is aware about its existence and can comprehend its electrical consciousness. The strong A.I should depict behavior similar to humans in relation to decision making skills without any pre-set data processing algorithms. The A.I model should be able to handle any given scenario a human can from the decision making and core – logic point of view of human intelligence. The A.I model should be able to think on its own as an individual body without any human influences.

Our brain consists of approximately 86 billion neurons. In the process of emulating the human brain one needs to create a digital copy of these neurons and manage to upload it to a relevant computational device that is powerful enough to handle the memory requirements of the digital model resembling the human brain. The concept of copying the mental state of the human mind and uploading it to a functional computational device in a digitalized form that can be manipulated by software is known as 'mind – uploading' [1].

A mind-upload is one of many suggested possible ways that a W.B.E { Whole Brain Emulation } can be achieved. Currently mind-upload cannot be performed successfully because the immense processing requirements of the process do not exist. However, these processing requirements would soon be met as mentioned in [2]



Today we can use other renowned technologies like algorithms based on Deep Learning and Machine Learning, Different Neural Network models and trusted procedures like neuromorphic computing to aid our pathway towards a strong Artificial Intelligence.

To fully understand Artificial Intelligence, we need to understand a broad spectrum of concepts that lead to the birth of Artificial Intelligence. The roots of Artificial Intelligence are embedded in Human psychology and in the thought of human consciousness. The pursuit for the development of a true Artificial Intelligence is based on the idea that there can be a species that has an intellectual level higher than that of humans. Artificial intelligence has paved vastly different ways from its early start in the 1950s. It has certainly helped human kind progress in numerous ways like sorting hundreds of petabytes of data and extracting useful information from them by the use of machine learning algorithms and neural networks but somewhere in these years it has lost its true purpose of origination due to this immense diversification of ideas.

This paper is solely based on the idea for the development of a strong Artificial intelligence model that can surpass human intelligence in every aspect of intellect possible. The purpose for creating this model of A.I is again extremely diverse and beneficial for human kind. If we successfully manage to create an actual self-aware A.I; it would change the human species forever. This “change” can currently not be predicted whether it would be in the favor of human kind or not.

Over the years scientists have adapted the idea of creating a model similar to that of the human brain for the basis of this true A.I. The problem at hand is the complexity of the human brain. The human brain is divided into mainly three parts the cerebrum, the brainstem, and the cerebellum. The cerebrum is the largest part of the brain and scientists have found that our consciousness resides in this part. The brain can be thought of as a region of space concentrated with neurons that differ in certain parts to handle different stimuli and make relevant computations specific to the scenario.

Humans currently don't know the following things about the human brain: the number of components the human brain has and how does the brain actually compute data by intercommunicating at a microscopic level between the neurons. Machines work in a similar way to the neurons, but they have some differences that give rise to certain complications. Neurons communicate by electrical synapses that pass from one end of the neuron to the other end; in the case of machines this electrical synapse is replaced by the flow of electrons that passes along the body of a conducting material.

The human brain mainly has 3 different chemicals that transmit information through the neurons in the form of electrical synapses these chemicals are  $K^+$ ,  $Na^+$  and  $Cl^-$ , think of these as three different flavors of electricity that flow through the brain and this is where the problem arises when we work with machines that are solely based on the transmission of electrons for the flow of electricity.

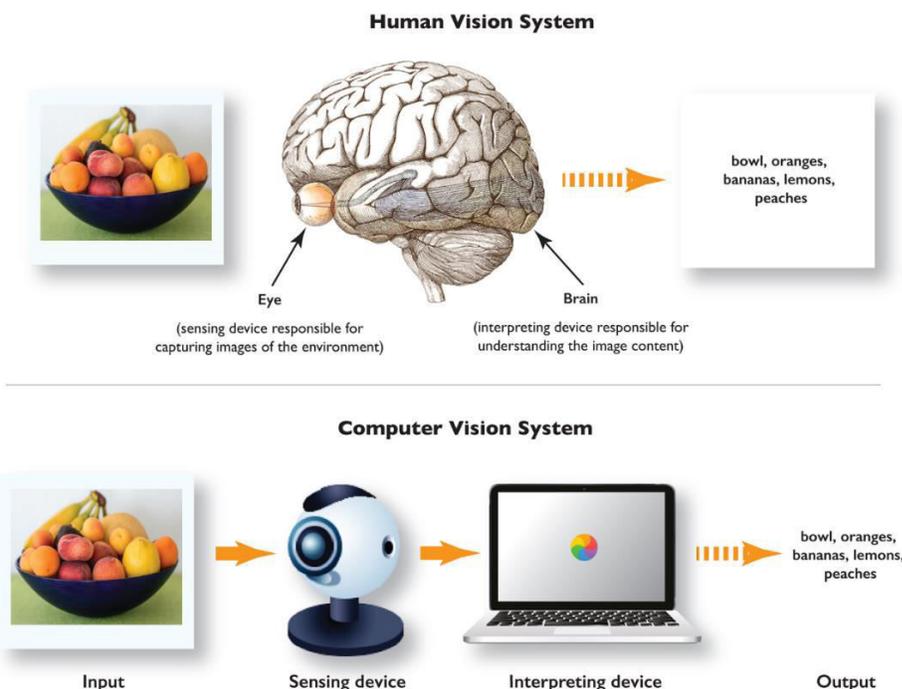
### Theory

Human Beings have 5 defined senses which are sight, sound, smell, taste, and touch. In the following section we will look at how we can use Machine Learning, Deep Learning and Neural networks to replicate these senses.

*Sight.*

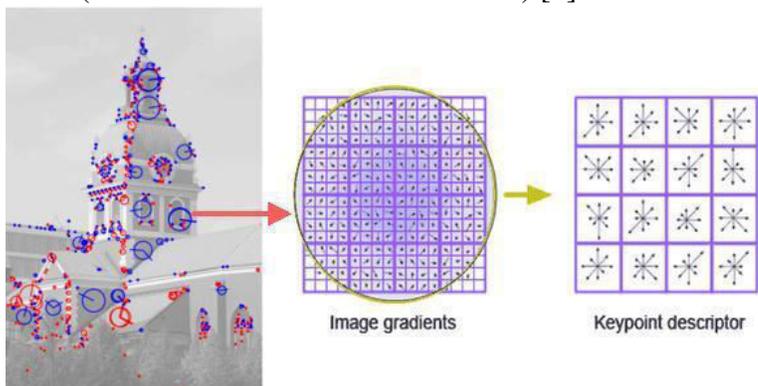
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What human beings call the sense of sight is referred to as Computer Vision [3] in the field of Artificial Intelligence.



Now let's look at algorithms used in Computer Vision.

1. SIFT ( scale-invariant feature transform ) [4]



Detects and describes local features in digital images by locating key points and refurbishing them into Quantitative information.

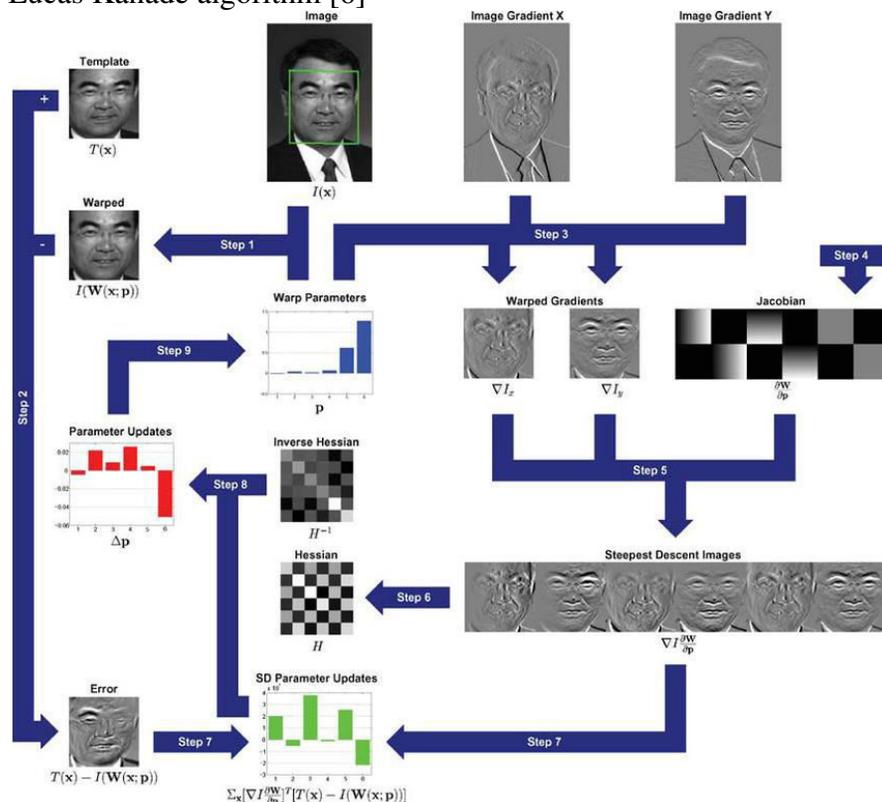
2. Viola – Jones Algorithm [5]

$$C_m = \begin{cases} 1, & \sum_{i=0}^{I_m-1} F_{m,i} > \theta_m \\ 0, & \text{otherwise} \end{cases}$$

$$F_{m,i} = \begin{cases} \alpha_{m,i}, & \text{if } f_{m,i} > t_{m,i} \\ \beta_{m,i}, & \text{otherwise} \end{cases}$$

It is used to detect a human face in an image with other items. The location of the human face should be irrespective of any quantifiable attributes of it.

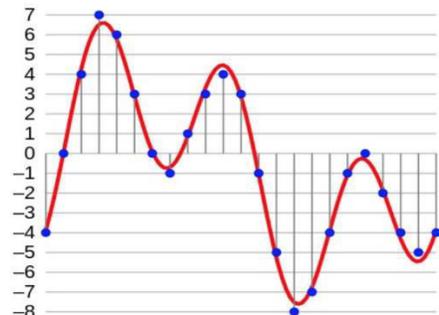
### 3. Lucas Kanade algorithm [6]



Gives an estimate for the movement of features in successive images of a reel loop.

## Sound

The sense of sound is replicated using audio analysis [7] by the help of Machine Learning and Deep Learning Methods.



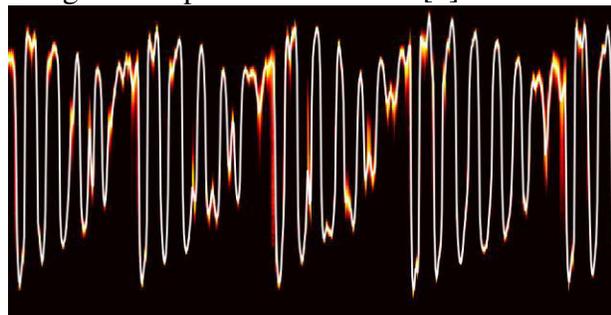
Sound wave



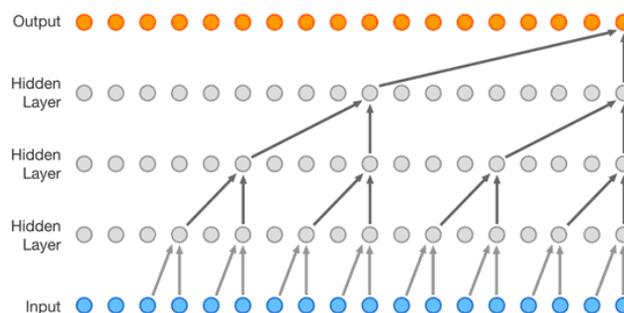
[-4, 0, 4, 7, 6, 3, 0, -1, 1, 3, 4, 3, -1, -5, -8, -7, -4, -1, 0, -2, -4, -5, -4]

Array

Google's Deepmind "Wavenet" [8]

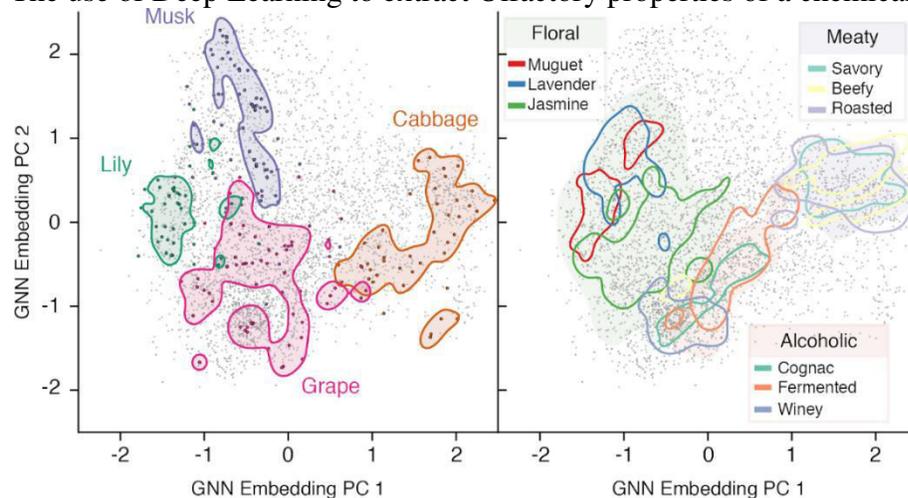


A deep neural network for the production of raw audio



## Smell

The use of Deep Learning to extract Olfactory properties of a chemical compound [9]



### *Taste*

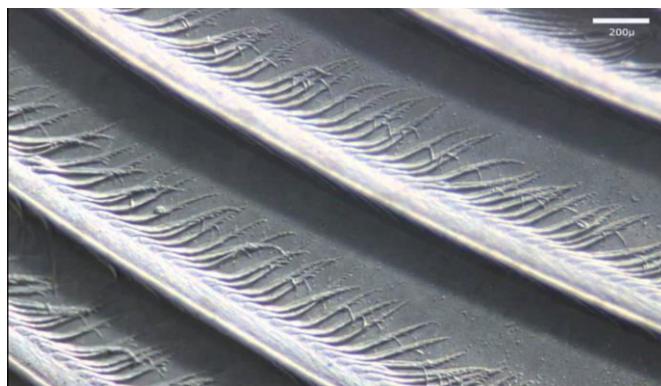
Like humans A.I does not have tastebuds hence as of now it is incapable of this sense, but it can still make recommendations whether a food item tastes good or bad and also what is the type of taste that food item possess ( Spicy, sweet, sour, bitter, etc. ) all of this is based on data that is produced by multiple human beings relating to their individual preferences. As of now, there are no tangible algorithms or systems that can make a A.I model primarily recognize taste as human do in real time without the help of a preference database produced by human beings.

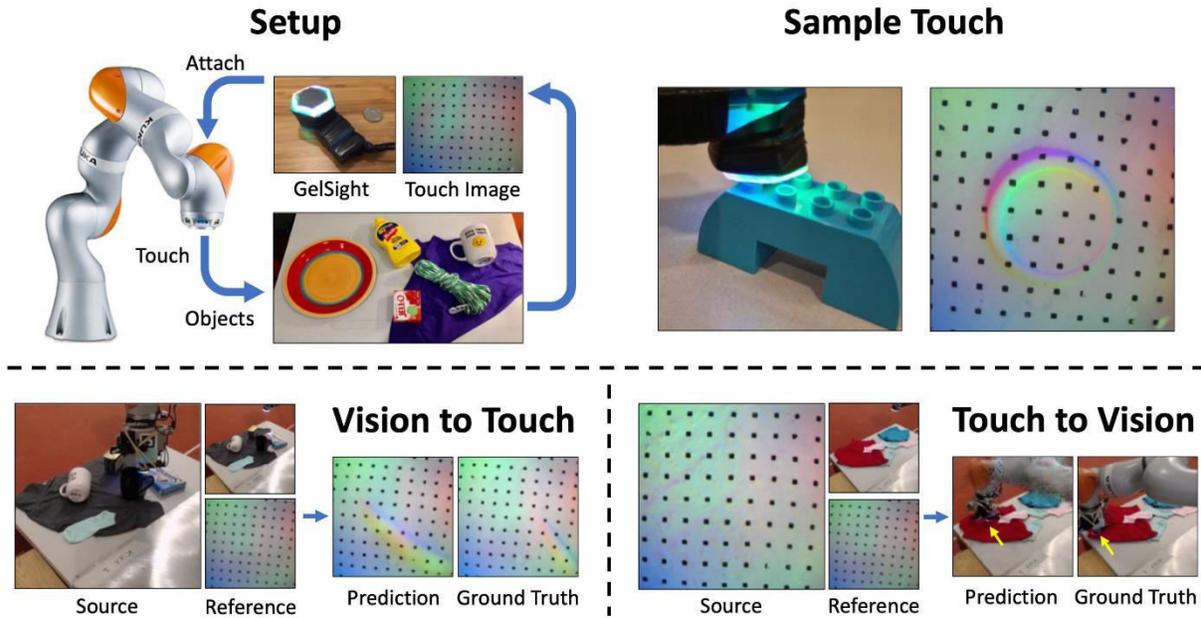
### *Touch*

The use of Deep Learning methods to simulate the sense of touch in machines. [10]  
Gel-sight [11] : A special tactile sensor designed at MIT



The use of Vis-gel [12] dataset to judge the amount of touch required to grasp an object.





### Final Method

We have looked at the 5 senses of the human beings and their extraction for A.I through Machine Learning , Deep Learning, and neural networks. Humans have these senses but on their own they are of no use, they need a central node from where these senses can be controlled this is where the human brain comes into picture, the brain acts as a central processing unit with an attached mother board where these senses are represented by different device drivers.

Let's now talk about how we can simulate this central point in a A.I model so that all the features { sight, sound, smell, taste, and touch } can be controlled consciously.

The closest thing that comes to simulate this human brain is a super computer [13]

A neuro-morphic super computer [14]





By using this computational device and earlier mentioned methods and algorithms we can now create one single model consisting of most human senses, this can now be further refined by collecting more data and parsing it according to the function needed. Humans have an advantage over this machine that they are constantly exposed to stimuli without the need of an input, but this can be overcome by an open source project being created where scientist from all over the world can input several types of data in this machine 24 hours thus solving the constant stimuli problem.

### CONCLUSION

This investigation managed to compile the most important algorithms to implement the 5 senses of humans in a tangible Artificial Intelligence model. A method for controlling these module features was also successful by the method of neuromorphic supercomputers. The essence of the paper is unique due to its nature of complexity relating to the amalgamation of several diverse systems and technologies. The limiting factor which was noticed throughout the compilation was processing power, computing power and financial cost to access the hardware needed to carry out this method in real life. It is extremely difficult for an individual to carry out this experiment due to its extensive cost nature hence it is advisable that this method is replicated by large organizations in the computing industry. The future of this research will be to develop more sustainable and scalable models of this method so that the A.I model can be created without the need of such large magnitude of resources. This can be achieved by the use of Quantum computing.

### REFERENCES

1. Kurzweil Tracking the acceleration of intelligence. Kurzweil Mind uploading featured in academic journal special issue for first time Comments. (2012, June 26). <https://www.kurzweilai.net/mind-uploading-featured-in-academic-journal-for-first-time>.
2. Sandberg, Anders; Boström, Nick (2008). Whole Brain Emulation: A Roadmap (<http://www.fhi.ox.ac.uk/Reports/2008-3.pdf>) (PDF). Technical Report #2008-3. Future of Humanity Institute, Oxford University. Retrieved 5 April 2009.
3. Joshi, N. (2019, June 26). The Present And Future Of Computer Vision. Forbes. Retrieved June 29, 2021, from <https://www.forbes.com/sites/cognitiveworld/2019/06/26/the-present-and-future-of-computer-vision>
4. Tyagi, D., 2019. Introduction to SIFT( Scale Invariant Feature Transform). [online] Medium. Available at: <<https://medium.com/data-breach/introduction-to-sift-scale-invariant-feature-transform-65d7f3a72d40>> [Accessed 29 June 2021].
5. Wang, Y., 2014. An Analysis of the Viola-Jones Face Detection Algorithm. [ebook] Cachan: Image Processing On Line.
6. Rojas, P., 2021. Lucas-Kanade in a Nutshell. [ebook] Berlin: Freie Universität at Berlin, Dept. of Computer Science. Available at:



<[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiX\\_dfEs73xAhX3ILcAHT5DMUQFjAQegQIIBAD&url=http%3A%2F%2Fwww.inf.fu-berlin.de%2Finst%2Fagi%2Frojas\\_home%2Fdocuments%2Ftutorials%2FLucas-Kanade2.pdf&usq=AOvVaw1b9RG932HtnYjKVE13s9Kf](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiX_dfEs73xAhX3ILcAHT5DMUQFjAQegQIIBAD&url=http%3A%2F%2Fwww.inf.fu-berlin.de%2Finst%2Fagi%2Frojas_home%2Fdocuments%2Ftutorials%2FLucas-Kanade2.pdf&usq=AOvVaw1b9RG932HtnYjKVE13s9Kf)> [Accessed 29 June 2021].

7. Mendels, G. (2019, November 18). How to apply machine learning and deep learning methods to audio analysis. Medium. <https://towardsdatascience.com/how-to-apply-machine-learning-and-deep-learning-methods-to-audio-analysis-615e286fcbbc>
8. Oord, A. van den. (2016, September 8). WaveNet: A Generative Model for Raw Audio. WaveNet: A generative model for raw audio. <https://deepmind.com/blog/article/wavenet-generative-model-raw-audio>.
9. Wiltchko, A. B. (2019, October 24). Learning to Smell: Using Deep Learning to Predict the Olfactory Properties of Molecules. Google AI Blog. <https://ai.googleblog.com/2019/10/learning-to-smell-using-deep-learning.html>
10. Fadelli, I. (2020, May 27). *Using deep learning to give robotic fingertips a sense of touch*. Tech Xplore. <https://techxplore.com/news/2020-05-deep-robotic-fingertips.html>
11. Hardesty, L. (2011, August 9). *Portable, super-high-resolution 3-D imaging*. MIT News | Massachusetts Institute of Technology. <https://news.mit.edu/2011/tactile-imaging-gelsight-0809>
12. Li, Y., Zhu, J.-Y., Tedrake, R., & Torralba, A. (n.d.). *VisGel*. VisGel. Retrieved June 30, 2021, from <http://visgel.csail.mit.edu/>
13. Stones, J. (2018, November 7). *A supercomputer that works like the human brain has just been turned on*. Alphr. <https://www.alphr.com/technology/1010154/a-supercomputer-like-human-brain-has-just-been-turned-on/>
14. Feldman, M. (2018, November 4). *Neuromorphic Supercomputer Hits a Million Cores | TOP500*. Top500. <https://www.top500.org/news/neuromorphic-supercomputer-hits-a-million-cores/>



### DEEP LEARNING AND NEURAL NETWORKS FOR ROADS

**Diya Rajesh Doshi**

B.K Gadia 'A' Level Junior College  
[diyadoshi661@gmail.com](mailto:diyadoshi661@gmail.com)

#### Abstract

With urbanisation happening at such a rapid pace and migration from rural areas into the city, traffic congestion in cities like Mumbai is proliferating. This paper aims to research on how to efficiently manage the traffic flow by detecting and showing the traffic to commuters who are planning to use the road and also operate signals according to the congestion so that people do not have to wait unnecessarily.

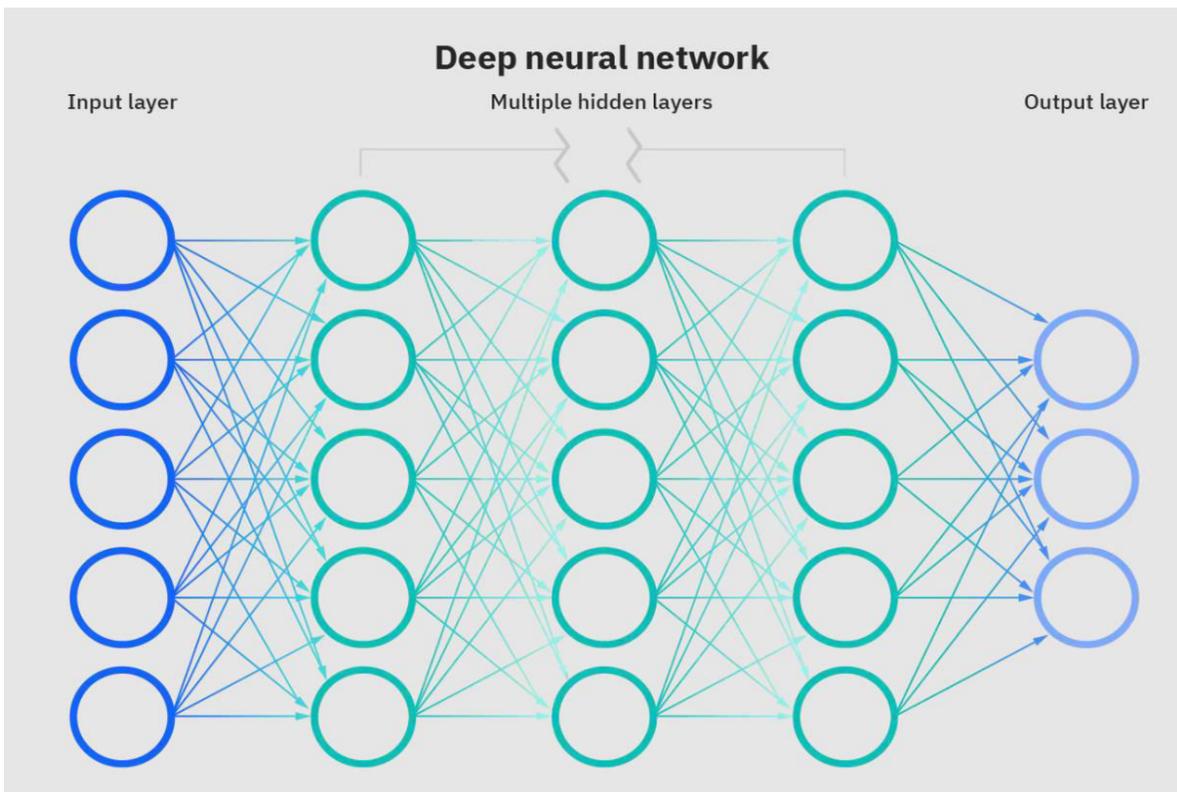
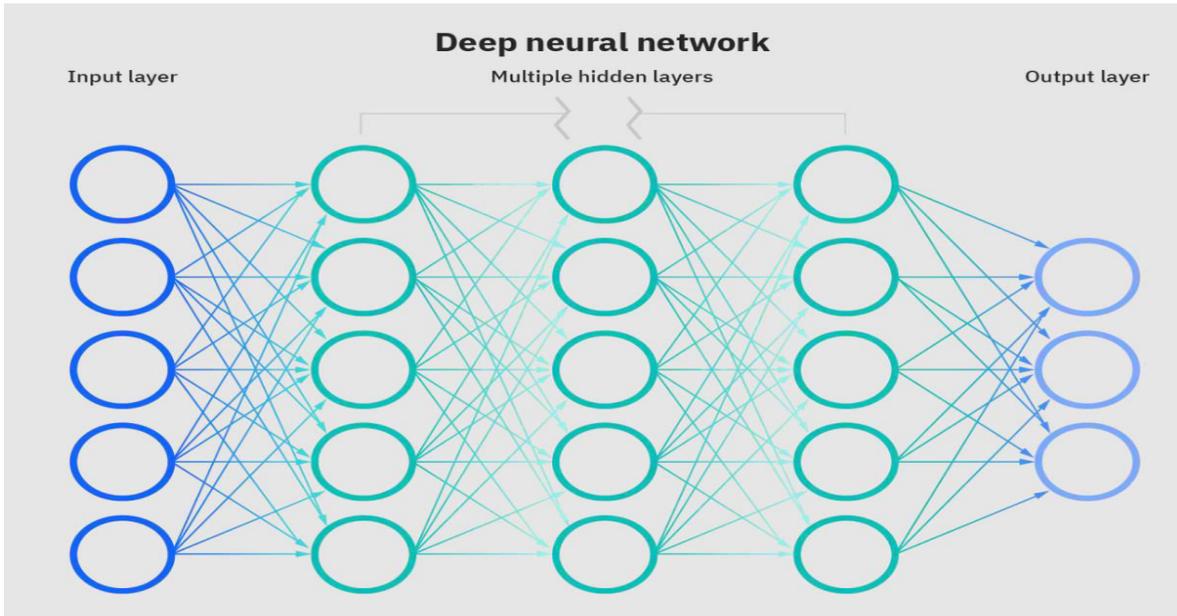
**Keywords:** *Deep Learning, Neural Networks, Global positioning system(GPS), traffic, neurons*

#### INTRODUCTION

Deep learning, a subset of artificial and machine learning, is becoming increasingly popular. Deep learning enables machines to mimic human behaviour. While imitating human behaviour, machines can process and store information like a human brain by using artificial Neural Networks. In the case of deep learning, distinguishable features are identified without human intervention by the neural networks itself. For example, Google Tulip fostered in the Netherlands acts as a link between Tulips and humans for communication. By this technology, humans know when tulips need sunlight, water or some other essential element. It is a technique by which engineers expect an output through algorithms trained with data. Using deep learning for roads can help Maps navigate areas with high traffic, notify police when an accident takes place and can also warn the civil department if there are any cracks on the roads.

#### THEORY

In machine learning each information has to be individually fed to the computer for it to process. However, in deep learning computers learn to think using structures called artificial Neural Networks. These networks are typically trained by backpropagation in a batch learning setting, which requires the entire training data to be made available prior to the learning task.[1]





In the picture above is an artificial neural network. Neural Networks consist of slabs of neurons which are the primary processing units of the network. First, we have the input layer which receives the input of data, it is distinctively coloured in dark blue in the picture given above. Next, the last layer in the diagram is the output layer. The hidden layers in between perform most of the computation required for our calculation. Each neuron in the input layer receives one pixel from the image. Each neuron is connected to the neurons in another layer by channels and a numerical value called bias is passed on to the next neurons. The value of those neurons is filtered by an activation function and those who pass successfully channel the values to the next layer. The output is determined when the second last layer sends the highest values to the output layer by forward propagation.[2]

If the output which is shown is false and wrongly predicted by the neural network, it is then compared to the real output entered by the programmer which exists because the neural network is still in the training stage. Then, by backpropagation, the rectified direction and magnitude of change is then transferred backward through the network. By doing this, the weights are adjusted and the process is continuously repeated until errors are almost impossible.[3]

### Experimental <https://core.ac.uk/download/pdf/286357582.pdf>

My experiment is based on how deep learning can help in analysing the traffic for GPS. A study [4] points out that people on average spend more than 75% extra travel time in traffic congestion. By deep learning, machines can be trained to detect the number of cars on road. This can then be used by GPS to show commuters a delay in their route. Also, detecting the number of cars on road, can send signals to traffic signals to change colours, which is especially useful in a four-way road. Rather than opening each way consecutively for 1-2 mins and keeping other lanes on hold, using deep learning to operate signals can reduce wait times of vehicles and can clear long miles of traffic congestion in one go. This can work on the concept where lane with the most traffic is opened first and for the longest time, and the one with only a few can only be opened for 10-15 seconds.

### Results

The experimental results include vehicle identifying, traffic measurement metric, and traffic congestion analysis. [4]

### Conclusion

This deep learning technique when implemented in real life can also help detect ambulance and turn the signal green for that lane so that the ambulance can move with ease and reach its destination fast.

### References

- [1]<https://arxiv.org/abs/1711.03705>
- [2]<https://www.pluralsight.com/guides/building-deep-learning-networks-with-pytorch>
- [3]<https://www.ibm.com/cloud/learn/neural-networks>
- [4]<https://core.ac.uk/download/pdf/286357582.pdf>



### BUSINESS INTELLIGENCE (BI): RAW DATA INTO ACTIONABLE INSIGHTS

**Koushal Sanjay Modi**

Prabhavati Padamshi Soni International Junior College  
koushalmodi1@gmail.com

#### Abstract

An electronic system that comprises of computers, machines, tools and processes is being widely used across businesses globally to speed up and improve the accuracy of business decision making and at the same time benefitting from the flexibility that it provides. In order to provide crucial information to the companies and organizations, this intelligence system uses modern softwares and manpower together to automatically extract, convert and transform raw data into actionable insights. This paper provides a thorough insight on business intelligence (BI), its importance and how the data is generated, transferred and which employee uses for what purpose and in which department.

**Keywords:** *Business Intelligence (BI), Traditional and Modern BI, Key Performance Indicators, Functional Departments: Human Resources, Marketing, Operations and Finance*

#### INTRODUCTION

Business Intelligence is the practice of turning raw unstructured data from all functional departments, that is, human resource, marketing, finance and operations into actionable and valuable insights by using modern tools and processes. It suggests what is happening now and what has happened in the past in detail.

Business Intelligence is used to understand the capabilities available in the firm; the state of the art, trends, and future directions in the markets, the technologies, and the regulatory environment in which the firm competes; and the actions of competitors and the implications of these actions.

The data engineer, data analyst and visualization expert can then be used to provide a coherent and well-structured data to the business manager. The study of historical data can offer key insights into future trends, and help a company anticipate and calculate risk. The aim of this paper is to indicate how firms operate with the use of BI and the real world examples of businesses who have equipped the use of BI. The purpose of this paper is to indicate how, with the help of BI and the data available them to previously, a company can anticipate risk and make better decisions.

Objectives of this paper include how Business Intelligence assists managers of every functional department to make better informed decisions.



### Theory

Traditional BI platforms have provided companies with insights, but only through hands-on work by the data team. This took time, saddled data professionals with tedious tasks, and limited employees' autonomy. Modern business intelligence services empower everyone to be their own data scientist. [1]

### Traditional BI team roles and responsibilities

#### Data Engineers

Data preparers are the first role to begin with BI. They are involved in sourcing data and are involved in decisions about data storage. Moreover, they have the responsibility to create data warehouses which inculcates storing all business data which is then optimized for analysis by the next job person in the BI process. Furthermore, they must have a profound knowledge on data systems, that is, they must be able to classify between structured and unstructured data.

#### Data Analyst

Bearing in mind the need for constructing metrics is essential to the BI system, the data analyst performs the role of extracting, transforming and loading. This means that the data analyst has to select, amend and combine data from tables, variables, columns from the business's databases and then transform the sourced data into presentable and appropriate structures. Lastly, for this primary function to be completed, the data analyst loads the data into models. Other quintessential task data analysts perform is to calculate metrics. This when they write formulae to calculate business performance such as cost of customer acquisition, net promoter score, qualified leads per month, customer loyalty and retention and even qualitative data such as employee happiness. Tools for analysis include Power Pivot, Tableau and many more.

#### Data Visualization

This particular job plays a great role for the results to be understood by the readers. Therefore, they convert data into visuals to highlight key data and communicate results. Besides combing multiple visuals, data visualization experts keep a track on Key Performance Indicators (KPIs') such as revenue and profit margin.

Their role is to assist in identifying areas where the business is doing well and where some more attention might be needed. These can be presented via the use of box and whiskers plot, heat maps, tree diagrams, tornados and many more. The data can be made more understandable for audience with less business knowledge.

#### Business Managers

This the action taking body of the business where decisions are taken after utmost caution and confidence. Business managers have the role to ask questions to the specialists presenting the results, which when being transparent upon increases motivation of the employees within the BI system and ensures their loyalty and a guaranteed commitment to the business.

As the data of previous years is available, the managers can compare the trend growth and gauge what measures and steps can be taken, to convert the data into Actionable Insights.



### Modern BI

The efficient use of advanced and up-to-date tools and processes worldwide to enhance decision making by Managers at companies and organizations is commendable. Thus, businesses can gain a competitive advantage as BI offers flexibility to generate reports and the results can be used to assist decision making.

Modern BI is used by businesses that have four key departments namely: Human Resource, Marketing, Operations and Finance. BI is evidently seen used by huge multinational businesses and large organizations since they have the ability to purchase the expensive tools which gives them an edge over small businesses which have few employees.

### Human Resource

Having studied the ways to achieve business objectives, Business Intelligence is used by HRM to analyze and forecast the number of workers and the skills of those workers that will be required. It is made possible by using reports to analyze newly recruited and turnover rates.

Moreover, in order to evaluate employees' skills and qualifications for recruitment and selection process, metrics such as experience, qualities and interviews are evidently subjective. To provide the HRM with the important data on the appropriate potential candidate, BI is very effective. Even further, the effectiveness of training can also be assessed which is necessary to ensure that needs of the business are aligned with those of employees.

Additionally, the HRM can benefit by using business intelligence as using a BI tool to retain employees can save money on redundancy packages and benefits this is because BI will itself compare the behaviors of current employees with those in the past and indicate a precise estimate of the outcome that will arise during the current financial year. HRM will, as a result can justify their costs to the finance department from the quantifiable and reliable data obtained.

Applicant tracking system and performance management system are not combined, however, if the HRM wants to find out which recruit performed the best, BI enables the HRM to aggregate data. Most reporting consists of ad hoc reporting- different extracts are manually combined. Here, BI tools can facilitate data aggregation and enable automated reporting to assist the HR team.

Analyzing results against KPIs will accurately assess which employees meet the expected standard and identify who needs additional sales training. Keeping in mind that BI tools are much better at analyzing data than the average HR system. Power BI and SAS, such enable the HRM to statistically analyze large quantities of data. BI tools best known for the use by the HR department are Qlik, Visier, Tableau and Power BI.

[2]

Business intelligence can help to drive a culture of employee care by using data to identify needs and find solutions. This may be anything from analyzing the results of employee satisfaction surveys and comparing them with productivity levels to uncover areas of concern, or even analyzing exit interviews to pinpoint exactly where it all





went wrong in the process. In addition, BI can also be used to drive corporate social responsibility, a role that often falls on HR. This can be done by correlating employees' social interests, for example, dogs, with a local social project, or even looking at the wider impact of the company on the community, for instance by implementing youth mentorship projects with job shadowing. [3]

### Marketing

Business Intelligence provides a holistic view of a wide range of marketing activities: customer acquisition, forecasting trends on advertising and promotional budget, the frequency that a loyal customer shops, number of new customers, average number of items purchased per customer visit, market share, total sales, customer satisfaction and brand identity.

Clearly, BI lays out the most preferred product of a business which the marketing department can address the operations department to produce that particular good or service, enhancing the efficiency of the entire business. Having considered further, BI can be used to improve the action plan of a marketing department to achieve its marketing objective. Market segmentation is the process of identifying different segments within a market and targeting different products or services to them.

Apart from using BI to increase revenue via analyzing Customer Relationship Management tools, BI can be used to collect response rates of customers online can be analyzed with the help of click-through rates, downloaded content, ad impressions, conversion rate for each launched campaign and number of followers on social media websites such as Facebook, Instagram and Whatsapp. Many customers are targeted and they interact with companies on these websites and in order to collect such vast data and for marketing managers to make decisions based on it, BI is quintessential.

Demography is the study of population data and trends, and demographic factors- such as age, gender, income, interaction pattern, family size and ethnic background- a way to segment markets. BI is used by most marketing teams to gather this demographic data by getting into the shoes of the existing and potential customers to know their desire and segregate it into high definition streams which can then be used for constructing marketing strategies such as to improve marketing campaigns to cater to these elements of target customers. [4]

Marketing teams can benefit by the use of BI tools as external information can be obtained by using competitive intelligence and the business can compare their position with the rest of the market. Additionally, they will be better equipped for delivering extraordinary customer satisfaction because of pool of information that is now readily available in a comprehensive and easy to understand format.

BI can be time saving since internal reporting and presentation of data into diagrams and charts. Primary research conducted has lead to the understanding that at PPSIJC, "Skolao" is a class management system which smoothens administrative activities allowing time savings. All the tools are easy to use and real time students' and staff attendance, leaves, fees collection can all be visualized graphically to make quick decisions. As a result, this ERP System is also used for employee management. An interesting point to note further is Skolaro facilitates in inventory management where all records of fixed and movable assets can be maintained and each item in inventory will have a vendor with vendor who has an evaluation report, attached.



As a result, BI can be used instead of manual work by employees, this benefit clearly allows employees to focus on other key areas, indicating that the business will benefit from increased productivity by the use of BI. BI generates its key KPIs according to the stance of the business and supplies the marketing team with relevant and realistic questions to ask.

Business intelligence together with business analytics can improve the results of predicting future sales by taking into account seasonal changes, start and end of promotional campaigns, price and income elasticity of demand. Furthermore, the finance department will use the sales forecasts of the marketing department to help construct cash-flow forecasts and operational budgets. In addition, they will have to ensure that the necessary capital is available to pay for the agreed marketing budget.

At the same time, the sales forecasts obtained by marketing team via BI will be used by human resources to help devise a workforce plan for all workers. It will be their key role to undertake recruitment and selection of appropriately qualified and experienced staff to make sure there are sufficient workers to produce and sell the sales planned for by the marketing department. The sales forecasts will be used by the operations department to plan for the capacity required, purchase of capital equipments like machines, robots and the stock of raw materials required for the forecasted output level. Business Intelligence for marketing help businesses adapt to customer needs and companies are investing heavily in the training of end-users on business intelligence tools, to encourage smooth and effective running of the BI process.

### **Operations**

Business Intelligence helps stock holders to identify the flow of inventory from their storage facility and it is crucial for the wholesalers and retailers to use BI to manage inventory in order to prevent lost sales and not hold idle production resources and at the same time procure enough inventory to not run out of it.

Recognizing the need to manage inventory better to save on costs like storage- insurance and refrigeration for example, risk of obsolescence or opportunity cost, BI backs up the operations team if they use the Just In Time process which requires holding inventories in warehouses by requiring supplies to arrive just as they are needed in production.

Bearing in mind the advantages that JIT brings to the business such as improved employee-employer relationship because of multiskilled and adaptable staff, substantial flexibility to match the desires and attitudes of customers in addition to those mentioned above, BI helps the operations team considerably.

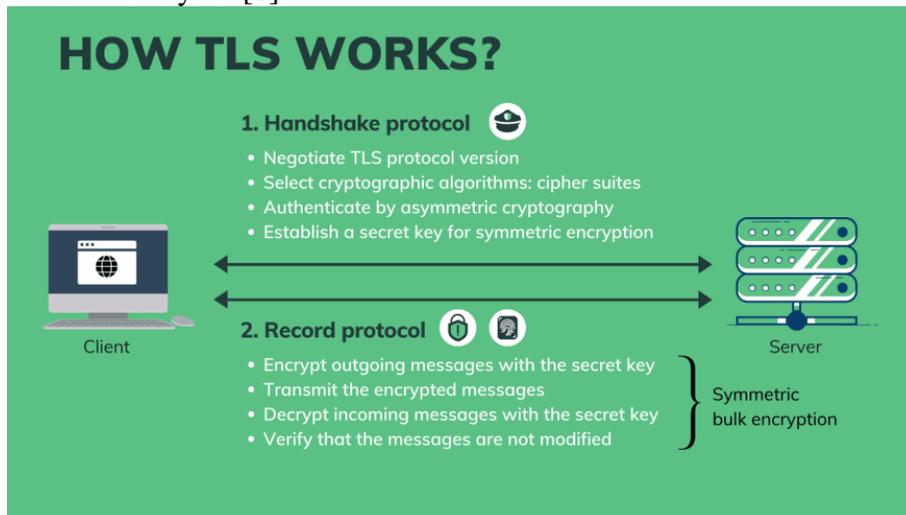
Computer controlled machinery and robots under the vigilance of BI will give a rich view of real-time data of output levels and once they team knows which models and the quantity of them are present, then shipping efficiency and fulfillment of orders will greatly improve. For example, the most picked items ought to be placed near the exit section (door area) to not waste and increase time for delivery; this will increase customer satisfaction and gain a competitive advantage. Inventory control is vital step for supply chain management which ensures that both important aspects occur at the same time: lower costs and efficiency.

Location intelligence is a valuable component of business intelligence, it assists the Chief Operating Officer (COO) in deciding where to open the next production facility based on factors such as capital cost, transport cost, labour cost and sales revenue potentials. The COO also

benefits by using BI's location intelligence because the tools will automatically take into account environmental concerns, infrastructure- port facilities and internet viability, public safety and future expansion chances into consideration. Expecting, operational efficiency will now upgrade. [5]

For instance, Toyota, uses JIT together with BI to maintain low amounts of raw materials at every stage of production and the marketing team co-ordinates with the operations team for forecasting of quantity of inventory of raw materials, work in progress and finished goods to be stored. In 2000 Toyota switched to business intelligence platform. The system included Hyperion's dashboard feature which allowed executives to visually see hot spots in their business units and investigate further to identify problems and their causes.

With the new TLS (cryptographic protocol that provides end-to-end security of data sent between applications over the Internet) system which uses colors meaningfully (red for danger) a business manager can see in real-time such as when delivery times are slowing and can immediately find the sources of the problems and even evaluate potential solutions by using 'what-if' analysis. [6]



[7]

Therefore, if a business wishes to stock warehouses and shops sufficiently with the correct type and quantity of inventory, BI will enable it to use real-time predictive needs of spare parts, preventing unnecessary wastage of resources.

Again, BI assists COOs for reacting quickly, making better decisions and optimizing warehouses, emphasizing that BI adds value to the Business since it helps in order fulfillments, low inventory costs, and higher profits.

### Finance

Business intelligence softwares are crucial to the finance department since they it acts as a platform to gauge the real-time financial performance and gives clear insights on investment opportunities and risks that underlie.

Noting with satisfaction, BI allows the finance manager to visualize the company's financial details by using dashboards and look out for risk associated places and to act accordingly by changing the course of action to prevent the risk from spreading any further, indicating that better informed decisions can now be made. BI also assists in deciding what



amount of money could be invested to earn a higher return on investment both within the business as well as outside the business.

Relevant and reliable information when collected together into a single warehouse is quintessential for the smooth functioning of the business. However, as some websites display incorrect information or have broken links. Using the faulty data in business decision making could lead to business's position in danger and eventually hamper the business's reputation in the eyes of the stakeholders. Viewing with appreciation, using Business Intelligence will aid the finance department manager as the data standards will not include overlapping or conflicting information which ensures that analysts are working with their exact requirements.

Therefore, BI based programmed softwares assist the finance department in reforming the cost and spending management which can finally be checked by auditing firms to make sure there is neither any fraudulent activity nor the performance of the business is flattered. Additionally, any inaccurate information during a company's external reporting could shatter the image of the company as a result BI will support the finance department to build a safe and secure environment (encrypted) since the user management access will be limited and pre-set by the manager.

Quantifiable measurements used to focus attention on the metrics most important to meet business goals. Key Financial Performance Indicators (KPIs) are also useful in helping a team understand how progress will be tracked and measured. Many ways to construct KPIs but they should all be measurable, practical, achievable, and provide direction.

The growing need to monitor working capital cycles, operating and net profit margins has lead to BI inventors to create tools that allow the finance manager to estimate the time at which cash will actually start coming into the business and at when will profits will start(notified by using BI tools) by using industry standard KPIs'. Time knowledge obtained will enable the finance department manager to communicate and co-ordinate with all other managers of functional departments and they can therefore plan their resources accordingly, thereby, benefitting the organization as a whole.

BI solutions collect financial and operational data, like NetSuiteAnalytics and produce dashboards timely to enable integrated analysis across multiple information sources and software suites which assists the CFOs to identify and forecast trends and decide on the allocation of resources.

A relevant example includes American Express. Business intelligence is instrumental in the finance industry. American Express has been using the technology to develop new payment service products and market offers to customers. The company's experiments in the Australian market have rendered it capable of identifying up to 24% of all Australian users who will close their accounts within four months. Using that information, American Express takes steps to retain customers. BI also helps the company accurately detect fraud and protect customers whose card data may be compromised. [8]

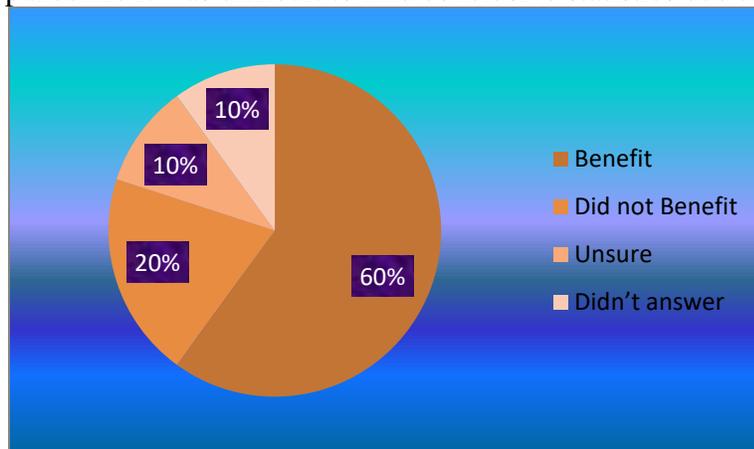
### Experimental

Having examined further, primary research was conducted as questionnaires were prepared and emails were sent to 10 businesses dealing in services, banking, finance, retailing, building industry ,oil and gas. Questions inculcated: rating BI from 1 to 10, explaining few benefits and limitations and what could be the future of BI in application to his business.

### RESULT

Primary research was conducted which lead to a leading property developer in Mumbai to highlight key areas. Benefits for included: BI assisting managers of operations to decide which location to choose by running its tools for comparing all the possible factors. Moreover, the company saved on time for reporting payments and receipts: GST, taxes, maintenance cost as well as sending across automated content and email to market the existing and potential customers. Limitations highlighted by the developer included high fixed cost and the need to frequently train employees on the usage and specifications of BI.

Results were up-to-date, realistic and relevant to the study conducted and therefore more useful than most secondary data. Effort was made to convince the respondents that the data provided would remain confidential. This led to the endeavor being time-consuming in comparison to the secondary data obtained from the Internet. Owing to the circumstances surrounding the pandemic it was difficult to find conclusive statistics due to downsizing of firms.



### CONCLUSION

Managers of any business have to have an understanding to analyze the data accurately to make strategized informed decision. Emphasizing the need to be able to match the business' position according to the dynamic environment based on the factors: competitive environment, technological changes, legal changes and environmental changes, managers make sure to use BI to convert raw and unstructured data into actionable insights.

BI facilitates to provide a holistic view of a company by displaying valuable information for each functional department within the organization, indicating, the top ranked managers take decisions which are backed up by facts and not assumptions. When certain criterias are predefined, business intelligence can be used to locate areas with problems where measures and actions can be necessary to avert them.

Business analytics goes hand in hand with the BI process. Since BI fulfils the requirement to gather the past data with trends, business analytics can then be used to predict future demand patterns, quantity of inventory, and source of finance to be chosen and how to produce a suitable marketing mix, that is: product, price, place and promotion. Additionally, identifying new markets for selling existing and new products is made possible by BI.



In order for managers to take tactical decisions, BI's tools and processes offer data 24\*7, unlike the traditional system where the employee can be asked about the data during office workers. This magnificent difference allows managers great flexibilities for reporting and looking over essential documents. Contemplating, managers within the business are required to give a higher return on investment, as a result, BI makes the process easy as decision making can be faster and time can be saved on wide range of calculations.

Along with the pros, the cons too have found their way into the new system of judgment and evaluation which are significant and are worth studying. One of the most pressing concerns with any data analysis system is the risk of leaks. If you use BI applications to handle sensitive information, an error in the process could expose it, harming your business, customers or employees.

The Times reported that in 2014 contractors and employees of Cambridge Analytica, eager to sell psychological profiles of American voters to political campaigns, acquired the private Facebook data of tens of millions of users — the largest known leak in Facebook history. [9]

Many employees and departments may be reluctant to adopt to use BI, this could be the result of lack of IT knowledge. Trade unions may take the side of their members instead of taking this new initiative in a positive way. If some departments do not agree then the organization as a whole will not be as effective as it would otherwise be. [10]

Additionally, BI provides substantial power to centralized managers; however the power that information brings to central managers could be abused and could lead to a reduction in the authority and empowerment extended to work teams and middle managers. BI if used for central control in an oppressive way could reduce job enrichment and hence motivation levels. Managers should not allow it to change their style of leadership to a centralized or authoritarian based on using data to control all aspects of the organization. Sculley, according to wired.com, was a genius in lifestyle advertising when he was with Pepsi-Cola. Both he and Jobs ran Apple as co-CEOs. However, the pair had differences that they couldn't resolve. So, they brought their disagreements to the board, where they eventually sided with Sculley. Jobs reaction? Well, he quit. So, that explains September 16, 1985, when Steve Jobs quit Apple. [11]

More than 30% of surveyed businesses cited security issues as the biggest challenge facing BI. Even further, the business also has the legal right to follow the regularly updated rules laid down by the law.

Capital costs for using BI is considerable. Apart from paying redundancy cost to replace workers with machine, the business now planning to use BI will have to invest on training workers. Also, job security could be hampered if many are made redundant. Therefore, employees will have to undertake courses on BI and the justification of implementing BI in the business should be done with democratic style of leadership. In this digital age, you have more information at your disposal than ever, but this can prove to be problematic. A surplus of data can mean that a lot of what your BI tools analyze is irrelevant or unhelpful, muddying results and slowing down processes.



Business Intelligence requires a very different organizational structure to that of traditional BI methods. This change in decision making towards not accepting the time consuming and less secured version of raw data can be of great benefit to business. Efficient use of BI can help increase productivity and this can create added value for a business. Even further, the multiskilled and adaptable staff required to use BI may gain from improved motivation and the business is likely to meet its goals since there is greater flexibility that the BI system offers, leading to quicker response times to meet changes in consumer demand or tastes.

Therefore, managers can frequently obtain data from all departments and regional divisions quickly- aiding overall control. Recalling, BI accelerates the process of communicating decisions to those in the organization that need to be aware.

The best managers will use Business Intelligence to improve and speed up their decision-making. Good leadership, strong motivation in workers, effective BI system and clear communication are hallmarks of successful businesses.

### REFERENCES

1. <https://www.thoughtspot.com/product/major-differences/between-traditional-modern-bi-services#:~:text=Traditional%20BI%20platforms%20have%20provided,be%20their%20own%20data%20scientist.>
2. <https://public.tableau.com/en-gb/search/all/%23nike>
3. <https://gethppy.com/employee-engagement/how-hr-can-benefit-from-business-intelligence>
4. <https://www.constructdigital.com/insight/the-importance-of-business-intelligence-in-marketing-today>
5. <https://360.here.com/2015/07/07/location-intelligence-is-business-intelligence/>
6. <http://bistudycase.blogspot.com/2012/02/toyota-from-excel-to-business.html>
7. <https://www.google.com/url?sa=i&url=https%3A%2F%2Fdev.to%2Ftechschoolguru%2Fcomplete-overview-of-ssl-tls-and-its-cryptographic-system-36pd&psig=AOvVaw31oNgi8ZvAjisUyhTe7ze5&ust=1625160514815000&source=images&cd=vfe&ved=0CAoQjRxqFwoTCLjG4u7wv ECFQAAAAAdAAAAABAD>
8. <https://www.netsuite.com/portal/resource/articles/business-strategy/business-intelligence-examples.shtml>
9. <https://www.nytimes.com/2018/04/04/us/politics/cambridge-analytica-scandal-fallout.html>
10. <https://customerthink.com/8-ways-how-business-intelligence-can-benefit-the-finance-department/>
11. <https://codeinstitute.net/blog/september-16-steve-jobs-quits-becomes-ceo/>



## HOW ORGANIZATIONS USE DATA ANALYTICS TO GROW BUSINESS AND MANAGE RISK

**Ujjwal Sharma**

Billabong High International School,  
Malad (IN677)  
ujjwaldsharma12@outlook.com

### Abstract

This research paper was written with the aim of exploring how various successful companies use data analytics to grow in their field and what makes them successful. This is based on examples of four main organizations whose work depends on data:

1. Tesla
2. American Express
3. Uber
4. Netflix

The paper further discusses what we can learn from these case studies, and describes the various processes used for data analysis in these corporates.

**Keywords:** RNNs (recurrent neural networks), Big Data, 4V Big data challenges, Data warehouse, Data visualization.

*How you gather, manage and use information will determine whether you win or lose - Bill Gates, Microsoft.*

### INTRODUCTION

Data Analytics and *Big Data* are tools that make it easier to make decisions for organizations by giving an overview of trends and patterns that are gathered from structured and unstructured data collected through various means, often through data mining (sifting through large *data warehouses* to find new information) and visualization through computers, machine learning, and so on. Business Intelligence is closely related to this- it is the process through which organizations around the world use data and their strategies to create a view for the future. This report will concentrate on how organizations use data analysis to expand their horizons, and how it affects our world today. Let us first dissect what *big data* means. Big data is recognized from what many analysts now call the *4V Big Data Challenges* (Yonsei University). These are:

1. Volume- The size of the data- the more the size, the more likely the data is to be classified as *big data*. Data gathered from collective consumers (not individual) in large amounts often classifies as *big data*.
2. Variety- The data format



3. Velocity- How fast the data streaming is.
4. Veracity- How truthful is the data collected? If it is an isolated case or the data is tainted, it will not qualify as *big data*.

Many organizations use these 4 factors to find out *big data* to help find business opportunities and grow, in various ways that will be further explored in this report. This report aims at understanding the ways in which organizations throughout the world use data analysis and *big data* to improve their businesses, and to an extent reduce risks involved in making major business decisions.

This will be explored with the help of examples of organizations using data analysis currently, and how other businesses, organizations, and even governments can employ similar methods to their advantage.

### Theory

As already mentioned before in the introduction, this report will concentrate on examples of companies and organizations, which have already taken up data analysis to grow- and see what we can learn from each of these implementations.

### TESLA

Tesla is one of the fastest growing companies in the world. Unlike most luxury car companies, it has flourished in the past few years in the pandemic. What people may not be aware of is that Tesla, has what can only be called the biggest database gathered by any company in the car sector. Tesla crowdsources its data from all of their products sold on the general market and use this data to enhance their performance and features. Other than just being used to advance their technology, it is also estimated to be at around \$750 billion, according to McKinsey and Co. With newer internet enabled features, this has become even easier.

This data has been widely used by Tesla to create products with advanced machine learning algorithms and creating data dense maps for things like traffic congestion. With the introduction of autonomous cars, Tesla has capitalized on using this data to beat the market at their own game. In fact, Tesla's relationship with Nvidia is based on the same fact- the use of data to allow autonomous movement of cars and using this new technology to convert this into a majorly Tesla-held market. Tesla has its cars working like an intranet, which has allowed more people to prefer these cars. The most interesting thing is Mr. Musk's business model. The major source of Tesla's business model comes from the additional 'technological package' sold with sedans from 2014 for an additional \$4250 (Albert Ahdoot, 2016)

This has allowed them to collect enough data over a year that they have been able to issue over the air updates (OTAs), which allowed the cars to be able to drive themselves. Rather than less people buying these packages to protect their data, more people valued the company higher. From data-driven cars, Tesla has also expanded to using customer data to improve the satisfaction level of the company. With real-time information, they use customer feedback to make improvements to their next models, which is very unlike most luxury car makers. Most luxury car makers almost never update their car models, while Tesla uses this data to improve their sales.

Most companies do not invest enough in data to be able to achieve what Tesla has done. Companies do not want to invest for the future, rather, they have grown accustomed to making



quick sales, or just cannot use their data through their current methods. One of the main successes of Tesla, the making of autonomous cars mainstream before most companies present in the business with the aim already can only be accredited to their management of data, and the direct method they have gathered this data. The same can be said for their now-infamous upgrades to their cars and servicing.

Tesla uses data for mainly the following reasons:

1. Improve the 'Autopilot' feature of their cars: This is what allows their cars to drive without needing human support. This is crowdsourced through the product consumers.
2. Product Improvement: They have used data from consumer forums to make improvements to their latest car model upgrades. This is seen in the improvements made to the new Tesla Model S, which has improved the EPA Fuel Economy that consumers requested. This direct data collection method has allowed them to rather than guess what consumers want, allow for a structured data collection method. Most companies do not have a method of using this data.
3. Product manufacturing: Tesla has used data from MES systems (Manufacturing Execution Systems) to lower their manufacturing costs and manage rapid demand. This was a response to failing to meet excess demand.

Even with the immense amount of competition in the field, data has helped push Tesla to the top of the market, and data is such an integral part of Tesla that articles now are less about the cars that Tesla manufactured and more about the technology and data they use.

### **AMERICAN EXPRESS (AMEX)**

*100% of our models are AI-powered and it cuts through the customer life cycle ... starting from new account origination, limit assignment, customer management, and fraud detection*  
-Anjali Dewan, VP of risk management at AMEX.

Anyone who has researched about machine learning in financial industries, even vaguely, knows all about AMEX and their long-time relationship with machine learning and data analytics. They use a machine learning model that is fed data from various sources such as membership details, spending details, merchant data, and even more to make millisecond decisions based on a *big data warehouse* collected throughout the years, as well as real-time. In 2010, to increase the strength of their data analytics tools, they bought a lab in Palo Alto, California, just for *Big Data* research, and moved to a Hadoop infrastructure (Apache's open-source data analytics software).

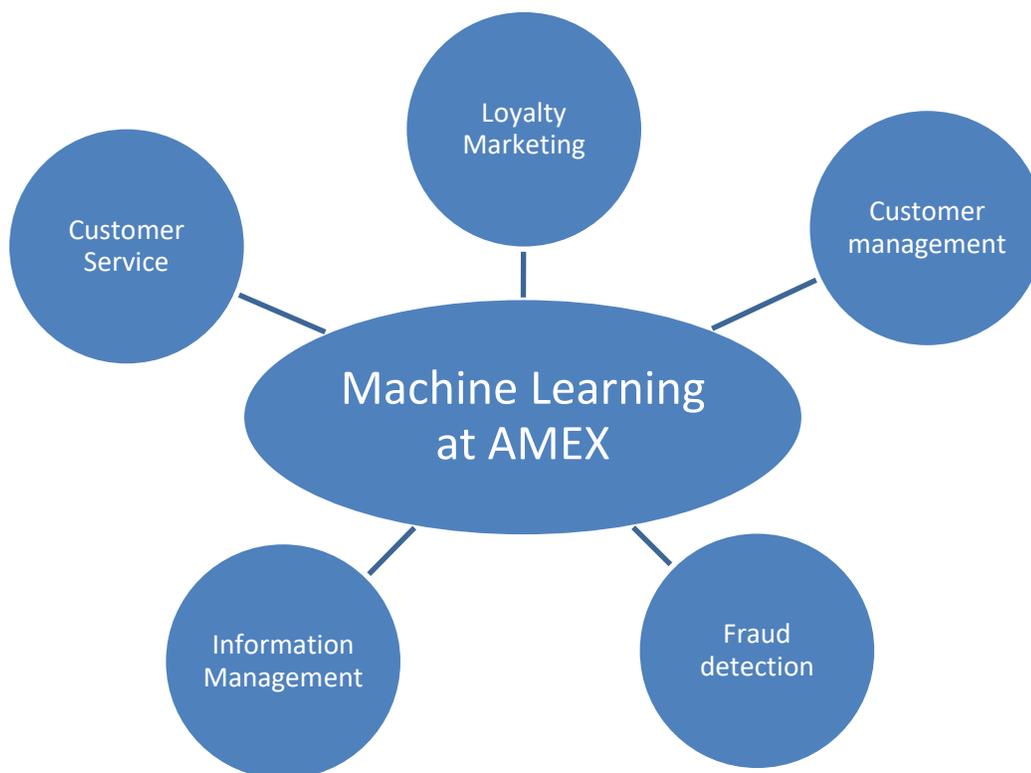


Fig 1.1: From an article by Charu Manglani, 2017

In other words, they use data analysis to cover them on all bases, and mainly for risk management and customers. AMEX uses historic predictive data from customer records, and *data visualization* software, using them to identify leaving customers, in turn taking marketing measures to retain them.

Moreover, they also use data analytics to prevent fraud. The company uses data analytics, especially through merchant data of suspicious behaviour. The various inputs into the pattern-evolving algorithms (AI) identify if any transactions have a large chance of being fraudulent. AMEX was not only amongst the earliest adopters of AI, but it is well ahead in the curve to extracting value from the model (John Koetsier, 2020). According to Anjali Dewan, VP of AMEX's risk management, the Nilson Report has come up with AMEX having the lowest fraud over thirteen years, approximately right after the data analytics and machine learning system was completely put in charge of analysing and managing 100% of all data. While by how much can be argued upon, it is clear the system is profitable, to say the least. Estimates by the company say the approach has identified \$2 billion in potential annual incremental fraud incidents, which the company was able to sort out before any money was lost (Charu Manglani, 2017).

Machine learning and AI techniques are at the heart of AMEX and hold an important part in their core businesses- during credit line assignments. They use techniques that give high predictive accuracy, by identifying non-linear relationships (relationships that aren't very recognizable without deep research and analysing of data, essentially hidden data relations). The company



uses long-term short memory *RNNs*(*recurrent neural networks*) to analyse customer behaviour and can build a consumer profile, making it easier to detect fraud. For example, if a person made an online purchase from an IP address registered in Nigeria, but the person is living in Atlanta, it is easy to detect fraud through this short-term memory system. This does not necessarily mean real-life frauds are this easy to process, there are over a million factors the AI runs through, of hundreds of millions of people every second.

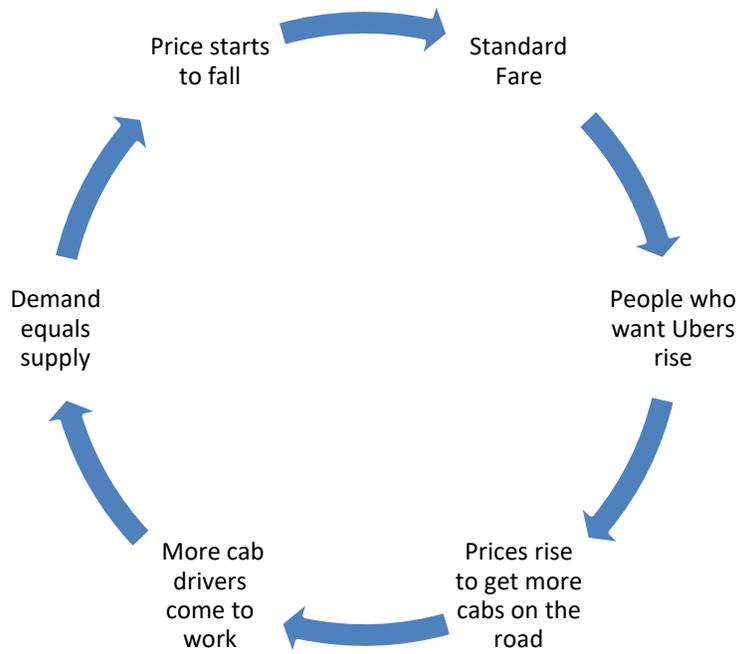
AMEX is a leader in the cards business, and *big data* analysis, as it has been explored, is one of the biggest reasons for this.

### UBER

*Uber lives or dies by data. Their overall mission and their sustainability is completely dependent on how good their data is. The more data they can collect, the more information they can derive from patterns and behaviours. Their ability to increase profits is all dependent on that*  
-Spencer, a former Uber driver.

Uber is a company that has been at the top of the field. Despite all that can be said about Uber, and all the complaints of cab drivers against it, there is no denying it is at the top of its field. And a lot of this success is from *big data* analysis. Uber collects every single piece of data they can using GPS tracking, for every single trip taken on their platform. Uber stores this data and uses data analysts, who analyse how the platform looks at a particular point in time. They use this data to connect the unused supply to where customers demand cabs. Most of this is done using tools like Hadoop and Spark, which can carry out this task in real-time.

Uber's entire business model is nothing but data. Uber as a business does not own cars. They use a database of drivers who own cars and allow them to use the platform to find customers for a fee. This means the only thing Uber as a company does is dealing with data analysis and allocating cabs to users, set fares that users find acceptable, and manage their database. Uber is more of a *big data* company than a cab company, hiring data scientists. Uber uses an algorithm made by their data scientists to allocate cabs within a 15-second time frame, to the nearest user. Uber also analyses public behaviour and road traffic to make the best use of time, enhance customer experience and maximise the number of customers taken on every day.



The algorithms mentioned earlier also take part in something called surge pricing, which has even been patented by Uber. Surge pricing has a unique structure it follows, by measuring traffic and demand to set *Big Data*-informed prices, and even encourage drives to come help when there is excess demand or stay at home when there is just not enough. While it is by no means a perfect system, with prices on an instance gone from \$27 to \$135 on 2011 New Year's Eve, it is effective for the company. The model above shows how this works.

Uber has created a cab business without buying a single cab and has propelled its user base in a field that was, and still is, extremely competitive. All of this was over 9 years, not exceptionally long for a business to go global. Data effectively gathered, paired with an idea, allowed the company to reach such heights. And this process is replicated in almost every successful industry we see today!

### NETFLIX

*People rate movies like Schindler's List high, as opposed to one of the silly comedies I watch, like Hot Tub Time Machine. If you give users recommendations that are all four- or five-star videos, that doesn't mean they will actually want to watch that video on a Wednesday night after a long day at work. Viewing behaviour is the most important data we have.*  
-Gomez-Uribe, a Netflix employee

It is almost impossible to talk about companies that use data analytics to grow and not talk about Netflix. The movie streaming platform is known for three things- its high rates, the selection of movies and shows available, and amazing predictions about what consumers like. Two of these three things are dependant completely on data analytics.



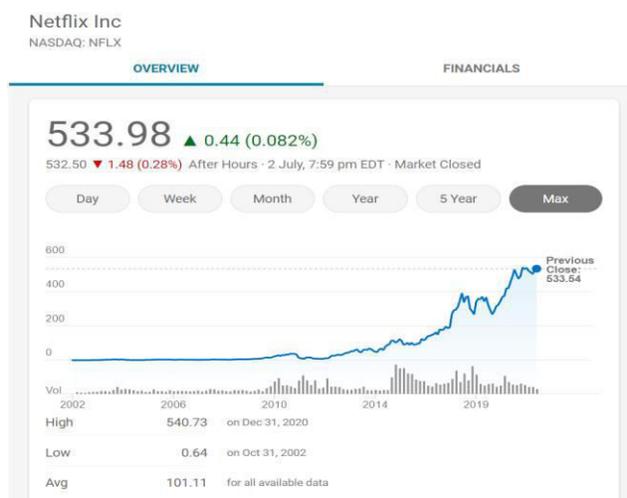
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In 2017, 93% of all Netflix original shows were renewed because of public interest, while only 35% of TV shows get renewed after the first season (Michael Dixon, 2019). This is only thanks to data analytics that Netflix was able to understand what their audience wanted. The company estimates that 75 percent of viewer activity is driven by recommendations (Tom Vanderbilt, 2013). Recommendations and finding what people liked is important for Netflix because when they started they were on a fixed budget, plus they were a pay-per-view company. It is still applying because people have gotten used to what Netflix recommends, and personalization is a very important part of the streaming platform.

At a point in time, Netflix used to be focused on consumer ratings, but their algorithm has developed over time to focus on what subscribers on the platform watched. When one opens Netflix and scrolls to recommendations, they may see shows no one has heard of, and even shows with ratings so horrible, one may want to cry. But Netflix analyses user behaviour and knows, you might just like the movie. Netflix trains its analysts not to let the data get tainted- a coloured view of data can result in a wrong recommendation. Netflix bet a lot of money on the success of 'Orange is the new Black'. And they went into profit, too. They only selected the show because their data showed that Jenji Kohan's previous hits had fared well on the platform and had a high content engagement.

Data at Netflix is collected in such an easy way, that it seems almost too easy that a company is making profits this way. Along with recording what you like, the thumbs up, thumbs down system on Netflix is another window into what the consumer likes. And it tells the user that it is using this data to collect information about what you like. Netflix is known as one of the most successful data analytics stories of all time, and not without good reason. It gives incredible insight into the power of data and allows them to make smart decisions to get maximum returns on what content they choose to keep.

### DISCUSSION



The graph shown above provided by NASDAQ (American Stock Exchange) and Bing shows that there is a growth in Netflix's revenue since 2010, which is by when data was sufficient



enough for Netflix to be able to create a significant shift in their chosen department. Netflix started experimenting with data to ‘substantially improve the accuracy of predictions about how much someone is going to enjoy a movie based on their movie preferences’, and it was only by 2010 they collected enough data- only resulting in an increased revenue stream. Similarly, the same is true for Uber, Tesla and AMEX.

Uber has made use of the Apache services and it’s own internal software, uLineage to ensure efficiency of their labour and resources. Accordingly, they have also put in their method by which they process data, putting it through various checks to ensure quality of data:



Quoting Uber themselves:

*Data must be as accurate and as timely as possible to support services on our platform. We worked hard over the past years to build infrastructure that scales to our global, 24/7 operations. A key part of our current work involves making our infrastructure run efficiently and support all of our internal users.*  
 -Uber employees Nikhil Joshi and Viv Keswani

This single quote has all the components of the 4V Big Data list. There is velocity, which is how fast the data must be processed (which they process real time), there is veracity (accuracy of data is one of the main aims according to the quote), there is Variety (as shown in the above image, and their own methods of dividing rideshare, and other forms of cabs, and also volume (which is evident through the image shown about their processing of data, wherein they take in enormous amounts of data of each and every customer they have.

AMEX has made similar comments in the past. Speaking from an article from their site, they consider these the biggest problems they want to deal with:

1. Find big data storage solutions that are scalable. The sheer volume of big data that makes it so helpful to organizations also introduces storage and analysis challenges. Compression and de-duplication can reduce the size of the files, but sorting and analyzing data requires the right tools as well. The amount of data continues to grow, which means companies must continue to scale their storage and analysis tools.
2. Analyze data quickly. If we think back to the 4Vs of big data, velocity—the speed at which organizations can accumulate and analyze data—is the most crucial. Converting big data into actionable insights quickly continues to be a challenge.
3. Enlist the help of big data management experts. As with many fields of technology, recruiting and retaining talent to implement big data projects, manage and analyze data can be a challenge.
4. Verify data. Another nod to the 4Vs of big data, organizations must find ways to test the veracity—or validate—the data.



The following is from an article written on AMEX's website which clearly highlights their need for the 4Vs as well.

### CONCLUSION

This research paper has always aimed at highlighting how much data plays an important role in increasing revenue and encouraging success. Data is a fundamental part of the new 21st century, and while the concept has governed the world even before computers, the new age successes show just how powerful data really is. It also highlights what is needed to succeed using data analysis:

1. Sufficient data in good quantities.
2. Direct and validated data.
3. A plan about what to do with the data.
4. Ability to structure data well.

This is evident from both the theory section of this report, as well as the discussion section of the report.

This brings me back to where this report had originated- the 4V Big Data Challenges. It is remarkable how these are just the 4Vs in a restructured format. All big companies still deal with these issues, because solving them leads to an effective workflow, better company infrastructure, and looking at the bigger picture, success.

The solution to these problems can help any company tap into their potential, and the report is greatly beneficial for start-ups who wish to succeed by applying data and facts to succeed. To conclude, it is just like a comment that Albert Einstein once made about the relevance of data:

*Not everything that can be counted counts, and not everything that counts can be counted.- Albert Einstein, Physicist*

### REFERENCES

- E. Foley. "What is Business Intelligence". IGI Global. <https://www.igi-global.com/article/business-intelligence/47193> (Accessed: May. 6, 2021)
- E. Stevens. "What are the different types of Data Analysis." Career Foundry. <https://careerfoundry.com/en/blog/data-analytics/different-types-of-data-analysis/> (Accessed: May. 07, 2021)
- Import.io. "Data Analysis: What, How, and Why to Do Data Analysis for Your Organization". Import.io. <https://www.import.io/post/business-data-analysis-what-how-why/#:~:text=Data%20analytics%20is%20used%20in%20business%20to%20help,need%20in%20order%20to%20make%20the%20right%20choices.> (Accessed: May. 7, 2021)
- L. Anselin and I. Syabri and Y. Kho. "GeoDa: An Introduction to Spatial Data Analysis". Springer Link [https://link.springer.com/chapter/10.1007/978-3-642-03647-7\\_5](https://link.springer.com/chapter/10.1007/978-3-642-03647-7_5) (Accessed: May 6. 2021)
- L. Goasduff. "Gartner Top 10 Trends in Data and Analytics for 2020". Gartner. <https://www.gartner.com/smarterwithgartner/gartner-top-10-trends-in-data-and-analytics-for-2020/> (Accessed: May 6. 2021)
- P. Pedamkar. "Types of Data analysis Techniques". Educba. <https://www.educba.com/types-of-data-analysis-techniques/> (Accessed: May. 6, 2021)



## An International Multidisciplinary Research e-Journal

- R. Ines. “What Is Data Analysis & What Are Some Examples?” MonkeyLearn. <https://monkeylearn.com/blog/data-analysis-examples/> (Accessed: May. 11, 2021”)
- S. Durcevic. “Introduction to The Basic Business Intelligence Concepts”. Datapine. <https://www.datapine.com/blog/business-intelligence-concepts-and-bi-basics/#:~:text=Put%20simply%3A%20Business%20intelligence%20is%20the%20process%20of,intelligence%20plays%20a%20pivotal%20role%20in%20the%20process.> (Accessed: May. 5, 2021)
- S. Durcevic. “Top 10 Analytics and Business Intelligence Buzzwords For 2021”. Datapine. <https://www.datapine.com/blog/business-intelligence-buzzwords/> (Accessed: May. 5, 2021)
- Suominen and H. Toivanen and M. Seppanen. “Firms' knowledge profiles: Mapping patent data with unsupervised learning”. Science Direct. <https://www.sciencedirect.com/science/article/pii/S0040162516303651> (Accessed: May. 5, 2021)
- Yonsei University. (No Date). Big Data Emerging Technologies. [Online]. Available at: <https://www.coursera.org/learn/big-data-emerging-technologies/home/info>
- J. Theums. “Top 10 examples of Successful Data Analysis”. UiPath. <https://www.uipath.com/blog/top-10-examples-successful-data-analysis> (Accessed: May. 14, 2021)
- TCS. “Application of Data Analytics in Capital Markets”. TCS BaNCS Research Journal. <https://www.tcs.com/content/dam/tcs-bancs/protected-pdf/Application-of-Data-Analytics-in-Capital-Markets.pdf>(Accessed: May. 14, 2021)
- M. Shabir and S. Gardezi. “Application of big data analytics and organizational performance: the mediating role of knowledge management practices”. Springer Open. <https://journalofbigdata.springeropen.com/articles/10.1186/s40537-020-00317-6> (Accessed: May. 14, 2021)
- M. Gavin. “3 Examples of Business Analysis in Action”. Harvard Business School Online. <https://online.hbs.edu/blog/post/business-analytics-examples> (Accessed: May. 14, 2021)
- E. O’Neill. “10 companies that are using big data”. ICAS. <https://www.icas.com/thought-leadership/technology/10-companies-using-big-data>(Accessed: May. 14, 2021)
- N. Tudor. “7 real-world examples of how brands are using Big Data analytics”. Bornfight. <https://www.bornfight.com/blog/7-real-world-examples-of-how-brands-are-using-big-data-analytics/> (Accessed: May. 14, 2021)
- B. Marr. “American Express: How Big Data and Machine Learning Benefits Consumers and Merchants”. Bernard Marr and Co. <https://www.bernardmarr.com/default.asp?contentID=1263> (Accessed: May. 16, 2021)
- C. Manglani. “American Express: Using data analytics to redefine traditional banking”. Digital Initiative. <https://digital.hbs.edu/platform-digit/submission/american-express-using-data-analytics-to-redefine-traditional-banking/> (Accessed: May. 16, 2021)
- R. Bean. “Inside American Express' Big Data Journey”. Forbes. <https://www.forbes.com/sites/ciocentral/2016/04/27/inside-american-express-big-data-journey/?sh=5672a9193d89> (Accessed: May. 16, 2021”)



## An International Multidisciplinary Research e-Journal

- N. Cameron. “How AMEX is using data and creative to tap into customer contexts”. CMO from IDG. <https://www.cmo.com.au/article/560678/how-amex-using-data-creative-tap-into-customer-contexts/> (Accessed: May. 16, 2021)
- M. Frankel. “Here’s Why American Express Can Charge More Than Visa or MasterCard”. The Motley Fool. <https://www.fool.com/investing/general/2014/06/16/heres-why-american-express-can-charge-more-than-vi.aspx> (Accessed: May. 16, 2021)
- E. Chatty. “How Amex Deals with Fraud Detection Using RNNs?”. Medium/Start it Up. <https://medium.com/swlh/how-amex-tackles-fraud-prevention-in-real-time-9b451ae0d44e> (Accessed: May. 16, 2021)
- J. Koetsier. “How Amex Uses AI to Automate 8 Billion Risk Decisions (And Achieve 50% Less Fraud)”. Forbes. <https://www.forbes.com/sites/johnkoetsier/2020/09/21/50-less-fraud-how-amex-uses-ai-to-automate-8-billion-risk-decisions/?sh=2199fe331a97> (Accessed: May. 18, 2021)
- B. Marr. “The Amazing Ways Uber Is Using Big Data Analytics”. LinkedIn. <https://www.linkedin.com/pulse/amazing-ways-uber-using-big-data-analytics-bernard-marr> (Accessed: May. 18, 2021)
- S. Jacobs. “How Uber Uses Data to Improve Their Service and Create the New Wave of Mobility”. NeilPatel. <https://neilpatel.com/blog/how-uber-uses-data/> (Accessed: May. 18, 2021)
- No Name. “How Uber uses data science to reinvent transportation?”. ProjectPro. <https://www.dezyre.com/article/how-uber-uses-data-science-to-reinvent-transportation/290#:~:text=Big%20data%20analysis%20spans%20across%20diverse%20functions%20at,payments%20and%20predict%20many%20other%20real%20time%20events> . (Accessed: May. 18, 2021)
- B. Helling. “Uber Surge pricing: How it works and How to Avoid It”.Ridester. <https://www.ridester.com/surge-pricing-explained/> (Accessed: May. 19, 2021)
- No Name. “Big Data Analytics – Netflix Case Study”. MBASKool.com. <https://www.mbaskool.com/business-articles/operations/17662-big-data-analytics-netflix-case-study.html#:~:text=Netflix%20data%20analytics%20shows%20the%20company%20wh at%20the,to%20the%20customers%20from%20their%20content%20and%20recommen dation>. (Accessed: May. 20, 2021)
- M. Dixon. “How Netflix used Big Data and Analytics to generate billions”. Selerity. <https://seleritysas.com/blog/2019/04/05/how-netflix-used-big-data-and-analytics-to-generate-billions/> (Accessed: May. 20, 2021)
- Z. Bulygo. “How Netflix uses Analytics to select movies, create content, and make Multimillion Dollar Decisions”. NeilPatel. <https://neilpatel.com/blog/how-netflix-uses-analytics/> (Accessed: May. 20, 2021)
- T. Vanderbilt. “The Science Behind the Netflix Algorithms That Decide What You'll Watch Next”. WIRED. <https://www.wired.com/2013/08/qq-netflix-algorithm/> (Accessed: May. 21, 2021)



## An International Multidisciplinary Research e-Journal

- R. Meltzer. “How Netflix uses Machine Learning and Algorithms”. Lighthouse Labs. <https://www.lighthouse labs.ca/en/blog/how-netflix-uses-data-to-optimize-their-product> (Accessed June. 10, 2021)
- M. DeBord. “Big Data in cars could be a \$750 billion business by 2030”. Business Insider. <https://www.businessinsider.com/car-data-business-mckinsey-and-co-report-2016-10?r=US&IR=T> (Accessed June. 26, 2021)
- A. Ahdoot. “How Big Data drives Tesla”. Colocation America. <https://www.colocationamerica.com/blog/how-big-data-drives-tesla> (Accessed June. 26, 2021)
- P. Saxena. “Role of IoT in road safety and traffic management”. INDIAAI. <https://indiaai.gov.in/article/role-of-iot-in-road-safety-and-traffic-management> (Accessed June. 27, 2021)
- B. Marr. “The Amazing Ways Tesla Is Using Artificial Intelligence And Big Data”. Forbes. <https://www.forbes.com/sites/bernardmarr/2018/01/08/the-amazing-ways-tesla-is-using-artificial-intelligence-and-big-data/?sh=29dd5bc24270> (Accessed June. 26, 2021)
- G. Paolini. “Tesla, The Data Company”. CIO. <https://www.cio.com/article/3433931/tesla-the-data-company.html> (Accessed July. 1, 2021)
- B. Karki. “Big Data and Analytics in Tesla Inc.”. LinkedIn. <https://www.linkedin.com/pulse/big-data-analytics-tesla-inc-bipin-karki> (Accessed June. 26, 2021)
- V. Singh. “Tesla: A Data Driven Future”. Digital HBS. <https://digital.hbs.edu/platform-digit/submission/tesla-a-data-driven-future/> (Accessed June. 20, 2021)
- E. Mixon. “Tesla: Automaker or Data Company?” AI Data and Network Analysis. <https://www.aidataanalytics.network/data-monetization/articles/tesla-automaker-or-data-company> (Accessed June. 20, 2021)
- T. Pham. “Data Analytics for Manufacturing: the Tesla’s Case Study (Part 1)”. <https://blog.trginternational.com/data-analytics-for-manufacturing-the-tesla-motors-case-study#:~:text=%20Data%20Analytics%20for%20Manufacturing%3A%20the%20Tesla%20E2%80%99s%20Case,is%20%E2%80%9Cdata%20source%20agnostic%E2%80%9D%2C%20i.e.%20users...%20More%20> (Accessed June. 20, 2021)
- F. Lambert. “Tesla’s new Model S gets official EPA range showing improvement in efficiency”. Elektrik. <https://electrek.co/2021/06/15/tesla-model-s-official-epa-range-improvement-efficiency/> (Accessed June. 26, 2021)
- N. Joshi and V. Keswani. “Uber’s Data Platform in 2019: Transforming Information to Intelligence”. Uber Engineering. <https://eng.uber.com/uber-data-platform-2019/> (Accessed June. 15, 2021)
- No name. “What is Big Data?” American Express. <https://www.americanexpress.com/en-ca/business/trends-and-insights/articles/what-is-big-data/> (Accessed June. 15, 2021)



### CRYPTOCURRENCY AND ITS FUTURE IN THE RETAIL

**Dhruv Rajkumar Varma**

Prabhavati Padamshi Soni Junior College  
dhruvarmaji@gmail.com

#### Abstract

This research was conducted for the main purpose of analyzing the acceptability and the views of the people on *cryptocurrency*'s future. *Cryptocurrency* has seen a meteoric rise in popularity since a few years as numerous business magnates have started to invest in it causing their values to rise exponentially. The main focus of this research would be on the *retail* sector of India as it makes around 9% to 10% of the country's GDP and is one of the largest *retail* sectors in the world. So what will be the effects of the advent of *cryptocurrency*? This is what the research will be about.

**Keywords:** Cryptocurrency/crypto : A digital asset that holds a monetary value, Retail : Buying and selling of goods by vendors , Blockchain : A digital ledger that stores all the transaction as blocks with a unique ID and that ID is also stored in the next transaction to link two blocks like a chain

#### INTRODUCTION

*Cryptocurrency* has been a very effective and secure way of transactions mainly due to its *decentralization*. This is done by the use of *blockchain*. A *blockchain* is a digital ledger in a currency which keeps track of all the transactions and is public so by that any discrepancy or fraudulent transactions can be traced quickly. Transactions can be anonymous between the two parties which gives an extra comfort of privacy. However throughout the years it has faced more criticism than praise especially in India as a lot a politicians and leaders find it a bit concerning to the economy of the country. Also the value of *cryptocurrencies* are not stable hence people have faced a lot of losses too adding to the backlash. That is why I decided to research about *cryptocurrency* in the *retail* sector to gain more insight of the common people on the same. This research is mostly going to be a hypothesis with the help of the little bit of an experimental data collected by my own and by the latest theories in the field and related to the country by giving my own assumptions and hypothesis then referencing some latest papers in the field. Finally we will take a look at the results of our experiment and comparing it to the hypothesis we will get the final conclusion of the research.

#### Theory

In theory, *cryptocurrency* might not have an exponential in few years as such in the western countries due to the financial bodies of government shoeing a little resistance towards it. Recently only the government was about to declare *cryptocurrency* as criminal. As their claim



was rejected by the Supreme Court, however recently the Ministry of Corporate Affairs (MCA) are trying to regulate *cryptocurrency* by making it mandatory that all the companies need to disclose their *cryptocurrency* at the end of every financial year. This might be a big step to regulate *cryptocurrency* and increasing the public confidence over it. A major growth will however require a full support from the government and introducing it publically with a wide awareness.

Now talking about the general public, most people have some knowledge or at least have heard the term *cryptocurrency* or bitcoin, being the most popular *cryptocurrency*. Still there's always a little doubt amongst them regarding the authenticity of *cryptocurrency*. This keeps the vendors from being uncomfortable about using *cryptocurrency* due to its notion. However when we look back in 2016, when the demonetization happened, which had cause the country shifting heavily to digital transactions. This shift to digital transactions was initially used by the businessmen and vendors which eventually led to this massive transition. This is the kind of influence or awareness which I aforementioned. If the government will not be in favor of *cryptocurrency* then neither will the citizens of this country will hence the *retail* might not see a boom in the use of *crypto* so early.

To actually make *crypto* mainstream in this country, the government needs to make big initiatives and encourage the citizens to actually make use of the *cryptocurrency*. Demonetization was kind of negative hence they would need a more positive and outreaching program and given that the government has an enormous PR they could make it possible given that they are totally sure about the idea.

Finally I would like to make a hypothesis for the same. Firstly, most of the people in the country, at least with the people having basic sources of information. The humongous popularity of *crypto* has surely reached a major number of the population.

Next would be whether the *cryptocurrency* should be banned or not? So for this I feel there might be a major conflict in the data as there might not be a lot of people pertaining their views heavily towards a more inclusive approach towards due to the lack of awareness and a slight sense of unsupportiveness of the government regarding the same. There won't be a mention of government's opinions though which might make it a little inclined towards the side of supporting it

However if we don't mention about the government there could be a change in results and probably there would be a slight leaning over to making it illegal. This is due to the fact that most people will actually base their decisions based on the opinions of the government, which is normal.

Next question is purely for the vendors and businessmen that will the *cryptocurrency* help them financially? Here I feel there would be a majority of views supporting the opinion that it might help them as they are more up to date with the economic sector and have a higher knowledge about it hence more knowledge of the pros and cons of the same and hence they will have better understanding to make the decision.

Another crucial thing is will the people be interested in investing into *crypto* and for that I feel that again we would see a majority yes due to seeing the latest trends and seeing mainly the rise of bitcoin over the years, people might be keen in making some profit of their own



Finally I might be asking about their views about the future of *cryptocurrency* whether it's a fad or a real innovation. I am believing people might have a quite positive response over it however there might be a major chunk of people who might be conflicting over it and even saying it a no.

### EXPERIMENTAL

The main motive of the research to get the views of the general vendors and buyers who would use *cryptocurrency* daily in their lives. To check this I had collected data by asking them various questions regarding the *cryptocurrency* and its future. My main target were the businessmen so for that I had a strong source of a medium sized manufacturer who really helped me getting their partners to help me collect the data. However even if one doesn't have a source of businessmen, one can even go at least to their nearest general store shopkeeper or a pharmacy which no matter a pandemic will be opened most the time. They can even connect one to their product distributors hence a varied data will be collected.

Speaking of varied the other side of the coin of *retail* would be the buyers, who will play an equal role hence collecting that data might not be a big problem as one can use their family, friends, acquaintances or anyone they know hence getting a wide view of the situation. The common people will give an insight of how comfortable they are with using it, how supportive they are for spending it and what would be their benefits for the same

For this I actually took help of my family itself and other friends and acquaintances of mine. So far it was a smooth collection as I had kept all the data anonymous so they are encouraged to give their opinion freely without worrying to be criticized or judged for the same. For theories I had visited various sites to get extensive information of the topic and studied the trends of the *cryptocurrency* too a little. The main issue of the research was the government area which I tried to keep touch with the new policies regarding the *cryptocurrency* in the country. Also to expand the content a bit I tried to read other new and upcoming types of *cryptocurrency* like Ripple, Stellar and many more.

There was obviously some hesitance from the people from whom the data is being collected so one needs to come forward and explain the cause properly and try not to spoil any answers for them to get an unbiased data Last but not the least I tried to convert all the information I had to my own words for the research and give a hypothesis before for the topic.

### RESULT

Comparing to my hypothesis, the results what I obtained were quite accurate per se. Most of the trends as I aforementioned turned out to be true except for one. For the question of whether the *cryptocurrency* should be illegal? There was a majority response of the people not supporting the decision which was quite surprising and made me realized that a lot of people actually have forward opinions on *cryptocurrency*

A grand majority of people had a general idea of *cryptocurrency* which was quite predictable. I already mentioned about the views of illegalizing *crypto* and its trend however the trend where people were mentioned that the government actually had a thought of banning it made few people change their decision.

Next question of would *cryptocurrency* help them financially in their business was only asked to businessmen and vendors and majority agreed for it. A majority of people agreed to

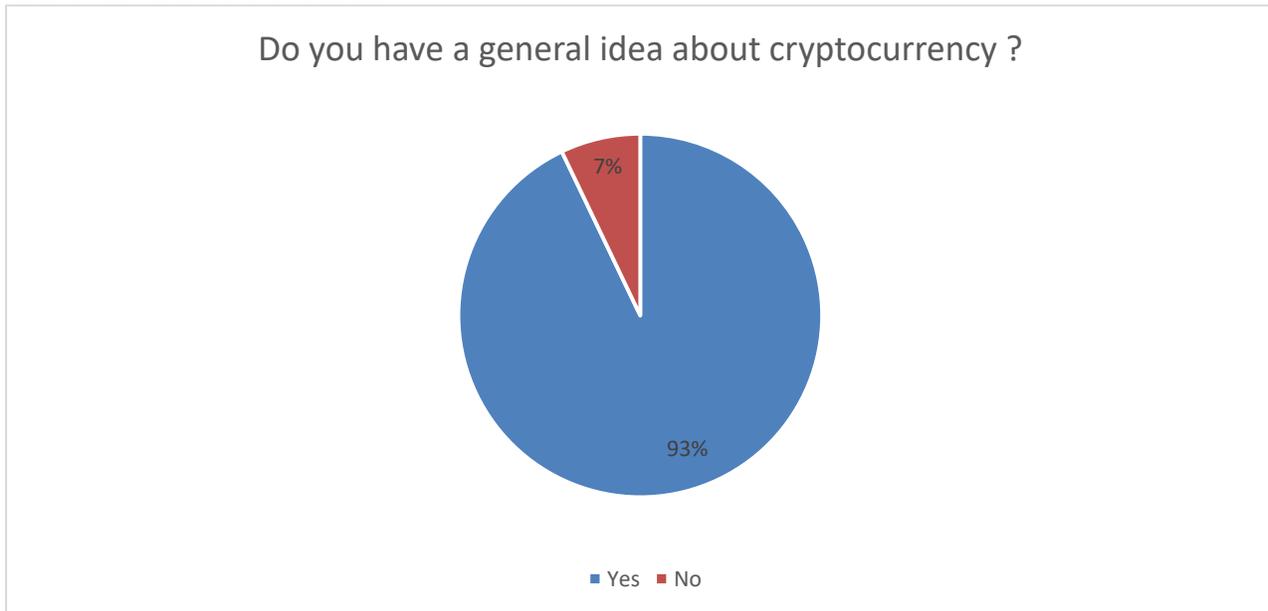
invest in *cryptocurrency* and finally for the future of *cryptocurrency*, the results came out to be quite mixed as it was discussed before in the hypothesis.

### DISCUSSION

Here are the various results of the main questions that were asked to the audience:

1) Do people have a knowledge of *cryptocurrency*?

Starting with the most fundamental question is whether the common people living their daily lives actually know what exactly *cryptocurrency* is to give a proper opinion and base their views further so here are the results:



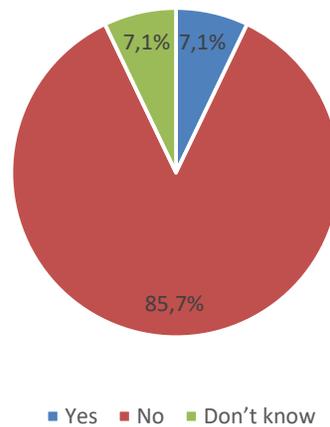
So as mentioned before a majority people possess the knowledge of *cryptocurrency* at the very least, the ones having general idea, know that it's a digital entity which has a certain value and people can invest in it. Also everyone were familiar with Bitcoin. Mostly the people who knew about *cryptocurrency*, gained the knowledge about it first in the December 2017 when the bitcoin shot up in its value with its highest peak at that time which gained it a wider recognition. Also considering the fact that it was only a year and a month later the demonetization, a financial intrigue was amongst every citizen of the country. Even if one isn't intrigued about it, the traction that news gained during that time was massive and only let masses getting awareness of it.

There are still some people who don't really have an interest for *cryptocurrency* and believe in the traditional way of transactions hence they never felt useful to know about *cryptocurrency* or simply some didn't care about the matter. These make up the small percentage of people who said no for having a general idea.

2) Do you think that *cryptocurrency* should be illegal?

So here are the results for the opinions of people thinking whether *crypto* should either be illegal or not or they are not sure about the idea and well the results weren't really according to my hypothesis:

Do you think that cryptocurrency should be illegal?



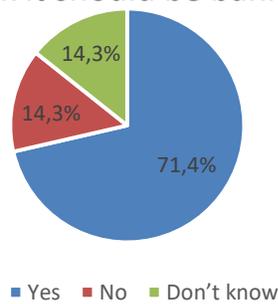
So in this majority of the people have shown resistance for the idea of criminalizing *cryptocurrency*. This was an unexpected result due to the notion that there is still not much traction of the technology in the country and a little weaker judgement of my own which one can easily take care of while writing their own paper.

The majority of the idea could be led by the fact that due to increase of social media advertisements of *crypto* wallets such as WazirX or CoinDCX, which are promoting the *cryptocurrency*, mainly bitcoin, to a very positive direction. They also time to time collaborate with Youtubers or broadcast their advertisement on televisions too. This might be one of the baby step to normalize the use of bitcoin. However we shall also be looking at the results of the answer people said when it was mentioned that the government was also thinking to ban *crypto* and the results would be interesting to see and analyze as it might change a few opinions.

3) The government was thinking to ban cryptocurrency so do you think it should be banned too?

Here actually the results I obtained were pretty similar to my hypothesis that there was a lot of change in opinions in the other direction by the people getting inquired to so here are the stats:

The government was thinking to ban cryptocurrency so do you think it should be banned too?



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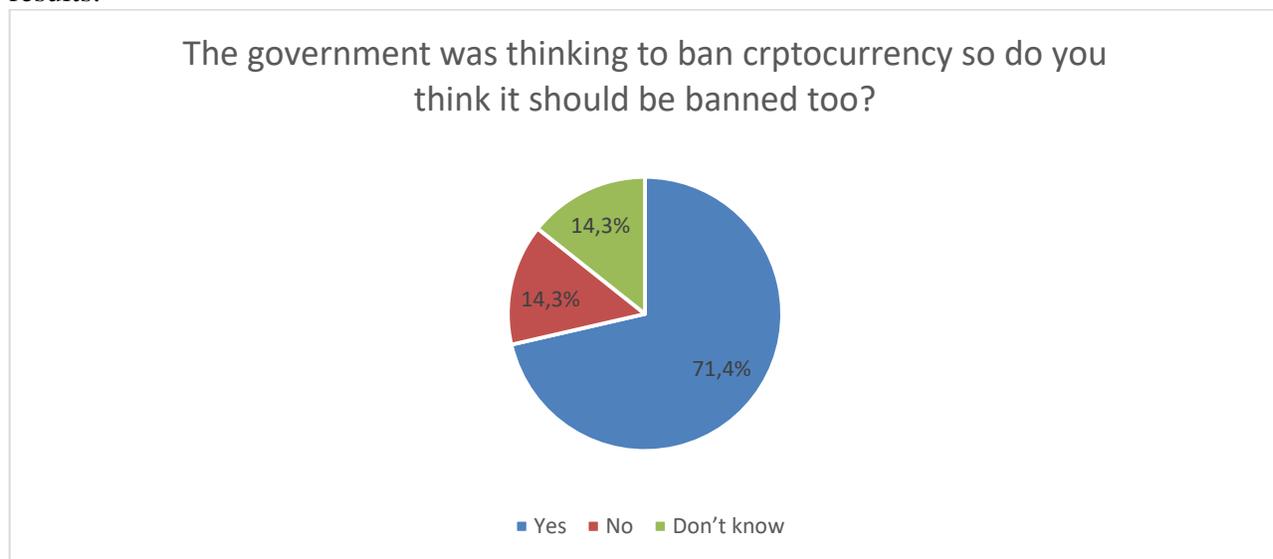
Here as you can see clearly there is a decline of people in supporting the *cryptocurrency* of not being illegal as people tend to base their views according to the government.

This shows how there needs to be an awareness by the government itself rather than trying to ban them to get people's attention as majority of them, as we saw before, support it and unless government makes no initiative there won't be a widespread of *cryptocurrency* in the country.

The people are also a little conflicted due to the same reason and will only be a hundred percent sure if they get a proper validation by the government.

#### 4) Do you think Cryptocurrency can be beneficial in your business?

This question is mainly for the businessmen and vendors, and here we received some expected results:



There's a clear majority of them supporting however there are quite a few who are actually conflicted or don't support it.

This could be a very average result as we have seen billionaires such as Bill Gates or Elon Musk support the idea of it but others like Warren Buffet don't as they like to go with a more traditional and conservative approach towards their business.

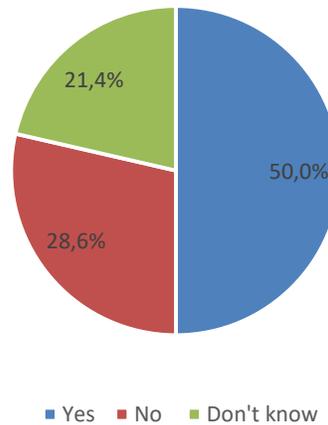
There is also a chunk of people still unsure of *cryptocurrency*. Either they want to use it partially and for just a few small transactions or are completely clueless about the idea of introducing cypto in their business.

#### 5) Are you interested in buying cryptocurrency?

Here people were simply asked whether they would want to invest into *cryptocurrency* and as expected people were a little supportive towards it. Here are the results:

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Are you interested in investing money into cryptocurrency?



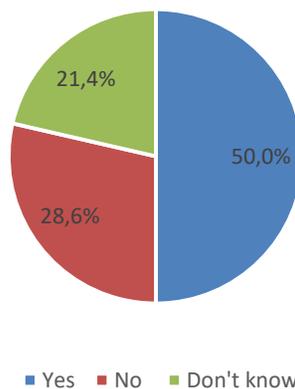
As one can see there is majority of people interested into investing in *cryptocurrency* but there is also a good chunk of people not supporting the decision as they are a little skeptical of the idea due to the value not being quite stable of *cryptocurrencies*.

However it also gives an idea that as aforementioned companies can work and increase those numbers who are investing in *crypto*.

6) Do you think the future is bright for cryptocurrency in the country?

This question was just asked as to check the confidence of audience over the idea of *cryptocurrency* and here are the results:

Do you think the future is bright for cryptocurrency in the country?



This data has the most mixed results as hardly 50% of the people think that the *cryptocurrency* will have a bright future. This shows that the people are in a major lack of awareness and need to be acquainted with the technology.

### CONCLUSION



The most important results were about whether people will wholeheartedly accept the idea of *cryptocurrency* or not which in turn will cause a widespread of use and eventually for the *retail* and hence the results have shown that there is a majority of people in the favor of *crypto* however the majority is not enough and certainly there is a room for improvement.

As more and more people start getting to know about *cryptocurrencies*, like how use them, their pros and cons, their different types and more then there would be a better share of people appreciating the technology. As the *retail* sector in the country has grown, and growing every day, digitally like a lot of people running their own small businesses over social media apps and with the era of the online shopping apps where the security of transactions has always been doubtful, the *cryptocurrencies* will actually solve that and make people even more confident to make transactions hence a growth in *retail* can be seen.

Obviously every technology has their own disadvantages too like *cryptocurrencies* being not stable in its value and as the whole technology is digital there's a chance that it could be hacked but obviously there might be solutions for them in the future.

Lastly as *cryptocurrency* is quickly getting to a global scale and looking for majority use with *blockchain* technologies to create various apps like for social media, booking sites and banking system so that one's' data is not shared with an organization but be as a single unit, then if India won't make an inclusive approach then the country may go behind further technology wise.

### REFERENCES

<https://www.businesstoday.in/latest/corporate/story/cryptocurrency-in-india-what-the-govt-stand-legal-status-its-future-296570-2021-05-20>



### ANALYSIS OF WHETHER DIGITAL EVIDENCE CAN BE RELIED UPON IN LEGAL PROCEDURES, AND DETERMINATION OF THE IDEAL DF MODEL

**Arhan Kamdar Pande**

Prabhavati Padmashi Soni International Junior College  
953@ppsijc.com

#### Abstract

The broad objectives of this research paper are to review the efficiency of existing Digital Forensics models in identification and collection of digital evidence, whilst analyzing whether the discoverable information on digital media is suitable for use in court. Research has been conducted using a mixed approach: both an experimental and a theoretical one. The theoretical sector of the paper is focused on determining the most well suited DF model. The experiment aims to investigate the ease of fabrication of digital evidences and whether individuals can tell apart a genuine evidence from a fake one. Since the results indicate that most people cannot identify fake evidences, it is deemed that the reliability of digital evidence is, currently, low. Further analysis is carried out to arrive at the major conclusion that using the IDIP model increases the reliability of digital evidence in court.

**Keywords:** *Digital Forensics, Cybercrime, Digital Evidence, DF Models, Investigation*

#### Introduction

With the advent of social media and the advancements in technology in recent times, the number of people who are active online has increased exponentially. Whilst the technology and the services on the Internet (such as email, chatrooms, social media sites and streaming platforms) can be put to efficient and positive use in numerous ways, it can very well provide a facade for those with malicious intent, and by doing so, increase their temptation to harass other people within the digital space. This unfortunate yet clearly evident rise in cybercrime levels has led to the popularisation of a new field in criminal investigations : Digital Forensics.

Digital Forensics is popularly defined as the process of preserving, identifying, extracting and documenting digital evidence which can be used by the court of law [2]. The importance of Digital evidence in criminal cases of today's world is severely undermined. According to Randy Hillman, Director of the DA association and Office Of Prosecution Services, Digital Evidence is prevalent in 90% of their cases, while DNA analysis is in a very small percentage of them [7]. Considering the previous statistic, it is irrefutably crucial for Digital Forensic investigations to yield accurate and reliable digital evidence. While criminal investigators have been using



Forensics since the past numerous decades, Digital Forensics is a new introduction to the investigation process and is still being developed to be used to its whole potential. Given that, it is undeniable that a DF investigator may face a considerable amount of challenges while collecting and presenting digital evidences. The vulnerability of digital evidence to sheer fabrication and manipulation leads to professional investigators not being able to solely consider what they have discovered online (or on other digital media) as proof to base their conclusion on. This is further supported by Hewling and Sant [1] with a quotation in their paper in the same field –“Digital evidence can be reproduced and manipulated by personnel involved with the investigation, maliciously or accidentally”. Physical evidence is widely considered to be “primary” evidence, and rightly so- due to its higher accuracy. This point can be very well summarized with a statement by David Chaikin [3]-“Digital objects bear less evidence of authorship, provenance, originality and other commonly accepted attributes than do analogue objects”.

Various digital forensic models have been developed and implemented by firms and law-enforcement personnel. The sole fact that this large a number of models exist and that there is no standardized process followed in digital forensic investigation goes to show, according to Hewling and Stan[1], that “there are some inconsistencies in the field”. These models will be discussed in greater detail later in the paper.

This paper will analyze the reliability of making use of digital evidence in favor of or against an individual accused of a cybercrime. It will provide a balanced and evaluated view on the subject by considering the accuracy and legitimacy of the digital evidence obtained by digital forensics. The paper will also focus on the evaluation of the numerous existing DF models. It will aim to identify the prime DF model to collect relevant evidence.

### Existing Digital Forensics Models (Theoretical)

Over the years, numerous authors have put forward their own optimized DF model, to be potentially used by professional investigators in the acquisition and analysis of digital evidence. The work of various individuals/organizations in this field with their invented framework is thoroughly discussed in this section. In this section, the focus will mainly be on the explanations of the working and functioning of each of the models. A comparison of these models will be included in the *Discussion and conclusion* section of this paper.

#### (I) Kruse and Heiser Model

This model was put forward by Kruse et al in their book titled “Computer Forensics: Incident Response Essentials”, published in 2001. The model was designed to be relatively simple use and understand, with a total of a mere three steps that needed to be followed:

##### Step 1 – Acquisition of the evidence.

According to Dr. Sudesh Rani [8], it was essential for this evidence to be acquired “without alteration or damage to the original evidence”. This is important because any accidental or intentional tampering of the original data would lead to the collected evidence not being considered genuine, *potentially* changing the outcome of the case altogether.

##### Step 2 – Authentication of the collected evidence by comparing it to the data originally obtained.

After the collection of digital evidence, professionals compare it to the data it was collected from, to check its consistency and (to some extent) its reliability.

### Step 3 – Analysis of the data

Once the digital evidence is confirmed to be authentic and consistent with the original “mother” data, It is handed over to DF investigators for thorough analysis. This is arguably the most important step of the three, for what majorly matters from a practical point of view is the magnitude of advancement

further in the case yielded by the DF process. And this advancement indefinitely requires an efficient analysis and evaluation of the secured evidence.

Because the three stages of the Kruse and Heiser Model are “Acquisition”, “Authentication” and “Analysis”, it is popularly recognized as the “3As”.

This model is briefed with **Fig.1** below:



**Fig.1**The three stages of the Kruse and Heiser Model for DF.

### (II) USDOJ (US Department Of Justice) Model

The USDOJ Model in DF follows four key stages :

#### Step 1 –Collection of the evidence

The collection phase involves searching for relevant data, identifying if it is applicable to the case, and then collecting this evidence. It is important for the individual carrying out this step to document every step taken in the process [9], so that it can be referred to in the future by other personnel working on the case.

#### Step 2 -Examination

The second stage deals with using methods such as advanced data mining in order to uncover and reveal other meaningful evidences of hidden and “obscure” nature [9]. This would include the information that is not explicitly available or visible, but can be extracted by a professional. The importance of the examination step is large to say the least, because the “hidden” data often proves to be the most useful type, when it comes to making advancements in the case.

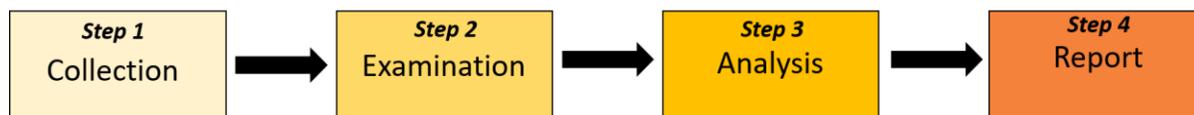
#### Step 3-Analysis

Prior to the thorough examination of the collected digital evidence, it must be analyzed. The analysis stage deals with interpreting the data in relation to the questions under investigation to reach a convincing solution. It is at this stage when investigators really begin to link the examined evidence with the actual case. Again, like with the collection stage, every step taken in the Analysis stage is compulsorily documented.

#### Step 4 – Report

For the evidence to have any effect on any kind of legal procedure, it must be presented before the court of law. In step 4, the examined and analyzed evidence is presented in form of a report, to ensure its usability in court. The report will document the whole process, from the first stage.

The USDOJ Model for DF is graphically summarized in **Fig.2** below:



**Fig.2**The four key stages of the USDOJ Model

### (III) Integrated Digital Investigation Process (IDIP)

In 2003, Carrier and Spaford designed a Digital Forensics model that considers the “dual investigative nature” (as worded by Dr. Sudesh Rani [8]) of the DF process. This model was known as the “Integrated Digital Investigation Process”. Both, the physical as well as digital aspects of a hypothetical case have been incorporated into this model. The model is divided into five different groups of phases (stages), with 17 phases in total between them:

#### Group 1 -Readiness phases

This group of phases is aimed towards ensuring that the professional team is able to fully support the investigation. The two phases under Group 1 are *operations readiness* and *infrastructure readiness*. The operation readiness phase has an objective of providing adequate training and equipment for the investigators. The infrastructure readiness phase focuses majorly on confirming that data relevant to the case exists.

#### Group 2 – Deployment phases

Prior to the Readiness phases, the Deployment phases are carried out. In the deployment phases, a set of fixed mechanisms is used in order to detect and confirm an incident. Group 2 consists of the *Detection & Notification*, *Confirmation* and *Authorization* phases, which are carried out in the same order.

#### Group 3 – Physical Crime Scene Investigation phases

As mentioned before in the paper, IDIP considers both, the physical as well as the digital perspective of a given investigation. Group 3 aims to, as its name suggests explicitly, collect and analyze physical evidence relevant to the case. Group 3 consists of the following phases:

*Preservation of physical scene, Survey for Physical Evidence, Document Evidence and Scene, Search for Physical Evidence, Physical crime scene reconstruction, and Presentation of complete theory*

#### Group 4 – Digital Crime Scene Investigation phases:

In this group, every digital device may be considered as a separate “crime scene”. The main purpose of this group of phases is to ensure the collection of maximum electronic (or “digital”) evidence. Group 4 consists of phases “identical” to Group 3, but in context of digital forensics rather than its physical counterpart:

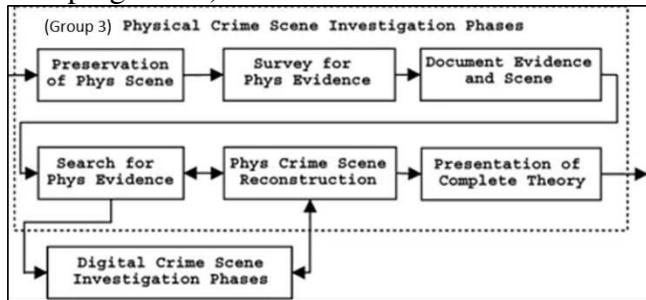
*Preservation of Digital scene, Survey for Digital Evidence, Document Evidence and Scene, Search for Digital Evidence, Digital crime scene reconstruction, and Presentation of complete theory.*

Refer to **Fig.3** and **Fig.4** for the working sequence of the respective phases in Group 3 and Group 4.

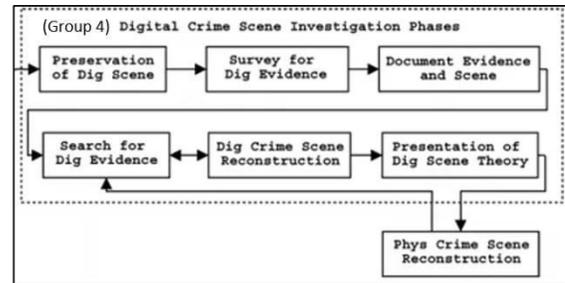
#### Group 5 – Review

The final group is Review, in which the entirety of the process is reviewed to find points of potential improvement, while identifying new procedures or new training requirements. Despite the fact that there are no separate phases within this group, the importance of reviewing one’s

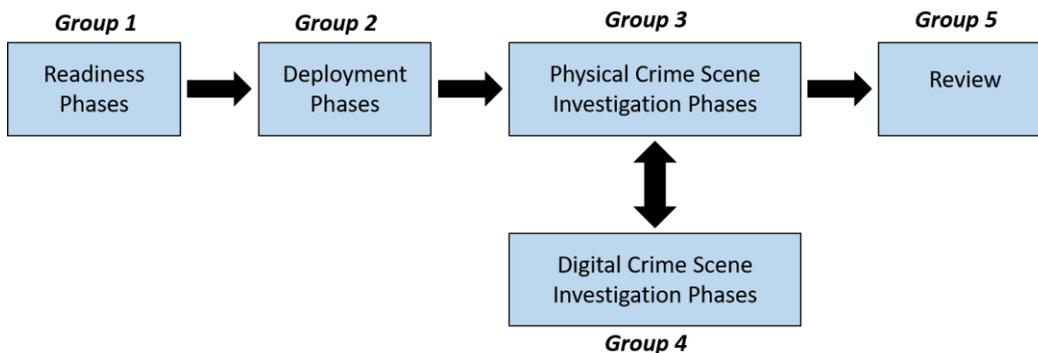
work is undeniable (it is the only way the model can be made more optimum and foolproof, as time progresses.)



**Fig.3** Phases and their order in Group 3



**Fig.4** Phases and their order in Group 4



**Fig.5** Summary of IDIP model structure (without inclusion of phases in individual groups)

### Experimental

In this paper, a single experiment was conducted with an aim to identify how difficult it is for one to fabricate evidence, and to analyze whether people can differentiate between fake and genuine digital evidence.

### Procedure-

In the first stage of the experiment, three evidences were fabricated using different applications and platforms. Along with these, three genuine evidences were obtained from the internet. In the second stage of the experiment, an online survey was conducted, in which people were asked to identify the fake and real evidences from a list of evidences that contained both. The purpose of the second stage was to analyze how accurate the faked evidence can be portrayed to be.

**Stage 1 of experiment**—In stage 1, a driver’s license, a tweet and a chat were fabricated.

(i) Driver’s License: In order to create a driver’s license that seemed genuine, a free template was downloaded from the web. **Fig.6** below is the template that was used.



Fig.6 Driver's License Template

A shutterstock image of an individual (Fig.7) was obtained from the internet and edited along with the License template to create the final fake license. The standard version of *Microsoft Powerpoint 2007* was used for all editing purposes. To make the license seem as genuine as possible, a signature (also found online) was included in the finished license.

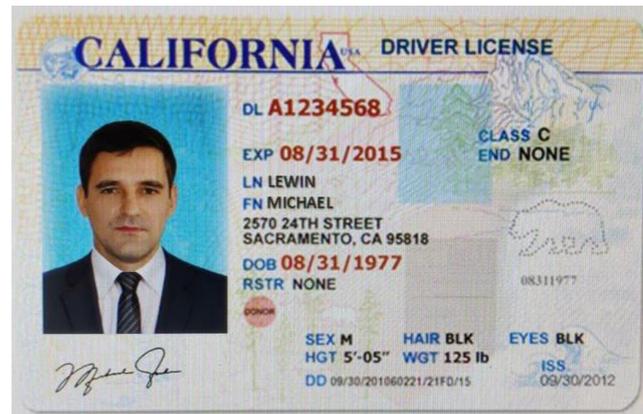
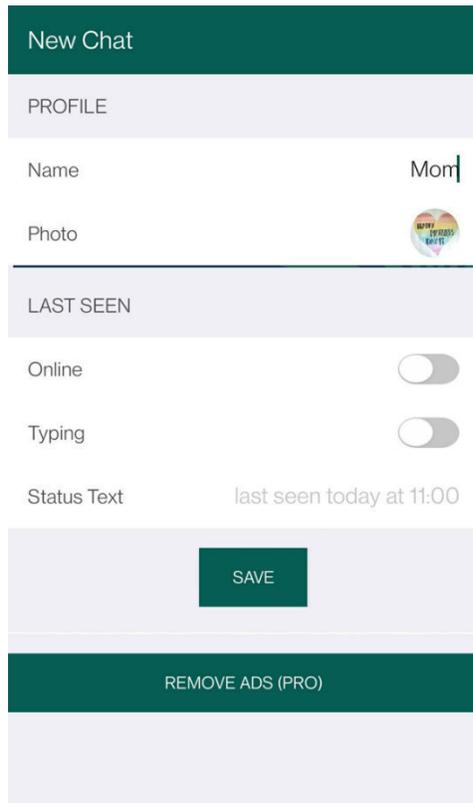
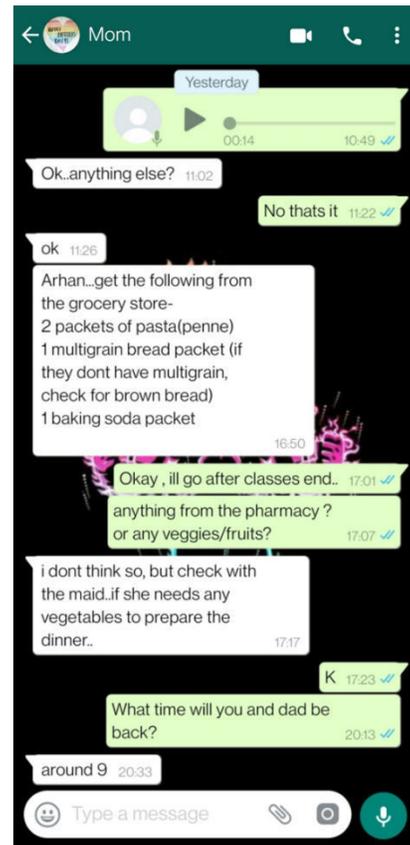


Fig.7 Shutterstock photo Fig.8 Finished License

(ii) Fake Chat: To create a fabricated WhatsApp chat, a free mobile application with the name of "Whatsmessage" was made use of. The application allows the user to create what can be best described as a "simulation" of a chat. The user can alter all aspects of the chat – such as the time the message was sent, the profile picture of the recipient, or the background of the chat. It should be noted that the chat that was created is naturally not something controversial or one that would be used in real cases, but a person with malicious intent could definitely use this technology to fabricate something of a more grave nature, which could be of actual relevance to a hypothetical case. Fig.9 shows the interface of the app that enables the user to create a new chat. Fig.10 is the final chat that was created. (Figures on the next page)



**Fig.9** App Interface



**Fig.10** Final chat

(iii) Fake tweet: With the rise of social media, it becomes increasingly crucial for one to be aware of their statements and/or opinions that they put out on the web. The website “Twitter” is known to allow individuals to freely voice their opinions. The posts that a person makes on the platform are known as “tweets”. The app “tweet creator” was used in order to fabricate the tweets. While in this case a simplistic tweet was created, this service could easily be put to unethical use. For instance- a person could fabricate offensive tweets under someone else’s name, to defame them. Even if the victim defends themselves by proving the absence of this particular tweet in their feed, It is easy for the accuser to claim that the victim simply deleted the post. Such a scenario is an example of how digital evidence, if inaccurate, could steer the case towards the wrong direction.

**Fig.11** below shows the tweet that was created



Ali  
 @dragonslayer7677

2021 has been a wonderful year for introverts like myself, retweet if you agree!

11:49 AM · 09 Jun 21 · Twitter for Android

View Tweet activity

129 Retweets 2806 Likes

### Fig.11 Fabricated tweet

#### Stage 2 of the experiment– Survey

The purpose of conducting the survey was to answer the question- “How genuine can the fabricated evidence be made to look?”. For the survey, three genuine evidences were downloaded from the internet. They consisted of a digital certificate, a shipping bill and a passport. Putting the three fake and three real evidences together, a total of six evidences were obtained. In the survey, which was conducted via Google Docs, subjects were asked to identify whether each of the six evidences was genuine or not.

#### Results of the Survey

A total of 78 people took part in the survey. No personal information was asked for in the survey, because it wasn't relevant to the research.

**Results for genuine evidences-** 53.8% of people incorrectly guessed the real passport to be faked, 83.1% of people incorrectly guessed the real shipping bill to be fake, and 51.3% of people incorrectly guessed the real digital certificate to be fake. These results are graphically presented in Figures 12 to 14 (next page):

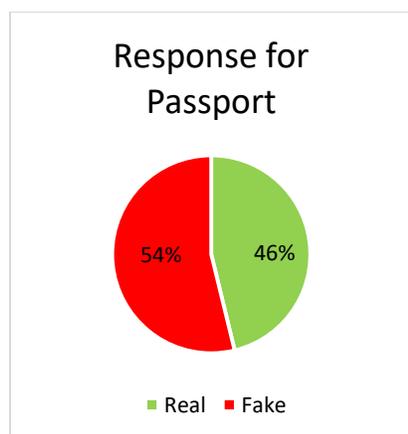


Fig.12 Response for Passport Certificate

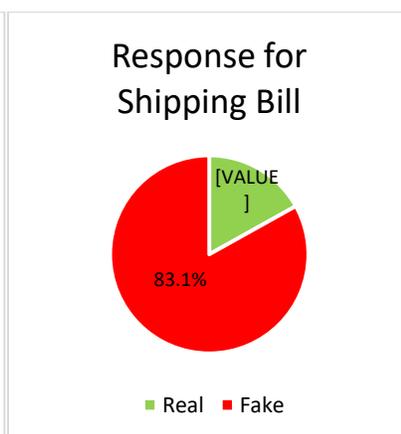
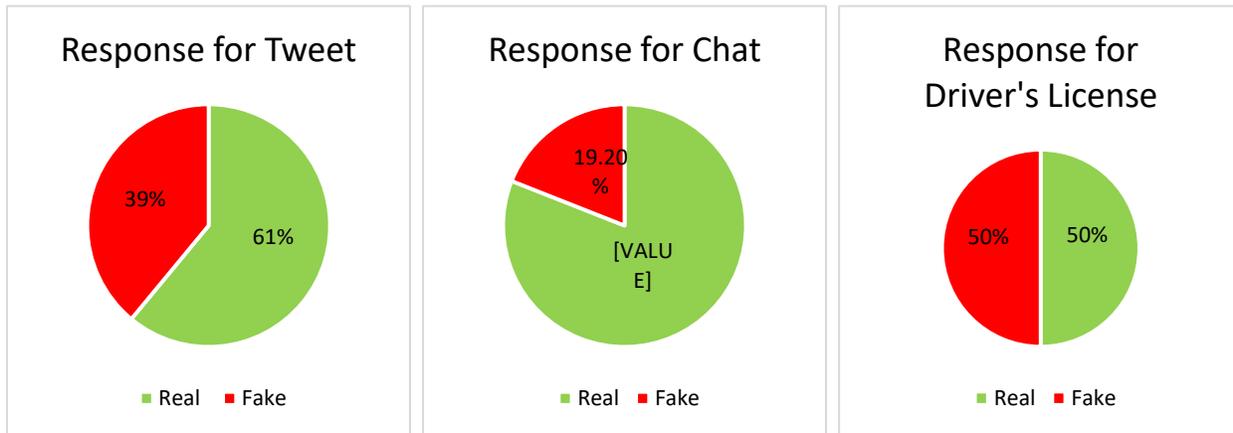


Fig.13 Response for Bill



Fig.14 Response for Certificate



**Fig.15** Response for Tweet  
 LicenDiscussion and Conclusion

**Fig.16** Response for Chat

**Fig.16** Response for

**Results for fabricated evidences-** 39% of people correctly guessed that the tweet was fake, 19.2% of people correctly guessed that the chat was fake, and 50% of people correctly guessed that the license was fake. These results are displayed graphically in figures 15 to 17 below. The discussion sector will be divided into two sections: The interpretation of the experimental results, and the discussion of the theoretical aspect to this paper.

### Section I – Experimental results

It is found that only 36.07% of all people were able to successfully guess that the fabricated evidences were, indeed, fake. Also, according to the results of the survey, 62.73% of individuals incorrectly guessed the genuine evidences to be fake. The latter statistic was especially alarming, because it wasn't expected that the real evidences would be voted to be fake more frequently than the fabricated evidences themselves. A fairly unbiased sample of subjects was taken in this survey, so it is safe to say that the majority of people are unable to differentiate between genuine and fabricated evidences.

All the fake evidences were fabricated by the use of basic and free software, and without the help of an expert. If data can be made to seem so genuine with such ease, it is a definite area of concern for cyber-crime authorities. If such evidence could be created using basic software and little equipment, one fabricated by someone with superior editing skills and/or more advanced equipment could potentially pass through the authorities undetected as a fake. One might argue that the DF authorities could hire ethical hackers to hack into the fabricator's system, but it is easier said than done. With facilities that allow offenders to hide their IP address and browse the internet without leaving any footprints whatsoever, a hacker's job has become more difficult than ever. The advancement of technology has skyrocketed to say the least, and it favors the offenders much more than it does the legal authorities. It can, hence, be concluded that the reliability of digital evidence in court is fairly low, and it is best if digital evidence is used as more of a supporting material than a key factor in deciding the outcome of the case.



To increase the reliability of the digital evidence, it is vital for it to somehow be linked to a more solid physical evidence (more about this in Section II).

### Section II – DF Models

Three models were discussed previously in the theoretical section of the paper– The Kruse and Heiser Model, USDOJ Model and the IDIP Model.

The major advantage of using the Krus and Heiser model is that it is easier, less time consuming and cheaper to implement than the other two models. However, the efficiency of the authentication process can be questioned, because it involves only “checking whether the recovered evidence is consistent with the data originally seized” [8]. In technical terms, this is a verification process (i.e, checking whether the data stored in two different locations are consistent with one another) rather than the equally essential validation process, which involves determining whether the data is factually correct. In other words, If the data from which the evidence had been collected was fabricated or tampered with in the first place, there is no way to identify the same.

The advantage of the USDOJ model over Krus and Heiser model is that it has the “Examination” step in the process, which involves digging deep into the evidence and attempting to find implicit details. Also, USDOJ accommodates a stage (Report) which involves presentation of the results before the court of law. This was absent in the Kruse and Heiser model. However, USDOJ does not attempt to correlate the digital evidence with physical evidence of any kind. As mentioned in Section I of the discussion, it is vital for the digital evidence to be interpreted in relevance of some physical evidence, for it to be of greater reliability. This aspect is present in none of the two models discussed above.

The third model, IDIP, does take the physical evidence into consideration. Linking the Physical Evidence with the Digital Evidence provides a stronger link between two possibly related scenario and proves to be more helpful in the court of law. Even though it is undoubtedly the most time consuming and expensive (due to equipment and training costs) to implement of the three, Government-funded investigative authorities already equipped with fairly advanced technology can comfortably afford to make use of this model. Keeping in mind also the fact that relating digital and physical evidences will be key to improving the reliability of the digital proof, it is conclusive that IDIP is the most optimum model to use in modern day DF investigations.

### References

- [1] Moniphia Hewling, Paul Sant “Digital Forensics: An integrated approach” presented at CFET, Canterbury, United Kingdom , September 20<sup>th</sup> 2012.
- [2] EC-Council “How Well Do You Know Digital Forensics”[eccouncil.org](http://eccouncil.org). <https://www.eccouncil.org/what-is-digital-forensics/> (accessed May 26 2021)
- [3] David Chaikin , “Network Investigations of Cyber Attacks : The Limits of Digital Evidence” in *Crime, Law and Social Change* 5<sup>th</sup> ed. FL , USA , Springer.



## An International Multidisciplinary Research e-Journal

- [4] Xiaoyu Du , Nhien-An Le-Khac , Mark Scanlon “ Evaluation of Digital Forensic Process Models with Respect to Digital Forensics as a Service” presented at ECCWS 2017 , Dublin , Ireland
- [5] Dan Manson, Anna Carlin, Steve Ramos, Alain Gyger, Matthew Kaufman, Jeremy Treichelt “Is the Open Way a Better Way? Digital Forensics using Open Source Tools” presented at the 40<sup>th</sup> Hawaii International Conference on System Sciences – 2007, Pomona, California, USA
- [6] Khuram Mushtaque , Kamran Ahsan , Ahmer Umer “Digital Forensic Investigation Models : An Evolution Study” (Not Presented), August 2015, Karachi, Pakistan
- [7] Andrew J. Yawn “In crime investigations, digital evidence ‘outweighs’ DNA”  
montgomeryadvertiser.com  
<https://www.montgomeryadvertiser.com/story/news/2015/09/30/digital-evidence-outweighs-dna/73082266/>
- [8] Dr. Sudesh Rani “Digital Forensic Models: A comparative analysis” published in “International Journal of Management, IT & Engineering” Vol.8 Issue 6, June 2018.
- [9] Michael Kohn, J.H.P Eloff, MS Olivier “UML Modelling Of Digital Forensic Process Models (DFPMs)” (Presentation details not available), University of Pretoria, South Africa.



### APPLICATIONS OF NEURAL NETWORKS AND DEEP LEARNING

**Sharvari Dhuri**

Rustomjee Cambridge International School  
and Junior College  
[dhurishar@gmail.com](mailto:dhurishar@gmail.com)

#### Abstract

This research paper briefly summarises what Neural Networks and Deep Learning is and how its applications are improving today's life. I have taken help of information available in various research papers on different websites. This spans from theory behind the Neural Network, Advantages, disadvantages to the uses of Deep Learning.

#### KEYWORDS

*Artificial Intelligence:* Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions.

*Machine Learning:* Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.

*Neuron:* Neurons are the fundamental units of the brain and nervous system, the cells responsible for receiving sensory input from the external world, for sending motor commands to our muscles, and for transforming and relaying the electrical signals at every step in between

*Normalisation:* Normalization is an approach which is applied during the preparation of data in order to change the values of numeric columns in a dataset to use a common scale when the features in the data have different ranges.

*Autoencoder:* An autoencoder is a type of artificial neural network used to learn efficient codings of unlabelled data

#### INTRODUCTION

We keep hearing words like Neural Network and Deep Learning from computer scientists and software professionals. What do they really mean? In what context they are used? These were some of the questions I had and it actually created interest in my mind due to its similarities with terminologies used in reference of Brain taught in Biology. Is it similar or is it totally different? If it is similar in what way it is similar and if different, how it is different?

So, this paper is the follow up on my enthusiasm to understand these concepts and understand why these concepts are being discussed by these professionals in today's world.

### THEORY

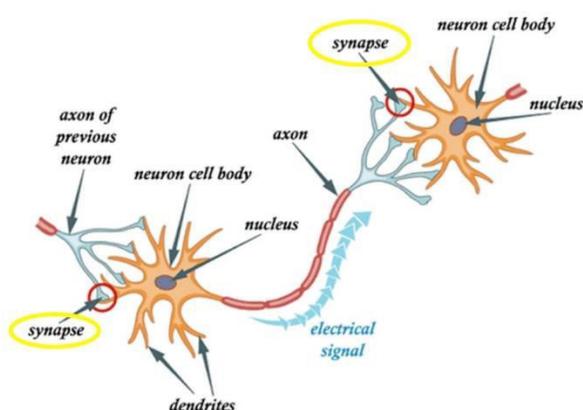
The formula given above is to determine the output at every node in a neural network.

$$Y = \Sigma (\text{input} * \text{weights}) + \text{bias}$$

### WHAT IS DEEP LEARNING AND NEURAL NETWORKS?

Deep Learning (DL) is a part of machine learning where in there is a system of artificial neural networks with a large number of hidden artificial neural network layers. The artificial neural networks try to simulate the functioning of the human brain. This allows the artificial neural networks to “learn” similar to human brain learning. If the artificial neural networks can process information on their own then why would we use Deep Learning? This is because an artificial neural network is a single layer which can make approximate predictions, however, if we want accuracy in predictions, we would need to use hidden layers which are present in Deep Learning.

### HOW DOES IT WORK?

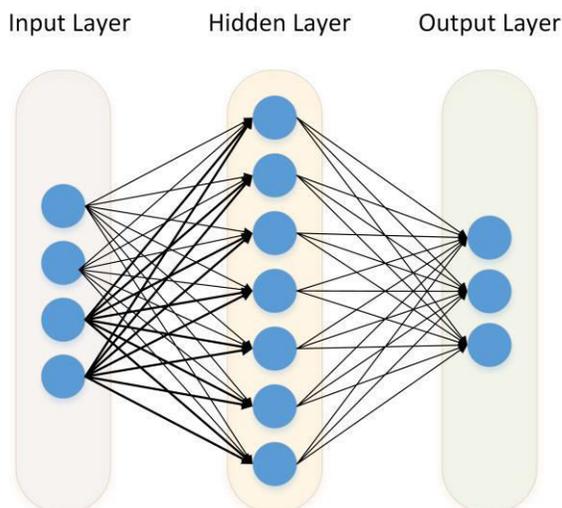


**Fig.1** Two Neurons Connected

Artificial Neural Networks try to simulate the function of brains therefore they will have similar structure to neurons, which are present in the human brain, connected to each other. At the one end of a Neuron there are many dendrites which are connected to the axon of another Neuron (as shown in Fig.1). The dendrites receive signals from the axon. The signal travels through the neuron and passes onto another neuron.

Such Artificial neural network can be created in software or hardware of computer. The network can be represented as shown in **Fig.2**. The circles are nodes which act as artificial neurons. The Neural Network mentioned above can be grouped into three different layers:

- I. Input Layer
- II. Hidden Layer
- III. Output Layer



**Fig.2** Neural Network present in DL



The Input layer receives data. The Output layer provides the output. Between these two layers, there is hidden layer. The hidden layer can be made up of one layer or multiple layers. The hidden layer does mathematical calculations on the inputs that we have provided in Input Layer. There are two steps in which all neural networks work and those are called forward propagation and backward propagation. Forward propagation is where we calculate the output by initializing parameters and using functions starting from Input Layer. Such functions and parameters are applied subsequently at every Node. When we get the output, it is compared to the expected output. If the output has an error in it so that it is not as per our expectations, we try to minimize this error by updating the parameters. This updating of parameters is called backward propagation.

To explain in detail how forward propagation works we will consider a neural network with two hidden layers. Then let the inputs be  $x_1$  and  $x_2$ . To calculate the output at every node we are going to use the equation mentioned under 'Theory' as given below.

$$Y = \Sigma (\text{input} * \text{weights}) + \text{bias}$$

For this equation to work, we will need parameters weight and bias and function 'Activation function'. Weights are the co-efficient of the equation which you are trying to resolve. Bias is a constant value which is used to shift the result of the 'Activation function' towards the positive or negative side. The Activation function is a mathematical function which normalizes the output. Thus, let the weights be  $w_1$  and  $w_2$ . So, equation would become:

$$Y = \text{activation function}(x_1 w_1 + x_2 w_2 + \text{bias})$$

This is how the final output 'Y' is achieved. The Neural Network that was explained here is a basic one. There are so many other types of neural networks to solve different types of problems. The Neural Networks listed below are few of the top Networks.

Types of Neural Networks:

1. Feed-Forward Neural Networks
2. Radial Basis Function Neural Network
3. Multilayer Perceptron
4. Convolutional Neural Network
5. Recurrent Neural Network
6. Modular Neural Network
- 7.

### ADVANTAGES OF NEURAL NETWORKS

- In this digital age the amount of data found on the internet is enormous and disorganized. If a normal Machine learning algorithm is used you would first need to organize the data. However, this is where Deep learning algorithms are at its best. Data of different formats can be used to train Deep learning algorithms.
- After training the deep learning algorithms perfectly, the algorithm can perform complex tasks in a matter of minutes with accuracy and precision.
- Deep learnings also can identify the features of a dataset without the researchers' help and therefore saves a lot of time and cost for the researchers.
- It also eliminates the need to label the data because the Deep Learning algorithm does not need any guidelines.



- Deep learning algorithm can detect error by itself which is very difficult to identify for humans.
- Deep learning algorithm's structure can be altered to a specific problem.

### DISADVANTAGES OF NEURAL NETWORKS

- Deep learning algorithms require a large dataset to give accurate results. So, if sufficiently large data is not provided the algorithm may fail.
- If the deep learning algorithm has a lot hidden layers in it, it will require processors of high power which increases the cost.
- The Deep learning algorithm can be prone to bias which exist in input data, such as racial bias.
- If there are a lot of layers, the training process will consume lot of time.
- There is no fixed theory on how you can structure a deep learning algorithm so the researcher has to have understanding of the topology and the parameters.

### APPLICATIONS

There is a difference between machine learning and deep learning where machine learning is often just used for specific tasks and deep learning, on the other hand, is helping solve the most complex problems of the human race. Some of the applications are as follows:

- Healthcare  
According to NVIDIA, the multinational company designing graphics processing units, "From medical imaging to analysing genomes to discovering new drugs, the entire healthcare industry is in a state of transformation and GPU computing is at the heart. GPU-accelerated applications and systems are delivering new efficiencies and possibilities, empowering physicians, clinicians, and researchers passionate about improving the lives of others to do their best work."  
Thus, there can be several deep learning projects like helping early, accurate and speedy diagnosis of life-threatening diseases, pathology results and treatment course standardization, understanding genetics to predict future risk of diseases and negative health episodes in the Healthcare domain. Readmissions in health care facility is a huge problem for the healthcare sector as it costs tens of millions of dollars in cost. But with the use of deep learning and neural networks, healthcare giants are reducing health risks associated with readmissions while bringing down the overall costs. Deep Learning is also being excessively used in clinical researches by regulatory agencies to find cures to untreatable diseases. However, physicians' disbelief and lack of a humongous dataset are still creating challenges to the use of deep learning in medicine.
- Stock Analysis  
Quantitative Equity Analysts are getting more benefits, to find the trends for a particular stock whether it will be bullish or bearish and they can use many more factors like number of transactions made, number of buyers, number of sellers, previous day closing balance, etc. when training the deep learning layers. Qualitative Equity Analysts use economic factors like return on equity, P/E ratio, Return on Asset, Dividend, Return on Capital Employed, Profit per Employee, Total Cash, etc. when training the deep learning layers.



- **Fraud Detection**  
Another area where Deep Learning is useful is the banking and financial sector that is suffering with the task of fraud detection with money transactions going digital. Autoencoders in free and open-source software libraries like Keras and TensorFlow are being developed to detect credit card frauds saving billions of dollars of cost in recovery and insurance for financial institutions. Fraud detection and prevention are carried on based on identifying patterns in customer transactions and credit scores, identifying anomalous behaviour and outliers. Machine learning is widely used in fraud detection however its downside is that it requires human deliberation. This is where deep learning is trying minimize human deliberation by scaling efforts.
- **Image Recognition**  
Can you imagine yourself going through a plethora of old images taking you down the nostalgia lane? You decide to get a few of them framed but first, you would like to sort them out. The maximum you could do was to sort them out based on dates but downloaded images lack that metadata sometimes. Due to Deep Learning now images can be sorted based on locations detected in photographs, faces, a combination of people, or according to events, dates, etc. Searching for a particular photo from a library (e.g., dataset as large as Google's picture library) requires high level visual recognition systems consisting of several layers from basic to advanced, to recognize elements. Large-scale image Visual recognition through deep neural networks is increasing growth in this segment of digital media management by using convolutional neural networks.
- **News Analysis**  
Now there is a way to filter out all the bad and ugly news from your news feed. Extensive use of deep learning in news aggregation is planned to customize news as per readers. While this may not seem new, recent levels of sophistication to define reader personas are being met to filter out news as per geographical, social, economic parameters along with the individual preferences of a reader. Further, detection of Fraud news is an important asset in today's world where the internet has become the primary source of all genuine and fake information. It is very difficult to distinguish fake news as bots replicate it across various channels automatically. The Cambridge Analytica is the best example of how fake news, personal information, and statistics can influence reader's perception (Bhartiya Janta Party vs Indian National Congress), elections (e.g., Donald Trump Digital Campaigns), and exploit personal data (compromising Facebook data for approximately 87 million people). Deep Learning helps develop classifiers that can detect fake or biased news and remove it from your feed and warn you of possible privacy breaches. Training and validating a deep learning neural network for news detection is really hard as the data is filled with opinions and no one can ever decide if the news is neutral or biased.
- **Self-driving Cars**  
Deep Learning is also spreading fast to bring life to autonomous driving. To train the machines to learn and then test the results in a safe environment, a million sets of data are fed to a system to build a model. The Artificial Intelligence Labs for Uber at Pittsburg is not only working on making driverless cars popular but also integrating several smart



features such as food delivery options with the use of driverless cars. The major concern for autonomous car developers is handling unprecedented scenarios. A regular cycle of testing and implementation typical to deep learning algorithms is ensuring safe driving with more and more exposure to millions of scenarios. Data from cameras, sensors, geo-mapping is helping to create concise and sophisticated models to navigate through traffic, identify paths, signage, pedestrian-only routes, and real-time elements like traffic volume and road blockages. MIT is currently trying to develop a new system that will allow autonomous cars to navigate without a map to handle roads beyond the small number of roads that tech companies have already mapped. However, this is challenging because it is much harder to reach the same accuracy and reliability as with detailed maps.

- **Natural Language Processing**

Understanding the complexities associated with language whether it is syntax, semantics, tonal nuances, expressions, or even sarcasm, is one of the difficult tasks for humans to learn. Regular training since birth and continuous exposure to different social settings help humans develop appropriate responses and a personalized form of expression to every scenario. Natural Language Processing (NLP) through Deep Learning is trying to achieve this by training machines to learn linguistic details and frame appropriate responses. The subsets in NLP where Deep Learning is gaining momentum are answering questions, language modelling, classifying text, twitter analysis. Before Machine Learning algorithms were used to build time-consuming complex models but now distributed representations, convolutional neural networks, recurrent and recursive neural networks, reinforcement learning, and memory augmenting strategies are helping achieve greater growth in NLP.

- **Virtual Assistants**

The most recognised application of deep learning is virtual assistants such as Alexa. The Virtual assistants learn more about your voice and accent when you interact with them. Virtual assistants use deep learning to know more about their subjects ranging from your most visited spots to your dine-out preferences to your favourite songs. They *learn* to understand your commands by evaluating natural human language to execute them. Another capability virtual assistants are showing is to translate your speech to text, make notes for you, and book appointments. Virtual assistants can do everything from running errands to auto-responding to your specific calls to coordinating tasks between you and your team members. Using deep learning applications such as text generation and document summarizations, virtual assistants can assist you in creating or sending appropriate email copy as well.

- **Language Translations**

One of the fascinating applications of Deep Learning includes the Image – Language translations. With the Google Translate app we can in real time automatically translate photographic images with text into language of your choice. All one needs to do is to hold the camera on top of the object and your phone runs a deep learning network to read the image, Optical Character Recognition takes place (i.e., convert it to text) and then translate it into a text in the preferred language. This is an extremely useful application in the current world where many languages are spoken from region to region and country to



country. With this application, languages will gradually stop being a barrier, allowing universal human communication.

- Pixel Restoration

In chemical photography, since the original film is analogue, the zooming is limited by the molecules on the photo film. Since molecules are very tiny, one can zoom deeply in a good quality chemical photo film. However, now, digital photography has replaced chemical photography due to other advantages. The side effect of this change is that zooming in is now limited by the digital pixels of original digital image. Deep learning is able to overcome this challenge by creating additional virtual pixels when one tries to zoom. The advantage of these deep learning based is that the zoom seems smooth to human eyes, while providing zoomed details. Companies like Google are working in this area.

- Demographic Predictions

Deep learning is able to identify makes & models of the cars it sees. At the same time, deep learning also has created correlation between types of cars owned by people of various income strata of society. Combining the two, companies like Google are able to make predictions of income levels of a particular location based on cars seen in that location.

- Mass customisation and real time analytics in Entertainment

Wimbledon 2018 used IBM Watson to analyse player's emotions and expressions through hundreds of hours of footage to auto-generate highlights for telecast. This saved a lot of effort and cost. Due to Deep Learning, they were able to factor in audience response and match or player popularity to come up with a more accurate model, otherwise it would just have highlights of the most expressive or aggressive players.

Netflix and Amazon are enhancing their deep learning capabilities to provide a personalized experience so that the viewers are recommended entertainment shows of their liking. To generate insights based on performance and popularity, VEVO has been using deep learning to create the advanced data services for not only personalized experiences for its users and subscribers, but also artists, companies, record labels, and internal business groups. Deep video analysis can save hours of manual effort required for audio/video sync and its testing, transcriptions, and tagging. Content editing and auto-content creation are now possible due to Deep Learning. Deep Learning AI is also bringing new revolution in the filmmaking process as cameras learn to study human body language to imbibe in virtual characters.

- Detecting Developmental delay in Children

Children suffering from Speech disorders, autism, and developmental disorders can deny a good quality of life to them due to any of these problems. An early diagnosis and treatment of differently-abled children can allow them live a life without any problems in physical, mental, and emotional health. Therefore, one of the noblest applications of deep learning is in the early detection and course-correction of these problems associated with infants and children. Researchers at the Computer Science and Artificial Intelligence Laboratory at MIT and Massachusetts General Hospital's Institute of Health Professions have developed a computer system that can identify language and speech disorders even



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before kindergarten when most of these cases traditionally start emerging. In this deep learning, disorders can be detected when combined with cofactors such as low birth weight, age, etc.

### CONCLUSION

We humans have been using electronic computers for last seventy years now. They have had given us great benefits by automating Yes/no or 0/1 rules. Now, with deep learning, computers can help us solve problems which do not have clear cut Yes/no rules, for example face recognition has no set of yes/no rules that can be implemented. But deep learning can help us solve these types of problems with confidence and low cost. Human welfare will definitely improve significantly if we implement deep learning responsibly.

A project using deep learning is to determine if a person is economically challenged based on the photographs of the condition of their house, so that the banks can identify how much loan to give to a person. I have done similar project in grade XI using machine learning and by manually tagging images of houses to estimated incomes of houseowners. This project can be expanded into deep learning so that society can benefit from it.

### REFERNCES

#### Book

S.Langfield and D.Duddell, Artificial Intelligence in Computer Science for Cambridge International AS and A Level, Cambridge, United Kingdom, Cambridge University Press, 2019, ch. 22, pp. 406-407.

#### Websites

- 1) IBM Cloud Education “Deep Learning” [ibm.com](http://ibm.com)  
<https://www.ibm.com/cloud/learn/deep-learning> (Accessed May. 23, 2021)
- 2) R.Raicea “Want to know how Deep Learning works? Here’s a quick guide for everyone.” [freecodecamp.org](http://freecodecamp.org)



- <https://www.freecodecamp.org/news/want-to-know-how-deep-learning-works-heres-a-quick-guide-for-everyone-1aedeca88076/#:~:text=%20In%20summary%20E2%80%A6%20%201%20Deep%20Learning%20uses,set%20and%20comparing%20the%20outputs%20will...%20More%20>  
(Accessed May. 29, 2021)
- 3) P. Shinde “Forward and Backward propagation” inblog.in  
<https://inblog.in/Forward-and-back-propagation-Be2cOEcnKL> (Accessed June 17, 2021)
- 4) F. Malik “Neural Networks Bias and Weights” medium.com  
<https://medium.com/fintechexplained/neural-networks-bias-and-weights-10b53e6285da>  
(Accessed June. 17, 2021)
- 5) A. Ghoshal “Types of Neural Networks” educba.com  
<https://www.educba.com/types-of-neural-networks/> (Accessed June. 30, 2021)
- 6) H. Ali Khan “Advantages and Disadvantages of Deep Learning” newsmaritime.com  
<https://www.newsmaritime.com/2021/advantages-disadvantages-deep-learning/> (Accessed June. 30, 2021)
- 7) P. P. Damkar “Deep Learning” educba.com  
<https://www.educba.com/deep-learning/> (Accessed June. 30, 2021)
- 8) M. Chatterjee “Top 20 Applications of Deep Learning in 2021 Across Industries” mygreatlearning.com  
<https://www.mygreatlearning.com/blog/deep-learning-applications/#:~:text=Top%20Applications%20of%20Deep%20Learning%20Across%20Industries.%201.Detection.%203%203.%20Natural%20Language%20Processing%20%28NLP%29%20> (Accessed July. 7, 2021)
- 9) Dr A. Woodruff “What is a neuron” qbi.uq.edu.au  
<https://qbi.uq.edu.au/brain/brain-anatomy/what-neuron> (Accessed July. 19, 2021)
- 10) A. Choudhury “Understanding Normalisation Methods in Deep Learning” analyticsindiamag.com  
<https://analyticsindiamag.com/understanding-normalization-methods-in-deep-learning/#:~:text=Normalization%20is%20an%20approach%20which%20is%20applied%20during,which%20can%20be%20used%20in%20deep%20learning%20models>  
(Accessed July. 19, 2021)
- 11) J. Frankenfield “Artificial Intelligence” investopedia.com  
<https://www.investopedia.com/terms/a/artificial-intelligence-ai.asp> (Accessed July. 19, 2021)
- 12) IBM Cloud Education “Machine Learning” ibm.com  
<https://www.ibm.com/cloud/learn/machine-learning> (Accessed July. 19, 2021)
- Figure*  
Fig.1 <https://www.brains-explained.com/how-our-brains-learn/> (Accessed May. 29, 2021)



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Fig.2 <http://www.marktorr.com/deep-learning/> (Accessed May. 29, 2021)



### BIOINFORMATICS: NUTRIGENOMICS & PERSONALIZED DIETS

**Samuel Seth Barrett**

Prabhavati Padamshi Soni International Junior College  
971@ppsijc.org

#### Abstract

The rise of nutritional genomics is ushering in a new era, where ordinary people can obtain detailed information about the makeup of their genes and therefore their ideal diet, which not only reduces significantly the chances of contracting allergy/diet related conditions, but also maximizes the health of the individual. A single letter change in the DNA of an individual could well dictate the types of food that suit you the best, and nutrigenomics can figure it all out for you.

**Keywords:** *nutrigenetics, nutrigenomics, personalized diets, bioinformatics*

#### INTRODUCTION

Nutrigenomics (nutritional genomics) is “the study of nutrition and its relationship with the genome.” Post the culmination of the Human Genome Project in April 2003[1], research projects on the dynamic between the diet and the genome have grown exponentially in number. It was soon discovered that nutritional intake can both affect and be affected by the genome. This revelation has incited a flurry of endeavors to find out how and why. The body’s ability to take nutrition in, use it efficiently and burn energy in an effective manner varies a lot between people. Therefore, studying an individual’s DNA can help create a personalized dietary plan. Although nutrigenomics can have remarkable effects in everyday life, very few people can claim to have benefitted from it, mainly due to a lack of awareness. In this paper, I look at the various effects and implications the DNA of an individual can have on their ideal diet.

#### Theory

##### The Human Genome in Numbers

The human genome comprises of approximately 2.9 billion nucleotides, or 30,000 genes [2], a lot of which are involved in metabolic pathways, composed of simply four chemical units, the base pairs- Adenine, Thymine, Guanine, and Cytosine ( A,T,G and C). Though most genes do not directly cause complex diseases, they can enhance our receptiveness to them. The 21<sup>st</sup> century’s genomic revolution [1] facilitated the study of these genes, thus creating nutrigenomics as a field.



### Personalized Nutrition

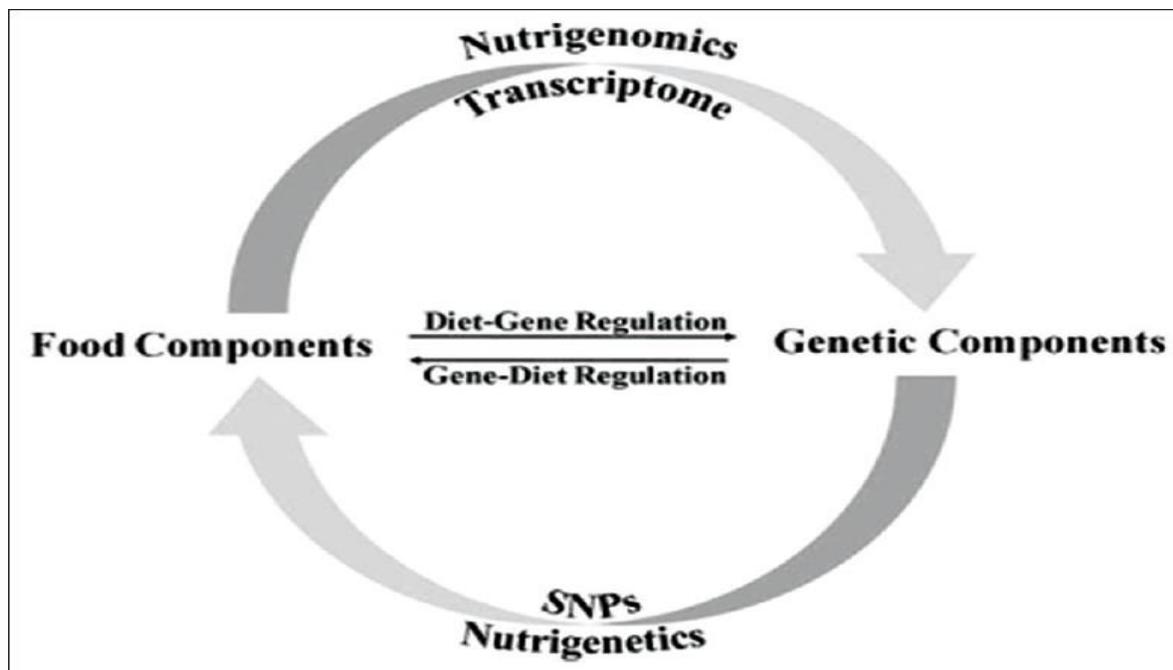
Personalized nutrition and nutrigenomics are not the same thing. Personalized nutrition, which does not involve the consideration of specific genes, has been around for ages[3]- when we tailor a person's nutritional intake to their preferences, nutrition, disease state, age, and sex, for example. The very act of omitting a particular fruit or vegetable from your diet due to personal preferences and/or allergic conditions can be termed personalized nutrition. When the personalized nutrition is gene-based, it can be termed nutritional genomics (to reduce health problems and delay the onset of diseases).

### Nutrigenetic tests

On their own, our genes do not dictate the state of our health. The newly-emerging science of epigenetics -“The study of how your behaviours and environment can cause changes that affect the way your genes work“-informs us how our biochemical environment decides which of our genes are turned on and which of them are turned off. Our modern diet, lifestyle and environment is actually responsible for the majority of all health problems, as opposed to our inherent genetic traits. Genetic profiles, together with functional testing[6], provide information that can raptly and concisely procure the finest ways to optimize your well-being. They could show patterns and behaviours that may result in health conditions that do not lessen in severity, in spite of following dietary and lifestyle advice that can be generally beneficial to most other people( A one-size-fits-all approach). Getting your genetic makeup tested is thus the first step to understanding what you can do to benefit and support your health, and is a very beneficiary process through the knowledge it can bestow you with, which may motivate you to change your lifestyle for the better. Nutrigenetics tests involve collecting DNA samples from individuals and analyzing it using complex bioinformatics tools in order gauge information, such as that mentioned in the following points about the individual:

- Tendency for inflammation
- Optimum methods of weight loss
- The strength of your biochemical pathways, what you can do to enhance it and its effect on you.
- Your detoxification capability for various toxins that you in everyday modern life.
- your natural caffeine and lactose intolerance, and your body's ability to create vitamin A from carotenoids like beta-carotene.
- your ability to break down oestrogen, and therefore your risk for several diseases that are common to both men and women.
- Antioxidant potential
- how your genes have an effect on your mood normally and your overall ability to wear down stress.
- risk factors for insulin resistance, obesity, addiction, cognitive decline, cardiovascular disease[5], osteoporosis, IBD (Inflammatory Bowel Disease such as Crohn's disease and ulcerative colitis)
- what types of functional tests you should take into account for preventative health measures.

## Nutrigenomics vs Nutrigenetics



**Fig.1**

Figure 1 depicts the differences between nutrigenetics and nutrigenomics. The investigation of how food components dictate changes in gene expression profile or transcriptome is outlined as nutrigenomics, while nutrigenetics can be defined as the study of how genetic variations such as single nucleotide polymorphism (SNP)[4] among people affect their response to a specific food component. The two branches are often referred to as two different sides of the same coin – they face opposite directions, but are also joined together at the same time.

### Genes and Food Preferences

The types of food that we enjoy and the ones that we don't have been associated with our genes. Taste receptors like T2Rs and T1R[7] may partially influence preferences for bitter or sweet foods, which can lead to overeating sweet, sugar-rich foods, while variation in ankyrin-B gene[8] can induce fat cells to store glucose at a much higher rate than normal.

A number of signals, such as blood sugar levels, the presence of certain nutrients, signals from the gastrointestinal tract (the brain-gut-microbiome axis is an imperative factor) and other sources all influence our desire to consume foods. Eating more or less than is necessary is often due to genetic factors that affect these signals.

### Questionnaire

In lieu of an experiment, an online questionnaire (primary research) was conducted in an attempt to gather information about the public about nutrition and their diet. A total of 220 responses were collected over a period of two days, from which the results of the study were based on. The following questions were asked in the questionnaire :



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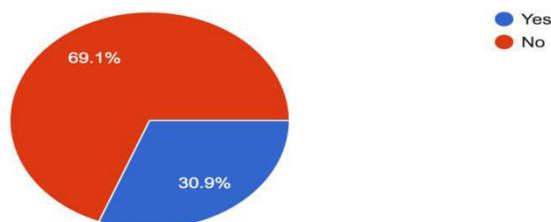
- 1) Do you have any known food-related allergies?
- 2) If yes, the reactions are : (severe/moderate/mild)
- 3) Are you currently on a diet?
- 4) If yes, how long have you been on a diet?
- 5) If you have been on a diet for more than a month, would you say that it has been effective?
- 6) Have you ever taken a nutrigenetics test?
- 7) Last Question. Do you like pineapple on pizza?

### RESULT

- 1) 30.9% of respondents stated that they have food-related allergies.
- 2) Of that 30.9 percent, 14.7% have severe reactions, 33.8% have moderate reactions, and the most, 51.5% have only mild reactions.
- 3) 28.2% of all respondents state that they are on a diet.
- 4) Of those on a diet,
  - 16.1% have been on a diet for more than a year
  - 24.2% have been on a diet for between 6 and 12 months
  - 27.4% have been on a diet for between 1 and 6 months
  - 27.4% have been on a diet for more than 2 weeks
  - 3.23% have been on a diet for one week
  - 1.61% have just started their diet
- 5) Of those who have been on a diet for more than one month, 83.9% feel their diet has been effective, while 16.1% feel little to no change.
- 6) Only 2.3% of all people questioned stated that they have taken a nutrigenetics test previously, 215 people out of 220 having never undergone one.
- 7) Only 17.7% of all respondent stated that they like pineapple on pizza, while 40.9% of the 82.2% that did not like pineapple in pizza felt very strongly about it, clicking the option “never in a million years”

### DISCUSSION

Do you have any known food -related allergies?  
220 responses



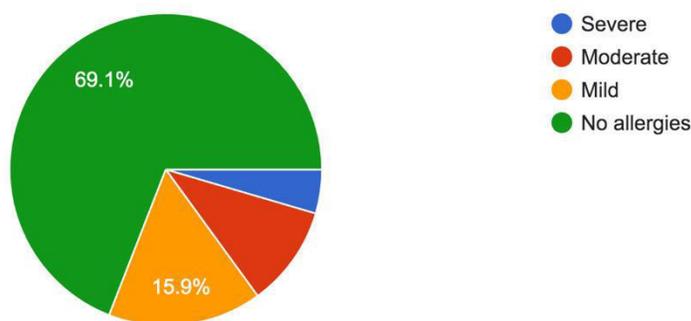


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- 1) This question was asked to gauge the percentage of people who suffer from food-related allergies. Roughly 31% do, indicating that approximately 1 in 3 people have a food-related allergy. Allergies can also be discovered through the use of bioinformatics, in nutrigenetic or genetic tests.

If yes, the reactions are:

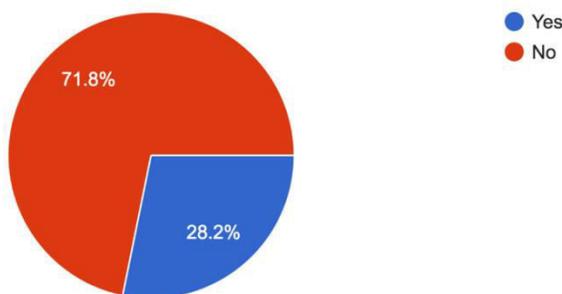
220 responses



- 2) Asked to find out the average severity of allergic reactions - 15% of all people with allergies have severe reactions, which is an alarming health condition that could be predicted through the use of nutrigenetic tests as well.

Are you currently on a diet?

220 responses



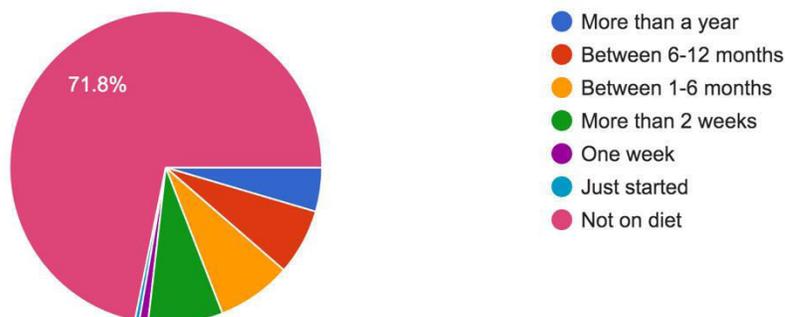


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- 3) 28% of people asked stated that they are on a diet, this is an example of personalized nutrition.

If yes, how long have you been on a diet?

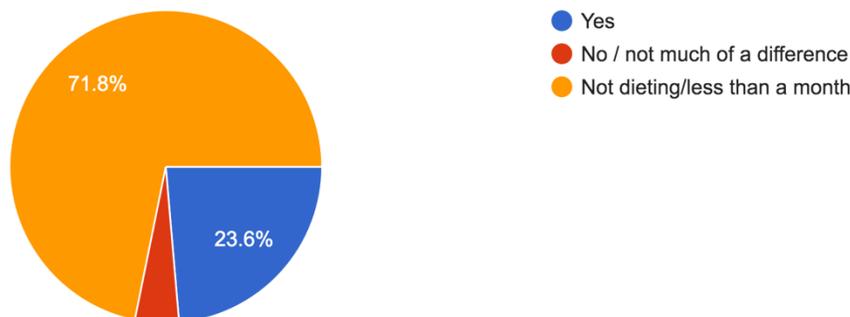
220 responses



- 4) The majority of people who are on a diet have been dieting for between 2 weeks and 6 months, while 17.5% have been dieting for over a year. This group of people have probably seen success in their diets, as seen in the next question, and have therefore decided to continue for a long period of time. A nutrigenetics test could inform people of a diet that they could follow in an optimum period of time, as well as the chances of a particular diet being successful

If you have been on a diet for more than a month, would you say your diet has been effective?

220 responses



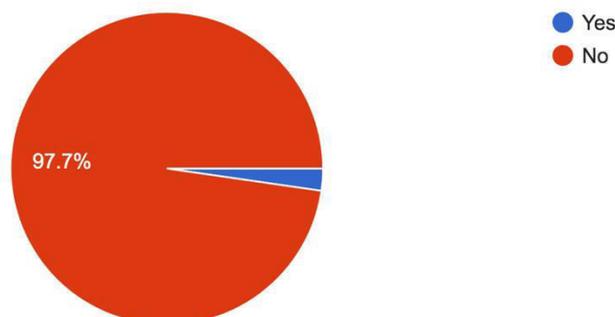


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- 5) 84% of all respondents who are following a diet have stated that they feel their diet has been effective, which leaves 16% who felt it has made no difference. This could also have been
- 6) Avoided with a nutrigenetic test, as a personalized optimum diet would have been recommended. The peoples who feel little to no difference are likely following a standard diet, which is not having an effect on their body due to the individual's specific genes.

Have you ever taken a nutrigenetics test?

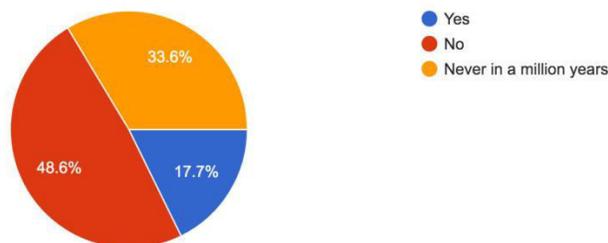
220 responses



- 7) Only 2.3% of all people asked had ever taken a nutrigenetics test, proving how little known the sciences of nutrigenomics and nutrigenetics are. With more awareness of the same, a greater percentage of people on a diet would have been able to claim that their diet has been effective, as well as figure out any possible allergies without triggering them first.

Last question. Do you like pineapple on pizza?

220 responses





- 8) The last question had a humorous spin, but it was also asked for the purpose of gauging the wide variety of tastes of the public. A whole 82% of people stated that they do not like pineapple on pizza, with 41% of them vehemently dismissing the idea (“Never in a million years”) On the other hand, 18% of all respondents actually state that they like pineapple on pizza, which goes to show how far apart people’s tastes may be. Tastes like these have customized many people’s diets to include foods that they like, and exclude foods that they do not, and can also constitute a personalized diet.

### Conclusion

All of this just goes to show how bioinformatics could impact everyday life in profound and meaningful manners, and its effects will soon become much more prominent once the technology spreads more and more awareness has been raised. Problems such as inefficient dieting, surprising allergies, and unexpected health conditions can stop being the plague that they currently are on society, as health and fitness become the norm.

### Acknowledgements

Google Forms was used to create the online questionnaire mentioned in the paper.

### REFERENCES

- [1] “The Human Genome Project”, <https://www.genome.gov/human-genome-project>, (Accessed June 24,2021)
- [2]Dr. V. Konstantinidou. “Nutrigenetics Nutrigenomics, what it is and what it is not” <https://www.dnanutricoach.com/nutrigenetics-nutrigenomics/> (Accessed June 20, 2021)
- [3] M. Abrahams “Nutrigenomics vs. Personalized Nutrition – there’s a difference”<https://marietteabrahams.com/>  
<https://marietteabrahams.com/2015/08/nutrigenomics-vs-personalized-nutrition-theres-difference/> (accessed May 30, 2021 )
- Fig 1. –image obtained from: [http://openi.nlm.nih.gov/detailedresult.php?img=2682937\\_CG-9-239\\_F1&req=4](http://openi.nlm.nih.gov/detailedresult.php?img=2682937_CG-9-239_F1&req=4)
- [4] SNP definition-<https://www.nature.com/scitable/definition/snp-295/>(Accessed July 10, 2021)
- [5] ”London Naturepath- Functional Medicine and Nutrition for Heart Diseases” [wisdomnutrition.co.uk](http://wisdomnutrition.co.uk)<https://wisdomnutrition.co.uk/london-naturopath-functional-medicine-and-nutrition-for-heart-disease/>
- [6] “Functional Laboratory Tests” [whole-nutrition.co.uk](http://whole-nutrition.co.uk) <https://www.whole-nutrition.co.uk/functional-laboratory-tests/>
- [7]Alexander A. Bachmanov and Gary K. Beauchamp, “Taste Receptor Genes” [ncbi.nlm.nih.gov](http://ncbi.nlm.nih.gov) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2721271/> (assessed July 12, 2021)
- [8]Sara N. Koenig and Peter J. Mohler, “The evolving role of ankyrin-B in cardiovascular disease” in Heart Rhythm, vol.14 ,issue 12 pp. 1884-1889 December 2017 <https://www.sciencedirect.com/science/article/abs/pii/S1547527117309566>
- [9]N. Bray “The microbiota-gut-brain axis” [nature.com](http://nature.com) <https://www.nature.com/articles/d42859-019-00021-3> (accessed 14th July, 2021)



## ARTIFICIAL INTELLIGENCE AND COVID-19 PANDEMIC

**Anjali Govind Chauhan**

Rustomjee Cambridge International School  
[rcdce066@school.rustomjee.com](mailto:rcdce066@school.rustomjee.com)

### Abstract

Bioinformatics is an interdisciplinary field of biology and computer science concerning biological data and understanding its methods of collection, classification, storage and analysis. Large and complex data sets, revolving often around DNA and amino acid sequences, are viewed from computational point of view. Molecular biologists make use of bioinformatics when analysing various protein sequences, biomolecules and biologic systems, etc. There are several disciplines under bioinformatics that are raised as research and thesis issues and problems, but the most significant ones are the fusion of computer science and molecular biology. Due to production of huge amounts of biological data, bioinformatics has a high scope of setting trends in machine learning in future.

**Keywords:** *Bioinformatics · Applications · Research Challenges · Future of bioinformatics · Biological Data Set*

### INTRODUCTION:

Bioinformatics is an intriguing fusion of biology, computer science, information engineering, mathematics and statistics. It conceptualises around biological data and queries which are analysed and solved using mathematical and statistical techniques, software tools and particular algorithms. This idea of modelling of biological systems is the reason why bioinformatics is also termed as “computational biology”. Most often, the biological data that is input is the form of molecular biology that is macromolecular structures, genome sequences, and the results of genomic experiments. The computational techniques that are made use of, to resolve this data, include sequence and structural alignment, database design and data mining, macromolecular geometry, etc. In other words, the first and foremost aim of bioinformatics is to make use of machine learning and data science to solve and simplify the issues and challenges noticed in biological systems and processes. With constant generation of tremendous amounts of biological data, machine learning has made it easier to predict sequences of DNA and RNA strands, count the number of nucleotides in a single human genome, and several other complex tasks which seem nearly impossible to accomplish if meant to do manually. With rapid advancements in development of drugs, diagnostic tools and vaccines, bioinformatics is definitely set to make new trends in future encouraged by the introduction of Artificial Intelligence.



Artificial Intelligence is an approach of replicating how a human brain thinks, learns, decides and works when analysing complex data. The objective of this intelligence is to be able to successfully make a computer, or a robot, imitate a human's way of reasoning, learning, problem-solving, perception and the ability to move and manipulate objects. AI in the field of Bioinformatics is a recently induced art and has already set a few recent trends. The two major categories of AI are 1) Machine Learning and 2) Deep Learning. With the use of these extensive and advanced learning, it is easier to analyse, process and categorise the huge amount of biological data to produce a logical conclusion, in a considerably less time. Several AI algorithms are generated which help in discovery of vaccines for diseases, silicon structure prediction for cancer (*in silico*), molecular dynamic simulations, design of active novel compounds for neurological disorders, and many more. These methods have shown a comprehensive impact on not just the present and future of bioinformatics, but also on biotechnology, pharmacology and medicine. The advanced algorithms of AI have helped in drug discovery and vaccine development for the increasing rate of mutations in microbes and viruses. AI also played a major role in the development of the Covid-19 vaccine. The *in silico* methodology was used to carry out a breakthrough on the corona virus' biological sequence which later on helped in the development of diagnostic tool with the help of reverse transcription polymerase chain reaction (RT-PCR). This research paper focuses on how Artificial Intelligence (AI) was involved with Bioinformatics in the making of the Covid-19 vaccine.

### **THEORY:**

6.3% of the people living in India have already been vaccinated for the deadly virus that has infiltrated the world since 2019 and 13.1% people across the globe. David Smith, an associate VP of virtual medicine at UMass Memorial Health Care explained that Artificial Intelligence can be used to study and learn about the mutating patterns of the virus in a more real time which will help to understand where the curve of the pandemic growth needs to be curbed first and also the distribution logistics of the vaccine so that most people are vaccinated in the least time. Matthew Putman, an AI expert and CEO of Nanotronics, pointed out that with new types of variants gradually coming to light, it is difficult for humans to do reprogramming as quick as possible with the tremendous amount of data. Hence, artificial intelligence agents are brought in to deal with this to keep up with pace, which is required. With people being more open to AI, it has been used from diagnosis to drug development, from forecasting the disease's spread to monitoring and surveillance of the population. Using AI was vaccine rollout, Putman said that it will definitely come handy in the near future after the first round of dosing since the blueprints would have been created which will be useful for mass inoculation. Researchers can use Artificial Intelligence to grasp data about how the Covid-19 virus is mutating time to time and how effective each vaccine to be able to refine vaccines regularly and develop new ones before complete development of additional strains.

### RESULT:

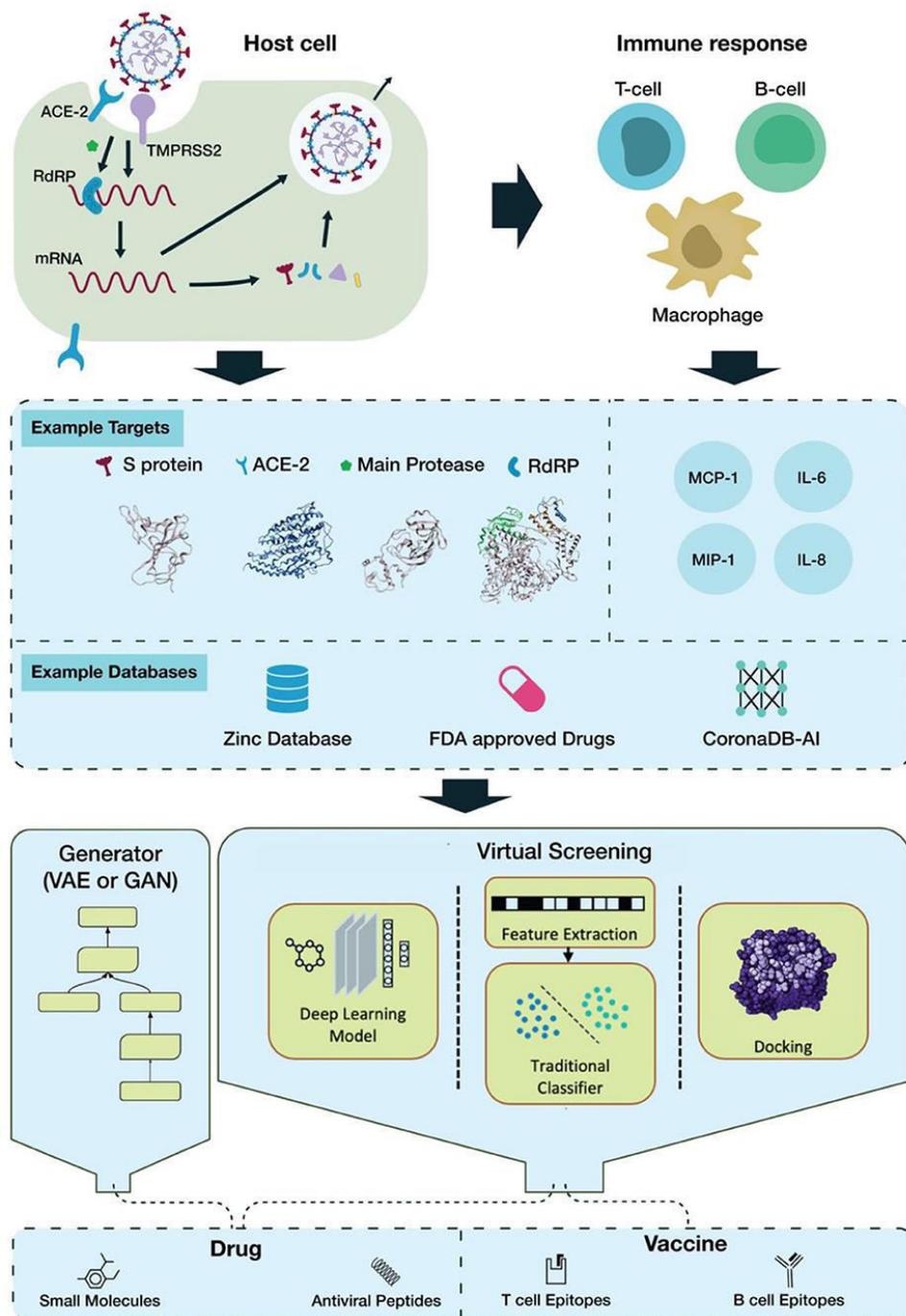


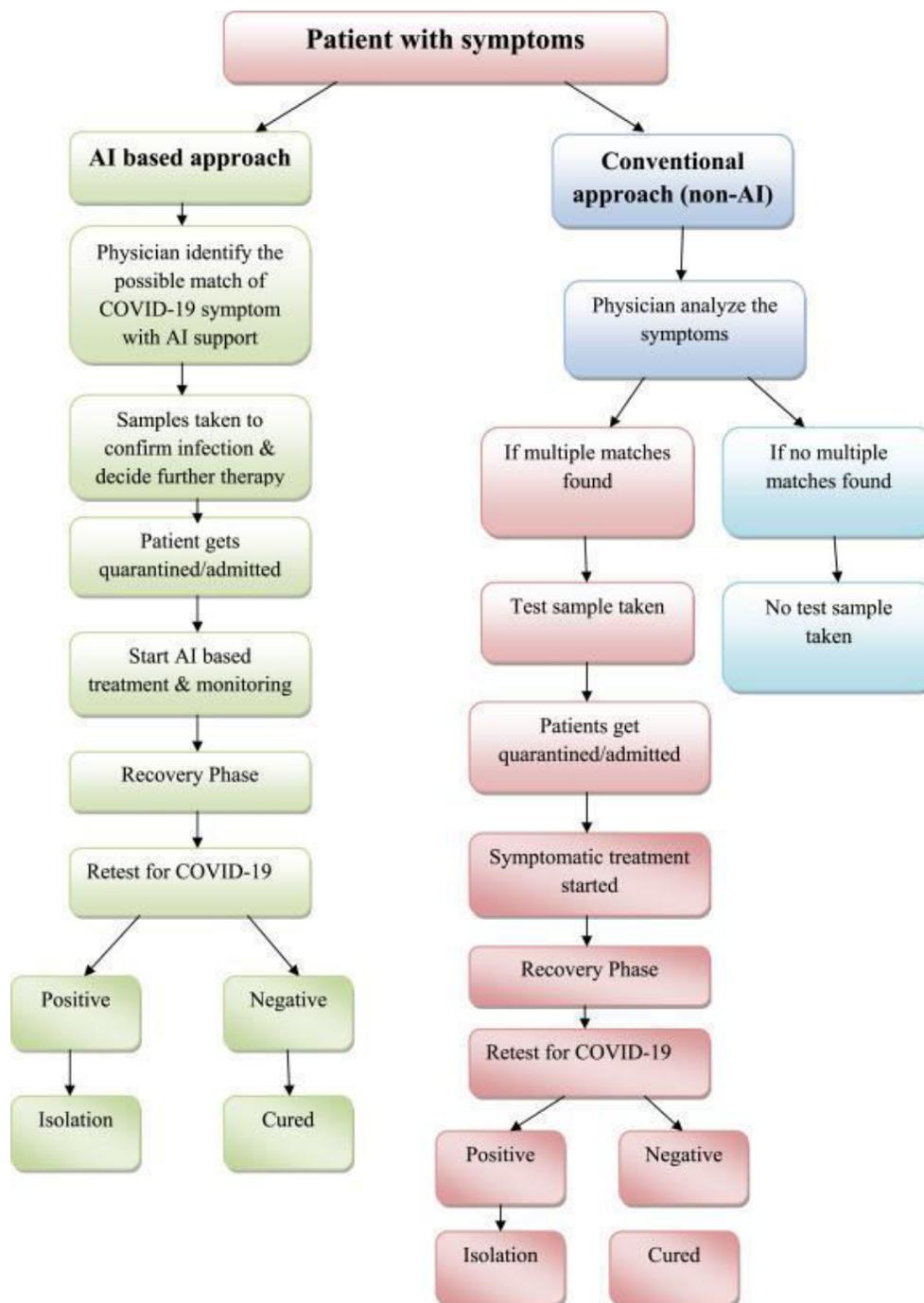
Fig 1. The pipeline of AI-based drug discovery and vaccine development for Covid-19



Several applications and techniques of Artificial Intelligence have been harnessed ever since the identification of the disease clusters, to monitoring of the cases, prediction of future outbreaks, diagnosis of Covid-19, lastly to drug discovery and vaccine development. AI was used to study the spread of the virus and develop early warning systems by extracting information from social media platforms, calls and news sites and provide useful information about the most likeable vulnerable regions. Using the approach of machine learning (ML), Bluedot was successful in tracking and giving a specific geographical location of the first Covid-19 outbreak. Then several mobile health applications had been created and introduced where a range of wearable devices including mobile phone and cameras were utilized to detect a possible occurrence of the corona virus by contact-tracing and efficient monitoring. Based on the data derived from monitoring the vital statistics and clinical parameters of a patient, AI techniques were used to obtain critical information which then helped in decision-making of prioritizing the need of the diagnostic tools like respiratory supports and ventilators. AI was employed to provide daily updates, store data and mark the trend analysis and chart the course of treatment, thus giving an idea about the chances of recovery or the mortality in Covid-19.

The approach of deep learning (DL) was harnessed to make a model named COVID-19 Detection Neural Network, which was helpful in differentiating between Covid-19 and the community-acquired pneumonia. The RT-PCR results of COVID-19 were predicted using AI-based classifiers and the data was derived from the 16 simple parameters of complete blood profiles. The methodology of Vaxign reverse vaccinology was used to develop vaccines for the COVID-19. This machine learning platform depended on supervised classification models to create vaccine the fastest against a pathogen, something which the world has never witnessed before. Machine Learning was applied on identified genomic structures for fast and an accurate identification of SARS-CoV-2 genomes, which led to the first wave of Covid-19 in 2020.

To sum it up, there are seven significant applications of Artificial Intelligence that were helpful in the Covid-19 pandemic. All these are used to detect the cluster of cases and where in the future will the virus affect the most, based on the data collected and analysed from the previous batch of data.



**Fig 2. The seven significant applications of Artificial Intelligence (AI) used for COVID-19 pandemic**



### DISCUSSION:

Covid-19 pandemic has become a global challenge affecting thousands of lives, healthcare centres and economy as well. As of lately, an average of 450 million samples were tested in India for the fight against corona virus, with an average of 410 million vaccines that were administered lately. With a spur in AI craze, AI techniques and tools have time and again helped on research of treatment rapidly analysing large volumes of research data. AI text and data mining tools can uncover the virus' history, transmission, and diagnostics, management measures, and lessons from previous epidemics. Several institutions have employed the deep learning approach to analyse old drugs and discover new ones that might help in Covid-19 treatment. Employing artificial neural networks and supervised learning methods has proven to be a vital game-changer when used for the purpose of virtual filtering and *de novo* design. AI technologies have proved to be a better alternative to infer epidemiological data at a faster rate than traditional methods of reporting health data. Dedicated platforms, news channels, social media trends study and analyse the real-time data on confirmed coronavirus cases, recoveries, and deaths, thus also making sure to find the origin of any false news of the same or rumours that might cause misunderstandings about the same, if any. Rapid diagnosis is harnessed to understand the spread of the disease at a rapid speed with the involvement of Artificial Intelligence. Population surveillance is being used to limit contagion in many countries and prevent the spread of the disease. Austria, China, Israel, Poland, Singapore and Korea have employed to using the Contact Tracing approach to make people aware of the approaching contact with the virus carriers and notify them immediately. Robots and drones are being positioned to be available for immediate help in the time of need in hospitals or healthcare centres for delivering food and medications, cleaning and sterilisation, aiding doctors and nurses, and performing deliveries of equipment. In general, Artificial Intelligence is the simulation of human intelligence that replicate human's tasks at a quicker pace and in a more accurate manner. It can read CT scans and identify clusters of pneumonia virus and rapidly comb through thousands of chemical compounds to identify promising drug candidates.

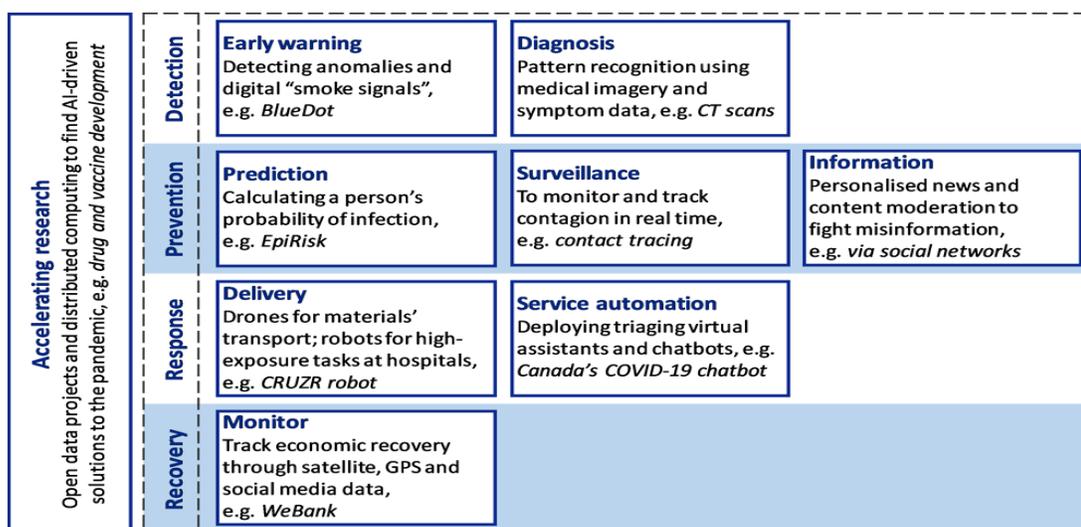


Fig 3. Using Artificial Intelligence to help combat COVID-19



### CONCLUSION:

The four-pronged approach based on Detection, Prevention, Response and Recovery is guaranteed to help in getting rid of the Covid-19 virus. Due to its proficient way to replicate human intelligence, AI is in immediate need for handling the coronavirus and finding all possible ways to avoid its spread in real-time before it proceeds to bring a new Phase 3. It is urgent to update the progress in all fronts from surveillance and monitoring to prevention and treatment before the third outbreak. As the SARS-CoV-2 mutates yet again, it is extremely necessary to decrypt the molecular mechanism of this variant. In recent times, many coronaviruses are being speculated to most likely be found in animal reservoirs. As of now AI is way ahead of the human methodology in COVID-19 diagnosis and drug discovery and development. But before the situation worsens to the third phase, it is very important to bring in bigger datasets for AI model training to bring them to their full potential to be able to work efficiently for clinical and epidemiological data, computational resources, scalability, privacy and ethical concerns.

### REFERENCES:

1. <https://en.wikipedia.org/wiki/Bioinformatics> (accessed July 17, 2021)
2. S.-Y. Zhang, S.-L. Liu <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics> (accessed July 17, 2021)
3. P. Baker <https://genomealberta.ca/genomics/a-quick-intro-to-bioinformatics.aspx> (accessed July 17, 2021)
4. A. Shreya <https://towardsdatascience.com/ai-in-bioinformatics-a1acdc3cdd89> (accessed July 18, 2021)
5. A. Ye <https://towardsdatascience.com/bioinformatics-how-ai-can-contribute-to-the-study-of-life-7a67f3d62a9f> (accessed July 18, 2021)
6. M. Selvamannikkam <https://becominghuman.ai/introduction-to-artificial-intelligence-5fba0148ec99> (accessed July 18, 2021)
7. J. Webb <https://www.frontiersin.org/articles/10.3389/frai.2020.00065/full> (accessed July 19, 2021)
8. W. Hanif [http://thesciencepublishers.com/biomed\\_lett/files/v5i2-8-BML201912102.pdf](http://thesciencepublishers.com/biomed_lett/files/v5i2-8-BML201912102.pdf) (accessed July 20, 2021)
9. R. Vaishya <https://www.sciencedirect.com/science/article/abs/pii/S1871402120300771> (accessed July 20, 2021)
10. N. Arora <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7692869/> (accessed July 20, 2021)



### TELEMEDICINE IN INDIA: A BOON IN THE ERA OF COVID-19

**Gaurav Anand**

JBCN International School,  
Borivali West, Mumbai  
[gauravanand904@gmail.com](mailto:gauravanand904@gmail.com)

#### Abstract

Telemedicine has been used in Indian health care earlier, however the COVID-19 pandemic has provided the nation an enormous opportunity to increase its access and coverage with an added dimension. It gives health-care providers an opportunity to incorporate a telemedicine system to reduce doctor-patient physical contact and help in breaking the chain of transmission of infection and at the same time not neglecting the healthcare of patients. Various measures have been taken in India along with the guidelines provided by the Medical Council of India for the Registered Medical Practitioner (RMP). In this article, the literature pertinent to telemedicine with special reference to recently released practice guidelines were reviewed and summarised along with providing awareness about different types of telemedicine.

**Keywords:** *Telemedicine, COVID-19, E-health*

#### Introduction

Today, in the 21st Century though the technological and scientific domain advancements are magnificent, the present Covid-19 pandemic situation has proved us incompetent in various fields. The losses impact not only physical health but mental health, the economy, and the overall existence of humanity.

With India being the second-most populous country in the world with a population of 1.21 billion, the challenges are manifold. Firstly, the disparate ratio of doctors to patients increases the challenges. In addition to this, 69% of the total population lives in rural parts, so adequate and equitable distribution of health services has always been a matter of high concern. Telemedicine is an important tool that uses information and communication technologies to combat geographical barriers and improve health care services.

#### Overview of Telemedicine

In 1970, a term coined as telemedicine, which literally means “healing at a distance” came into existence. Based on various studies of peer review, the World Health Organization adopted the following description:

“The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid



information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities.”

Telemedicine claims its roots way back in the year 1959 when the first real-time video consultation by the doctors at the University of Nebraska used interactive telemedicine for neurological examination. Telemedicine also proved substantial in disaster management when NASA first used telemedicine services during the 1985 Mexico city earthquake in 1985 and the Soviet Armenian earthquake in 1988.

Substantial milestone in public health management using telemedicine was the establishment of a space centrenamed Medical Informatics and Technology Applications Consortium at Yale University in the year 1997 by NASA. The advancement in technology resulted in the transfer of images, sharing of medical files including X-rays and scans, audio and video consultation made telemedicine an effective tool.

### **Telemedicine can be classified into four types**

1 On the basis of the timing of the information transmitted and people involved.

a. Real-time telemedicine or synchronous: In this method, the individuals involved need to be simultaneously present for the transmission of information which can be either in the form of telephone calls or video conferencing.

b. Store-and-forward telemedicine or asynchronous: In this method, the exchange of pre-recorded data between two or more people at different times takes place. It is an easier and simpler method as doctors can see the patient investigation sheets, USG or X-ray reports later at a convenient time.

2 On the basis of mode of communication-

a. Videos b. Audio c. Text-based

3 On the basis of the purpose of the consultation-

a. First time consult- the patient may consult with the doctor for diagnosis and treatment

b. Follow-up-Patient use the service for follow-up consultation on the ongoing treatment.

4. On the basis of the individuals involved-

A. Patient to Doctor. B. Caregiver to Doctor

C. Doctor to Doctor. D. Health Worker to Doctor

### **Application of telemedicine in the various sectors**

1. Tele-education: Telemedicine has great prospects for medical education. The incorporation of telemedicine can provide positive and promising results in comparison to the traditional educational approach. With the help of telecommunication technologies, distance learning is possible which allow students to contact real patients and qualified specialists resulting in better knowledge and improved clinical skills. Also, it is flexible and interactive too.

2. Telehealthcare: One of the biggest challenges in rural healthcare is easy access to various health services. Telemedicine helps to solve these problems by providing medical services to the patient regardless of the location. The patient can be remotely examined about key vital signs and medical history; evaluated; diagnosed; and prescribed the drugs. It significantly reduces the need for unnecessary commuting to a place, saving time, money, and effort.



3. Disaster Management: Telemedicine can play a pivotal role in providing healthcare assistance to the victims of natural disasters such as earthquakes and tsunamis; and man-made disasters like wars and civil unrest among others. Telemedicine helps the victim to access medical services after any disaster. If communication links don't work during a disaster, satellite connectivity and customized telemedicine software work well during that time. Likewise, telemedicine also provides opportunities to remote contact patients who are in the quarantine phase. The patient's condition like temperature and oxygen level can be monitored through smart devices which are wearable. This feature really helped prevent the situation from getting worse during the COVID 19 pandemic worldwide.

4. Tele-home health care: Telemedicine technology can be applied to provide health care for prison inmates, elderly people, or homebound patients with chronic illnesses. To monitor patients for twenty-four hours, a Computer Telephone Integrated (CTI) system is used to provide substantial readings and give immediate warnings in case of emergencies. So, the patient is monitored remotely from a central station rather than traveling to remote areas for routine check-ups. Tele home care improves health care quality at reduced costs, and increased access to health care providers. It is less expensive, saves time, and efficient method.

### Telemedicine in India

Telemedicine of India is growing steadily as Indian Space Research Organization (ISRO), Department of Information Technology (DIT), Ministry of External Affairs, Ministry of Health and Family Welfare, along with the state governments are substantial in its development.

Indian Space Research Organization is the pioneer of telemedicine in India with a Telemedicine Pilot Project in 2001, linking Chennai's Apollo Hospital with the Apollo Rural Hospital. Over the past few years, Indian Space Research Organization telemedicine network has expanded to connect 45 remote and rural hospitals and 15 super-specialty hospitals has been successful in covering the remote areas like the islands of Andaman and Nicobar and Lakshadweep, the hilly regions of Jammu and Kashmir, and some of the rural hospitals in other states also.

In past few years, the Ministry of Health in the Government of India has taken up several projects which has been substantial like Integrated Disease Surveillance Project and National Cancer Network, National Rural Telemedicine Network, National Medical College Network, etc. Few major milestones in making telemedicine become the future for tomorrow, standard telemedicine practice guidelines by the DIT in the Government of India, and the setting up of a National Telemedicine Task Force by the Health Ministry play a substantial role. For placing Indian telemedicine in the global scenario, various initiatives by the External Affairs Ministry are being nurtured like the Pan-African eNetwork project and the South Asian Association for Regional Co-operation Telemedicine Network Projects.

Few success stories of telemedicine in India include oncology at Regional Cancer Centre, Trivandrum; mammography services at Sri Ganga Ram Hospital, Delhi; and many more. Even during the Maha Kumbha Melas, the Government of Uttar Pradesh practices telemedicine through Mobile Telemedicine system vans equipped with videoconferencing systems enabling doctors in remote places to connect to any of the telemedicine-enabled medical hospitals for expert opinion. Even a few private sector organisations like Apollo Telemedicine Enterprises,



Asia Heart Foundation, Amrita Institute of Medical Sciences, and Aravind Eye Care along with the support of central and state governments are playing a pivotal role in making telemedicine a reality in India.

At present many gadgets like mobile phones, cameras, and wearable biosensors for clinical information are in use. Many useful telemedicine applications like Practo (<https://www.practo.com/health-app>), mfine (<https://www.mfine.co/>), and DocsApp (<https://www.docsapp.in/>), among others, are being tried to have a patient-specialist interface for smooth access and sharing of clinical information. Although, telemedicine has so much potential still it hasn't received an overwhelming response from the people because of various reasons including lack of awareness and acceptance of new technology among the main reasons.

### **Telemedicine in India during COVID -19 Pandemic**

The entire world is at a standstill with the current situation of Coronavirus disease (COVID-19) and humanity is facing a novel viral pandemic. Despite all the advancements made by humans in various sectors, battling this deadly virus still seems challenging in many ways. However, the primary challenge is to contain the contamination from spreading along with adequate healthcare facilities being provided to the infected people.

Numerous nations, including India, have been following various measures like social distancing and wearing of masks to contain the spread of infection. Even the lockdown has helped to delay the spread of infection and given ample amount of time to deal with the current emergent situation. But, at the same time the lockdown also brought about an enormous loss of livelihood. So, though with the lockdown security can be taken care of, but it puts at risk the livelihood and security of millions of people of the country. Along with this, the population size and inadequate infrastructure also pose the biggest challenges to cope with the situation.

In this pandemic, fast progression in innovation will help in accomplishing the objective of providing accessible, cost-effective, and quality health service. And so, in the wake of the COVID-19 outbreak, telemedicine holds the answers to many of the problems. Technology should be the heart of the stimulus plan and telemedicine can act like a frontline weapon to deal with the current pandemic situation.

Telemedicine is the future of healthcare and its efficacy in the present situation is the proof of its impact. It is expected that by the year 2025, the telemedicine market in India is expected to reach \$5.4 billion. To strengthen the "Make in India" initiative in the health sector, we must use information technology-related tools. Along with it, the Ayushman Bharat Scheme launched by the Indian government is empowering telemedicine to a great extent for the advancement of the health sector in the country.

Telemedicine is definitely a promising tool providing benefits to health care professionals as well as patients.

- As telemedicine consultation is possible from any part of the world, it provides a tremendous opportunity for health care professionals to be connected to the patient regardless of where the patient is located. Thus, it is cost-effective, saves time, and provides prompt professional access to the patient in need.



- With the ongoing situation of COVID-19 and following social distancing norms, telemedicine proves to be an answer to various problems and situations. It is a safe and effective alternative to in-person care.
- Telemedicine can be effectively used for patients with various chronic diseases like hypertension, diabetes, and old-age complications that need to be constantly monitored with their medical conditions as they are more susceptible to COVID-19.
- Telemedicine can be used for providing useful information and making the patient as well as other family members aware of the contagious disease and its precautionary measures.
- Telemedicine can also provide psychological support during these times when patients are confined to their homes and coping with the disease can bring a lot of trauma to the patient as well as family members.
- With the current pandemic situation while being home quarantined, the patient can be monitored round the clock, thereby reducing the exposure of the patient, and at the same time hospital footfalls can be reduced to a great extent, and only the patients with critical conditions can be hospitalized. Especially in India with its over exploding population, one of the reasons for the situation not turning into a horrible state and out of control is the gift of telemedicine.

Realizing telemedicine's potential in healthcare delivery, the Board of Governors of Medical Council of India (MCI) on 25 March 2020 along with the partnership with NITI Aayog has adopted the "Telemedicine Practice Guidelines" which includes its principles and a practical framework of telemedicine.

### **The guidelines proposed by the Medical Council of India 2020**

- a. Scope- These guidelines are designed to act as a tool to enhance healthcare services to a great extent. These guidelines are specifically designed for the Registered Medical Practitioner (RMP) under the Indian Medical Council Act (IMC) 1956. It provides the standards and norms for the RMP to consult patients through telemedicine, and information on all channels of communication with the patient like audio, video, or text messages.
- b. Guidelines having few exclusions :
  - No provision for consultation of the patient outside the jurisdiction of India
  - Any specification details for hardware and software, infrastructure building, and maintenance.
  - Usage of digital technology to perform any surgical procedure remotely
- c. Online course of the practice of telemedicine: In order to make the RMP familiar with the process along with the limitations of telemedicine practice-
  - An online program to be developed
  - All registered RMPs need to complete a mandatory online course within three years of its notification to provide consultation via telemedicine
  - Qualifying the course as prescribed will be essential prior to starting practicing telemedicine.
- d. Telemedicine application
  - Tools are the backbone of telemedicine and are used extensively in telemedicine for carrying outpatient consultation e.g. telephones, videos, internet, devices connected over LAN, WAN or mobile phones, chat platforms include WhatsApp, Facebook, etc. or Internet-based platform like skype, email or fax, etc.
  - Telemedicine application can be classified into four types- mode of communication, timing of the information, purpose of communication and interaction between the individuals



e. Seven elements necessary for any telemedicine consultation-

1. Context –

- The RMP should use their judgment to decide whether a telemedicine consultation or an in-person consultation is needed
- The RMP shall follow the same standard of care within the intrinsic limits of telemedicine like an in-person consultation.

2. Identification of RMP and Patient –

- Patient and the RMP should not be anonymous.
- The patient's details, registered ID, and the RMP credentials and contact details should be known to each other.
- The RMP in order to issue a prescription should know the age of the patient and can seek age proof.
- The RMP needs to disclose his name and qualifications before the beginning of the consultation.
- The RMP shall display State Medical Council registration numbers on prescriptions, websites, or other modes of communication.

3. Mode of Communication –

- In order to deliver proper care multiple options of technologies can be used to deliver telemedicine consultation.
- Primary modes of communication can be video, audio, or text.
- Based on the situation necessity, the RMP can use professional judgment to decide the best technology to use to diagnose and treat the patient.

4. Consent –

- For any telemedicine consultation patient consent is necessary.
- The consent is implied if the patient initiates the telemedicine consultation.
- If a health worker or a caregiver initiates a telemedicine consultation, explicit patient consent is necessary.
- Patient consent can be in the form of email, text, or audio and the RMP must record it in the patient record.

5. Type of Consultation –

- First consult-it means, the patient is consulting with the RMP for the first time, or more than six months have elapsed since the previous consultation or the patient has consulted for a different health condition earlier.
- Follow up-it means the patient is consulting with the same RMP for the same health condition. However, if the RMP doesn't recall the context of previous health treatment or some new symptoms which are not in the spectrum of the same health condition, then it will not be considered as a follow-up.

6. Patient Evaluation –The RMP before making any professional judgment should collect all the required medical information about the patient.

- The RMP should gather patient information in the form of investigation reports, history, examination findings, etc. to reach a proper judgment.
- The RMP can collect the information with the healthcare worker or provider by technology-based tools.



- If the RMP feels the information provide is inadequate, then he can request additional information from the patient.
- Depending upon the necessity, the RMP shall recommend video consultation or examination by another RMP or whether In-person consultation.
- The information required by one RMP may vary from another based on professional experiences and for different medical conditions
- The RMP shall keep a patient record in the form of case history, images, investigation reports, etc as appropriate.

### 7Patient Management

- Based on the RMP professional judgment, he can provide health education or provide counselling or can prescribe medicines
- The RMP can impart health education which could be related to diet, physical exercise, hygiene practices or contagious infections, etc.
- The RMP can counsel patients with specific advice related to food restrictions, do's and don'ts for a patient or physiotherapy, etc.
- The RMP may prescribe medicine via telemedicine only when RMP is satisfied with the amount of information gathered about the patient. It will be considered professional misconduct if the RMP prescribes medicine without an appropriate diagnosis.
- Few specific restrictions for prescribing medicines-

**List O:** Those medicines which are safe to be prescribed through any mode of teleconsultation like paracetamol, cough syrup, ORS solution, etc.

**List A:** those medicines which can be prescribed during the first consult which is a video consultation and are relatively safe medicine with low potential.

**List B:** those medicines which RMP prescribes during in-person consultation for the same medical condition, can be prescribed who are undergoing follow-up consultation.

**Prohibited list:** those medicines which have a high potential of abuse and could harm the patient or society at large or the medicines listed in Schedule X OF Drug and Cosmetic Act or any Narcotic and Psychotropic substance listed in the Narcotic Drugs and Psychotropic Substances, Act, 1985.

### f. General Duties and responsibilities of an RMP-

- Protecting patient privacy and confidentiality as per IMC ACT and binding by the principles of medical ethics is required.
- All RMPs would be required to abide by IMC Regulations 2002 and with relevant provisions of the IT Act.
- All RMP should make sure to take utmost care for patient privacy and confidentiality.
- All actions of RMP which violate the patient care or privacy and confidentiality are not permissible, for example, misusing patient image and data, uploading an explicit picture of the patient on social media, etc.
- Penalties for the RMP are as per IMC Act, ethics, and other prevailing laws.

### g. Documentation of consultation-

- Record of telemedicine interactions
- Patients reports, images, investigation reports, etc
- Prescription records to be maintained.

### h. Telemedicine consultation fees-



- The treatment given to it is the same way as in-person consultation.
- Patient should be provided with the receipt for the charged consultation.

### Barriers in telemedicine

- 1.Patient privacy and confidentiality-In comparison to face to face consultation, telemedicine faces a high risk in terms of privacy and security. No platform is completely safe from hackers, several laws should need to be well in place in order to build trust between the providers and patients in terms of privacy and confidentiality being maintained.
- 2.Data accuracy and misdiagnosis- the internet bandwidth affects the validity and reliability which can impact the health care practitioner making decisions and recommendations based on potentially inaccurate data.
- 3.Medical liability-simply applying existing principles of malpractice liability is not enough, special attention should be given to prevent errors, breaches of privacy, or technology failures.
- 4.Reimbursement- a proper process needs to be developed for the reimbursement provided by the health-care providers through telemedicine.
- 5.Technical requirements-for successful implementation of any telemedicine program require secure, high internet connection and software to be functional.
- 6.Training- in order to have a proper system of telemedicine to function, proper training to the support staff is required along with technical skills needed to set up and use equipment, professional knowledge, and professional development, etc.
7. Fear of change- resistance is seen amongst the health care providers as well as the patients. Patients mostly feel that face-to-face meetings and consulting the health care providers is more reliable. Even the health care providers doubt the quality of images and fear misdiagnosis.
- 8.Poor infrastructure and lack of facilities- despite various efforts to make telemedicine an effective way, the reality is that rural parts are still lacking in the basic facilities and proper infrastructure needed for the proper functioning of telemedicine.

### Conclusion

Telemedicine seems essentially an effective and versatile product of the twenty-first century and has the potential to change the scenario of healthcare. It was anticipated that telemedicine will significantly change the healthcare service delivery from hospitals to homes. Though, due to various reasons telemedicine could not reach its true potential due to a lack of awareness and acceptance of new technology both by the public and by the professionals. Now, with the current pandemic situation telemedicine will continue to grow and be adopted by more healthcare practitioners and patients soon. Telemedicine applications are surely bringing the world closer, and distance no longer seems to be a barrier to the attainment of quality health care. Governments are taking a keen interest in developing telemedicine guidelines resulting in a slow and steady increase in its utilization in public health services.

Telemedicine cannot answer all problems and at the same time has its own limitations and barriers in terms of in-person consultation or emergency medical situations. Still, telemedicine has contributed to a great extent during the current pandemic of COVID-19 and with its wider acceptance and implementation due to its ease and availability will attain its true potential in the years to come.



### References

1. Census of India. *GOI*. 2012. [Last accessed on 2021 June 06]. Available from: <http://censusindiagov.in>
2. Home-ATA Main. [Last accessed on 2021 June 10]. Available from: <http://americantelemed.org>.
3. WHO. *Telemedicine-Opportunities and Developments in Member States*. 2<sup>nd</sup> ed. Geneva, Switzerland: WHO Press; 2010. [Google Scholar]
4. A Brief History of NASA's Contributions to Telemedicine. *NASA*. 2013. [Last accessed on 2021 June 06]. Available from: <https://www.nasagov/content/a-brief-history-of-nasa-s-contributions-to-telemedicine/>
5. History of Telemedicine-md Portal; 2015. [Last accessed on 2021 May 22]. Available from: <http://mdportal.com>.
6. ISRO Telemedicine Initiative. [Internet] *Televitalcom*. [Last accessed on 2021 May 28]. Available from: <http://www.televitalcom/downloads/ISRO-Telemedicine-Initiative.pdf>.
7. Ministry of External Affairs, Government of India. [Internet]. *Mea.gov.in*. [Last accessed on 2021 June 28]. Available from: <http://www.mea.gov.in/>
8. Mehta, Kedar & Parag, Chavda. (2013). TELEMEDICINE : A BOON AND THE PROMISE TO RURAL INDIA. *J Rev Prog*. 2013;1:1–3. [Google Scholar]
9. Chellaiyan, V. G., Nirupama, A. Y., & Taneja, N. (2019). Telemedicine in India: Where do we stand?. *Journal of family medicine and primary care*, 8(6), 1872–1876. [https://doi.org/10.4103/jfmpc.jfmpc\\_264\\_19](https://doi.org/10.4103/jfmpc.jfmpc_264_19)
10. Gajarawala, S. N., & Pelkowski, J. N. (2021). Telehealth Benefits and Barriers. *The journal for nurse practitioners : JNP*, 17(2), 218–221. <https://doi.org/10.1016/j.nurpra.2020.09.013>
11. Sageena, G., Sharma, M., & Kapur, A. (2021). Evolution of Smart Healthcare: Telemedicine During COVID-19 Pandemic. *Journal of The Institution of Engineers (India): Series B*, 1–6. Advance online publication. <https://doi.org/10.1007/s40031-021-00568-8>
12. Maksut Senbekov, Timur Saliev, Zhanar Bukeyeva, Aigul Almabayeva, Marina Zhanaliyeva, Nazym Aitenova, Yerzhan Toishibekov, Ildar Fakhradiyev, "The Recent Progress and Applications of Digital Technologies in Healthcare: A Review", *International Journal of Telemedicine and Applications*, vol. 2020, Article ID 8830200, 18 pages, 2020. <https://doi.org/10.1155/2020/8830200>
13. Agarwal, N., Jain, P., Pathak, R., & Gupta, R. (2020). Telemedicine in India: A tool for transforming health care in the era of COVID-19 pandemic. *Journal of education and health promotion*, 9, 190. [https://doi.org/10.4103/jehp.jehp\\_472\\_20](https://doi.org/10.4103/jehp.jehp_472_20)
14. *Doctor Patient Ratio in India*. [Internet]. 164.100.47.190. 2018. [Last accessed on 2021 June 29]. Available from: <http://164.100.47.190/loksabhaquestions/annex/12/AS86.pdf>
15. *Telemedicine Practice Guidelines - Enabling Registered Medical Practitioners to Provide Healthcare Using Telemedicine. Appendix 5 of the Indian Medical Council (Professional Conduct, Etiquette and Ethics Regulation) 2002*. [Last accessed on 2021 June 21]. Available from: <https://www.mohfw.gov.in/pdf/Telemedicine.pdf>  
[https://www.who.int/goe/publications/goe\\_telemedicine\\_2010.pdf](https://www.who.int/goe/publications/goe_telemedicine_2010.pdf)



### INVESTIGATION ON THE LINK BETWEEN GENETICS AND PARKINSON'S DISEASE

**Mohammad Petiwala**

Billabong High International School  
[mohdpeti0405@gmail.com](mailto:mohdpeti0405@gmail.com)

#### Abstract

Many scientists have researched day and night to prove that Parkinson's disease is a hereditary disease but have been unsuccessful. However, there are many different forms that have shown Parkinson's disease to be established in patients with relatively rare type of Parkinson's; this is the monogenic form of Parkinson's disease. This research paper covers the main genes that affect Parkinson's disease, why and how gene mutations affect Parkinson's and statistics related to the same. Familial Parkinsonism has been seen to be established when there are certain mutations in 5 specific genes that are taken into consideration in this research paper. Those 5 include SNCA, PARK2, DJ-1/PARK7, PINK1, LAARK2. However, functions of these genes and their mutations leading to Parkinson still remain to be fully elucidated.

**Keywords:** SNCA, PARK2, DJ-1/PARK7, PINK1, LAARK2, Mutation, Hereditary.

#### INTRODUCTION

The domain that this research paper comes under is "Bioinformatics and scientific computing". Bioinformatics aims to include representing data, communication of data, and in the end processing of data. Analysis can be done by the use of informatics. Bioinformatics together means studying and representing the biological analytical data to give the required output. This research paper is aims to understand the current scenario based on Parkinson's disease and its relation with genetics; Investigations that have taken place for the same have also been taken into consideration. Parkinson's disease is one of the most common diseases which includes nerves and neurons just after Alzheimer's disease. Parkinson's disease is a brain disorder that makes the body vibrate or shake in its own way without any control of the human being. Basically, the body now becomes involuntary in movement. The causes for this disease are when the neurons in the brain that control movement gets impaired or die. This results in dopamine reduction which intake causes all types of moving disorders. Moreover, the nerve endings that produce norepinephrine (a chemical messenger) are also lost.



### Theory

When considering Parkinson's disease it's necessary to talk about Gene mutations. Firstly, Mutations are sudden changes in any genetic material of an organism or living being. When mutations are taken into consideration; Specific DNA bases are changed and are affected. Mutations are subjective and can have extensively different consequences based on what gene is affected when and where. This can also be caused by several environmental factors; examples include radiation or extreme weather conditions. Seeing whether Parkinson's disease is heritable; mutations have to be studied to be passed on to the next offspring. Sometimes some mutations can only affect the next generation or the next individual that carries them. However, some mutations can affect all the offspring that are mated by the carrier. Carriers are those individuals that are capable and vulnerable to pass a mutation or a genetic mutation to the next generation. They can carry gene mutations of diseases that may or may not show symptoms. These are usually those who show recessive traits. So what is recessive and what does apply to?

There are alleles in all our bodies that are alternative forms of genes that can either form from mutations or are naturally affected. Alleles can also be called gene variants that pass a trait to the next generation. Alleles are made of two types recessive and dominant. The allele that shows and has an effect on the hybrid or heterozygous organism is said to be Dominant and on the other hand, the allele which has no effect is said to be Recessive. The extensively varied alleles contain varied sequences of bases. This is aroused from mutation.

Mutations can also cause a change in the number of whole chromosomes. The broad gene mutations can affect or change sequences of bases in three different types; which are base substitution, base addition, and base deletion. Base substitution as the name suggests; is when one base is replaced by another base. Base addition is when one base or more bases are added to the sequence. Finally, Base deletion is when one or more bases are deleted from the sequence. Each gene that codes for Parkinson's disease when gets mutated; goes through one of the three processes mentioned of base editing. When Parkinson's disease is considered to be hereditary it is usually from one parent and is known as autosomal dominant. This means that whenever only one part of the gene is altered the parent is a carrier to the next generation causing a vulnerability of Parkinson's disease.

The first gene that is involved and gets depleted in Parkinson's disease is the SNCA gene. The SNCA gene supplies adequate commands in need of the creation of a small protein that is known as alpha-synuclein. At the ends of neurons there are small, tiny gaps called synapse or the synaptic cleft. At the ends or the tips of these neurons are small specific structures called presynaptic terminals. This is where alpha-synuclein protein is found in abundance. In the gaps between the neurons (synapse); the body releases neurotransmitters in small vesicles. The role of alpha-synuclein is that it maintains regulation and a good amount of synaptic vesicles in these gaps. As mentioned earlier that Dopamine depletion plays an important role in Parkinson's disease. What can be the relation between Dopamine and SNCA gene?

The vesicles in the synapse have a specific amount of Dopamine intending to maintain and function the passing of neurotransmitters. The alpha-synuclein protein has a function in the genesis (formation or creation) of the dopamine vesicle. Therefore when there is a mutation in the SNCA gene which is located on the fourth chromosome on the human genome; there is a depletion or shift in levels of alpha-synuclein. Intake affecting dopamine levels and making the human being more vulnerable to Parkinson's disease. This mutation can be base substitution



which is a missense mutation. When more than one allele inhabits a specific gene's, location restricted to a specific population it is known as gene polymorphism. There is a particular single-nucleotide polymorphism in the SNCA gene that can lead to specific and particular mutations which in intake leads to vulnerability of Parkinson's disease. This development of Parkinson's disease can either be autosomal recessive or by the risk of specific dominant mutations.

After looking at mutations and the first gene of Parkinson's disease; the effects of mutations on random genes should also be looked at. Mutations are particularly random and can happen in any given situation given the circumstances. Sometimes one specific mutation can have an enormous effect; However, sometimes many mutations can sum up to a big transformation which each has small effects. The more the bases of the gene are affected the more the chance of each being mutated. This intake causes a larger probability of damage to one's genes. This same applies to Parkinson's disease. There is something known as distributions of mutational effects that show how many mutations occur in a given amount of population. Scientists use that to calculate the probability for the same.

The second and one of the most important gene is the PARK2 which helps in the creation and formation of the Parkin protein. This is a particular protein that helps in the recycling of other proteins. As mentioned earlier the autosomal recessive disorder of Parkinson's disease can also be caused by gene mutations. This form of Parkinson's disease which includes autosomal recessive can be caused by what is called as germline mutation on the PARK2 gene. Germline mutation, basically when mutations occur on the germ cells. These are the cells in humans which can be passed onto the next generation. There are two germ cells sperm and ovule. When mutations occur on these they are called germline mutations. For example there is cancer caused by germline mutation which is known as hereditary cancer.

When PARK2 gene gets mutated it can cause a rapid decrease in the dopaminergic neurons in a certain part of the brain called the substantia nigra. Dopaminergic neurons are those same neurons or neurotransmitters that contain or make dopamine. Substantia nigra is a part in the midbrain posterior which has two fixed segments. One of which is very important in containing dopaminergic neurons called the pars compacta. Basically, when PARK2 gets mutated it results in loss of Dopamine in this certain part of the brain. As discussed before intake this would result in an early onset of Parkinson's disease. The gene is located on the Chromosome 6q26 which is also responsible for cancer and can make the body vulnerable. When the gene PARK2 gets mutated to cause Parkinson's disease it disturbs or shifts the ubiquitin-proteasome enhancing system of the body, this makes the body vulnerable to accumulate unnecessary proteins and cause disruptions.

Dopamine has been mentioned many times in this research paper and is an important factor in Parkinson's disease. The other name of Dopamine is hydroxytyramine, it is organic compound formed by involvement of a nitrogen group. Dopamine is the forerunner of the hormone norepinephrine. When nerve impulses are inhibited for transmission in certain parts for the brain such as the substantia nigra and basal ganglia; the dopamine now functions as a neurotransmitter. As mentioned before when there is a decrease in dopamine in the substantia nigra which intake leads to cellular death it causes Parkinson's disease. Norepinephrine which is released at the end of sympathetic nerve fibers; it has the function that helps to increase the muscle contraction of the skeletal which is therefore directly linked to Parkinson's disease.



The next gene that affects Parkinson's disease is the PARK7 gene or DJ-1 gene. DJ-1 protein reacts to oxidative stress conditions in the body when proteins need to be regulated in redox reactions. The body needs molecular chaperones. Briefly, the proteins help in protecting cells from oxidative stress. What is this oxidative stress? When free radicals which are any molecules of oxygen that have an uneven number of electrons which makes easily react with other molecules this causes oxidative stress. Moreover, DJ-1 helps in binding of proteins in 3-dimensional shape and can also help in refolding of damaged proteins. PARK7 gene mutations make the DJ-1 protein very small and ineffective; This can also change how the amino acid functions disrupting the making of the protein.

DJ-1 causes early onset of Parkinson's disease when it has just started at a tender age. The gene is found on chromosome 1p36. DJ-1 is also very important in homeostasis of mitochondrial calcium and regulation as well as protection of the mitochondrial structure. DJ-1 is very small of only about 20 amino acids and therefore when a change is occurred in such a small structure is causes a lot of harm to the body. An amino acid that makes two disulfide bonds when it pairs with itself it cysteine and DJ-1 needs perfect, conserved activity of this amino acid for all its function. Oxidation of this specific cysteine amino acid occurs in oxidation stress conditions. In all DJ-1 also has many cytoprotective functions that can be proven from the same.

Another gene that's directly linked to the control of the mitochondria and therefore has some relation with DJ-1 or PARK2 is PINK1. A kinase is a certain enzyme that specifically transfers phosphate groups to substrates. PINK1 as all the other Parkinson's genes supplies specific commands to genesis or making of a protein known as PTEN which is a putative kinase 1. PTEN is a protein which is almost found everywhere in the body inside the cells in the mitochondria. Mitochondria is a cell organelle that help providing energy to all the biochemical reactions that are within the cell. During cellular stress for example oxidation stress the PTEN protein is said to help the mitochondria. PTEN is phosphate and tension which can be really vulnerable in cancer is known to be mutated during the same. Among Parkinson's disease PTEN decrease or insufficiency causes severe mitochondrial abnormalities.

There are two specific regions of the PTEN protein: The first region is called the mitochondrial targeting motif. The second region is known as kinase domain. The mitochondrial targeting motif helps in being the target address for the PTEN protein; it helps it reach the mitochondria and ensures the delivery of the protein. The kinase domain aids the functions of the protein for example it helps in its protective functions of the protein. PINK1 gene mutations causes a drastic change in this kinase domain causing the proteins protective functions. Moreover, if mutations are caused on the mitochondrial targeting motif same would happen to the delivery of the protein to the mitochondria. Therefore when cells are stressed the mitochondria can't do anything except because of the mutations on PINK1 gene. This causes many cells in the brain and the muscles to be affected and in the end many nerve cells are also affected causing Parkinson's disease.

The next gene is the LRRK2; leucine-rich repeat kinase 2. LRRK2 is also a protein like many of the genes that affect Parkinson's disease are proteins. There was Alpha-synuclein mentioned before in this research paper and that is again linked to the LRRK2. This gene also give commands on the genesis or making of the protein dardarin. Some parts of the dardarin protein is associated with leucine-rich regions which help in interactions of proteins with other proteins for example assembling of amino acids or signal transmission over all the proteins together. Dardarin is known for its kinase activity which specifically helps the phosphate group to transfer



to amino acids from the ATP generating energy molecule. LRRK2 is certainly associated with the late-onset of Parkinson's disease and its mutations are studied extensively.

Mutations that occur in the LARRK2 affect the specific amino acids that are replaced by these mutations and therefore affect the analogy and structure of the protein dardarin. Certain mutations that replace amino acids can cause severe damages. For example there is a mutation which replaces the amino acid arginine with amino acid glycine which is a very common form of Parkinson's disease that is specifically originated from the Basque region that is located between Spain and France. Around 7% of the world population show that LRRK2 gene casues familial Parkinson's disease and is directly affected to it. There is also proof of sporadic Parkinson's disease by mutations of the LARRK2. In the protein coding of the exons of the gene LARRk2 at least 128 mutations have found to be occurred which majority of all are said to be base substitutions.

### DISCUSSION

The main genes that affect Parkinson's disease have been discussed. Investigations and analytical data of the same has to be discussed and the theory relating to that will also be discussed further in the research paper. The age places an important factor in a person being diagnosed with Parkinson's disease. The risk of getting the disease increase with age. Considering any disease crude prevalence rate (CPR) is taken into account which is basically the new cases per 100,000 of population which gives an approximate number for the new cases. For example if we take 100,000 people. Only 41 of them will get diagnosed with Parkinson's disease in their fourth decade of their life which is in their 40s. However, there will be more than 1900 people out of those 100,000 getting diagnosed with Parkinson's disease. Only about 4 percent of people get diagnosed before the age of 50 which shows its relevance with age and how age plays an important factor in it. Moreover, as the statistics show men are 1.5 times more likely to get diagnosed with Parkinson's disease then women. Statistics show that about 7-10 million people worldwide are currently diagnosed with Parkinson's disease.

America has seen many Parkinson's disease cases overtime and still many are diagnosed with the same. Each year there are approximately 60000 cases of Parkinson's disease that are diagnosed in America. Currently about a million people in the US are said to be living with Parkinson's disease, this is said to rise to about 1.2 million by 2030. America has taken up a project called the Parkinson's prevalence project which ensures resources for each and every citizen having Parkinson's disease. A countries government needs to have data and accurate statistics to know where each Parkinson's disease patient lives, how many people have the disease and what are the required resources needed for the same. This ensures equality between all Parkinson's disease patients. There are two important words that need to be addressed when talking about the same. These are incidence and prevalence. Incidence is basically how many new cases are diagnosed in a given amount of time; this is almost always taken over a year. However, prevalence is not only knowing how many individuals have the disease but also obtaining a measurement of all the individuals.

In our country India; which has the second highest population in the whole world showed a low crude prevalence rate of about only 53 out of 100000 population getting diagnosed with Parkinson's disease. However, in the city of Bangalore; it was seen that the rate was three times in rural areas as compared to urban areas. The CPR of only the city was 41 in rural areas but it



was only 14 in the urban areas. If we look at the statistics of a specific community in India. The Parsis; we see that it has an CPR of 328 which is higher than most developing countries and developed countries. Age specific CPR for Parkinson's disease go upto 247 above the age of 60 for the generic population. Most sex related CPR studies showed men were more prone to get diagnosed with Parkinson's disease than women. This had an exception of eastern India which showed women were more commonly affected than men in that region. In India mostly the prevalence rate of Parkinson's disease is very low.

If United Kingdom is taken into consideration, every hour one patient is diagnosed with Parkinson's disease. By 2025 the expected prevalence is said to rise by 18% and by 2065 they are said to be almost doubled. The prevalence for idiopathic Parkinson's disease is approximately 128 in the London only; making it one of the highest in the world. Seeing about 10-20% community patients go undiagnosed the idiopathic Parkinson's disease is 200 for every 100000. As discussed before in the document as the age increase the risk of Parkinson's disease increases even more. Therefore in the UK people above the age of 70 have the prevalence of 1500-2000 in every 100000 which is massive. The crude prevalence is about 193 in total of only the city London. If we take the whole UK its about 500 people; there are about 127000 people with the disease currently living over there.

Dr. Rajendra Jhanwar. With MBBS, MD-General Medicine, DM-Neurology. Having experience of 16 years; he is one of Mumbai's top-rated neurologist. He sees patients with severe headache, migraines, epilepsy vertigo, Parkinson's disease, dementia, memory loss etc. Established in the year 2014, he performs nerve conduction study, electromyography tests and special tests regarding Parkinson's disease. I took an interview of him to know more about Parkinson's disease and his say on it.

There were a total of 15 questions asked and the interview went as follows:

I am writing a research paper on investigation in the link between genetics and Parkinson's disease. This is a project for MISA competition. The domain that covers this is Bioinformatics and scientific computing therefore statistics is something that we are looking at. These are the survey questions for Dr. Rajendra Jhanwar, questioned orally by Mohammad Petiwala. Writer of this research paper and orally answered by the doctor:

1. Since how long have you been practicing as a Neurosurgeon?

I have been in this field for quite sometime meeting different patients almost half of my life. I have a total experience of 16 years with 15 years as a specialist where I could treat them on my own.

2. In these many years approximately how many Parkinson's disease patients have you met and treated?

It's hard to say there were so many patients I have met that I myself have left track of the same. I have treated Parkinson's disease for a long time seeing people from all age groups having the disease. I would say about 5000 plus or minus 500 patients are approximately the number of Parkinson's patients I have met and treated.

3. Do you think it's a common neurodegenerative disease among Indians?

Yes absolutely, If I have only seen 5000 patients then its one of the most common neurodegenerative disease in India. Just think how many neurologists are in India and if each



might have approximately seen 5000 patients then this disease is very common. However, I might say the therapy is difficult and patients need a lot of attention.

4. Which age group have the majority of people affected by this disease?  
By the fourth decade of one's life; A person starts being more prone to the disease and as the age increases the crude prevalence rate and number of people having the disease also increases. If you tell me to give a range then it would be 55-70 years. That will be the range that I have seen maximum patients from.
5. Therefore which age group gets treated to the highest extent?  
I would say this question is too subjective to the patient and truly what's the will power of the patient. However, yes I would say that if its diagnosed at a later stage in the life then it's tougher to treat it fully. Therefore I would say if a patient is diagnosed in his/her 50s then the treating extent is the highest.
6. What are the different stages of this disease?  
I would simply say Mild moderate and very advanced.
7. Is treatment possible for all these stages?  
Absolutely, if the patient has the will power then yes treatment is possible.
8. What are the most common treatments, and which ones do you prefer?  
Dopamine agonists is one of the most common treatments as its drug based and easier to perform on the patient. Many doctors prefer it as they don't have to put a lot of effort and have to wait for the drug to do its work. However, I prefer the Syndopa Plus tablet treatment which comprises of Levodopa and Carbidopa.
9. What has been your experience with the trauma of this disease?  
Very severe as it affects the patient physically, emotionally and financially.
10. Are there any demographics specifically more vulnerable to this disease?  
Debatable question but according to me no there are no demographics more vulnerable.
11. Is physical therapy just as important as medicinal drug treatment?  
Absolutely!
12. Would you say the disease is still to be well understood?  
True, we still don't know exact cause of this disease. All research doctors have tried their best to give an explanation but none have been successful with the same.
13. What are the genes that are mutated and can cause Parkinson's disease?  
PARK gene and LRRK gene. PARK gene mostly causes the dopamine problem; I won't go deep in it as there is a lot to understand. However, I would say the dopamine inefficiency which specifically causes the movement disorders as it affects the specific nerve impulses in the brain.
14. Research has been going on for a long time about the genes that are affected and mutated. According to you, Is Parkinson's hereditary or not? Why do you say so? And can you take examples of the genes that are affected?  
I would again say this is very debatable and research is still yet to prove everything of genes and hereditary. It takes immense pleasure to answer such interview of students who themselves are researching on the same but I would say only 10% of the patients have hereditary Parkinson's. The gene which I have seen to be always affected is the PARK gene which causes the immense hassle. Research is yet to prove everything. I am just a specialized



doctor helping patients overcome the disease and myself would like to know more if genes are taken in consideration.

15. How does mutation in these genes affect dopamine production because till date its not fully understood why and how does this happen?

Again same answer for this its yet to prove everything and research is what will provide you with the answer. I would say this is not fully understood and will take many years of ahead research to prove this.

### CONCLUSION

In a nutshell, there are many genes that are directly linked with Parkinson's disease in specific chromosomal positions. Parkinson's genetics has come a long way; from where no every scientist doubted its relation to Parkinson's to get a knowledge and understand its specific impact Therefore the discovery of certain genes such as the Alpha-Synuclein or the PARK2 has distinctly shown phenotypes that would affect Parkinson's disease. Parkinson's is more to be a motor disease than a non-motor disease. Research for proving it to be a non-motor disease still continues as there is a definitive diagnostic test involved in doing so. There are a lot of research papers trying to prove the existence of genes in the disease to completely stop it before it affects the body other than just trying to arrest the disease by slowing its effect on each ones body. Doctors for better control of the disease are now switching to methods that help inhaling dopamine directly from the use of medicinal drugs rather than using physical treatment which can affect in the patient in many ways. These are the new delivery methods to restrict the symptoms of the disease rather easily than physical. There have been a study for the gene therapy which is yet to be used by doctors but it does show promising results for Doctors to go ahead with. Moreover, patients with gene mutations will have a easier treatment than those without as Gene mutations are currently only seen in specific genes such as PINK1, PARK2, PARK7 and some more.

### REFERENCES

1. No name. "Parkinson's Disease". National Library of Medicine. <https://www.nlm.nih.gov/health/parkinsons-disease#:~:text=Parkinson's%20disease%20is%20a%20brain,have%20difficulty%20walking%20and%20talking>(accessed May. 4, 2021).
2. Dr. Lawrence Loewe. "Genetic Mutation". Scitable by nature education. <https://www.nature.com/scitable/topicpage/genetic-mutation-1127/>(accessed May. 5, 2021).
3. Donna Krasnewich. "Carrier". National Human Genome Research institute. <https://www.genome.gov/genetics-glossary/Carrier> (accessed May. 6, 2021).
4. No name. "Types of mutation". Understanding evolution. [https://evolution.berkeley.edu/evolibrary/article/0\\_0\\_0/mutations\\_03](https://evolution.berkeley.edu/evolibrary/article/0_0_0/mutations_03) (accessed May. 8, 2021).
5. No name. "SNCA gene". National Library of Medicine. <https://medlineplus.gov/genetics/gene/snca/> (accessed May. 8, 2021).
6. NevraAlkaniand Arzu Ay. "The Relationship between Alpha-Synuclein (SNCA) Gene Polymorphisms and Development of Parkinson's Disease." Intech Open.

- <https://www.intechopen.com/books/synucleins-biochemistry-and-role-in-diseases/the-relationship-between-alpha-synuclein-snca-gene-polymorphisms-and-development-risk-of-parkinson-s> (accessed May 9, 2021)
7. No name. "The Genetic link to Parkinson's disease". John Hopkins Medicine. [https://www.hopkinsmedicine.org/health/conditions-and-diseases/parkinsons-disease/the-genetic-link-to-parkinsons-disease#:~:text=About%2015%20percent%20of%20people,SNCA%20gene%20\(see%20below\)](https://www.hopkinsmedicine.org/health/conditions-and-diseases/parkinsons-disease/the-genetic-link-to-parkinsons-disease#:~:text=About%2015%20percent%20of%20people,SNCA%20gene%20(see%20below)) (accessed May. 10, 2021).
  8. Selvaraju Veeriah. "Somatic mutations of the Parkinson's disease associated gene PARK2 in glioblastoma and other human malignancies." Nature genetics. <https://www.nature.com/articles/ng.491> (accessed May. 10, 2021).
  9. Jamie N. Guzman, Javier Sanchez-Padilla, C. Savio Chan and D. James Surmeier. "Robust Pacemaking in Substantia Nigra Dopaminergic Neuron". US National Library of Medicine. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2784968/#:~:text=Dopaminergic%20neurons%20of%20the%20substantia,structures%2C%20such%20as%20the%20striatum> (accessed May. 10, 2021).
  10. No name. "Dopamine". Britannica. <https://www.britannica.com/science/dopamine> (accessed May. 10, 2021).
  11. No name. "PARK7 gene". National Library of medicine. <https://medlineplus.gov/genetics/gene/park7/> (accessed May. 11 2021).
  12. No name. "PINK1n gene". National Library of medicine. <https://medlineplus.gov/genetics/gene/pink1/> (accessed May. 15 2021).
  13. JieQiong Li, Lan tan and Jin-tin Yu. "The role of LRRK2 gene in Parkinsonism." Biomedcentral. <https://molecularneurodegeneration.biomedcentral.com/articles/10.1186/1750-1326-9-47> (accessed May. 20 2021).
  14. Chou Chai and Kah-Leong Lim. "Genetic insight into sporadic Parkinson's disease Pathogenesis". US National Library of medicine. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3924245/> (accessed May. 22 2021).
  15. No name. "Parkinson's Disease Statistics". Parkinson's news today. <https://parkinsonsnewstoday.com/parkinsons-disease-statistics/?cn-reloaded=1> (accessed May. 24 2021).
  16. No name. "Statistics". Parkinson's foundation. <https://www.parkinson.org/Understanding-Parkinsons/Statistics> (accessed May 25 2021).
  17. M Gourie-Devi. "Epidemiology of neurological disorders in India: Review of background, prevalence and incidence of epilepsy, stroke, Parkinson's disease tremors.". Neurology India. <https://www.neurologyindia.com/article.asp?issn=0028-3886;year=2014;volume=62;issue=6;spage=588;epage=598;aulast=Gourie-Devi> (accessed May. 30 2021).
  18. A Schrag, Y Ben-Schlomo, N P Quinn. "Cross sectional prevalence survey of idiopathic Parkinson's disease and parkinsonism in London.". International Quality and Safety in HEALTHCARE Europe. <https://www.bmj.com/content/321/7252/21.short> (accessed June. 1 2021).



19. Lynn M.Bekris, Ignacio F. Mata, Cyrus. P Zabetian. “The Genetics of Parkinsons disease.”. US National Library of Medicine National Institutes of Health. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3044594/> (accessed June 8, 2021).
20. No name. “Parkinson’s disease: moving forward”. A Train Education. <https://www.atrainceu.com/content/14-conclusion-and-epilogue> (accessed July 1, 2021).



## THE CURRENT HURDLES WHICH DIGITAL FORENSICS HAS TO CROSS

**Sanjit Muralikrishnan**

BK Gadia A levels Junior college

Email Address-sanjitmuralikrishnan@gmail.com

### Abstract

Digital forensics is becoming a very important piece in solving many criminal investigations. However this technique is still in its infancy stage. There is a plethora of problems and short comings which effectively reduce its success rate. This research paper try's to explore the current shortcomings of this method such as lack of popularity in countries such as India and other problems such as data overload and potential solutions to these problems such as integrating AI and using better marketing methods to raise its popularity. Whilst the topic itself has been discussed before this research paper tries to integrate its own ideas and opinions on this topic.

**Keywords:** Anti-forensics, Internet Of things, Disk Degaussing

### INTRODUCTION

The earth is about four and a half billion years old. And in this colossal amount of time humans never stopped evolving. Starting from ancient primates and then evolving into a sophisticated species. Many discoveries came along the way like the lightbulb etc. However it is an indisputable fact that the 21<sup>st</sup> century is the era where the most evolutions occurred due to advancements in technology. Similarly digital forensics also evolved, many cases have been solved with digital forensics. A few cases that come to mind are –

- The Matt Baker case where he was convicted for murdering his wife by overdosing her with sleeping pills, Investigations using digital forensics found out he searched “Overdosing on sleeping pills” and he also used multiple pharmaceutical websites just before her death.
- Krenar Lusha who was arrested based on his searches on the internet, he was found to have downloaded a researchmanual on how to make explosives. He also was found to have 71.8 liters of petrol.
- Larry Jo Thomas was arrested with the help of his Facebookposts; he was convicted of the murder of Rito Llamas Jaurez who was shot with a gun. Larry Jo Thomas was found to be the murderer .as he had taken a phot with the same model of gun with which Rito Llamas Jaurez was shot. He was also seen wearing a bracelet in one of his posts, the exact same bracelet was found near Rito Llamas Jauerez’s body.



Digital forensics has also branched out into many categories such as- Disk forensics, network forensics, wireless forensics, database forensics, malware forensics, Email forensics, memory forensics, mobile phone forensics etc. However the evolution of digital forensics has proven to be insufficient. Compared to other forms of more established forensics methods, digital forensics fails to meet their high standards of accuracy. Though there have been cases where digital forensics has succeeded like the ones mentioned above, there have also been times where it failed or wasn't accepted in the court. One such famous example is the Griffith V. state case[7] where photos from a social network company called "Myspace" was used to prove that the girlfriend of the defendant had tried to threaten others to not give a testimony in court. Evidence showed that a Myspace account with a matching profile picture had sent threats to other people; however investigators couldn't prove that it was sent from her Mac or IP address due to insufficient amount of available data. It was very possible that it could have in fact been a fake account trying to stage her and so it could not be used as evidence. Digital forensics needs something more to become truly successful. With the number of crimes going up like crazy, digital forensics is becoming more and more needed. Unfortunately, numerous GB's of data needs to be analyzed, stored, reported etc. It also doesn't help that a lot of technical knowledge is required. This creates a huge backlog of cases which are still yet to be solved. In 2014, Darren Quick and Kim-Kwang Raymond Choo stated 3 things which could be leading to this backlog of cases.[1]

- 1) The sheer amount of devices which are being taken in for analysis has been increasing for every single case
- 2) There has also been a significant inflation in the number of cases where digital evidence is being accepted
- 3) There is also more evidence nowadays on any devices being seized for analysis.

The above 3 points should give a basic idea as to why backlogs occur. This situation is very serious as sometimes long delays lead to prosecutions being missed in court. This paper will review the current problems with digital forensics and will suggest potential solution to problems like using AI technology more frequently, better marketing to attract more youngsters and so on.

### Theory

#### Improvements of digital forensics in the recent past-

Before going into the problems, the evolution of digital forensics should be acknowledged. During digital forensics early infancy, it was a small industry only used to support the investigation and was primarily used only at the end of a case to verify small details. It was nothing much of note. However, times have changed and now digital forensics can be considered as the left arm of crime investigators. It is immediately used at the beginning of investigations to clarify details and collect evidence. Many famous TV shows such as CSI: Crime Scene Investigation incorporates such aspects into the show. One of these fields' biggest achievements is hosting the DFRWS (Digital Forensic Research Workshop)[2] every year since 2001 to help educate young and aspiring future investigators and young people who are interested in Computer forensics.



### Problems with digital forensics-

With advancements in technology, cybercrimes have started to become a common recurrence. However digital/cyber forensics is helping companies to avoid losses in money by identifying the crime occurring finding evidence available on laptops such as emails and files. However all is not well with digital forensics and there are few glaring problems. To summarize them simply before diving deep, we should see the 5 points which Sriram Raghavan stated in his research “Digital forensic research: Current state of the art” –[1]

1. The problem of complexity, this occurs because data is collected in the binary form. With the increasing amounts and complexity of metadata, advanced reduction techniques may be needed before analyzing the data.
2. The problem of diversity which is occurring due to increasing amounts of data coupled with the lack of techniques and to tools to analyze the ever increasing amount of data and different sources.
3. The consistency and correlation problem which arises from the fact that the tools used in digital forensics aid in finding out fragments of evidence but not to aid in investigation otherwise.
4. The volume problem which arises from the increasing number of devices which can store crucial information for an investigation and the lack of tools to analyze all the devices.
5. The unified time-lining problem which occurs due to different sources giving different times due to multiple reasons such as lag or problems with the set device timing.

Another glaring issue is that even though awareness of digital forensics is increasing, this is not affecting cybercrimes at all. In 2020 alone, over 1 trillion dollars (were predicted to be lost in cybercrime (as reported by the McAfee). To give a comparison, in 2018 the losses were about 600 million dollar; this is a jump in more than 50%. For computer forensics to be a success it need to slowly bring these values down even by a little bit.[8]

### Antiforensics-

Technological evolution, as we discussed is never stagnant, so it should have been anticipated that something or the other would have been developed as a foil to digital forensics. This foil is called anti-forensics and every analysts dread it. Anti-forensics are techniques used to obstruct analyst. As of this moment, most people believe anti-forensics is purely a malicious practice for people with malicious intent. However, there are those who believe anti-forensics as ways to show the world the defiance’s of digital forensics, thereby helping analysts to correct these problems and improve the art. Anti-forensics may also tempt analysts to work harder and collect better evidence which will make digital forensics better. While the points I have mentioned above are all true to some extent, I am certainly of the opinion that it isn’t beneficial. This situation can be compared to the situation medical researchers are facing with pathogens. Each time an antibiotic is developed to kill a bacterium, after some time, the bacterium evolves and becomes resistant to it. The medical researchers again have to make an antibiotic and the game goes on like a never ending cat and mouse chase. Digital forensics and anti- forensics methods are following the same route. A never ending battle which will go on for generations to come.

Few techniques which were developed to aid digital forensics and cyber security are now cleverly being used in anti-forensics. The most famous example is encryption. Encryption is the



process by which the user makes a message unintelligible to third party access. It uses an encryption key which is a type of a mathematical algorithm to rearrange or change letters which makes the message make no sense to hackers. It was used to establish secure connection between computers and servers and to protect confidential files. Now people use these encryption techniques to hide files with potential evidence to prove one guilty thereby making it harder for analysts to discover the evidence.

Another currently unpopular anti-forensic technique is steganography. Steganography is a way of concealing messages in within other messages or another physical object as well. Steganography when correctly used can disturb the forensic processes. What's more is that criminal can use it to hide messages from digital forensics analysts making their lives all that much more harder. Currently steganography is not very popular but in due time it can become forensic analysts nightmare.

Another data hiding technique is spoofing. Spoofing disguises communication and makes a unknown and unsafe source seem like an authentic, safe and known source. Spoofing is very versatile technique which can be used in a variety of ways such as emails, websites or even phone calls. Spoofing is commonly used infiltrate a network and infects it with malware so that personal information can be retrieved. How can spoofing be used in antifoensics? Spoofing can be used to infiltrate systems with important digital evidence for a case. Criminals can even hide their IP address making it a whale of a task to track them down.

All of the above mentioned techniques are some form of data hiding. However these aren't the only types of anti forensic techniques. Other such examples include. Artifact wiping, Disk destruction techniques, and trail obfuscation.

Instead of simply hiding potential evidence from investigators, artifact wiping involves destruction of evidence. Once evidence is destroyed it becomes near impossible to retrieve them. Artifact wiping itself has multiple sub-categories such as disk cleaning utilities, file wiping utilities and disk degaussing/ destruction techniques. Disk cleaning utilities is basically a tool to overwrite existing data on hard disks. There are variety of techniques and tools which can be used in disk wiping. File wiping systems delete files from a operating system of a computer. File wiping utilities are much faster in their jobs than disk wiping and they also leave a much smaller signature than disk wiping utilities. Dis degaussing or destruction is a highly effective method. T generally involves applying a strong magnetic field to a device clearing it of all data. It is a known fact that anything good comes with a cost, this is literally the case with this method as it is very expensive to apply despite being highly effective and is hence not very widely used.

### **Hyper Formalisation-**

However the problems do not stop with antifoensics. Another major problem in this field is that the bar has been set very high with little to no room for improvisation due to the standards and guidelines which are followed to the T. Even though it is often argued that different companies have different standards for digital evidence and so there is no set or defined standard or quality the evidence has to be, while this true the major problem lies elsewhere. The roble is that there are so many situations where the full evidence cannot be retrieved without modifying it slightly. In today's world digital crime uses multiple gigabytes and terabytes of data and critical systems which cant be taken offline for analysis because of which it is unrealistic to expect the digital forensic community to retrieve all of it without modification and it is also unrealistic to expect



them to seize all of the available data. Other common problems include the volatility of data and the fact that some digital media has only limited lifespan, limited bandwidth while transferring data during investigations has always been a recurring problem. However the organizational and guidelines often fail to address such situations and end up making wrong choices. This has been termed as hyper-formalisation.[2]

### **Lack of knowledge on multiple Operating systems and low standards of Research-**

It is surely an advantage to the digital forensics community as the ability to deeply analyze digital artifacts has been developed. However this has caused another problem. Almost all of this knowledge is based on the Windows and Linux operating systems. This is due to the insane popularity of both of these operating systems especially Microsoft, to put it into context Microsoft market share is 87.56% of all shares, the mac os is 9.54% of the share and linux has 2.35%. Due to this the digital forensics community only focuses on these systems and forgets that there are a few more less popular ones. All applications on these operating systems such as Mozilla Firefox, Outlook etc. have been thoroughly studied and analyzed but people have forgotten about other systems such as ZFS and UFS along with countless other examples.

Another problem is the need to raise the bar for the standard of research in the digital forensics community. The problem until not so long ago was the fact that digital forensics was new to the world and the knowledge available on the subject was quite limited and many people didn't have much research experience on this topic. Computer science was always very famous like it is now. However real world digital training and cases is quite a bit harder and people writing research on this topic had to overcome huge volumes of learning and information. This lead to low standards of research in the community. Research papers on digital forensics are quite new and don't compare to the number of research papers in other fields. As time goes on journals and papers tend to be of higher quality as the readership and number of people writing it increase exponentially whilst the acceptance rate reduces forcing people to write papers of imperious quality, relevance and importance. This is definitely changing and evolving as time goes on but there is still room for significant improvement.

### **Cloud Computing-**

Another thorn to the digital forensics community is cloud computing. 'Cloud' is a very common service used by people in the 21<sup>st</sup> century. It essentially allows you to backup data and access your data from anywhere as long as you are connected to the internet. Many cloud services have come up in the past decade or so such as google drive, i-cloud etc. Though cloud computing has had a profound benefit on your layman's life it has added a whole other layer of complexity to digital forensics.

Data stored on cloud is usually stored over a number of nodes unlike the common forensic situation where all the important data is stored on one device/system. Due to this distribution, crucial data can potentially exist across multiple places making the digital forensics procedure more time consuming and expensive.

Additionally the problem of CSP's (Cloud Service Providers) also arises. Investigators will start becoming dependent on CSP's for their cooperation in extracting and using their clients data. All CSP's are different from each other, They are different in terms of security levels, service level agreements which both a thorn in digital forensics growth. Cloud accounts are



usually made with very little information which makes identifying criminals and suspects in investigation near impossible. Anti-forensics techniques such as encryption are also very regularly used in cloud based crimes. Commonly used digital forensics tools such as Linux dd have proven to be insufficient in extracting data from cloud services. A research conducted Theti and Keane .shows that most forensics tools took a considerable amount of time to take 30 gigabytes of data from a cloud account.

### **Improvements of digital forensics in the recent past-**

Another hurdle faced by the digital forensics community is IOT(Internet of things).[4] Internet of things refer to as every object or system which have technologies which enable them to connect to the internet. A research by Juniper research in march 2020 showed that there were 35 billion IOT devices in 2020 and this number is expected to increase to 83 billion in 2024[3] which is a increase in about 130% in just four years. IOT has a very good scope of becoming a arrow in the quiver of digital forensic analysts, however for now it remains a thorn. There is always less certainty from where the data came from. These devices also tend to have a limited memory which means the challenges in cloud forensics will also be applied for IOT devices. IOT devices also add to the complexity problem due to differences in operating systems etc.

### **CONCLUSION**

This research paper was made to discuss the current problems with digital forensics and areas which should be improved on such as cloud computing and IOT devices. All these problems are thorns in the path of digital forensics and is making the whole analysis process a lot harder for the digital forensics community. What's more is that even though each of these problems are problematic enough on their own, when all of them are occurring at the same time the difficult compounds by multiple times. The ever increasing amounts of data consumption and usage aren't showing any sign of stopping. A research conducted by the telecom ministry in 2020 showed that Indians used 308 petabytes of data and the data consumption increased by 13% in short amount of time. This sort of increase in data consumption will soon lead ballooning in case volume which will only hamper the progress of this art even more. Unless these issues at hand are tackled with, digital forensics will be in serious trouble.

### **REFERENCES**

- David Lillis, , Brett A. Becker, Tadhg O'Sullivan and Mark Scanlon,"Current Challenges and Future Research for Digital Forensic Investigation", Annual ADFSL Conference on Digital Forensic, Date accessed:May.24 2016[Online], Available:<https://commons.erau.edu/cgi/viewcontent.cgi?article=1346&context=adfs>
- Nicole Beebe,Digital Forensic Research: The Good, The Bad, The Unaddressed", in Advances in digital forensics, Gilbert Peterson, Sujeet Sheno, Eds, Fifth IFIP WG 11.9 International Conference on Digital Forensics, Orlando, Florida, January 26-28, 2009, Available: [https://link.springer.com/content/pdf/10.1007%2F978-3-642-04155-6\\_2.pdf](https://link.springer.com/content/pdf/10.1007%2F978-3-642-04155-6_2.pdf)
- Sam Smith, "IOT CONNECTIONS TO REACH 83 BILLION BY 2024, DRIVEN BY MATURING INDUSTRIAL USE CASES", Juniper Research,



<https://www.juniperresearch.com/press/iot-connections-to-reach-83-bn-by-2024> (Accessed:31 mar 2020)

- “What is IOT?”, Oracle India, [https://www.oracle.com/in/internet-of-things/what-is-iot/#:~:text=The%20Internet%20of%20Things%20\(IoT\)%20describes%20the%20network%20of%20physical, and%20systems%20over%20the%20internet.&text=Oracle%20has%20a%20network%20of%20device%20partners](https://www.oracle.com/in/internet-of-things/what-is-iot/#:~:text=The%20Internet%20of%20Things%20(IoT)%20describes%20the%20network%20of%20physical, and%20systems%20over%20the%20internet.&text=Oracle%20has%20a%20network%20of%20device%20partners).
- N.Theti and A.Keane, “Digital Forensics Investigations in the Cloud”, 2014 IEEE International Advance Computing Conference (IACC), Gurgaon, Haryana, India, 21-22 Feb2014,  
Available: [https://www.researchgate.net/publication/271547130\\_Digital\\_forensics\\_investigations\\_in\\_the\\_Cloud](https://www.researchgate.net/publication/271547130_Digital_forensics_investigations_in_the_Cloud)
- L.Cameron, “Future of Digital Forensics Faces Six Security Challenges in Fighting Borderless Cybercrime and Dark Web Tools”, computer.org, <https://www.computer.org/publications/tech-news/research/digital-forensics-security-challenges-cybercrime>
- P.Callaghan, “Legal Lessons Learned: 5 Times Digital Evidence Was Denied In Court”, Pagefreezer, <https://blog.pagefreezer.com/legal-lessons-learned-5-times-digital-evidence-was-denied-in-court>
- S.Ramasubramanian, “Cyber Crime Could Cost the World 1 Trillion Dollars in 2020, Says MCafee”, The Hindu, <https://www.thehindu.com/sci-tech/technology/cybercrime-could-cost-the-world-almost-1-trillion/article33269047.ece> (December 07, 2020)



### SMART DATA PACKET MOVEMENT – ASSESSING A POSSIBLE WAY TO REDUCE NETWORK TRAFFIC

**Atharv Garg**

JBCN International School (Borivali)  
mark.atharv@gmail.com

#### Abstract

The paper aims for a fail-proof model that expects to be given the modification rights in the Internet Layer or at a relay stations increasing speed and efficiency of the data packets that are being sent to and from sources and destinations.

**Keywords:** *Data Packets, Data Packets loss, Internet Protocol (IP) Routing methodology, Nodes, Client-Side Prediction, Packet switching, Carrier-sense multiple access with collision avoidance (CSMA/CA)*

#### INTRODUCTION

This paper outlines a way to predict traffic congestions. What effect does this bring to today's networking systems? (Focusing on the broad aspect: Internet) How often these congestions occur? Could these congestions be predicted using a neural network algorithm?

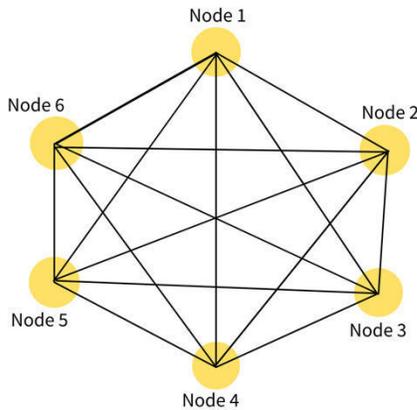
While reading this paper, one needs to have basic understanding of networking, data packet movements, Client-Side Prediction, CSMA protocols and various other access modes. Due to the increasing traffic on a large scale (World Wide Web A.K.A WWW), there are frequent "roadblocks" on the network.

To overcome these road-blocks various methods can be applied. Few of them consists of solving the roadblock by (i)sorting out which Data Packet gets priority to pass through, (ii)re-route the packet stuck in the roadblock, (iii)re-route the packet approaching the roadblock so that the block does not get out of control and/or (iv)close intakes on the particular network line.

The fourth (iv) case will rarely be used due to the fact that it becomes inefficient to close down a whole network line. Case three (iii) will be the case discussed in this paper. This action can also be performed by a forceful use of a switch but predictiveness of these roadblocks can help the network lines to work in more efficient way between a node-to-node communication.

#### Theory

To simulate a situation that is stated in Case three (iii). A closed network consisting of a mesh topology can be used. The topology consisting of six node points (*represented in the Fig. 1*). The primary motive of the third (iii) case is to predict a problem and send out cautions to intermediate nodes so that they can re-route or route the data packets accordingly.



*Fig. 1, A mesh topology containing six nodes*

A data packet can travel from *Node 1* to *Node 4* without any obstructions in a straight path. Let's say suppose the particular network line is blocked due to traffic, the data packets can be re-routed to follow the path *Node 1*(origin) to *Node 2*(intermediate node) to *Node 3*(intermediate node) to *Node 4*(destination). This switch can also be performed using a switch or just sending out the data packets on that path but what if during the journey an overload of data packets occurs on a network line?

Addressing the motive of this paper, In the stated scenario a node will have the autonomy to re-route the chain of data packets if the allocated path has blockages. This autonomy can be gained by assessing previous traffic overloads on the network line, finding and using a simple neural network algorithm. A resonating technology called as Client-Side prediction has been a successful cheat in the world of game production.

Client-Side prediction creates an artificial image of the player, and its prime goal is to predict a player's movements and create a lag free environment for the receiving player. This is one way of addressing reduced network traffic but it has limitation of only being used in the field projection of already assessed data [1].

Continuing, The data packet travelling from *Node 1*(origin) to *Node 2*(intermediate node) encounters another network line blockage between *Node 3*(intermediate node) to *Node 4*(destination) to overcome this the data packets are routed to *Node 4* directly from *Node 2*.

In today's autonomous world, this decision can either be made by predicting how often there are data packet loss between two nodes or by giving out an advisory to the preceding node received from the succeeding node. The latter case is quite impossible as a data packet is usually sent in the form of signals and there is not a way to give out caution advisory to the receiving node faster than a relay signal.

The reason for mentioning Client-Side prediction is What if the client could predict these roadblocks on certain relay lines? This could result to having the data packets consisting of another set of (optional) instruction containing information for the nodes that a particular network line has a chance of a blockage so send the data packet through another route.

Assessing a past made data packet loss prediction model, [2, Fig. 7] *In scenario 3*(Fig. 2), the model got 65% data packet loss prediction accuracy for the farthest network (USA - Korea) tracking route for having loss of  $\leq 20$  packets was considered on the "no loss" side of the data collected.

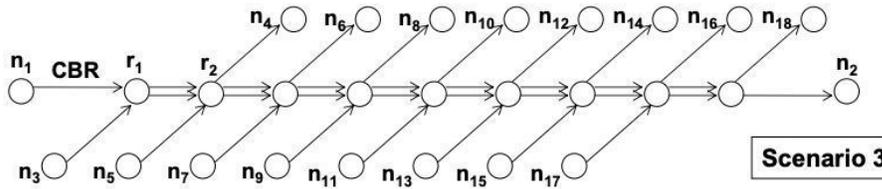


Fig. 2, scenario 3, extracted from [2, Fig. 7]

Since this model was tested in late 2005's, the accuracy of the model is subject to degrade due to better data lines and relay methods. Although, the same model with a bit of modifying can be used to predict the amount of packet loss on a particular data line. These figures could then be used to predict the time or conditions that are giving significant data packet loss.

Given that a Carrier-sense multiple access with collision avoidance (CSMA/CA) protocol sends out data frames to check whether the channel is clear or not, the node waits for a random period of time before checking again. This consumes a lot of time. CSMA/CD uses the data packets collided or lost on a data line to check if data line is clear or not, this sets of a random timer to send out the data packets again. This process is time and resource consuming.

A model which can predict on past collided data packets and set a timer for a predicted time instead of a probability of 'p' time should be optimal for solving the issues with CSMA protocols. This gives the sovereignty to a node to decide and rectify the path of the data packet to a much more stable route without any significant data packet loss.

Recalling the statement about the possibility of adding another layer of instructions predicting the packet loss on a particular line can be included in the TCP/IP model. A complex calculation of creating a "Hoax" route, plotting out the points or time frames a data packet should encounter a blockage, optimal alternative routes, and the alternative routing instructions for the nodes.

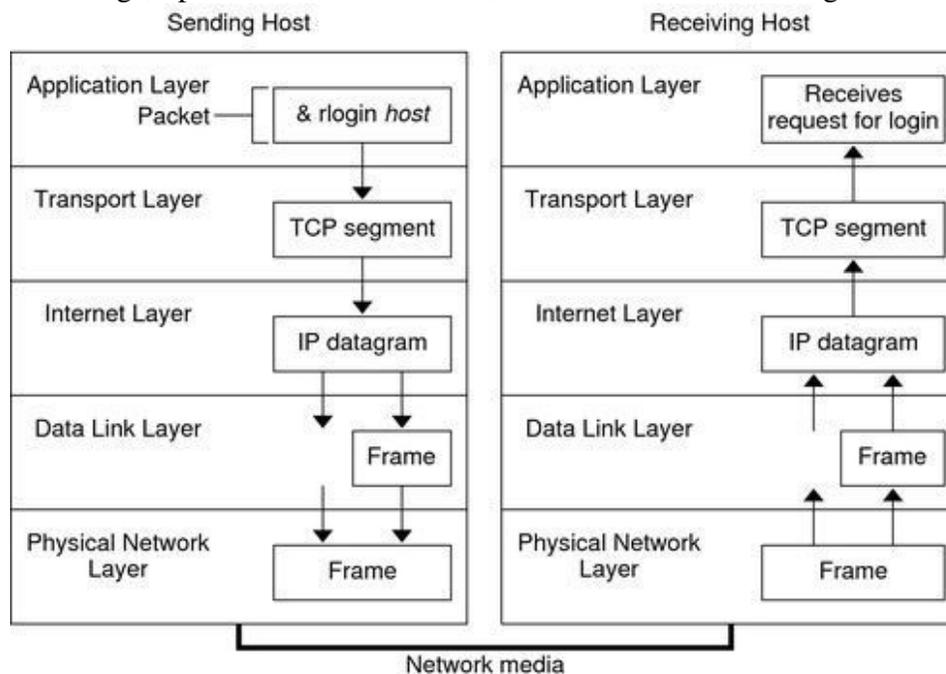


Fig. 3, TCP/IP Stack, extracted from [6, Fig. 1-1]



In a TCP/IP connection, a proper and secure “three-way handshake” is required for the data packets to be forwarded to the receiving node. The Application layer sends out a login request to the receiving host and then further the Transport layer ensures that the data is reached in a reliable way. The Transport layer also creates a virtual path and attaches a header to each encapsulated data packet so that they are forwarded to the right track. If there are reports of data packets lost the protocol sends the data packets to the host again.

Since TCP is a connection-based protocol, it may not be suitable to real time data sending. UDP a “connectionless” protocol [6] does not check if all the packets have arrived at the destination or not. This makes it efficient but it reduces the quality of a real time image/video/game being projected to the user.

The Internet layer determines if the packet is in IP datagrams or not, this could be useful for the forwarding ports as if there is a need to edit the route the resonating datagrams could be edited efficiently.

A writeable functionality in the Transport Layer and the Internet Layer provided to the forwarding ports could determine a way of changing the routes. Even though protocols like PPP (Point-to-Point Protocol) have proved to be a secure connection with the internet, there are high expectations for it to have data packet loss.

The way a best routing is chosen is based on few factors depending on the dynamic protocols being used. [4] A hop count between source and destination (Routing Information Protocol, RIP), getting a cost based shortest route from source to destination (Open Shortest Path First, OSPF) and calculating the bandwidth, delay, load and reliability (Enhanced Interior Gateway Routing Protocol, EIGRP). A routing table helps the router to decide which route should be assigned to a data packet. Since these are considered to be the most efficient protocol and also use routing tables consisting pre-defined routes, there is a high possibility that they end up having multiple collisions due to them being overused.

Routing is the only stage where a data packet is given the complete freedom to be writable in terms of the route to be followed. Pre-defined routes do give a benefit of less processing power being used up for assigning routes. A paper discussing broadening the size of a routing table [5] has been presented in a previous conference. They have outlined a methodology using ‘\*’ to represent different addresses in Class A, B and C. The ‘\*’ is only to define the number that needs to be passed randomly.

The routing table model can be narrowed down by using multiple queries. A suggestion of implementing a ‘delay’ column could help the router decide what routes would be suitable. This delay accounts for the lines that are jammed; this delay could also be considered as the ping.

Considering the situation where the data packet has been assigned a route and is on its path, a line block while transportation is highly possible as well. As outlined before CSMA protocols could fail in high traffic cases. Giving a relay node to have read and writable function allows the incoming data packets to be re-routed.

The problem of how a node should decide whether to overwrite the current path arises. This requires the nodes to also have an internet layer. Stated before, this layer could consist of a table that contains past data packet loss data and predicts whether a particular route is subject to have packet loss or a ‘traffic jam’ at a particular instance.

A relay node shall only have this forceful action after there has been a trigger. This trigger is set off if there are multiple data packets being lost in a short time, the data packets are not



completing the entire journey in the expected time, the CSMA/CD protocol fails on one particular network line and/or the data packets are not being sent at all for a prolong period of time.

$n$  = number of packets being lost

$k$  = number of packets not completing the journey in expected time  $t\#$  (time in seconds)

$p$  = number of data packets not being sent from a station after a period of time $\#$  (time in seconds)

$j$  = number of times the protocol has failed

$e$  = number of average failures, or the average time period in which the data packet is not considered to be stale

if  $n \geq 20$ :

refer to the routing table with predictive values and decide a new route

if  $k > 1$ :

refer to the routing table with predictive values and decide a new route

if  $p > e$ :

refer to the routing table with predictive values and decide a new route

if  $j > e$ :

refer to the routing table with predictive values and decide a new route

All of the above conditional statements having an else statement to repeat their original cycle and try again if it fails.

The system is aiming for a fail proof method that supports all other backups if one of the cases fails.

If the number of packets lost are more than or equal to 20 data packets (as stated by the data packet loss prediction model) the model moves onto a writeable state. The same state is achieved if the number of packets not reaching in the expected time of journey, if the number of packets not being sent after a period of time is not achieved (this value usually should be taking in account the maximum time the packet can be held at the station) and finally if the CSMA/CD protocol fails 'j' after a certain period of average failure 'e' decided by the past data.

This flexibility of relay nodes having the ability to write also requires them to acquire a routing table from their location to consider all the factors stated above.

If the writable state is not achievable by the succeeding nodes, then the previous nodes shall also consider adding in the optimal alternative routes in the routing header of a data packet.



### CONCLUSION

In totality, there are three significant ways there could a better model implemented. One, the nodes could be used to predict the blockage period using past data loss and route the incoming data packets to another network lines. Two, the data packets consisting of the TCP/IP model could have another layer of header consisting of the required information for the nodes to deviate from their path. Three, instead of having another layer, the relay nodes could rectify the current route to reach the destination in an optimal time predicted using a classification predictive model. This classification model takes in consideration of the values which are considered to be 'not the optimal time' and the values which are the 'optimal time'. Furthermore, an average from the optimal time could be taken to get the best results out of the data (assuming that it has no illegal values – many values that are not far away from being considered as either of the restrictions).

### Acknowledgements

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### REFERENCES

- [1] Y. W. Bernier, "Latency compensating methods in client/server in-game protocol design and optimization", presented at Game Developers Conference 2001, Mar 20, (Vol. 98033, No. 425).
- [2] L. Roychoudhuri and E. S. Al-Shaer, "Real-time packet loss prediction based on end-to-end delay variation," in IEEE Transactions on Network and Service Management, Nov. 2005, vol. 2, no. 1 , pp. 29-38, doi: 10.1109/TNSM.2005.4798299.
- [3] Tech Target Contributor, "CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance)", TechTarget Search Networking, <https://searchnetworking.techtarget.com/definition/CSMA-CA> (accessed June 28, 2021)
- [4] Cisco press, "Cisco Networking Academy's Introduction to Routing Concepts", Cisco Press, <https://www.ciscopress.com/articles/article.asp?p=2180208&seqNum=9> (accessed June 30, 2021)
- [5] Draves, R.P., King, C., Venkatachary, S. and Zill, B.D., "Constructing optimal IP routing tables." In IEEE INFOCOM'99. Conference on Computer Communications. Proceedings. Eighteenth Annual Joint Conference of the IEEE Computer and Communications Societies. The Future is Now (Cat. No. 99CH36320) (Vol. 1, pp. 88-97). March, 1999.
- [6] Oracle, "How the TCP/IP Protocols Handle Data Communications", OracleSystem Administration Guide: IP Services , [https://docs.oracle.com/cd/E18752\\_01/html/816-4554/ipov-29.html](https://docs.oracle.com/cd/E18752_01/html/816-4554/ipov-29.html) (accessed July 17, 2021)



### WHAT ARE EXACTLY CRYPTOCURRENCY TECHNOLOGIES AND BITCOIN AND HOW DOES IT IMPACT ECONOMIES?

**Tara Kharat**

Billabong High International School  
Malad(W)  
tarakharat@gmail.com

#### Abstract

Objectives of the research revolve around the idea of what cryptocurrency technologies and Bitcoin entail and how it impacts economies. Cryptocurrency being such a new concept is a novelty in itself, and this potential future currency and its impacts must be explored further. This concept is relatively new, with bitcoin dating back to 2009, made under the pseudonym Satoshi Nakamoto.

**Keywords:-** *Cryptocurrency, Bitcoin, Blockchain, Satoshi, Mining, Private and public keys, Block*

#### INTRODUCTION

Cryptocurrency is essentially a virtual currency and is guarded by cryptography, eliminating the possibilities of counterfeiting and double-spending. Cryptocurrency runs on blockchain technology which is a database technology. Blockchain technology is fundamentally comprised of blocks that are all attached by chains. These blocks contain data and are then connected in the chronological order of the added data. The problem with cryptocurrency is that it is still comparatively new and most of the population find it too intricate as possible users. People looking to use and invest in bitcoin and other cryptocurrencies don't even know where to start and doubt the anonymity factor. One of the latest publications includes one by Shangrong Jianga Xuerong Lib Shouyang Wangab that talks about "Exploring evolution trends in cryptocurrency study: From underlying technology to economic applications." The research paper's objectives scrutinize research hotspots and evolution trends of cryptocurrency. This paper was received on 8 January 2020, revised on 20 March 2020, accepted on 10 April 2020, available online on 4 May 2020. Another recently written paper by Malcolm Campbell-Verduyn explores the fundamentals of cryptocurrencies like bitcoin, their features and how to use them, and how cryptocurrencies impact economies.

#### Theory

The supposed founder Satoshi Nakamoto created Bitcoin as a response to the Great Financial Crisis. Depending on banks as an intermediate body for financial transactions, the world would then be succeeded by a peer-to-peer network system. This system wouldn't use a third party but would rely on algorithms to authenticate a transaction. Here is where blockchain technology comes into play. The technology stores transactional records and also secures transactions. Investors now look at Bitcoin as a form of inflation insurance where this insurance can also



include gold, precious stones, and more. Bitcoin is also transportable, where it can make any device into a virtual wallet. Even with all these attractive traits, some are still hesitant to invest in bitcoin, especially governments. Governments fear that cryptocurrency can be used with corrupt intentions such as money laundering or purchases of things such as arms and ammunition. This fear they have is viable, seeing their reasoning. Governments prefer using fiats which are the currencies set by themselves. These fiats have value because the governments claim they do, and even though this claim means nothing to the masses, the governments have a ton of control over these currencies. Governments can control the aggregate supply of money to either slow down or boost the economy, and this is done via banks. Bitcoin and other cryptocurrencies rule out the intermediae bodies, which are banks. This would then severely impact economies around the world. Governments wouldn't be able to track currency movements, transactions, and most efforts to control and trace crime would go down the drain. A paper by A. Seetharaman, A.s. Saravanan."Impact of Bitcoin as a World Currency."

[researchgate.net.https://www.researchgate.net/publication/317134650\\_Impact\\_of\\_Bitcoin\\_as\\_a\\_World\\_Currency](https://www.researchgate.net/publication/317134650_Impact_of_Bitcoin_as_a_World_Currency) (accessed May.13,2021) goes on to say how "There is no consistency in guidance on the legal, accounting, tax and audit-related standards. Thus, Regulation has become one of the most debated issues facing the digital currency industry. Bitcoin technology has many of the unique and unprecedented features that give it the potential to be disruptive and impacting a broad range of industries and institutions. The ability to send money anywhere in the world in minutes, its peer-to-peer decentralized nature of value transfer and its completely digital existence, makes effective regulation of digital currencies so challenging for governments and policymakers have no clear legislation on digital currencies, which makes the process even more complex." Governments wouldn't be able to control excess inflation, recession, and power over the currency, in general, would be lost, thus potentially being a loophole for crime to be committed. This briefly summarized the impact of bitcoin on the economy.

### Experimental

An abundance of papers on cryptocurrency technologies has been written. An experiment by Yli-Huumo, Jesse, et al. "Where is current research on blockchain technology?—a systematic review." *PloS one* 11.10 (2016): e0163477. used systematic mapping study as the research methodology. After searching for relevant papers and screening them, they do a mapping study process where keywords are identified from the abstracts.

### Result

Out of the 55 selected papers, 41 were selected as primary papers. The security aspect of bitcoin was one of the most common topics. Wasted resources and privacy were other topics that popped up.

### Discussion

The security aspect talks about all privacy breaks and other incidents like scams and frauds like mining scams and more were thoroughly discussed. The wasted resources aspect talked about how bitcoin would need large amounts of energy to run on, and efficient use is not guaranteed. The study showed the papers to majorly talk about solving challenges that cryptocurrencies



currently face and how features can be improved and added to improve things like privacy, use the platform easier, and have stricter security.

<https://journals.plos.org/plosone/article/figure?id=10.1371/journal.pone.0163477.g003>

### Conclusion

Bitcoin is an online currency that works on blockchain technology, and an intermediate body doesn't exist here. As advance as the technology is, it does come up with issues like privacy and security concerns. These concerns apply to the users as well as the economy. Not being able to track currency movement can be taken advantage of by criminals etc. Aside from these limitations, the advantages of bitcoin would include eliminating banking fees, discretion, and more. Overall, cryptocurrencies are an up-and-coming piece of technology, and as exceptional as they are, the challenges that come with them must be eventually faced.

### Referencing

- J.Frankenfield. "Cryptocurrency". Investopedia.com. <https://www.investopedia.com/terms/c/cryptocurrency.asp> (accessed May.1,2021)
- L.Conway. "Blockchainexplained". Investopedia.com. <https://www.investopedia.com/terms/b/blockchain.asp> (accessed May.1,2021)
- "Bitcoin". Bitcoin.com. <https://bitcoin.org/en/> (accessed May.1,2021)
- J. Herrera-Joancomartí. "Research and Challenges on Bitcoin Anonymity". ResearchGate.com. [https://www.researchgate.net/publication/281773799\\_Research\\_and\\_Challenges\\_on\\_Bitcoin\\_Anonymity](https://www.researchgate.net/publication/281773799_Research_and_Challenges_on_Bitcoin_Anonymity) (accessed May.1,2021)
- S. Jiang, X. Li, S.Wang. "Exploring evolution trends in cryptocurrency study: From underlying technology to economic applications". ScienceDirect.com. <https://www.sciencedirect.com/science/article/abs/pii/S1544612320300374> (accessed May.1,2021)
- M. Campbell-Verduyn. "Bitcoin, crypto-coins, and global anti-money laundering governance" Springerlink.com. <https://link.springer.com/article/10.1007/s10611-017-9756-5> (accessed May.1,2021)
- "Bitcoin 101: What is Bitcoin and Why Was it Created?". Finacialgym.com. <https://finacialgym.com/blog/2021/1/2/bitcoin-101-what-is-bitcoin-and-why-was-it-created#:~:text=Why%20was%20Bitcoin%20created%3F,intermediaries%20of%20all%20financial%20transactions.&text=This%20way%2C%20the%20banks%20did,in%20each%20and%20every%20transaction> (accessed May.1,2021)
- J. Mcwhinney. "Why Governments Are Afraid of Bitcoin". Investopedia.com. <https://www.investopedia.com/articles/forex/042015/why-governments-are-afraid-bitcoin.asp> (accessed May.1,2021)
- A. Seetharaman. "Impact of Bitcoin as a World Currency "ResearchGate.com. [https://www.researchgate.net/publication/317134650\\_Impact\\_of\\_Bitcoin\\_as\\_a\\_World\\_Currency](https://www.researchgate.net/publication/317134650_Impact_of_Bitcoin_as_a_World_Currency) (accessed May.1,2021)
- J. Zichu, S. Zerdoumi, S.Zhang. "THE GLOBAL VIEW OF BITCOIN AND ITS ECONOMIC IMPACT" presented at 20th Malaysian Finance Association Conference 2018 Innovative



Ecosystem for Financial Revolution August 1 – 2, 2018 II Langkawi, Malaysia At: Langkawi, Malaysia Volume: 1

-J.Yli-Huumo,D. Ko,S. Choi ,S.Park,K.Smolander. “Where Is Current Research on Blockchain Technology?—A Systematic Review”.

Plos.org.<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0163477> (accessed May.1,2021)

-N.Reiff. “What Are the Advantages of Paying With Bitcoin?”  
Investopedia.com.<https://www.investopedia.com/ask/answers/100314/what-are-advantages-paying-bitcoin.asp> (accessed May.1,2021)



### LEVERAGING DATA SCIENCE TO CURB COVID-19

**Soumya Doshi**

Savitridevi Hariram Agarwal International School  
doshisoumya1@gmail.com

#### Abstract

The COVID-19 pandemic has hit the global at a colossal scale. Being a highly infectious disease, with worldwide reported positive cases of 182 million, it has led to a grievous impact on humanity. As all the countries are struggling to alleviate the losses due to the outbreak, enforcing lockdown has become the primary defence mechanism. With researchers working around the clock to find an advancement in the diagnostics and treatment of the pandemic, it has presented global health services with the most appalling challenge. Inspired by latest advances and applications of data science in these areas, this paper aims at highlighting its importance in responding to the COVID-19 outbreak and preventing the severe effects of the COVID-19 pandemic. It also presents few limitations to big data in handling the epidemic.

**Keywords:** *Pandemic, Covid-19, Big data, Data analysis*

#### Introduction

This paper first presents fundamental knowledge of Covid-19 (Section-I) and data science (Section-II) and then it reviews the applications of big data in fighting the covid-19 pandemic (Section-IV). For example: Identifying the covid-19 patients, tracking the covid-19 outbreak, developing drug researches and improving the medical treatment. Lastly, a number of limitations of data science applications are outlined and discussed (Section-IV).

#### Theory

##### Section I: Covid-19

The world would remember the year 2020 as a devastating year for humanity on this planet earth. Pneumonia of unknown aetiology (novel coronavirus) identified in the city of Wuhan, China in December 2019 [1] with its first mortality reported on January 10, 2020, has become a pandemic [2]. It is named as COVID-19 (Corona virus disease 2019) by the World Health Organization (WHO) [3] and declared as a pandemic by WHO on 11<sup>th</sup> March 2020 [4]. At the time of writing, globally, as of 6:32pm CEST, 29 June 2021, there have been 181,176,715 confirmed cases of Covid-19, including 3,930,496 deaths, reported to WHO [29].

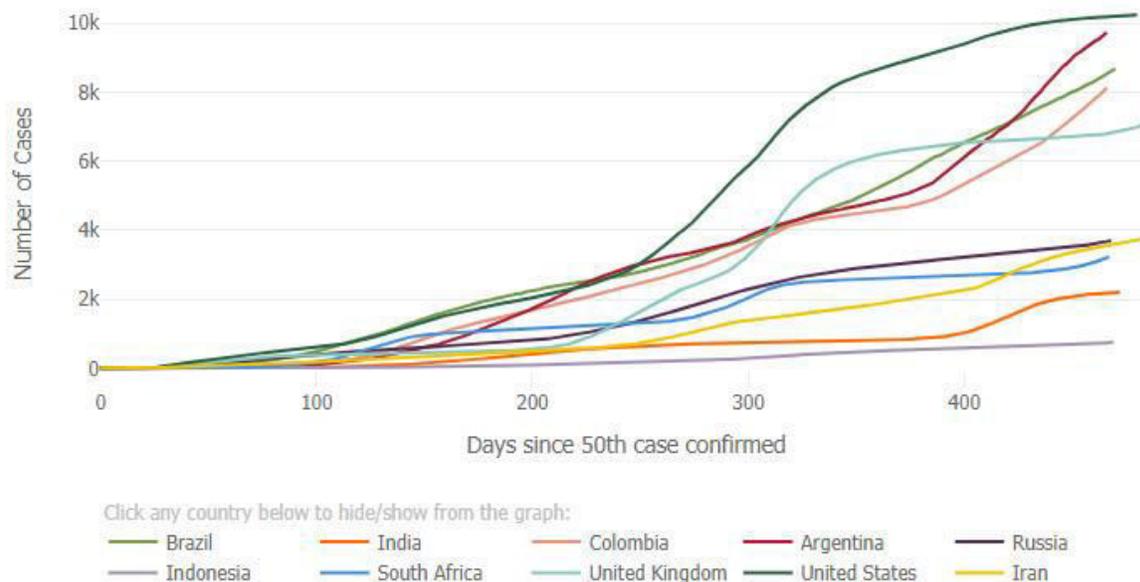


Table 1 -Covid cases [5]

Coronavirus disease-19 (COVID-19), caused by a novel coronavirus, has changed the world notably, not only in the health care space, but also in many aspects of human life such as education, transportation, politics, supply chain, etc. People infected with Corona virus, usually undergo respiratory illness and can recover by taking effective medications. Infected COVID-19 people may undergo respiratory illness but can recover with effective and appropriate treatment methods. What makes COVID-19 much more threatening and easily transmissible than other Coronavirus families is that the COVID-19 virus has become highly efficient in human-to-human transmissions [30]. Due to the substantial impact of Covid-19 on the globe, abundant efforts are paid as solutions to combat against this outbreak. Government's efforts are mainly responsible to stop the pandemic, e.g., lock down the (partial) area to limit the spread of infection, ensure that the healthcare system is able to handle the outbreak and provide crisis package to decrease effects on the national economics and people, and adapt compatible policies according to the COVID-19 situation. At the same time, individuals are encouraged to stay healthy and protect others by following some advice like wearing the mask at public locations, washing the hands frequently, maintaining the social distancing policy, and reporting the latest symptom information to the regional health center. On the other hand, research and development relevant to COVID-19 are now prioritized, and have received special interest from various stakeholders like governments, industries, and academia. For example, studies in [6], [7] showed tremendous influences of the COVID-19 pandemic on the global supply chain, and took into account different directions of supply chains, including viability, stability, robustness, and resilience.

Over 180 million people across 180+ countries affected and the humungous amount of data requires systematic analysis and trillions of data points to decipher trends to combat COVID-19, which brings forth many opportunities for applying data science techniques [8], hence ameliorating the pressure on health care services. So now let's take a look at how we can use modern technology namely Data science in this regards.

### Section II: Data Science

Data science is the discipline that deals with vast volumes of data which use recent tools and techniques to look for camouflaged patterns, extract significant information, and make business decisions. Data science uses complex machine algorithms to build such predictive models.[8]. Data science is an umbrella term that encompasses all of the techniques and tools used during the life cycle stages of useful data.

To give a further clarity on understanding this cycle, here is a detailed description of the stages involved in the life cycle of a typical data science project.

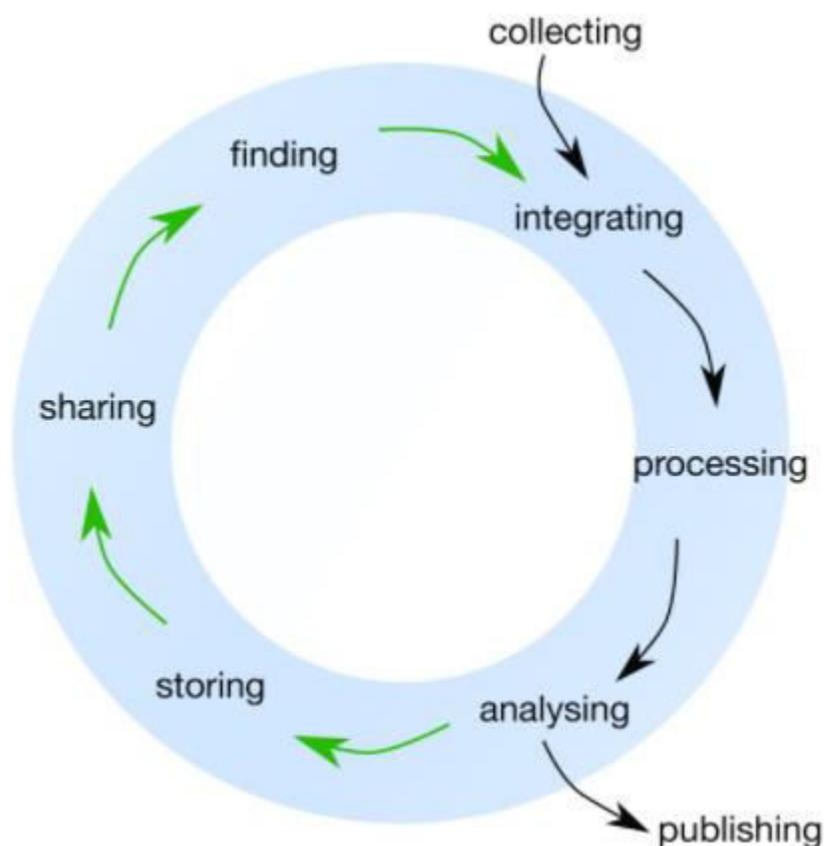


Figure 1: Life cycle of a typical data science project [9]

#### *1) Data generation and collection*

First, the cycle starts with collection of data which is generated by people like us. Every search query performed, movie watched, book read, picture taken, message sent, contributes to the massive digital footprint we each generate. After generation comes collection. All the data



generated is not collected, maybe out of choice because we do not need or want to, or for practical reasons as the data streams in faster than we can process.

### 2) *Data Processing*

After obtaining data, the next immediate thing to do is scrubbing data which includes cleaning, filtering and normalizing. If the data is unfiltered and irrelevant, the analysis result will not be useful. One simple example of normalizing data is reconciling formats of the data. In this process, data is converted from one form to another and everything is consolidated into one standardized format across the entire data.

### 3) *Data modeling and interpretation*

Interpreting model and data is final but most crucial step in the cycle. This step helps present the data in a clear and simple way that a human can readily understand and visualize. Modeling data is to reduce the proportion of the data set given. As all values and features are not required for prediction of model, only the relevant ones that contribute to determination of results have to be selected. It is at this stage in the data life cycle when we need to consider, along with functionality, aesthetics, and human visual perception to convey the results of data analysis.

## **Discussion**

In order to combat an epidemic the government has to take decisions such as limiting population movements, allocating scarce resources, which will play a key role in ensuring the survival and well being of the citizens. One basis for taking these decisions is the availability of the right data. Big data refers to extremely large data sets that require specialized and often innovative technologies and techniques in order to efficiently use the data.

The spread of the global pandemic, COVID-19, has generated tremendous and varied amount of data, which is increasing exponentially. This data can be made useful by leveraging big data analytic techniques in a wide range of areas.

## **Section III: Data Science applications for Covid-19**

Figure 2 shows potential application areas. (next page)

### *1. Risk assessment and patient prioritization*

Healthcare systems around the globe are facing prodigious duress on their resources (e.g. availability of intensive care beds, respirators) [31]. This brings about the necessities to immediately access and supervise patient risk, while allocating resources appropriately. In order to recognize the patients at maximum risk for unfavourable outcomes because of care disruptions, health systems can first look for similar care disruption trends in past. Once sufficient data sets have been collected which recognize patients who have experienced health care disruptions in the past, predictive models can then be created. Due to diverse symptoms and disease trajectories, researching technologies for data driven risk-assessment and management in Covid-19 patients would be useful. For example traits like age, gender, or health state can be utilized to provide an estimate of mortality risk. This is particularly important when resources are limited, for example- patient prioritization when intensive care units (ICU) are insufficient.

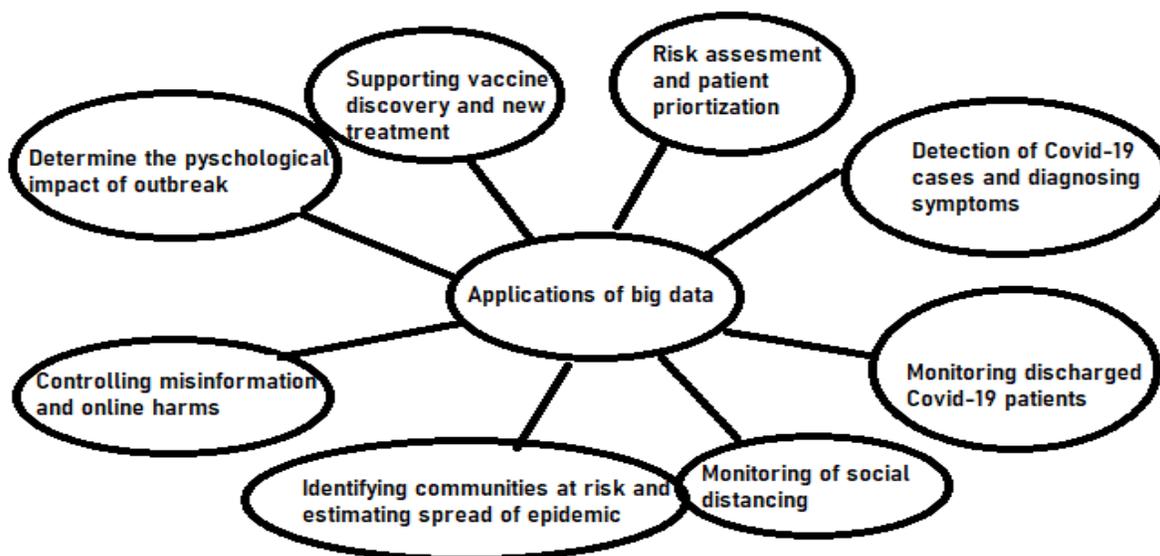


Figure 2

### 2. *Detection of covid -19 cases and diagnosing symptoms*

Since majority of infections become evident only upon symptom emergence, ongoing methods for testing are doubtful to identify pre - symptomatic carriers, which is a significant challenge for the implementation of early-stage interventions that reduce transmission. As many as 20% of individuals with COVID-19 are asymptomatic, assisting further viral spread[32]. Some remote computational tools exist which could be expanded, for example- smartwatches can be used for real- time health monitoring and surveillance[33]. An online detection algorithm has been developed which is used to identify early stage of infection by heart rate monitoring [11]. Automated tools can further be developed to facilitate screening in larger groups of people (example-airports) by using computer based thermal imaging to detect fever[10].

### 3. *Monitoring discharged covid-19 patients*

A study shows deployment of a Remote patient monitoring [RPM] programme with post discharge patients of Covid-19 was associated with a decreased risk of re admission to hospitals, and provided a saleable mechanism to monitor patients in their home environment. The enrolled patients had an app and they self- reported oxygen saturation and temperature daily. And when abnormal symptoms or vital signs were flagged, a pool of nurses assessed the situation.[12]

### 4. *Monitoring of social distancing*

This is a no-pharmaceutical intervention adopted by many governments that reduces human contact within the population and hence constraints the spread of Covid-19. Data science can support contact tracing for monitoring of social distancing, for instance by extracting data from



social media[13] which can be used for general population tracking to understand compliance with social distancing. This could then be complemented with other datasets (example- cellular trace data or air pollution monitoring)[14] to better understand human mobility patterns in the context of social distancing. However, these solutions present complex trade offs with regards to privacy.

### 5. *Identifying communities at risk and estimating the spread of epidemic.*

PCCI, which is an organization of data scientists, has launched a vulnerability index as a way to assist community and healthcare leaders to address the factors that cause Covid-19's exponential spread. By analyzing the Geo-spatial distribution of Covid-19 risk factors, PCCI is able to identify communities at risk for Covid-19 allowing for targeted community support and intervention[15]

### 6. *Controlling the misinformation and online harms*

From suggestions that people can defeat Covid-19 by drinking bleach to deceptive theories that vaccines can alter a person's DNA, the Covid-19 pandemic has made clear the challenges medical misinformation constitutes in this digital age. A study[16] estimates that about 5,800 people were admitted to hospital as a result of false information on social media. Social media platforms are one of the most significant abettors to the spread of misinformation and disinformation, and their algorithms have computed the problem[17]. In order to control this infodemic, classifiers and techniques can be developed to stem this flow. Fondazaine Bruno Kessler (FBC) institute in Italy, uses Twitter data to quantify collective sentiment, social bot pollution, and news reliability and displays this visually[18].

### 7. *Determine the physiological impact of covid-19 outbreak*

The Covid-19 pandemic and the resulting economic recession have negatively affected many people's mental health and created new barriers for people already suffering from mental illness and substance use disorders. There are a variety of ways pandemic has affected mental health, particularly with widespread social isolation resulting from necessary safety measures[20]

### 8. *Supporting vaccine discovery and new treatments*

The international effort to discover or re-purpose drug treatments and vaccines can also benefit from extensive data science work predating COVID-19[22]. Computational methods can reduce the time spent on examining data, predicting protein structures and genomes[23]. It can also assist in identifying eligible patients for clinical trials, which is often a time-consuming and costly part of drug development[24].

## **Section IV :Key limitations to data science techniques for Covid-19 control**

Various challenges may hamper the advantageous outcome from the implementation of big data analysis tools in the health sector that have been confronted while devising solutions in context to the COVID-19 epidemic, which will be discussed in the following subsections.

### *A. Data reliability*

The internet and social media are chief sources for circulation of incorrect medical information and rumors, like the effects of virus, impact of vaccine, all of which pose a threat to the



government's and health agencies' endeavor to constrict the transmission of virus and maintenance of good health. It is also prone to have unfavourable psychological outcomes on society. Furthermore, absence or inaccuracy of some studies, data may lead to biased study-findings.[28]

### *B. Data sharing*

Data sharing plays a crucial role for digital governments and smart cities in tackling such massive public emergencies. In 2015, China's state council issued the action to promote the development of big data[26], which suggested that big data should be used as an essential means to amplify the government's governance range, ameliorate the level of government decision making, and handle risk prevention through well-planned collection and integration of government and social media data. However in practice, data sharing has exhibited a silo effect. Data sharing among Chinese departments and regional governments remains insufficient, and the phenomenon of "block islands" still exists. For example, using private travel and health condition information, a two-dimensional risk assessment code is generated. And when these health codes were used, many regions did not identify the assessment codes generated by other regions.

### *C. Data security, privacy and ethics*

Coming up with solutions that showcase reasonable results and at the same time protect privacy stick to sophisticated ethical guidelines is an underrated obstacle. Medical data is confidential and shared only under explicit circumstances and for definite research purposes, as healthcare data security and patient privacy issues are a matter of concern[25]. Hence, it is vital to state the working, strategies, and guidelines that govern and ease access to medical data with trade-offs to patients' privacy or without exploiting the data for inappropriate uses, specially when grave situations occur and with the transmission of deadly epidemics that need immediate solutions, such as Covid-19.

## **Conclusion**

The world-wide epidemic of Covid-19 has had an unforeseen impact on the entire human race. This paper not only gives a explains how leveraging data science techniques can ease the pandemic pressure but also outlines the its limitation with regards to this situation and hence how to use technology with it's limitation. With today's relatively advanced data science, if we use big data techniques to advance a rapid, accurate and timely grasp of the development trend of the epidemic or to predict the response of people and take more effective preventive measures, we can expect to reduce the negative impact of epidemics on people's production and life.

## **References**

- [1] C. Huang, Y. Wang, X. Li, L. Ren, J. Zhao, Y. Hu, *et al.*  
Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China  
Lancet, 395 (10223) (2020), pp. 497-506
- [2] C. Sohrabi, Z. Alsafi, N. OfiNeill, M. Khan, A. Kerwan, A. Al-Jabir, *et al.*



World health organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19)

Int J Surg (2020)

[3] Organization W.H., et al. Naming the coronavirus disease (COVID-19) and the virus that causes it. 2020a.

[4] WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020

[5] <https://coronavirus.jhu.edu/data/cumulative-cases>

[6] D. Ivanov and A. Dolgui, "Viability of intertwined supply networks: Extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak", *Int. J. Prod. Res.*, vol. 58, no. 10, pp. 2904-2915, May 2020.

[7] Ivanov, "Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case", *Transp. Res. E Logistics Transp. Rev.*, vol. 136, Apr. 2020.

[8] Wing, J. M. (2019). The Data Life Cycle. *Harvard Data Science Review*, 1(1). <https://doi.org/10.1162/99608f92.e26845b4>

[9] Philippa C. Griffin, Jyoti Khadake, Kate S. LeMay, Suzanna E. Lewis, Sandra Orchard, Andrew Pask, Bernard Pope, Ute Roessner, Keith Russell, Torsten Seemann, Andrew Treloar, Sonika Tyagi, Jeffrey H. Christiansen, Saravanan Dayalan, Simon Gladman, Sandra B. Hangartner, Helen L. Hayden, William W.H. Ho, Gabriel Keeble-Gagnère, Pasi K. Korhonen, Peter Neish, Priscilla R. Prestes, Mark F. Richardson, Nathan S. Watson-Haigh, Kelly L. Wyres, Neil D. Young, Maria Victoria Schneider

Version 2. F1000Res. 2017; 6: 1618. Published online 2018 Jun 4. doi: 10.12688/f1000research.12344.1 PMID:PMC6069748

[9] <https://www.cnbc.com/2020/04/02/this-smart-thermometer-could-help-detect-covid-19-hot-spots.html>

[11] Mishra, T.; Wang, M.; Metwally, A.A.; Bogu, G.K.; Brooks, A.W.; Bahmani, A.; Alavi, A.; Celli, A.; Higgs, E.; Dagan-Rosenfeld, O.; et al. Pre-Symptomatic Detection of COVID-19 from Smartwatch Data. *Nat. Biomed. Eng.* 2020, 4, 1208–1220. [CrossRef]

[12] Gordon WJ, Henderson D, DeSharone A, Fisher HN, Judge J, Levine DM, MacLean L, Sousa D, Su MY, Boxer R. Remote Patient Monitoring Program for Hospital Discharged COVID-19 Patients. *Appl Clin Inform.* 2020 Oct;11(5):792-801. doi: 10.1055/s-0040-1721039. Epub 2020 Nov 25. PMID: 33241547; PMID: PMC7688410.

[13] A. Signorini, A. M. Segre and P. M. Polgreen, "The use of Twitter to track levels of disease activity and public concern in the US during the influenza A H1N1 pandemic", *PloS One*, vol. 6, no. 5, 2011.

[14] M. Cadotte, "Early evidence that COVID-19 government policies reduce urban air pollution", Mar. 2020.

[15] <https://pccinnovation.org/pccis-vulnerability-index-taking-the-fight-to-covid-19/>

[16] <https://www.ajtmh.org/view/journals/tpmd/103/4/article-p1621.xml>

[17] Pennycook G, et al. Fighting COVID-19 misinformation on social media: experimental evidence for a scalable accuracy-nudge intervention. *Psychol Sci.* 2020;31(7):770–80.

[18] <https://www.fbk.eu/en/press-releases/the-full-version-of-the-of-the-fbk-comune-lab-infodemic-observatory-on-covid19-is-now-released/>



- [20] Yamada, Y., Čepulić, DB., Coll-Martín, T. *et al.* COVIDiSTRESS Global Survey dataset on psychological and behavioural consequences of the COVID-19 outbreak. *Sci Data* **8**, 3 (2021). <https://doi.org/10.1038/s41597-020-00784-9>
- [21] Leander, P., Kreienkamp, J., Agostini, M., & PsyCorona Collaboration (2020). Mapping the Moods of COVID-19: Global Study Uses Data Visualization to Track Psychological Responses, Identify Targets for Intervention. *APS Observer*, 2020(September). <https://www.psychologicalscience.org/observer/covid-19-psyCorona-global-psychological-response>
- [22] Mitchell, JBO 2018, 'Artificial intelligence in pharmaceutical research and development', *Future Medicinal Chemistry*, vol. 10, no. 13, pp. 1529-1531. <https://doi.org/10.4155/fmc-2018-0158>
- [23] Paul, Debleena et al. "Artificial intelligence in drug discovery and development." *Drug discovery today* vol. 26,1 (2021): 80-93. doi:10.1016/j.drudis.2020.10.010
- [24] Lee, J Jack, and Caleb T Chu. "Bayesian clinical trials in action." *Statistics in medicine* vol. 31,25 (2012): 2955-72. doi:10.1002/sim.5404
- [25] Karim Abouelmehdi, Abderrahim Beni-Hssane, Hayat Khaloufi, Mostafa Saadi, Big data security and privacy in healthcare: A Review, *Procedia, Computer Science*, Volume 113, 2017, Pages 73-80, ISSN 1877-0509, <https://doi.org/10.1016/j.procs.2017.08.292>.
- [26] The State Council released the "Outline of Action to Promote the Development of Big Data". China Paper Newsletter. 2015.  
URL: [http://yuxiqbs.cqvip.com/Qikan/Article/detail?id=666542015&from=Qikan\\_Search\\_Index](http://yuxiqbs.cqvip.com/Qikan/Article/detail?id=666542015&from=Qikan_Search_Index)
- [27] The big data behind the health code is revealed. Today Science and Technology. 2020.  
URL: <http://qikan.cqvip.com/Qikan/Article/Detail?id=7101192711>
- [28] Richardson, S.; Hirsch, J.S.; Narasimhan, M.; Crawford, J.M.; McGinn, T.; Davidson, K.W.; The Northwell COVID-19 Research Consortium. Presenting Characteristics, Comorbidities, and Outcomes among 5700 Patients Hospitalized With COVID-19 in the New York City Area. *JAMA* 2020, 323, 2052–2059. [CrossRef]
- [29] <https://covid19.who.int/> [accessed on 29 June 2021 6:32 pm CEST.]
- [30] Elrashdy F, Redwan EM, Uversky VN. Why COVID-19 Transmission Is More Efficient and Aggressive Than Viral Transmission in Previous Coronavirus Epidemics?. *Biomolecules*. 2020;10(9):1312. Published 2020 Sep 11. doi:10.3390/biom10091312
- [31] Alexander T Janke, Hao Mei, Craig Rothenberg, Robert D Becher, Zhenqiu Lin, Arjun K Venkatesh. Analysis of Hospital Resource Availability and COVID-19 Mortality Across the United States. *Journal of Hospital Medicine*, Jan. 20, 2021; DOI: [10.12788/jhm.3539](https://doi.org/10.12788/jhm.3539)
- [32] He, Jingjing et al. "Proportion of asymptomatic coronavirus disease 2019: A systematic review and meta-analysis." *Journal of medical virology* vol. 93,2 (2021): 820-830. doi:10.1002/jmv.26326
- [33] Blaine Reeder, Alexandria David, Health at hand: A systematic review of smart watch uses for health and wellness, *Journal of Biomedical Informatics*, Volume 63, 2016, Pages 269-276, ISSN 1532-0464,

### TECHNOLOGICAL ERA WITH VACCINE

**Shrey Shah**

Savitridevi Hariram Agarwal International School  
[shahshrey2006@gmail.com](mailto:shahshrey2006@gmail.com)

#### Abstract

Since the birth of IoT (Internet of Things) in 1999 by MIT's Kevin Ashton, it has gained significant momentum as technology and many things have transmuted around the globe in the history of humanity. Not only this invention availed humans to make their standard of living to elongate it at a next level, but it has thoroughly transmuted all the work fields such as medical, science and engineering. This paper focuses on definition of IoT, why technology Era is consequential to humans. Besides of it we have withal discussed potential risks and peril utilizing IoT contrivances and how cyber security proves to be a vaccine to the current threats likely hackers who are one of the most sizably voluminous risks to IoT contrivances.

**Keywords:** Internet of Things, Technology, Raspberry Pi, Hacking, Cyber Threats, Cyber Security

#### Introduction

The vision of a connected and keenly intellectual world can be traced back to 1920s, as expounded by Nikola Tesla in 1926: "When wireless is perfectly applied the whole earth will be

converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole. We shall be able to communicate with one another instantly, irrespective of distance. . . . A man will be able to carry one in his vest pocket" [1]. Nowadays, in this modern world, everything can be done within a blink of your ocular perceivers due to the avail of IoT (internet of things). Internet of things a.k.a IoT refers to a system of interrelated, internet-connected objects that are able to accumulate and transfer data over a

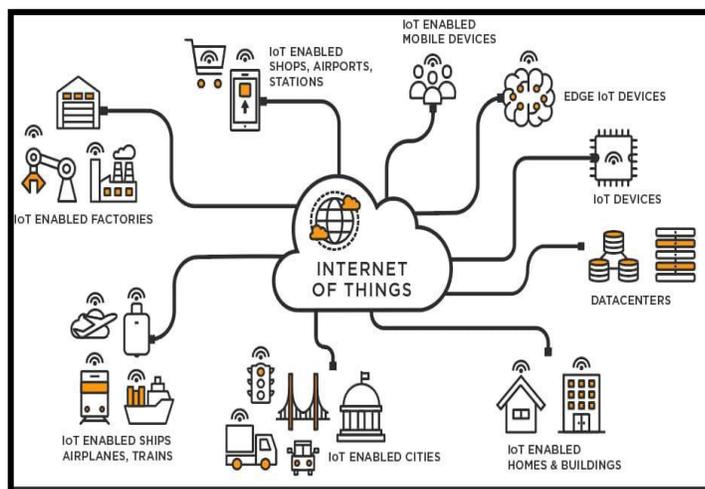


Fig. 1

wireless network without human

intervention. The number of contrivances connected to internet in 2008 was even more sizably voluminous than human population present on earth at that time. It has made our life more luxurious and more facile. It is present virtually everywhere in some different forms such as perspicacious phones, navigation system in conveyances, hi-tech machines in hospitals, and so on. However, in additament to these positives, IoT systems have withal magnetized negative attention from malignant users who aim to infiltrate impotency within IoT systems for their own gain, referred to as cyber security attacks. Consequently in this paper we're going to discuss:

- 1) How is IoT Utilizable?
- 2) Working of IoT with fundamental contrivance
- 3) Cyber Threats to IoT
- 4) How to surmount threats by Cyber security

### Theory

#### 1) How is IoT Utilizable?

IoT contrivances have capability to connect you to anyone in the whole world from wherever you are staying now. In some IoT contrivances there are AI or programs by which they act according to the current situation by themselves without any command such as, if a heart patient suddenly has problem in the heart then if he would have worn a wrist band measuring heart beat extraordinary or suspicious then it itself calls for most nearest ambulance without commands. IoT has a purpose to simplify human's day to day work and avail in some emergency situation so everything could be done much more expeditious and efficiently. Furthermore, with the avail of it many companies have turned from labor-intensive to capital-intensive as for a work where we required 20 people, now with assistance of machines only one worker could do the same work, and even he's more efficient and more expeditious at the work which results in cost-cutting of companies as now they have to pay wages to lesser labours.

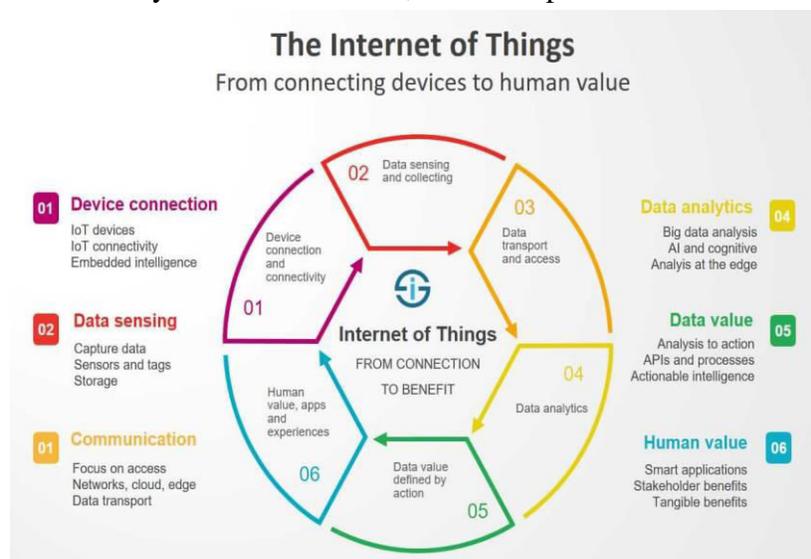


Fig. 2

### 2) Working of IoT with fundamental contrivance

Internet of Things (IoT) is revolutionizing the electronics industry. With more and more applications habituating IoT, it is consequential for the engineers of today to get acquainted with this technology.

The Arduino Uno and the Raspberry Pi 3 are popular culs when it comes to DIY, IoT, or just fun engineering projects. They can be utilized for prototyping and authentic-world engineering solutions i.e. Into the Blue utilizing Arduino & Raspberry Pi boards for an submerged camera, Netflix documentary, Chasing Coral. They were additionally abaft the Autonomous racing robot.

The Raspberry Pi 3 is a Single Board Computer (SBC). This denotes that the board is a plerarily functional computer with its own dedicated processor, recollection, and can run an operating system (runs on Linux). The Raspberry Pi 3 includes its own USB ports, audio output, and has a graphic driver for HDMI output, exhibiting how it can run multiple programs. You can even install other operating systems that include Android, Windows 10, or Firefox OS.[2]

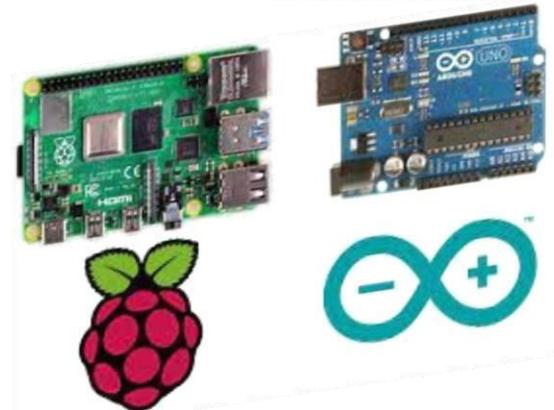
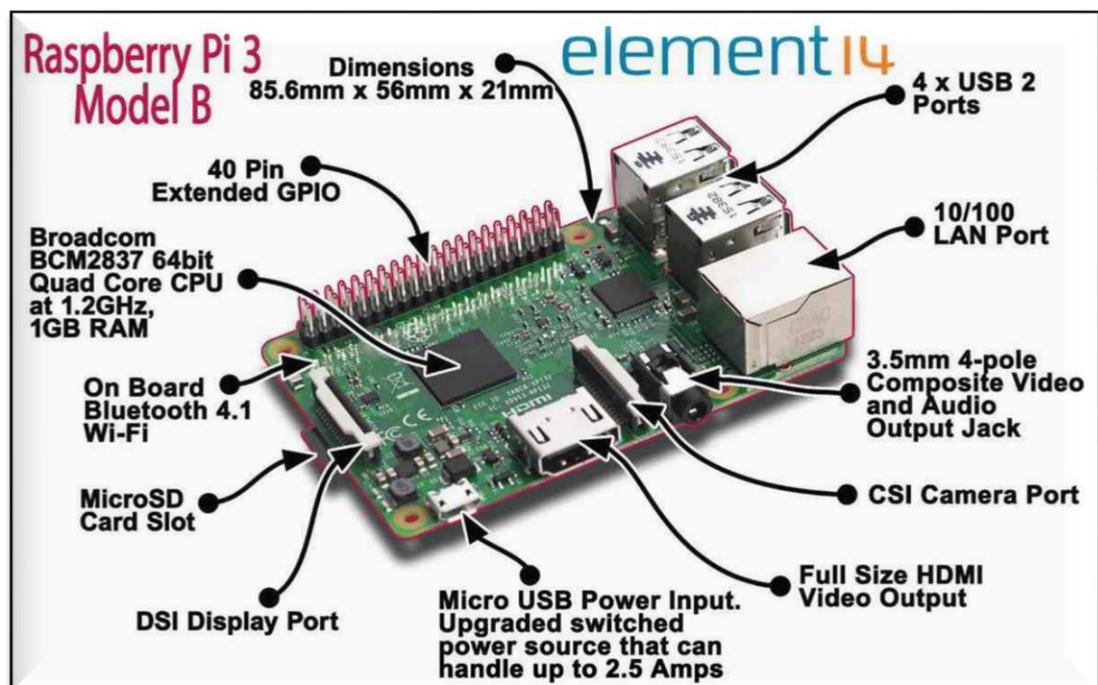


Fig.3

### Raspberry Pi IoT Projects

- Estimate Crowd Sizes and Fight the

Fig. 4



Virus.  
...

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- Smart Energy Monitor Predicated on IoT. ...
- Build a Wi-Fi Range Extender With Raspberry Pi. ...
- Create an IoT-Predicated Agricultural Solution. ...
- Develop a Face Apperceiving Robot with Raspberry Pi. ...
- Build an IoT-predicated Perspicacious Home System with Raspberry Pi. [3]

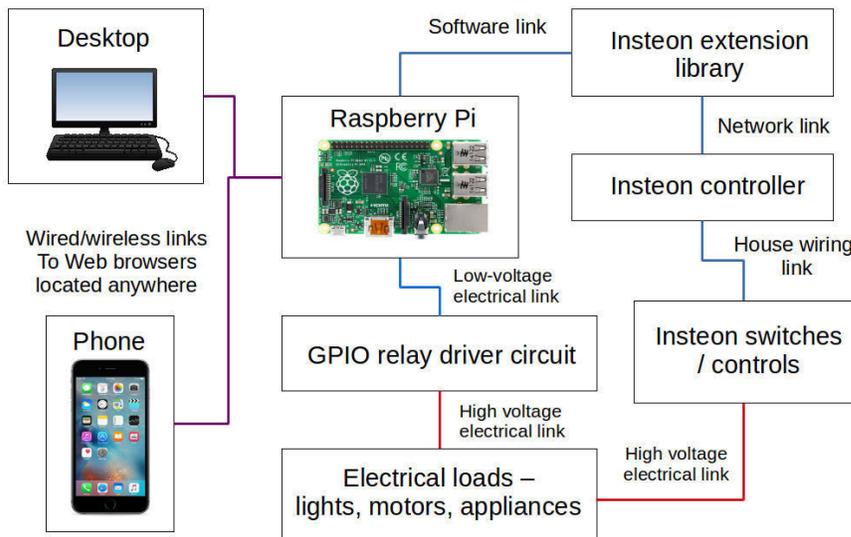


Fig. 5 System block diagram

### Raspberry Pi Remote Control

The Raspberry Pi hosts a simple Web server. Controls household contrivances utilizing Insteon technology. That signifies the utilizer can configure this project to control GPIO relay drivers, Insteon controls, or both. The advantage of the Raspberry Pi in a project like this is that it's minute and frugal enough to be dedicated to the remote control task, perhaps put out of the way on a shelf, and it will reliably accomplish its objective without tying up a more astronomically immense computer that has more consequential work and that might need to be powered down periodically. [4]

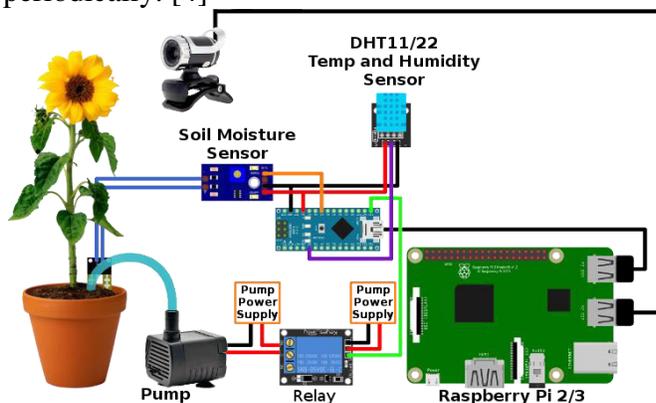


Fig. 6 The circuit diagram of the watering system



### Soil moisture sensor

This fig. shows precision soil moisture which consists of two probes that are inserted into the soil. When the current passes through the probes, the soil contains less moisture offers less resistance, and passes high current. That variable resistance is the parameter to identify the caliber of soil moisture. [5]

### 3) Cyber Threats to IoT devices

One of the distinct challenges in the IoT infrastructures is the constrained computation power and minimal resources of most of the IoT contrivances [6]. These constrained resources preclude the state-of-the-art cryptographic techniques that are indispensable for securing IoT contrivances, thereby making them vulnerably susceptible to a diverse range of security attacks [7], such as the denial of service attacks and privacy attacks such as data exfiltration or leakage attacks. Nowadays if IoT connected contrivance not has good antivirus software then it is thoroughly vulnerably susceptible to hackers and viruses and they infiltrate the contrivance, due to which your all personal information including password, images, credit card number, and so on are now in control of hackers. Every 39 seconds, there is a new attack somewhere on the web. Globally 30000 websites are hacked daily. Statistics shows 12.7 million Americans were victims of identity theft. There are open security gaps that require opportune controls to mitigate them. The challenge is that the currently proposed systems do not provide a consummate security solution that tackles all IoT security and privacy requisites. For instance, most of the proposed methodologies target one or two security requisites, e.g., confidentiality and authentication [8]. An efficient and reliable IoT data sharing requires an all-inclusive security solution for securing the data while limiting the interference that might occur if integrating several independent techniques to provide the required services [6].

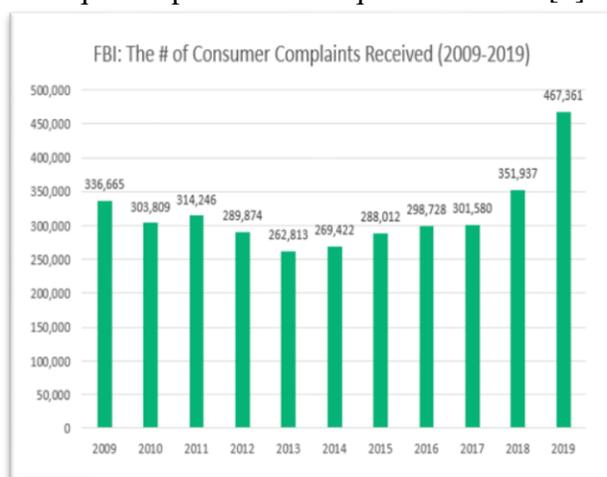


Fig. 7 42 Cyber Attack Statistics by Year: A

### Look at the Last Decade

Also nowadays there are literally thousands of ways to hack your contrivances such as when downloading something containing malware or spyware, then receive mails and SMS containing phishing scam, and so on. Besides from hackers, there are some more risks which come with IoT. For example, if there is a robot which works at your home and avails you normally, but one day it there is some issue in its wiring or somehow it malfunction then it could even harm you as

it is now out of your control and it can damage your personal properties like break things, and so on which is very expensive. In addition to it, if there is a hospital and if any system malfunction and shows wrong readings then it could even cause your life as due to malfunction in machines reports are printed wrong and so doctor gives you false prescription and you intake irrelevant medicine which is very harmful.

**Have the IoT devices that your organization manufactures/uses experienced a cyberattack in the last 12 months?**

	YES	NO OR DONT KNOW
Global	80%	20%
China	83%	17%
Germany	85%	15%
Japan	60%	40%
UK	86%	14%
US	81%	19%

### 3) How to overcome Cyber threats

Securing IoT contrivances is an immensely colossal challenge, as everyday the AV-TEST Institute registers over 350,000 new malicious programs and potentially unwanted applications. Even though there is much good antivirus software which is capable to track down the suspicious looking things, and additionally we could take many safety measures to obviate the hackers.

Ransom ware attacks have become one of the most notorious cyber threats. In these attacks the hacker will encrypt the data of your device so that you cannot access it. An attacker will decrypt critical data only after receiving a ransom. It can be one of the most sophisticated IoT security threats. Researchers have demonstrated the impact of ransom ware utilizing astute thermostats. With this approach, researchers have shown that hackers can turn up the temperature and refuse to go back to the mundane temperature until they receive a ransom. Similarly, ransom ware can withal be used to attack IoT contrivances and keenly intellectual home. For instance, a hacker can

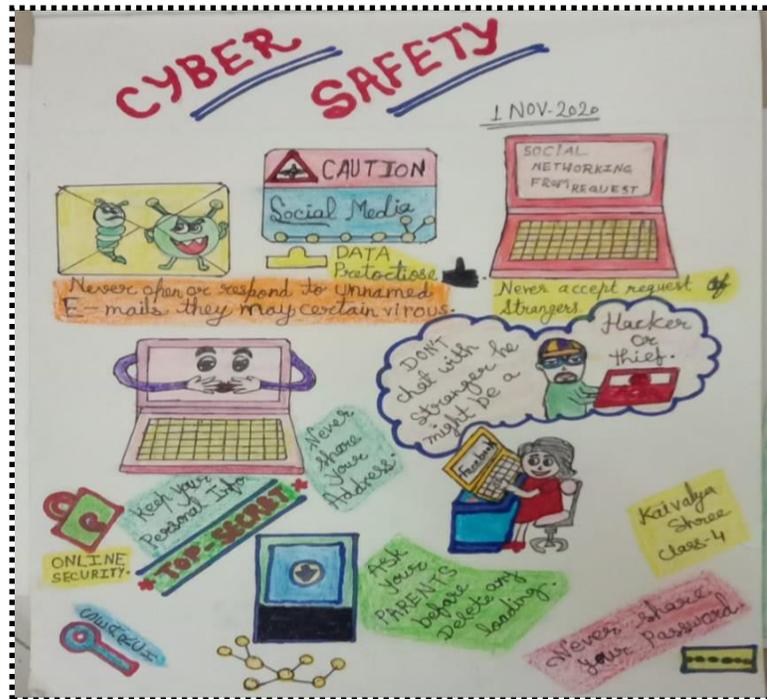
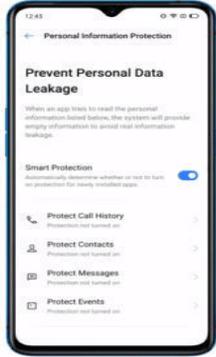


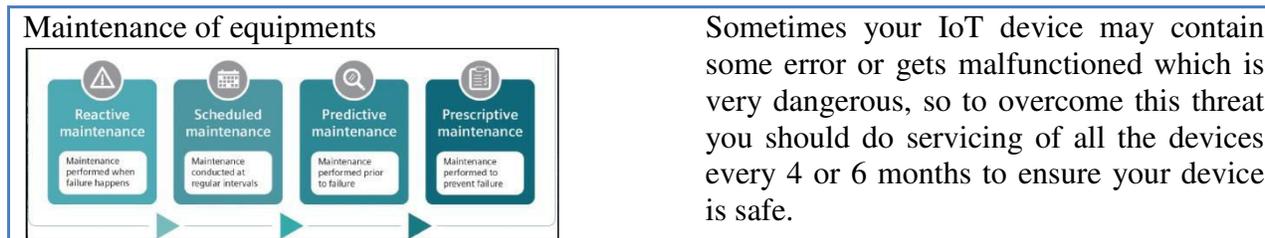
Fig. 8



Fig. 9

attack a smart home and send a notification to the owner to pay a ransom [9].

Safety measures	Explanation
<p>Prevent giving out personal information</p> 	<p>Many times you receive e-mails saying that your account is hacked, disabled, and so on and tells you to click on a link which redirects you to a page where they ask your all personal information which is known as Phishing. It looks like e-mail has been given by a legit person and the site also is purely same as real one, so never ever click on the links.</p>
<p>Keep a strong password</p> 	<p>Sometimes people keep such a password like his birth date or name, due to which hackers could easily crack your code and gain access of your system. So make a password at least 8 characters long including numbers, letters and special characters such as @ or #.</p>
<p>Never go for free</p> 	<p>It happens that if you want to watch some web series and movies or play game, but we need to pay money for these so to overcome these problems we search it on internet to get it for free which is absolutely wrong as sometimes when you download these things for free then the viruses and malwares also comes for free with it due to which your device is hacked and you don't even realize what to do until the hacker steals your information so never fall for free.</p>



### Experimental

#### 1) How IoT is useful

Let's take a case where IoT is included and another where not included. If at midnight, an elder person suddenly feels uneasiness as he's a heart patient, so first he has to himself stand up and make some noise so family members come to know that there's something wrong. After family tries to find most nearest possible hospital manually as they don't have phone to probe for it. Conclusively an ambulance comes and takes the old person with them to hospital and doctor then starts check up and tries to find problem. All this process will take much long time, due to which it may end up being life or death scenario. Now let's say that same happens with another old person, but this time he has worn a contrivance which suspects itself abnormal heart readings. Now contrivance itself contacts most nearest ambulance and sends all readings to hospital doctor before hand so that he could already analyze situation and be ready. After some minutes ambulance comes and takes the patient. After reaching hospital doctor is ready with equipment for operation. In the second scenario we could see that how useful is IoT in the situation and it availed the old man to survive easily [10].

#### 2) Threats to IoT and cyber security for it

To explain the following topic, let's take a case to understand well. There is Family X who has gone for a vacation to Simla. Now a larcenist comes to know there is no one in there as the



Fig. 11

family posts their pictures on social network, so he first tries to enter through main door but it is of good quality and unbreakable. Now larcenist searches a spot to enter and he finds that windows are breakable so he breaks through it and enters house. After he finds the locker room and he break opens the door of room. Now he tries some passwords to open locker and he finds out password is 9999. At last he steals everything and flees away from there[11]. So, we could understand

from this case that firstly hackers analyses the entire situation like the larcenist who found that Family X went out. Then next he tries to find loopholes in your system to hack by every method possible and then attacks on your personal data stored in the contrivance to utilize it as per his will. But then what about cyber security??? So for it let's continue our case of Family X. After finding that someone stole everything in their house, the family calls police and let them find the



larcenist. But the family wants to do something to stop this scene to happen again, so they call intelligence team to help them out. Now the team recreates the whole scene and makes the following report that tells that although your main door is impenetrable but your windows are too weak, so add some metal grills or rods so the larcenist cannot break in. Although if he somehow comes in, so like the main door, make every room's door impenetrable. But even if he somehow reaches to locker room, make sure that you have made a strong password including numbers, special characters and letters [12]. Now we could understand from the situation that the family took some safety measures to stop intruder. Like this even we could take some safety measures to stop the hackers to get access to your data such as buy a strong firewall which cannot be overridden by the hacker, and install good antivirus to find suspicious activity. Additionally set a very strong password so hacker cannot even guess it in his dreams.

### Conclusion

IoT has plenary transmuted the world and it is even more connected to our lives than our soul. No matter whichever field are you working in, somewhere IoT is present and you are utilizing it to do your work. People who stays in smart cities or has utilized IoT devices couldn't even stay without it a day or two. But due to this bonding, there are cyber threats which capitalize on it. One of them are hackers who hacks your IoT devices by finding loopholes in it, so they could get all your personal data and they utilize it according to themselves to earn money which is called unethical hacking. But as time passed, we developed cyber security for ceasing hackers. But still there are many cases around the globe which even cyber security cannot stop. So for concluding, I would verbalize that don't stop utilizing IoT, as it is not any solution but don't be too dependent on it and never give your personal details to anyone or anywhere and always install good antivirus software to find that you have any malware in your contrivance.

### Acknowledgement

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### References

- [1] M. Novak, "Nikola Tesla's Incredible Predictions for Our Connected World." [Online] Available: <https://paleofuture.gizmodo.com/nikola-teslas-incredible-predictions-for-our-connected-1661107313>
- [2] [Online] Available: <https://www.arrow.com/en/research-and-events/articles/comparing-arduino-uno-and-raspberry-pi-3>
- [3] [Online] Available: <https://www.upgrad.com/blog/raspberry-pi-iot-projects/>



- [4] [Online] Available: [https://arachnoid.com/raspberry\\_pi\\_remote/index.html](https://arachnoid.com/raspberry_pi_remote/index.html)
- [5] [Online] Available:  
[https://www.academia.edu/48896340/IOT\\_and\\_Raspberry\\_Pi\\_Based\\_Smart\\_Irrigation\\_System](https://www.academia.edu/48896340/IOT_and_Raspberry_Pi_Based_Smart_Irrigation_System)
- [6] Wei Emma Zhang<sup>1</sup> , Quan Z. Sheng<sup>2</sup> , Adnan Mahmood<sup>2</sup> , Dai Hoang Tran<sup>2</sup> , Munazza Zaib<sup>2</sup> , Salma Abdalla Hamad<sup>2</sup> , Abdulwahab Aljubairy<sup>2</sup> , Ahoud Abdulrahmn F. Alhazmi<sup>2</sup> , Subhash Sagar<sup>2</sup> , and Congbo Ma<sup>1</sup> School of Computer Science, The University of Adelaide  
[Online] Available: <https://arxiv.org/pdf/2012.01594.pdf>
- [7] M. Sain, Y. J. Kang, and H. J. Lee, “Survey on Security in Internet of Things: State of the Art and Challenges,” in Proc. of the 19th International conference on advanced communication technology (ICACT 2017), PyeongChang, Korea, 2017, pp. 699–704.  
<http://web.science.mq.edu.au/~qsheng/papers/CIC2020.pdf>
- [8] S. A. Hamad, Q. Z. Sheng, W. E. Zhang, and S. Nepal, “Realizing an Internet of Secure Things: A Survey on Issues and Enabling Technologies,” IEEE Communications Surveys & Tutorials, vol. 22, no. 2, pp. 1372–1391, 2020.  
<http://web.science.mq.edu.au/~qsheng/papers/CIC2020.pdf>
- [9] [Online] Available: <https://www.allerin.com/blog/8-types-of-security-threats-to-iot>
- [10] 5 Minutes Engineering [Online] Available: <https://youtu.be/APH6Nrar27w>
- [11] MJ WebHacks [Online] Available: <https://youtu.be/Hm1Fvw6oi3I>
- [12] MJ WebHacks [Online] Available: <https://youtu.be/YXV9oeMxM48>



# Indian Scholar

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### DATA SCIENCE- A NEW SURVEILLANCE TOWARDS THE INDICATION OF A FUTURE PANDEMIC?

**Mahi Shukla**

EuroSchool, Airoli

[mahishukla1210@gmail.com](mailto:mahishukla1210@gmail.com)

#### Abstract

Pandemics and epidemics can cause sudden, widespread morbidity and mortality as well as convivial, political, and economic disruption. The main objective of the following research paper is to provide a pellucid analysis and methods of how data science can be utilized in the engenderment of an algorithm that can be habituated to detect a further pandemic or epidemic as a component of '*How data science techniques can be utilized for handling epidemic and pandemic*' domain. The research paper provides an elaborated study for identically tantamount. The research for the following was done over a period of a fortnight and we must conclude from the study below that imageries of data science and its use in the detection can possibly foster life in case of a future pandemic and how political institutions must work along and be yare in advance to cope up with the situation with the engenderment of vigorous strategies.

**Keywords:-** *Epidemic/pandemic prevention, predictive analysis, public, algorithms, future, technology*

#### Introduction

Pandemics and epidemics are a constant threat to public health ecumenical. In the past few decades, several major outbreaks of various such pandemics that are inclusive of the 2009 influenza pandemic, the 1957 Spanish flu and the 2019 COVID-19, etc. These have been potent reminders of the desideratum for a robust surveillance systems and timely replications. The following research paper highlights the detection phase prior to its outbreak and involves the engenderment of data science algorithms that will detect the pandemic in the future itself & surveillance systems. Data science is a field of science that deals with the utilization of scientific methods, process, algorithms and systems to extract cognizance and insights from structured and unstructured data. These algorithms are sums of simple analytics that can take place essentially centered around estimating the transmissibility while keeping in mind sundry factors such as population size, the size of the country's economy and its healthcare infrastructure.

#### Theory

Regimes around the world, perpetually put efforts in amending their healthcare systems by investing a high quantity of their budget in healthcare. However, the emergence of a pathogen up brings a major public health concern, by incrementing the possibility of an



epidemic/pandemic. An efficacious response to such an outbreak is dependent on the timely intervention of the accumulation, visualization and analysis of outbreak data by the regime as the intricacy of such data increases with time owing the diversity in types of data, questions and available methods to address them. Data science is an interdisciplinary field that utilizes scientific methods, processes, algorithms and systems to extract cognizance and insights from structured and unstructured data, and apply erudition and actionable insights from data across a broad range of application domains. (1) Firms can utilize astronomically immense data analytic techniques to deal with extreme uncertainties such as those caused by the current COVID-19 pandemic. A Predictive analysis is concerned with what may transpire in the future (what impact will the outbreak have on the economy?, the degree at which the outbreak shall effect the population, how efficaciously can the current healthcare system deal with the degree of the outbreak?, how frequently may the RNA/DNA structure vary to lead in formation of incipient variants of the pathogen?, the prognostication of how long will the outbreak last, etc... ) and is generally considered as the utilization of ‘statistical techniques to analyze current and historical facts to make presages about future events and/or behavior’. We may classify the predictive analytic techniques into 3 main categories as explained in the table below. That is inclusive of a structured and an unstructured data. Analyzing both structured and unstructured data becomes a consequential source for understanding patterns in data. (2)

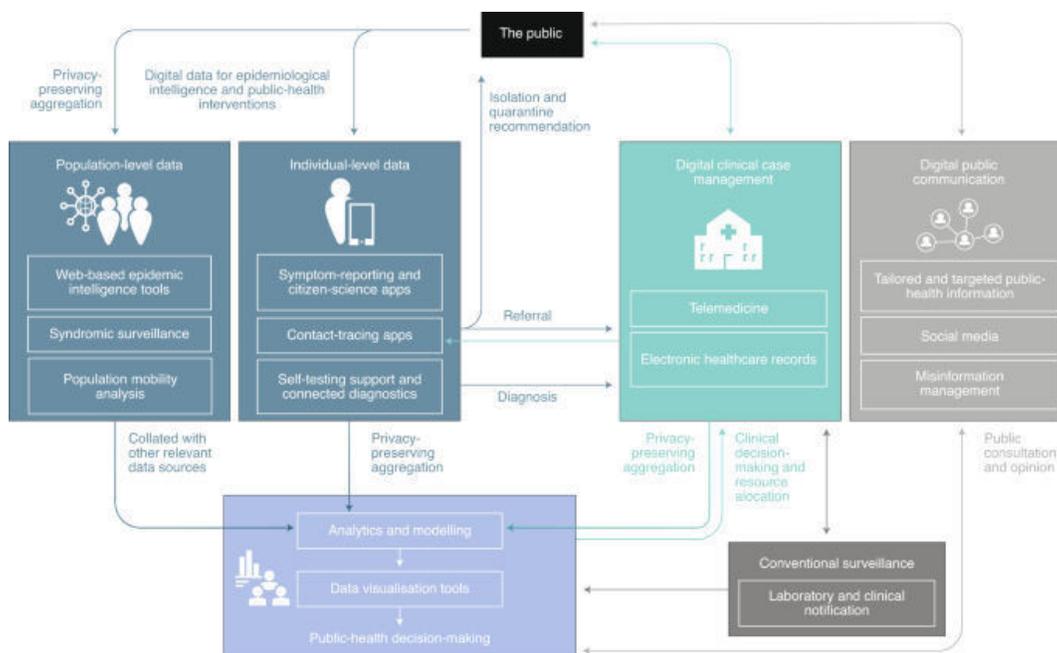
**Table 1**, Main methods of predictive analysis, <https://onlinelibrary.wiley.com/doi/10.1111/1467-8551.12441>

Methods Category	Brief Description	Applications
<b>Statistical Inference</b>	Utilize statistical approach to analyze a substantial amount and a high dimensional structured dataset.	Resource allocation; credit risk evaluation; churn prediction.
<b>Machine Learning</b>	Utilize machine learning algorithms to build complex models on profoundly and astronomically immense datasets to prognosticate future outcomes.	Capacity planning; risk profiling; customer segmentation; demand forecasting, sale forecasting, churn prediction, fault detection
<b>Methods for unstructured data analysis</b>	Quantify unstructured data to find and expound patterns in human behavior.	Predict customer or user behavior; recommendation; monitor product or service quality; real-time interaction.

Established population-surveillance systems typically rely on health-cognate data from laboratories, notifications of cases diagnosed by clinicians and syndromic surveillance networks. In the past two decenniums, data from online news sites, news-aggregation accommodations, convivial networks, web searches and participatory longitudinal community cohorts have aimed to fill this gap. Data-aggregation systems, including ProMED-mail, GPHIN, HealthMap and EIOS which use natural language processing and machine learning to process and filter online data, have been developed to provide epidemiological insight.

Early and expeditious case identification is crucial during a pandemic for the isolation of cases and opportune contacts in order to minimize onward spread and understand key risks and modes of transmission. Digital technologies can supplement clinical and laboratory notification, through the utilization of symptom-predicated case identification and widespread access to community testing and self-testing, and with automation and expedition of reporting to public-health databases. (3) Digital technologies join a long line of public-health innovations that have been at the heart of disease-aversion-and-containment strategies for centuries. Public health has been more gradual to take up digital innovations than have other sectors, with the first WHO guidelines on digital health interventions for health-system fortifying published in 2019. (4) Digital technologies cannot operate in isolation and need to be incorporated into the existing public healthcare systems. Digital data sources, like any data source, need to be integrated and interoperable, such as with electronic patient records. Analysis and the usage of these data will depend on the digital infrastructure and readiness of public-health systems, spanning secondary, primary and user friendly systems. The logistics of distribution to ascertain population impact are often given too diminutive attention and can lead to over-fixate on the individual technology and not its efficacious operation in a system. The coordination of interventions is withal a challenge, with multiple symptom-reporting sites in a single country, which perils fragmentation. Looking ahead, there is a desideratum for a systems-level approach for the vision of the ideal fit-for-purport digital public-health system that links symptom-tracking apps, expeditious testing and case isolation, contact tracing and monitoring of aggregated population-mobility levels, access to care and long-term follow-up and monitoring, with public communication. Figure 1 below provides a flow of information in a digitally enabled and integrated public health system during an outbreak of an infection disease that may lead to an epidemic/pandemic.

**Fig. 1,** Flow of information in a digitally enabled and integrated public health system during an outbreak of an infection disease that may lead to an epidemic/pandemic





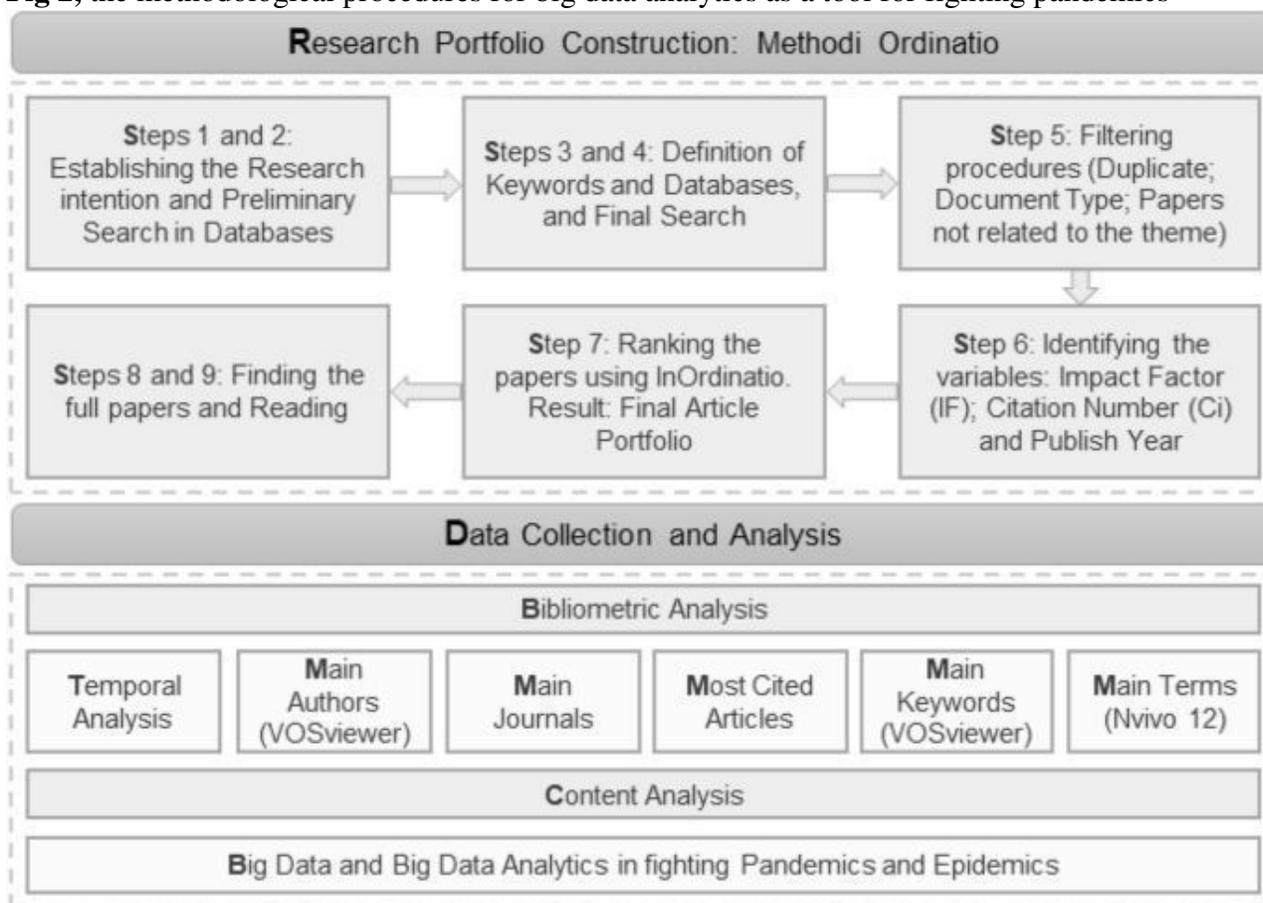
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Enabling an early outbreak detection and authentic time disease surveillance avails in detecting the widespread of the disease afore its emergence. Currently AI is utilized to ingest and fuse near authentic time data from varied sources- including news aliments, gregarious media, public health data, clinical health data and digital health implements- to monitor outbreaks, gauge incipient hotspots, and quantify the progress and astringency of the virus. However in the near future, AI models can prognosticate the spread down of a pandemic/epidemic to a country level, engendering an implement that can avail appraise local policy decisions. AI driven platforms would provide bellwethers and health officials with tailored alerts and authentic time circumstantial cognizance of emerging threats. (5)

### Experimental

The methodological procedures for big data analytics as a tool for fighting pandemics were divided into two components: (3.1) construction of the research portfolio, which will be the source of data amassment and analysis; and (3.2) data accumulation and analysis procedures, as shown in Fig. 2, and described in the sequence. (6)

**Fig 2**, the methodological procedures for big data analytics as a tool for fighting pandemics



A paramount initial step in amassing data as a component of a field investigation is determining the mode of data accumulation (e.g., self-administered, mailed, phone or in-person interview, online



survey) The mode in part dictates the format, length, and style of the survey or questionnaire. Factors to consider when deciding on data assessment methods include the following:

- **The feasibility of reaching participants through different modes.**

What type of contact information is available? Do participants have access to phones, mailing addresses, or computers?

- **Replication rate.**

Mailed and Internet surveys traditionally yield lower replication rates than phone surveys; however, replication rate for phone surveys additionally has declined during the past decennium.

- **Sensitivity of questions.**

Certain sensitive topics (e.g., sexual demeanors) might be better for a self-administered survey than a phone survey.

- **Length and intricacy of the survey.**

For example, for a long survey or one with intricate skip patterns, an interviewer-administered survey might be better than a self-administered one.

- **Control over plenaries and authoritatively mandate of questions.**

Interviewer-administered surveys provide more control by the interviewer than self-administered ones.

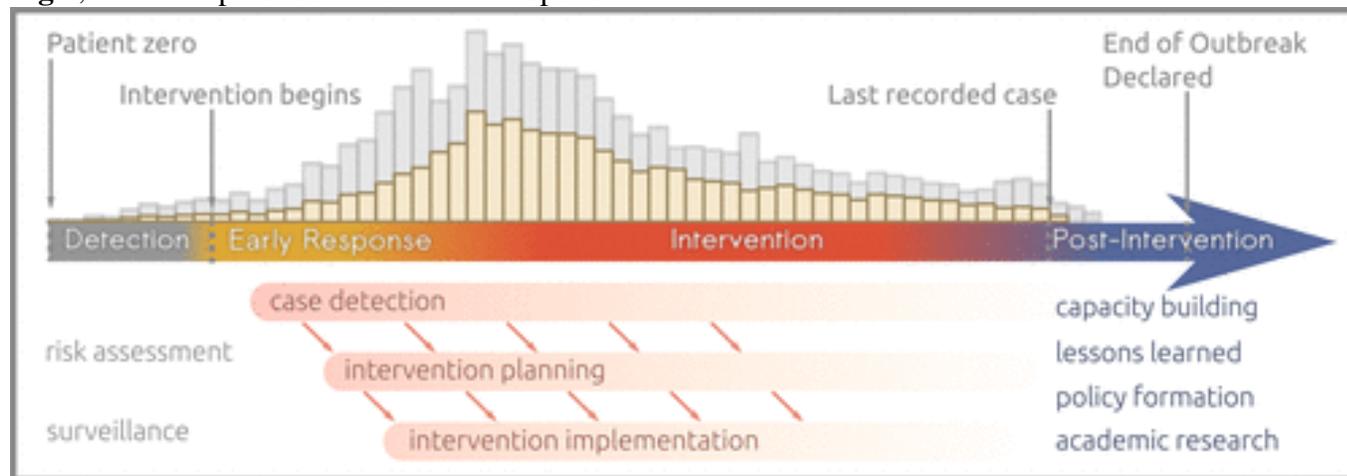
- **Cost (e.g., interviewer time).**

A mixed mode of survey administration (e.g., mailed survey with phone follow-up) might be less extravagant to conduct than a phone-only survey, but it additionally increases study intricacy. (7)

### RESULT

The focus of the public health replication shifts during the course of an epidemic or outbreak, and so do the analytics. We identify four main stages :The detection stage commences with the first case and ends with the first intervention activities (e.g. patient isolation, contact tracing, vaccination) and involves surveillance systems and mostly qualitative risk assessments. Next, the early replication is the initial part of the intervention during which the first simple analytics can take place, essentially centered around estimating transmissibility. This blends into the intervention stage, where more involute analytics may be involved to apprise orchestrating (e.g. vaccination strategies), which ends once the last reported case has recuperated or died. The post-intervention stage is for edifications to be learned, for amending preparedness for the next epidemic and for training and capacity building. (8)

**Fig 2,** Different phases of an outbreak response



### DISCUSSION

The following research study, provided an overview on ways of accumulating different forms of data for the detection of a future pandemic. Outbreak analytics is embedded within a broader public health information context that commences with disease surveillance systems, followed by risk assessment and management, the epidemiological replication itself, and culminates with the engenderment of actionable information for decision making. A component of the challenge that this incipient field will face in the coming years pertains to the seamless integration of data analytics pipelines within subsisting workflows. As responders can allocate only inhibited time to data analysis, analytics resources should engender simple, interpretable results, highlighting the most pressing issues that need addressing and monitoring all germane designators to apprise the replication.

### CONCLUSION

Despite huge technological advances over the past few centuries, infectious diseases still threaten health worldwide. The probability of the expeditious, unexpected spread of an infectious pathogens across the world has become much higher, due to the increasing globalization admits countries from all around the globe. Expeditious urbanization, an incrimination in international peregrinate and trade, and the modification of agriculture and environmental changes have incremented the spread of vector populations, putting more people in peril and uncertainty. To avert the spread of outbreaks, we require to ken which diseases are where, what rate they're spreading at, and how they're spreading. This involves pulling together erudition from hospitals, GPs, and community health workers across different locations. Piecing together the spread of a disease across a region often requires communication between sites, which only transpires if people are concretely concerned. This can be a non-nugatory task when electronic notes are not always taken and are often not interoperable.



The future of public health is liable to be increasingly digital, and apperceiving the paramount of digital technology in this field and in pandemic preparedness orchestrating has become imperative. Key stakeholders in the digital field, such as technology companies, should be long-term partners in preparedness rather than being partners only when emergencies are perpetual. Viruses ken no borders and, increasingly, neither do digital technologies and data. There is a clamant desideratum for alignment of international strategies for the regulation, evaluation and utilization of digital technologies to reinforce pandemic management and future preparedness for COVID-19 and other infectious diseases.

### REFERENCES

- (1) <https://royalsocietypublishing.org/doi/10.1098/rstb.2018.0276>
- (2) <https://onlinelibrary.wiley.com/doi/10.1111/1467-8551.12441>
- (3) <https://www.nature.com/articles/s41591-020-1011-4>
- (4) [https://apps.who.int/gb/ebwha/pdf\\_files/WHA71/A71\\_20-en.pdf](https://apps.who.int/gb/ebwha/pdf_files/WHA71/A71_20-en.pdf)
- (5) [https://www.nscai.gov/wp-content/uploads/2021/01/NSCAI\\_White-Paper\\_The-Role-of-AI-Technology-in-Pandemic-Response-and-Preparedness.pdf](https://www.nscai.gov/wp-content/uploads/2021/01/NSCAI_White-Paper_The-Role-of-AI-Technology-in-Pandemic-Response-and-Preparedness.pdf)
- (6) <https://link.springer.com/article/10.1007/s12652-020-02617-4>
- (7) <https://www.cdc.gov/eis/field-epi-manual/chapters/collecting-data.html>
- (8) <https://royalsocietypublishing.org/doi/10.1098/rstb.2018.0276#d3e956>



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### ASSESSING CYBER-SECURITY AWARENESS AMONGST K12 STUDENTS & PARENTS

Isha Ukey

Grade X

Utpal Shanghvi Global School

[ishauk@outlook.com](mailto:ishauk@outlook.com)

#### Abstract

The COVID pandemic has completely changed on how students use the internet – moving from using “Google” search for research work, to using the internet as the primary medium for online learning and productivity (negligible use of pen and paper). From earlier “fear of internet” parents are more open now & believe that their child’s online activities are contributing to their hobbies & special interests, while not affecting their academic performance.

On the cybersecurity side, while device security, access to location & personal data is a concern across both the audiences (parents and students)- students are the least concerned when it comes to privacy online considering they access social media daily (Facebook, Instagram, Pinterest). Antivirus & device updates are primary tools used to protect devices from cybercrime. Surprisingly, password protection of digital assets has the least awareness which is a weak spot considering the high usage of internet connected devices.

**Keywords:** cyber-security, education, K12, COVID-19, Online Learning, Cyber- bullying, internet, social media

#### INTRODUCTION

Protecting the integrity & confidentiality of data in a connected world of internet is the most challenging job. With COVID-19 students of all age groups in K12 are connected to the internet for 2-8 hours every day- starting with synchronous learning for submitting assignments to online tests. This also opens access for children to the “**broader spectrum**” of the world wide web – including deep & dark web. Most of these activities start with simple things like gaming, project research, social, messaging, shopping, and videos (short & long). Data suggests that to get a good perspective of the problem its best to divide the problem statement in to two areas: **Online Frauds & Child Abuse** – *the fact being that “Online Frauds” is a much more understood topic due to financial/data implications related to these activities and focus from regulatory and nodal agencies.*

1. **Online frauds:** With weak security systems (passwords, firewalls, VPNs, Antivirus software) most educational institutions and student hardware is exposed to malware or



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cyber-attacks. Visiting malware infected websites, replying to phishing/fraud emails, storing data on insecure cloud locations, sharing confidential information over the phone/messaging, or exposing personal information in social networks are some of the common mistakes which most students make. Most attacks simply start with social networks but could involve financial/bank details and at times school IP, patents and research works.

2. **Child Abuse:** Curiosity and revenge may be primary reasons for students to get involved in cyber-crimes (e.g., cyber bullying). Lot of times students are not aware of the implications of cybercrime. Girls are the most found victims of the cyber-crime.

The broader solution lies in **increasing digital literacy and online safety measures** that expose our children to high risks of online crime and abuse such as cyberbullying, harmful material, grooming and sexual exploitation.

This research aims at looking at the non-financial aspects of cybercrime considering two audiences: **Parents & Students**. The objective is to ensure that there are **no student biases in the study and to bring out a holistic perspective (parent view) to the challenges related to cyber security for K12 students.**



### Manifestations of child online threats, abuse, and exploitation in India

Cyberbullying	Online sexual abuse	Online sexual exploitation	Cyber radicalization	Online attacks and fraud	Online enticement
Grooming	Grooming	Grooming	Grooming	Grooming	Grooming
Emotional harassment	Sexual harassment	Production and consumption of child sexual abuse material	Ideological indoctrination and recruitment	<b>Attack on devices:</b> malware infection	<b>Harmful behaviour:</b> exposure to inappropriate content, access to alcohol and drugs
Defamation and exposure	Sexual solicitation, also Aggressive	Sexual solicitation, also Aggressive	Threats or acts of extreme violence	<b>Exposure to inappropriate content:</b> Pharming	<b>Illegal behaviour:</b> cheating, plagiarism, gambling, drug trafficking
Intimidation	Blackmail and financial extortion	Commercial sexual exploitation and trafficking		<b>Identity theft:</b> phishing, hacking, privacy breach	<b>Self-harm:</b> sexting, self-exposure
Social exclusion				Malvertising	
				Production and consumption pirated music and videos	
				Financial fraud	
				Enticement to drug trafficking	

*Text in red constitutes legal offence in India*

### Theory

India has **roughly 275M students enrolled in Grade 12 with around 170M having access to the internet (62%)**. Nearly **25M children in the age group 13-17 years are on Facebook (19.5M: Male & 5.5M: Female)**. That's nearly **10% of our K12 students and if you take internet access as a criterion its nearly 15% of students**. Instagram shows similar trends with 6.7M children in the above age group (5.3M: Male & 1.4M: Female).

Protecting school children while being online is a global concern. With COVID-19 the concerns are now multiplied as most of the grade 12 learning models have moved online (both



synchronous/ asynchronous modes). Kids of all age groups are now turning to devices for learning, playing games and interacting with teachers, friends & classmates. The increase in screen time adds a new layer of worry for parents & educators. Industry data suggests that the **average time spend online for education has increased from 60 mins/day to 95 mins/day in 2020.**

The “**BIG QUESTION**” is *how safe the students are online and if they able to make the right decisions, when it comes to being safe online?* There is also the question of “**Digital Competence**”, which is the set of skills, knowledge and attitudes needed when using ICT and digital devices to perform responsibilities, such as problem solving, information management, collaboration with respect to effectiveness, efficiency and ethics. Internet is a great place of learning but, with limited digital competence people are at risk of getting exposed to new challenges like online fraud (while doing financial/non-financial transactions), cyber bullying (especially for teens), racism (gender, skin, ethnicity, physical disabilities), pornography, violence & cyber terrorism.

Offline forms of crime find new avenues online & at times get magnified due to the reach of internet. Being able to stay anonymous online and impersonate others, emboldens people to perform offensive & criminal acts, as it lowers the efficacy/ seriousness laws existing in the offline world. While India has initiatives around “**Digital India**” & “**Skill India**”, these models exclude the impact, technology has on school children.

The challenge in India is primarily related to **unavailability of data (primary/secondary) on the extent, patterns & trends of child online abuse and exploitation in India- since no single agency has carried out a comprehensive survey on these issues.** National Crime Report Bureau (NCRB) data focused more on 'commercial frauds' or 'online radicalization' -with less data on online child abuse.

This study focuses on “**Impact of Technology, specially from a cyber-security perspective**” and ensuring that these conversations happen early. This requires taking a holistic view of all stakeholders: **Students & Parents**. The overall study is about **BEING HONEST, ACKNOWLEDGING PROBLEM AREAS, BUILDING TRUST** & the importance of **BEING CAREFUL ONLINE**. Through primary & secondary research it has been tried to bring together the role of students, parents, educators and other regulatory/policy institutions to make this transition safe for children.

### Experimental

This survey was designed keeping 2 audiences in mind: **Students & Parents**. The aim is to use Google Forms/Microsoft Forms online so that a broader audience can be reached.

**Sample Selection:** Students

- Audience: (currently attending/had attended regular classes online)
- Students: K9-K12 (CBSE, ICSE, International Boards (IB, IGCSE, Other State Boards)
- Parents: K9-K12 (CBSE, ICSE, International Boards (IB, IGCSE, Other State Boards)
- Sections: Online Frauds (non-financial) & Child Abuse
- Medium of instruction: English (also for accessing internet)
- Geography: Pan-India

**Questionnaire Design:**



1. The survey questions are a combination of **multiple-choice questions (MCQ)**, **open ended questions**, and **some matrix & demographic questions**.
2. **Multiple choice questions (MCQ)**: the answer options are fixed; it's expected respondents have an easier survey-taking experience. To get structured survey responses that produce clean data for analysis. Wherever there's a challenge with a need for "exceptions" an "**Others**" option was added to the MCQ to enable accuracy of data.
3. **Rating Scale**: gives an option to the respondent to select the answer that most accurately represents their response, while providing context to numerical rating scales (if desired)
4. **Matrix Questions**: While it is easier to combine questions with similar responses, Matrix questions have been avoided as there are challenges with displaying them on mobile devices. Specific pillars in "Child Abuse" & "Online Frauds" have been combined as questions in a matrix.
5. **Demographic Questions**: While the sample design does not need to cover a lot of demographics- gender based demographics might be relevant to the study to identify biases by gender.

### RESULT

1. **Internet Time**: 32% of the students spend >6 hours/day & 21% spent 4-6 hours/day on the internet. *This is an impact of COVID19, as all school/off school learning is happening online, which has increased the "screen time" of students.*
2. **Device Usage**: 43% of the students spend >4 hours/day on desktop/laptop devices, clearly linked to the *synchronous/asynchronous learning models being adopted by schools and other institutions.*
3. **Online Privacy**: Students are the *least concerned when it comes to privacy online* with only 10% of the respondents saying that it matters to them. One of the reasons could be that >60% of respondents have social media accounts (Facebook, Twitter, Instagram, Pinterest).
4. **Parents –The "Trust Factor"**: Parents for this age group are very *trusting with digital devices and their children*. 75% of parents believe that their child's online activities are contributing to his/her hobbies & special interests, while 55-60% of respondents think that media their academic performance is not getting impacted by using digital medium.
5. **Apps Consumption**: The *pandemic has also increased usage of online meeting* (Google Meet, Zoom, Microsoft Teams) time with 42% of the respondents spending 4-6 hours every day in online meetings.
6. **Social Media Risks**: 20% of the respondents are not aware of the risks of sharing photos on social media- *might be an indication of the regular consumption of medium like WhatsApp & Instagram.*
7. **Device Safety & security**: Operating system updates & Antivirus are some of the common tools used from a safety and security perspective while using the internet with >80% of respondents agreeing to the same. *Surprisingly, password protection of digital assets has the least awareness with <35% of respondents replying in the affirmative.*



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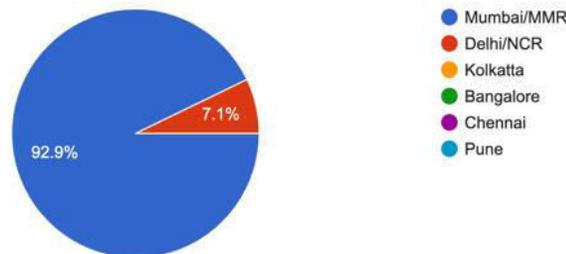
### DISCUSSION

As the questionnaire was administered over the internet (without any interventions) it was critical the respondents, got the feel, that they could say “No” to answering certain questions or give responses that were outside the choices being presented.

#### Additional considerations taken:

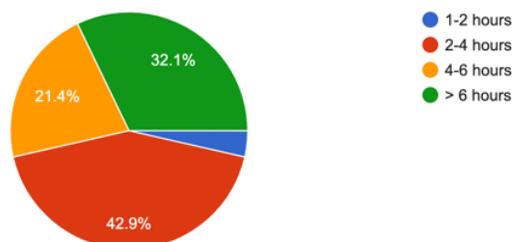
- 1) **Consent Form:** to weed out privacy concerns of respondents, a mandatory consent form was added. This ensured that if any of the respondents has some concerns, they could exit the survey without impacting the survey results.
- 2) **Grade selection (9-12):** For both the audiences (parents and students), the grade selection provides for a screening- assuming which they are not in the 9-12 grade, they will automatically exit the survey, without impacting the results.

Which city is the school based out of?  
28 responses



**Demographics:** While, there were pan-India insights with respondents from Mumbai, Delhi/NC, Kolkata, Bangalore, Chennai, Pune & Ambala, the data still has an urban bias. Also, across audiences >50% of students are studying international curriculum (IB, IGCSE, etc.), while about 18-36% in national curriculum (CBSE, ICSE, etc.) & the balance in state boards (SSC, etc.)

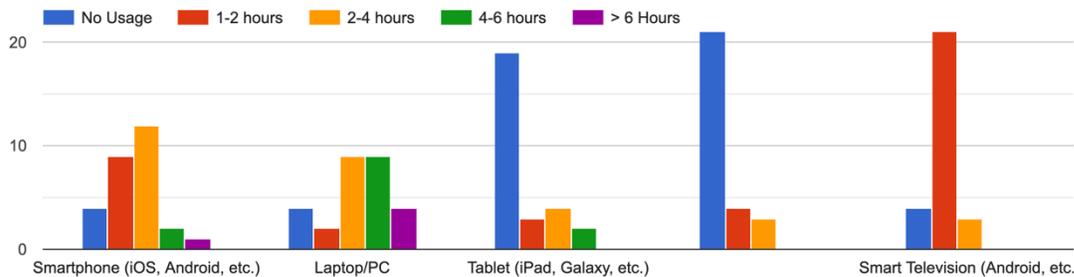
INTERNET TIME: What is the average number of hours/day you spend on multiple devices- excluding weekends/holidays?  
28 responses





**Internet Time:** >50% of the audience spend >4 hours per/day on the internet, while 3% of the audience said that they spend <1hour/day on the internet.

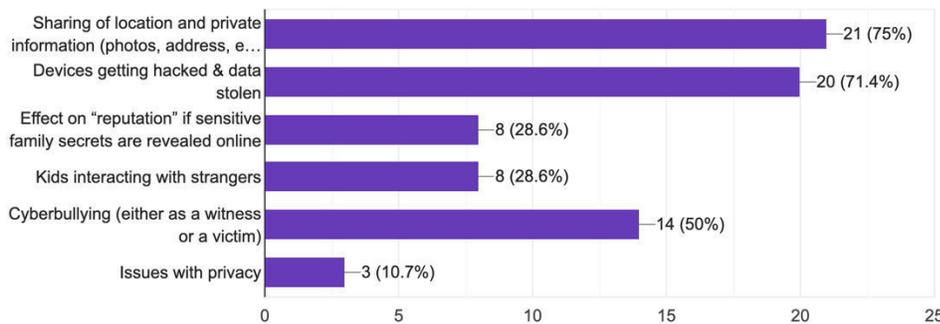
Which internet connected devices do you use every day, and for how long?



**Analysis:** While our audience consumes content across Normal/Smart TV & smartphones, overall usage is <2 hours for TV & <4 hours for smartphones. Due to the pandemic most of the education has moved online and 43% of the students spend >4 hours on desktop/laptop devices.

What is your biggest fear when you are on the internet?

28 responses

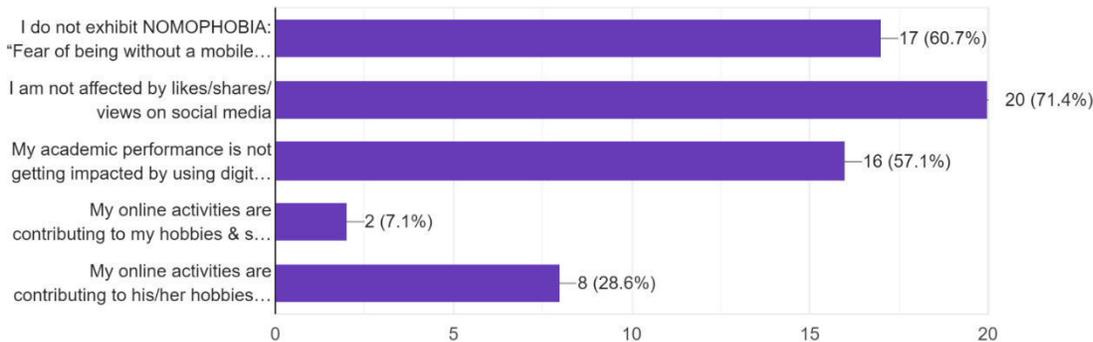


**Analysis:** While device security & access to location/personal data (>70% of respondents) is a concern across both the audiences while connecting to the web- students are the least concerned when it comes to privacy online with only 10% of the respondents saying that it matters to them. One of the reasons could be that >60% of respondents have social media accounts (Facebook, Twitter, Instagram, Pinterest). Cyber-bullying also ranks high amongst both the audiences with 60-70% agreeing that it is an area of concern.

Interestingly, parents are also concerned about issues like pornography, phishing, cyber-stalking, or children surfing unnecessary websites.

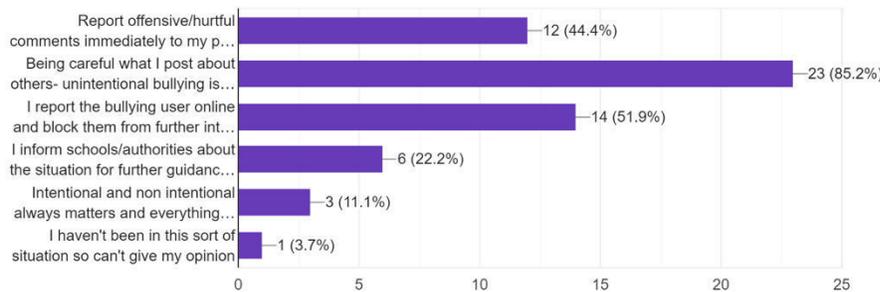


I take utmost care that I do not get addicted to digital devices and internet. I do not exhibit these behaviors:  
 28 responses



**Analysis:** Parents for this age group are trusting with digital devices and their children. Most students and parents believe that they can live in a world without a mobile device (60-70%), but there are strong gaps on how parents and students perceive the impact of social media on their lives- >50% of parents believe that social media feedback and comments have an impact on the child, while >70% students believe that there is no impact of social media. 75% of parents believe that their child's online activities are contributing to his/her hobbies & special interests, while 55-60% of respondents think that media their academic performance is not getting impacted by using digital medium.

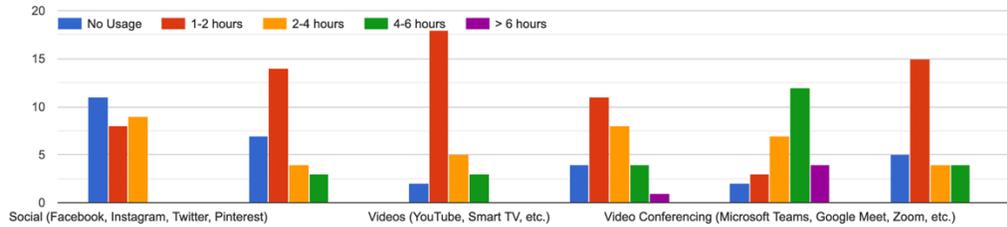
I ensure that I understand the following regarding "Cyberbullying"  
 27 responses



**Analysis:** Most parents and nearly 85% of the students understand that it is important to be careful what they post about others. More than 50% of audience believe that they report offensive/hurtful social media comments immediately to parents or teachers while also blocking offenders from further interaction.

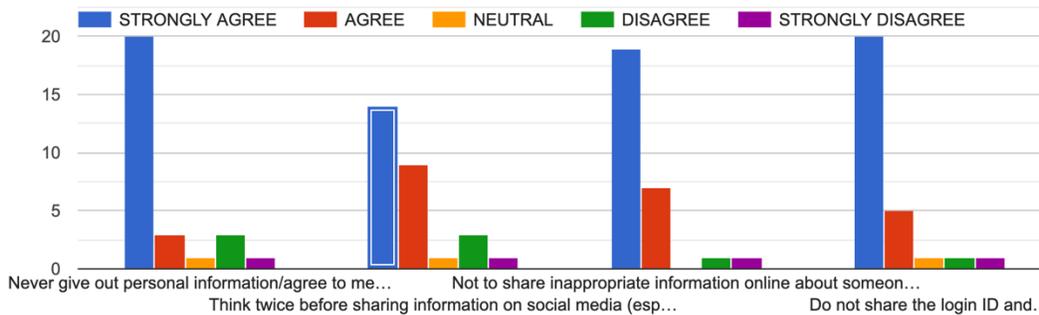


How long do you use the following apps?



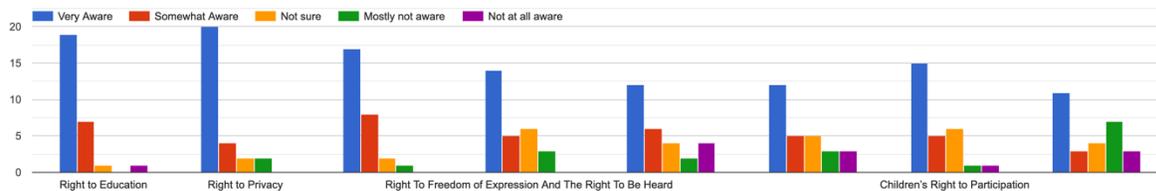
**Analysis:** Video consumption (WhatsApp, Tik-Tok, YouTube, TV) is the highest across students and used daily for 1-2 hours by 50-60% of the audience. WhatsApp sees the highest consumption for messaging with >50% or respondents using it for at least 1-2 hours a day. The pandemic has also increased online meeting (Google Meet, Zoom, Microsoft Teams) time with 42% of the respondents spending 4-6 hours every day in online meetings. 40% respondents do not use social media (Instagram, Facebook, Pinterest) on a daily basis.

I ensure that I understand the following regarding "Social Media"



**Analysis:** >70% of respondents are aware of the risks of social media and avoid sharing personal information, inappropriate information online about someone they know or don't know and sharing credentials with someone. 20% of the respondents are not aware of the risks of sharing photos on social media.

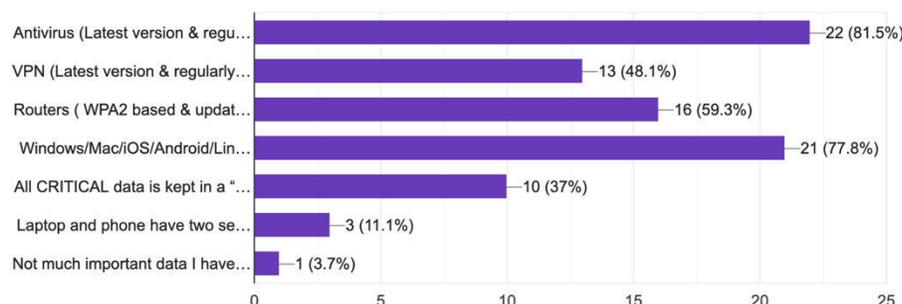
"Digital Rights"- I am aware that online privacy and freedom of expression online are rights that every child has. I am aware of the following rights:





**Analysis:** While >80% respondents understand Right to Privacy & right to be safeguarded from abuse, violence & exploitation - <40% of respondents are aware of IP rights and right to be forgotten on the internet.

I use the following hardware/software across all my devices to keep myself safe  
 27 responses



**Analysis:** Operating system updates & Antivirus are some of the common tools used from a safety and security perspective while using the internet with >80% of respondents agreeing to the same. Only 50% of the respondents have a good understanding of VPN's and router security features. Password protection of digital assets has the least awareness with <35% of respondents replying in the affirmative.

### CONCLUSION

Clearly more than 1 year of the pandemic has impacted the way student learning is happening. Kids of all age groups are now turning to devices for learning, playing games and interacting with teachers, friends & classmates.

Results clearly show that regular that >60% of students use social media apps daily and protecting school children while being online is a global concern. This study clearly answers the question in terms of **“Digital Competence”** of our urban students. While the data can be deduced from K4-8 easily, considering that they are also using synchronous and asynchronous methods of learning today, there can be a few **limitations of this study:**

1. The **“Urban”** nature of the respondents- which might not generate similar responses when planned in rural areas.
2. While more and more students in K9-12 have access to personal devices in urban areas, for K4-8 students the devices are generally shared with the parents- so the **usage pattern is clearly dictated by a shared device.**

To conclude, this study while not done at a national level, can serve as a baseline for conducting a broader research on the extent, patterns & trends of child online abuse and exploitation in India, as it brings in a perspective of both the child and the parent. It is recommended to add one more pillar – **“Educators”** so that we have an **“holistic approach”** in building **“digital competencies”** of children.



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### Acknowledgements

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2. Miss. Sunita Kumari, Data Security Council of India (DSCI) | A NASSCOM® Initiative

### REFERENCES

1. StayCyberSafe campaign: <https://www.dsci.in/content/stay-cyber-safe>
2. National Cyber Security Awareness Month: <https://www.dsci.in/content/NCSAM/2020>
3. Child Online Protection in India: 2016 (UNICEF): <https://www.icmec.org/child-online-protection-in-india/>
4. Cyber safety handbook for students of secondary & senior secondary schools : 2020 (CBSE in collaboration with Cyber Peace Foundation)
5. Parent Questionnaire- <https://forms.gle/5TPyVexUEbXVAtdQA>
6. Student Questionnaire- <https://forms.gle/G9YqGY9kuuK2TSe47>

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### IoT AND CYBERSECURITY APPLICATIONS IN THE MILITARY

**Anishka Rao**

Euro School, Airoli  
anishkarao02@gmail.com

#### Abstract

This paper is based on a situation where robotic soldiers and biomechanical robotic prosthetic limbs are used to fight battles and wars. This paper is based on the hypothetical, yet possible circumstance where the artificial intelligence-oriented devices are hacked mid battle, costing humans their lives, and aims to find a solution using a coordination between the Internet of Things and Cybersecurity to prevent such an issue from happening, or resolve it if it occurs. It explores the uses of IoT and Cybersecurity and how a protective software can be developed using them.

**Keywords:** *Internet of Things, Cybersecurity, Military, malware, Internet of Robotic Things, cyberattacks.*

#### Introduction

Technology is becoming a major part of everyone's lives in today's world. One part of this is the Internet of Things (IoT). The Internet of Things refers to physical devices containing sensors, software and many other technological conundrums meant for the exchange and sharing of data over a network like the Internet. IoT is very commonly used today, with its capabilities growing more and more by the day. Another important and common technology is Cybersecurity. With more devices connected over a common network – the internet – cyber threats become a rising danger. Cybersecurity is particularly important for a device part of any network to remain secure. One uncharted use of IoT and Cybersecurity is in the Military. A very recent development in the IoT industry is the Internet of Robotic Things (IoRT). This technology is being made specifically for robots using Artificial Intelligence. These robots use various kinds of sensors, metal detectors, integrated circuit systems and wireless cameras to receive and interpret data, and then carry out a certain task related to the data received. [1] We see robotic soldiers and weapons being built with A.I., but what do these ultimately require to function? The answer is IoT. Along with this, it is very important for lethal devices like these to prevent any malfunctions for the sake of the people working with them. Here is where Cybersecurity comes into play. The objective of this paper is to determine how IoT and Cybersecurity can be used together in the Military to improve efficiency of the technology being created while ensuring safety of those working with them. Interpretation of this paper will require basic knowledge in Computer Science and Information and Technology, as well as awareness about cybersecurity. [2]

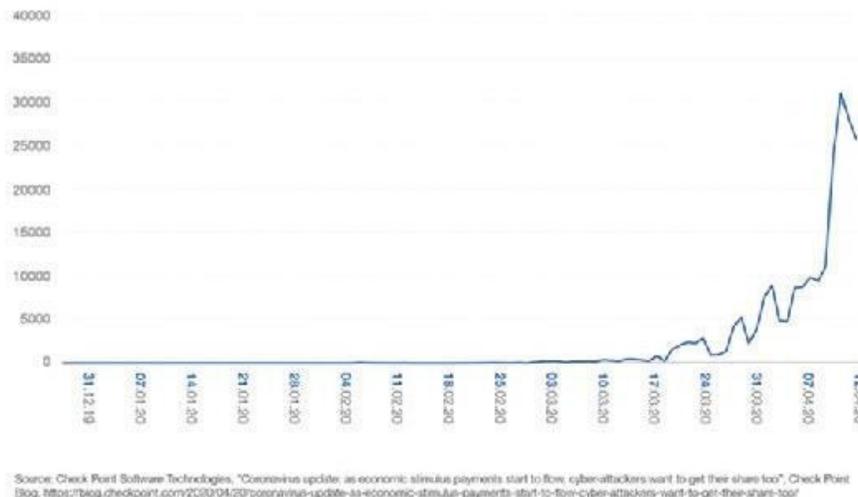


### Theory

The Internet of Things is defined by its name. Billions of devices connect to the internet over a wireless network to share data and information, and this is IoT. IoT devices are widely used in smart homes or connected homes, but they can also be a simple wireless pet camera or a medical device implanted in your body such as a pacemaker. These devices connect to the internet. They work by using sensors, microprocessors and actuators.

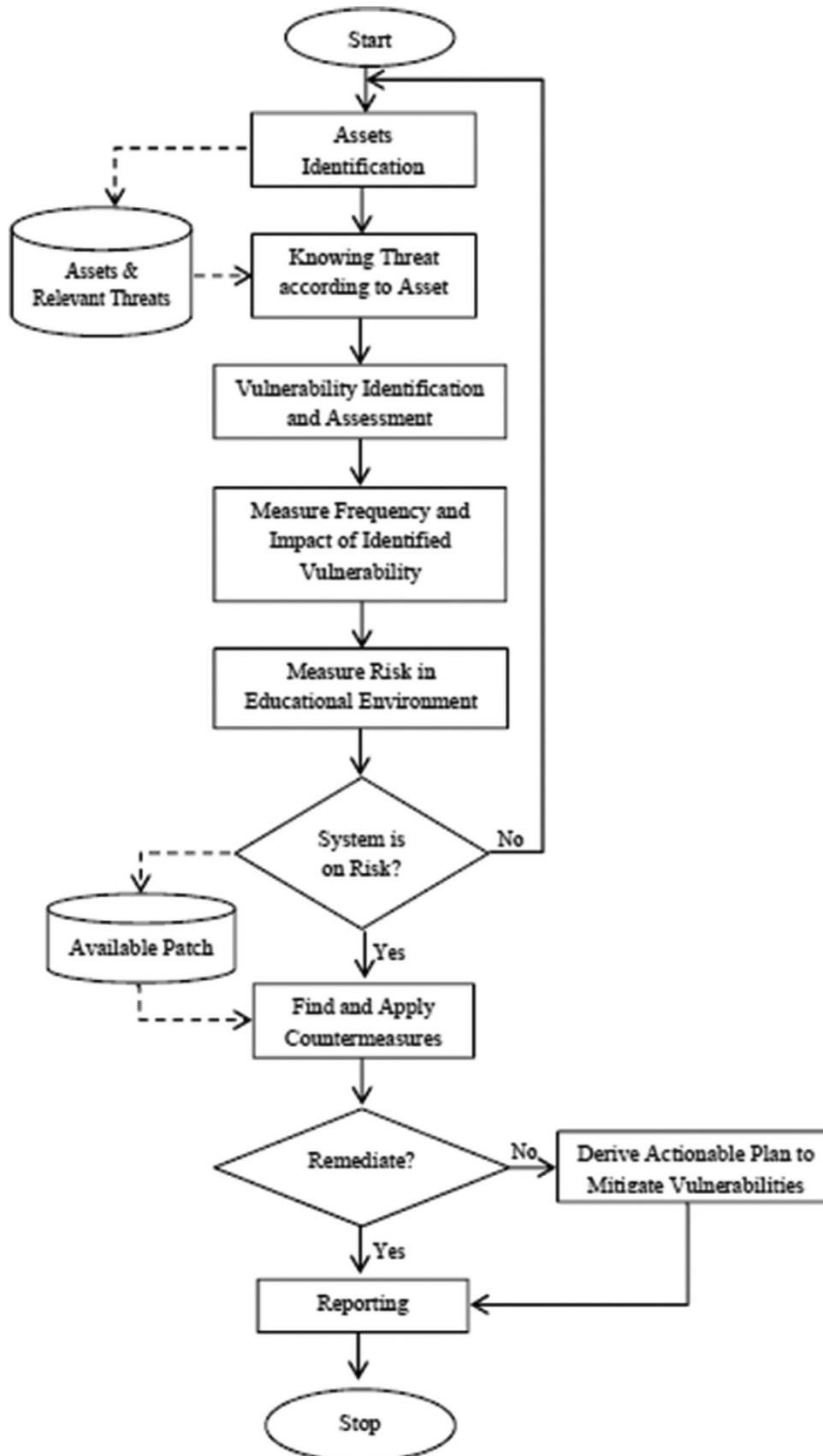
The sensors in the IoT device sense and record data in the form of binary digits (1s and 0s). This data could originally have been in analogue form like sound, pressure, temperature, movement, light, moisture, humidity, and many more. Once the sensors record the data, it is transmitted to the microprocessor where it is analyzed and interpreted. In case of alarm systems, if this data is outside the acceptable range, the microprocessor sends a signal over a network giving instructions to an actuator that performs a physical task like sounding an alarm. In case of a smart home, this microprocessor will interpret the data and send an appropriate command or instruction over the internet to perform a task such as turning on the lights. What makes IoT devices smart is their capability of machine learning, where certain algorithms help a machine remember a user's preferences or choices, and recommend options related to those. Connecting over a common network – the internet – can be resourceful, however it makes a device vulnerable to hacking and malware.[3]

Cybersecurity is the process and method of preventing cyberattacks on devices and networks, and recovering said devices and networks when these attacks happen. Cybersecurity is very important in today's world as without it, cybercriminals could use malware to steal and destroy sensitive data and files, or even extort money. Cyberattacks are a growing cause and have destroyed many businesses, reputations of people, as well as the financial lives of people. [4]



Cyberattacks are a growing cause for concern, and the recent pandemic hasn't helped a lot. Over the last few years, with the advancement of technology, cyberattacks have increased more and more in number. Even though cybersecurity software like anti-virus and anti-malware has been developed, so have various methods of penetrating software and

malware. In 2016, a business fell prey to a ransomware attack every 40 seconds. According to a report by Cybersecurity Ventures, this is anticipated to increase to every 11 seconds by 2021.



This flowchart explains the basic logic used in a cybersecurity system. First, the suspicious files – the ones that could possibly be under attack – are identified. The threat is then acknowledged and assessed according to the file as well as in general. The impact the vulnerability has created is then measured – whether it has corrupted a file, or if it has accessed private information, or if it has extorted money – and if the system is at risk, appropriate countermeasures and counterattacks are applied. This process is repeated until the threat is fully eradicated.

The Internet of Robotic Things (IoRT) is a fairly recent technology that combines simple principles of robotics with the Internet of Things to allow robots to sense and analyze



their surroundings using IoT technologies like sensors and microprocessors to connect to the internet and perform tasks on their own using machine learning. These robots can decide courses of action based on the conditions in their environment by manipulating and controlling objects in the physical world. The main difference between IoT and IoRT is that IoT is designed to handle and perform specific tasks while IoRT is designed to help robots react to unexpected conditions. [5]

IoT and cybersecurity must work together to ensure efficient and safe use of the devices. The same logic, as mentioned in the flowchart above, is used to do so. There are different measures that can be taken to protect a device from malware and ransomware. This is done using anti-malware and anti-virus software, along with firewalls. This helps protect and secure the network the IoT is a part of, thereby securing and protecting all devices on the network. Another way of protecting data is through physical authentication and verification systems like biometric sign-ins on computers. These would ensure data doesn't fall into the wrong hands. The Public Key Infrastructure strategy uses cryptographic public and private key pairs to ensure secure forms of communication, data exchange and money exchange. This is sometimes referred to as encryption.[6]

IoRT is used in the recent military robotics projects in which robots are being developed for the military with the capabilities of a soldier. Even biomechanical prosthetic limbs that perform the task the user thinks of uses IoRT. Sensors in the robot's surroundings pick up information that is transmitted to the microprocessor, and a task is performed by the actuator. However, when it comes to these devices, getting hacked can endanger the lives of the people wearing the prosthetic limb, or the soldiers fighting alongside the robot. This is the reason a reassuring cybersecurity system must be installed.

The logic of the cybersecurity system is to detect a threat, analyze how dangerous it is, and then repair it with a counterattack. To interlink cybersecurity with IoT, we would have to use the principles of IoT and IoRT technology; sensors and microprocessors. The following hypothetical situation can be used to explain the concept. During a battle, there are two sides. The side opposing the robot soldier or the soldiers with prosthetic limbs is likely to cause a cyberattack. There are three ways this cyberattack could be detected:

1. The cyberattack uses malware that causes the robot to malfunction  
This would cause parts of the robot to fire in the wrong direction, fire at itself, stop moving, move in the direction of civilians, fire the wrong weapons, or go into a "stealth mode". The sensors used to detect these would be motion sensors, temperature sensors, pressure sensors and optical sensors. Since these robots use machine learning, the sensors and microprocessors could detect these attacks by looking for anomalies in movement patterns of the robot, looking for a sudden change in direction (coordinate system) or if there is damage to any part of its exoskeleton. They could also analyze the input data and look for the use of the wrong weapons, or extreme use of unauthorized weapons. To analyze if the robot is moving in the direction of the civilians, facial recognition could be used to see whether the people it is moving towards are wearing uniforms.
2. The cyberattack causes intentional friendly fire



This would cause the robot to fire at its fellow soldiers. This could be detected using sensors and microprocessors. The data will be input using optical sensors and image sensors, and will be sent to the microprocessor. The microprocessor will then run this data through facial recognition software which will determine the identities of the soldiers the robot is firing at. If the data matches the robot's fellow soldiers, it will be identified as intentional friendly fire.

3. The cyberattack deactivates the robot

This would cause the robot to stop moving and functioning completely. This could either be detected using a possible back up system in the robot, or would require visual assessment from the fellow soldiers. If a backup system is available, it can be used to counterattack and reactivate the robot's system. If a backup system is not available, the cyberattack can only be prevented.

For all of these situations, if the data is out of the acceptable range, and if malware or a cyberattack is detected, a counterattack will be administered by a protective software. This will follow an algorithm where if a check for firewall comes back negative, a check for malicious software possibilities comes back positive, and any abnormal data or code apart from the original is detected, a counterattack will be ordered. The countermeasure will include a new firewall being put up, a thorough reboot of the robot's system being performed, and an anti-virus or anti-malware code being used to destroy the malware along with the hacker being tracked and identified.

### Methodology

A protective software can be created to respond to these threats and prevent them. The algorithm for this is shown in the following flowchart. Before the flowchart begins, data from the microprocessor will be input into the cyberattack detection software. This data will then be analyzed to see if it is in the acceptable range. If it is outside the acceptable range, a threat has been detected. Next, the software will check if the firewall has been penetrated. If it has, the software will then review if any abnormal code has been detected. This could be malicious software that is causing damage to the robot. To rule out any known bugs, the software will check if the code is from an unidentified source. If this is true, the level of danger of the threat will be evaluated. If the threat turns out to be dangerous, and if it is the cause of the malfunctioning of the robot, countermeasures will be taken. A new firewall is created and an anti-malware or anti-virus software or code is administered. A signal is then sent to track the IP Address of the source of the threat and its location is found. The hacker is identified and added to a list of offenders to be found later. Lastly, a thorough reboot of the robot's system is performed to repair internal damage, and the robot is fully functional again. This protective software system will also prevent a cyberattack from happening as machine learning could also help the microprocessor analyze and predict if a threat is possible. If it is, a stronger firewall will be installed.





### Conclusion

This algorithm will not only prevent a cyberattack from occurring, but it will also neutralize the threat that has appeared in the robot's system. This can be used in any IoRT device to protect it in a way that uses IoT along with cybersecurity and not just the latter. After this algorithm, once the robot has rebooted, the offender will be tracked and retaliatory actions will be taken. The machine learning in the robot's system will allow it to analyze the threat and create a stronger security system to prevent attacks of the same kind. This is how IoT and Cybersecurity can be used together to create a protective software.

### References

1. "The Internet of Robotic Things (IoRT): definition, market and examples." I-scoop.eu. <https://www.i-scoop.eu/internet-of-things-guide/internet-robotic-things-iort/> (Accessed Jul. 4, 2021).
2. "What Is IoT?." Oracle.com. <https://www.oracle.com/in/internet-of-things/what-is-iot/> (Accessed Jul. 4, 2021).
3. K. Chivers. "What is the Internet of Things? How the IoT works, and more." Norton.com. <https://us.norton.com/internetsecurity-iot-what-is-the-internet-of-things.html> (Accessed Jul. 11, 2021).
4. A. Johansen. "What is cyber security? What you need to know." Norton.com. <https://us.norton.com/internetsecurity-malware-what-is-cybersecurity-what-you-need-to-know.html> (Accessed Jul. 11, 2021).
5. K. Matthews. "The Internet of Robotic Things: How IoT and Robotics Tech Are Evolving Together." Iot.eetimes.com. <https://iot.eetimes.com/the-internet-of-robotic-things-how-iot-and-robotics-tech-are-evolving-together/> (Accessed Jul. 11, 2021).
6. N. Agarwal. "How to Ensure Cybersecurity in the Age of IoT." Appinventive.com. <https://appinventiv.com/blog/how-to-ensure-cybersecurity-in-iot/> (Accessed Jul. 11, 2021).



### HOW CAN DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE TECHNOLOGIES HELP PREDICT AND CONTROL FUTURE PANDEMICS AND EPIDEMICS?

**Richita Sarda**

Euro School, Airoli  
[richitaaa11@gmail.com](mailto:richitaaa11@gmail.com)

#### Abstract

We have seen many pandemic and epidemic bursts over the past years, the rate of which has gradually been increasing. This trend is unlikely to discontinue, unfortunately, and the intensity of these outbreaks has also been anticipated to rise. An example of this would be the outbreak of the COVID-19 virus, which caused a major uproar and large-scale panic over the high death number and damage to the economy. It has become a necessity to learn how we can predict and control any future pandemics and epidemics. This paper explores the way data analytics can help with that while carefully examining the case of the COVID-19 and using it as an example to help deduce the ways we can further our technology so as to ensure minimum damage in the future.

**Keywords:** Pandemic, Pathogenic outbreak, Data Science, Artificial Intelligence.

#### INTRODUCTION

The recent outbreak of the COVID-19 pandemic has left us with the realisation of just how unprepared we are in the face of a pathogenic outbreak as severe as this. Unfortunately, statistics have proven that the COVID-19 is not going to be our last encounter with these ever-evolving, mutating, infectious pathogens. Especially as the frequency of pathogenic outbreaks over the decades, along with their intensity, is increasing dramatically.

First declared as a global crisis on 30th January, 2020 by the WHO (World Health Organisation), the COVID-19 virus has been the cause of mass-panic and mass-destruction. It has taken the lives of around 409,000 people and has infected more than 190,000,000. The economies of various countries all over the world also took a toll. Many lost their jobs and any source of income.

We need to find a suitable enough method to enable us to predict and control the outbreak of these pathogens. Data analytics and Artificial Intelligence technologies are a very suitable method for the same. This research paper explores how these technologies could be employed so the damage that the COVID-19 virus had caused wouldn't repeat itself.

Theory



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In this section, the summary of the theoretical basis should be given, if any. Here, you can cite handbooks or classical papers in the field, and use equations, if necessary. Do not use equations which are common knowledge.

### Experimental

Describe your experiments so that they could be reproduced by another researcher. Do not describe in detail the methods commonly used or already published, cite them instead. Emphasize the critical steps.

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[Kindly note the above header will change as per the research topic selected. Till Introduction, Learners are requested to follow the same format]

### RESULT

In this section, your results and their interpretation should be given. It should be a separate section.

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### DISCUSSION

In this Section, discuss about your results obtained and explain it in detail with the help of statistical tools (like bar graph, pie chart and etc.) [ For more details refer the Annexuresection]

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### CONCLUSION

In Conclusion, you should not repeat sentences from the Abstract, Introduction, and the Results sections. It should summarize the most important results, their novelty advantages, and limitations. Here you may also mention planned future work and/or recommendations to others.

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Acknowledgements

Acknowledgments of people, funds, etc. should be placed here.

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### REFERENCES

The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text. For the format of Reference writing, kindly refer to the Annexure I attached.

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### EVALUATION OF GREEN COMMUNICATION

**Krishi shah**

Savitridevi Hariram Agarwal International School  
459krishis@agarwalinternationalschool.co.in

#### Abstract

Green technology is one of the fastest-evolving technologies. It attempts to analyse of sustainability in terms of the environment, energy efficiency, also communication purposes, mostly on mobile devices. It's a responsibility to motivate environmental responsibility and encourage the research of environmentally-friendly network equipment and systems. The goal of this paper is to provide the most recent research in green communications and networking for next-generation wired networks, as well as the direct and indirect environmental implications. It offers a review of the literature on protocols for increasing the energy efficiency of green communication networks.

**Keywords:** *Green communication, Mobile devices, Energy efficiency.*

#### Introduction

Today, Communication technology is exceptionally crucial. Machines and computers control the majority of real-world tasks. All of this is feasible as a result of information and communication technology advancements technology. The data rate in wireless communication is as a result of technological advancements and electrical and communication development on a large scale, technology. The world of data and communications communities is currently confronted with two major challenges: first, the amount of transmitted multimedia-rich data is rapidly increasing, and second, the total energy consumption by communication and networking devices, as well as global Carbon dioxide emissions, is increasing rapidly.

#### Theory

##### Section 1: What is green communication?

Green communication is the process of using energy-efficient communications and networking technology and products in all areas of communication, limiting resource consumption whenever achievable. Over the previous decade, the number of mobile subscriptions has skyrocketed in the information and communication technology (ICT) field. Globally, the total number of Internet users is projected to grow from 3.9 billion in 2018 to 5.3 billion by 2023 at a Compound Annual Growth Rate (CAGR) of 6%. In terms of population, this represents 51% of the global population in 2018 and 66 % of global population penetration by 2023.

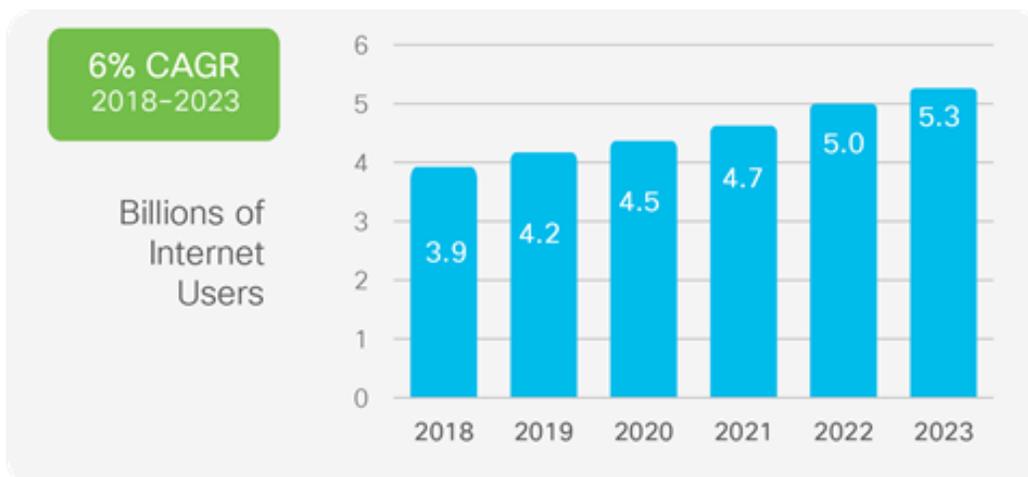


Figure 1 Global Internet user growth (2018-2023)

### **Section 2: Origins of Green Communications**

Climate change and the energy crises are not merely distant future issues; their consequences are already being felt. Global warming is caused by greenhouse emissions such as CO<sub>2</sub> and methane, which have disastrous repercussions for the earth and human civilisation, as documented in Reference. The Kyoto protocol to the United Nations Framework Convention on Climate Change (UNFCCC) established in 1997 indicates that mainly the developed countries are responsible for the current levels of greenhouse gases, followed by a strong objective to take action against global warming. In the Conference of the Parties (COP) 17 climate change conference in Durban, 2011 scientists raised concerns that the measures taken so far are not sufficient to avoid global warming beyond 2°C (a limit established in the G8 meeting in L'Aquila in June 2009 to avoid unpredictable environmental damage) and more urgent action is needed. Besides environmental concerns, the energy crisis becomes apparent with claims stating that approximately 50% of the world petroleum resources are already exploited [1], creating major obstacles for power supply with negative consequences on the economy. In general, energy pricing influenced by fuel prices is showing an increasing trend according to the forecast study performed by the Energy Information Administration (EIA) of the US Department of Energy [2].

### **Section 3: Environmental impacts**

Many keywords are used while addressing green technology, and they are often used and misunderstood. Because of the problem of global warming and climate change, carbon emissions are presently receiving the concentration. Air pollution, water pollution, and soil quality, as well as the conservation of the ozone layer, the utilization of natural resources, and waste reduction, must all be also addressed when contemplating an environmentally friendly solution.

Off-grid installations that offer coverage for rural locations are mostly responsible for CO<sub>2</sub> emissions. The majority of these installations are powered by diesel generators. Radioactive power emits extremely few greenhouse gases, but it does have significant environmental consequences, such as the disposal of nuclear waste.



In order to guarantee that wireless devices have a longer battery life, energy efficiency is also crucial. As the number of mobile phone users grows, the battery in these devices must become more efficient in order to operate for longer periods of time. Several research are being conducted in this regard, with the goal of enhancing battery technology for mobile phones as well as electric cars [3]-[4]. However, progress and growth in this field of study is leisureier than its application. As a result, energy-efficient communication and the manufacture of reusable gadgets are worthwhile investments. One of the major aspects of green communication is the use of energy-efficient equipment and the management of power consumption in cellular networks.

### **Section 4: green technology:**

Green Technology is an umbrella term that refers to the application of science and technology to develop environmentally friendly goods and services. Green technology is linked to cleantech, which refer to items or services that improve operational performance while cutting costs, reducing energy consumption, minimising waste, or mitigating negative environmental effects. Green technology attempts to protect the environment, undo past environmental damage, conserve natural resources, and preserve the Earth's natural resources. Green technology has also developed into a burgeoning industry that is raking in large quantities of money.

### **Experiment**

Environmentally Friendly Solutions Should Be Considered When Assessing Direct and Indirect Consequences: When analysing direct and indirect impacts, environmentally friendly solutions should be considered. Implementing a solution that decreases a service's energy usage, for example, has a direct impact. The indirect effects of solutions are linked to the broader ideas of solution adoption. Email's presence eliminated the need for letter writing, transportation, and paper use, among other things. Environmental concerns are usually limited through indirect effect minimization. Because these are contingent on fluctuations in political, economic, and informational circumstances, such reductions are generally more difficult to anticipate. The major method for reducing environmental consequences is to improve efficiency. When it comes to email adoption, one might argue that by replacing every letter written with an email, we are significantly diminishing the impact of those letters. This scenario demonstrates that estimating the indirect environmental effects of solutions is a challenging undertaking that must be approached with caution.

### **DISCUSSION**

Positives of using green technology:

The world of green technology solutions in the construction industry is rapidly evolving, and there are several definitions of what green technology is and how it benefits the construction industry. Simply defined, green construction technology entails the creation of new structures that include one or more features of ecologically friendly solutions. By creating new liability and environmental criteria, building green has upped the bar for the whole housing sector. it helps to reduce the Expenditures and switch to an eco-friendly way at the same time. it creates employment; when it comes to sustainable solutions in the construction sector, professionals with the necessary skills are needed. Green energy is a rapidly expanding sector that will last for many generations. As a result, a wide range of job opportunities emerge, including



environmental health engineers, solar energy specialists, and efficient lighting experts. There are mainly two groups of methods for improving network energy efficiency: increasing the use of alternative energy sources to minimise reliance on the main power grid, and network load optimization to reduce energy usage.

The goals associated with green communication networks:

- Improving the network's intelligence through trade-offs between energy usage and external factors, such as traffic loads.
- Integration of the network infrastructure and network services to enable the network to be more responsive and to require less power to operate.
- Reduced carbon emissions. [5]

### CONCLUSION

This article provides an overview of energy consumption issues in green communication networks as well as methods to reduce network energy usage. The common energy consumption problem in green communication networks is highlighted, and the strategies utilized to enhance the energy efficiency of these networks are described. The time and frequency domains can be used to address this problem. The challenge of energy conservation across numerous systems or networks is less well understood. From modelling to specific solutions, more work is required. Other deep concerns are the variations in mobile operator coverage and service kinds from one location to the next. As the world's communication networks expand at an exponential rate, it's critical to give wireless access networks primary priority in the design and development process.

### Acknowledgments

*I would like to express my special thanks of gratitude to my teachers as well as our principal who gave me the golden opportunity to do this wonderful research paper on the topic Green Communication, which also helped me in doing a lot of Research and I came to know about so many new things I am really thankful to them. Second, I'd like to express my gratitude to my parents and friends for their assistance in completing this research report in such a short amount of time.*

### References

- [1] A. P. Bianzino, A. K. Raju, and D. Rossi, "Apple-to-Apple: A framework analysis for energy-efficiency in networks," Proc. of SIGMETRICS, 2nd GreenMetrics workshop, 2010.
- [2] T. Chen, H. Kim, and Y. Yang, "Energy efficiency metrics for green wireless communications," 2010 International Conference on Wireless Communications and Signal Processing (WCSP), pp. 1–6, 2010.
- [3] Amin, A. (2016) Energy Efficient Machine-Type Communications over Cellular Networks: A Battery Lifetime-Aware Cellular Network Design Framework. Dissertation submitted to KTH Royal Institute of Technology.
- [4] Iova, O.; Theoleyre, F. and Noel, T. (2014) Improving The Network Lifetime With Energy-Balancing Routing: Application to RPL. In Proceedings of 7th IFIP Wireless
- [5]. Mohammed H. Alsharif, RosdiadeeNordin, andMahamod Ismail, Department of Electrical, Electronics and Systems Engineering, Faculty of Engineering and Built Environment,UniversitiKebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia, Received 24 August 2013; Revised 31 October 2013; Accepted 17 November 2013



## USING DATA ANALYTICS TO PREDICT SARS-COV-2 (SEVERE ACUTE RESPIRATORY SYNDROME CORONAVIRUS) PANDEMIC

**Aditi Mallya**

Euro school, Airoli  
[aditi.mallya@hotmail.com](mailto:aditi.mallya@hotmail.com)

### Abstract

SARS-coV-2 has become a huge threat to humankind throughout the world. Machine learning (ML) techniques are used to analyze and interpret massive datasets and predict their output. ML techniques can be used to predict if a patient has been infected by SARS-coV-2 based on the symptoms stated by the WHO and CDC. First, the information on this virus is obtained which includes factors like its origin, its transmission capacity, its symptoms, its mutation rate, etc. Second, data analytics are applied to the existing data present. In this review, the methods for predicting future cases based on the existing data and as well as the algorithms used are discussed.

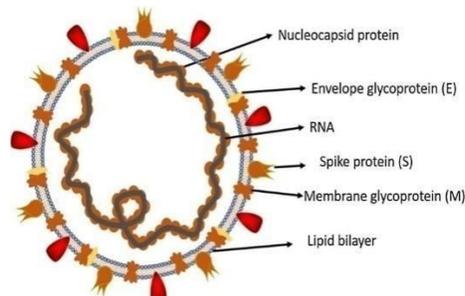
**Keywords:** SARS-coV-2; Machine learning; Datasets; Data analytics

### INTRODUCTION

In this era of technology, data science and machine learning play an important role in many types of industries especially the health care industry. They make it convenient for medical professionals to manage their tasks. ML helps hospitals to maintain administrative processes and treat infectious disease [4][5]. Scientists are working and experimenting with machine learning (ML) to develop viable and acute solutions to diagnose and treat diseases. ML can identify diseases and virus infections more accurately so that patients' disease can be diagnosed at an early stage, the critically threatening stages of diseases can be avoided, and there can be fewer cases where the disease reaches an advanced stage. In the same manner, ML can be used to automate the task of predicting COVID-19 infection and help predict future COVID-19 infection counts [1].

The current pandemic, which has taken the world by storm, is caused by a virus named SARS-coV-2. It originated in Wuhan City, China in Dec. 2019. Coronaviruses are a type of virus that mainly causes respiratory diseases in humans whose severity can be very high (SARS - Severe Acute Respiratory Syndrome or MERS - Middle East Respiratory Syndrome) or very low (common cold or cough) [2]. First, we need to check the similarity of this virus with past outbreaks to get a clearer understanding of this pathogen. SARS-CoV-2 has a 79.5% similarity to SARS-CoV and 96% similarity to the bat coronavirus [7][8]. Coronaviruses come under the Coronaviridae family. They are segregated into four genera: beta-, alpha-, gamma- and delta-coV. The viruses currently responsible for causing the disease in humans belong to alpha- or the beta-coV [2]. There are crown-like spikes present on the outer surface of the virus hence its

name, coronavirus. Coronaviruses are 65–125 nm in diameter and contain a single-stranded RNA as a nucleic material. (fig. 1) [3]



**Fig. 1** [3]

The first cases which were reported from Wuhan proved to be a member of the beta-coV group [3]. Initially the coronavirus has an incubation period on 2-14 days in the human body, but recent data shows that the incubation period has increased from 14 to 20 or 28 days because of the mutation of the virus. it is transmitted by via an infected person’s sneeze or cough [1]. The WHO declared COVID-19 as a global health emergency on the 30<sup>th</sup> of January 2020 and a global pandemic on the 11<sup>th</sup> of march, 2020 [6].

### Theory

There are numerous methods or ML techniques which can be used to predict and forecast future pandemics. Some of them are linear regression (uses one independent variable to explain or predict the outcome of the dependent variable Y), logistic regression (a statistical analysis method used to predict a data value based on prior observations of a data set), using different types of models like predictive modelling, data visualizations and data sources which consists of data extracted from verified sources like John Hopkins University, WHO and DingXiangYuan (a website authorized by the Chinese government) [9] [1].

The dataset which is used and analysed here is provided the John Hopkins University available in Kaggle repository. [10] The dataset consists of 35775 records up till June 4, 2020, which includes state, country, longitude, latitude, date, confirmed cases, deaths and recovered cases. This dataset has records of cases in 213 countries and according to these records, these 213 countries have 6,632,985 confirmed cases, 391,136 death cases, 3,371,886 active cases and 2,869,963 of recovered cases. Table 1 shows the global spread of COVID-19 in 20 countries with the highest number of confirmed cases along with the other attributes like death and recovery rate. According to the table, USA has the highest number of confirmed cases.

**Table 1.** [7]

Country	Confirmed	Deaths	Recovered	Active	Death Rate	Recovered Rate
USA	1872660	108211	485002	1279447	5.78	25.90
Brazil	614941	34021	254963	325957	5.53	41.46
Russia	440538	5376	204197	230965	1.22	46.35



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Country	Confirmed	Deaths	Recovered	Active	Death Rate	Recovered Rate
UK	283079	39987	1219	241873	14.13	0.43
Spain	240660	27133	150376	63151	11.27	62.48
Italy	234013	33689	161895	38429	14.40	69.18
India	226713	6363	108450	111900	2.81	47.84
France	192330	29024	69573	93733	15.33	36.17
Germany	184472	8635	167909	7928	4.68	91.02
Peru	183198	5031	76228	101939	2.75	41.61
Turkey	167410	4630	131778	31002	2.77	78.72
Iran	164270	8071	127485	28714	4.91	77.61
Chile	118292	1356	21305	95631	1.15	18.01
Mexico	105680	12545	74758	18377	11.87	70.74
Canada	95269	7717	52184	35368	8.10	54.78
Saudi Arabia	93157	611	68965	23581	0.66	74.03
Pakistan	85264	1770	30128	53366	2.08	35.33
Mainland China	83027	4634	78328	65	5.58	94.34
Qatar	63741	45	39468	24228	0.07	61.92
Belgium	58767	9548	16048	33171	16.25	27.31

The COVID-19 pandemic is compared to four epidemics that has occurred in the past. This is done to get a clearer understanding of the mortality rate and the transmission capacity which is based on the number of people infected in total. The four other datasets [12] [13] [14] [15] are referred to in Ref. [7]. The four epidemics, which the COVID-19 pandemic is being compared to, are EBOLA, SARS, H1N1 AND MERS diseases. Table 2 shows the comparison of the pandemic to above named past epidemics. Based on the table, the number of infections in the current pandemic is higher than the SARS, EBOLA AND MERS epidemics but H1N1 disease still has the highest number of confirmed cases despite having a low mortality rate [7] [11] [12] [13] [14] [15].



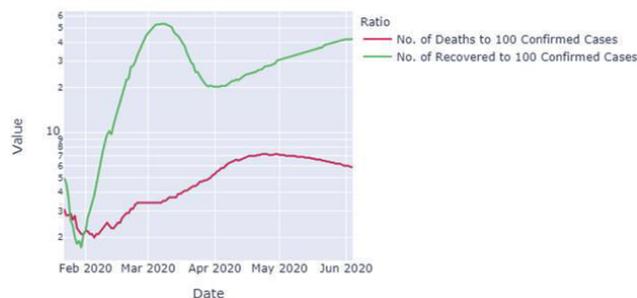
**Table 2.** [7]

Epidemic/pandemic	Start year	End year	confirmed	deaths	death rate
COVID-19	2019	–	6,632,985	391,136	5.90
SARS	2003	2004	8096	774	9.56
EBOLA	2014	2016	28646	11323	39.53
MERS	2012	2017	2494	858	34.40
H1N1	2009	2010	6724149	19654	0.29

Using the dataset in Ref. [10] which is from Ref. [7] several observations and trends can be drawn. The data shows the number of confirmed cases was substantially higher in the united states than any other country. Despite having the highest number of confirmed cases in February 2020, China in June 2020 is ranked 18<sup>th</sup> in terms of confirmed cases which shows that they had managed the spread. Fig. 2 shows the recovery rate and death rate across the world from January 22, 2020, to June 04, 2020. Death and recovery rate is defined by the ratio of recovery/death rate to confirmed cases. It shows that the recovery rate had increased from January to the first week of March. The dataset also shows that there was a sharp increase regarding the death rate in the first week of March 2020. It also shows that the global percentage of active cases was 42.20% of all confirmed cases and the recovered cases

was 51.90% of all confirmed cases [7] [11].

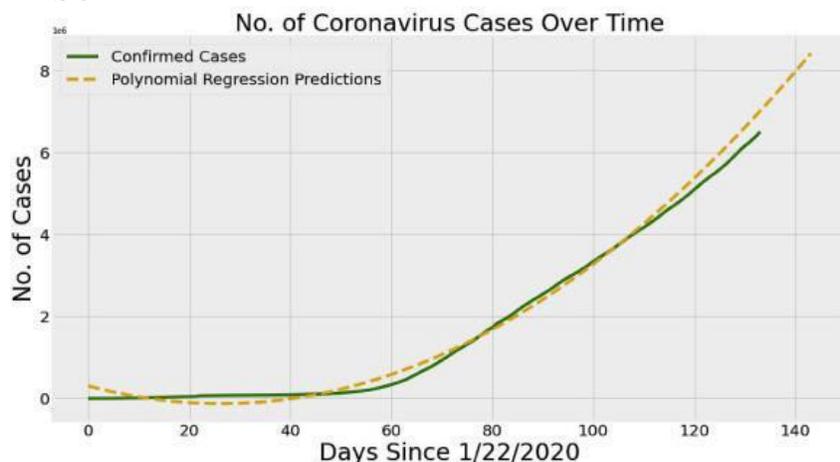
Recovery and Mortality Rate Over The Time



**Fig. 2** [7] [10]

The application of data science on COVID-19 can be implemented by the use of various machine language classifiers [16]. The programming languages which can be used are Python, MATLAB etc. for prediction of an event or a problem, feature selection methods can be used to find the highest effect or factor affecting the problem [17] [18]. Then the classifiers can be used to conclude prediction results [17] [18]. Usage of the regression and feature selection process in algorithms is done and the regressions are expressed into formulas and the values are obtained which indicate the forecast of the COVID-19 pandemic.

### RESULT



**Fig. 3** [7][10]

Fig. 3 shows the number of confirmed cases plotted against the number of days starting from January 22, 2020. The green solid line is for actual data and the dashed lines are for predicted ones obtained from the created algorithms. Table 3. Shows the estimated values of the predicted confirmed cases.

Future dates	Predicted confirmed cases
June 5, 2020	7286283
June 6, 2020	7423297
June 7, 2020	7561566
June 8, 2020	7701090
June 9, 2020	7841868
June 10, 2020	7983901
June 11, 2020	8127188
June 12, 2020	8271730
June 13, 2020	8417526

**Table 3.** [7] [10] [17] [18]

### CONCLUSION

In conclusion, the dataset which has been referred to here [10] can play a vital role in monitoring and predicting outbreaks such as COVID-19. The results concluded shows that a gradual increase in the confirmed cases was expected. With the help of ML and the availability of appropriate datasets, accurate predictions can be made which will help countries and especially their healthcare industry prepare for worst. The ongoing COVID-19 pandemic has deeply affected the status of many countries and has resulted in a worldwide emergency. The aim of this



study was to forecast the number of confirmed cases of SARS-coV-2 so it could help industries prepare well before an event of major crisis.

### REFERENCES

1. Painuli, D., Mishra, D., Bhardwaj, S., & Aggarwal, M. (2021). Forecast and prediction of COVID-19 using machine learning. *Data Science for COVID-19*, 381–397. <https://doi.org/10.1016/B978-0-12-824536-1.00027-7>
2. WHO/2019-nCoV/FAQ/Virus\_origin/2020.1
3. Shereen, M. A., Khan, S., Kazmi, A., Bashir, N., & Siddique, R. (2020). COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. *Journal of advanced research*, 24, 91–98. <https://doi.org/10.1016/j.jare.2020.03.005>
4. Shirsath, S.S. and Patil, S., 2018. Disease prediction using machine learning over big data. *International Journal of Innovative Research in Science, Engineering and Technology*, 7(6), pp.6752-6757.
5. Sreeja, S., Bhavya, L., Swamynath, S. and Dhanuja, R., 2019. Chest x-ray pneumonia prediction using machine learning algorithms. *Int. J. Res. Appl. Sci. Eng. Technol*, 7(04), pp.3227-3230.
6. David J Cennimo Discusses Coronavirus Disease 2019 (COVID 19). Available from: <https://emedicine.medscape.com/article/2500114-overview>.
7. M. Rubaiyat Hossain Mondal, Subrato Bharati, PrajoyPodder, Priya Podder, Data analytics for novel coronavirus disease ,Informatics in Medicine Unlocked ,Volume 20,2020100374,ISSN 2352-9148, <https://doi.org/10.1016/j.imu.2020.100374>.
8. Zhou, P., Yang, XL., Wang, XG. *et al.* A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* **579**, 270–273 (2020). <https://doi.org/10.1038/s41586-020-2012-7>
9. Binti Hamzah FA, Lau C, Nazri H, Ligot DV, Lee G, Tan CL, et al. CoronaTracker: Worldwide COVID-19 Outbreak Data Analysis and Prediction. [Preprint]. Bull World Health Organ. E-pub: 19 March 2020. doi: <http://dx.doi.org/10.2471/BLT.20.255695>
10. [COVID-19 Dataset | Kaggle](#)
11. Dey, SK, Rahman, MM, Siddiqi, UR, Howlader, A. Analyzing the epidemiological outbreak of COVID-19: A visual exploratory data analysis approach. *J Med Virol*. 2020; 92: 632–638. <https://doi.org/10.1002/jmv.25743>
12. [Ebola | 2014-2016 | Western Africa Ebola Outbreak | Kaggle](#)
13. [MERS Outbreaks data 2012-2019 | Kaggle](#)
14. [Ebola Cases, 2014 to 2016 | Kaggle](#)
15. [SARS 2003 Outbreak Dataset | Kaggle](#)
16. Sumayh S. Aljameel, Irfan Ullah Khan, Nida Aslam, Malak Aljabri, Eman S. Alsulmi, "Machine Learning-Based Model to Predict the Disease Severity and Outcome in COVID-19 Patients", *Scientific Programming*, vol. 2021, Article ID 5587188, 10 pages, 2021. <https://doi.org/10.1155/2021/5587188>
17. Bharati S, Podder P, Mondal R, Mahmood A, Raihan-Al-Masud M. Comparative performance analysis of different classification algorithm for the purpose of prediction of lung cancer. In International Conference on Intelligent Systems Design and Applications 2018 Dec 6 (pp. 447-457). Springer, Cham.
18. Raihan-Al-Masud M, Mondal MR. Data-driven diagnosis of spinal abnormalities using feature selection and machine learning algorithms. *Plos one*. 2020 Feb 6;15(2):e0228422.



## THE IMPLEMENTATION OF TECHNOLOGY TRANSFER IN THE MEDICAL INDUSTRY

**Hritika Thadesar**

Dr. Sarvepalli Radakrishnan Vidhyalaya International School,

Borivali West, Mumbai

[Pink2s99@gmail.com](mailto:Pink2s99@gmail.com)

### Abstract

Technology transfer and management are important in the medical industry to ensure that the technology released into the market is suitable for those that need the technology. This article covers all the needed procedures to research, develop, and release a device into the market and technology transfer's relation to the current Covid-19 worldwide pandemic.



### Introduction

Technology transfer in the medical industry means the procedure that leads to producing a successful product starting with the innovation of the product to research to product development, clinical trials, and finally commercialization. This is the process where the innovator of the technology makes the technology available by collaborating with commercial partners that can release it to the general public.

### The Importance of Technology Transfer and Its Benefits

To start, technology transfer is important in the medical industry as any bug in the introduced technology can affect its users. To prevent flaws, technology transfer requires specific documents that include required information about the technology to transfer the technology from research & development to manufacturing without faults, information to transfer technology of current products between different manufacturers and to give examples of procedures and concerns about the technology/invention. It is also important the invention receives the protection of intellectual property (IP) in ways like receiving a patent, copyrights, and trademarks of the invention. This allows the inventor to be known and prevents anyone else from replicating the technology by law.

Technology transfer also has many benefits when done right, including a few like efficiency, products of better quality, and a standardized process resulting in time and cost-effective production. Technology transfer allows innovators to release technology that can be important for society or even makes way for new technology in the future resulting in revenue that can allow the developing company to improve the technology with the help of increased faculties, increasing employment, and more



time for research or create new products advancing the company's business forward. Technology transfer can allow the release of life-saving or health-improving technology and even technology that can create a cleaner environment. Technology transfer even has benefits to the tech-producing nation by increasing its economy's worth.

Small and medium-sized enterprises (SMEs) also depend on technology transfer. These companies use this process to help them compete with larger companies. Using technology transfer allows these small and medium-sized enterprises to release technology that contributes to future technology and they use the profit made to increase the size of their company.

### **The Parts of the Technology Transfer Process**

The technology transfer process varies depending on the nature of the project so one process may not be fit for all. Though, in most processes the common steps include the following:

1. The innovator submits an Invention Disclosure form which includes the name of the inventor and invention, a description of the invention, details of the funding the innovator received, if the innovator has disclosed anything about the invention publicly, and any other information needed. This form will then be reviewed and a meeting will be made between the innovator or researcher and the technology transfer office (TTO) of the company or university.
2. The office then decides whether they want to file a patent application or not after evaluating the invention disclosure on whether it is non-obvious (something that is not apparent and cannot be easily made based on previous



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innovations), is useful, relevant, unique, and can be put in the inventor's name, which is all the points needed for patentable inventions. They also decide the possible commercial value and the best type of intellectual property protection and commercialization for the new technology/invention.

3. A patent is filed only after careful consideration. This is because filing a patent is very expensive which also means that the company or university does not accept all invention disclosure forms it receives. After careful consideration, they file a patent for a patentable innovation. According to USTPO, "You cannot get a patent if your invention has already been publicly disclosed. Therefore, a search of all previous public disclosures should be conducted. A search of foreign patents and printed publications should also be conducted." After about 22 to 32 months, the patent gets issued and the university or company has to pay maintenance fees before it expires after 20 years from the date of filing.
4. The university/company starts to market the technology to possible partners or licensees after the patent has been filed. To do this the company/university conducts a test for the technology, the results are used to market the invention.
5. To introduce the invention to the public and commercialize the technology/invention, the company/university has to permit an organization or licensee to receive profit or benefit from the technology. In simpler terms, the organization receives permission to produce, use, and sell the technology.



6. After the company has a licensing agreement with the organization, they can begin to work together to develop a business plan to sell the technology and how they will distribute the revenue they receive.

### **The Research & Development Procedure for Drugs**

Research and Development (R&D) is a major part of technology transfer when creating an important drug and taking proper care during R&D will show positive results in the final product. Specifications that can be done and are done include,

- Preparation of specified materials and designing the procedures based on the technology's characteristics.
- R&D identifies the level of quality a product will have based on specifications given by the innovator of the technology. This is done through stability tests that are for the innovator product and the soon-to-be-manufactured product. Stability testing is a method used to check the quality of a system and how well a product conserves its quality throughout its use.
- If the product is a drug, R&D fills out a technology transfer dossier document to give to product development. This document contains information about the drug, like:
  - A master formula card containing product name and benefits, generic name, master formula card number, page number, effective date, market, and shelf life.
  - A master packaging card containing packaging type, the material of packaging, and shelf life of packaging.



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- A master formula gives formulation order and manufacturing instructions. This gives the order of the process to make the drug, and environmental conditions needed.
- Standard test procedures (STPs) and specifications help to know active ingredients and excipients present in the drug, process specifications, specifications about the product release, and any other details.
- To check if the product is stable after processing it, R&D conducts validation studies that verify this. Only after this production can begin.
- A development report is also submitted. This contains information about new drug substances and drug products, raw materials used, dosage form rationing and formula designs, manufacturing methods, and specification and test methods of drug substances.
- A technology transfer plan that describes the item and contents of the transferred technology, the date of completion of technology transfer, and other important data needed for technology transfer.
- A report is made at the end which is used to confirm that the innovator's specifications have been included in the product.

### Examples of Technology Transfer

Technology transfer can be used anywhere including pharmaceuticals, medical devices, alternate energy solutions, computer technology, transportation, AI or Artificial intelligence, robotics, agriculture, aerospace, etc.



### How Technology Transfer is Used to Create Vaccinations

For the past year, the world has been battling with a COVID-19 pandemic, because of this, researchers have been trying to create a vaccine to prevent the virus from spreading even more. For this reason, World Health Organization (WHO) has worked with scientists, businesses, and other global health organization to fast-track the making of a vaccine. In the past, WHO had created a strategy to increase the production of influenza vaccines in low-medium income countries (LMICs) by creating a technology transfer hub. In this technology transfer hub, a publicly funded institution provides necessary manufacturing and clinical and regulatory expertise to create a documentation package with corresponding training modules. This package is sent to different developing countries vaccine manufacturers (DCVMs) so that they can efficiently produce vaccines that are cost-efficient. This was a highly effective technology transfer hub and which established 14 DCVMs that produced influenza vaccines. However, this hub does not work for patented vaccines therefore also new vaccines.

In 2020, WHO had a new strategy to rapidly create and supply COVID-19 vaccines all over the globe through the ACT-Accelerator. According to WHO, “The Access to COVID-19 Tools (ACT) Accelerator, is a groundbreaking global collaboration to accelerate development, production, and equitable access to COVID-19 tests, treatments, and vaccines.” WHO has also created Global Target Product Profiles (TPPs) for COVID-19 which contains the attributes of a safe and effective vaccine, for example, vaccines for people at high risk for protection against COVID-19 in the long-term. This had created over 300 candidate vaccines with a composition and supply that met the needs to create billions of vaccines. By December 2020, just 10 months after the pandemic began, more than 11 vaccines



were in Phase 3 trials of the 6 phases mentioned earlier. The extent of financial and political commitments made for the development of the vaccine has also been a major part in the rapid development of a COVID-19 vaccine.

### Conclusion

Technology Transfer is the process used to allow innovators to create an invention that benefits society, creates solutions to problems, and to generate profit to fund further Research & Development.

### References

- M.S. Manral, B. Prashar, and Y. Sheikh “Technology Transfer in Pharmaceutical Industry; Facts and Steps Involved,” American Journal of Pharmtech Research, Solan, Himachal Pradesh, India, Jun. 14 2012 [Online]. Available:<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.301.373&rep=rep1&type=pdf>
- S.E. Crager MD “Improving Global Access to New Vaccines: Intellectual Property, Technology Transfer, and Regulatory Pathways,” American Journal of Public Health, Los Angeles, California, Unites States of America, Dec. 7 2018 [Online]. Available:<https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2014.302236r#abstract>
- World Health Organisation, “Background paper on Covid-19 disease and vaccines” WHO international, Dec. 22 2020. Available:



## An International Multidisciplinary Research e-Journal

<https://www.who.int/publications/i/item/background-paper-on-covid-19-disease-and-vaccines>

- Jackson State University, “Technology Transfer Process” [jsums.edu](http://jsums.edu).  
<https://www.jsums.edu/technologytransfer/technology-transfer-process/>
- University Industry Innovation Network, “Technology Transfer Management- The Ingredients of a Successful Technology Transfer Model” [uiin.org](http://uiin.org),  
<https://uiin.org/2019/04/05/technology-transfer-management-ingredients-successful-technology-transfer-model/>
- TWI-global, “What is Technology Transfer (Definition and Examples)” [twi-global.com](http://twi-global.com).  
<https://www.twi-global.com/technical-knowledge/faqs/what-is-technology-transfer>
- World Health Organisation, “Manufacturing, safety and quality control of vaccines”, [who.int](http://who.int).  
<https://www.who.int/news-room/feature-stories/detail/manufacturing-safety-and-quality-control>
- World Health Organisation, “What is the Act-Accelerator”, [who.int](http://who.int).  
<https://www.who.int/initiatives/act-accelerator/about>
- U.S. Patent and Trademark Office, “Patent process overview”, [ustpo.gov](http://ustpo.gov).  
<https://www.uspto.gov/patents/basics/patent-process-overview#step2>



### CYBER SECURITY AND SOCIAL MEDIA: TRUSTING THE OPERATORS

**Tisha Jasani**

Jamnabai Narsee International School  
[tisha.jasani@jnis.ac.in](mailto:tisha.jasani@jnis.ac.in)

#### Abstract

There has been a massive increase in the popularity and the users of social networking sites over the years. Although, with this growth comes responsibility to its operators. This study aims to understand the drawbacks of revealing too much information and placing trust on social networks. It also considers the various security and privacy concerns with regard to social media sites and discusses a survey based on it. The results for which showed that some users needed to be more informed about their data security and the majority were indeed concerned about their private information being disclosed to the operators.

**Keywords:** *Personal information, Privacy, SNS, Data security*

#### Introduction

In recent times, Social Networking Sites (SNS) like Facebook, Whatsapp etc. have grown increasingly popular. According to most recent reports, Facebook has 2.7 billion users that are active monthly. Further research reveals that the number of social media users have increased from 2.07 billion users in 2015 to 3.96 billion users in 2020, a 92.76% rise in just 5 years. These sites have become an essential part of the personal lives of most individuals since communication can be done quickly and efficiently using these platforms. These platforms are used to interact with family, chat with friends, connect companies and even for marketing and advertising purposes. They enable users to create a personal profile where they can share pictures, videos and blogs that can be viewed by selected friends or everyone.

However, with these benefits come downsides, there is not just a boost in the number of users on the sites but also excessive data relating to social interactions is available and a fair amount of personal information is being shared with its operators. This includes contact details, personal details and addresses which need to be protected. This raises privacy concerns among the users about whether their data is safe or not because if they are not mindful about the content they share, it can lead to various security breaches, identity theft and misuse of private details. Furthermore, the fundamental concept of privacy is that the users should have control over how their information is being utilised. The users deserve some amount of privacy and should be able to share content with the intended audience only. And since all interactions are online at present, it adds on to the problem. Despite features provided by the operators like end-to-end encryption, these issues have to be considered. Most tend to ignore these risks and continue placing their trust on the operators, disclosing all personal details. The paper discusses these security concerns



and provides a study based on an online survey where respondents put forward their opinions and experiences.

### Theory

#### Social Networking Sites

SNS are defined as a medium through which people can build personal relations with others that have corresponding likes and dislikes. These relationships grow through sharing content with each other through photos, videos, and direct messaging.

In 1997, the first SNS that involved making friends online was SixDegrees.com after which a lot of other sites grew more and more conventional including Facebook, Whatsapp etc. Facebook has more than 2.7 billion users across the globe. These users may display personal information on their profiles without any second thoughts making them vulnerable to their private information getting leaked or the operators using it for illegal activities. They agree to privacy terms and conditions that grant access to their information, for example, their location, the device information and operating system.

#### Privacy Concerns

Most users disregard the privacy settings on their social media. With a public account anybody can access their information. The users do not understand the significance of the information they share and how it can be used without their knowledge. On Facebook, even with a private account, an acquaintance who the user does not know well can still access their information. These shoddy settings give way to cyber-attacks and leakage of personal information. Furthermore, Facebook is a SNS that allows third party applications to ask for access to users' information and when they provide that the apps can use any of that information without their knowledge.

Some worry that their personal preferences and behaviour can be interpreted by their browsing history. It records the users likes and preferences and the same kind of content gets recommended to them and that is what makes up the users' algorithm. In the documentary 'The Social Dilemma' [9] many experts claim that it is a way of manipulation because this data is harvested so that the users get addicted to the sites. In the same way, this technique is used for marketing where users are recommended advertisements based on their algorithm. They have a very basic business strategy and that is to track human behaviour and sell products based on their wants.

In 2018, the Facebook-Cambridge Analytica scandal happened where information of approximately 80 million US/ EU users was exploited for illegal political reasons. Their harvested data was utilized by third party apps for advertising campaigns for elections. The app was called "This Is Your Digital Life" and it had a survey in which the respondents gave out personal information and this was used as an analysis for the Trump election campaign in 2016.

The scandal was then unveiled in 2018 by a former employee of Cambridge Analytica. Facebook was then sued for 'losing control' of data with a penalty of £500,000. Even now there are concerns that the end-to-end encryption of WhatsApp has its limitations, some of the metadata gets shared with Facebook which is its parent company.



In January of 2021 WhatsApp updated its privacy policy which raised doubts among most users. They received a notification asking them to agree to certain terms and conditions that entailed sharing some data which lead to them thinking it will be shared with Facebook, the parent company, too. And if they did not agree to them within a month their account would be deleted. During the week, the users dropped by more than a billion and so the issues had to be addressed and the date for the updates was pushed.

### **Role of the Government**

The government of India recently released the new report of IT rules of 2021 and gave social media applications 3 months to comply with the changes. They are contributing to the problem of violation of users' privacy when they ask WhatsApp's operators, according to the rules, to trace the original sender of the text. WhatsApp had to file a complaint in the court against them and this is an ongoing issue. Furthermore, these rules are likely to break the end-to-end encryption that originally states that no third-party applications, WhatsApp or Facebook can access the users' texts. The government would be able to find the original senders of any message. The fundamental right to speech and expression would be violated with this, making the Indian users extremely apprehensive about their data privacy.

### **Research Design**

The purpose of this research is to acknowledge the different privacy concerns faced regarding the trust placed on the operators of SNS. An online survey was conducted within a span of 10 days to understand the opinions and experiences of different age groups regarding privacy on Social Networking Sites like Facebook, Instagram etc.

### **Result**

The survey was run in July and there were 25 respondents of different ages starting from 15. Each of them responded to questions about their issues with privacy and their own suggestions about how data security can be improved. The inference was that all of them use SNS and the most used SNS was WhatsApp. However, more than half of the respondents do have privacy issues of some kind and some of which include: usage of contact details and residential addresses, getting advertisements based on likes and fear of personal chats available to operators. This only proves that users are in fact facing issues yet continue to use the sites.

The questions that followed included hacking and what they thought best to do when they were hacked was: changing the password, deleting the account and informing people about the hacking. This only means that the operators need to make the applications more secure so that the users do not have to face hackers. If the operators do not do anything about it, the users will harbour more mistrust.

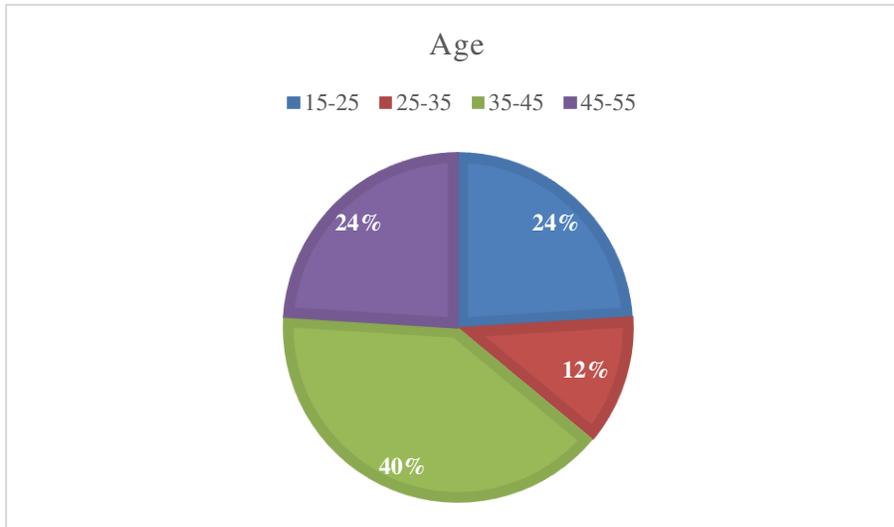
The last question was about the users' suggestions on what can be done better and the responses included: A two factor authentication if logged in through another device, making privacy terms and conditions simpler, an update as to 'who can see your post' prior to confirming every upload, not wanting pop-ups of marketing companies based on their preferences, the need of profiles to be verified and many more. This indicates that the users do have various suggestions and all of them valid yet they do not approach the authorities with them. It also



suggests that the government can take the users' opinions before making decisions like changing the IT rules which violate their privacy.

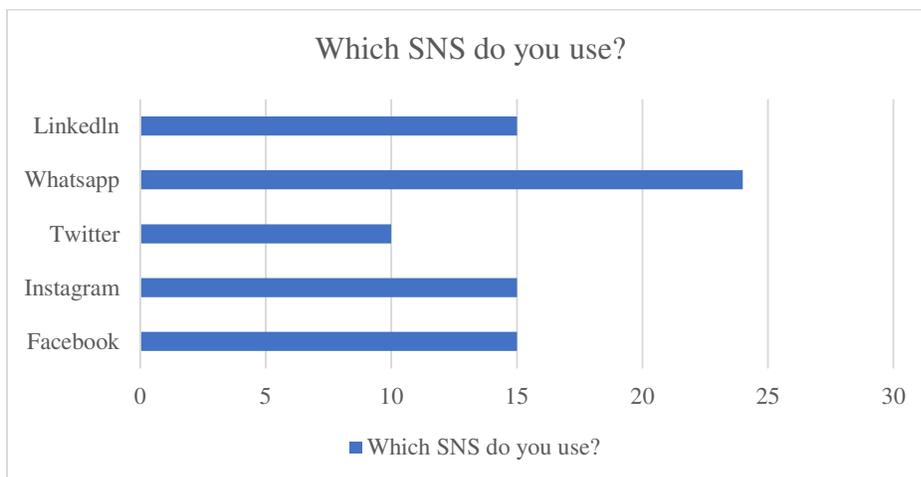
### Discussion

These are some of the figures that depict the results of the survey. There were respondents from every age group and most of them 35-45 years old. The purpose of this was to get accurate results since different age groups have different thought processes.



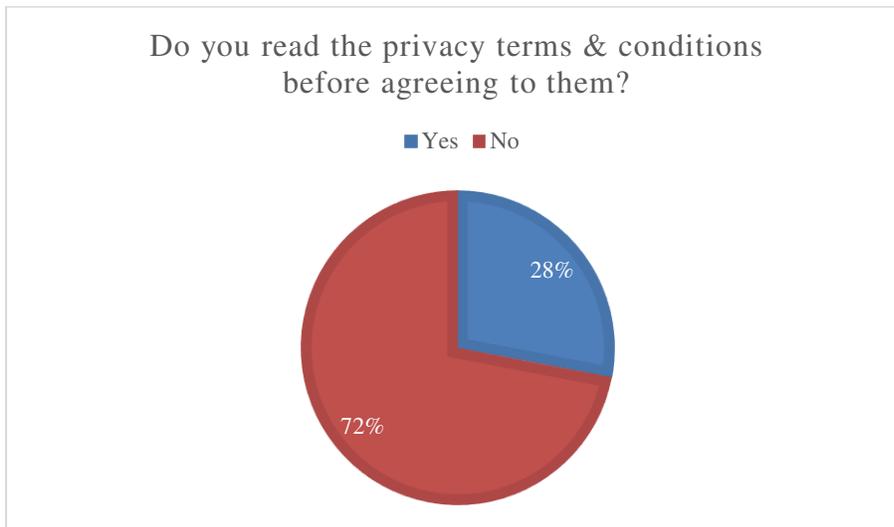
**Fig. 1** Ages of respondents

All of the respondents who took the survey used social media sites and the most used site was WhatsApp. 24 out of 25 respondents use the app making it the most popular according to the results. Further analysis showed that most of the users of Facebook were between the ages of 35-55 and for Instagram between 15-35.



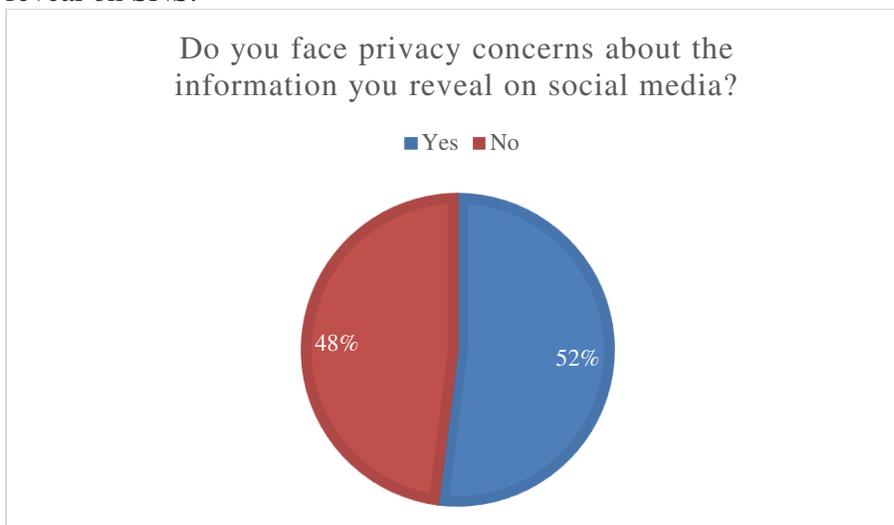
**Fig. 2** Most used SNS

The next question was asked to know if the users were aware of the data they were sharing. A majority of 72% of them do not read privacy terms and conditions which indicates that they have no idea about what can be done with their data. This is extremely dangerous because they agree to something that gives a lot of access to operators without knowing about it.



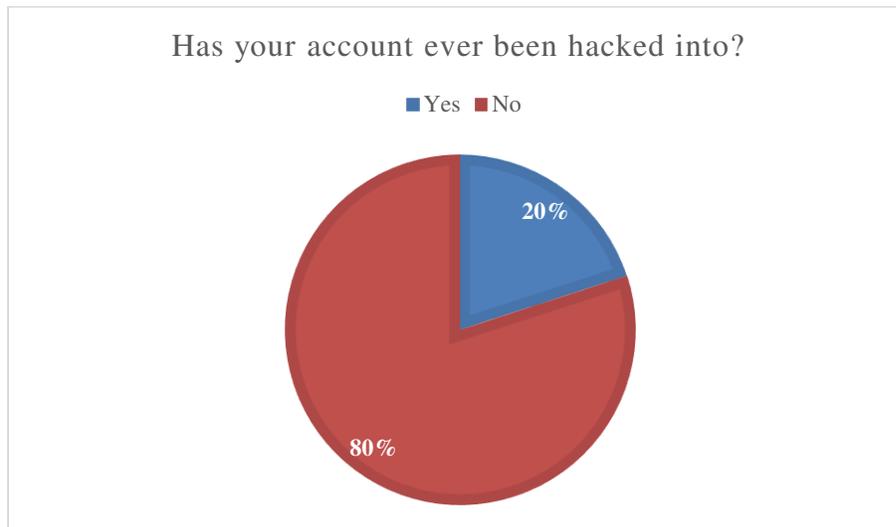
**Fig 3.** Reading terms & conditions

Fig 4 displays that more than half of the users do face privacy concerns. The results show how much online privacy matters to the users which is directly proportional to the information they reveal on SNS.



**Fig 4.** Facing privacy issues

Lastly, Fig 5 illustrates that 20% of the users have been hacked before. This is a huge number and reflects how unsafe the sites are since 2 out of every 10 people could have been hacked. Hacking results in revealing of plenty of personal information, messages, pictures and more. It is an invasion of privacy and if the operators do nothing about it, it will add on to the problem of trust.



**Fig 5.** Hacking

### Conclusion

To end with, this study helps to understand that almost half of the users were neither aware of the reciprocations of the content they share nor were they concerned about the problems they might face in the future. This research will help them understand and stay informed regarding the same. Moreover, the other users who were aware and apprehensive of the issues had listed down their concerns in addition to a few solutions too. Therefore, this study will be helpful to operators too who are looking to improve data security on their sites. However, there were limitations. All the respondents were from the same country and most of them aged 35-45. Hence, they had similar perceptions regarding the kind of issues they faced. Nevertheless, the study overall gives an insight into the opinions of various users which can be relied on for further study into the topic.

### Acknowledgements

Thanking the survey respondents that added value to the results by listing the most plausible suggestions and concerns: Simoni Kanani, Ruchita Jasani, Manish Singh, Amit B, SheebaPavamani, Ankit Naval, Tanisha Agrawal.

### References

1. Ashish Gupta and Anil Dhama, "Measuring the impact of security, trust and privacy in information sharing: A study on social networking," [link.springer.com/https://link.springer.com/article/10.1057/dddmp.2015.32](https://link.springer.com/article/10.1057/dddmp.2015.32) (accessed May 24, 2021).



## An International Multidisciplinary Research e-Journal

2. DolvaraGunatilaka, “A Survey of Privacy and Security Issues in Social Networks,” [cse.wustl.edu/https://www.cse.wustl.edu/~jain/cse571-11/ftp/social/index](http://cse.wustl.edu/https://www.cse.wustl.edu/~jain/cse571-11/ftp/social/index) (accessed May24, 2021).
3. Sonja Grabner-Kräuter and Sofie Bitter, “Trust in online social networks: A multifaceted perspective,” [tandonline.com/https://www.tandfonline.com/doi/full/10.1080/07360932.2013.781517](http://www.tandfonline.com/doi/full/10.1080/07360932.2013.781517) (accessed June10, 2021).
4. Michael Beye, Arjan Jeckmans, ZekeriyaErkin, Pieter Hartel, ReginaldLagendijkand Qiang Tang, “Literature Overview - Privacy in Online Social Networks,” [ris.utwente.nl/https://ris.utwente.nl/ws/portalfiles/portal/5095526/literaturereview.pdf](http://ris.utwente.nl/ws/portalfiles/portal/5095526/literaturereview.pdf) (accessed June 10, 2021).
5. Zak Doffman, “Why You Should Never Use This ‘Dangerous’ WhatsApp Export Feature,” [forbes.com/https://www.forbes.com/sites/zakdoffman/2021/01/30/stop-using-this-dangerous-whatsapp-setting-on-your-apple-iphone-or-google-android-phone/?sh=69d35c8b2c7d](http://www.forbes.com/sites/zakdoffman/2021/01/30/stop-using-this-dangerous-whatsapp-setting-on-your-apple-iphone-or-google-android-phone/?sh=69d35c8b2c7d) (accessed June 10, 2021).
6. Will Kenton, “Social Networking Service (SNS),” [Investopedia.com/https://www.investopedia.com/terms/s/social-networking-service-sns.asp](http://www.investopedia.com/terms/s/social-networking-service-sns.asp) (accessed June 28, 2021).
7. Anonymous, “Facebook sued for 'losing control' of users' data,” [bbc.com/https://www.bbc.com/news/technology-55998588](http://www.bbc.com/news/technology-55998588) (accessed June 28, 2021).
8. Kristie Pladson, “WhatsApp controversy highlights growing fears about data privacy,” [dw.com/https://www.dw.com/en/whatsapp-controversy-highlights-growing-fears-about-data-privacy/a-56266093](http://www.dw.com/en/whatsapp-controversy-highlights-growing-fears-about-data-privacy/a-56266093) (accessed July 2, 2021).
9. Anonymous, “The Social Dilemma,” [en.wikipedia.org/https://en.wikipedia.org/wiki/The\\_Social\\_Dilemma](http://en.wikipedia.org/wiki/The_Social_Dilemma) (accessed July 2, 2021).
10. MashaelAljohani and Kelly Blincoe, “A survey of social media user’s privacy settings & Information disclosure,” [kblincoe.github.io/https://kblincoe.github.io/publications/2016\\_secau\\_social\\_media.pdf](http://kblincoe.github.io/publications/2016_secau_social_media.pdf) (accessed July 15, 2021).
11. Debopama Bhattacharya, “The Information Technology (IT) Rules, 2021,” [idsa.in/https://www.idsa.in/idsacomments/it-rules-2021-dbhattacharya-040621](http://www.idsa.in/idsacomments/it-rules-2021-dbhattacharya-040621) (accessed July 15, 2021).



### TECHNOLOGY TRANSFER ACROSS INDUSTRIES OVER THE YEARS

**Trinab S. Goswamy**

Children's Academy Thakur Complex  
trinabsauravrajgoswamy@gmail.com

#### Abstract

This paper aims to establish

- Technology Transfer identical with Commercial Scientific Progress
- Broad classifications of observed technology transfer to industry,
- The impact of Technology Transfer in shaping our world
- Role of Technology Transfer in making inaccessible and unaffordable more accesible and affordable
- Indispensibility of Technology Transfer in bringing about productive side-effects of planned obsolescence.
- The detrimental effects of the lack of proactive and efficient technology transfer Through real-life examples and case studies and tries to show the above aims, obectives and theoretical assumptions to be true.

It tries to consolidate most relevant information on technology transfer and its industrial and scientific roles to give a comprehensive qualitative analysis on the same.

**Keywords:** “technology” , “transfer” , “nature , “ Military” , “ academia” , “ research” , “institutions” , “AIIMS” , “CERN” , “air” , “travel” , “jet” , “ advantages” , “ bullet train” , “shikansen” , “biomimicry” , “graphene” , “wireless” , “ headphones” , “IIT-H” , “Planned” , “obsolescence” , “phoebus” , “radio” , “ lightbulb”

#### INTRODUCTION

Technology transfer which serves as the base of this research is commonly described as process of transferring technology from the person or organization that owns or holds it to another person or organization. In most cases this is referenced and concerned with commercialization of technological innovations and solutions from organization(s) that develop it preliminarily. An important concept to grasp in order to comprehend the research as intended is that of the meaning of technology. Technology, the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment [0]. Simply put, it is the use of scientific phenomena and natural laws to solve a problem in the ecosystem, society, life processes, economy or with respect to human convenience. It is due to this interpretation that the main assumptions and conclusions are in line



with the belief that technology in its existence and development isn't solely by virtue of the activities of humankind or its forces. Keeping that in mind, it becomes very clear that transfer of technology as pointed out eventually has shaped, is shaping and will continue to shape the world as we know it. It is indirectly or directly integral to consistency in growth and incentivising scientific development of mankind.

### **Why technology transfer is intrinsic to scientific development**

Technology that is developed in labs and as part of experimental studies have the power to change the world but as capitalism demonstrates, unless a monetary incentive associates itself with such science, it is impossible to successfully make the most impact with the technology. In today's modern economic world that monetary incentive is in the form of profit from commerce. So in order for a greater realization of the potentials of a technology leading to the wide-scale implementation of the same in the world that is consistent with the ultimate aims of technology development, this technology must find a way to be adapted for the consumer. This is brought about by technology transfer to industry.

### **Classification Of Technology Transfer To Industries**

Technology transfer processes are observed from wide categories; a very conservative scheme of describing technology transfer would classify most of it under transfer or commercialization of tech from academic institutions to co-orporate entities. They would also refer to some of the organizational technology however the classification in essence is seen to be more diverse. They can be seen from Nature (Biomimicry), from research institutions, from academia, from another industry or Military.

#### **a) Technology transfer from Nature to Industry:**

The transfer or technology existent in nature in any way, shape or form to man made applications thus commercialized is referred to as technology transfer from nature to Industry.

This is where the thought process regarding the understanding technology comes into the picture. Technology can exist anywhere even without man's intervention. After all it is just a means to an end with respect to application of scientific phenomena and principles to resolve a problem. Therefore the various adaptations in nature for survival and growth if mimiced and replicated for use in the human world mainly in industry product.

Probably the best example of such a technology transfer is that of the Japanese Shinkansen.

The Shinkansen introduced in Japan arguably revolutionized high speed train-travel. It was the birth of the Bullet Train as we know it. However in the 1980s, one of the problems that developed with the early Shinkansen E1 was that it produced irritable loud sounds while running thus inconveniencing people especially in residential places[1]. To solve this issue a team was assembled to redesign the shinkansen and develop the E2. One big advantage they had was that Eiji Nakatsu, the general manager of the technical development department - was a bird watcher[1].

Throughout the entire design of the train, design cues have been seen to have been adapted from birds. For instance :

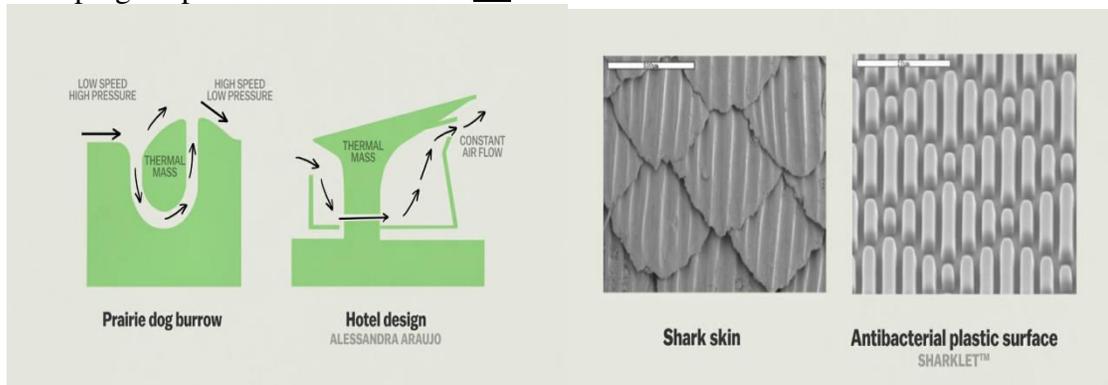


The Pantograph of the train was inspired by Owl feathers. The supporting shaft was adapted from the smooth body of the Penguin to reduce air drag and noise.

The most important part of the train - the nose was inspired by the beak of the Kingfisher which dives into water to catch its prey but the unique shape of its beak allows it to do so while barely making a splash[1].

All in all these changes and biomimicry made the resultant 2nd generation shinkansen 10% faster, 15% more power efficient than the first and helped it remain under the 70dB noise limit in residential areas. The E2 broke numerous world speed records in part due to these birds and their inspiring biology[1].

Similarly companies like Kohler, Kraft, Nike, P&G, Boeing, nysesda, General Electric have all hired biomimicry experts and biologists to help them adapt efficient technologies and design elements from nature into their products. From designing air-ventilation systems in hotels after prairie dog burrows Mimicing shark skin to create antibacterial plastic surfaces. Or arranging wind turbines in the same drag reducing pattern in which schools of fish swim in. Transfer of technology to industry from nature is helping shape the world around us[2].



Similarly the surfaces of lotus leaves can be mimiced to make any product water proof; Imagine it being applied in your cars. Newer ideas help to mimic communication systems between ants to find food can be mimicked in software; also in autonomous vehicles such as self driving cars.



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### b) Technology transfer from Research institutions

Technology transfer often us seen to occur from institutions usually government owned, that specilize in undertaking implementation of experimental technology at a very niche scale as a part of scientific explorations or studies. These technologies developed as proof of concepts can be later adapted for public use by consumers by commercialization of the said technology.

When Institutions like AIIMS, ISRO, NASA , CERN perform research, they use and develop certain technologies that have potentially revolutionary Implimentations

Embedded web technology was developed by NASA to enable astronauts to conduct and monitor experiments on the ISS, remotely over Internet. This embedded web technology was later released in the public domain, served as a foundation to the Internet of Things which was later developed at CERN[3].

An interesting spin-off from the research at CERN is that the GEM (Gas Electron Multiplier) which is a specialized gas detector is employed extensively in high energy physics and has been adopted in medical imaging, biotechnology, material analysis, radiotherapy dosimetry, radiation detection monitoring and even astrophysics[4].

### c) Transfer of technolgy from academia

Transfer of technlogy from academia refers to the transfer of technology to Industry from institutions like colledges, polytechniques, universities, schools or anyother educational institutions by its students or faculty.

A recent example of such technology is in India's solution to the blackfungus epidemic: Researchers at Indian Institute of Technology, Hyderabad (IIT-H) have developed oral solution for the blackungus, which could be mass-produced now, to treat it providing huge relief to patients affected with it and doctors finding it hard to treat the patients along with allaying the fears of another uncontrolled widescale health disaster. [5]

After two years of advancement of examination, the researchers are now confident that the technology as usually done, can be transferred to acceptable pharmaceutical industry-partners for wide-scale production[5].

Arguably academia plays a very important role in the technology transfer process because of scope of scholarly collaboration between them and research institutions and government agencies that source ideas from youth scientists.

### d) Transfer of technology from Military:

At the height of the Cold War, military commanders were seeking a computer communications system without a central core, headquarters or base of operations that could be sabotaged by enemies thus blacking out the entire network in one fell swoop.[6] This arose a desire to share information over great distances without the need for dedicated phone connections between each computer on a network. This gave birth to the devlopment of ARPANET

ARPA(research) played a key role in launching the “Information Revolution,” including developing or furthering much of the conceptual and theoretical basis for ARPANET, a pioneering network for sharing digital resources among geographically separated



computers. Its initial demonstration in 1969 built up to the Internet, whose world-changing consequences unfold on a daily basis today. A seminal step in this sequence took place in 1968 when ARPA contracted BBN Technologies to build the first routers, which later enabled ARPANET to become operational. [7]

ARPANET adopted TCP/IP on January 1, 1983, and from there researchers began to assemble the “network of networks” that became the modern Internet. This technology was adapted and then commercialized to form the modern internet as we know today.

This is but one example of technology transfer from Military to Industry.

### Lets Discuss

#### Why Technology Transfer ?

The advantages of Technology Transfer are as follows:

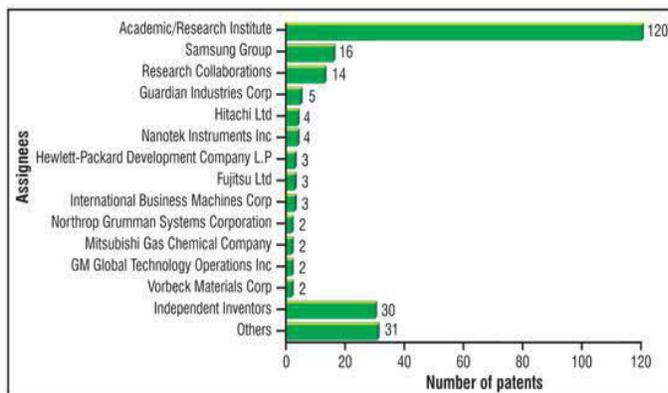
1. It provides incentives for new innovations and discoveries in the field of Science and Technology by commercializing the products on a large scale thus allowing considerable royalties to the organization and person behind the technology.
2. It humanises the technology i.e adapts raw proof of concepts to better suit human needs.
3. Brings about co-operation between two nation, organizations and institutions when technology is shared between them(we will explore this further later).
4. Maximises resource utilization as any amount of monetary or infrastructure or any other resources provided for any research and development open avenues to innovations in the desired field or area but also simultaneously in seemingly unrelated applications.

#### Lack of Successful Technology Transfer Initiatives

In cases of lack of efficient technology transfer initiatives, humanity can miss out on potentially world changing innovations - the biggest example is the case of Graphene.

Graphene is a one-atom-thick layer of carbon atoms arranged in a hexagonal lattice[8]. It is the building-block of widely-used Graphite , but graphene is a mindblowing substance on its own - with a multitude of path-breaking properties which repeatedly earn it the title “wonder material”[8]. Harder than diamond, elastic than rubber; tougher than steel but lighter than aluminium. Graphene is the toughest or strongest known material[9]. Not only is its high electron mobility is 100x faster than silicon, its heat conductivity is also 2x better than diamond; its electrical conductivity is 13x better than copper; it absorbs only 2.3% of reflecting light[9]. Yet, graphene still hasn't taken over the world. Why?...The growth of graphene in industries are very much related to two main items: *money and research*.

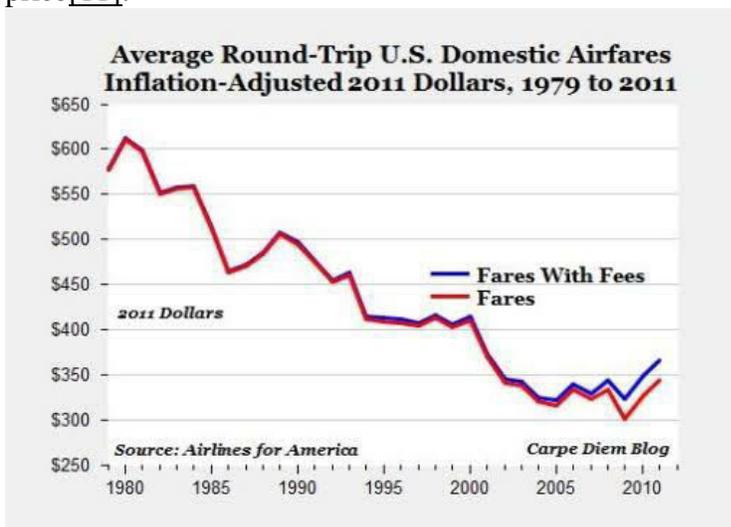
Despite its easy method of isolation, researchers are still trying to find a way to optimise the commercialisation of this material. After the 15 years since it was first discovered, people have gone from producing flecks to barrels of graphene. The evolution of graphene is not an overnight process. Its production process requires further refining in order to enable graphene to leap out of the lab to the marketplace[10].



From the above chart we can infer that while graphene has been widely undertaken for research and experimentations - it has not been commercialized or transferred to industries on a significant scale over the last two decades since its discovery.

### How does technology transfer make technology more accessible and life easier ?

Sixty years ago, air travel was far too expensive for the masses. Book a flight between New York and London on Pan Am in 1960, and you'd be paying somewhere around \$300, or about \$2,600, adjusted for inflation. But in 2019, you can catch the same flight for almost a tenth of the price[11].



The cause of reduction of the average flight price so drastically are

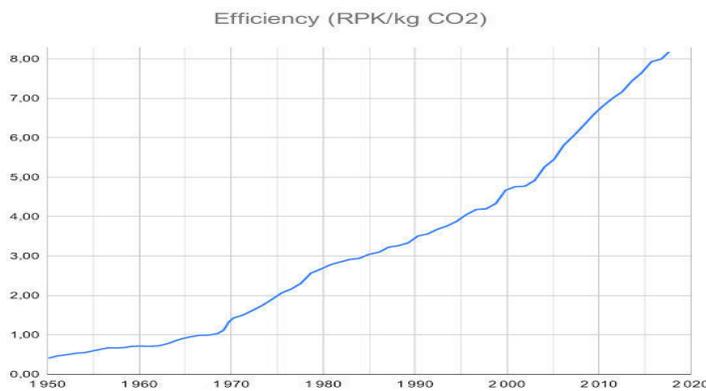
- Reduction of flight times and consequent increase in the number of flights
- Having more powerful engines to allow larger planes to fly which accommodates more people in a single flight thus improving the supply-demand ratio.
- There has also been reduced dependency on pilots due to the integration of computers into the avionics thus reducing involvement of manual work if marginally.
- The use of computers to book plane tickets thus increasing reach of the service allowing airlines to reduce price by economies of scale.

Thus we can see from the above examples that computers are playing a great role in reducing flight prices and as we have discussed before, that is a product of technology.

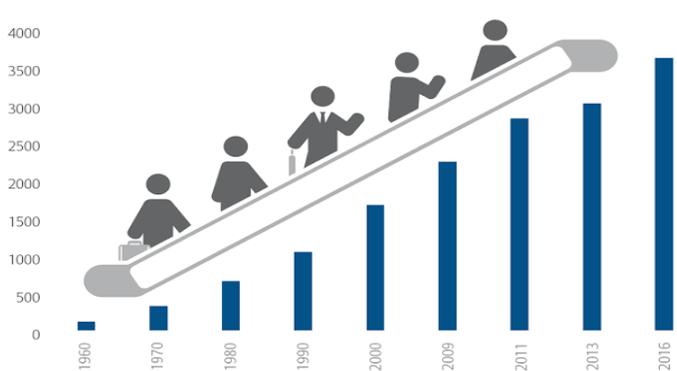
Furthermore the main factor affecting flight prices is that the airline industry is almost completely dependent on jet planes. In the 1960s this wasn't the case.

How does using Jet planes help ?

- Less vibrations in the plane body increases longevity and reduces maintenance costs[12].
- They produce more overall thrust thus reducing flight times and increasing plane capacities[12].
- Can fly at higher altitudes thus increasing flexibility leading to greater number of flights even in bad weather[12].

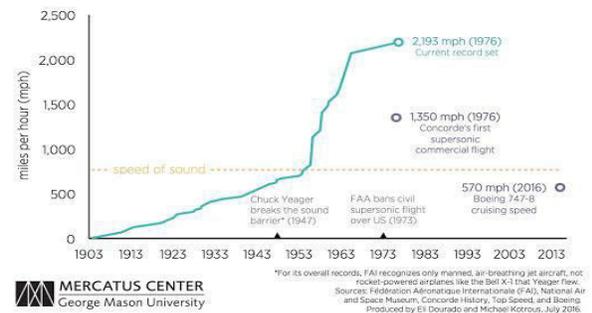


Global passenger numbers on the move (millions)



Sources: IATA Airline Industry Forecast 2012-2016  
 Graphic: Allianz Global Corporate & Specialty

Top Airplane Speeds and Their Dates of Record, from Wright to Now



\*For its overall records, FAA recognizes only manned, air-breathing jet aircraft, not rocket-powered airplanes like the Bell X-1 that Yeager flew.  
 Sources: Fédération Aéronautique Internationale (FAI), National Air and Space Museum, Concorde History, Top Speed, and Boeing. Produced by Eli Dourado and Michael Kotrovic, July 2016.

Ever since the introduction of the jet planes in civil aviation in 1952[12], the sizes, capacities, fuel economy and number of people using air travel has only undergone a steady increase.

All of these reasons make the development of jet engines one of the main factors which contributed the increased affordability of flight travel. Along with this the introduction of booking by personal computers, increased the reach of these services as people started availing these with increased flexibility.



BUT

Before World War II, in 1939, jet engines primarily existed in labs. The end of the war, however, illustrated that jet engines, with their great power and compactness, were at the forefront of aviation development[13].

A young German physicist, Hans von Ohain, worked for Ernst Heinkel, specializing in advanced engines, to develop the world's first jet plane, the experimental Heinkel He 178. It first flew on August 27, 1939[13].

Building on this advancement, German engine designer Anselm Franz developed an engine suitable for use in a jet fighter. This airplane, the Me 262, was built by Messerschmitt[13].

Following the end of the war the German jet aircraft and jet engines were extensively studied by the victorious allies and contributed to work on early Soviet and US jet fighters. The legacy of the axial-flow engine is seen in the fact that practically all jet engines on fixed-wing aircraft have had some inspiration from this design[13].

By the 1950s, the jet engine was used in almost every combat aircraft. By this point, some of the British designs were already cleared for civilian use, and had appeared on early models like the de Havilland Comet and Avro Canada Jetliner[13].

This affordability and increased accessibility is thus a by-product of technology and commercialization of technology once experimental in nature.

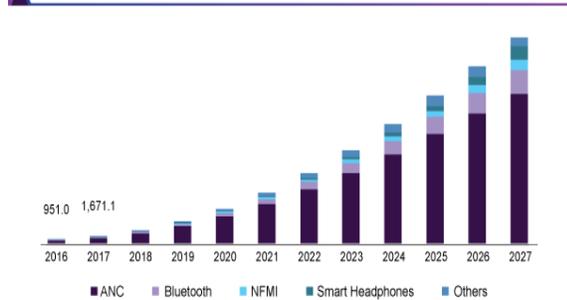
### How does planned obsolescence in the field of science of technology use tech transfer to incentivise innovation:

Planned obsolescence is the calculated act of making sure the existing version of a product will become dated or useless within a given time frame[14]. It involves deliberately worsening a product or technology for the sake of sales. In most cases and in a way of thinking, it might stand out as almost evil but this paper poses a different perspective to the practice pointing out that in certain cases mostly in the fields of science and technology, this in fact causes innovation by availing technology transfer.

### Case Study : Wireless Headphones

The wireless audio technology has existed as Proof of concept since the 1970s, however has become commercially viable only recently.

Asia Pacific earphones & headphones market size, by wireless technology, 2016 - 2027 (USD Million)



From grandviewresearch's charts we can infer that there has been significant growth in the wireless headphone market since 2016 when Apple dropped the headphone jack from their iPhone 7 series. It is worth noting that during the same time (about 2018-2019) as most of the

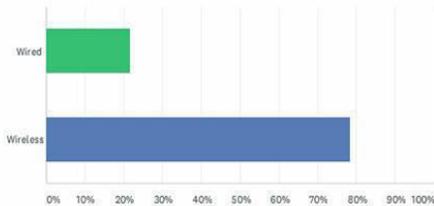


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smartphone brands followed Apple's footsteps by dropping the headphone jack from their flagship or upper-midrange products and later their midrange products in 2019-2021 there was substantial growth in the market cap of wireless headphone products owing to the increased demand and promotion of the same as an alternative to conventional audio appliances born out of corporations' business strategies.

What kind of headphones/earphones do you plan to buy next?

Answered: 3,686 Skipped: 623

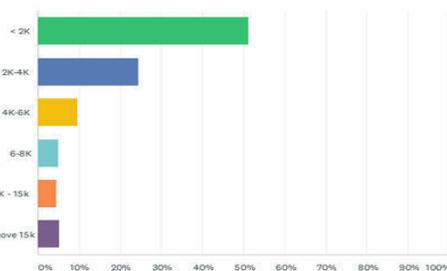


ANSWER CHOICES	RESPONSES	Count
Wired	21.51%	793
Wireless	78.49%	2,893
TOTAL		3,686

The increased demand for wireless headphones has incentivised innovation in the sector and more and more brands entering the market has improved the variety and quality of products increasing competition and thus making them more affordable.

Q11 What's your budget for your next headphones/earphones?

Answered: 3,686 Skipped: 623



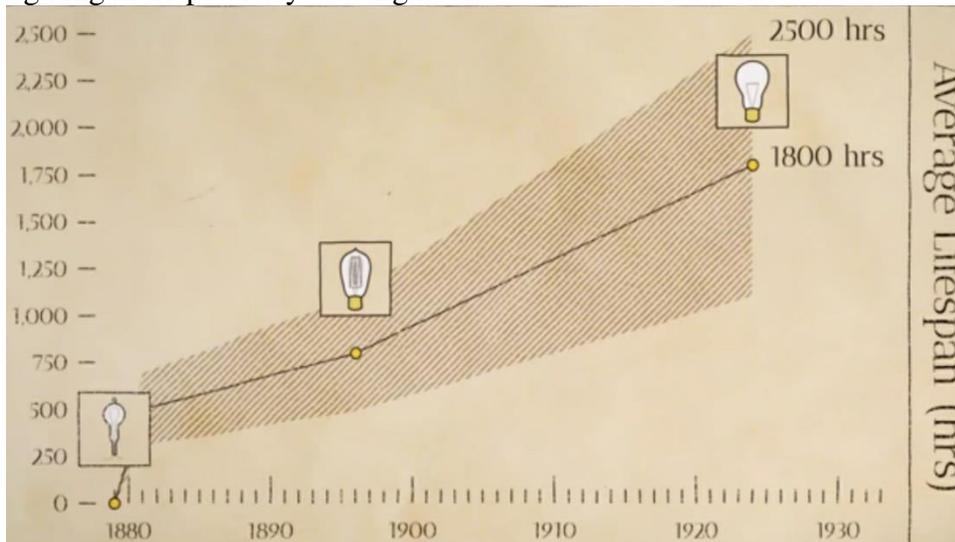
ANSWER CHOICES	RESPONSES	Count
< 2K	51.17%	1,886
2K-4K	24.50%	903
4K-6K	9.58%	353
6-8K	4.99%	184
8K - 15k	4.45%	164
above 15k	5.32%	196
TOTAL		3,686

In digit's survey, observations were a pretty decent shift in the price range that the respondents would make their next purchase in [15]. The above Rs. 15,000 price range climbed to 5.32 percent, however, the sub Rs. 2000 range saw a colossal shift, with a whopping 51.17 percent saying that their next purchase of headphones would be under Rs.2,000 [15]. That's an increase of almost 10 percent in this price range! This is mainly due to the fact that brands such as Xiaomi, Realme, Zebronics, pTron, and others are offering an array of sub Rs.2000 audio products with a decent set of features as well [15]. There are even multiple true wireless in-ears that are being offered at this price range, which is a massive shift from 2016-2017, when only the premium, high-end brands had captured this segment. There are sub Rs.2000 products that offer

voice assistant support, a sizable battery life, an IP rating, and sometimes, even touch controls[15]!

Wireless headphones use low power radio signals to communicate wirelessly with your audio source[16]. This technology can be said to have been adopted from the military communication devices such as those used by the secret service for morse communication using aforementioned radio technology again used by the military for remote control[17]. It is from here that the technology was transferred to consumer electronics industry which enabled mass commercialization.

A good example of such phenomenon is also the planned obsolescence in the field of artificial lighting more precisely - the lightbulb.



Since lightbulbs were invented, their lifespan rose from 14 hours to 100 hours to 1000 hours and kept growing through the 1900s till 1930s with some bulbs reaching even 2500 hours at that point, but that when this growth not stopped but infact saw reduction in average bulb lifespans[18].

The single most threat faced by manufacturers at that time were longlasting lightbulbs, as it discouraged second round of sales after explosive first round of sales.

It was to solve this problem that in Christmas of 1924, top executives from International General Electric, Osram, Philips, Tokyo Electric and Associated Electric held a closed-doors meeting in Geneva to form the Phoebus cartel[19]. All these corporations decided to work together to help each other by controlling the world average of lightbulb life because by this time all the world's smaller smaller lightbulb manufacturers had been more or less consolidated into these 5 corporations[19]. They themselves would refrain from manufacturing lightbulbs with lifespans above 1500 hours and would ensure the same for other cartel members by auditing their products and issuing fines in case of violation of agreed upon terms of product lifespan[19]. It is therefore a classic example of planned obsolescence. This in turn had manufacturing companies looking towards other areas to incentives their products through[19].

This eventually led to transfer of the LED technology to this industry from Nasa's Space program to create LED bulbs which are brighter, more eco friendly than traditional incandescent bulbs and last longer.



### CONCLUSION

We thus conclude that the process of technology transfer is fairly identical with trying to bring about practical implementations of science and technology by seeing the various ways in which this process and its forms has helped create the technologies that we now commonly use. We see the diverse and often non-intuitive links between popular technologies and their sources, tertiary adaptations or implementations. Technology transfer has and will continue to make novel and exclusive scientific and technological wonders more accessible to the common masses while helping employment and economies through industries. The wireless headphone market boom caused due to planned obsolescence by IOT companies, was actually prepared by the ready technology transfers performed to optimize and adapt military technology to consumer electronics and the point is only further complemented by the historical analysis and study of the evolution of the lightbulb and the proven phoebus conspiracy. Furthermore to omit or prevent mistakes like those in the case of graphene, we must look aid the technology transfer process in terms of funding and commercial research to avoid waste of intellectual resources and scientific study.

### Acknowledgements

I'd first and foremost like to acknowledge the efforts of my mentor - **Mrs. Seema Dinesh** who has stood by and guided me throughout this novel research experience, helping spark new ideas and thought processes that have materialized in this paper in one way or another. My brother - **Mr. Trideep Ghosh (B.Tech ECE - VIT)** who has by virtue of his experience in the field, guided the form of arguments put forth to make a point throughout the paper via his constructive feedback. **Miss Deepa Avudiappan -Assistant Project Manager at IIT-Bombay** who has helped in the review of the paper and first hand interaction with research experts and **Mr. Rathin Biswas -Project Manager at IIT-Bombay** who has reviewed the paper. Last but not the least I would like to mention my parents - **Mr. Sauravraj Goswamy** and **Mrs. Meghana Goswamy**, conversation with whom on this topic has lead to the refinement and development of several concepts introduced through this paper.

### REFERENCES

1. Britannica, The Editors of Encyclopaedia. "Technology". Encyclopedia Britannica, 15 Apr. 2021, <https://www.britannica.com/technology/technology>. Accessed 18 July 2021.
2. Kohlstedt, K. (1970, January 1). Biomimicry: How Designers Are Learning from the Natural World. 99% Invisible. <https://99percentinvisible.org/article/biomimicry-designers-learning-natural-world/>.
3. Joshinav. (2018, December 9). How is space technology used in everyday human life? Application development. <https://www.allerin.com/blog/how-is-space-technology-used-in-everyday-human-life>.
4. McFadden, Christopher. "These 7 CERN Spinoffs Show The Project Isn't Just Theoretical." Interesting Engineering, Interesting Engineering, 6 Mar. 2019, <https://interestingengineering.com/these-7-cern-spinoffs-show-the-project-isnt-just-theoretical>.
5. Reddy, R. Ravikanth. "Oral Solution for 'Black Fungus' Is Now Ready for Technology Transfer: IIT Hyderabad Researchers - The Hindu." The Hindu, The Hindu, 29 May



## An International Multidisciplinary Research e-Journal

- 2021, <https://www.thehindu.com/news/national/tehrangana/oral-solution-for-black-fungus-is-now-ready-for-technology-transfer-iit-hyderabad-researchers/article34676380.ece>.
6. ARPANET.” Encyclopædia Britannica, Encyclopædia Britannica, <https://www.britannica.com/topic/ARPANET>. Accessed 19 July 2021.
  7. Defense Advanced Research Projects Agency, <https://www.darpa.mil/about-us/timeline/arpamet>. Accessed 19 July 2021.
  8. What Is Graphene? | Graphene-Info.” Graphene Info | The Graphene Experts, <https://www.graphene-info.com/graphene-introduction>. Accessed 19 July 2021.
  9. Michael Berger. “Graphene Properties and Applications.” Nanowerk, Nanowerk, 9AD, [https://www.nanowerk.com/what\\_is\\_graphene.php](https://www.nanowerk.com/what_is_graphene.php).
  10. Why Hasn't Graphene Taken over the World?” LinkedIn, <https://www.linkedin.com/pulse/why-hasnt-graphene-taken-over-world-cornelia-notoprajitno#:~:text=It%20also%20has%20the%20ability,to%20take%20over%20the%20world%E2%80%A6>. Accessed 19 July 2021.
  11. Why Air Travel Is so Cheap | Business Insider India.” Business Insider, 8 Nov. 2019, <https://www.businessinsider.in/business/news/why-air-travel-is-so-cheap/articleshow/71973930.cms#:~:text=Computer%20systems%20began%20to%20replace,to%20get%20even%20more%20competitive.&text=Budget%20airline%20models%20were%20able,regularly%20click%20the%20cheapest%20prices>.
  12. 7 Benefits Of Jets Over Piston Powered Airplanes | Boldmethod.” Online Flight Training Courses and CFI Tools | Boldmethod, <https://www.boldmethod.com/blog/lists/2017/10/7-benefits-of-jet-engines/>. Accessed 19 July 2021.
  13. [Jet Engines.” Stanford Computer Science, <https://cs.stanford.edu/people/eroberts/courses/ww2/projects/jet-airplanes/planes.html>. Accessed 19 July 2021.
  14. Planned Obsolescence Definition.” Investopedia, [https://www.investopedia.com/terms/p/planned\\_obsolescence.asp](https://www.investopedia.com/terms/p/planned_obsolescence.asp). Accessed 19 July 2021.
  15. Datta, Dhriti. “The Consumer State of Mind in India When Purchasing Headphones | Digit.” Digit.In, Digit, 12 Oct. 2020, <https://www.digit.in/features/general/the-consumer-state-of-mind-in-india-when-purchasing-headphones-56796.html>.
  16. Montoya, Greg. “How Do Wireless Headphones Work [2021].” Wireless Headphones - WirelessHeadphones.Com, <https://www.facebook.com/wirelessheadphonesdotcom/>, 5 June 2017, <https://wirelessheadphones.com/how-they-work/>.
  17. Smith, Caspar Llewellyn. “Now Hear This: The History of Headphones | Music Industry | The Guardian.” The Guardian, The Guardian, 30 Oct. 2011, <https://www.theguardian.com/business/2011/oct/30/history-of-headphones>.
  18. [Full Page Reload.” IEEE Spectrum: Technology, Engineering, and Science News, <https://spectrum.ieee.org/tech-history/dawn-of-electronics/the-great-lightbulb-conspiracy>. Accessed 19 July 2021.



## SIGNAL BREAKING BARRIERS FOR TRAFFIC MANAGEMENT USING IOT

**Tasmiya Khan**

Bombay Cambridge International School  
me.tasmiyakhan@gmail.com

### Abstract

We find that people disregard traffic signal rules and cause a commotion at signal points, resulting in traffic and accidents. We devised a road blocker to address this issue. Depending on the traffic signal, stop the vehicle on the appropriate course and put an end to the disobedience of traffic light rules to reduce or eliminate. a speed breaker to control the speed of cars. Using a mechanism, we created a speed breaker. We can use this that was created to operate the road. This road blocker is controlled by a timing sensor. For emergency situations, we have a second entry gate ambulance.

*Keywords : commotion, mechanism, timing sensor*

### Introduction

Because of the growing number of vehicles and limited infrastructure, traffic congestion is becoming more and more of an issue. The conventional timer-based traffic light systems are unable to control traffic in this situation. A real-time traffic control and monitoring system incorporating road spike blocks was used to overcome this impediment.

These are some of the pointers that will be taken into consideration

1. To stop the violation of traffic signal rules.
2. To avoid accidents and traffic at signal points.
3. Fast Alert System to nearby police stations.
4. To provide option for ambulance

### Theory

Overcrowding is a big issue in many Indian cities, as well as other countries. Road congestion has been caused by signal failure, poor law enforcement, and inefficient traffic management. One of the primary issues in Indian cities is that the existing infrastructure cannot be expanded any further, leaving only better traffic management as an alternative. Congestion has a negative influence on the economy, the environment, and the quality of life in general. As a result, it is past time to address the traffic congestion issue efficiently. Video data analysis, infrared sensors, inductive loop detection, and other approaches are offered for traffic management.



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The Internet of Things (IoT) connects real-world objects to the virtual world, allowing anything with an on/off switch to be connected at any time and from any location. It refers to a world in which actual items and living humans interact with virtual data and environments. Because there are so many gadgets connected to the internet, a lot of data is generated. As a result, in order to construct effective systems, this vast volume of data must be managed and transformed into meaningful information. The focus of this study is on an urban IoT system that is utilised to develop intelligent transportation systems (ITS).

### Mechanism

Signal Light Detection and Detecting Signal Jump Status, Command Hardware Relay, Extract Near Police, and Sending Alert are the three key aspects of this project.

Sensor values are utilised to detect a signal jump. It will only operate if the RED signal is turned on. The idea behind utilising an IR sensor is that if someone breaks the signal, they will come within range of the IR sensor, which will turn it on. The signal is relayed to the microcontroller, which turns on the camera. The system will now select the car image. Also, if a vehicle comes to a halt on a zebra crossing, it is deemed a signal jump. To prevent people from stopping at zebra crossings, this is done. The research has been divided into follow phases

- Research:
  - To do a complete automation of signal spike and speed breaker control.
- Desktop Application:
  - To collect the signal data based on status and light data
  - To monitor speed breaker values and status.
- Spike Controllers:
  - Control spike and motor.
  - Monitor the status of the signal.

### Conclusion

I can conclude that the road spike system is utilised for a variety of applications depending on the situation, such as traffic management, and one-way road directions, ensuring that traffic regulations are followed correctly. The number of accidents that occur can be reduced by employing this approach.

### References

- Title :Traffic Signal Automation using Spike Road Block.  
<https://www.rijse.com/wp-content/uploads/2019/12/Traffic-Signal-Automation-using-Spike-Road-Block..pdf> - 18/07/2021
- R.Prabhu,M. Premalatha “Traffic Control System For Congestion Control,Ambulance Clearance And Stolen Vehicle Detection” - 18/07/2021



### DEFENSE AGAINST DARK HUMANS

**Monik Bhatt**

D.S.R.V International School  
big-10-152-monik@dsvborivali.org

#### Abstract

Till today all things are online, we as general people from banking to shopping a napkin it's all online. So you might ever have a thought that what if someone controlled the whole internet or we can say IoT. The person controlling it would be the richest one. Our personal life has a lot of value and what if someone accesses, probably you would never give out your bank details they often tend to trick you and take out details, and people doing this work we named them as Dark Humans, There are plenty ways how they attack you, and you might be helpless if don't read this

**Keywords:-**Phishing/Pharming, Viruses, Spyware and key-logging software

#### INTRODUCTION

Everyone including me , I also use mobile phone as it helps to store data and so sometime people keeps most important data on phones . The main point is the data in phone is safe , but there are certain threats that the phone can be accessed by someone else this is also know as hacking such as confidential information like bank details can be accessed by someone and withdraw all money . Many time people done do it for money they can eve do it to target you , bank details was only an example . And how to prevent these attacks you will get to know further

#### Theory

##### PHISING

The first attack that is phishing its very common and is executed using email, probably they send legit-looking emails and as the target clicks on it they take you to a website that also looks legit, mark my words look legit but is no and just tells you to fill in details regarding bank or something like an official message from bank but its fraud. This trick may not always work because there are some browsers where this type of message just go to scam so if you know that the user is legit then only open message .One more way to identify it that never open attachments ending from extensions .exe or .bat, .com, .php .If you have opened it then call the cyber cell of you country. This are most relevant ways are this and are stated for many students in their textbooks but official website of cyber cell also states the same ways.



### ✚ PHARMING

The second main issue is regarding this one move of dark humans sending malicious code on preys computer, the code will redirect the user to a fake website similar to phishing. This is similar but more risky as even in this personal information gaining is easy as it would take some seconds. But the thing is defense against this technique may be a bit risky some software's will detect and not allow the malicious code to you. Its actually the fraudulent practice of directing internet users to a bogus website that mimics the appearance of a legitimate one, in order to obtain personal information such as passwords, account numbers, etc. While malicious domain-name resolution can result from compromises in the large numbers of trusted nodes from a name lookup, the most vulnerable points of compromise are near the leaves of the Internet. Pharming attacks are harder to detect than other malicious online activity due to their covert nature, so educating yourself and your employees as to how to identify fraudulent websites, and the steps you can take to protect yourself will go a long way to keeping your business safe. The most effective way to mitigate your risk is by ensuring your employees receive regular, comprehensive training to help them identify online threats, and act accordingly. outdated security software leaves your network vulnerable. Ensure your security software is up to date, and running regular antivirus checks and spyware removal software will add an additional layer of safety. Change the default password on your Wi-Fi router. When a scammer tries to access your computer, the first place they check is the router. If the router still has the default password, your network is vulnerable to attack.

### ✚ Viruses

A computer virus is a type of computer program that, when executed, replicates itself by modifying other computer programs and inserting its own code. If this replication succeeds, the affected areas are then said to be "infected" with a computer virus. Computer viruses generally require a host program the virus writes its own code into the host program. When the program runs, the written virus program is executed first, causing infection and damage. A computer worm does not need a host program, as it is an independent program or code chunk. Therefore, it is not restricted by the host program, but can run independently and actively carry out attack. But there are solutions to all problems, so how can this be solved just by using antiviruses this can be solved. Using antiviruses software will detect the viruses and will not allow any kind of antiviruses, yet if you don't have an idea how to download a antivirus your software is capable.

### ✚ Spyware and key-logging software

Key-loggers or keystroke loggers are software programs or hardware devices that track the activities (keys pressed) of a keyboard. Key-loggers are a form of spyware where users are unaware their actions are being tracked. Keystroke logging, often referred to as keylogging or keyboard capturing, is the action of recording the keys struck on a keyboard, typically covertly, so that a person using the keyboard is unaware that their actions are being monitored. Data can then be retrieved by the person operating the logging program. This is the most vital attack because you might not know when you are being monitored by someone else, and that's quite risky as whatever you type will be visible online. But some methods can be determined such as a good keyboard security



may stop the person who wants to access to your pc, Hence same installing some trusted antiviruses is the best way to prevent.

### Experimental

The problems which we saw were just some of it and it's really hard to think that there are problems such as discussed above, but the things or suggestion which we provided will it work let's see from a professional view. This problems were first faces by some global companies and at that period no one had an idea how to solve so many issues if affect together .But there are some sharp minders who solved the problems by using this ways and led their way out of troubled waters

### RESULT

The things we read and saw were just some way how can you protect you devices from being scammed well scammed is a big term used to compare shortly I would say that the ways that we interpreted are 100% reliable and truth and the basic is to just make you living secure by taking more precautions as the main aim is to protect .But this results are correct well this results are not written by me they are used by big branding companies such as apple aka Mac devices specially. Well there are quite determined ways to protect you devices from being scammed.

### DISCUSSION

The method mentioned above are much accurate such as downloading antiviruses as these point it's the best way of working as downloading antiviruses would not only protect you from 1 problem but from many such as keystroke and viruses and phishing and pharming this are just some examples there may be many more issues that will be cleared when used in a correct way

### CONCLUSION

In the last 20 years that the effect of viruses has been decreased by antiviruses  
In 2000 the viruses were effective 23% and antiviruses softwares used to protect were 75% efficient  
In 2010 the viruses were 79% effective and antiviruses that stop were 87% effective  
In 2020 viruses affecting chances increases to 99% and the safety ensurance increases to 100%  
Yet still the statement cannot be passes that the viruses can be stopped by using antiviruses the things we discuses are ways of protecting people from small and basic computer viruses as there is a new Virus created every day and for every new virus there are antivirus for same. Hence the techinques infromed may not prevent from 100% attacks but it assures that there wont be anything damaged

### Acknowledgements

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- National Cybercrime Training Centre (NCTC) ...
- Cybercrime Ecosystem Management Unit. ...
- National Cyber Crime Research and Innovation Centre



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## REFERENCES

- ❖ Wikipedia
- ❖ Mha.gov.in
- ❖ Fraudwatchinternational.com
- ❖ Us Norton.com
- ❖ Cadia.org



### ROOTING GREEN ROUTES

**Mithas Jain**

Sanjay Ghodawat International School  
[mithas23206@gmail.com](mailto:mithas23206@gmail.com)

#### Abstract

Though the burning woods and coals; boiling water can provide us energy now, these will not be enough then. Today, the requirement of energy has increased and it will continue to increase until we all realize that we are left with no resources to produce energy. So, in order to prevent the extinction of the resources, the scientists and other researchers are pressing to shift to renewable sources of energy. This in turn will benefit us: we can save the non-renewable sources of energy and reduce the global warming, hence saving our Mother Earth.

Communication sector, now being the most important sector, consumes 1 million gallons of diesel per day to power up the whole network and uses<sup>[8]</sup> 2% of the global energy, which is expected to rise by 6% in the near future. Also, a mobile phone network uses 40 – 50 Mega Watt of power per day. The internet or communication sector releases about 4% of carbon dioxide into the environment which, is more than that released by the aviation sector.<sup>[8]</sup>

**Keywords:** *Green network, Li Fi, advancement in technology, smart topology*

#### Introduction:

Green communication aims for sustainability with the minimum utilization of energy so that it cuts down the carbon dioxide emissions and the operational costs. It is an innovative way where it uses algorithms which helps in reducing the energy required for operating the wireless networks. Green communication could be incorporated with the renewable sources of energy like solar, wind, etc. which again will help to reduce the carbon dioxide emissions and the costs in the long run. There are a few categories that the network topologies today could work on: the engineering, adaptation of the smart devices.

#### Categories:

- **Re-engineering:** new energy efficient hardware devices.
- **Dynamic adaptation:** intelligent modulation and rating modulating the capacities of packet processing systems and of the network interfaces.
- **Sleeping/ stand-by:** intelligent networks by introducing smart devices and software.



### Techniques:

Green network is what the world is now aiming for. So, there are a number of techniques where the existing networks can be converted to green ones:

Utilization of:

- **Power amplifiers(adoptive link rates)** can help to boost the signals sent instead of resending it again and again reducing the traffic in the network, hence the energy required.
- **The renewable sources of energy**: can reduce the cost of buying non-renewable sources of energy and also will cut down the CO<sub>2</sub> emissions.
- **Smart topology (energy aware infrastructure)** like making a compact structure of the complete network, agile bases, femto cells (low power cells).
- Operations like: **set level turn off (interface proxing)** (will turn off the system and divert signals when there are less data packets sent or received), **cognitive radio**(it checks for the active route and also changes the route to the empty line when there is a lot of traffic in one line), **OFDMA**: orthogonal frequency – division multiple access (it solves the congestion problems caused by simultaneous access by multiple users by accommodating multiple users at same time by giving each user better internet access, **smart grid**(helps in the efficient, two-way flow transfer and restoration of electricity).
- **Energy aware application**: instead of making the hardware energy efficient, it is software that we make more energy efficient.

All these techniques when combined can help reduce the overall requirement of energy and cost as well.

### Advancement in network technology

As the technology is getting enhanced faster than anything, so is the technology of the network. It started from 2G and is still increasing 3G, 4G and now 5G. So, the technology at each transition of network is more energy efficient, eco-friendly and cost effective. The 5G network can be greener than the 4G network because of its network topology. The wavelength of the frequencies used in 5G are millimeter waves (28 GHz and 39GHz) which, though can be absorbed by the trees and buildings (opaque objects), provides a better internet speed. 5G networks use beamforming where the focused stream of data is sent to a specific user so that the capacity of the outgoing data and incoming signals can be increased and uses the full duplex way of transmission. There are also efforts made to increase the capacity of the nodes by adding multiple input and output devices. The clustering of the sensors, small cells (low power cells which can help to get the signals around an opaque object) and cluster heads can also help to provide an energy efficient mechanism to the network.



### Li Fi (light fidelity) Technology

Internet is the most important thing to survive after Food, Water, Shelter and Clothes. So, in order to make internet available easily and in a cheaper way Prof. Harald Hass introduced Li Fi on TED, on July 2011. Li Fi is a technology that can transfer data packets using the visible, artificial lights: light communication. So, basically, the light sources in Li Fi continuously flickers (this flickering of light is so fast (>million times per second) that is in not visible to our naked eyes), which later forms the algorithms of 0s and 1s to transmit data. Moreover, we can both download and upload data through this flickering.

Li Fi, though requires a special type of light technology, it can be used as a normal visible light and hence it saves the energy and power cost of putting an extra light source. Also, as Li Fi is a normal LED lights it can last for a longer time, moreover, it would not be harmful for the environment and the technology relatively consumes less energy as compared to the traditional Wi Fi systems. Also, as the Li Fi is mainly built indoors it is more secure. The overhead network in the houses and offices; the smart signal conditioning, provide a better internet speed which reaches approximately 100 GPs. Although, the speed and security of Li Fi is really good, it is only good for a short range.

But, if the Li Fi technology is implemented in all the closed areas, then it could be a potential way of saving a lot of energy. Though, it may be a little costly initially, but it could save costs of energy and pollution caused.

### References [10]

1. <https://www.sciencedirect.com/topics/computer-science/green-communication>
2. <https://www.ijert.org/research/a-review-on-green-communications-IJERTCONV6IS13053.pdf>
3. <https://www.hindawi.com/journals/wcmc/2018/1921353/>
4. <https://www.hindawi.com/journals/misy/2016/8719763/>
5. <https://purelifi.com/technology/#:~:text=LiFi%20signals%20can%20be%20defined,hospitals%2C%20power%20plants%20and%20aeroplanes.>
6. <https://lifi.co/news/lifi-good-for-environment/>
7. <https://www.livemint.com/Opinion/tFei3PUmaFtGO3T2hDSciN/LiFi-A-green-avatar-of-WiFi.html>
8. <https://dig.watch/trends/digital-and-environment>
9. [https://www.researchgate.net/publication/293645271\\_Green\\_Cell\\_Planning\\_and\\_Deployment\\_for\\_Small\\_Cell\\_Networks\\_in\\_Smart\\_Cities](https://www.researchgate.net/publication/293645271_Green_Cell_Planning_and_Deployment_for_Small_Cell_Networks_in_Smart_Cities)
10. <https://www.electronicdesign.com/power-management/article/21800637/lifi-receiver-optimization-program-comes-to-light>



### CYBER PSYCHOKINESIS

**Anuja kokate (10A IGCSE)**

Sanjay Ghodawat International School, Atigre

Email ID- nuja9906@gmail.com

#### Abstract

Nowadays, the most rudimentary option to spy used is drones, it carries its own features which attracts many to use it for espionage but few techies are too. This demand for more grows due to its multi-purpose application, it literally provides bird -eye to watch anything or hear too for far distance accessible almost anywhere and any time. Although, ascendancy carried its own vulnerabilities too. For years, malicious use of drones among criminals and technocrats alike. The probability and frequency is highly devastating so we need specific counter measures to be taken beforehand or during one attack or even after to restrain more noxious effects on the system. This paper aims to highlight possible attacks, emerging threats, and countermeasures too. Moreover, this paper will emphasize the use of unmanned aerial vehicles in various domains (ex. Military, medical, terrorism etc.) and critically focus on association with the cyber world. On an experimental approach an adequate important citation is maintained to make readers aware of vulnerabilities of UAV in various domains and come up with enhanced techniques to detect and prevent one. As a result, various antidotes can be reviewed.

**Keywords:-** Cyber threat, Security, Drones, Malicious activities, Domains and many more.

#### Introduction:-

##### I. Use and vulnerabilities

The reliance of drones is increasing globally due its various hallmarks like live streaming, image capture and real time video experience, along with its capability to fly and transport goods. The prediction of size expansion to USD 11,295.1 million by 2028 while exhibiting a CAGR (Rate) of 25.39% between 2021 and 2028 [1] is very possible. This is mainly due its compatibility over commercial helicopters for price and size. These are identified as vulnerable to cyber-attacks because of their uniqueness of network and dispersed physical systems. Attacks which can result in the defective operation of the control loop, denial of service, demolition and exfiltration, and information. Drones aren't limited to civilian domains only but even used by law enforcement agencies and border surveillance proposes for intelligence. In this modern atomic world, drone technology is mainly used for military purposes and defensive areas. Its usage is rapidly growing



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for defense purposes. These microdevices are flying in the air 200 feet above the ground. This range of height varies from device to device and purpose to purpose. This range can be in Meters, kilometers and Feet. Flight time of these intelligent devices also varies from device to device.

PARAMETERS	2GHz	5Ghz
Frequency band	Low speed	High Speed
Cost	Cheaper	Expenditure
Range	Extended range	Undersized range
Noise effects	Very much noisy	Slighter Noise
Interference	Prone to interference	Less prone to interference
Physical barriers	Overcomes physical barriers	Incapability to over physical barriers
Performances	Disturb Wi-Fi speed	Don't disturb Wi-Fi speed

[2][3]

### A. Effective rules and regulations

Many countries have tried to optimum to have strict rules for UVA usage for civilian purposes. For instance, in the USA a verified certification is essential for citizens of the country.

- One must be able to read, speak, write, and understand English (exceptions may be made if the person is unable to meet one of these requirements for a medical reason, such as hearing impairment).
- One must be in a physical and mental condition to safely operate a small UAS.
- 16 years age is minimum requirement
- One must pass an Aeronautical Knowledge Test—also known as the Part 107 test—at an FAA-approved knowledge testing center.
- One must undergo Transportation Safety Administration (TSA) security screening. [4]

Whereas, foreigners or special travel considerations have different sets of rules.

- Whether you plan to fly for fun or for work, you must register your drone with the FAA using the **FAADroneZone portal**.



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- If you plan to fly your drone for recreation in the U.S., you must take The Recreational UAS Safety Test (TRUST) required by the FAA.
- If you desire to fly for work, you must obtain a certification from the FAA and follow the rules for commercial flying.
- When traveling domestically in the U.S. with your drone, the U.S. Transportation Security Administration (TSA) allows the carrying of drones in carry- on luggage only. You may not pack your drone in checked luggage. [4]

Such rules are strictly expected to be followed by drone owners for safe drone flights. Heavy fines and punishments can be faced by the owners of the drone if such rules are violated.

### B. Structural features of modern drones

A typical unmanned aerial vehicle is made of light composite materials to reduce mass and increase maneuverability. This composite material strength makes itself useful for military purposes at extremely high altitudes.

- UAV drones are equipped with different state of the art technology such as infrared cameras, GPS and lasers (consumer, commercial and military UAV). Drones are controlled by remote on ground called ground control systems (GSC) and also called as ground cockpit.
- An unmanned aerial vehicle system mainly has two parts, its own system and the control system.
- Sensors and navigational system are present in noisy parts of these air vehicles
- The rest of the body is full of drone technology systems since there is no space required to accommodate humans.
- highly complex composites are used to design to absorb vibration, which decreases the sound produced. These materials are very light weight.
- Few high tech drones follow various sensors making them really useful. For instance, Vision Sensor, Ultrasonic, Infrared, Lidar, Time of Flight (ToF), Monocular Vision [5]

### C. Drone Communication Categorisation

- **Drone-to-drone:** Drone to Drone communication is not yet legalized. In wireless environment machine learning can be used as mode of communication. This is also known as peer-to-peer communication. Such communication is more prone to jamming and DoS attacks.
- **Drone-to-ground location:** This type of communication is mainly standardized specific protocols with 2 GHz and 5 GHz frequencies. It can also be operated via Bluetooth and Wi-Fi. Due security and authentication issues these kinds of communication modes can't be used in public areas. Such communication is more prone to eavesdropping and man-in-the-middle attacks as shown in Fig. 1.
- **Drone-to-network:** Such communication allows network selection for control and transfer of information. Several Wi-Fi networks can be used at different frequencies in such communication.
- **Drone-to-satellite:** GPS devices are involved to provide real-time communication in such types of drone communication. Drone communicates with the satellites for

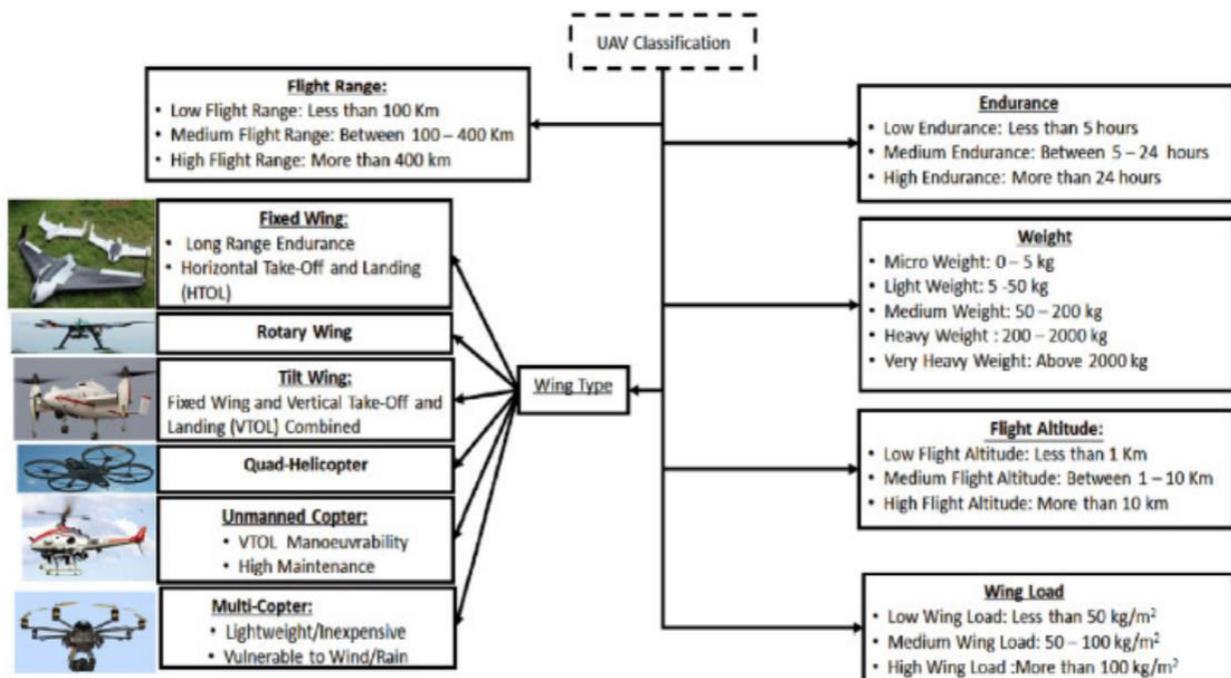
latitudinal and longitudinal measurements. This communication is more secure and safe as compared to other categories and is used in the military. [6]



### D. Types of Unmanned Aerial Vehicles

- 1) **Single-Rotor drones** Helicopters are very popular in manned aviation, but currently only fill a small niche in the drone world.
- 2) **Multi-Rotor drones** UAVs that use more than two rotors with fixed-pitch spinning blades that generate lift. ... By varying the speeds of particular rotors, it is also possible to make the drone turn or move in a various direction. One of the biggest ascendancy of this kind of aircraft is their manoeuvrability compared to fixed-wing aircraft. This enables them to fly in areas other drones can't reach, hover in a stationary position and provide vertical take-off and landing (VTOL) ability.
- 3) **Fixed-Wing drones** These usually carry heavier payloads for longer distances and flight times than VTOL (Vertical Take-off and Landing) UAVs, while using less power. This makes them functional for long distance missions, such as mapping, surveillance and defense, where long endurance can be an important factor.
- 4) **Micro Drones** are efficiently monitor the progress and track volumes and stockpiles, and can create real-time project overviews for better planning, safety and collaboration. Job tracking even reduces labor and materials waste for construction companies. These are even used in detecting gas leakages in methane pipelines specially.

5) **Racing Drones** Recently they added the Pro Class racing drone, which is currently the largest competitive drone racing format in the world. Racing drones are designed for speed and agility, as opposed to a photography/video drone which is focused more on hovering. [7][8][9][10][11][12]



## II. Drone security and Secrecy Apprehensions

Drone technology is always proven advantageous for surveillance needs. Security and privacy breaches are also addressed properly. Recording and capturing individuals without their consent can be proven illegal as privacy is hammered.

It is highly recommended to maintain secrecy, reliability, obtainability, verification and non-denial possessions above message passing in network range. This can be achieved through AAA procedures and progressions:

1. Authorization can be achieved by providing access to the control unit of the drone/UAV.
2. Verification can be obtained by using multi-level authentication using specific knowledge

Security threats to drones are not necessarily to be physical but cyber attacks are highly welcomed too. It's highly important to minimize civilian drone use only for military and

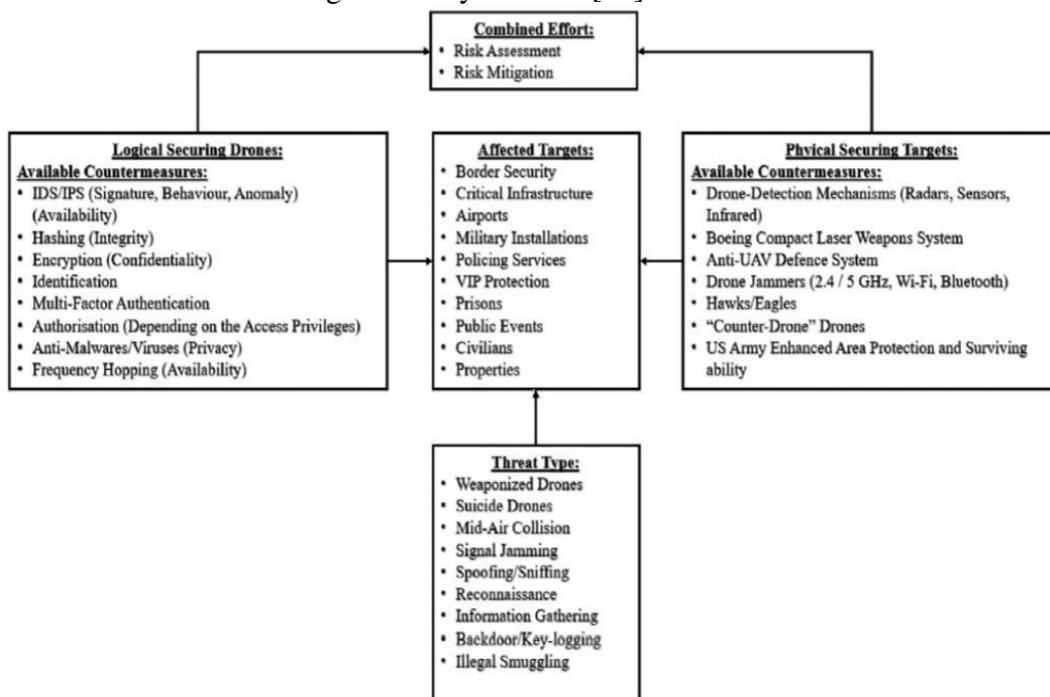
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surveillance purposes drone certification should be permitted. Drone owners use bluetooth or Wi- Fi to control drones in restricted areas, these kinds of breaches give techies a chance to hold control over drones and other electronic devices connected to the network. [13]

### A. Safety apprehensions

A drone is very tiny, lightweight, and has high mobility characteristics. It can be used to monitor criminal activities which are done at a high level of privacy. Such acts can create damage to civilians. Several terrorist groups can associate armed objects with a drone to perform their illegal activities. Security doesn't constantly deliver protection. There are chances of damage done by the civilians in civilian areas which can result in financial loss [14]. The following list follows some safety concerns in brief.

1. Minimum safety features in architecture can lead to control drone usage. This can result in damage and loss [15].
2. Minimum mechanical and operative ethics include smashing avoidance techniques which can lead to drone's incapability to identify airliners [16].
3. Absence of Administrative knowledge: especially it mainly occurs when people have less knowledge of safety features [17].



### B. Confidentiality apprehensions

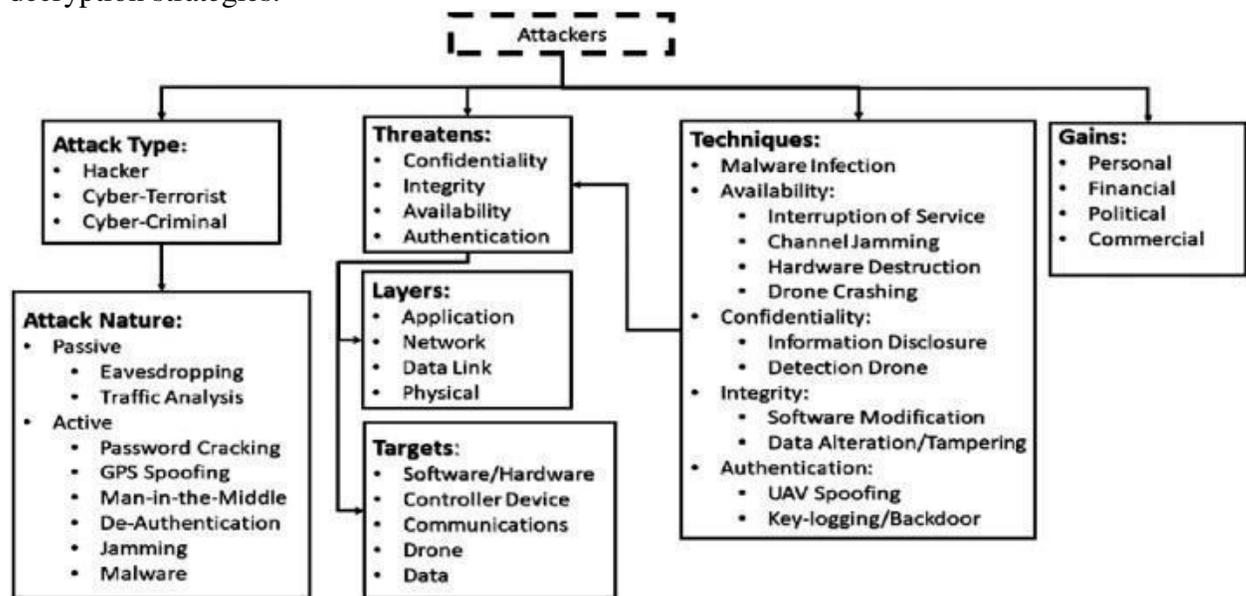
Privacy is also the main factor to be considered by or for people. Drones must be kept out of those areas which are private. One must know the level of privacy of people before capturing or entering a private legacy. Three types of privacy threats are discussed below.

- Flying drones over someone's property is considered a major issue because of the risks associated with this act. Because such data can be used by scammers for negative purposes.
- Monitoring somebody's location must be avoided without their permission [18].

- Monitoring someone's acts and doings is also another unethical act which is also a matter of concern [19].

### III. Security threats to drones

Drone vulnerabilities differ according to its size, use and controlling mechanism. The typical designs of drones using the communication network are Wi-Fi networks with ground stations. These networks are vulnerable to security breaches. Moreover, due to improper chip encryption most pro drones are vulnerable to get hijacked. The bottleneck so far emerged was that with no encryption drones may be hijacked by individuals. The concept of IoD is highly fancied yearly millions are attracted to buy advanced drones connected to the internet but these drones are not designed with security mechanisms in mind. Few of the major issues are security and privacy leakages in IoD domains, data confidentiality, data protection, data flexibility, data accessibility, and data encryption and decryption strategies.



### IV. Relative counter measures

- Updating drone's firmware regularly**-There is always a security threat emerging when new drones are established, so regular updating can keep your drone ahead of the hackers.
- Use a strong password** for your base station application. Using a mix of characters, numbers and special signs to create a very strong passcode which might deter hackers; most can give up and go after easier prey. This should help avoid a malefactor hacking the drone signal.
- If you're using a smartphone or laptop as your controller**- Secure it and don't let malware infect the system. Use anti-virus software, and prevent downloading dodgy programs or apps.
- Subscribe to a Virtual Private Network (VPN)** from stopping hackers from accessing your communications connected to the network. VPN can act as a secure gateway to the internet and encrypts your connection, so a hacker can't get in.



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- E. Set a limit-** Firmly number the devices to be connected to the base station, so that less vulnerabilities have occurred.
- F. Ensuring drones have a "Return to Home" (RTH) mode.** Once home point is set, it will enable the drone to return if it loses signal, if signal is jammed, or if the battery is depleted. This will make it easier to recover a drone from a hijack situation. However, because RTH depends on GPS to work, it's not immune to GPS spoofing.[20]

Above are preventive measures but if a surveillance drone is already bombarded by an attack detection can also follow methods.

- Radar is one of the useful methods used for detection, but completely not reliable; for instance, it can mistake birds for drones. Acoustic sensors can also be better way to detect unwanted drones, since they can be programmed to recognize the sound signatures of a particular type of drone.
- By using electromagnetic spectrum RF scanners can spot rones in open skies by recognizing drone transmissions. But GPS drones and non radio drones for navigation are completely impossible to find by this way.
- Finally, thermal imaging is also an effective method.Using thermal footprints electronics objects can be detected. However, there's a high rate of false positives too.[20]

### V. Future

The (FAA) Federal Aviation Administration believes drones are expected to have a better market for commercial purposes than hobbtical ones. Drones could soon be reliable for deliveries, support surveying and mapping services, monitor crops, and be used for building up safety inspections too.

Given the possibilities, there will certainly be more drones around in air and will create a bigger drone security threat.

It may not yet be clear how drones can be proven functional to improve their security, but businesses will have to do so before commercial drone use becomes widespread. So, it's important that drone security issues are properly addressed by drone manufacturers or even owners too, and that you lock down your internet and home network to be safe from the menace of drone hacking.[20]

### References [20]

1. <https://www.globenewswire.com/news-release/2021/06/14/2246684/0/en/Commercial-Drone-Market-Size-to-Reach-USD-11-295-1-Million-by-2028-Stoked-by-Growing-Demand-for-Drones-across-Several-Applications-Says-Fortune-Business-Insights.html>
2. E. Biddlecombe, "UN predicts 'internet of things'," July 6, 2009.
3. D. Butler, "2020 computing: Everything, everywhere," Nature, vol. 440, no. 7083, pp. 402-409, 2006.
4. <https://uavcoach.com/drone-laws-in-united-states-of-america/>
5. [dronezon.com/learn-about-drones-quadcopters/what-is-drone-technology-or-how-does-drone-technology-work/](https://dronezon.com/learn-about-drones-quadcopters/what-is-drone-technology-or-how-does-drone-technology-work/)
6. [https://thesai.org/Downloads/Volume12No5/Paper\\_84-Drone\\_Security\\_Issues\\_and\\_Challenges.pdf](https://thesai.org/Downloads/Volume12No5/Paper_84-Drone_Security_Issues_and_Challenges.pdf)
7. <https://aerocorner.com/blog/types-of-drones/>



8. <https://www.unmannedsystemstechnology.com/category/supplier-directory/platforms/multirotor-drones/>
9. <https://coptrz.com/fixed-wing-vs-multirotor-drones-for-surveying/>
10. <https://www.auav.com.au/articles/drone-types/#:~:text=Single%2DRotor%20Helicopter&text=Helicopters%20are%20very%20popular%20in,motor%20for%20even%20longer%20endurance.>
11. <https://www.unmannedsystemstechnology.com/category/supplier-directory/platforms/fixed-wing-uav/>
12. <https://www.microdrones.com/en/content/10-ways-microdrones-systems-are-being-used-for-business/#:~:text=Drones%20can%20efficiently%20monitor%20progress,materials%20waste%20for%20construction%20companies.>
13. [https://thesai.org/Downloads/Volume12No5/Paper\\_84-Drone\\_Security\\_Issues\\_and\\_Challenges.pdf](https://thesai.org/Downloads/Volume12No5/Paper_84-Drone_Security_Issues_and_Challenges.pdf)
14. R.L. Finn and D. Wright, “Unmanned aircraft systems: surveillance, ethics and privacy in civil applications”, *Comput. Law Secur.*, vol. 28, no. 2, pp. 184–194, 2012.
15. H. Du and M.A. Heldeweg, “Responsible design of drones and drone services: Legal perspective synthetic report”, 2017.
16. K. Wackwitz and H. Boedecker, “Safety risk assessment for UAV operation, Drone Industry Insights”, Safe Airspace Integration Project, Part One, Hamburg, Germany, 2015.
17. E.B. Carr, “Unmanned aerial vehicles: examining the safety, security, privacy and regulatory issues of integration into us airspace”, *Natl. Centre Policy Anal. (NCPA)*, 2014.
18. R.L. Finn, D. Wright and M. Friedewald, “Seven types of privacy”, *European data protection: coming of age*, Springer, 2013.
19. R. Clarke, “The regulation of civilian drones’ impacts on behavioural privacy”, *Comput. Law Secur. Rev.*, vol. 30, no. 3, pp. 286–305, 2014.
20. <https://www.kaspersky.co.in/resource-center/threats/can-drones-be-hacked>



### GREEN COMMUNICATION

**M. Sai Sannihit Kumar**

Sanjay Ghodawat International School, Atigre  
Sannihit2008@gmail.com

#### Abstract

The foremost objective of this paper is elaborating term Green Communication and its impacts. This research provides the reader with recent advancements in Green Communication and Technology. Recent years, portable technology is involved in exploitation of resources which has triggered the need of innovative and sustainable technology. This paper expands about various protocols to improve the standard of energy efficient generation of networking and manifests overall analysis of distribution, expansion, concept of green communication and networking.

Keywords:- *Green Technology, Resources, communication, energy efficiency, sustainable, environment.*

#### Introduction

“Green Communication” often referred as “Green Technology” or “Sustainable Technology”, aims chiefly addressing about sustainability, energy consumption. Green technology has led to an ecological generation of networking peripherals and systems. It gave rise to innovative solutions for present technical adversities, has enabled vast array of methods to maintain sustainability as well as communication abilities. They create direct as well as indirect impact on the environment.

Today, the world is facing an extremely potential threats such as increase in Carbon and Energy Footprints and the major contributor is telecommunication sector. In accordance to experts, this level of emission and usage will increase unless a better variant of technology is initiated. It has been noted that- presently ICT's share of Global contribution to carbon emission is 3.7 %. and usage of power over few years has risen about 6% i.e: (11% according to recent census). For the use of potential knowledge in this paper, reader should have hold of fundamentals of ICT, Networking, Environmental Studies.

#### Theory

On 2017 November 22-23, The First Regional Conference on Sustainable Industrial Development: Promoting Sustainable Energy consumption and **Clean Technologies** in Vienna International Center (VIC) organized by United Nations Industrial Development Organization

(UNIDO) discussing effective ways to overcome real time problems. One of the effective ways to improve the standard of environmental footprint is through implementation of “Circular Economy”-Which refers to less energy use will lead to reduced material losses, reduce solid waste and a decline of water footprint. This will not only aid the environment but help us also improve our production capacities and affordability.

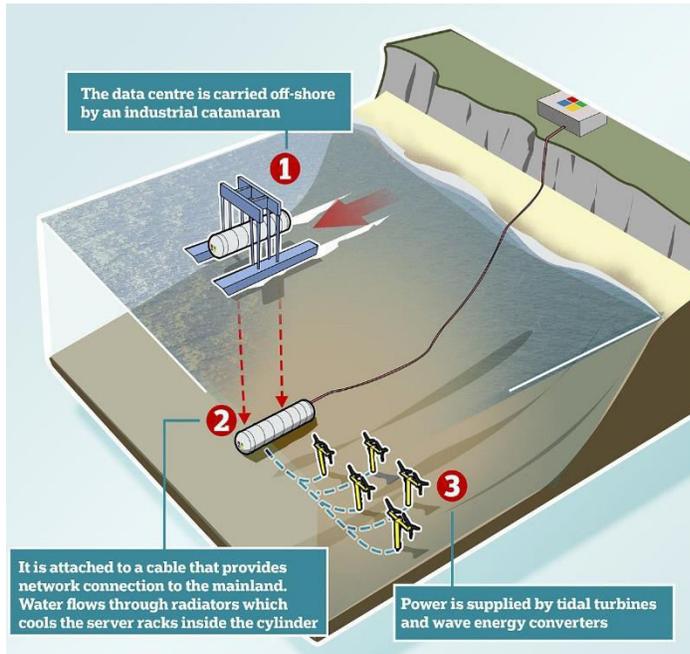
### Experimental

The need for the most energy and time efficient data centers is crucial move for branch in telecommunications. So, Microsoft has just reached end of two years stage 2 experiment- Sinking their data to the ocean floor. On 9<sup>th</sup> July 2020 Microsoft has reeled up what’s called “**Northern Isles**”. This experiment involves usage of 12.2 m long steel cylinder in which lies the Data servers collecting and transmitting data as usual filled with dry nitrogen, it has started similar long-term experiment 10 miles off the coast of Scotland in the Orkney Isles, Archipelago.



### Result

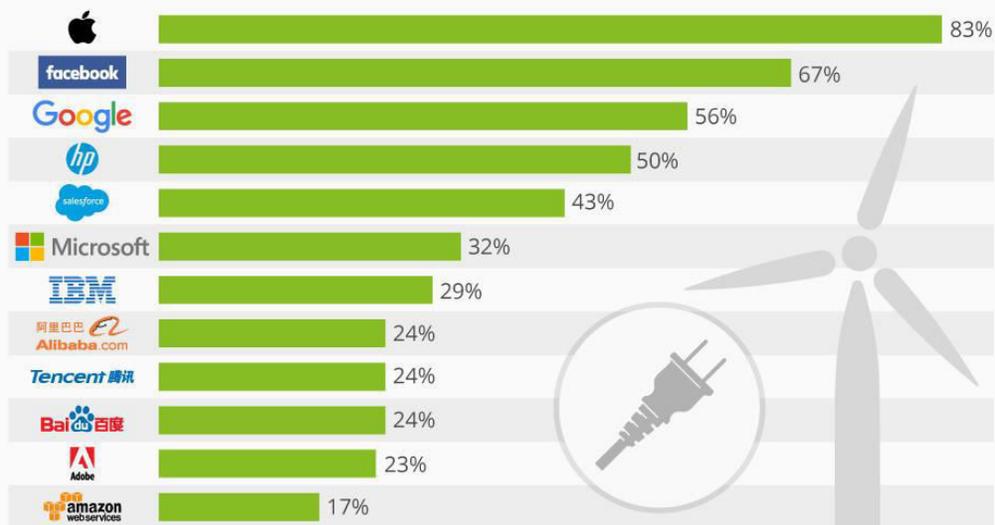
During the following experiment Although handful servers went offline, Microsoft’s energy footprint and maintenance regarding the sunk data center’s fell to This due to convectional heat transfer from the water surrounding the steel cylinder when compared on land data centers consumes high energy to keep it on peak performance as well as the tidal turbines powers up these cylinders. And their study proved it to be eight times more efficient over the land-based data centers there were not many adversities faced by the data centers underneath were able to transmit data up to 27 petabytes per second.



### Discussion

#### GreenTech: The Top Companies

Percentage of renewable energy in the power supply





This chart manifests the percentage of renewable energy in the power supply of leading tech companies. Where Apple, Facebook, Google with 83%, 67% and 56% respectively stand in top 3 positions.

As part of its obligation to combat against climate change and create a sustainable environment, Apple today announced its global facilities are powered with 100% clean energy. This includes retail stores, offices, data centers and co-located facilities in 43 countries including the United States of America, the United Kingdom and India. The company also proclaimed nine additional manufacturing partners have committed to power all of their Apple production processes with 100 percent Renewable energy, bringing the total number of supplier commitments up to 23. As mentioned, Renewable projects initiated by Microsoft, it also invested on its several solar energy project in Ireland as well as experimenting various solutions for electricity sustainability such as for backup power at datacenters it started to experiment on tests hydrogen fuel cells. Therefore, Motivating other Telecom establishments for sustainable future.

### Conclusion

This paper presents an overview of energy consumption adversities in green communication networks and describes energy saving techniques. It is identified that high energy consumption is the common problem. Green communication describes the techniques that have been used to improve the energy efficiency in branches of telecommunication. The study on green communication delivers an insight to a brief summary of enhancements that have occurred.

### References

1. 1.Volume 6, Issue 13, (2018), International Journal of Engineering Research & Technology (IJERT), Vinay M Assistant Professor Dept. of Computer Science, SBRR Mahajana FGC, Mysuru.
2. <https://www.bbc.com/news/technology-44368813>
3. Green Communication: An Emerging Telecommunication Technology-Its Research Challenges, Techniques and Applications, Dr. Padmavathy, Vishnu Institute of Technology.
4. <https://youtu.be/XNcG5XSpAr4> (UNIDO) United Nations Industrial Development Organization.
5. [www.rfglobalnet.com/doc/energy-efficiency-in-the-telecommunications-network](http://www.rfglobalnet.com/doc/energy-efficiency-in-the-telecommunications-network)
6. [www.apple.com/in/newsroom](http://www.apple.com/in/newsroom)
7. <https://news.microsoft.com/innovation-stories/microsoft-sse-ireland-solar-energy>



### DATA SCIENCE TECHNIQUES FOR HANDLING EPIDEMIC AND PANDEMIC

**Vishwajeet Vishal Chavan**

Sanjay Ghodawat International School,  
Atigre, Kolhapur, Maharashtra  
[vishwajeet.chavan119@gmail.com](mailto:vishwajeet.chavan119@gmail.com)

#### Abstract

My main objective was to find out new ways to deal with pandemics and epidemics using Data Science techniques. Data science helps us to find hidden insights or patterns from raw data which can be of major use in formation of big decisions. The techniques which I have developed can be used very efficiently for the precaution of the pandemics and epidemics.

**Keywords:-** *Data Science, Aarogya Setu App. What Kind of Information do we need?, How to collect this Information?, Output of this Information, Features of the App, Profit of the App*

#### INTRODUCTION

During a Pandemic or Epidemic, the main problem that the government faces is lack of information. To get this information, there is a clever technique called DATA SCIENCE. We all know that precaution is better than care, so we should always try to be precautious of a pandemic or epidemic rather than taking care afterwards. To take this precaution, we need to know the symptoms of a disease, the steps to take for avoiding the disease, the medication required, people who are affected or are in danger of the disease, etc. but what if this all was presented in a app in our Smartphone.....

#### THEORY

During the first wave of covid-19 pandemic in India, the Indian government released an app named “Aarogya Setu” which tracks the people for their travel history and contact with covid-19 contaminated people. This partially helped to solve the problem of the lack of information. But we need a more detailed collection of the information which should be updated frequently.

#### WHAT KIND OF INFORMATION DO WE NEED?

1. General Information:- Information about the person which is includes-name, height, weight, blood group, age, etc.
2. Contact details:- Contact details will be required for the contact between the government an the users.
3. Location:- The Location of the users will be required to track them for warning them.
4. Medical History:-Medical history of the person for better understanding of the disease patterns and hidden insights.



### HOW TO COLLECT THIS INFORMATION?

This information can be collected by creating an application for the Smart phones. As everyone nowadays has it and have a frequent usage of this device, we can create the app for this so it will be easier to collect latest information as early as possible.

### WHAT WILL BE THE OUTPUT OF THIS?

With this information we can create and bigger app which could solve many problems.

### FEATURES OF THE APP:-

- Travel History Checking: - With the location setting on the user's phone on, we can track their travel history. This will be used to inform them if they have come in contact with a disease contaminated person or have visited a area where the contamination of that disease is more.
- Health Suggestions :- If the disease outbreaks on a large scale like a pandemic or epidemic, then normal cases of cough or cold are often looked upon suspiciously. If this list of diseases and their symptoms can be uploaded on Artificial Intelligence [A.I], the program can tell the possible list of diseases and guide the user about it .
- Doctors Information: - In case of an emergency, we can see the doctors available near us and their qualifications and speciality.
- Medication Reminder :-if there are some medications to take, the app will remind you about this
- Danger Level Intimation: - If a pandemic or Epidemic occurs then there are few regions that will have more danger than others. Via this application we can gather the data and show real time danger level.

### RESULTS

- Decreased work for doctors in the pandemic or epidemic
- Awareness of the contamination in the people
- Ease in tracking possible future cases in the problem
- Early realization of diseases leading to better treatment options.
- End of the situation of "Lack of Information"
- No delay in medication among people

### DISCUSSION

Due to the introduction of this app based on the principles of data science, the workload of doctors in the pandemic can decrease as the normal cases will go down and they can focus on the pandemic or epidemic cases. This introduction of this app can also lead to awareness among the people about the concentration gradient of the disease cases so they can avoid going to those regions. Due to the location feature, we can track the travel history of a patient and contact those that they have met. This will help in controlling the number of patients. The early realization that will come due to the medical assistant feature can lead to better treatment. As the app collects information, there will no longer be a "lack of information" case. Also the extra feature of medication reminder will help the people to not miss the medication and take their doses on time.



### CONCLUSION

It can be concluded that this app will be a lot beneficial as it will be easier for data scientists to collect the information for tackling the pandemic. This app will even help people in their everyday life regarding their medication. This research can be further made more profitable if the researcher could consult a person with the field of programming and try to make a small scale copy of this idea to check its drawbacks.

### ACKNOWLEDGEMENT

This work was supported by Sanjay Ghodawat International School, Atigre, Kolhapur, Maharashtra. I thank Mr. Indrajeet Thorat Sir and Mrs. Deepa Mane ma'am for their guidance. I would like to thank Mr. Vaibhav Bhalerao for his words of wisdom.

### REFERENCES

- Dhar .V and Jeff Leek “Data Science” en.wikipedia.org  
[https://en.wikipedia.org/wiki/Data\\_science](https://en.wikipedia.org/wiki/Data_science) (accessed 17 July, 2021)
- “Aarogya Setu Mobile App” [www.mygov.in](http://www.mygov.in)  
<https://www.mygov.in/aarogya-Setu-app/> (accessed 17 July, 2021)

### ENERGY HARVESTING AND TRANSFER: REVIEW

**Chaitanya A Padhye**

Trinity International School, Mumbai  
pes.trinityis@gmail.com

#### Abstract

Green communication focuses on investigating and exploring different ways to increase energy efficiency in communication. Energy consumption is ever increasing. And with time it will increase even more. This paper aims to explore various methods of electrical energy harvesting and its transfer. And to study the works done by other researchers in this field. We will also have a look at the results of a personal survey. And finally observe the conclusion.

**Keywords:** *Energy, energy transfer, energy harvesting, electricity distribution, wireless power transfer*

#### INTRODUCTION

Electricity has become an inseparable part of people's daily lives. The rising global energy consumption has increased our dependency on fossil fuels as a source for energy generation. Hence, there is a need to shift to renewable sources like water, wind, sunlight etc.

In this regard, energy harvesters have become an efficient and green alternative for gathering energy from the environment. Energy harvesting systems can obtain energy from sources available in industrial or other environments such as mechanical vibration, temperature gradients, natural or artificial light, elevated levels of noise, pipes with air or water.[3]

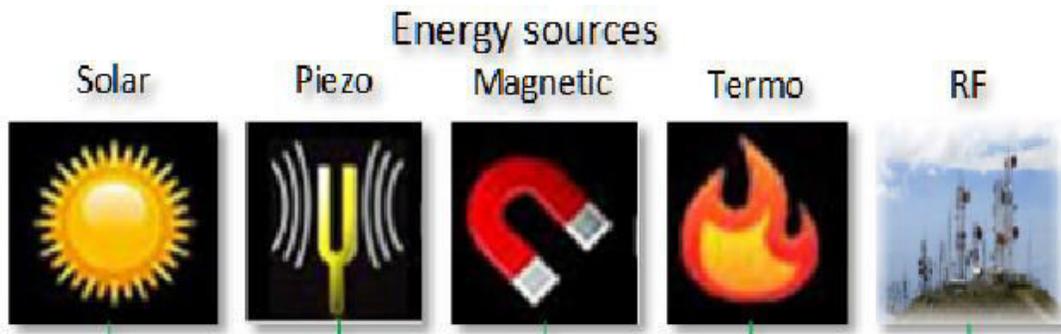
This research work organizes and analyses the different energy harvester technologies and energy transfer method and also provide some application examples.

#### ENERGY HARVESTING OVERVIEW

Harvesting methods and applications

In most of the cases, energy is wasted in the form of heat. Energy harvesting devices capture energy from various sources and convert it to electricity.

Fig. 1 Different sources of energy



(Image credit: [www.semanticscholar.org](http://www.semanticscholar.org))

Large solar panels and wind generators are the most efficient energy harvesters. They are fast becoming the next alternative source of energy.

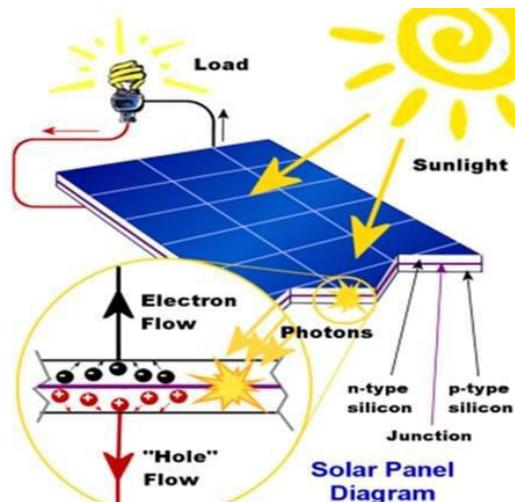
Many forms of energy harvesting technologies are used currently. Some of the common energy sources are light, heat, vibration and RF.

### Solar technologies

Photovoltaic (PV) or solar cells use light energy to convert into electricity. Of all the various energy harvesting devices, photovoltaic cells have the highest power output.

Solar cells are commonly found in consumer and industrial applications. Watches, calculators, portable power supplies, toys and satellites are some of the examples. Solar cells are also used to charge batteries.

Fig. 2 Solar energy module



(Image credit: [www.semanticscholar.org](http://www.semanticscholar.org))

### Thermoelectric technologies

Thermoelectric technology converts thermal energy into electric. These harvesters are useful in environments with temperature gradients. The temperature gradient between the material terminals provides the potential for efficient energy conversion, while heat flow provides the power [3]. Thermoelectric devices, have limited capability, and cannot provide more energy even in case of higher amount of heat flow, because of low material efficiencies.

Thermoelectric harvesters are without any moving parts and are silent, reliable, scalable and easy to install.

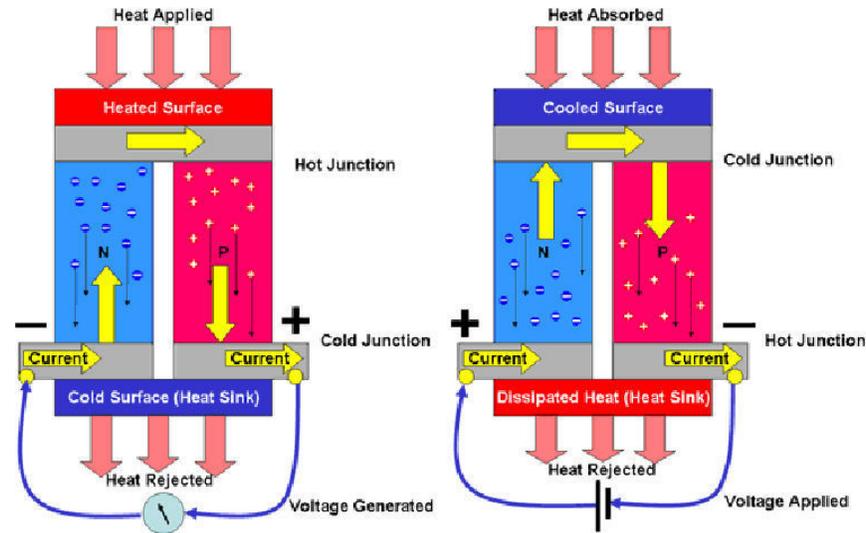
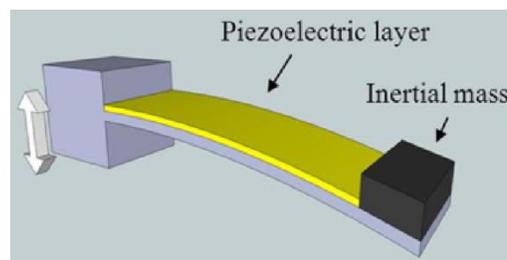


Fig. 3 Thermoelectric harvester  
(Image credit: [www.semanticscholar.org](http://www.semanticscholar.org))

### Piezoelectric technologies

The piezoelectric effect converts kinetic energy in the form of vibrations or shocks into electrical energy. Piezoelectric harvesters are useful in converting normally wasted vibration energy in the environment to usable electrical energy. They are ideal in applications like charging a battery, super capacitor, or directly powering remote sensor systems.

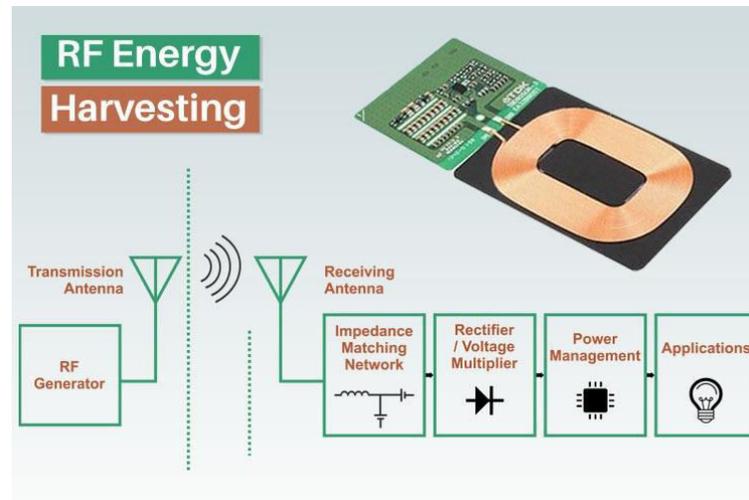
Fig. 4 Piezoelectric harvester  
(Image credit: [www.researchgate.net](http://www.researchgate.net))



Radio frequency - RF

Radio frequency (RF) harvesters obtain energy from RF and wireless microwave power. The background RF radiation emitted by broadcast transmitters, cell phone towers, Wi-Fi nets or low power wireless networks, are good sources of energy harvesting.

Fig. 5 Radio frequency energy harvester



(Image credit: [www.iotdesignpro.com](http://www.iotdesignpro.com))

The harvested power depends on the incident power density, the distance between the transmitter and receiver, the power conversion efficiency and the harvester antenna dimension. Thus, the intercepted power directly depends on the size of the antenna aperture.

### ENERGY TRANSFER

Electricity is distributed to the homes in the following way:

- 1) Electricity is made at a generating station by huge generators. Wind, coal, natural gas, or water are used as source of energy.
- 2) The current is passed on to transformers that increase the voltage to push the power to long distances.
- 3) The electrical charge travels through high-voltage transmission lines that are installed all across the country.
- 4) Inside a substation, the voltage is lowered so it can be transferred through smaller power lines.
- 5) It travels through distribution lines to the local neighborhood. Smaller transformers reduce the voltage again to make the power safe to use in homes.
- 6) It connects to the house and passes through a meter that measures how much the family uses.
- 7) The electricity goes to the service panel in a basement or garage, where breakers or fuses protect the wires inside the house from being overloaded.
- 8) The electricity travels through wires inside the walls to the outlets and switches all over the house.

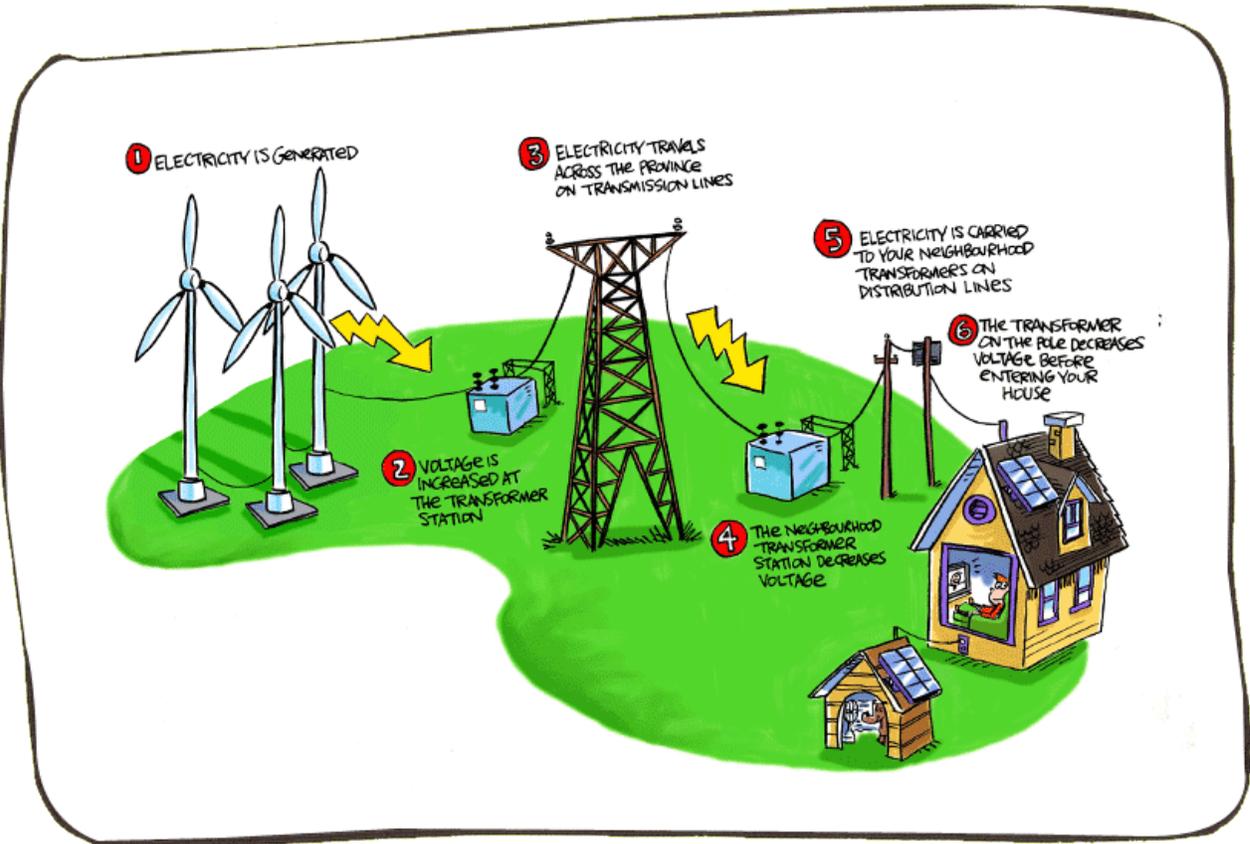


Fig. 6 Transfer of electricity to our homes  
(Image credit: [www.thinglink.com](http://www.thinglink.com))

### Wireless power transfer

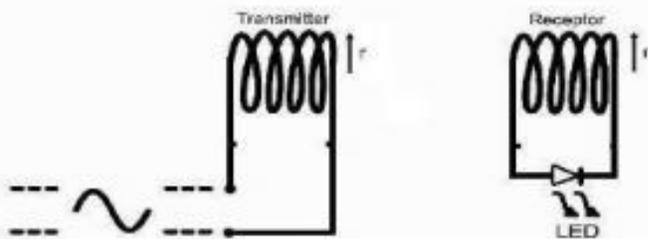


Fig. 7 Basic Concept of WPT  
(Image credit: [www.irjet.net](http://www.irjet.net))

Wireless power transfer has been present for a long time, the most common method of wireless transfer being inductive coupling, invented by Nikola Tesla more than a century. It has many applications[1], including:

- 1) Charging mobile and wearable devices - Some mobile devices, like smart phones, wearables and electric toothbrushes have a charging pad or bench on which the devices are placed.
- 2) Charging and operating devices and implants in the medical field - Wireless power transfer, especially with high power, allows convenient continual charging and operation of under the



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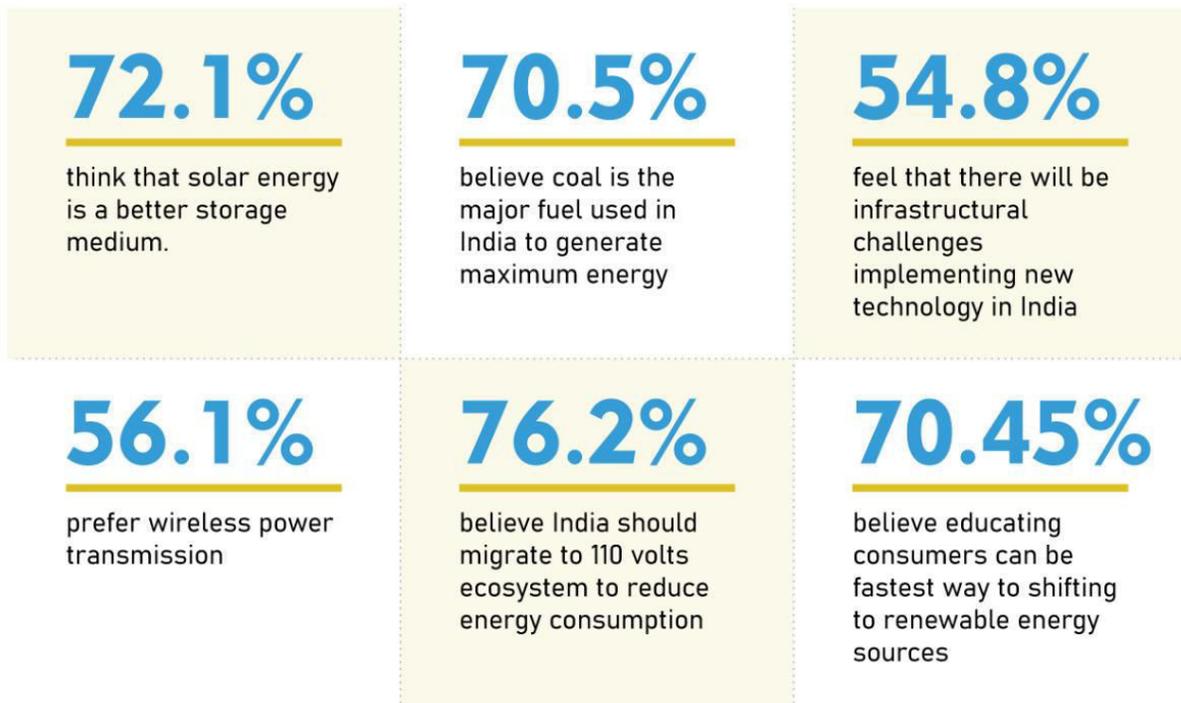
skin drug supplies, pacemakers and similar implants.

- 3) Electric charging roads - Over 3 years ago, the first electric road opened in Sweden, recharging the batteries of cars and trucks driving on it. According to The Guardian, this system reduces carbon dioxide emissions by 90%. [2]

Wireless power transfer is proving to be an effective energy source for indoor application. There have been some experiments in outdoor application as well. More studies is needed to scale up this technology to larger area coverage.

### PERSONAL SURVEY

A survey conducted online, provided insights and suggestions for the current state of energy harvesting and transfer systems. According to the survey, participants were aware of the various renewable energy sources. Most of them believed use of coal for energy production must be reduced. Although most participants wished for newer and better tech for energy transfer, they also anticipated challenges in its implementation like availability of skilled personnel and affordability. The participants believe wireless power transmission is better and safe than wired technology.



### CONCLUSION

The research work presented in this article explains some of the energy harvesting technologies that can convert various types of energy present in environment into electric energy. Thus not only do these harvesting models provide energy, but also reduce the environmental footprint at the same time.



### ACKNOWLEDGEMENTS

I would like to express my special thanks of gratitude to my teacher Mrs. Amudha Manickam who gave me the golden opportunity to do this wonderful project on the topic of Green Communication, which also helped me in doing a lot of research and I came to know about so many new things. Secondly I would also like to thank my parents who helped me a lot in finalizing this project within the time frame. I am really thankful to them.

### REFERENCES

- [1] Marvin M.. “Wireless Power Transfer: Working principle, Benefits, and Applications” [engineering.electrical-equipment.org. https://engineering.electrical-equipment.org/electrical-distribution/wireless-power-transfer.html](https://engineering.electrical-equipment.org/electrical-distribution/wireless-power-transfer.html). (accessed May 10, 2021)
- [2] D. Boffey. “World's first electrified road for charging vehicles opens in Sweden” [theguardian.com. https://www.theguardian.com/environment/2018/apr/12/worlds-first-electrified-road-for-charging-vehicles-opens-in-sweden#:~:text=The%20world's%20first%20electrified%20road,national%20map%20for%20future%20expansion](https://www.theguardian.com/environment/2018/apr/12/worlds-first-electrified-road-for-charging-vehicles-opens-in-sweden#:~:text=The%20world's%20first%20electrified%20road,national%20map%20for%20future%20expansion). (accessed May 17, 2021)
- [3] NiloufarZabihi and Mohamed Saafi. “Recent Developments in the Energy Harvesting Systems from Road Infrastructures” <https://www.mdpi.com/2071-1050/12/17/6738/pdf>



## GREEN NETWORKING

**Nishtha Lakhani**

Euro school Airoli

[anushri.lakhani25@gmail.com](mailto:anushri.lakhani25@gmail.com)

### Abstract

The Information and Communications Technology sector produces roughly 2% of the world's carbon footprint per annum. If the communication industry continues on this current path it will prove to be fatal for the environment, and thus the time for amendment towards green computing is now. Green networking refers to the processes used to optimize networking functions to make it additional energy economical. Data Center networking infrastructures consider power-hungry devices to work. This study will explore some modern sanctionative technologies like software outlined Networking, Edge Computing, and Virtualization, and the way these distinct ideas can together empower efficient green network solutions.

**Keywords:** *Edge Computing, Visualisation, Data centre, Cloud computing*

### INTRODUCTION

As technology advances, the footprint created will grow heavily. Once the fifth-generation (5G) wireless networks are launched, traffic volumes are expected to increase one thousand times and therefore the range of connected devices will be 10-100 times more than these days [1,2]. A user is predicted to induce data speeds up to 1Gbps and latency of <10 milliseconds. Advances in technologies such as artificial intelligence (AI), autonomous internet of Things (IoT), massive information analytics, machine learning, blockchain, and augmented/virtual reality can play a major role in providing high-speed, low-latency, secure connectivity that's ubiquitous and reliable. Research is afoot beyond the fifth-generation (B5G) networks, additionally referred to as 6G to support an additional range of users on multi-gigabits transmission rate than 5G networks. The challenges for the long run networks are set to attain ten times the energy potency along with spectral potency compared with today's 4G systems.

Since the origin of computers, abundant architectural style focus has been directed to high speed and low complexity of the system. However, studies and recent events have shown that the energy costs of computing are negatively impacting the environment. In recent years, green networking has become progressively more vital to cut back green gas emissions within the environment. The main goal of green Networking is to cut back computing's carbon footprint and reduce its impact on carbon emissions. This paper presents a few of some popular green computing initiatives that are already creating their way into the ICT industry.



Datacenters leave quite a bit of space for energy savings as they are typically designed without considering energy consumption. Many studies are going on for green networking under hardware and software system areas. Two main rising technologies are software-defined network (SDN) and network function virtualization (NFV). These 2 technologies highly complement one another. Therefore, the target here is to explore facultative technologies like Edge, SDN, and NFV for energy saving in datacenters.

This paper will detail the results from a simulation that utilizes the ideas of SDN, Edge Computing, and Virtualization in a huge region under ICT infrastructure. It will explore how the adoption of virtualization and edge computing among a network topology will lead to reduced energy consumption and increased service quality for network end-users.

### Theory

#### **1. Motivation and background**

Extension of green networking ideas covers any methodology that reduces latency, saves bandwidth, or decreases computation time, as a discount in these factors invariably results in power savings. These savings can directly translate into lowering greenhouse emissions, a key concern within the modern ICT era. Increased energy consumption among the ICT field comes from various sectors. This paper will focus primarily on datacenters, that are the second highest leading perpetrator in greenhouse emission (Personal Computers being the number one source)[3]. Each day there are over two quintillion bytes of data created, these data originate from distinctive sources and typically need to be routed across the net [4]. Datacenters, with their centralized style and superior processing power, have become one amongst the main destinations.

#### **1.1 Edge Computing**

Edge computing refers to the infrastructure of computing that exists “on the edge” of the data. Edge computing allows the gathering and processing of data nearer to the source, reducing latency times [6]. Edge computing is an umbrella term encompassing others like Mobile Cloud Computing, Cloudlets, Fog Computing and Mobile Edge Computing. Current trends among the expansion of devices connected to the net shows that there will be new amounts of traffic travelling over it in the future. The arrival of the IoT heralds the ultimate incorporation of billions of devices (including sensors, watches, actuators, embedded systems) into the net . 5G mobile users are contributing to this increase, and their demand for network services pushes our networks to their extremes. Therefore a viable resolution rests in transporting the “Cloud” nearer to the devices requesting services [6]. This is often the concept behind edge computing, where computational resources are brought nearer to the user. Widespread distribution of these edge computing devices requires that some computation is completed at the sting before the information is shipped off to remote datacenters. This can reduce not only service delay, but conjointly energy consumption.



### **1.2 Software Defined Network (SDN)**

SDN is solely a paradigm rather than an ossified design. Hence, it's cheap for researchers to review the technologies for networking by adopting the core plan of SDN, not being restricted to a minimum of one mounted structure. Then the SDN can be extended to varied situations, like datacenter networks, network security, optical networks, satellite networks, and mobile edge and wireless networks on the far side 5G[7]. whereas the thought of SDN is relatively old, it's solely in recent years that the technology has seen widespread adoption, as it will build network devices less complicated, modify higher control over the network and increase network performance. The key idea of SDN is to separate the control plane for switches and routers from the data plane. It permits networks to run easy programs that permit dynamic rules.

### **1.3 Virtualization**

As mentioned in the introduction, virtualization refers to the creation of a Virtual Machine (VM) in a Physical Machine (PM). The goal of virtualization is to boost quantifiability by centralizing tasks of a machine. Many virtual machines will run on one physical host, which reduces overhead, increasing potency and giving a lot of accessibility of resources compared to the older methodology of “one host, one machine”[8,10,11]. Virtual machines use a hypervisor, that basically is also a VM monitor; that is nothing but a pc software that creates and runs virtual machines. VMs conjointly capture snapshots of this virtual atmosphere, that is, the state of a virtual machine at an exact point in time. It permits the machine's state to be reconditioned later if required. In addition, if one needed to maneuver the VM to a unique host machine, the snapshots are typically migrated over to the other host machine that options a hypervisor.

### **1.4 Reference model for virtualization**

Virtualization within the broader sense refers to the thought of sharing. A reference model is usually used to describe the differing forms of the concept and also the architectural implementations. In [9] a green maturity reference model bestowed uses a layering concept; a type of numerous layers of abstraction through which virtualization is typically applied. Higher levels of virtualization maturity correspond to lower levels of energy consumption. Therefore, architectures supporting higher levels of maturity are green and given a lot of attention. Shown here is an example of a green maturity model:

Level zero – No virtualization

Level one – Logical virtualization

Level 2- Datacenter virtualization

Level 3- Cloud virtualization

This paper focuses on datacenter virtualization.

## **2. Related work**

Virtualization will facilitate reduction of the power consumption of a datacenter, one amongst the primary contributors to ICT emissions. Virtualization has a lot to supply. One such profit is minimizing downtime by using the flexibility to migrate virtual machines between hosts. It conjointly offers the load leveling of labor , which can increase the employment rates of physical hosts, while closing down alternative physical hosts for raised ascendible power savings. Resources of the physical host are typically shared, and monitored simply within a virtualized

setting which may additionally save power [10,11]. Datacenter topology plays a major role in deciding the extent of failure resiliency, ease of incremental expansion, communication bandwidth and latency. The aim is to make a robust network that offers low latency, typically up to many microseconds, and high bandwidth across servers. Several network designs are projected for datacenters in [8, 9]. These networks usually accompany a large degree of path redundancy that permits for raised fault tolerance. Though the majority of these topologies are symmetrical, in practice, datacenter networks end up to be typically a-symmetrical because of frequent failures of network parts (switches, links, ports, etc.). In distinction to mounted networks, reconfigurable topologies involve optical circuit change, wireless or a mix of each to adapt to traffic demands. These topologies believe quick algorithms that take into account the reconfiguration latency.

### Experimental

#### Simulation design

The main datacenter was designed with 10 hosts, each being a Dell PowerEdge R840 multipurpose server. The smaller edge datacenters that act as the edge computing element of the simulation used a single host of the same hardware to keep up scale. Because the datacenters during this design are comparatively tiny, they were given a ten Gbps link to the surface network.

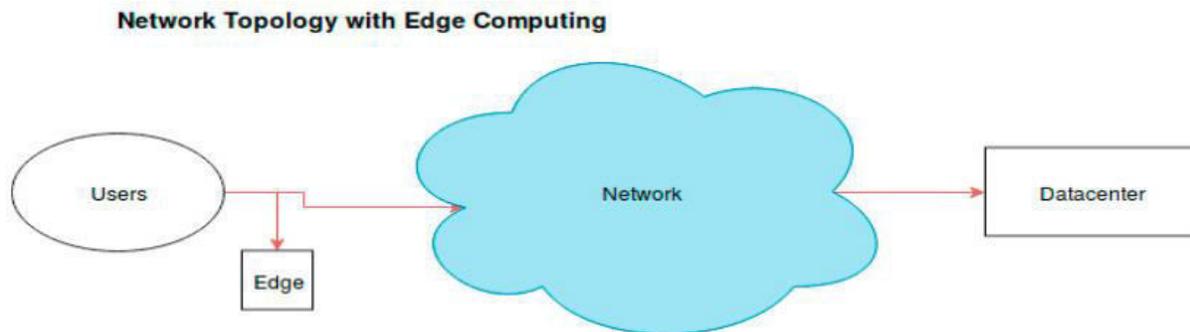


Fig. 1. Design of the Network

The execution of a Cloudlet is as follows. First, the datacenter Broker creates the Cloudlet (task) and submits it to at least one of its VMs. The input size of the task determines however long it'll take to reach the datacenter primarily based upon links within the network and their several latency. The task's instruction count and the MIPS rating on the physical host confirm the execution time of the task on the VM. Once the task is finished executing, it comes back to the datacenter Broker.

### RESULTS

The simulation program was written in Java using the CloudSim API. The program was designed to modify dynamic creation of VMs and Cloudlets and permit their submission by brokers according to the antecedently outlined traffic model. 2 factors tested within the experiment were virtualization and the inclusion of an edge (Cloudlet). Virtualization had 3 levels, as outlined by



the CloudSim API: Best fit, 1st fit and simple fit. The edge element in the network topology was either present or not, its presence achieved by setting extra nodes within the network topology as smaller datacenters with four restricted hardware resources. The results are plotted in Figure 3.

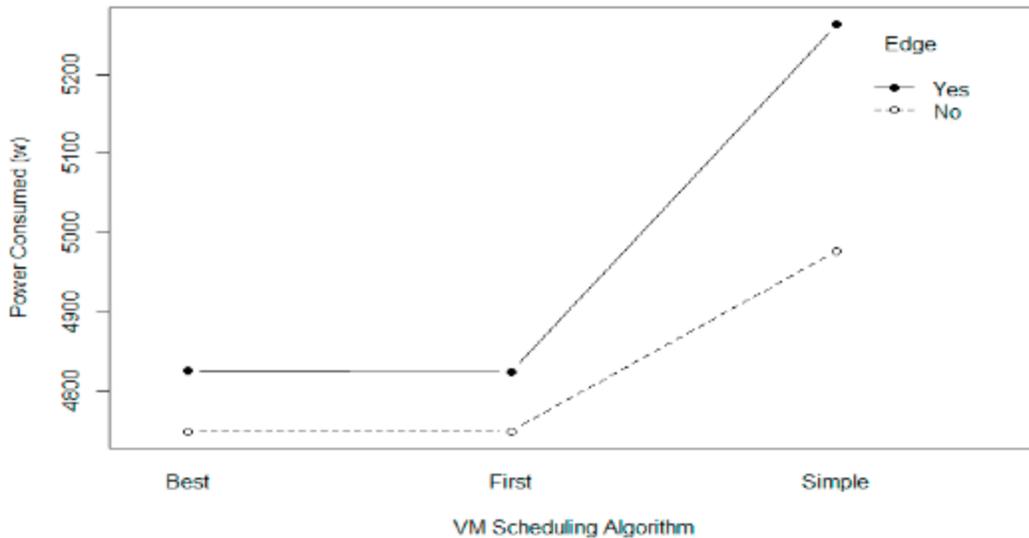


Fig 3. Cost of VM scheduling algorithms.

## DISCUSSION

### Interpretation of Results

Virtualization: From the results, it can be shown that due to virtualization there is up to a nine percent savings in energy consumption. there is a negligible distinction in first fit algorithm versus the best fit algorithm when edge computing is taken into account.

Edge: The VM scheduling algorithm is a vital contributor to energy savings across the edge factor. However, when considering the case of edge vs no edge, there is a dip energy potency. This can be attributed to the overhead prices incurred within the setup of further nodes.

## CONCLUSION

As worldwide ICT infrastructure grows, and also the power consumed by the ICT field rises, the importance of green networking solutions are crucial for sustainable growth. Datacenters are one amongst the leading contributors to greenhouse emissions, and thus a green networking target for reducing carbon footprint. With the rise of IoT and mobile devices being promptly accessible to international client markets, this is projected to grow exponentially. This study has shown how green networking principles embedded within these networking infrastructures accomplish energy savings that scale with the size of the network. We have seen how virtualization is a primary factor in energy savings. Adoption of potent\ VM scheduling algorithms (such as Best Fit) lead to notice energy savings of up to nine percent.



### REFERENCES

1. Copyright Collection (Library of Congress), For Earth's Sake: The Life and Times of David Brower, KCTS Television, Seattle, Wash, USA, 1989.
2. S. Solomon and the Intergovernmental Panel on Climate Change. Working Group I, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 2007.
3. R. Horne, T. Grant, and K. Verghese, Life Cycle Assessment : Principles, Practice, and Prospects, CSIRO Publishing, Collingwood, Australia, 2009.
4. [4] Gartner, "Green IT: the new industry shock wave," in Proceedings of the Symposium/Itxpo Conference, Cannes, France, November 2007.
5. "SMART 2020: enabling the low carbon economy in the information age," GeSI's Activity Report, The Climate Group on behalf of the Global eSustainability Initiative (GeSI), Brussels, Belgium, June 2008.
6. B. Rankin, "Solid state hard drives," July 2009, [http://askbo.brankin.com/solid state hard drives.html](http://askbo.brankin.com/solid-state-hard-drives.html).
7. Cisco White Papers, "Evaluating and enhancing green practices with cisco catalyst switching," 2009.
8. A. J. S. Chandrakant D. Patel, "Cost model for planning, development and operation of a data center," Tech. Rep., HP Laboratories, Palo Alto, Calif, USA, June 2005.
9. R. Mitchell, "Seven steps to a green data center," published by CIO, April, 2007, <http://www.cio.com>.
10. D. Pointon, "Data center sustainability: a facilities view," in Proceedings of the Symposium on Sustainability of the Internet and ICT, University of Melbourne, Melbourne, Australia, November 2008.
11. Google, "Google container data center tour," April 2009, <http://www.flixxy.com/google-container-data-center.htm>.
12. G. J. K. Mallon and D. Burton, "Towards a high-bandwidth, low-carbon future: telecommunications-based opportunities to reduce greenhouse gas emissions," Tech. Rep., Telstra, 2007, <http://telstra.com.au>.
13. Byteback, 2009, <http://www.bytebackaustralia.com.au/>.
14. RoHs, 2005, <http://www.rohs.eu/english/index.html>.
15. ENERGY STAR, 2009, <http://www.energystar.gov.au/products/computers.html>.
16. Climate Savers Computing, 2009, <http://www.climatesavercomputing.org/>.
17. ISO, "ISO 14000 essentials," 2009, [http://www.iso.org/iso/ iso 14000 essentials](http://www.iso.org/iso/iso-14000-essentials).
18. EPEAT, "Green electronics made easy," 2009, [http://www .epeat.net/](http://www.epeat.net/).
19. M. Weiser, "The computer of the 21st century," Scientific American, vol. 265, no. 3, pp. 66–75, 1991.
20. IEEE Standards Association, 2009, [http://grouper.ieee.org/ groups/1888/](http://grouper.ieee.org/groups/1888/).



### ISSUES WITH CYBER SECURITY IN INTERNET OF THINGS

**Ritika Ritesh Mathur**

Bombay Cambridge International School (East)  
[Mathur.ritika065@gmail.com](mailto:Mathur.ritika065@gmail.com)

#### Abstract

IoT is the technology where a network of machines and devices are able to communicate between themselves and other internet-enabled devices over the Internet. They are embedded with software, sensors, and network connectivity that enables them to collect and exchange data. They have become a huge advancement in healthcare and medicine; helping monitor patients more closely and analyse the data. However, there are concerns about privacy and security since these devices constantly need to be connected to the internet. This paper covers the benefits of IoT in healthcare and the security issues that come along with it.

Keywords: *Internet of things, Healthcare, Medical devices, Privacy, Security*

#### INTRODUCTION

In the past few years, the internet of things has become very successful and attracted the attention of many. These devices contain sensors, which take in information about the object or its surroundings, and actuators, which convert the signals into physical action. For an IoT device to function, it should have a connection to the internet. IoT devices have the ability to Intake information on their own, without human interference. They can make coherent decisions by themselves, as well as communicate the information to other devices through the Internet and execute those decisions in the real world by themselves or through other internet-connected devices. When the devices have collected the data, they send it to a central location, often referred to as an IoT platform- typically hosted by the cloud. The data is organized and relocated here, the platform guides the device's response to the information it's received. For instance, it is used in;

- Smart city, for city traffic Management, Waste Management, Water Distribution, Electricity Management, etc. IoT makes people's lives easier.
- In automotive engineering; for self-driven cars.
- Industrial Application- Factory Digitalization, product flow monitoring, quality control of the product, manufacturing, energy management
- Farming and agriculture- Drip Irrigation, understanding crop pattern or using a smart greenhouse
- Smart Supply-chain Management



The flexibility of IoT technology and embedded devices cause them to be beneficial in a wide variety of applications and environments.

### Literature review

Benefits of IoT devices in healthcare

IoT eHealth can effectively process, analyse, and manage multi-scale, multi-modal information, dispersed and heterogeneous data produced through connected sensors in less time. This permits to extraction of beneficial actionable records from health data. It can monitor patients providing effective emergency services to patients. It is likewise getting used as E-fitness utility on distinct aspects together with early detection of clinical issues, emergency notification. Another benefit of IoT is that it permits patient monitoring in real-time, as a result substantially reducing down unnecessary visits to doctors.

Patients can also receive comprehensive additive data on their past, present, and future health; Patients can fight illness better since continuous patient monitoring and real-time data helps in diagnosing diseases at an early stage or even before the disease develops based on symptoms. The chances of errors in the data are significantly less. IoT is easy to use and can be operated by users since it only requires a few clicks. Devices such as smartphones can be connected with the sensor to monitor health. This system provides efficient monitoring and tracking that helps to improve the resource management of people; as well as providing a data-rich personalized analysis of the health.

Some examples of IoT in healthcare include- wearables such as fitness bands, blood pressure, and heart rate monitoring cuffs, glucometers. Depression and mood monitoring can also be done by organizing and collecting data such as heart rate and blood pressure since it can be hard to interpret feelings precisely and relate it to mood swings and other symptoms. Another way IoT is used is in Robotic surgery- miniature robots' movements can be controlled from far away. However, IoT devices are far more expensive than the ones which do not require the internet.

Doctors can monitor a higher number of patients by relying on the healthcare IT systems, by tracking treatment plans, progress, and looking out for any immediate medical attention; basically, be able to connect with patients proactively since it is far more efficient. It also enables physicians to make evidence-based conclusions. Moreover, besides coherent decisions in healthcare, IoT can reduce the number of errors and make the diagnosis more accurate and precise.

IoT can be used in hospitals since the devices contain sensors that can track the present location of medical equipment for example- wheelchairs, oxygen pumps, and other healthcare devices. Another application is in hygiene monitoring devices which help prevent patients from infections. Apart from their use in noting patients' health, they are widely used in asset management as well; like pharmacy inventory control, environmental monitoring- which includes measuring temperature and humidity.

How IoT is used in healthcare during covid

IoT gives a platform that permits public-health corporations to get access to information for monitoring the COVID-19 pandemic. It offers possibilities for performing modelling research of viral activity and for guiding countries in healthcare to enhance preparation for the outbreak.



By using this technology, doctors will simply observe changes in crucial parameters of the COVID-19 patient, enhancing the detection and diagnosis of COVID-19. They can be utilized in elder care, which includes monitoring aged residence/patients at a nursing home and health facility as well as in data gathering, within the medical field.

IoT's focus is to assist perform the treatment of various COVID-19 cases. It makes the surgeon's job easier by reducing risks and increasing performance; Improving treatment systems in the hospital. Along with the advantages to the patient and the doctors, medical students can currently be higher trained for disease detection to reduce casualties. It can be tailored to observe calorific intake and treatment like asthma, diabetes, and inflammatory disease of the COVID-19 patient. Thus, improving the healthcare system during the COVID-19 days. In healthcare, it can be used for chronic disease, medical emergencies, creating better patient-care, fitness, blood pressure monitoring, health check system, measurement & control system, heart rate checking system, and hearing aids.

### DISCUSSION

The Internet of Things brings many of the same security and privacy issues, but it is a much greater risk because these devices act automatically. Doctors are now able to program ICDs to monitor a patient's heart condition. These devices can deliver data about that person's heart rhythms to a doctor. It can also send the right level of electrical shock to get the heart beating properly. Researchers have been able to demonstrate how a malicious hacker can trigger the device to malfunction, delivering a dangerous shock; it alters the reading which can be fatal in some cases.

Unauthorized access can lead to misuse of personal information, it could expose individuals to the risk of identity theft. It can facilitate attacks on other systems and will put confidentiality, availability, privacy, and integrity at risk.

Personal medical devices can be either planted in patients' body or attached externally. These devices use a wireless system to interact. However, just like the other IoT devices, these devices constantly need to be connected to the internet, if the device is connected to multiple different networks, then personal information such as location and physical conditions can be easily accessed. Apart from the security concerns, the increased use of these devices also create traffic on the network

### RESULT

IoT is used in so many industries, if the devices fail to function, it would cause a huge inconvenience, so there should be security measures taken. Security measures include conducting a risk assessment before the device is released for use in the market, authentication measures should be built into the device. Make sure that authentication is properly followed, firmware being sent to the device is verified, and device-to-device communication is monitored; an authentic mechanism should be used and the device access should be limited. It needs to be ensured that there is proper access control, so no unauthorized individual can access the data.

For safety there should be layers of security is in place to protect against risks.

There are numerous devices connected that process and transfer the medical data to the cloud. The most common attacks at device layer are tag cloning, spoofing, RF jamming, cloud polling and direct connection. In general, security measures at device layer include identity,



authentication, and authorization management, secure booting (i.e., prevent unauthorized applications to be executed), application sandboxing, whitelisting, fine-grained access control capability of resources, protection of data during capture, storage, and transit, traffic filtering feature, fault tolerance, password enforcement policies, secure pairing protocols, and secure transmission mechanisms.

At the network layer the most common attacks are Eavesdropping, Sybil attack, Sinkhole attack, Sleep Deprivation attack, and Man-in-the-Middle attack. To secure the network layer, it is very important to use trusted routing mechanisms, message integrity verification techniques as well as point to point encryption techniques based on cryptographic algorithms. This layer is important because it connects the device to the sensor.

The individuals controlling should be trained well on how to use the device to prevent disclosure of their critical medical data, and the device should be tested before going out in the market.

### CONCLUSION:

IoT significantly helps various industries. It has numerous advantages as discussed in the paper, this paper mainly focuses on the healthcare aspect IoT. Although it is useful, safety measures should be prioritized because these intelligent devices could malfunction; it could be lethal because in healthcare even a small mistake could have severe consequences. Data security and privacy are huge concerns, considering how the number of smart devices has increased exponentially in recent years. Ways such as having layers of security so no unauthorized individual can access, should be used to reduce the risks.

### References:

1. K. Ullah, M. A. Shah and S. Zhang, "Effective ways to use Internet of Things in the field of medical and smart health care," 2016 International Conference on Intelligent Systems Engineering (ICISE), 2016, pp. 372-379, doi: 10.1109/INTELSE.2016.7475151.
2. Wipro "What can IoT do for healthcare?" [https://www.wipro.com/business-process/what-can-IoT-do-for-healthcare-/](https://www.wipro.com/business-process/what-can-IoT-do-for-healthcare/)
3. Abdur Razzaq, Mirza & Habib, Sajid & Ali, Muhammad & Ullah, Saleem. (2017). Security Issues in the Internet of Things (IoT): A Comprehensive Study. International Journal of Advanced Computer Science and Applications. 8. 10.14569/IJACSA.2017.080650.
4. Bahar Farahani, Farshad Firouzi, Victor Chang, Mustafa Badaroglu, Nicholas Constant, Kunal Mankodiya, Towards fog-driven IoT eHealth: Promises and challenges of IoT in medicine and healthcare, Future Generation Computer Systems, Volume 78, Part 2, 2018, Pages 659-676, ISSN 0167-739X, <https://doi.org/10.1016/j.future.2017.04.036>.
5. Ting, D.S.W., Carin, L., Dzau, V. *et al.* Digital technology and COVID-19. *Nat Med* **26**, 459–461 (2020). <https://doi.org/10.1038/s41591-020-0824-5>
6. Selvaraj, S., Sundaravaradhan, S. Challenges and opportunities in IoT healthcare systems: a systematic review. *SN Appl. Sci.* **2**, 139 (2020). <https://doi.org/10.1007/s42452-019-1925-y>
7. Javaid M, Khan IH. Internet of Things (IoT) enabled healthcare helps to take the challenges of COVID-19 Pandemic. *J Oral Biol Craniofac Res.* 2021;11(2):209-214. doi:10.1016/j.jobcr.2021.01.015



## DIFFERENT METHODS TO HANDLE PANDEMICS AND EPIDEMICS

**Kian K. Pinto**

Billabong High International School, Malad  
IGCSE

**Ms.Vijeta Darekar**

### Abstract

The purpose of this research paper, is to find out how a country or society can be prepared for and handle an epidemic or a pandemic. In 2020, when COVID-19 hit India, the whole country was unprepared. India was among the worst hit countries in the world. The country saw around 100,000 cases per day at peak and the country proclaimed success in its ability to handle cases though it didn't have sufficient beds to handle the patients. In 2021, the country had around 400,000 cases per day with around 3000 deaths and the whole country was in disarray. This clearly indicates that the current form of data capture and communication is inadequate to handle problems of this magnitude [1].

This study aims to determine how governing bodies can better handle and prepare for deadly outbreaks. The information was collected from various websites including WHO and statistics from local bodies within the country. The results prove that we need to communicate detailed, correct and live information, obtained from various diagnostic tools and imagery via the media depicting the seriousness of the outbreak. This will help the governing bodies to enact tough laws, stock medicine and supplies and build infrastructure to support public health. This could also play a massive role in predicting future trends.

### Introduction

The topic of epidemics and pandemics are not often discussed in modern society. The Spanish Flu occurred over a whole century ago killing over 50 Million people while COVID-19 has been described as a black swan event taking 4 Million lives. Modern society has short lived memory. Media coverage of the pandemic peaked during March 2020 (at 10% of total news articles compared to the number of new cases) and dropped to an all-time low in June 2020 (at 4% of total news articles compared to the number of new cases). This proves that modern society has short lived attention and has taken the pandemic very lightly despite paramount urgency [2].

This research paper speaks about what steps are already in process, but also recommends the future of how governments should take tougher stands in order to protect interest of its weakest and most vulnerable population.



### 1. Media and communication

Communication plays a big role in combating pandemics and epidemics. It refers to the real-time exchange of information, advice and opinions between health experts or officials and people who face a threat to their survival, health or economic or social well-being. Its ultimate goal is that everyone at risk is able to take informed decisions to mitigate the effects a disease outbreak and take protective and preventive action. Communication also plays a huge role in slowing down the amount of deaths caused by pandemics and epidemics. Effective risk communication not only saves lives and reduces illness (by informing people on how to protect their health), it also enables countries and communities to preserve their social, economic and political stability in the face of emergencies [3].

Now, with access to social media, the internet, radios, newspapers, television news channels, etc; communication is a lot easier. People in poorer countries can also communicate with each other and spread detailed information more effectively.

To prove this point, the Black Death killed around 75 – 200 Million people from 1346 to 1353, whereas during the peak of the HIV and AIDS pandemic, around 35 Million people lost their lives. Evidently, the deaths caused by the HIV – AIDS Pandemic is much lower than that of Black Death. This shows the drastic impact of having better communication.

### 2. Tools For Diagnostics

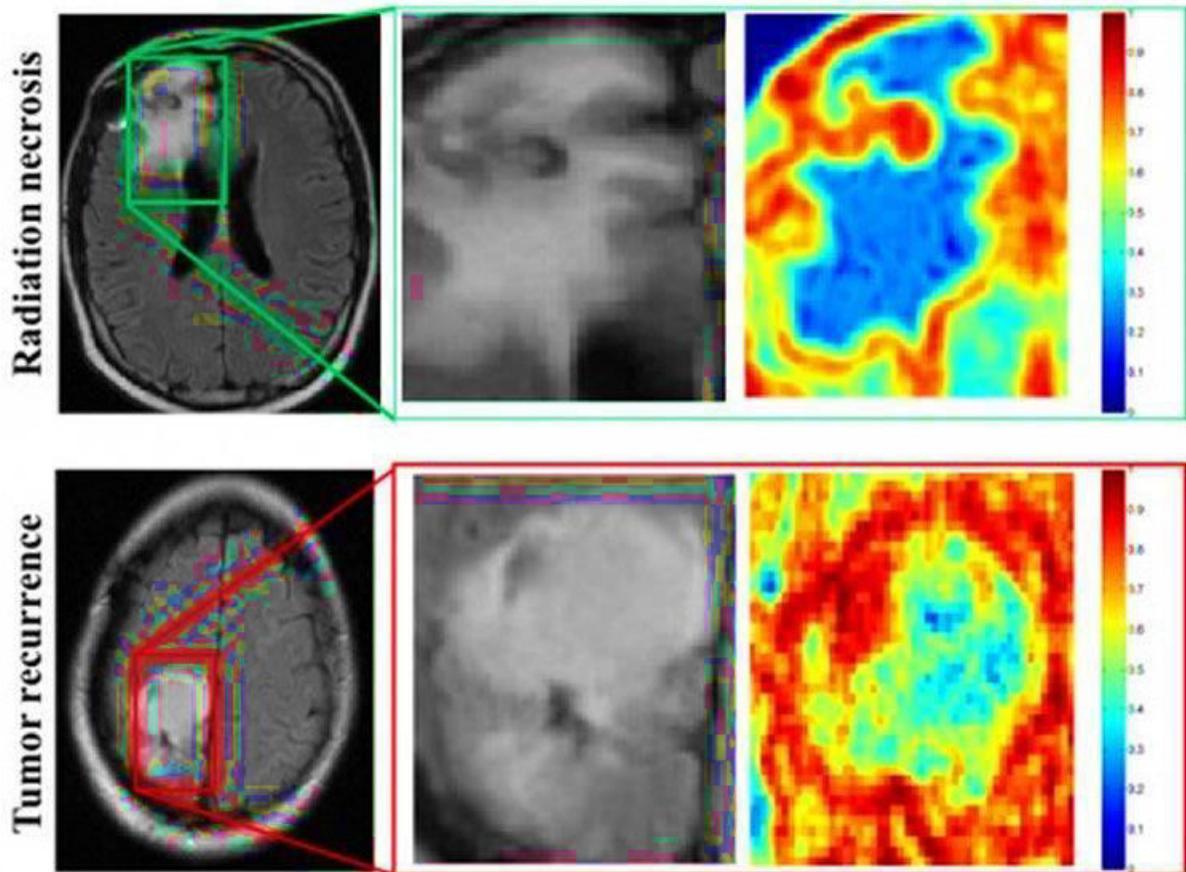
The direct detection of viruses in clinical and other samples include microscopy, antigen detection such as ELISA, and molecular detection of the viral genomic material by PCR. Popular molecular diagnostic techniques including qPCR or RT-qPCR also allow quantification of viral loads. While these techniques are highly sensitive for the detection of specific viruses in a sample, they can only identify viral sequences that match a pre-defined search image that matches the designed PCR primers. Thus, these established diagnostic tests frequently yield negative results when a patient presents a clinical phenotype, but no virus is detected. This can be either because an uncommon variant of a known pathogen is present in the sample, or because a novel virus is the causative agent of the disease. Notably, the difference between these two possibilities is continuous, reflecting increasing evolutionary distances along the viral phylogeny. Bioinformatic approaches allow PCR panels to be designed that capture an increasingly diverse array of viruses, but these assays will always remain limited to detecting viruses within a known range, and cannot extrapolate to identify completely novel ones. This may be resolved by untargeted (shotgun) sequencing of isolated viruses or complete sample DNA (metagenomics). Variants of known viruses may be detected by aligning the reads derived from the sample to the reference sequence of the known virus that was originally used for designing the primers. If enough high-quality reads span the regions where the primer sequences should anneal with the target, specialized variant detection tools can call the variant with a high degree of confidence, and new PCR primers can be designed to capture them. For example, a recent PCR-based investigation of the widespread human gut-associated bacteriophage Cross - Assembly Phage, designed globally applicable primers by screening an alignment of sequencing reads from a range of publicly available metagenomes and identifying highly variable regions of the appropriate size (1000–1400 nucleotides) that were flanked by conserved regions which could be targeted by primers, and were present in  $\geq 90\%$  of all metagenomic samples ( $< 10\%$  gaps). These

primers allowed a range of collaborating laboratories to independently detect Cross - Assembly Phage in samples from 62 different localities on six continents.

### 3. Medical Image Analysis

Popular imaging techniques include Magnetic Resonance Imaging (MRI), X-ray, computed tomography, mammography, and so on. Various techniques are utilized to tackle the difference in modality, resolution, and dimension of these depictions. Many more are being developed to boost the image quality, extract information from images more efficiently, and come up with the most clear cut interpretation. The deep-learning based algorithms increase the diagnostic accuracy by learning from the previous examples before recommending greater treatment solutions. The most common image-processing techniques specialize in enhancement, segmentation, and denoising that enables deep analysis of organ anatomy, and detection of numerous disease conditions. The most promising applications aim to identify tumors, artery stenosis, organ delineation, and so on . Different techniques and frameworks contribute to medical imaging in numerous aspects.

Image 1



MRI scans of patients with radiation necrosis (above) and cancer recurrence (below) are displayed in the left column. Close-ups in the middle column show the areas are indistinguishable on routine scans. Radiomic descriptors unearth fine variations displaying radiation necrosis, in the top right panel, has much less heterogeneity, displayed in blue,



compared to cancer recurrence, in the lower right, which has a much higher degree of heterogeneity, depicted in red.[4]

Hadoop, a famous analytical framework, employs MapReduce to seek out the optimal parameters for tasks like lung texture classification. It applies machine learning methods, support vector machines (SVM), content-based medical image indexing, and wavelet analysis for solid texture classification.

This shows how multiple programs and apps can work together using data from observations and external inputs, to get very detailed understandings on diseases. This would help us learn about the threats that these diseases impose on us and would help us be prepared by the time the next outbreak hits.

#### 4. Predicting the future for pandemics and epidemics

Knowing what the next pandemic will look like is not as easy as you think. Historically, flu pandemics have all differed slightly. There were always different strains of the virus (6 variants of COVID-19) and outbreaks hit some places and people harder than others. What we need is a way to separate things that are specific to a particular flu outbreak in order to clearly identify and understand solutions to the flu. For example, it is likely that social interactions are important in spreading flu. During the 2009 pandemic in Hong Kong, there are lots of infections in busy places like schools. But we also know that children had less immunity to this virus than adults. So what kind of behaviour is actually important for epidemics? What sort of data should we be collecting before an outbreak if we want to predict how infections might spread? These questions play a crucial role in finding out the types of potential future outbreaks. A study was conducted by Adam Kucharski and his team. They built a mathematical model of the Hong Kong outbreak. Using data on social behaviour and immunity, they tried to predict different people's risk of getting flu. They created over 100 models in total covering a whole range of behaviours. The most accurate ones showed that if they wanted to predict infection patterns, they would need data on physical contact. They would also need to know who is more prone than others to a virus or flu. They know our risk of flu infection drops when we leave our childhood and enter our twenties; but it increases again when people become parents. This approach was powerful because it wasn't limited to one location. Once they knew which kinds of behaviour were important, they could put in data from any country. For example, Hong Kong residents typically had physical contact with around five other people each day. The UK is similar but in Italy the average is 10. It was a promising start, but to predict epidemics they don't just need to know how many contacts people have. They need to know where they travel and where the infection might spread. So, they invited UK residents to download a specifically designed phone app. This allowed them to collect data on age, occupation and overall health. It also tracked their movements and allowed them to track other social information that was useful in getting important data for the study. They analysed the data of over 50,000 people. These people were school children, pensioners, healthcare workers, etc. Basically, the app was being used by society at large. With such data and our growing insights into how behaviour shapes epidemics, we will be able to study flu pandemics in a whole new level of detail. We can look at how quickly they might spread and which groups might be most at risk. We can also see the potential effects of control measures like school closures or vaccination campaigns and we will be able to do all of this before the next outbreak hits [5].



### Case Study - Summary

COVID 19 has been one of the deadliest outbreaks we have ever been exposed to. We were underprepared when the virus came to our country and hence, it took many lives. But what if we were prepared? How could things have been done differently? And most importantly, what next steps can we take for our country?

In this conclusion, we will see how these techniques can be best put to use altogether. The population of India is 1.4 Billion. Out of this, 469.3 Million people use smartphones (most users being from major cities). This could play to our advantage. The government could collaborate with phone companies to promote using an application that records data on age, occupation and overall health. It must track the user movements and must track proximity to other people along with other social information via GPS and control towers. It should track this information as we know that movements and proximity play an important role in the transfer of viruses. For privacy issues, residents of the country must be given codes that maybe given by the telephone company. Thus, the customer information can be with the telephone company.

The result of this will be more accurate statistics for the government, making there be less corruption in the government system and resulting in better decisions; There will be more customer information for telephone companies as well. Also, this will allow authorities to track those who travel the most and those who can be potential COVID-19 patients. This also will result in more accurate COVID-19 testing, better prediction for pandemic hotspots, etc. The media will come in use in promoting the app and spreading important information regarding new strains, statistics, etc. all found by diagnostic tools and imaging analysis companies working together.

### References

1. World Health Organisation, WHO. Website.  
<https://covid19.who.int/region/searo/country/in>
2. Pearman Olivia. (2021, January 2021). COVID-19 media coverage decreasing despite deepening crisis. Website. [https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196\(20\)30303-X/fulltext#fig1](https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(20)30303-X/fulltext#fig1)<https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section11.html>
3. World Health Organisation, WHO, (2018) Managing epidemics. Website.  
<https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdf>
4. Pallavi Tiwari, <https://neurosciencenews.com/ai-brain-cancer-neurology-5058/>
5. Kucharski, Adam. [TED Archive]. (2019, January 24). How data can predict the next pandemic | Adam Kucharski.[Video]. Website.  
<https://www.youtube.com/watch?v=tsr2nXInMpU>



### HEY ALEXA, HOW SECURE IS THE INTERNET?

**Husein Hakim**

Billabong High International School Santacruz

[huseinhakim@gmail.com](mailto:huseinhakim@gmail.com)

#### Abstract

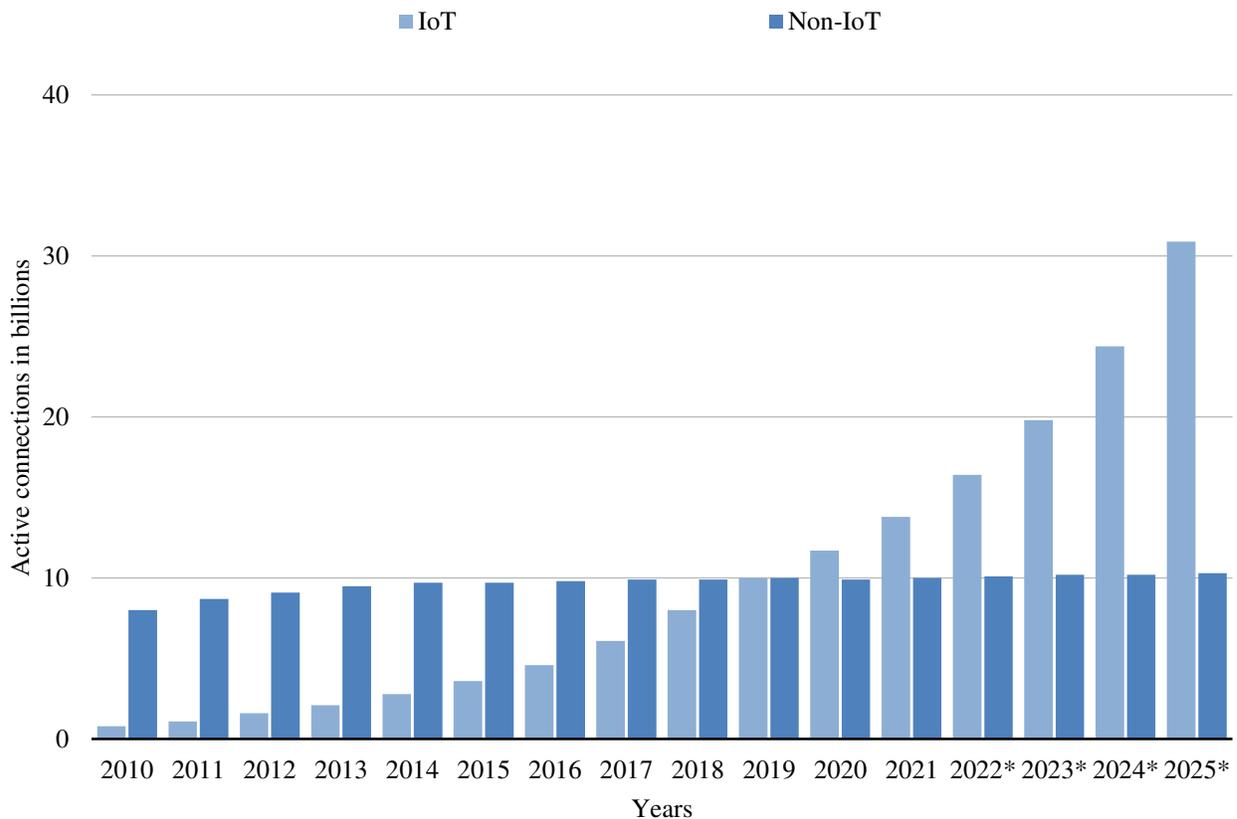
Internet of Things (IoT) devices are growing more common, and IoT services are becoming more widespread. New emerging technologies are influencing the globe today. As a result, we are constantly surrounded by smart devices. These smart devices make life simpler and more convenient for us. Their success has not gone unnoticed, and threats and attacks against IoT devices and services are also on the rise. Cyber-attacks are nothing new in the IoT world, but as the IoT becomes more deeply ingrained in our lives and communities, it will be vital to step up and take cyber defense seriously. As a result, there is a pressing need to secure IoT, which necessitates a thorough understanding of the dangers and attacks against IoT infrastructure. This study aims to categorize threat types as well as assess and characterize intrusions and assaults that affect IoT devices and services.

**Keywords:** *IoT(Internet of Things), Cyber-attack, WSN.*

#### I. Introduction

IoT refers to a trillion devices that are connected to the internet from all across the world that collect and share data. Due to the advent of super-low-cost computer chips and the ubiquity of wireless networks, something as small as a pill can be converted into something as large as an aircraft into part of the IoT. Connecting and adding sensors to all the various objects adds a digital intelligence level to devices that are otherwise stupid so that they can communicate real-time data without the involvement of a person. The possibilities for personal or professional development are limitless. Insecure connections and data storage are the most common causes of data security concerns in IoT applications. Compromised devices can be exploited to access personal data, which is one of the major challenges for IoT privacy and security.

The unintentional use of passwords, the failure to change passwords, and the lack of device updates have all exacerbated cybersecurity threats and given hostile programmes access to sensitive data in IoT systems. Data breaches and other dangers are more likely as a result of such poor security policies. According to findstacks' reports, 35.82 billion IoT devices will be installed globally by 2021, and 75.44 billion by 2025. As a result of these enormous amount of gadgets, attackers have a surface to attack. The graph below demonstrates how the number of IoT devices have grown as time has passed and technology has progressed.



## II. Application of IoT

Almost every aspect of our lives is affected by the Internet of Things. Some of the aspects are as follows:

### A. Smart Homes

Consider waking up to the scent of coffee while the curtains slowly open behind you. Your sleep sensor has made sure not to disturb you during a session of REM sleep, so you get a

Restful night's sleep. Your voice assistant tells you the weather forecast for the day, suggests



outfits based on the prediction, and announces your calendar activities, including daily reminders. While you were sleeping, your iRobot softly cleaned. You go to the bathroom, and a smart toilet sensor detects health signs in your pee. Your smart fridge has already submitted an electronic order for milk to an online grocery store since you've run out of milk for your cereal. This house is the epitome of a smart home. It's all thanks to the Internet of Things!

### B. Smart Cars

Self-driving cars have long seemed like something out of a sci-fi movie. Digital technologies have made their way into the automotive sector, thanks to the Internet of Things transforming the transportation industry. The Internet of Things permits human-to-human, machine-to-machine, and human-to-machine connections, all of which will influence how our cars run. Sensors have been added to IoT connected automobiles, allowing them to collect data from their surroundings. These sensors and cameras (such as the reverse camera) give the driver with a continuous stream of diagnostic data on which he or she can act. Some vehicles even feature automatic braking systems that activate when sensors detect something in the vehicle's path.

### C. Smart Cities

Cities are becoming digitally networked and hence smarter as a result of the Internet of Things' power. Cities are enhancing the lives of residents by gathering and analysing large quantities of data from IoT devices across many city systems. Data on infrastructure needs, transportation demands, and crime and safety may help smart cities make smarter decisions. According to a research, cities may improve quality of life indices (such as crime, traffic, and pollution) by 10% to 30% by using current smart city apps. In everyday life, IoT devices link to make your house, transit, or city more efficient and pleasurable.

### III. IoT communication models

#### A. The device-to-device communication model

Instead of going via an intermediate application server, two or more devices connect and interact directly with one another. These devices use a variety of networks to connect, including IP networks and the Internet. However, to create direct device-to-device interactions, these devices frequently employ protocols like Bluetooth, Z-Wave, or ZigBee.

#### B. Device-to-cloud communication model

To exchange data and regulate message flow, the IoT device connects directly to an Internet cloud service, such as an application service provider. This method typically uses existing communication techniques, such as standard wired Ethernet or Wi-Fi connections, to create a link between the device and the IP network, which then connects to the cloud service.

#### C. Device-to-gateway model/device-to-application-layer gateway (ALG) model

This means that there is application software running on a local gateway device that works as a middleman between the device and the cloud service, providing security and other features like data or protocol translation.

This model may be found in a variety of consumer products. In many situations, a smartphone running an app to connect with a device and pass data to a cloud service serves as the local gateway device. The development of "hub" devices in home automation applications is another



variation of this device-to-gateway paradigm. These are devices that act as a local bridge between IoT devices and cloud services.

#### D. Back-end data-sharing model

Refers to a communication architecture that allows users to export and analyse smart object data from a cloud service, as well as data from other sources. This design accommodates "the [user's] wish to give third-party access to the uploaded sensor data." This method is a development of the single-device-to-cloud communication paradigm, which might result in data silos if "IoT devices upload data solely to a single application service provider." A federated cloud services strategy, or cloud applications programming interfaces, offers a back-end sharing architecture that allows data gathered from single IoT device data streams to be pooled and analyzed (APIs), to make data from smart devices stored on the cloud interoperable.

#### IV. IoT security issue

##### A. Unauthenticated access

Unauthenticated access is one of the most frequent firmware flaws that enable threat actors to get access to an IoT device, making it easier to abuse device data and controls.

##### B. Weak authentication

When the firmware has a poor authentication mechanism, threat actors can simply obtain access to devices. These techniques can range from single-factor and password-based authentication to cryptographic methods that are vulnerable to brute-force assaults.

##### C. Hidden backdoors

Hidden backdoors are a popular hacker target when it comes to firmware. Backdoors are deliberate flaws that are implanted in an embedded device to allow anybody with the "secret" authentication information remote access. Although backdoors may be useful for customer assistance, they can have serious repercussions if they are found by hostile actors. Hackers are experts at locating them.

##### D. Password hashes

Most gadgets' firmware has hard-coded passwords that users can't alter or default passwords that they seldom update. Both of these outcomes provide gadgets that are very simple to exploit. The Mirai botnet, which infected over 2.5 million IoT devices around the world, used default passwords in IoT devices to launch a DDoS assault in 2016, bringing Netflix, Amazon, and The New York Times down with it.

##### E. Encryption keys

When encryption keys are kept in a format that may be readily hacked, such as variants of the Data Encryption Standard (DES), which was originally established in the 1970s, they can pose a significant threat to IoT security. DES is still in use today, despite the fact that it has been proved to be ineffective. Hackers can use encryption keys to listen in on conversations, get access to the device, or even construct rogue devices capable of performing harmful activities.

##### F. Buffer overflows

When writing firmware, if the programmer employs unsafe string-handling methods, buffer overflows can occur. Attackers spend a lot of time looking at the code inside a device's software, attempting to find out how to create unpredictable application behaviour or crashes, which can



lead to a security breach. Buffer overflows can be used to gain remote access to devices and to launch denial-of-service and code-injection attacks.

### G. Open source code

The quick creation of complex IoT solutions is made possible by open source platforms and frameworks. However, because IoT devices commonly employ third-party, open source components with unknown or undocumented origins, firmware is usually left unsecured, making it an attractive target for hackers. Although upgrading to the newest version of an open source platform would usually solve the problem, many devices are introduced with known flaws.

### H. Debugging services

Developers gain internal system knowledge of a device via debugging information in beta versions of IoT devices. Unfortunately, debugging systems are frequently kept in production devices, allowing hackers to get access to the same inside information.

### V. IoT attacks

#### A. Physical attacks

An attacker gets physical access to a physical asset in the infrastructure system in order to damage, disable, steal, or utilize it in an unfavorable way.

#### B. Sinkhole attacks

Sinkhole attacks occur when a hacked node attempts to attract network traffic by announcing a bogus routing change. One of the consequences of the sinkhole attack is that it may be used to launch additional attacks such as selective forwarding, acknowledgment spoofing, and routing information drops or changes.

#### C. Eavesdropping

An eavesdropping assault, also known as a sniffing or spying assault, is when a computer, smartphone, or other connected device steals information while it is sent across a network. The attack uses unprotected network communications to get access to data as it is delivered or received by the user.

#### D. Reconnaissance attacks

An unauthorized user's attempt to identify and map network system devices, services accessible on those systems, and the vulnerabilities of those systems is known as reconnaissance. It's also known as data collecting, and it usually happens before a real access or Denial of Service (DoS) assault. The malicious intruder will usually start by pinging the target network to see which IP addresses are live and responding. As a result, the intruder may be able to learn what services or ports are active on the live IP addresses. The intruder uses the active IP address information to query the application ports to identify the programme kind and version, as well as the type and version of the operating system.

#### E. Denial-of-service (DoS)

A denial-of-service (DoS) attack is a type of cyber-attack that prevents legitimate users from accessing computer systems, networks, services, or other information technology (IT) resources. In these sorts of assaults, the attackers often flood web servers, systems, or networks with traffic, overloading the victim's resources and making it difficult or impossible for others to use them.

#### F. Node Replication

The security of wsn is thought to be jeopardized by replication. On this technique, an attacker attempts to capture sensor nodes by obtaining the credentials of real sensor nodes. Once

captured, the attacker creates a clone or replica of the real node in the same network in order to make it appear that the injected clone is identical to the real node (Game & Raut, 2014). Replicas are difficult to spot since they seem to be legitimate network nodes. It's possible that an attacker will target numerous sensor nodes by capturing the entire cluster or cluster head and creating a clone or copy of the whole cluster.

### G. Tag Swapping

### Conclusion

The Internet of Things (IoT) has developed as a key technology. The data provided by sensors or RFID tags may include sensitive information that must be kept secure from unwanted access. IoT communication between two nodes is insecure, and IoT device physical security should not be jeopardised. IoT must integrate services like encryption, end-to-end environments, and access control for real-time and critical infrastructure security to accomplish secure communication. Staying one step ahead of the adversary in cybercrime is difficult. We may expect better security for smart devices in the future, as well as higher privacy standards for IoT connectivity, allowing users to automate activities more easily with this technology.

### References

1. Mohammed, Husamuddin & Qayyum, Mohammed. (2017). Internet of Things :A Study on Security and Privacy Threats. 10.1109/Anti-Cybercrime.2017.7905270.
2. Mohamed Abomhara and Geir M. Kjøien. 2015. 'Cyber Security and the Internet of Things: Vulnerabilities, Threats, Intruders and Attacks'. Vol(4). Issue 1. Page: 65-88.
3. Jack Steward. The Ultimate List of Internet of Things Statistics for 2021' <https://findstack.com/internet-of-things-statistics/>
4. 'Internet of Things (IoT) and non-IoT active device connections worldwide from 2010 to 2025' <https://www.statista.com/statistics/1101442/iot-number-of-connected-devices-worldwide/>
5. <https://www.strate.education/gallery/news/iot-daily-life#:~:text=Some%20real%2Dworld%20examples%20of,day%20will%20be%20unavoidable%20soon>
6. 'Unsecured IoT: 8 Ways Hackers Exploit Firmware Vulnerabilities' <https://www.darkreading.com/risk/unsecured-iot-8-ways-hackers-exploit-firmware-vulnerabilities/a/d-id/1335564#:~:text=Hackers%20actively%20exploit%20weaknesses%20in.credit%20card%20theft%2C%20among%20others>
7. G. Wyss, P. Sholander, J. Darby, and J. Phelan. 'Identifying and Defeating Blended Cyber-Physical Security Threats'.
8. George W. Kibirige, Camilius Sanga. 'A Survey on Detection of Sinkhole Attack in Wireless Sensor Network'.
9. Jake Frankenfield <https://www.investopedia.com/terms/e/eavesdropping-attack.asp#:~:text=An%20eavesdropping%20attack%2C%20also%20known,or%20received%20by%20its%20user>
10. <https://cdn.ttgtmedia.com/searchNetworking/downloads/PIXFirewallCH01.pdf>
11. Kevin Ferguson, Peter Loshin. Denial-of-service attack. <https://searchsecurity.techtarget.com/definition/denial-of-service>
12. Harpreet Kaur. 2018. UWDBCSN Analysis During Node Replication Attack in WSN. 18 Pages.



## GREEN COMMUNICATIONS AND WIRELESS NETWORKING

**Jayaram Braganza**

Ram Ratna International School  
jshettybraganza@gmail.com

### Abstract

Technological advance has led us to countless environmental problems on a global level and higher energy consumption, and this research paper aims to bring to light the problems and certain concepts that theoretically/practically be potentially used to counter the issues brought about.

**Keywords:**-Emissions, power consumption, telecommunications, ICT, efficiency, RAN

“It has become appallingly obvious that our technology has exceeded our Humanity” - Albert Einstein

### INTRODUCTION

Technology is the application of scientific knowledge to practical human lives or, to manipulate the human environment. In the long term, technological advancement is essential to economic growth and development, and as technology advances, the local and global economy can thrive faster.

Today, advances in various forms of technology have the potential to drive production and economic growth and create new and better jobs to replace old ones. Potential topics like Energy efficient device-to-device network, energy efficient ultra-sense networks, energy efficient spectrum efficiency, and many more are being discussed and looked into. Studies have shown that the number of mobile subscriptions around the world has increased exponentially from 500 million in 2000 to 5 billion in 2012. In short, the increase in network communication is on a fast track, and with it comes the increasing data and energy costs, high energy consumption, and many environmental problems. And that's where green communication came to fix the issues at hand.

Green communication is basically the application of the idea of choosing from different energy-efficient communications and communications technology and products, thereby reducing the usage of resources where possible in all communication branches. And while the introduction to green communications has produced substantial expectations, improving on the wireless networks is still an open research field and hasn't been perfected.



Yet, human-to-human or human-to-machine or machine-to-machine communications rely heavily on wireless communications and huge demands such as this can inevitably cause environmental issues on a global scale, making energy consumption a key issue. Thus, shifting to green communications is very essential.

According to the well-known Gartner report i.e., Gartner, 2007, the ICT market contributes to about 2% of global greenhouse gas emissions. A typical mobile phone network consumes about 40-50 MW and a service provider such as Vodafone uses more than 1 million gallons of diesel per day to power its networks. This means that wireless connectivity could create a weighty bulk of the total energy consumption of the ICT infrastructure. To save costs, two major issues need to be addressed in green communications:

- 1.Reduce energy consumption to reduce operating costs.
- 2.Creating a more friendly environment by reducing carbon emissions. Therefore, it is necessary to develop new and advanced algorithms to reduce the total energy required for the operation of wireless access networks.

When considering the environmentally friendly solution, air pollution, water pollution, and soil quality, ozone layer protection, natural resources, waste minimization, and many others have to be considered the main impact. Telecommunications equipment usually contains a large number of scarce materials and heavy metals. The biggest challenge is to extract these materials through mining and treatment of the waste, which is one of the main challenges to the environment.

To get a complete view of the environmental impact of a product, all five stages should be considered, particularly material extraction, production, use, transport, and end-of-life. The drag on the issue of energy consumption, which is important to the use of ICT in relation to carbon emissions should also be considered. While discussing the same, we should consider the emission of greenhouse gases such as methane, nitrous oxide, carbon dioxide, PFCs, HFCs and sulfur hexafluoride. These greenhouse gases have a different global warming potential (or GWP for short) considered for a hundred years horizon.

When analyzing the direct and indirect impacts, environmentally-friendly solutions should be considered. For example, implementing a solution that reduces the energy consumption of a service has a direct impact. Indirect impacts of solutions are related to the broader concepts of solution acceptance. The presence of email instead of letter writing, issues of transport, paper usage, etc. Indirect impact reduction often limits environmental issues. Since political, financial, and media differences depend on this, such reduction is very difficult to predict.

### Experimental

Increasing efficiency is a key strategy in reducing environmental impacts. If we consider the adoption of email, one could state that by replacing every letter sent by email we are largely reducing the impact of those letters. This case shows that initiating the indirect environmental effects of solutions is a difficult task that must be done with great care. The structures of the carbon footprint of site manufacturing and construction for the radio access network (or RAN for short) are based on a comprehensive analysis of the Life cycle of network equipment. The total RAN electricity consumption in 2007 was almost 20kwh. Recent research



gives us an idea about the construction of new sites and the removal of old site equipment. From the survey by Vinay M and Rudresh Y R, in their paper “A Review on Green Communications” in 2018, it is known that on average there is a 10 percent decrease in the new base station when compared to the previous year.

Energy efficiency metrics provide information that can be used to evaluate and compare the power consumption of different parts of a mobile network and of the network as a whole. These metrics also help us to set long-term research goals to reduce energy consumption. With the proliferation of research activities related to green communication and due to internal differences and the importance of different communication systems and operational measures, it is difficult for one metric to suffice. While the definitions of energy metrics for buildings and equipment levels are straightforward, it is very difficult to define energy performance metrics at a system or network level. Network level metrics evaluate energy efficiency at the network level by bearing in mind the features and properties of the coverage and capacity of the network. Here are goals that are connected with green cellular network:

- ✓ Improvement of energy efficiency.
- ✓ Improvement of the intelligence of the network through tradeoffs between energy consumption and external conditions, that is, traffic loads.
- ✓ Integration of the network infrastructure and network services to enable the network to be more responsive and to require less power to operate.
- ✓ Reduced carbon emissions.

### RESULT

Currently, LTE marketing solutions are not available for all architecture/BS. Therefore, provided power models are usually found in existing solutions and may diverge each other's. The relay case is symbolic in this sense: these low power nodes are categorized by a reduced area covered than the macrocells, so they can significantly decrease the irradiated power relative to M-BS. In addition, they are expected to have simpler structures than M-BS which has consequences, resulting in lower aggregate power consumption.

### DISCUSSION

It is also important to deal with the appropriate components of wireless structures that may affect the power consumption greatly. According to Figure 1 below, the power consumed by the retail group, data centers, core transmission, mobile switches, and BS is about 2%, 8%, 15%, 20%, and 55%, respectively.

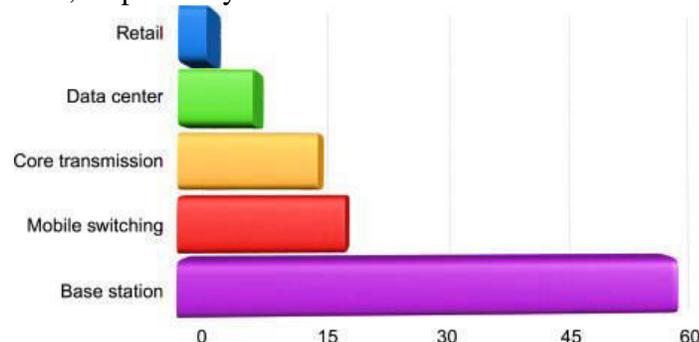


Fig.1 Percentage of power consumption in the cellular network infrastructure.



This suggests that BS or access point could be an important part of future research. Increased power consumption on wireless networks results in greenhouse gas emissions which can be considered a major threat to environmental protection and sustainable development.

In fact, before the green radio program, there have been efforts to progress energy savings in wireless networks. Ways such as developing additional efficient power amplifiers, implementing passive cooling, and minimizing the feeder losses. However, these efforts were not sufficient to achieve the goal of saving energy within 5 to 10 years. On the other hand, the GR program with innovative solutions, based on high-quality architecture and integrated construction at all levels of the system and protocols, can certainly bring more results soon.

### CONCLUSION

Green communications research focuses a lot on reducing the energy usage from a system perspective, often disregarding the effect on RF radiated power. However, some green solutions may reduce a few APs to operate with greater radiated power. Recently, public concern has arisen over the potential impact of electromagnetic fields on human health, and the mobile community should improve the adoption of existing wireless systems by reducing human exposure without compromising QoS. Therefore, it is necessary to understand the trade between fundamental green enablers and EMFs and to investigate joint ventures that reduce energy consumption and exposure to electromagnetic radiations.

### Acknowledgements

This paper and the research behind it would not have been possible without the exceptional support of the staff of my school, Ram Ratna International School, my ICT teacher, Ms. Soniya Robins, and the Vice Principal, Smita Gandhi. Their enthusiasm, knowledge and exacting attention to detail have been an inspiration and kept my work on track without any distractions. I am also grateful for the insightful comments offered by my peers. The generosity and expertise of one and all have improved this study in innumerable ways and saved me from many errors; those that inevitably remain are entirely my own responsibility.

### REFERENCES

1. Britannica (<https://www.britannica.com>)
2. Brookings (<https://www.brookings.edu>)
3. Hardee Business (<https://hardeebusiness.com>)
4. Science Direct (<https://www.sciencedirect.com>)
5. Journal of Communications Vol. 15, No. 3, March 2020 ([https://www.researchgate.net/publication/339310550\\_Green\\_Communication\\_Networks\\_Challenges\\_Opportunities\\_and\\_Future\\_Role](https://www.researchgate.net/publication/339310550_Green_Communication_Networks_Challenges_Opportunities_and_Future_Role))
6. International Journal of Engineering Research & Technology [IJERT] ([ijert.org](http://ijert.org))



### THE NEW TECHNO WORLD

**Shubham. P. Jatania**

S.H Agarwal International School  
shubhamj@agarwalinternationalschool.co.in

#### Abstract

IoT is a vast platform that has drastically changed our lives directly or indirectly. Reports show a sudden rise in the use of IoT in daily life. People are more dependent on technology than before. Robots and AI are replacing human work. Why? Because of IoT development and its influence on our daily life. Let us go deeper into the topic.

**Keywords:** - Following are some keywords to be helpful to read this document.

1)IoT(Internet of Things): -System of networked devices that form a connection to share data.

2)Ecosystem: - A basic level system of data handling and transfer using IoT.

3)Assistant tech: - A tech in which a specific human activity tool works on your digitally interpreted command.

4)Cybersecurity: - A specific security measure system that gives properadaptive security according to the data.

5)Biometrics: - A type of security measure over data in which it uses your face, fingerprints, or eyes to open. It is one of the most prevalent cybersecurity measures.

6)Cloud:- a virtual storage space with a specific data value.

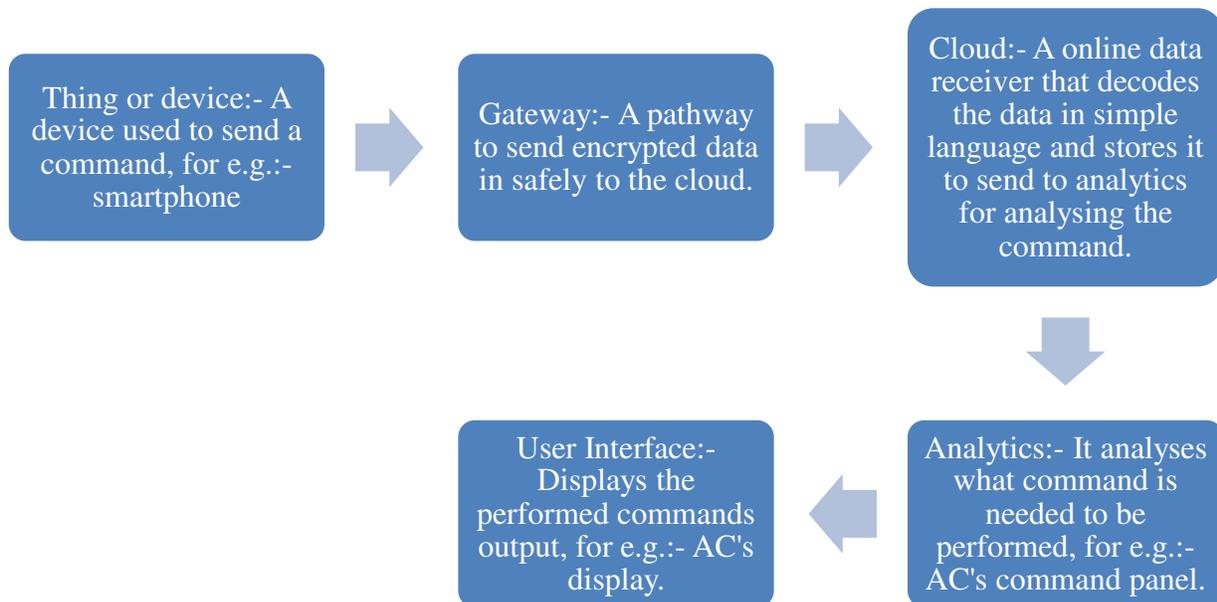
#### INTRODUCTION

IoT or Internet of things is a system of networked devices that form a connection to share data. The data can be a set of commands, instructions, a message, a money transaction, or a specific information. All of this has changed the world more than any other technology proposed in the world. It has had a drastic change in our lives. I am going explain two main significant things in human life, day to day activities and security.



### Theory

On basic level, IoT is an ecosystem that makes sure any type of data that is transferred by anyone is appropriately done. Following a basic diagram of its ecosystem: -



But it does require various things like sensors and to detect the need of the user and the environmental conditions to send a valid command data. It needs actuators to understand the entered command and start the processing of data in the hardware mechanism. Connectivity, which can be through Wi-Fi, Bluetooth, Mobile data, or any other specific authorized network.



Every single device has an RFID sensor (Radio frequency identification sensor) to understand the location to activate the sensors accordingly as it is a metered connection. They even need security measures to make sure the data is encrypted and safe for transfer. This ecosystem is the base to every single command that is processed using this system.

Experimental

Let's research to find people with smart devices.

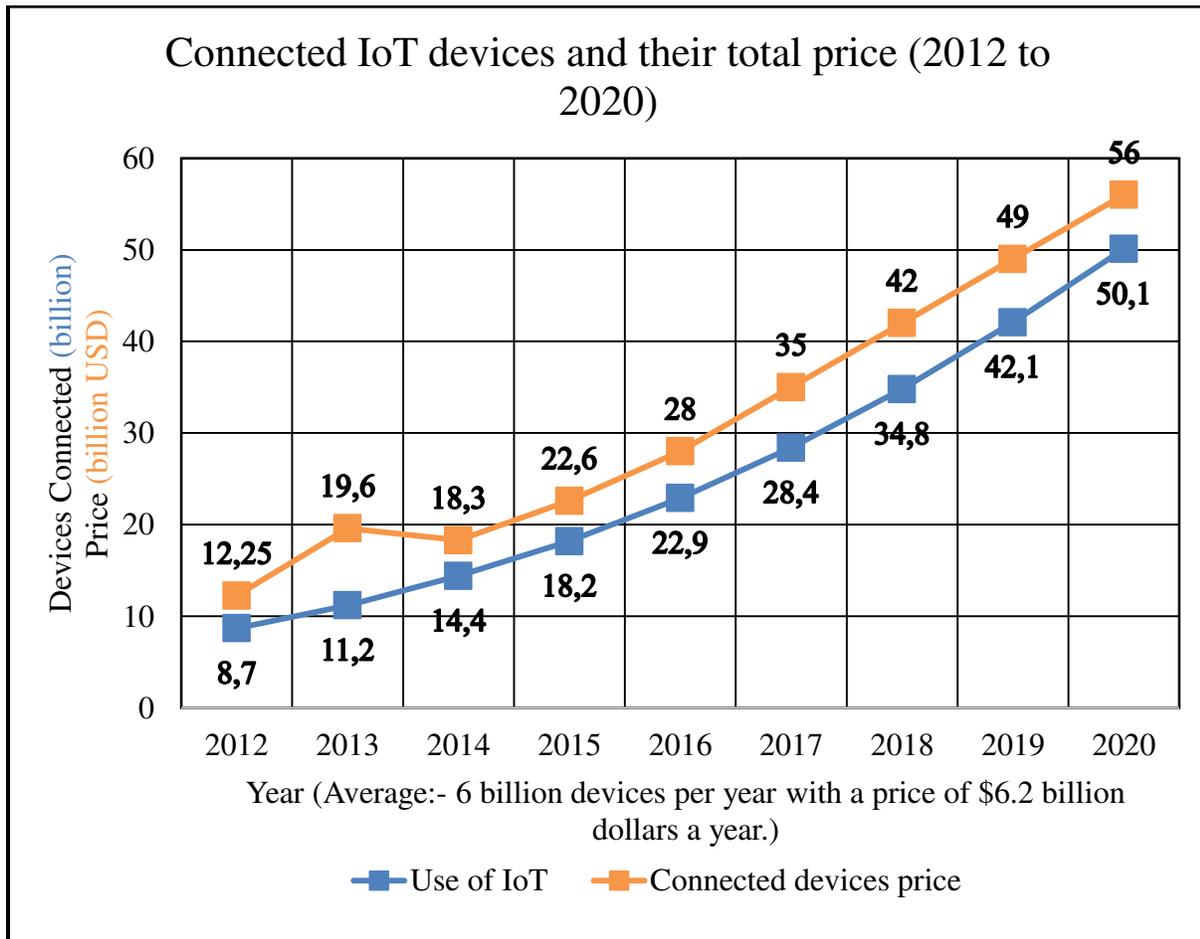
- 1) Make a survey sheet.
- 2) Randomly go to any house in your neighbourhood and ask about any specific appliances, vehicle, device, or any specific personal amenity that is controlled or linked to an app or device.
- 3) Make a proper tally of the number of intel techs they have.
- 4) Count even the smart tech you own.
- 5) Count it and calculate the total.

### RESULT

The use of IoT in daily life has increased. From household to devices to cars, everything has become a part of this vast chain of devices. Even statistics show that IoT's use has grown. The reason for the growth it's integration in daily life, and the price of the devices is cheap and affordable. It fast, easy to use and very strictly secured. Every single technological device can be replaced by this big global market's products. Even when results collected you may find that it will be a massive sum of products. The reason is the rapidly growing market of IoT technological developments.

### DISCUSSION

The life of human beings has changed by time. The development in this field has raised from a small sum to aenormous amount. Human life has more ease than before. From 2012 there has been a significantboost in this field which has grown in size to another level. The growth is increasing inpopularity over the years. Companies are hiring researchers to make new inventions to move ahead in this never-ending race. While companies like Tesla, Neural ink, Amazon, LG, Godrej, Haier, and various other companies. Even statistics claim that the growth has occurred and has happened with a great leap. Following is the statistics.



The trend is going up, so we can say that there is growth in its market. Even other statistics show that there is more growth to come and more devices to connect to embrace this technology to its fullest. There is an expectancy that by 2025, there will be 40 billion connected devices. The development rate has increased due to its impact on our daily life. Simply speaking, it is all assistant technology that helps in everyday life. It is a feature that uses your set of commands to do a specific task.

Following are some of the prominent IoT developments that have caused its growth and development to date:-

1)Smart Home:- It is a term that defines the use of third party or inbuilt apps to control various software integrated utilities in your house. This can include your any appliances, vehicles, and devices, thus makes your life much easier than before.

2)Cybersecurity:- As earlier mentioned, it is crucial to keep your device or data secured. Cybersecurity means security for a device. As there are multiple devices linked together, there can be chances that your data can be at risk. So thus, there are numerous ways to save it. These options include Biometrics(security measure that uses your face, your eyes, or your fingerprint), Pins and Passcodes(alphanumeric keys) and Data encryption(securing the data as a complex code so that no one can hack it.). The most popular of all is Biometrics as it is complex and well encrypted and only a specific registered fingerprint, eye pattern or face can be used to unlock it.



3) Mass digital connectivity:- The entire world is connected in this vast chain, thus making data transfer easy and efficient. People nowadays can transfer documents, cash, videos, photos, messages etc., all over the world. You are one fingertip away from sending any data to anyone. The growth is due to the increasing dependency of humans on machines. Today's human has faith in devices to do a job. But the plus point is that devices with highly advanced technology inside them are much better at doing jobs beyond imagination of human brain. They can help, serve, protect, care, and even fight for us. If every single person wants to live happily, you can put your faith in a machine.

### CONCLUSION

To conclude, IoT is a platform of mass development and there is no limit over its development. Soon we will see a lot more astonishing growth in this field that may ultimately alter the life we live today and may even give a start to a new technological era, starting a never-ending chain of development that no human has ever imagined from any technological development.

### ACKNOWLEDGEMENTS

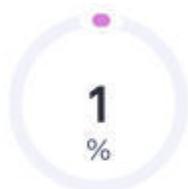
Research is a bridge between theoretical and practical working. And I would like to thank my institution for giving me this opportunity and my teachers for their constant encouragement, motivation, support, and guidance that helped me to submit my paper on time. And of course, my family, my pillar of strength and the reason why I keep pushing and can face all the struggles, pain and hardships with a smile on my face. I would like to thank all of them for their support and encouragement. Finally, I would like to thank the organizers of the event, who have given us an opportunity to build our knowledge and skills.

### REFERENCES

[https://www.researchgate.net/figure/Number-of-connected-IoT-devices-from-2012-to-2020\\_fig2\\_327272757](https://www.researchgate.net/figure/Number-of-connected-IoT-devices-from-2012-to-2020_fig2_327272757)  
<https://www.statista.com/graphic/1/254266/global-big-data-market-forecast.jpg>

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### MAKING SUSTAINABLE ENERGY ATTAINABLE

**Tia Thakkar**

Utpal Shanghvi Global School  
[tiathakkar123@gmail.com](mailto:tiathakkar123@gmail.com)

#### Abstract

Technology has formed a monarchy in the 21st century. However, its negative environmental impacts are as superior as the technology - especially the escalation in ICT (Information & Communication Technology). This paper centers on the sustainability of green communication, with network energy reduction techniques to improve the energy efficiency of these communication networks.

**Keywords:** *Energy efficiency, energy consumption, wireless communication networks, CO<sub>2</sub>.*

#### INTRODUCTION

The use of wireless devices has multiplied to an extent where infrastructure for wireless communication networks, for connecting people and objects, is a need. A substantial amount of data is being transferred daily in the form of files, storing information on the cloud, making online transactions, etc. As a consequence, the volume and coverage has increased with the mobile traffic in these communication networks. Bandwidth storage, capacity, slower data rates and interference were some obstacles faced by the generation of 4G. As a solution, 5G has been considered as the best option to prevent these inconveniences. 5G can serve numerous devices with 1000 times greater capacity and bandwidth. Due to this new advent, the connected devices will grow. [1]

It becomes vital to increase the number of transmission power to support these devices. In addition, telecommunications equipment contains a potential amount of scarce material; extracted through mining. Consequently, this extraction contributes to greenhouse gas emissions and adds to the scarcity of resources. Facts reveal that during the year 2020, the communication networks consume between 2-3% of global energy and produce 2% of global CO<sub>2</sub> emissions, among which wireless networks account for 57% of this energy consumption. [1] Heat in the form of waste is released when high amount of energy is consumed, and results in electronic pollution. Electronic waste (also referred to as E-waste) is caused when electronic devices become outdated or come towards the end of their useful life. [2] Technological convergence is a primary cause for an increase in electronic waste. The disposal of these electronic devices results in an overflowing of the landfill. Consecutively the toxic chemicals of electronic devices could cause serious health risks if they seep into the soil and the groundwater. Many of these devices aren't wasteful at all but are easily recycled for reuse. According to WHO (World Health Organization), recycling valuable minerals from e-waste has become a source of income for developing industrialized countries. Kyoto Protocol is an agreement between many nations, aiming to reduce the release of greenhouse gases (methane, carbon dioxide, nitrous oxide

etc) in the atmosphere.[3]Great Lakes Electronics in the United States is a recycling center for E-waste recycling with a zero-landfill policy in all locations. [1]They have portrayed sustainability and contributed to the conservation of the environment. An increase in energy consumption increases greenhouse gases, causing global warming and climate change. It is necessary to know that every greenhouse gas has a different global warming potential (GWP).

The greenhouse gas emissions in the telecommunications industry are minimal than any other industry. However, it is imperative to take precautions to reduce it after the evident increase in the demand for digitalization. [4] If sources are believed, the carbon footprint can contribute to 14% greenhouse gas emissions by 2040. Specific Absorption Rate (SAR) calculates the contact between human tissue and radio signal. Higher the SAR number, the more it becomes detrimental to not only the health of humans but also the environment. The rapid growth in the IT sector has disturbed the ecological balance.

### What is green communication?

Green communication is a sustainable approach towards carbon footprint reductions by the networking sector through efficient use of scarce resources and energy-efficient technologies. It entails using such software and hardware techniques that can minimize the energy consumptions of network components.

It is quintessential to have energy efficiency for the extended battery life of wireless devices to sustain. On witnessing a daily rise in mobile users, efficient batteries should be available for a lengthy working-life of these devices. In the next section, this paper exhibits a review of a few green communication techniques used in 5G.

### Theory

#### Green Communication Techniques

Renewable energy sources do not harm the environment with CO<sub>2</sub> emissions. Therefore, these resources are useful for improving the energy efficiency of cellular networks. Fossil fuels (majorly oil resources) are depleting significantly. Techniques like energy harvesting is used to obtain energy from the external resources of surrounding environment and convert it into usable electric power.[5] One of the drawbacks is the tiny amount of power produced from this method.

#### Device-to-Device communication

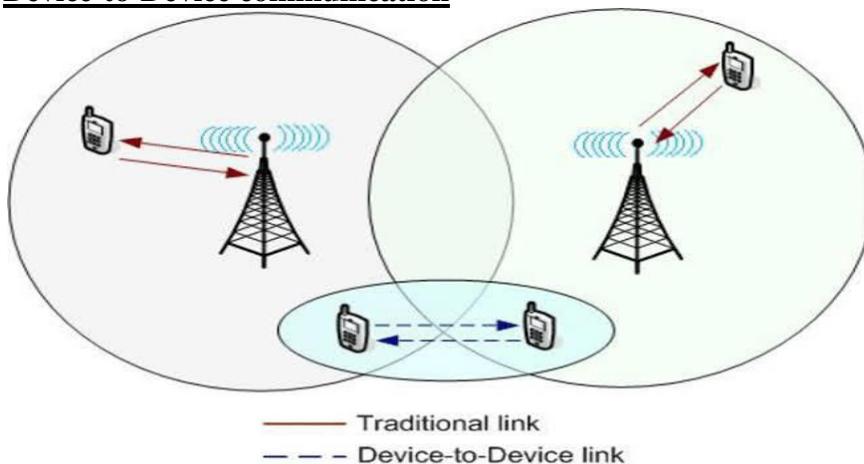


Fig.1. Device-to-Device communication.

Device-to-Device communication, also referred to as D2D communication, is a radio access technology that gives users living in closer proximity an opportunity to communicate directly, eliminating the need for a network infrastructure (illustrated in Fig.1). A lot of transmission of power takes place when the users are at the edge of their cells. Due to this technique, delays for data transfer are removed and data traffic is reduced at the base stations. The base stations are enabled to store power by going into a sleep mode. As an outcome, lower levels of energy will be consumed, thereby lessening the CO<sub>2</sub> emissions. In this way, energy efficiency comes in wired and wireless networks. [5]

### Green IoT

IoT is a vast network with devices connected. All the data is saved and transferred from the device through sensors. Digital technology's exponential growth is complementing the transformation of work in all sectors. The change in tastes and fashion favors availing the smart and connected devices which make the Internet of Things (IoT) famous amongst everyone. IoT is a comprehensive infrastructure of the network that involves using sensors and actuators. [6]When these devices are inserted into a physical object, they gain the ability to sense, operate and transfer information over the network. About IoT devices, their hardware is categorized into general and sensing devices. The sensing devices are connected with wired and wireless interfaces and are the major center for exchanging information. Sensing devices are sensors actuators that calculate temperature, humidity, light intensity and, other criteria. The IoT devices are controlled by gateways that transfer the data collected to the Cloud. To summarize, the cloud acts as a storage unit.



Fig.2. Green IoT.

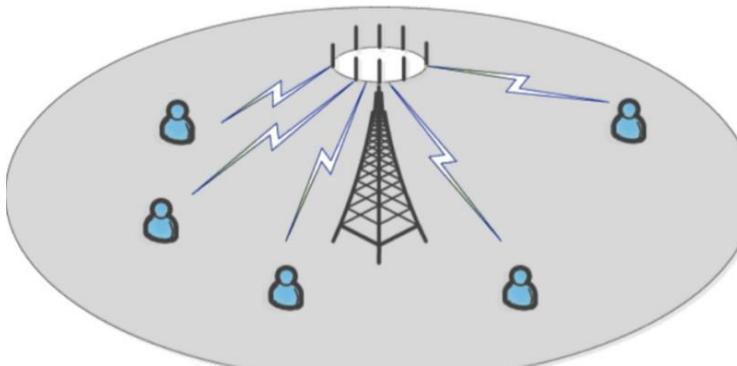
Green IoT focuses on the sustainable smart growth of the world. It believes in innovation and applications for societal changes with lower energy consumption of IoT devices. Thereby, it emphasizes the energy efficiency of IoT devices, as mentioned in Fig.2, to reduce the contribution to the greenhouse effect from its present appliances. It aims to make the complete IoT process green. Green IoT prioritizes the conservation of natural resources that will lessen the burden on the environment caused by the technology and even lessen the costs. Hence, green IoT focuses on green manufacturing, green utilization, green design, and green disposal. [7] Green manufacturing can be achieved by using electronic components and other subsystems which have minimum impact on the environment. Green utilization can be achieved by utilizing the information systems in an environmentally sound manner that reduces the energy consumption. Energy-efficient IoT equipment, servers, computers, and sound components can be designed to achieve green design. Lastly, green disposal can be achieved by recycling and reusing unwanted computers and other equipment from electronic waste.

Green IoT even involves using the Green WSN and Green CC.

**Green WSN:** Wireless Sensor Networks (WSN) include base nodes and automated sense nodes. To adopt a green system, these nodes can: use the devices sleep mode, reduce the working time, use renewable energy sources harnessed from the environment, effectively use radio transmission techniques and use data reduction techniques. [5]

**Green Cloud Computing (Green CC):** In cloud computing, users can pass a large number of resources. As a sustainable approach, these shared resources produce the adoption of energy-efficient hardware and software. Many power-saving techniques energy-efficient models can be used. [5]

### Massive MIMO

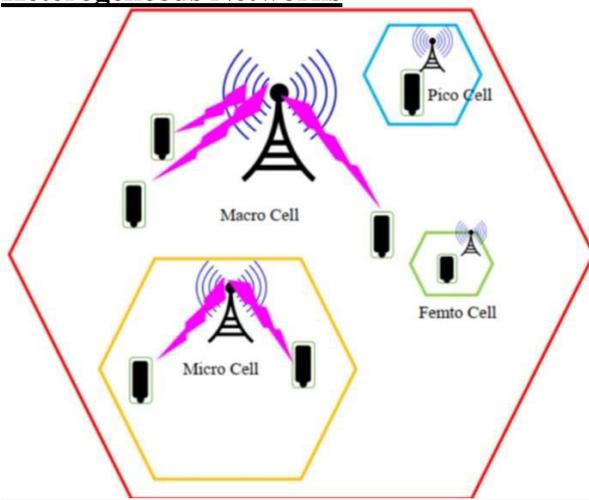


**Fig.3.** Massive MIMO.

Multuser Multiple Input Multiple Output (MIMO) is a base station of multiple antennas that serve multiple users, with single-antenna equipment at the same time. Multiplexing is a technology that allows many communication signals to come together. [8] When independent data signals from individual antennas are transmitted, multiplexing gain happens. All users share the multiplexing data, as illustrated in Fig.3. A greater number of antennas in massive MIMO makes it energy efficient and produces overall benefits of good energy efficiency, latency

reduction, increased throughput, and high capacity gains. In this system, choosing the correct antenna becomes quintessential. To control the consumption of power, energy-efficient antennas are required. Its structure simplification also contributes to reducing power consumption. Antenna muting is a technique to reduce energy consumption for LTE (Long term evaluation) cells by working for a shorter time scale. [9] The power can be saved significantly up to 50% when the antenna is muted in a low load or no-load environment. While considering this, an antenna with two or more ports can turn off the rest of the ports, while keeping only one of them on. This will not have an impact on the performance of the system and will conserve substantial energy. [7]

### Heterogeneous Networks



**Fig.4.** Architecture of HetNets

The concept of heterogeneous networks (HetNets) for green communication is illustrated in Fig.4. HetNets are a combination of individual cells. In the architecture of HetNets, there is one macrocell and several small cells such as microcell, picocell, and femtocell. A lesser number of macrocells in a HetNet reduces the consumption of power. Due to this type of mixed wireless system, the Het-users are brought nearer to the network. This leads to a higher Signal to Interference noise ratio (SINR). This method provides a strong link and good QoS (Quality of service). Moreover, HetNets has lower bandwidth issues due to frequency reuse. When there is little or no load, the microcells can be put into a sleep mode to reduce the energy consumption. [10]

### Challenges

While green communication provides myriad benefits, they are even associated with a price. Some key problems can slow down the deployment of green solutions. Green communication is expected to have high energy efficiency. To make devices energy-efficient, a high cost is involved. Similarly, a massive MIMO system also increases the cost significantly. Techniques such as heterogeneous networks require new infrastructure to be built. Therefore, the cost is a primary challenge for green communication.



In the previous section, several greenhouse techniques were studied. Particularly for 5G cellular communications, Massive MIMO is said to be the most effective energy-efficient technique. However, a significant numbers of antennas required can increase power consumption. [7] Therefore, it becomes imperative to select the correct antenna. Additionally, massive MIMO is a complex architecture and, the multiplexing and demultiplexing unit can consume a large amount of power.

Energy harvesting techniques can also be unreliable. For example, solar energy cannot provide sufficient power during cloudy conditions and at night.

To achieve conservation of energy and reduced CO<sub>2</sub> emissions, the communication equipment can be treated in two ways. Firstly, the development of by-products should be a boost by reducing the level of the optical-electronic system. Alternatively, the PCB (Printed Circuit Board) single disk density can be reduced.

### CONCLUSION

Energy consumption metrics are the energy consumed per unit. These details are required to analyze and compare how much energy is consumed by the various components of cellular network. These metrics support reducing energy consumption by setting long-term research goals. This paper portrays an overview of energy consumption issues and explains several green communication techniques like Device-to-Device communication, Green IoT, Massive MIMO, and Heterogeneous networks. Drawbacks involved with these techniques are also discussed. More efforts are required to design and develop wireless access networks. There is a drastic increase in green communication along with the growth of information and communication technologies. Network security and secured power optimization also need to be considered for the future of green communication. Overall, green communication is a way towards a sustainable future.

### REFERENCES

1. Hindawi. 2021. Recent Advances in Green Communications and Networks. [online] Available at: <<https://www.hindawi.com/journals/wcmc/si/732028/>> [Accessed 11 July 2021].
2. Great Lakes Electronics. 2021. Effects of Electronic Waste Pollution | Great Lakes Electronics. [online] Available at: <<https://www.ewaste1.com/effects-of-electronic-waste-pollution/>> [Accessed 11 July 2021].
3. 2021. [ebook] Available at: <<http://a-review-on-green-communications-IJERTCONV6IS13053.pdf>> [Accessed 11 July 2021].
4. Ww3.wipo.int. 2021. Climate-Friendly Information and Communication Technology. [online] Available at: <[https://www3.wipo.int/wipogreen/en/news/2020/news\\_0021.html](https://www3.wipo.int/wipogreen/en/news/2020/news_0021.html)> [Accessed 11 July 2021].
5. 2021. [ebook] Available at: <[https://www.researchgate.net/publication/320293847\\_Green\\_Communications\\_Techniques\\_and\\_Challenges](https://www.researchgate.net/publication/320293847_Green_Communications_Techniques_and_Challenges)> [Accessed 11 July 2021].



## An International Multidisciplinary Research e-Journal

6. 2021. [ebook] Available at: <<http://ignited.in/I/a/130396>> [Accessed 11 July 2021].
7. 2021. [ebook] Available at:  
<<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.701.3426&rep=rep1&type=pdf>> [Accessed 11 July 2021].
8. Globalknowledge.com. 2021. What Is Multiplexing?. [online] Available at:  
<<https://www.globalknowledge.com/us-en/resources/resource-library/articles/what-is-multiplexing/#gref>> [Accessed 11 July 2021].
9. Ieeexplore.ieee.org. 2021. Enhancing Energy Efficiency in LTE with Antenna Muting. [online] Available at: <<https://ieeexplore.ieee.org/document/6240248>> [Accessed July 2021].
10. 2021. [ebook] Available at:  
[https://www.researchgate.net/publication/335516365\\_A\\_Review\\_on\\_Challenges\\_and\\_Expected\\_Solutions\\_for\\_Green\\_Communication](https://www.researchgate.net/publication/335516365_A_Review_on_Challenges_and_Expected_Solutions_for_Green_Communication)> [Accessed 11 July 2021].

### GREEN COMMUNICATION

**Prisha Gupta**

Jamnabai Narsee International School  
prisha.gupta@jnis.ac.in

#### Abstract

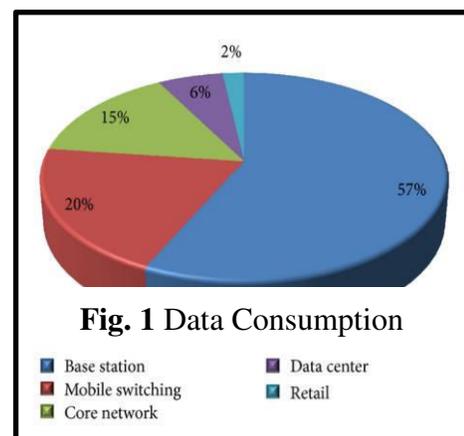
It is undeniably true that today people across the globe are linked together by an efficient telecommunication system; and with the increasing developments in this field, it has proven its importance in the modern society- a world without media is beyond our imagination. It has faced an exponential growth over the past few years, and will keep growing, giving rise to a more close-knit world. The increased demands are leading to the production of new, advanced devices. However, there's a flip side of the coin- this has enormous impacts on the environment (energy consumption, radiation, biological impacts, etc.) These prevalent issues have given rise to the concept of 'Green Communication'.

**Keywords:** *Green communication; Energy consumption; Energy efficiency; Sustainability; CO2 emissions; Wireless media*

#### INTRODUCTION

In the present scenario, the availability of communication devices over a range of affordable prices and varied features has increased the growth of its applications around the globe. Moreover, the introduction of new, updated and highly advanced devices such as portable mobile phones has expanded faster than anticipated, enabling people in every corner of the world to connect. Consequently, the demand for energy consumption and distribution has increased drastically in many parts of the world.

Statistics suggest that about 57% of energy is consumed by the base stations while 20% is utilized by switching of mobiles alone. In addition, a lot of power is used to process e-waste, especially when it is not disposed in the right manner. From the figures, it is clear that more than 65% of the consumption is due to electricity sectors, production sector, and areas that are prominent of pollution. The only solution to combat all of the above problems is Green Communication. This futuristic technology aims to reduce the carbon dioxide emissions, energy consumption, radiation, or any other environmental impact, without compromising the quality for the users. Even though the topic is not much talked about;

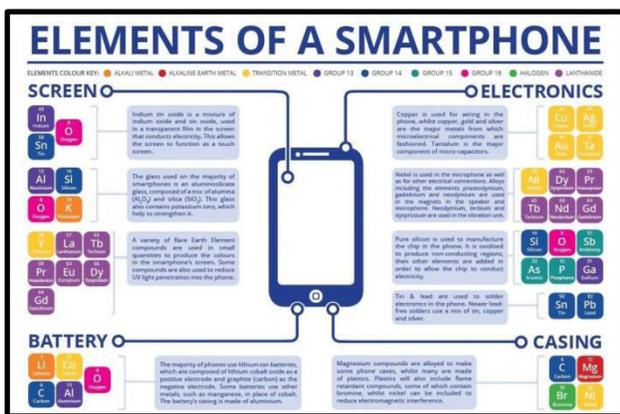


**Fig. 1** Data Consumption

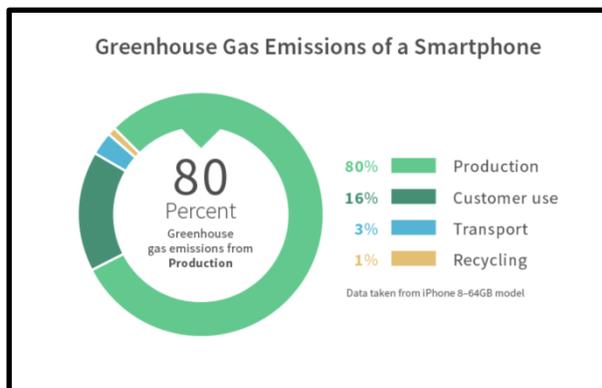
it has received a lot of attention recently. There have been a lot of surveys that summarize a blend of different opinions on the work carried out and actions taken on the above concept.

### ENVIRONMENTAL IMPACTS

While the telecommunication industry has many ill effects on the environment, lately carbon dioxide emissions have gained a lot of importance due to its role in global warming and climate change. Other major impacts include water pollution, air pollution, ozone layer depletion, exploitation of natural resources and more. Since this industry requires large extracts of rare metals and other sparse materials, it is hard and damageable to gain and dispose the waste matter.



The picture on the left shows the various

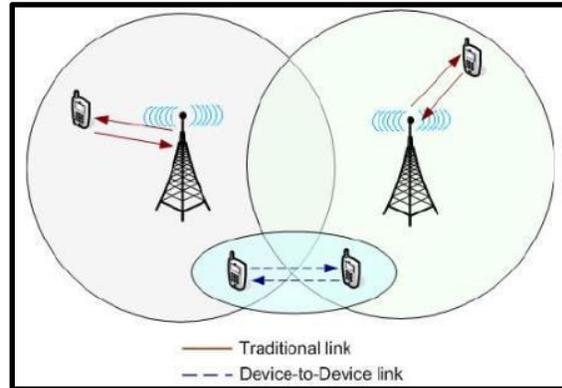


components that go into making a smartphone. As mentioned earlier, its sale is faster than anticipated, increasing the thirst for new advancements. People buy the latest technology, unaware of the impacts the disposal of old and production of new devices is having on the environment. The statistics on the right suggest that the production of each smartphone is responsible for about 80% greenhouse emissions, followed by 16% from customer usage, 3% for transport and 1% for recycling. While this may seem like shocking numbers, in 2019, an estimated of 82% the world's e-waste was dumped or burned rather than recycling increasing the emissions by more than 48%. The overall carbon footprint of the phone has jumped from 17 megatons of emissions per year to 125 megatons of emissions per year (730% increase). A mobile phone used 1 hour a day has a carbon footprint of 63 kg a year.

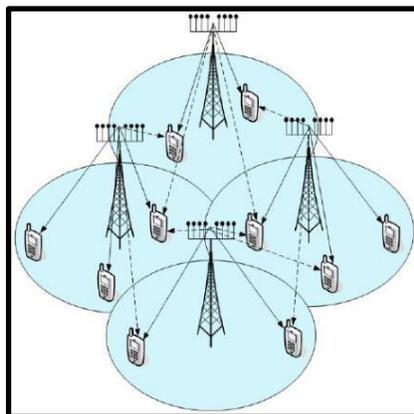
Berners-Lee, a famous computer scientist and inventor of the World Wide Web stated that, "It would take 34 years of average use for the footprint of electricity to equal the footprint of the phone itself. So, if you keep your phones twice as long, you almost halve the total annual footprint."

### TECHNIQUES

5G is a major component in the green communication techniques. Here I have explained 4 of the major techniques used. The first and most widely used is device-to-device (D2D), which is the radio network access and communication between devices in proximity. This is a very efficient way since it reduces latency and reliable link through the direct communication system. In this method, since users communicate directly, it reduces the load of the data traffic at the stations, this allows the stations to be dormant and save power at intervals. This in turn reduces the carbon footprints. The figure to the right shows the



**Fig. 4** Device to Device



reduced involvement of data centres with the D2D method.

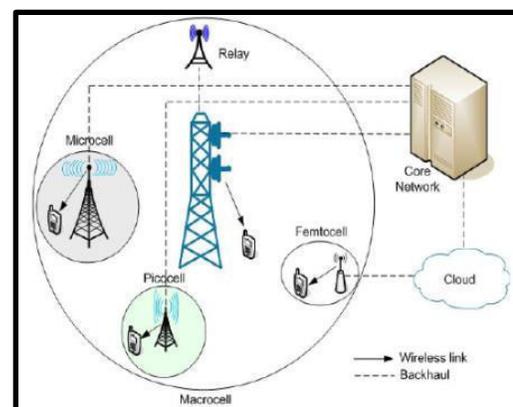
The second most widely used method is called Multi-user Multiple Input Multiple Output (Massive MIMO). Here, a base station with numerous antennas can simultaneously serve multiple users. As represented by the illustration on the left,

**Fig. 5** Massive MIMO

one station can benefit lots of devices. This system of Massive MIMO is very robust, efficient, helps in latency reduction, high-capacity gains, profit and more. In this method, the type of antenna plays a significant role. It can be integrated in 3 ways: network, single and distributed. The choice of method is based on the number of devices, network needed and area covered by the centre.

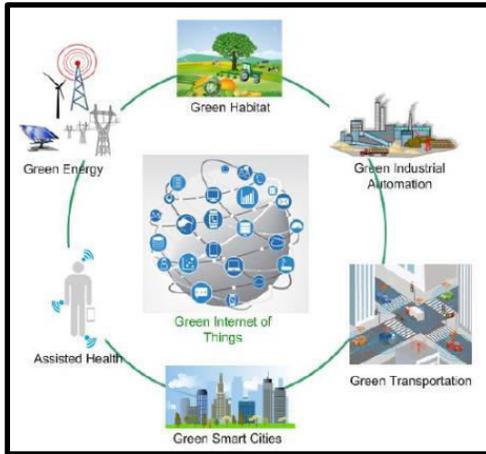
However, this method is used lesser than D2D method as it involves more resources and is more expensive. Hence, it mainly deals with larger data.

The next technique is known as heterogeneous networks, often referred to as Hentet. It consists of small cells. A network is generated by connecting to the base station to the main network through a series of wires, wirelessly, or in some cases both. The picture to the right shows the framework of connections. This mixed usage of wired and wireless technology helps Hentet to be robust with minimal bandwidth issues. The power can be saved by putting the cells in sleep mode when there is little or no load on the network. This helps save energy as well as make the system more efficient in time of use.



**Fig. 6** Heterogenous network

Finally, Green Internet of Things is yet another branch of 5G technologies. The image to the left shows the various industries it is used in. Green IoT greatly aids in reducing greenhouse effect through the different methods it possesses. One of the main components in IoT is Wireless Sensor Networks. In Green IoT, you can keep the nodes in these sensors on sleep mode and reduce power when needed, thus saving about 19% of energy being wasted. It can be used with various methods, but when interlinked with D2D, it can become even more energy-efficient.



**Fig. 7** Industrial uses of Green IoT

### CHALLENGES

Green Communication, however, has a huge price to its benefits.

The main drawback is cost. Even though green communication involves lesser use of energy, the installation and infrastructure of the devices is not very cost-effective. Moreover, in order to establish an efficient network, we need a complex and expensive computer system.

The other secondary challenges may include bandwidth, spectrum efficiency and antennas. There are variable factors, thus making it hard to make the right choice and get the desired result.

### CONCLUSION

Overall, this research paper talks about Green Communication, its environmental importance, its techniques and its challenges. Green Communication is the concept referring to establishing a network system with least number of resources and energy being wasted. It is very important, especially after the rising concern over carbon footprints and global warming. There are various techniques to practice it- most common being device to device (D2D), massive MIMO, Hentet and Green IoT. While there are many negative sides, main ones include cost, choice of devices, bandwidth, spectrum efficiency, etc.

### ACKNOWLEDGEMENTS

I would like to thank MISA for coming up with this productive initiative; my school, Jamnabai Narsee International School for presenting us this wonderful opportunity; Ms.Neha Parekh who guided me as my teacher in-charge throughout the competition.

### REFERENCES

- <https://www.sciencedirect.com/topics/computer-science/green-communication>
- <https://www.ijert.org/research/a-review-on-green-communications-IJERTCONV6IS13053.pdf>
- [https://www.researchgate.net/publication/340738992\\_A\\_Review\\_of\\_Techniques\\_and\\_Challenges\\_in\\_Green\\_Communication](https://www.researchgate.net/publication/340738992_A_Review_of_Techniques_and_Challenges_in_Green_Communication)



<https://ieeexplore.ieee.org/document/5769068>  
<http://www.jocm.us/show-237-1519-1.html>  
<https://www.hindawi.com/journals/wcmc/2018/1921353/>  
<https://manometcurrent.com/green-communication-market-may-see-big-move-with-major-giants-juniper-network-sprint-relion/>  
<https://www.qualcomm.com/5g/what-is-5g>  
<https://indianexpress.com/article/explained/what-is-5g-and-how-prepared-is-india-to-adapt-to-this-tech-7150641/>  
<https://www.rcrwireless.com/20170628/5g/what-is-massive-mimo-tag17-tag99>  
<https://spectrum.ieee.org/computing/networks/applications-of-devicetodevice-communication-in-5g-networks>  
<https://www.sciencedirect.com/science/article/abs/pii/S1389128620311452>  
<http://www.telecomabc.com/h/hetnet.html>  
<https://manometcurrent.com/how-is-the-2g-3g-4g-5g-wireless-network-infrastructure-market-evolving-by-segment-and-region/>



### ARTIFICIAL INTELLIGENCE IN THE FIGHT AGAINST COVID-19

**Raghav Satish Samani**

Sanjay Ghodawat International School

[raghavsamani11@gmail.com](mailto:raghavsamani11@gmail.com)

#### Abstract

**Background:** COVID-19 erupted in Wuhan, China, in December 2019, causing national and foreign disruptions in health care, business, education, transportation, and virtually every part of our everyday lives.

**Objective:** The paper will study, explain, and summarise the characteristics of the established AI techniques and data sets used for their creation and validation.

**Methods:** I examined the most used electronic databases (for eg, MEDLINE, EMBASE, and PsycInfo). These words were chosen depending on the intended action.(i.e., AI) and the disease of interest (ie, COVID-19).

**Results:** AI was also employed in drug and vaccine research, forecast the spread of COVID-19, measuring the magnitude of COVID-19.assessing the severity of COVID-19, predictingmortality risk.

**Conclusion:** The included studies demonstrated that AI has the ability to combat COVID-19.

**Keywords:** *artificial intelligence; mortality risk; electronic databases;*

#### INTRODUCTION

##### Background

COVID-19 broke out in Wuhan, Hubei Province, China in December 2019, spreading across the world and killing over 330,000 people as of May 2020.COVID-19, which was caused by SARS-CoV-2, was considered a global pandemic.The World Health Organization had declared a pandemic in March 2020.Many people infected with COVID-19 developed fever.Some patients had cough and nausea, while others had a dry cough.Some experienced a serious course of the medical condition, necessitating intensive care, including hospitalisation and mechanicalventilation. COVID-19 and its contagiousnessan enormous number of cases all over the world have resultedglobal and international disturbances in industry, health care, and education, transportation, and almost every other part of our everyday lives.To mitigate the impacts of this pandemic, prompt and successful countermeasures are required; robust public health policies including monitoring, diagnostics, and clinical trials are required.Care and study are needed.

Using digital platforms and software to tackle COVID-19 will supplement public health interventions, such as using chatbots to answer public questions about COVID-19.Furthermore, public health practitioners may use interactive resources tomonitor the occurrence of COVID-19



infections in real time, model their projection if possible. Artificial intelligence (AI) is one such tool—a field of computer science concerned with intelligently processing and managing complex knowledge. —intensifying public health campaigns to combat COVID-19. Despite the excitement for AI applications since the 1950s, only a few have been created. Because of the availability of AI, there has recently been a surge in interest of high-performance computer processing as well as massive quantities of data being produced every second.

AI allows computers to become intellectual, comprehend questions, sift through and bind mountains of data points, and draw actionable conclusions. Thus, specifying the taxonomy AI is not a simple task; its approaches can be classified depending on the aim is to learn from experience, investigate, and discover. Draw conclusions from knowledge, and reason from knowledge. Several nations, research institutes, and technology industries issued calls to action immediately after the COVID-19 pandemic broke out throughout the world, asking researchers to take action and create AI solutions to combat the disease. Help with COVID-19-related investigations. From a hierarchical standpoint, AI will help COVID-19 at many levels: molecular (e.g., medication and vaccine discovery), patient (e.g., patient diagnosis), and global population-level surveillance (for example, epidemiological surveillance).

### Research Problem

AI can analyse large data sets by aggregating and sifting through mountains of health care data (including patient data) to produce insights that can allow predictive analytic examination. The opportunity to gain these inputs quickly enables physicians and other partners in the health care community to make efficient, secure, and prompt decisions to better serve patients as well as public health policy. There has been a consistent increase in the number of reports on the use of AI techniques to fix or overcome the COVID-19 pandemic. During the COVID-19 pandemic, much of the AI development activity was dispersed, and there was a need to investigate and summaries how AI worked. Technologies are being used to tackle or fix the many issues. COVID-19 challenges will help us plan how to proceed. Make use of AI technology in the event of a present or potential pandemic. Several reports on AI strategies used to combat the COVID-19 pandemic have been published. The majority of the work, however, has taken the form of literature reviews or systematic evaluations focused on a particular application. A.I. (for example, COVID-19 diagnosis and prognosis). As a result, a more complete and comprehensive inquiry is required Experimental.

### Search Sources

I conducted searches on the following online databases between April 10 and 12, 2020: MEDLINE (through Ovid), EMBASE (via Ovid), PsycInfo (via Ovid), IEEE Xplore, ACM Digital Library, arXiv, medRxiv, bioRxiv, Scopus, and Google Scholar. In the case of Google Scholar, and owing to the amount of returned hits, I only evaluated the first 100 results, since I discovered that results beyond this point soon lose relevance and application. In addition to scanning bibliographic databases, I checked the reference lists of the included studies and pertinent reviews for other relevant studies that might be included in this review (backward reference list screening).



### Study Eligibility Criteria

I focused on any AI-based tool or method utilised for any purpose connected to the COVID-19 pandemic, including as diagnosis, epidemiological forecasts, and outbreak response, Treatment and vaccine development, as well as patient prediction outcomes. I did, however, omit papers that provided an overview, or by presenting a viable AI method for COVID-19, or by doing research things were solely considered from a scientific standpoint I looked at peer-reviewed papers, theses, dissertations, conference proceedings, and preprints published in English between December 25, 2019, and April 12, 2020, while omitting reviews, conference abstracts, proposals, editorials, and comments. I imposed no limitations on the country of publication, research design, comparator, or results.

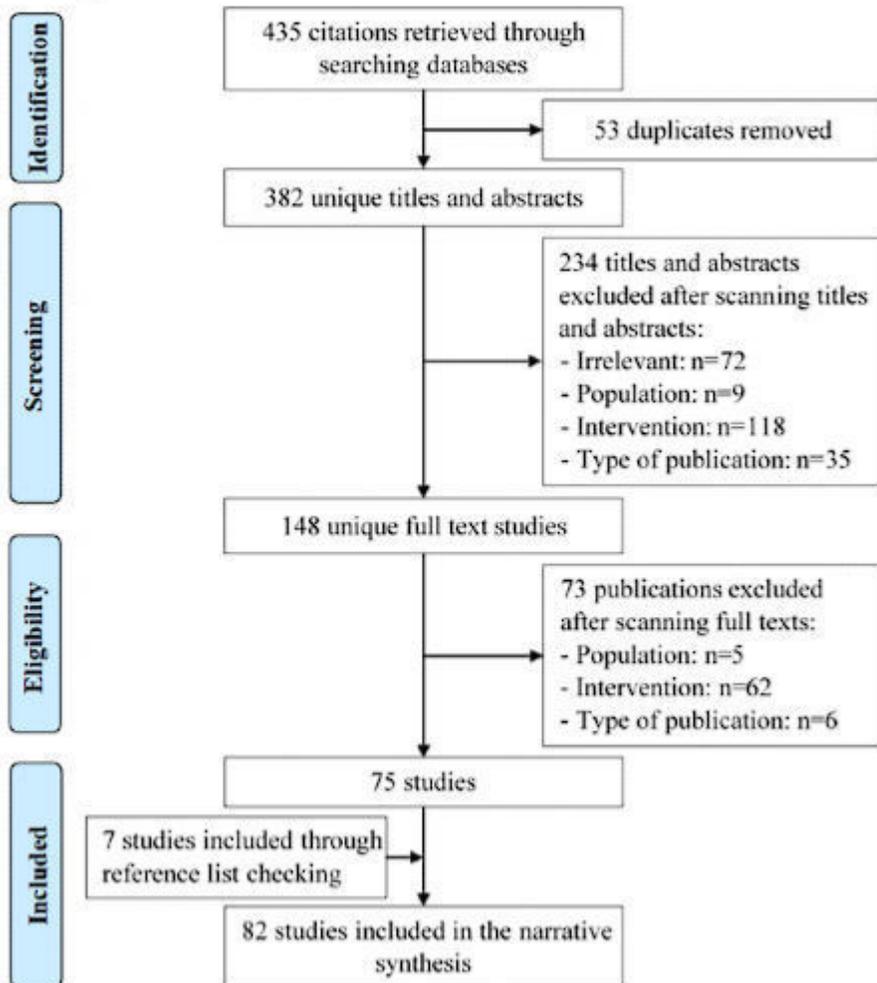
### Data Synthesis

I utilised a narrative method to synthesise the data after extracting it from the selected studies. I classified and described the AI techniques used in the included studies in terms of their purposes (e.g., diagnosis and drug and vaccine development), AI area or branch (e.g., traditional AI models and algorithms (for example, decision tree, random forest, and naive Bayes), as well as platform (ie, computer and mobile). Furthermore, I described the data sets used for AI model development and validation in terms of data sources (e.g., public databases and clinical settings); data type (e.g., radiology images, biological data, and laboratory data); and data type (e.g., radiology images, biological data, and laboratory data); size of the data collection, the kind of validation, and the proportion of training, validation, and test data sets are all important considerations. To handle data synthesis, I utilised Microsoft Excel (Microsoft Corporation).

## RESULTS

### Search Results

By searching the indicated bibliographic databases, I was able to locate 435 studies (Figure 1). I eliminated 53 duplicate studies before screening the titles and abstracts of the remaining 382 papers. For reasons stated in Figure 1, the screening process resulted in the removal of 234 research. I eliminated 73 papers after reviewing the complete texts of the remaining 148 studies because they did not fulfil all qualifying requirements. As a result, the remaining 75 studies were included. By reviewing the reference lists of the included studies and related literature reviews, I discovered 7 more research. This review comprised 82 papers in total.



**Figure 1.** Flowchart of the study selection process

## AI-Based Techniques Used for COVID-19

### *Purposes or uses of AI Against COVID-19*

During the epidemic, AI methods have been employed for five purposes. AI was utilised in 31 studies to diagnose COVID-19 cases or detect probable COVID-19 cases using different markers such as computed tomography (CT) pictures, x-ray images, laboratory tests, genomic sequences, and breathing patterns. AI was used in 20 trials to develop treatments and vaccines for COVID-19. In particular, 9 research utilised AI to find medicines that might be used to fight COVID-19, while 2 studies used AI to repurpose currently available pharmaceuticals that could be used to treat COVID-19. There was one research that used artificial intelligence to estimate the safety of utilising traditional Chinese medicine for COVID-19. AI was used to identify COVID-19 vaccines in four trials. Another four studies utilised AI to anticipate the microstructure of SARS-CoV-2, aiding researchers and pharmaceutical firms in the discovery of COVID-19 medicines.



AI was utilised in 17 research to do epidemiological modelling tasks. In specifically, 14 of this research deployed Intelligence to anticipate epidemic development (e.g., numbers of confirmed, recovered, death, suspected, asymptomatic, and critical cases, as well as durations and ending times), while three studies used AI to predict epidemic development.

AI was employed for patient outcome-related tasks in 14 research. Six research, in particular, employed AI for segmentation and quantification of COVID-19-infected areas in the lungs, allowing the severity of the illness to be assessed. AI was also employed in four trials to identify patients that were at high risk of progressing to severe COVID-19. Furthermore, AI was utilised to predict mortality risk, related variables, and length of hospital stay in COVID-19 patients.

AI has also been applied to epidemiology. Specifically, AI was utilised to raise awareness about the need of water, sanitation, and hygiene by integrating authentic sources of information with daily headlines.

### DISSCUSSIONS

I did a scoping assessment of the application of AI against COVID-19 in this work. In December 2019 and January 2020, I discovered a dearth of publications. This is not surprising given that SARS-CoV-2 was only discovered on January 7; insufficient data was available to support scientific publications, particularly those published internationally; and the virus's contagiousness and aggressiveness were underestimated (the first lockdown in China occurred on January 23). Half of the research included in this study were first published in China. Because SARS-CoV-2 originated in China and was the most prevalent during the first three months of the epidemic, it had the most data on COVID-19. Given the duration of the publishing process and the large number of COVID-19-related article submissions, it is not unexpected that the majority of the included research were preprints.

AI was utilised for five goals in the included studies: diagnostic, therapy and vaccine development, epidemiological modelling, patient outcome-related activities, and infodemiology. None of the research featured employed AI for additional objectives, such as tracing people's contacts, teaching students and health care workers, or using robots to deal with suspected and quarantined cases.

The majority of the AI techniques utilised in the included research were deep learning approaches like CNN and RNN. Except for one research, all were conducted on desktop computers, workstations, and clusters rather than mobile platforms. The computational requirement in training AIs can explain this. Although all major smartphone manufacturers have AI coprocessors in their top models, these coprocessors only speed up inference, which is a computationally far lighter operation. Furthermore, federated learning (a machine learning privacy-preserving approach commonly employed in mobile phones) is still in its early stages, raising concerns about data sovereignty, scalability, and performance.

### Conclusions

I present a scoping review of 82 AI research against COVID-19 in this paper. Given that many of the recommended approaches are not currently clinically approved, I believe that the most fruitful research will focus on strategies that have potential usefulness beyond



COVID-19. I feel that mobile phones have untapped potential, but further study towards energy-effectiveness of no pharmaceutical treatments is a relatively untapped research area, especially given the data driving this study is publicly available, unlike most of the data produced by clinical studies. Standardized reporting standards for AI investigations are required for AI to acquire widespread adoption. Similarly, additional study on AI ethics and explainable AI is required, as well as public education campaigns.

### REFERENCES

- Bukhari SUK, Bukhari SSK, Syed A, Shah SSH. The diagnostic evaluation of convolutional neural network (CNN) for the assessment of chest x-ray of patients infected with COVID-19. medRxiv. Preprint posted online March 31, 2020. [doi: 10.1101/2020.03.26.20044610]
- Chowdhury MEH, Rahman T, Khandakar A, Mazhar R, Kadir MA, Mahbub ZB, et al. Can AI help in screening Viral and COVID-19 pneumonia? arXiv. Preprint posted online March 29, 2020. Ghoshal B, Tucker A. Estimating uncertainty and interpretability in deep learning for coronavirus (COVID-19) detection. arXiv. Preprint posted online March 22, 2020. Hemdan EED, Shouman MA, Karar ME. COVIDX-Net: a framework of deep learning classifiers to diagnose COVID-19 in x-ray images. arXiv. Preprint posted online March 24, 2020.
- Narin A, Kaya C, Pamuk Z. Automatic detection of coronavirus disease (COVID-19) using x-ray images and deep convolutional neural networks. arXiv. Preprint posted online March 24, 2020. Ozturk T, Talo M. Yildirim EA, Baloglu UB, Yildirim O, Rajendra Acharya U. Automated detection of COVID-19 cases Using deep neural networks with x-ray images, *Comput Biol Med* 2020 Jun;121:103792 [EREE Full text] [doi: 10.1016/j.compbimed.2020.103792] [Medline: 32568675]
- Sethy PK, Behera SK. Detection of coronavirus disease (COVID-19) based on deep features. Preprints. Preprint posted online March 19, 2020. [doi: 10.20944/preprints202003.0300x1]
- Ucar F, Korkmaz D. COVIDiagnosis-Net: deep Bayes-SqueezeNet based diagnosis of the coronavirus disease 2019 (COVID-19) from x-ray images. *Med Hypotheses* 2020 Jul;140:109761 (FREE Full text) [doi: 10.1016/j.mchy.2020.109761] [Medline: 32344302]
- Wang L., Lin ZQ. Wong A. COVID-Net: a tailored deep convolutional neural network design for detection of COVID-19 cases from chest x-ray images. *Sci Rep* 2020 Nov 11;10(1):19549. [doi: 10.1038/s41598-020-76550-z] [Medline: 33177550]
- Zhang J, Xie Y, Li Y, Shen C, Xia Y. COVID-19 screening on chest x-ray images using deep learning based anomaly detection. arXiv. Preprint posted online March 27, 2020.
- Meng Z, Wang M, Song H, Guo S, Zhou Y, Li W, et al. Development and utilization of an intelligent application for aiding COVID-19 diagnosis, medRxiv. Preprint posted online March 21, 2020. [doi: 10.1101/2020.03.18.20035816]
- Feng C, Huang Z, Wang L., Chen X, Zhai Y, Zhu F, et al. A novel triage tool of artificial intelligence assisted diagnosis aid system for suspected COVID-19 pneumonia



## An International Multidisciplinary Research e-Journal

10.1101/2020.03.19.20039099] fever clinics, medRxiv. Preprint posted online March 20, 2020. Lopez-Rincon A, Tonda A, Mendoza-Maldonado L., Claassen E, Garssen J, Kraneveld AD. Accurate identification of

- Kong W, Li Y, Peng M, Kong D, Yang X, Wang L, et al. SARS-CoV-2 detection in patients with influenza-like illness. *Nat Microbiol* 2020 May;5(5):675-678. [doi: 10.1038/s41564-020-0713-1] [Medline: 32265517]
- Coronavirus disease (COVID-19): situation report- 121. World Health Organization. 2020. URL: <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200520-covid-19-sitrep-121.pdf> [accessed 2020-04-19]
- Chen Y, Li L.. SARS-CoV-2: virus dynamics and host response. *Lancet Infect Dis* 2020 May;20(5):515-516 [FREE Full text] [doi: 10.1016/S1473-3099(20)30235-8] [Medline: 32213336]
- Del Rio C, Malani PN. COVID-19-new insights on a rapidly changing epidemic. *JAMA* 2020 Apr 14;323(14):1339-1340. [doi: 10.1001/jama.2020.3072] [Medline: 32108857]
- Fontanarosa PB, Bauchner H. COVID-19-looking beyond tomorrow for health care and society. *JAMA* 2020 May 19;323(19):1907-1908. [doi: 10.1001/jama.2020.6582] [Medline: 32301955]
- Yang P, Wang X. COVID-19: a new challenge for human beings. *Cell Mol Immunol* 2020 May;17(5):555-557 [FREE Fulltext] [doi: 10.1038/s41423-020-0407-x] [Medline: 32235915]
- Ting DSW, Carin L., Dzau V, Wong TY. Digital technology and COVID-19. *Nat Med* 2020 Apr;26(4):459-461 [FREE Full text] [doi: 10.1038/s41591-020-0824-5] [Medline: 32284618]
- Contreras I, Vehi J. Artificial intelligence for diabetes management and decision support: literature review. *J Med Internet*
- Res 2018 May 30;20(5):e10775 [FREE Full text] [doi: 10.2196/10775] [Medline: 29848472]
- Shaw J, Rudzicz F, Jamieson T, Goldfarb A. Artificial intelligence and the implementation challenge. *J Med Internet Res* 2019 Jul 10;21(7):e13659 [FREE Full text] [doi: 10.2196/13659] [Medline: 31293245]
- van Hartskamp M, Consoli S, Verhaegh W, Petkovic M, van de Stolpe A. Artificial intelligence in clinical health care applications: viewpoint. *Interact J Med Res* 2019 Apr 05;8(2):e12100 [FREE Full text] [doi: 10.2196/12100] [Medline: 30950806]
- Russell S, Norvig P. *Artificial Intelligence: A Modern Approach*, third edition. Upper Saddle River, NJ: Prentice Hall, 2010.
- Alimadadi A, Aryal S, Manandhar I, Munroe PB, Joe B, Cheng X. Artificial intelligence and machine learning to fight COVID-19. *Physiol Genomics* 2020 Apr 01;52(4):200-202 [FREE Full text] [doi: 10.1152/physiolgenomics.00029.2020] [Medline: 32216577]
- Bullock J, Luccioni A, Hoffman Pham K, Sin Nga Lam C, Luengo-Oroz M. Mapping the landscape of artificial intelligence applications against COVID-19. arXiv. Preprint posted online March 25, 2020. [doi: 10.1613/jair.L.12162]



### DATA SCIENCE - REMODELLING PANDEMIC ADMINISTRATION

**Yaksh Dinesh Dharod**  
Utpal Shanghvi Global School  
yakshdharod@gmail.com

#### Abstract

Pandemic diseases are highly contagious. Great efforts will be needed to successfully combat this disease. In this paper, we evaluate the role of data science. Data science, combined with statistical analysis, computer science and computational biology, is helping in numerous ways with applications including epidemiology, drug discovery, and molecular design for diagnostic and therapeutic purposes. A number of data driven models, mathematical models, correlations and predictive models have been established. Challenges faced by the data scientists at present have been highlighted. Finally, open source datasets sources are mentioned that can be potentially used in curing and evaluating the health policies.

**Keywords:-** *Data Science Technology, Medical Science, Data Analytics, Artificial Intelligence*

#### INTRODUCTION

Infectious diseases represent a main challenge for health systems worldwide, either in private or public sectors. With the increase in cases related to these problems, combined with the recent global pandemic of COVID-19, the need to study schemes to cure these health disturbs is even more latent. Data Science has been addressed in this situation with the chance of predicting, mapping, tracking, monitoring, and raising alertness about these epidemics and pandemics. Thus, the main motive of this study is to find how it can help in cases of pandemics and epidemics. Data science technologies today are supporting medical science in reaching new milestones in medical imaging, genetics and genomics, drug discovery, patient– customer assistance, and predictive medicine. COVID-19 has put this in a spotlight. Data analytics has been effectively used to monitor real time disease outburst, forecasting, and spotting real time trends for governments, health organizations, and society in general. Data science field can be categorized into data management, data visualization and statistical machine learning. Each field has methods that can be used for organization, sorting, processing and enabling real time data analysis. At present, chemical engineers can aid in managing COVID-19 response with suitable data analytical techniques. These techniques are generally used to exploit the correlations in the datasets due to the mass transfer, energy transfer and basic thermodynamics and can be implemented for process modelling, diagnostics and predictions. In comparison to the earlier outbreaks, open source datasets for countries and cities have been made widely available for



COVID-19. Combining these with the socio-economic factors, investigators have been engaged in mathematical modelling and use of artificial intelligence. Applications in the field of risk assessment, diagnostics, modelling, contact tracing, economic and logistic planning, understanding effect of government policies and social interventions have helped us in gaining insights into the pandemic. The current research to detect the anomalies of pandemic, besides the diagnostics and therapeutics, is around detection of virus using CT scans data mining to collate information from social media and patient records, diagnostics of lungs and respiratory sound analysis in addition to speech and sound processing. The use of modelling techniques has become particularly beneficial during the COVID-19 pandemic for forecasting of trends and apply it for anticipating resource requirements, informed policy making, and ensuring adequate non-pharmaceutical interventions. This article aims to review the various ways in which modelling and artificial intelligence are being used to handle the pandemic situation efficiently and effectively.

### Theory

1. Numerical analysis of pandemic trends there has always been a nearby association between biostatistics and epidemiology for health planning and policy making. Statistics can be grouped into descriptive statistics and inferential statistics. Utilization of statistical analysis for describing the diagnostic test accuracy has been a benefit in the present COVID-19 scenario. Datasets are accessible publicly to enable population-based study taking individuals age and chronic medical conditions to scrutinize the consequence on death rate and approximation of recovery time. The most popular use of statistical correlation is evident in analyzing the consequence of climate conditions as well as the socio-economic factors on spread of disease. However, there are a few statistical explorations that claim that the spread of pandemic depends on population and its density, and that it is impervious to the weather conditions. Clustering analysis has been used extensively to visualize the likenesses in the countries based on the active cases per population and per area network analysis to estimate the incubation period of virus, infection rates, and fatality rates and spatial statistical analysis for analyzing the spread of the disease along with the grouping of the similar behaving countries. To normalize the irregularities in the datasets, fractal interpolation and dimensions has been confirmed to be well-organized and effective. The isolation strategy, a probable option for lockdown, has been established to assist health planning based on the predictive analysis of the number of tests.
2. Mathematical modelling: Due to the nuances involved in modelling of contagious diseases, mathematical models including the Susceptible Exposed-Infectious-Recovered model have been developed specifically for epidemiology. Some variations of the model consist of simulations of the spread of the disease based on constraints. Researchers have aimed to alleviate limitations of the model by accounting for health care capacity, underreporting of data, ICU beds accessible and precision of modelling the number of fatalities.
3. Use of artificial intelligence in modelling of pandemic: The flexibility of artificial intelligence has surged up the momentum to implement the modus operandi for medical and societal adversity. AI cover a varied biomedical area. However, only few



implementations are successful. The application of multilayer perceptron neural network in predicting the incident rates, recurrent neural network in combination with long short-term memory models for forecasting the infected cases and convolutional neural network for detecting the virus by analyzing the patients X-ray have offered useful insights about the spread of disease. In addition, algorithms like support vector regression for predicting the spread and analyzing the growth/transmission rate, random forest machine learning model for anticipating compound growth rate with respect to social distancing stringency and as a discrimination tool for early screening have contributed towards gaining an improved understanding of the potential risk factors. For early stage diagnostics, scope of implementation of methods like random forest classification, lasso based generalized linear models and supervised machine learning algorithms are being explored. However, for predicting the trends, genetic programming and models based on ensemble empirical mode decomposition with artificial neural network have proven to be effective.

4. Managing pandemic using data science and technology: Data technology has helped in assessing the associated risk factors, curing and surveillance. Furthermore, data analysis assists in realizing the effectiveness of non-pharmaceutical interventions & development of vaccines. Technology start-ups in partnership with the clinicians, academicians and government officials, are helping in managing the pandemic. The Bluecoat artificial intelligence, a Canadian start-up, was among the first one to identify, track and forecast outbreak in Hubei province and predicted the first 8 cities that would import the virus. Their real time data intelligence helps with monitoring of the pandemic movements. AI powered diagnostic systems developed by Alibaba has 96% efficiency for diagnosing coronavirus in few seconds based on the CT scans of patients. Google Deep mind AI is helping to identify the structure of protein associated with the respiratory diseases like coronavirus whereas Benevolent helps in determination of potential drug candidates. Terra drones are being used to deliver the medical supplies to minimize the human to human contact whereas robots are being used for cleaning and sterilization. In the present pandemic situation, data technology and artificial intelligence are playing a critical role in effective management of the outbreak.

### Experimental

Before policymakers reopen their economies, they must be certain that the resulting new COVID-19 cases will not force indigenous healthcare systems to resort to crisis standards of care. Doing so needs not just prevention and suppression of the virus, but ongoing measurement of virus activity, assessment of the efficacy of suppression measures, and forecasting of near-term demand on local health systems. This demand is extremely variable given community demographics, the prevalence of pre-existing conditions, and population density.

Data science can already offer ongoing, precise estimates of health system demand, which is a constraint in almost all reopening plans. We need to go beyond that to a dynamic approach of data collection, analysis, and forecasting to inform policy decisions in real time and iteratively optimize public health recommendations for re-opening. While most reopening plans propose extensive testing, contact tracing, and monitoring of population mobility, almost none consider setting up such a dynamic feedback loop. Having such response could determine what level of virus activity can be tolerated in a zone, given regional health system capacity.



By using current technology, it is likely to set up that feedback loop, which would maintain healthcare demand under the threshold of what is available in an area. Just as the maker community stepped up to cover for the failures of the government to provide adequate protective gear to health workers, this is a chance for the data and tech community to partner with healthcare professionals and provide a measure of public health planning.

For the data science effort to work successfully, we need to fix delays in data collection and access introduced by existing reporting processes. At this time, many sectors of public health are collecting and reporting metrics that are not helpful, and are reporting them with 48 hour delays, and often with mistakes. Although there are examples of regional excellence in such reporting, by and large, the recommendations from the health IT community around precise and fast public health reporting remain overlooked. For instance, consider the amount of COVID-19 hospitalizations, which is the greatest indicator of the disease's burden on the regional health system. Currently, as a result of time lags in confirming and reporting cases and a failure to distinguish between current and cumulative hospitalizations, even regions that report hospitalization data often provide only an unclear picture of the burden on the regional health system. Regions should ideally account both suspected and confirmed hospital cases and specify the date of admission, in addition to the date of report or authorization.

Even with perfect reporting, there are fundamental delays in what such data can tell us. For example, new admissions to a hospital today reflect virus activity as of 9 to 13 days ago. Not factoring in such considerations have led to significant over-estimation of hospitalization needs nationwide. We therefore need to measure virus activity via proxy measures that are indicative early in the lifecycle of the virus. We must benchmark these against the number of new and total COVID-19 hospitalizations as well as ideally the number of new infections, assuming it is accurately measured through large scale testing. Available proxy measures include test positivity rates in health systems, case counts, deaths and perhaps zero positivity rates. Ongoing symptom tracking via smartphone apps, daily web or phone surveys, or cough sounds can identify potential hotspots where virus transmission rates are high. Contact tracing, which currently requires significant human effort, can also help tracking of potential cases if it can be scaled using technology under development by major American tech companies.

With reliable tracking and benchmarking in place, we can calculate infection prevalence as well as daily growth and transmission rates, which is essential for determining if policies are working. This is a problem not only of data collection but also data analysis. Issues of sensitivity, daily variability, time lags, and confounding need to be studied before such data can be used reliably. For instance, symptom tracking is nonspecific and may have difficulty tracking virus activity at low prevalence. Other emerging data sources such as wastewater and smart thermometer data hold similar promise but will have to grapple with these same issues.

Several efforts have quantified the impact of mobility on virus transmission and a few have suggested “safe” sorts of mobility. While there are many potential ways to quantify population mobility — like via traffic patterns, internet bandwidth usage by address, and site of MasterCard swipes — the foremost scalable mechanism to live mobility appears to be via tracking of smartphones. Groups like the COVID-19 Mobility Data Network offer such data daily in anonymized, aggregated reports.

Once the power to project from mobility to transmission to health system burden is made, we will “close the loop” by predicting what proportion mobility we will afford given measured



virus activity and anticipated health system resources within the next fortnight. Researchers have already attempted to calculate “tolerable transmission” within the type of maximum contagion prevalence during a given geography which may not overload health systems. Coupling such tolerable spread estimates with daily assessments of a legitimate sample of the population would allow nursing of changes in transmission which may alert us to the necessity to intervene, like by reducing mobility. As new measures like contact tracing cut transmission rates, these same monitoring systems can tell us that it's harmless to extend mobility further. Uninterruptedly analyzing current mobility also as virus action and projected health system capacity can allow us to line up “keep the distance” alerts that trade off tolerable broadcast against allowed mobility. Concretely, then, the crucial “data science” task is to search the counterfactual function linking last week’s population mobility and today’s transmission rates to project hospital demand fortnight later. It's blurry what proportion days of knowledge of every proxy measurement what scientific form this function might take, and the way we do that correctly with the observational data accessible and avoid the trap of mere function-fitting. However, this is often the info science problem that must be undertaken as a priority so that the situation comes back to normal.

### RESULT

Implementing such technology and data science to stay anticipated healthcare needs under the edge of availability during a region requires numerous privacy trade-offs, which can require thoughtful legislation in order that the solutions invented for enduring the current pandemic do not lead to loss of privacy in perpetuity. However, given the immense economic also as hidden medical toll of the shutdown, we urgently got to construct an early warning system that tells us to reinforce suppression measures if the next COVID-19 outbreak peak might overwhelm our regional healthcare system. It is imperative that we focus our attention on using data science to anticipate, and manage, regional health system resource needs supported local measurements of virus activity and effects of population distancing.

### CONCLUSION

Contagious and infectious diseases represent a serious test for health systems, both public and personal, round the world. As it may be a recent epidemic, little has been originate within the literature on the utilization of knowledge within the control and monitoring of pandemic. Thus, methods and advancements used in other epidemics and pandemics have been mapped to recount them to the COVID-19 pandemic, seeking to highlight possible strategies that may help in this context.

Therefore, in order to classify how Data Science can help in the fight against epidemics and pandemics, we mapped the types of data and sources used for analysis and creation of techniques that support the fight against epidemics and pandemics. Equally, the techniques wont to treat these data were also mapped, thus showing their correlation with the present COVID-19 pandemic.

The changes Data Science can transport back the healthcare sector promise to be much bigger than many, governments, companies and organizations, can realize. With the emergence of a series of smart devices capable of collecting, storing, analyzing, and sharing user data during a mist, will make many data available to many people. This situation will change, almost completely, the way the health science outcome is attained.



The limitations of this study is that the incontrovertible fact that the review used only articles from journals, excluding studies published in other sources and websites to some extent.

We have realized that the Health Area is a fruitful field for Data Science, in which not both can broadly benefit from future studies, but the whole society as well. From these studies, results, dashboards for monitoring information, and even insights on data from patients who contracted the disease, future outbreaks could be early identified and stop illnesses to spread. Lastly with the data science we can eradicate the pandemic quickly.

### REFERENCES

Nikita Saxena, Priyanka Gupta, Ruchir Raman & Anurag S. Rathore. Role of data science in managing COVID-19 pandemic. Full article: Role of data science in managing COVID-19 pandemic. <https://www.tandfonline.com/doi/full/10.1080/00194506.2020.1855085> (accessed April. 21, 2021)

Eric Luellen. How is data science helping with the COVID-19 pandemic? How is data science helping with the COVID-19 pandemic? / By Eric Luellen. <https://towardsdatascience.com/how-is-data-science-helping-with-the-covid-19-pandemic-ecb524df6a19> (accessed April. 21, 2021)

Abe Dearmer. How Has COVID-19 Impacted Data Science? COVID-19 and Its Impact on Data Science / Xplenty. <https://www.xplenty.com/blog/covid-19-and-data-science/> (accessed April. 21, 2021)

Alana Corsi, Fabiane Florencio de Souza, Regina Negri Pagani & João Luiz Kovaleski Journal of Ambient Intelligence and Humanized Computing (2020). Big data analytics as a tool for fighting pandemics: a systematic review of literature. <https://link.springer.com/article/10.1007/s12652-020-02617-4> (accessed April. 21, 2021)

Castro R., Luz P.M., Wakimoto M.D., Veloso V.G., Grinsztejn B. and Perazzo H., “COVID-19: A Meta-Analysis of Diagnostic Test Accuracy of Commercial Assays Registered in Brazil”, Brazilian Journal of Infectious Diseases, 24(2), pp. 180–187 (2021).

Banerjee A., Pasea L., Harris S., Gonzalez-Izquierdo A., Torralbo A., Shallcross L., Noursadeghi M., Pillay D., Sebire N., Holmes C., Pagel C., Wong W.K., Langenberg C., Williams B., Denaxas S. and Hemingway H., “Estimating Excess 1-Year Mortality Associated with the COVID-19 Pandemic According to Underlying Conditions and Age: A Population-Based Cohort Study”, The Lancet, 395(10238), pp. 1715–1725 (2021).

Barman M.P., Rahman T., Bora K. and Borgohain C., “COVID-19 Pandemic and its Recovery Time of Patients in India: A Pilot Study”, Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14(5), pp. 1205–1211 (2021).

Menebo M.M., “Temperature and Precipitation Associate with COVID-19 New Daily Cases: A Correlation Study Between Weather and COVID-19 Pandemic in Oslo, Norway”, Sci. Total Environ., 737, pp. 139659 (2021).



Livadiotis G., “Statistical Analysis of the Impact of Environmental Temperature on the Exponential Growth Rate of Cases Infected by COVID-19”, PLoS One, 15(5), pp. e0233875 (2021).

Kumar A., Rani P., Kumar R., Sharma V. and Purohit S.R., “Data-driven Modelling and Prediction of COVID-19 Infection in India and Correlation Analysis of the Virus Transmission with Socio-Economic Factors”, Diabetes Metab Syndr Clin Res Rev, 14(5), pp. 1231–1240 (2021)

Chatterjee A., Gerdes M.W. and Martinez S.G., “Statistical Explorations and Univariate Timeseries Analysis on COVID-19 Datasets to Understand the Trend of Disease Spreading and Death”, Sensors (Switzerland), 20(11), pp. 3089 (2021)

Meraj G., Farooq M., Singh S.K., Romshoo S.A., Sudhanshu N.M.S. and Kanga S., “Coronavirus Pandemic Versus Temperature in the Context of Indian Subcontinent: A Preliminary Statistical Analysis”, Environ Dev Sustain (WHO), pp. 1–11 (2021)

Zarikas V., Pouloupoulos S.G., Gareiou Z. and Zervas E., “Clustering Analysis of Countries Using the COVID-19 Cases Dataset”, Data Br, 31, pp. 105787 (2021).

Wang P., Lu J., Jin Y., Zhu M., Wang L. and Chen S., “Statistical and Network Analysis of 1212 COVID-19 Patients in Henan, China”, Int. J. Infect. Dis., 95, pp. 391–398 (2021).

Neil M., Fenton N., Osman M. and McLachlan S., “Bayesian Network Analysis of COVID-19 Data Reveals Higher Infection Prevalence Rates and Lower Fatality Rates Than Widely Reported”, J. Risk. Res., 0(0), pp. 1–14 (2021).

Huang R., Liu M. and Ding Y., “Spatial-Temporal Distribution of COVID-19 in China and its Prediction: A Data-Driven Modeling Analysis”, J. Infect. Dev. Ctries., 14(3), pp. 246–253 (2021).

Franch-Pardo I., Napoletano B.M., Rosete-Verges F. and Billa L., “Spatial Analysis and GIS in the Study of COVID-19. A Review”, Sci. Total Environ., 739, pp. 140033 (2021).

Melin P., Monica J.C., Sanchez D. and Castillo O., “Analysis of Spatial Spread Relationships of Coronavirus (COVID-19) Pandemic in the World Using Self Organizing Maps”, Chaos Solitons Fractals, 138, pp. 109917 (2021).

Păcurar C.M. and Necula B.R., “An Analysis of COVID-19 Spread Based on Fractal Interpolation and Fractal Dimension”, Chaos Solitons Fractals, 139, pp. 110073 (2021).

Djilali S. and Ghanbari B., “Coronavirus Pandemic: A Predictive Analysis of the Peak Outbreak Epidemic in South Africa, Turkey, and Brazil”, Chaos Solitons Fractals, 138, pp. 109971 (2021)



## An International Multidisciplinary Research e-Journal

Maheshwari H., Yadav D., Chandra U. and Rai D.S., “Forecasting Epidemic Spread of COVID-19 in India Using Arima Model and Effectiveness of Lockdown”, *Adv Math Sci J*, 9(6), pp. 3419–3432 (2021).

Ren H., Zhao L., Zhang A., Song L., Liao Y. and Lu W., “Early Forecasting of the Potential Risk Zones of COVID-19 in China’s Megacities”, *Sci. Total Environ.*, 729, pp. 138995 (2021)

Mohamadou Y., Halidou A. and Kapen P.T., “A Review of Mathematical Modeling, Artificial Intelligence and Datasets Used in the Study, Prediction and Management of COVID-19”, *Applied Intelligence*, 50, pp. 3913–3925 (2021)

Annas S., Isbar Pratama M.I., Rifandi M., Sanusi W. and Side S., “Stability Analysis and Numerical Simulation of SEIR Model for Pandemic COVID-19 Spread in Indonesia”, *Chaos, Solitons Fractals*, 139, pp. 110072 (2021).

Karako K., Song P., Chen Y. and Tang W., “Analysis of COVID-19 Infection Spread in Japan Based on Stochastic Transition Model”, *Biosci. Trends.*, 14(2), pp. 134–138 (2021).

Fox G.J., Trauer J.M. and McBryde E., “Modelling the Impact of COVID-19 on Intensive Care Services in New South Wales”, *Med. J. Aust.*, 212(10), pp. 468–469 (2021).

Hu Z., Qianqian C., Junmei H., Xia W., Sha W.E.I. and Zhidong T., “Evaluation and Prediction of the COVID-19 Variations at Different Input Population and Quarantine Strategies, a Case Study in Guangdong Province, China”, *Int. J. Infect. Dis.*, 95, pp. 231–240 (2021).



### ROLE OF IOT DURING COVID-19 PANDEMIC

**Asmi Karnik**

Billabong High International School

Email id-[vaidya.sonali@gmail.com](mailto:vaidya.sonali@gmail.com)

#### Abstract

In recent years there have been advancements in the application of IoT in the field of healthcare. Since 2020 our world struggled with the covid-19 pandemic, during this hard time IoT came to the rescue. This research paper surveys how the application of IoT has helped and become a crucial part of combating the pandemic, and the state-of-the-art technology used to do this. The objective is to prove the advantage and safety provided by using the Internet of Things in two key phases of detection of suspicious cases and quarantine of confirmed cases.

**Keywords:** *Internet of Things (IOT), Covid-19 pandemic, detection of suspicious cases, quarantine of confirmed cases.*

#### INTRODUCTION

Kevin Ashton was the first person to use the term “Internet of things” in a presentation. Since then, the technology of the internet of things has been incorporated into many fields and services. One of these is healthcare, where IOT is having a humungous impact and is becoming vital to the treatments of patients. Since the year 2020, the entire world has been struggling with the Covid-19 pandemic, though many countries have managed to curb cases; there is again a boost in cases worldwide, during this time the health sector is coming across many challenges of detecting suspicious cases, and ensuring patients follow quarantine guidelines.

This has helped people to actually realize the importance and advantage of IoT in healthcare. The pandemic continues to infect people all around the globe. There is desperate need to safely and efficiently detect covid cases in hard hit countries such as India which have been experiencing a rise in cases again. IoT has proven to be a safe technology in the key phases of detection and quarantine. Using devices and advanced technologies such as a multitude of Robots, vast variety of wearable technologies to track patient’s vitals, all circumvent the hurdles of the pandemic. Other technologies include drones to provide fast help, IoT buttons to perform various tasks only at a touch and Smart phone applications to keep everyone updated and provide a popular interface for all the patient’s needs. IoT devices can instantly capture patients’ vitals and safely test without human interaction, and can monitor a patient’s health remotely and ensure patients adhere to quarantine. They are cost efficient and provide rapid response.

#### Phase 1-Detection of covid-19 cases

The first phase to curb the spread of this virus is detection of suspected Covid-19 cases, this is an important phase as identification of infected persons and surveillance of disease is extremely



vital for identifying public health threats. “IoT devices speed up detection by effectively capturing data with sensors and then analyzing data for health authorities to effectively diagnose and control this virus.” IoT devices such as drones and robots are the solutions to problems such as distance and accessibility to deliver test results, samples and medical aid. The following are some examples of IoT devices that can be used to easily detect suspected covid-19 cases: -

**1. Wearable technologies**-These devices provide an efficient means for early detection. They are devices that can be worn by a person and are primarily meant for health and fitness. They have sensors which can record body temperature and oxygen level of a person, also they can confirm if the patient is exhibiting any symptoms of covid-19. Some examples of these devices are Smart helmets, Smart thermometers and Smart glasses. “It is predicted that healthcare providers will spend \$20 billion annually till 2023 to monitor patients”. Further description on wearable IoT technology is as follows: -

- a. Smart thermometers: -They have been made to constantly record a person’s body temperature. These devices are stuck onto the patient’s skin and are available in a multitude of varieties, shapes and sizes such as a patch or a wrist band. Their advantage is that they prevent the unsafe usage of infrared thermometers, which actually lead to increased infection due to proximity of the patient and healthcare provider which is less than 2 meters. Health officials can access the data recorded by the thermometers on their phones. Some widely used smart thermometers include; Tempdrop, iFever and Kinsa’s thermometers.
- b. Smart helmet: -This IoT device is safer than using infrared thermometer guns. It detects a person’s body temperature with the help of the thermal camera on the helmet. It simultaneously identifies a person using an optic camera. It is useful for reducing human interactions during tests. “Google location history can also be incorporated into this helmet, so the places visited by the person can be disinfected ensuring public safety. Countries such as Italy and China have incorporated this to assist health officials from safe distances. An example of a Smart helmet is a Chinese helmet named KC N901.

**2. Drones**-Small aircrafts flying by remote control, called Unmanned Aerial Vehicles. The use sensors, GPS and communication services to operate. The Internet of Drone Things enables drones to perform research work on the virus with human supervision. Some are designed for a specific purpose, like the thermal imaging drone which captures temperature of people in crowds. An example of a drone is the pandemic Drone application developed by a Canadian company which can remotely monitor, check for sneezing and detect infection using a connected drone. Other drones include disinfectant, medical and surveillance drones.

**3. Robots**- “Robots are machines that resemble living creature and can move independently.” There are four categories of robots which are; telerobots, collaborative, autonomous and social robots. These robots are outfitted with thermometers and infrared imaging allowing for easy detection without human interaction “An example is the intelligent care robot developed by Vayyar imaging and Meditemi. It can detect any symptom of covid in 10 seconds using touch-less scanning of the person at a distance of 1 meter.”

**4. IoT Buttons**-They are as the name suggest, are small buttons which through wireless communication are connected to the cloud. The device is able to perform repetitive tasks according to its code. These buttons allow patients to alert authorities, regarding public health safety in to time at all, all at a touch of a button. If a person is in the proximity of a suspected



covid-9 case, they can immediately touch the button and alert authorities regarding the suspected case.

**5. Smart phone applications:** -These apps are designed for the specific purpose of reducing Covid cases and ensuring public safety. They offer cost effective, online consultation with doctors and can warn users when they are in the vicinity of a positive or suspected case of Covid. Smart phone applications have one disadvantage though, they are limited by their users, they cannot access the information of someone who has not downloaded the app. Below are some examples: -

- a. nCapp-An app developed in China using a cloud platform, it has eight functions, and gives a questionnaire on the basis of which a diagnosis report will be produced on which the doctor will divide it into confirmed, suspected and suspicious. They are then further divided into critical, severe, moderate or mild case.
- a. MobileDetect-Using this app, a test is taken at home using a nasal swab, the test results can then be viewed 30 minutes after the test. Then the user sends the report to the doctor for prescribing medicines and advice on further steps.

### Phase 2-Treatment and Quarantine

The second phase to combat the covid-19 pandemic is treatment and quarantine of positive cases. The method of quarantine is used to isolate suspected or confirmed cases of Covid-19 away from others, this prevents further spread of the virus. Following quarantine is key to stopping the pandemic; this is ensured by IoT devices which use innovative track-and-trace methods using devices such as drones, robots, wearable devices and patient's phones. Below are the explanations to usage of IoT in this phase:

1. **Wearable technologies**-These technologies can be worn at all times. They are helpful in preventing patients from flouting rules of quarantine. These are cost effective appliances which can be tracked by GPS. Medical authorities can track a positive case through the wearable; or a device which is connected by Bluetooth to the wearable such as a phone; this way authorities will know the location of the person, and take action. Authorities receive alerts if a patient leaves the quarantine area, then the patient is immediately contacted. Some examples are the incorporation of IoT-Q-Band in airports in Hong Kong which are wristwatches that monitor recent arrivals and Ankle bracelets/Ankle monitor in USA to monitor people who refuse to comply with quarantine rules.
2. **Drones**-Drones are important in the field of medication to reduce human interactions. They are often used in hospitals and delivery services as they can cover long distances in short times and can reach remote locations with ease, using the disinfectant and delivery drones.
  - a. Disinfectant Drone-Used to thoroughly sanitize areas during quarantine, keeping health workers safe from danger of getting infected.
  - b. Delivery Drone-Used to transfer test-kits, samples and medical supplies between medical center, acting as a safe and fast alternative.

Some examples of real-life working drones include, Delivery drone by Canada Inc. which moves Covid goods such a test samples and swabs. It is also used for postal and grocery services for quarantined families.



3. **Robots**-During this pandemic, robots have been useful in the treatment of patients, different varieties of robots have been developed for diverse purposes such as surgery and remote diagnosis, below are some varieties and their purposes.
  - a. Telerobots-Made for remote diagnosis, measuring a patient's body temperature, treatment and surgeries. They are remotely controlled by a surgeon when operating on a patient. Examples include the DaVinci Surgical robot, which is operated by an expert surgeon while the patient is safe under a plastic sheet.
  - b. Collaborative robots-These robots are also called Cobots, and have been created to aid healthcare workers, but are not as beneficial as telerobots. An example is the "eXtreme Disinfection robot, known as XDBOT which has been implemented by Nanyang Technological University in Singapore. "It is used to disinfect the area around hospital beds and are wirelessly controlled by a supervising person.
  - c. Autonomous robots-These are the most widely used and are utilized in various scenarios such as; sterilize or disinfect contaminated areas to decrease risk of infection to health workers. An example is a "robot created by Xenex which is capable of cleaning and thoroughly disinfecting areas of virus and bacteria by using UV light to destroy the DNA and RNA of the microbes."
  - d. Social robots-Created to deal with mental health problems which might be developed during isolation. The robots act as lovable friends which relieve a patient and reduce their stress levels, a robot called Paro is an example.
4. **IOT buttons**-IoT buttons can track patients during quarantine, the program will track whatever device the patient has with them, all at a touch of a button. The Sefucy IOT button is used for tracking patients and emergency notifications for the healthcare provider.
5. Smart phone applications-A variety of smart phone applications have been developed to help track a patient's whereabouts to make sure they are adhering to the rules of quarantine, they use technologies such as GPS tracking. Some examples of these apps are as follows: -
  - a. Social monitoring-Mandatory surveillance app in Russia to track patients. A patient requests a QR code when they need to go outside and leave quarantine areas, the code represents a person's identification through which authorities track them.
  - b. Aarogya Setu-App developed by the Indian government can show a person's status in whichever area he or she enters by using data of patients from nearby area and giving a diagnosis such as safe or not safe depending on the number of cases it detects in the area. This allows people to remain cautious where they go.

### Safety and Cybersecurity of using IoT devices

Numerous IoT devices have been manufactured during pandemic, and millions of users and healthcare centers trust them with their data. There is a vital need to protect the patients and user's data from cyberattacks or cyberthreats. The continuation of IoT technologies in healthcare must be maintained by keeping out hackers, viruses and other cyberthreats. By ensuring security and privacy of the people, we can create a reliable interaction between the physical and cyber worlds. There are two kinds of threats out there; the first being external attacks such as attacks on systems by hackers and the second being the misuse of data and privacy. Authorities must make

sure that patient records, details and test results must be kept safely in the system using methods such as passwords, encryption, firewalls and ensure that allemployees receive regular security training to keep out threats. To prevent internal threats, authorities should run complete background checks on employees who regularly access confidential data.

### Experimental

A survey was conducted by me on public opinion of Aarogya Setu app using Google Forms. The questionnaire was conducted among 46 people, it contains two close ended questions; the first one being "Do you use the Aarogya Setu app?" And the second question being "Do you think the Aarogya Setu app has helped during this COVID-19 pandemic", the open-ended question being "Why do you think Aarogya Setu has/has not/some-what helped during COVID-19 pandemic." The results were compiled into pie charts and short answers. The following is the link to the form: <https://forms.gle/yqsqyce47hXRYaw37>

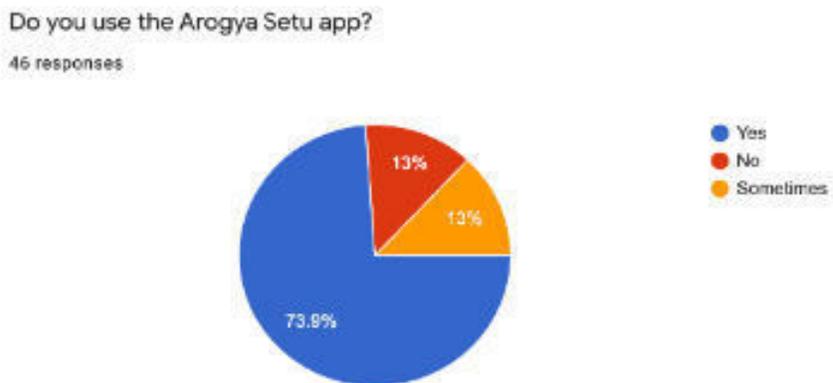
### RESULT

- Maximum amount of the people surveyed, regularly use the Aarogya Setu app, while exponentially less people don't use it. Equal amounts of people think that the app has helped very much and moderately, while equally lesser amount of people think it hasn't helped or are not sure.
- The Aarogya Setu app has assisted people during this pandemic, but it still has its problems and issues. The data depends on the number of people who have downloaded the app and given their true medical status. The government still can make much improvement in this app to improve user experience.

### DISCUSSION

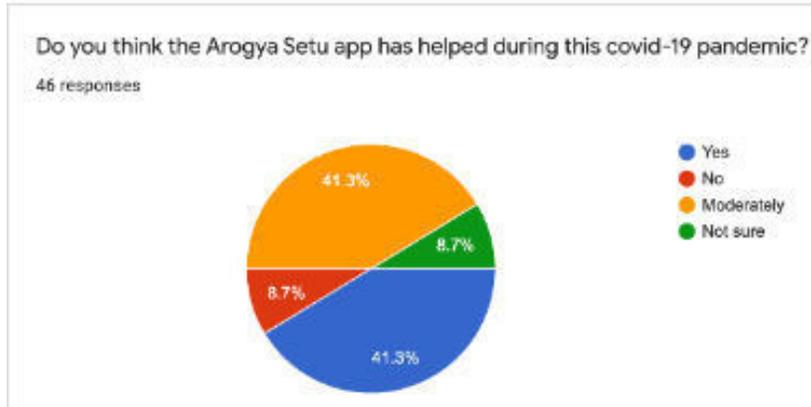
After collating the data received, the data was converted into Pie chart form by Google forms, below are the results and their respective statistics: -

- As seen in the Pie Chart, we can see that 86.9% of the people surveyed; more than half the people surveyed use the Aarogya Setu app showing that it is widely used and popular tool for assisting people to combat the pandemic and ensure their safety, while only a small amount of people that is 13% do not use the app.



**Fig.1** Screenshot of Pie chart taken from google forms

- By observing this Pie Chart, I inferred that 82.6% of the people surveyed found the app useful, proving that IoT technology such as this Smart Phone application is the solution to stopping further spread of covid-19 and that the method used by this app has been effective and useful to help people be on their guard against the virus. The chart also shows a significant amount of 8.7% of the surveyed persons did not find the app useful, showing that even though the services provided by the app are effective there is still much room for further updates and improvement.



**Fig.2** Screenshot of pie chart taken from google forms

- Why do you think the Aarogya Setu app has/has not/some-what helped during Covid-19 pandemic? -The last question of the survey is an open-ended question, asking for a short answer on their views. I received 46 responses from which I listed some from each of the three points of views and explained them: -
  - Has helped:** - “It has helped in warning it's users of any exposure to an infected person thus giving an initial warning for remedial actions to its user. Also, it has helped corporates, in combating the spread of the disease through its usage.” And “It has helped for contact tracing around a COVID positive case to an extent, also lots of latest updates regarding vaccination centers and vaccine registration are available on Aarogya Setu app. So yes, it has helped.” Both these views describe how the Aarogya Setu app has given alerts; and information regarding vaccination and how is it used to track positive covid patients who have taken the test. These positive views highlight the benefit of using this application.
  - Some-what helped:** - “It helped but a lot could have been improved in its UI and efficiency. The Bluetooth functionality was erratic and it asked to re-login every time it was opened. But at least it gave a tentative estimate of people and infection around you.” And “Basically the app does not have a QR code approach. It is not capturing the data in real time. It should ensure mapping of people who are getting tested positive and map them with people with whom they have come across. This way the app will automatically raise alert for the person in real-time if they are under threat of infection. Also, it will help the govt to inform and track people. Movement of people can be tracked better.” These two opinions describe that the app did not always function perfectly, was erratic and did not show real time information. This describes that though app has been useful track some cases and register for vaccines; it has many bugs and problems which need to be fixed and updates to be made to improve user experience and functionality.



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- c. **Not helped:** - “Many people do not share true status, so it becomes difficult for other healthy people.” And “Concept was hinging on user declaring correct info, if user hides info, then entire purpose is lost. It would have been perfect if It was linked with master data base of Indian Govt.” Views such as this which did not find the app useful mainly highlighted its two problems, that are the fact that all the people haven’t installed the app and most people do not share their true medical status with the app, leading to incorrect data.

### CONCLUSION

IoT has indeed taken a great leap forward during the pandemic, and has proven to be an effective and efficient solution during quarantine and identification of COVID patients. Technologies such as wearables, which include ankle bracelets, smart bands, glasses and helmets which are easy to wear provide cost-efficient and no-contact strategies to control the spread of this virus; alongside various kinds of drones such as medical, delivery and disinfectant drones, which cover large distances in short time. Robots such as telerobots, collaborative and autonomous robots are made to assist health-workers and monitor patients while social robots are for patients to relieve stress. Smart phone applications have been developed around the world and most have been successful and useful to citizens, but much still remains to be improved for better user experience. “IoT is becoming a norm in healthcare, Covid has opened the gateway for IoT adoption in healthcare”.

### REFERENCES

- Nasajpour M., Pouriyeh S., Parizi R. M. et al. “Internet of Things for Current COVID-19 and Future Pandemics: an Exploratory Study”. J Healthc Inform Res 4, 325–364, 2020, Accessed-May 10 2021, Available: <https://doi.org/10.1007/s41666-020-00080-6>
- Ravi Pratap Singh, Mohd Javaid, Abid Haleem, Rajiv Suman, “Internet of things (IoT) applications to fight against COVID-19 pandemic” Diabetes & Metabolic Syndrome: Clinical Research and Reviews, Volume 14, Issue 4, 2020. Accessed-May 10 2021, Available: <https://www.sciencedirect.com/science/article/abs/pii/S1871402120301065>
- Z. Hassan, H. A. Ali, “Internet of Things (IoT): Definitions, Challenges and Recent Research Directions”, Accessed-May 10 2021, Available: [https://www.researchgate.net/profile/Zozo-Hassan/publication/320532203\\_Internet\\_of\\_Things\\_IoT\\_Definitions\\_Challenges\\_and\\_Recent\\_Research\\_Directions/links/59ea1d4ba6fdcccf8b08cc3e/Internet-of-Things-IoT-Definitions-Challenges-and-Recent-Research-Directions.pdf](https://www.researchgate.net/profile/Zozo-Hassan/publication/320532203_Internet_of_Things_IoT_Definitions_Challenges_and_Recent_Research_Directions/links/59ea1d4ba6fdcccf8b08cc3e/Internet-of-Things-IoT-Definitions-Challenges-and-Recent-Research-Directions.pdf)
- C. A. Da Costa, C. F. Pasluosta, B. Eskofier, D. B. Da Silva, R. Da Rosa Righi, “Internet of Health Things: Toward intelligent vital signs monitoring in hospital wards” Accessed-May 10 2021, Available: <https://www.sciencedirect.com/science/article/pii/S0933365717301367>
- Erini Christaki (2015), “New technologies in predicting, preventing and controlling emerging infectious diseases”, Virulence, Accessed-May 10 2021, Available:
  - <https://www.tandfonline.com/doi/full/10.1080/21505594.2015.1040975>



## An International Multidisciplinary Research e-Journal

- A. Farr., T. Abonil., “AI, big data, cybersecurity and IoT in the era of coronavirus”  
<https://www.elsevier.com/connect/ai-big-data-cybersecurity-and-iot-in-the-era-of-coronavirus>  
(Accessed May. 10, 2021)
- Centers for Disease Control and Prevention. “When to Quarantine.”  
<https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html>  
(Accessed May 10,2021)



# Indian Scholar

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### DATA SCIENCE: A WEAPON AGAINST PANDEMICS

**Anuva Khanna**  
EuroSchoolAiroli  
[anuvakhanna07@gmail.com](mailto:anuvakhanna07@gmail.com)

#### Abstract

Out of all health related adversities, an epidemic is the most unpredictable one. An epidemic is a pathogen that affects people of only a certain country. While a pandemic is a pathogen that affects people across the globe, In 2020, COVID 19, a novel airborne virus, emerged as the 7th amongst the 6 previously known coronaviruses. This pathogen uses RNA (Ribonucleic acid) instead of DNA (Deoxyribonucleic acid). The virus contains spikes, thus making penetrating the cells much easier. This causes the contracted person's symptoms to go unnoticed, making it harder to track. In the wake of the COVID 19 surge, data scientists have been using various tools like Artificial Intelligence, Big Data, and Machine Learning to predict the rate of spread of the virus. This paper talks about the factors taken into consideration and the methods used to predict the speed and spread of the novel coronavirus.

**Keywords:** *Data Science in Epidemic Prediction, Big Data Analytics in Epidemiology, Virus case count prediction, Virus transmission rate algorithms, Machine learning, AI, Big Data in Epidemics, Prediction in Epidemics*

#### INTRODUCTION

Over the decades, various viruses have affected micro level healthcare systems and macro level healthcare systems. Since the early Stone Age, the world has seen several such pathogens arising. Some of the most harmful pathogens were: the Bubonic Plague (1346-1353) [1], the Spanish Flu (1918-1920) [2] with an estimated case count of 500 million, Influenza Virus A (H1N1) (1918) [3], Influenza Virus (H2N2) (1918-1919) [4], Human Immunodeficiency Syndrome (1981) [5] and the currently ongoing COVID 19 [6]. With the technological advancements in the past century, healthcare systems have strengthened and dealing with epidemics has become more effective. Data Science, a field that uses mathematics and statistics to analyse current data and to predict future data, has played a major role in the prediction of COVID 19 cases. Under this broad category come several other emerging technologies. Machine learning is one such example. It is a type or form of Artificial Intelligence that allows machines to imply future scenarios from data. This research is of utmost importance as it will affect the actions of the future. This is because the case count predictions for a particular location will



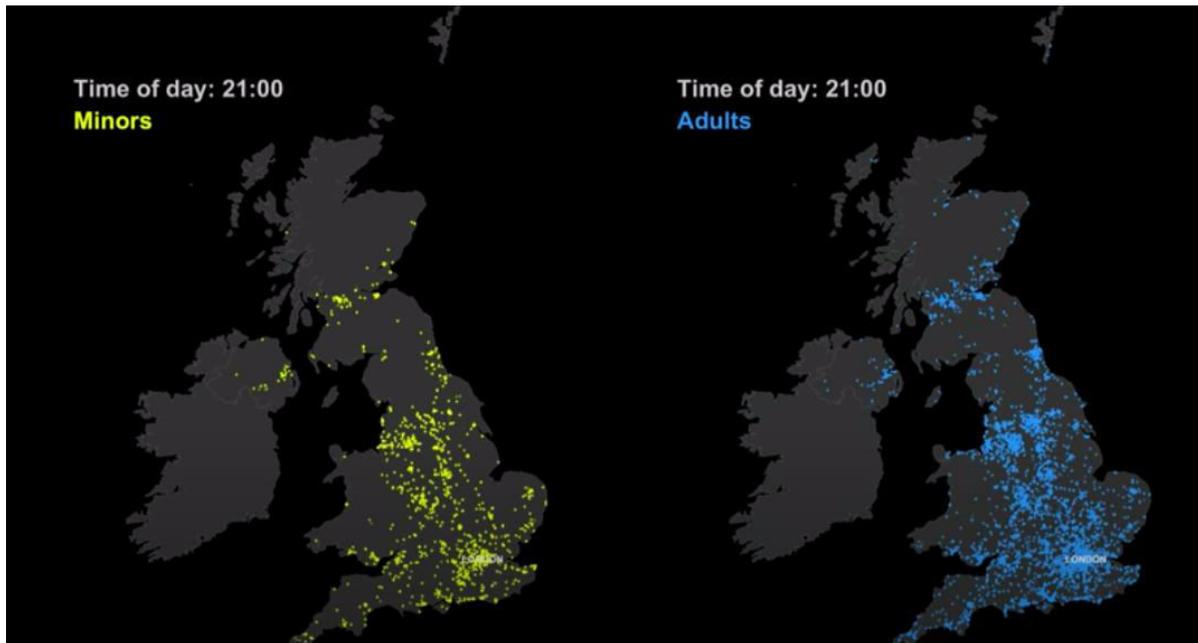
decide whether the place will be in containment for that period of time or will be ‘unlocked’ due to fewer cases. This is a strategy that the governments of several nations have been using, to ensure that minimal risk is taken with the case increase while also ensuring that economic activity in the nation does not halt completely. Not only does this affect government action, it also affects micro-level decision making as the prediction proves fruitful for people to understand the risk level to a certain age group, also affecting economic and entrepreneurial decisions made on the microscopic level. For these reasons, the predictive part of Data Science’s contribution to the pandemic is the most vital part. This research is not just restricted to predicting the number of cases in a certain locality. It can extend to predictive analysis for recovery from the virus. Such research can include factors like predicting the number of vaccines a city or district will need. Recent research predicted through algorithms in data science (Sicilia, 2020, 9) has been using one aspect of public interaction through the Internet like Google and other social media to understand the severity of cases in that particular area via the tonal implication of the searches. Google Flu Trends, a source of study that is now discontinued, was a tracking platform to check how many times questions about a certain persisting disease were asked on Google. This is one of the many types of data used to predict the case count in different locations using prediction and transmission rate algorithms. This is just one example of how different data sets are being used for predictions, thus proving how useful Data Science can be in a health crisis like this.

### **Body: An Overview**

As a topic of current discussion, lots of research and conclusions have been carried out. Each paper has taken into account different variables that could help in prediction of the case count. All these variables play instrumental roles in the course of the virus’ rapid spread, also giving a rough idea of how the virus will travel and where it could potentially cause the most harm. Listed below and explained in detail are the factors considered while predicting the virus’ movements, effective recovery from the virus and prediction of future viruses for the world to be better prepared for, also showing how Data Science was used to collect this information and implicate it. [7]

### **Prediction Factor A**

Due to the unpredictable nature of an epidemic, it is impossible to predict where the spread will escalate the quickest. For this reason, data scientists consider the movement of the population on a daily basis [8]. Factors like the lifestyle of a population can give useful insight and can help understand where the virus might spread easily. The first and most commonly used variable to form data sets in Data Science is the understanding of where hotspots could potentially be formed. This is ideally the first approach in the wake of a pandemic as the data available for this set is relatively easily available.



Fig

*1* Caption: Satellite tracking of adults and minors [9]

As shown above, Fig 1, depicts the real time satellite tracking in the normal life of people in the location recorded. This data shows the number of commuters in different places across the country. Based upon this data, it becomes easier to predict where cases could rise quickly after analysing where most people travel to and fro from. Though in this case, the sets show different possible ‘hotspots’ as it examines different age groups. However, this problem can be solved. These sets could become one cohesive set after combining the commuter number for both minors and adults, thus giving an estimate of the population travelling across the country and the places where travel is more frequent. This could result in earlier allocation of preventive measures like imposing night curfews, weekend lockdowns and restriction of the number of people attending social events, thus slowing the spread of the virus.

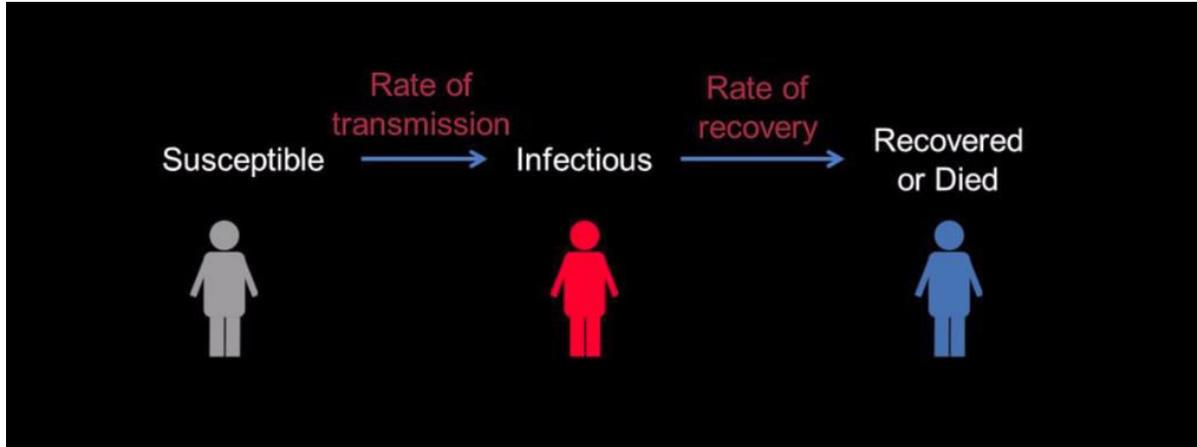
### **Prediction Factor B**

The second predictive factor comes into play in a later stage where a number of people have already been infected and are now susceptible to carrying the virus. This factor is actually a number of different factors in synchronisation. Though this dataset is used much later into the pandemic, it is more effective than Predictive Factor A since it is actually dealing with the real time statistics of those who have been infected, those who have recovered, the death count and the population of the area, based on the level that the data scientists are dealing with. This method is more efficient in analysing smaller ecosystems. Such analysis on a national level would be more inconvenient as it requires more data than other methods.

In this predictive method, several factors are taken into account:

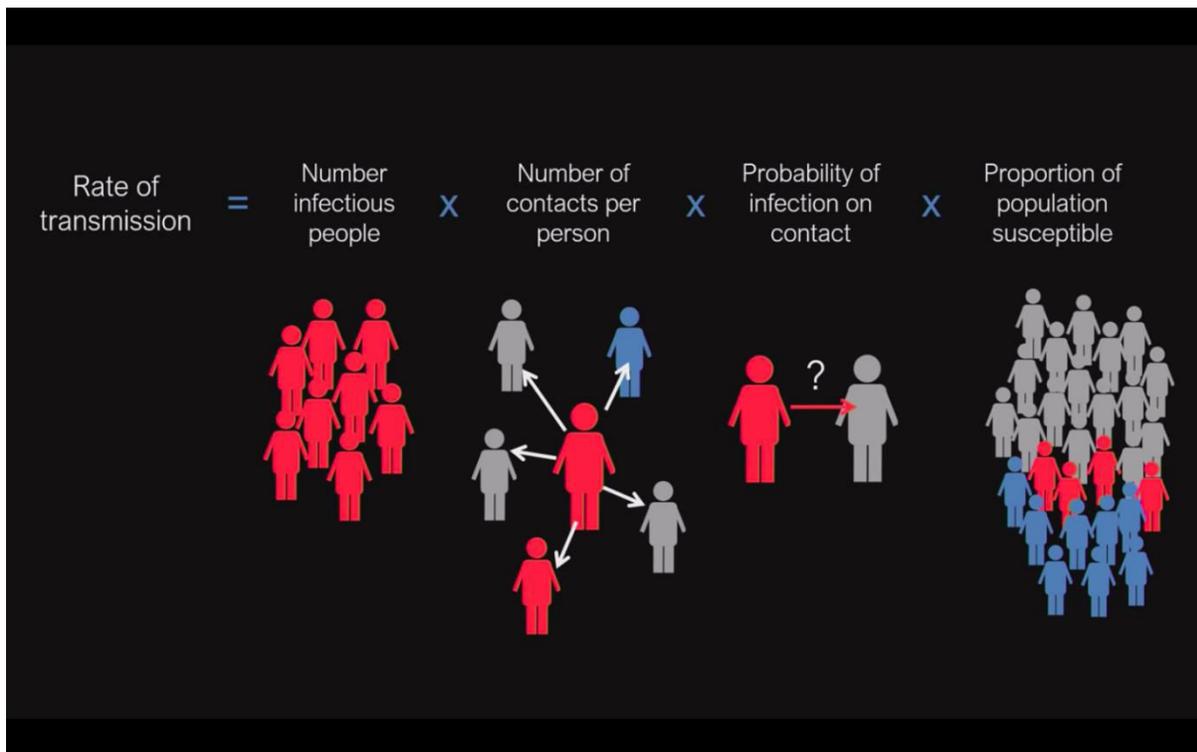
1. The death count of that location
2. The number of infected people
3. The number of contacts for the infected and susceptible people

4. The number of recovered people
5. The population of that location (including minors)



Fig

2: Caption: Factors involved in prediction [10]



Fig

3: Caption: Formula to predict the rate of transmission, to predict case count [11]

As shown in Fig 3, the transmission rate can be predicted by multiplying the number of infectious people by the number of contacts by the probability of the infection on contact by the



susceptible population proportion. Another method around this is subtracting the death count, recovery count and case count from the total population.

*Total population = Number of people who died + Number of people who recovered + Number of people who have contracted the virus + Remaining population vulnerable to the virus*

This gives a very accurate estimate on the number of people who are still vulnerable to the virus, as compared to the population on a whole, thus giving a ratio of vulnerable to the total population. This, once multiplied by the rate of transmission, can be used to predict cases in that location.

This method is effective with small populations as it gives an accurate prediction and can help the governing bodies to decide on which steps to take next. But other more widely available predictive factors can be used to reach a conclusion for large scale communities and ecosystems, that would otherwise require more data if this predictive factor was applied. Based on the predictions, the leading body of the community can decide on which activities can be cut down on. The body can also decide to which extent must these activities be held off and for long they must be held off. Also, the decision of which activities should go on to avoid the economy from coming to a complete standstill can be made.

### **Predictive Factor C**

Predictive Factor C is not used for prediction of positive cases in a certain area. This factor uses another aspect of Data Science helping in battling epidemics, it aids the immediate response sector like hospitals, testing centres and other healthcare based institutions that are helping in battling the pathogen. Despite this, Factor C uses Data Science at its heart to get the information needed to carry out the required action and allocation. This factor uses predictive graphs to help understand the medical supplies needed to battle the virus. As an epidemic is a sudden jerk to the healthcare ecosystem, it is difficult to predict the medical supplies that will be needed to treat patients who have contracted the virus. Furthermore, it is difficult to predict cases, which will indirectly affect the prediction of the stockpile of medical equipment, including medicines, needed to treat those patients.

As the number of cases increased, the World Health Organisation or WHO, came up with a 'Hospital Readiness Checklist for COVID 19'. [12]



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 <b>World Health Organization</b>	<b>RAPID HOSPITAL READINESS CHECKLIST FOR COVID-19</b>
<p>The WHO 2019 novel coronavirus (2019-nCoV): strategic preparedness and response plan for novel coronavirus disease (COVID-19) outlines the public health measures that need to be considered by countries to prevent, prepare for and respond to the COVID-19 pandemic. The plan supports countries to rapidly identify relevant actions from their national action plans for health security and pandemic influenza preparedness, which are pertinent to managing the COVID-19 pandemic and can be adapted using the knowledge that has been gained about the COVID-19 virus. Using these plans will help guide and align all national and international partners to support national governments in managing the pandemic. The nine pillars of the Strategic Plan for COVID-19 refer to different aspects of the pandemic and allow countries to develop capacities to respond to the crisis, including by taking measures to strengthen their health systems. In the context of COVID-19, specialized services offered by health care facilities, especially those available in hospitals, will be required to serve the affected population.</p>	
<p>On 30 January 2020, the Director-General of the World Health Organization, declared the COVID-19 outbreak to be a global public health emergency of international concern under the International Health Regulations. Following the spread of COVID-19 cases in many countries across continents, COVID-19 was characterized as a pandemic on 11 March 2020 by the Director-General, upon the advice of the International Health Regulations Emergency Committee.</p>	
<p>The current and rapidly evolving nature of the COVID-19 pandemic requires hospitals to have in place all essential preparedness measures. These measures may vary depending on the designated role of each hospital and the way in which hospitals are linked to the country's overall plan for managing the pandemic while continuing to provide essential services to other patients who require care. These roles are likely to include (a) testing people for COVID-19 and managing early investigations to identify confirmed cases who require hospital care, (b) providing treatment for COVID-19 cases, (c) continuing to provide routine essential health services, (d) preventing patients from acquiring COVID-19 while in hospital, and (e) communicating information on COVID-19 as part of the country's and hospitals' risk communication strategy in coordination with the central response system and communities, with the aim of containing and mitigating the pandemic.</p>	
<p>This WHO rapid hospital readiness checklist for COVID-19 was developed based on WHO's COVID-19 strategic response and preparedness plan, hospital preparedness for epidemics and interim versions of similar checklists from the WHO Regional Office for the Americas/Pan American Health Organization, the WHO Regional Office for Europe and WHO headquarters. The purpose of the Checklist is to help hospital managers prepare for COVID-19 patient management by optimizing each hospital's capacities. It has been designed to be user-friendly, taking into consideration the human resources and the assessment time required to conduct and complete the checklist in its entirety.</p>	

*Fig 3: Caption: A Tabular Summary of the WHO Hospital Readiness Checklist[13]*

The World Health Organisation has also established detailed guidelines and a certain standard set per criterion for every hospital to go by through all stages of the pandemic [14]

Over the course of the pandemic however, several hospitals, particularly over the course of the passing of the Delta variant in India in early January, have struggled with severe shortage of supplies [15]

This situation could have been avoided had hospitals gotten some idea on the estimated amount of supplies needed for that particular period. A recent survey shows how unprepared hospitals were for the second wave, which in turn slowed down the recovery rate [15]

Despite the fact that the epidemic is a completely unpredictable healthcare scenario, to a certain extent, an estimate of the supplies could've been taken. Using data from previous cases in the area, the hospitals could've been assigned a certain amount of emergency stock. Based on carrying factors like the hospital's popularity amongst the crowd, the location and how convenient it is to travel to, hospital budget, rooming capacity, staff number, staff qualification, type of hospital (specialisation). number of positive tested patients checked in and ranking in terms of facilities available, hospitals should be allocated a minimal amount of resources to use for treating patients. In this manner, hospitals of all areas and all specialisations will, to a minimal extent, get access to basic resources and equipment needed to treat and help patients recover from the virus.

While this factor is time consuming and will need more data as the population increases, it is one of the fewer and more fool proof ways to understand the hospitals' readiness in terms of supply of vaccines and important dosages and medications for the surge in cases and their equippedness in terms of hospital staff and qualification. Despite the detailed analysis that will come out of



such a survey, this factor can only be restricted to less densely populated areas as such an in-depth analysis will be difficult when the area is more widespread as the place will have more hospitals.

However, with the World Health Organisation's Checklist, it becomes easier. The implementation of government rules could help understand the preparedness of hospitals. If the government (Central or State), gives out rules that every public and private hospital has to submit the checklist. If made a compulsion, this rule can help immensely. If this is followed by allocating a separate Cabinet to affairs of recovery from the virus, effective measures can be taken more quickly, thus reducing the potential risk. The creation of such a cabinet will streamline the process of allocation of resources. This particular body could analyse reports submitted by hospitals from that region. After this, it could submit a collective estimate of the supplies of injections, masks, sanitisers, Personal Protective Kits, vaccines and oxygen cylinders that the region needs.

This could not only help in the current situation, it could also help streamline the healthcare ecosystem. This division of work will help people on a micro level, thus affecting the population on a macro level. This, in turn, will help nations prepare themselves for the next epidemic or major global health crisis in the foreseeable future. This particular method will take time. However, it is one of the long term benefits and should not be overlooked. With more people in such a Cabinet and more data scientists and surveyors, this particular method could become streamlined and could eventually become a part of our healthcare system.

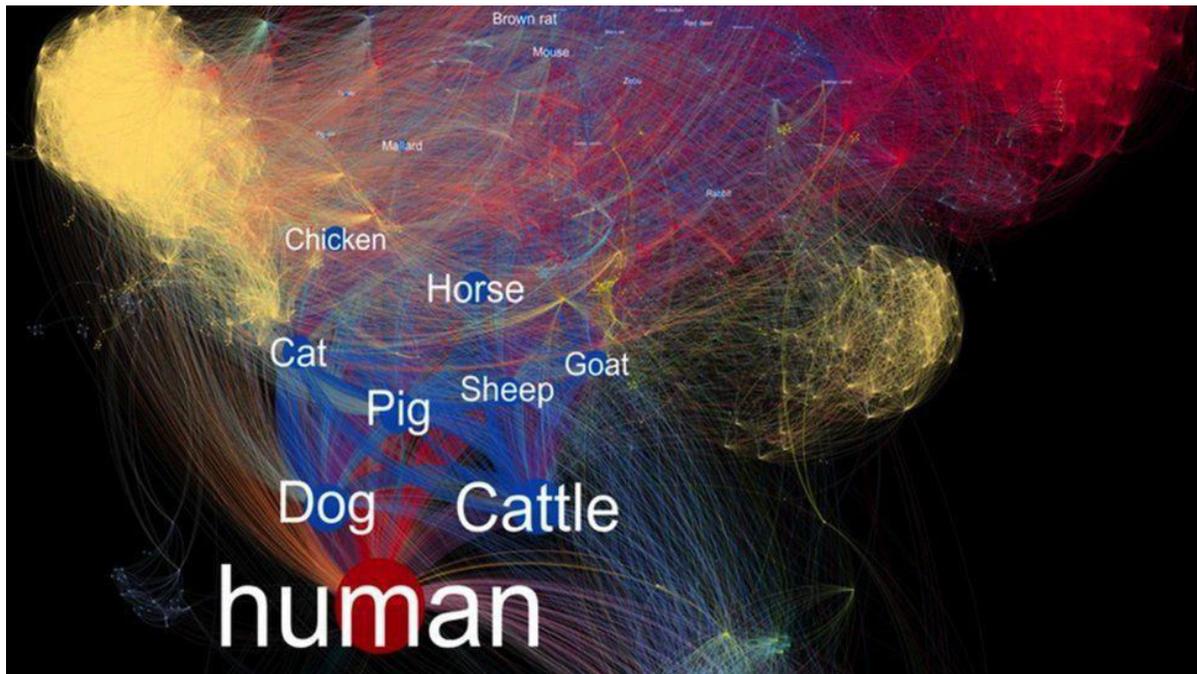
### **Predictive Factor D**

Predictive Factor D is a vastly different statistical and analytical factor. It involves Artificial Intelligence and Data Science working hand in hand.

This factor requires information from past pandemics and major health crises like the Bubonic Plague (1346 – 1352), Influenza Virus A (H1N1) (1918), Influenza Virus (H2N2) (1918-1919), Human Immunodeficiency Syndrome (HIV)(1981) and other pandemics to understand the connection between the causes of these viruses, particularly zoonotic diseases, as those are the most uncertain amongst other types of viruses.

The Bubonic Plague's outbreak was caused by a bite from a contaminated flea [16]. Swine Flu was caused by pigs [17]. The Avian Virus began due to a contaminated bird, most likely a chicken [18]. The novel SARS-CoV-2 began due to a contaminated bat.

These examples all have zoological and habitual connections. Such research has already begun by the BBC [19].



*Fig 4: Caption: A Visual Representation of the Potential Diseases between Different Species [20]*

This research involves Data Science to collect information on every epidemic and pandemic in history, along with the causes, symptoms, severity and cure. With this information, connections can be made. It will become easier to predict the next virus and its nature. This can be predicted by understanding the location of the disease's rise, the animal species, the behaviour and habitat of the species and how it has affected other species in relation. This will save a lot of unexpected trouble that will arise in the future when the next pandemic hits, as it is a known fact that the novel coronavirus will not be the last.

### Conclusion

All of the evidence above thus proves the importance of Data Science in all parts of dealing with a pandemic: predicting the cases through the different waves and mutations, the imposition of lockdowns and curfews, immediate response for vaccination and prediction of the next epidemic. With Data Science, we have an advantage our ancestors did not have: technology. Using pure statistics along with Machine Learning and Artificial Intelligence, we can get through this pandemic and prepare ourselves for the next pandemic, now that we are truly aware of the impending danger a virus can bring.

### Acknowledgements

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### REFERENCES

1. Anonymous, 'The Bubonic Plague', Edited July 17, 2021
2. Centers for Disease Control and Prevention, 'The History of 1918 Flu Pandemic', March 21, 2018
3. Centers for Disease Control and Prevention, 'Types of Influenza Viruses', November 18, 2019
4. Anonymous, '1957-1958 Flu Pandemic', 4 July, 2021
5. Centers for Disease Control and Prevention, 'HIV', June 1, 2021
6. World Health Organisation, 'Coronavirus Disease', October 12, 2020
7. Benjamin Daziel, BabakPourbohloul and Stephen P. Ellner, The Royal Society, 'Human mobility patterns predict divergent epidemic dynamics among cities', September 7, 2013
8. Bernard Marr, Forbes Magazine, 'Coronavirus: How Artificial Intelligence, Data Science And Technology Is Used To Fight The Pandemic', March 13, 2020[7]: Benjamin Daziel, BabakPourbohloul and Stephen P. Ellner, The Royal Society, 'Human mobility patterns predict divergent epidemic dynamics among cities', September 7, 2013
9. Bernard Marr, Forbes Magazine, 'Coronavirus: How Artificial Intelligence, Data Science And Technology Is Used To Fight The Pandemic', March 13, 2020
10. Ted Archive, Adam Kucharski, 'How Data Can Predict the Next Pandemic', January 24, 2019
11. TEDx Talks, Rosalind Eggo, 'Epidemics and the End of Humankind', July 25, 2018
12. TEDx Talks, Rosalind Eggo, 'Epidemics and the End of Humankind', July 25, 2018
13. World Health Organisation, 'Rapid Hospital Readiness Checklist', November 25, 2020
14. World Health Organisation, 'Rapid Hospital Readiness Checklist', November 25, 2020
15. World Health Organisation, 'Rapid Hospital Readiness Checklist', November 2020 (Detailed PDF)
16. Ruth Pollard, Sudhi Sen, Bloomberg, 'It's Like a War', April 28, 2021
17. Centers for Disease Control and Prevention, 'Information on Swine/Variant Influenza', August 6, 2018
18. Centers for Disease Control and Prevention, 'Avian Influenza A Virus Type Infection in Humans', April 18, 2017
19. Victoria Gill, BBC News, 'AI used to predict the next coronavirus', February 16, 2021
20. Victoria Gill, BBC News, 'AI used to predict the next coronavirus', February 16, 2021[7]: Benjamin Daziel, BabakPourbohloul and Stephen P. Ellner, The Royal Society, 'Human mobility patterns predict divergent epidemic dynamics among cities', September 7, 2013
21. Bernard Marr, Forbes Magazine, 'Coronavirus: How Artificial Intelligence, Data Science And Technology Is Used To Fight The Pandemic', March 13, 2020
22. Ted Archive, Adam Kucharski, 'How Data Can Predict the Next Pandemic', January 24, 2019
23. TEDx Talks, Rosalind Eggo, 'Epidemics and the End of Humankind', July 25, 2018



## An International Multidisciplinary Research e-Journal

24. TEDx Talks, Rosalind Eggo, 'Epidemics and the End of Humankind', July 25, 2018
25. World Health Organisation, 'Rapid Hospital Readiness Checklist', November 25, 2020
26. World Health Organisation, 'Rapid Hospital Readiness Checklist', November 25, 2020
27. World Health Organisation, 'Rapid Hospital Readiness Checklist', November 2020 (Detailed PDF)
28. Ruth Pollard, Sudhi Sen, Bloomberg, 'It's Like a War', April 28, 2021
29. World Health Organisation, 'Plague', October 31, 2017
30. Centers for Disease Control and Prevention, 'Information on Swine/Variant Influenza', August 6, 2018
31. Centers for Disease Control and Prevention, 'Avian Influenza A Virus Type Infection in Humans', April 18, 2017
32. Victoria Gill, BBC News, 'AI used to predict the next coronavirus', February 16, 2021
33. Victoria Gill, BBC News, 'AI used to predict the next coronavirus', February 16, 2021



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10



### COVID AND AI

**Natasha Datar**

Sanjay Ghodawat International School,  
Atigre, Maharashtra.  
[natashadatar@gmail.com](mailto:natashadatar@gmail.com)

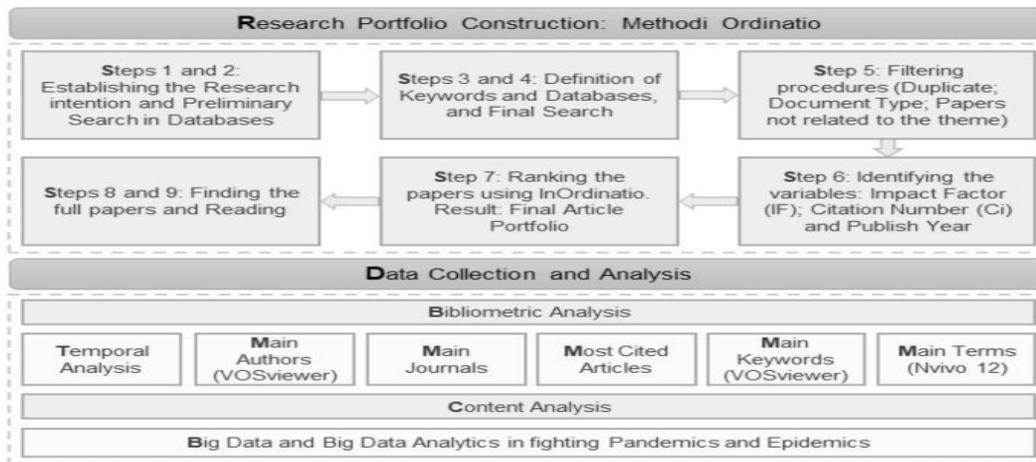
#### Abstract

The COVID-19 pandemic has created an oversized quantity of human harm within the economic, social, and health care systems all around the world. Such kinds of infectious and contagious diseases square measure a serious challenge for health care systems worldwide. With the rise in cases associated with these issues during this recent international pandemic, there's a necessity to check ways to treat these health issues. Understanding these characteristics and behavior of such viruses may be known by aggregation and analyzing the large knowledge. Big Data, still as massive knowledge Analytics techniques, are content during this context by predicting, tracking, monitoring, and elevating awareness concerning these epidemics and pandemics. So, the goal of this study is to spot however BDA (Big knowledge Analytics) will facilitate these cases. A meta-synthesis was administered using the methodology Methodi Ordinatio. The software NVivo twelve and VOS viewer were used for assortment and analysis. Its intent was to spot however massive knowledge will facilitate fight epidemics and pandemics. The results showed that most sources of knowledge return from social media and net search engines.

**Keywords:-** *Big data - Big data analytics(BDA) - Pandemics - Epidemics - COVID-19 - Meta-synthesis - Methodi Ordinatio.*

#### 1. INTRODUCTION

The term huge knowledge is wide accustomed to describe the exponential growth of knowledge in recent years. It means is sort of varied. It is often understood as a group of knowledge with high volume, diversity of selection, coming back from totally different sources, like cell phones, social networks, sensors, etc that want specific techniques and tools for his or her process. Big knowledge Science is that the study that compasses different options of massive knowledge, as well as knowledge storage capability, and analysis speed. It is often engaged within the study of various areas, like health knowledge, genomes, surroundings, social media, and industrial activities (Rana and Mugavero 2019). All of those use knowledge analytics and straightforward knowledge. Thus, huge knowledge Analytics (BDA) has become a contemporary apply for analyzing knowledge. BDA consists of a collection of advanced analytical techniques, from connected fields like statistics and data processing, reassuring the likelihood to get information from huge volumes of knowledge.



## 2. THEORY

A)

On thirty Jan 2020, the globe Health Organization declared the unfolding of the COVID-19 pandemic as a reason behind the threat and involved increasing the extent of health emergencies. Afterward, the government of the dominion of the Kingdom of an Asian country desperately took many strict measures to limit the unfolding of the pandemic among the regions of Saudi Arabia [1,2]. The Saudi Ministry of Health (MoH) and plenty of alternative countries have dead WHO steerage associated with the identification and isolation of suspected COVID-19 cases. Even so, the pandemic has unfolded dramatically, with the number of infected individuals over eighty-two million, and therefore the variety of deaths surpassing a meg [3]. The uncontrollable unfold of the pandemic, with its constant developing patterns and therefore the distinction in its



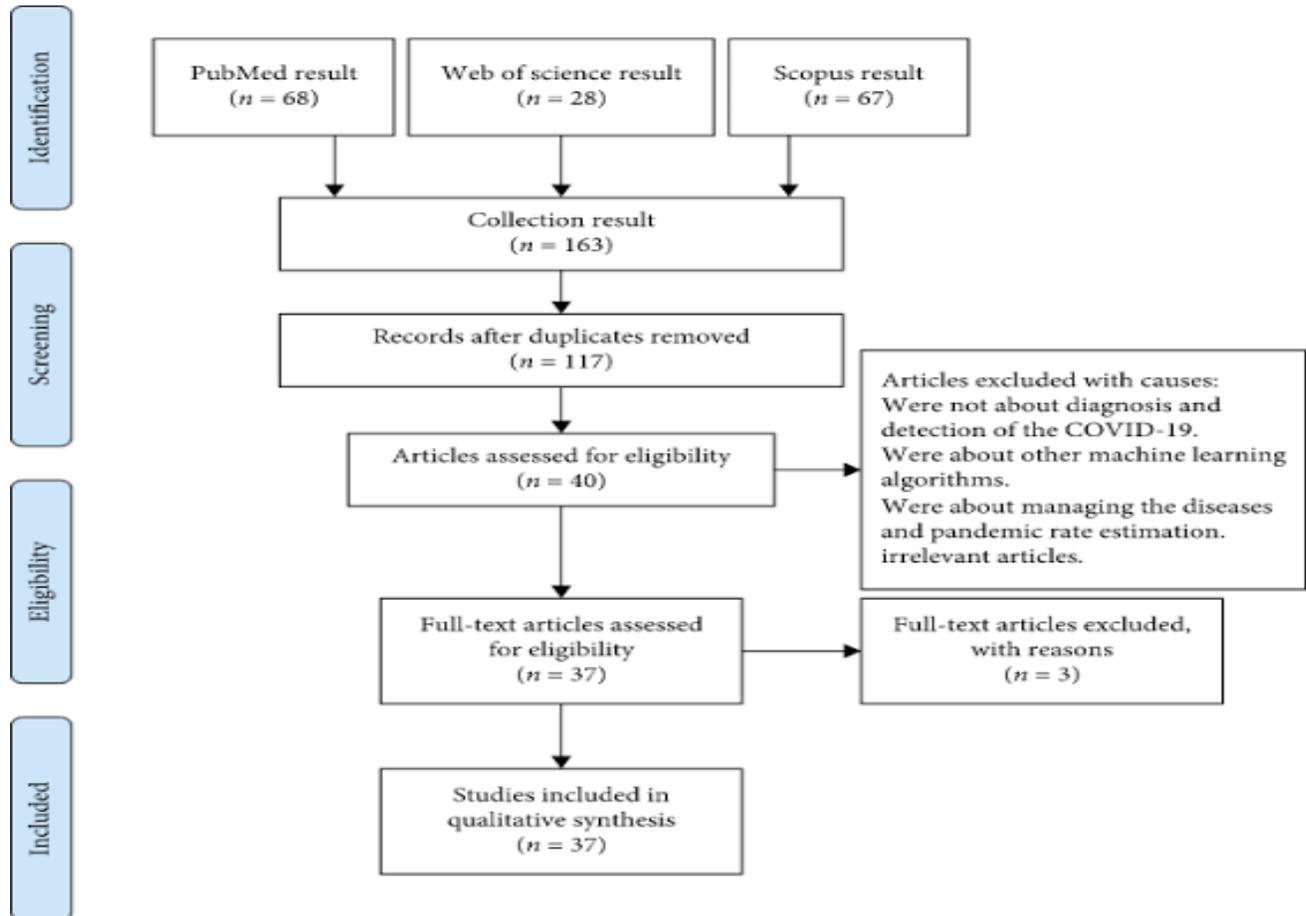
symptoms makes it harder to manage. Additionally, the pandemic has affected care systems and therefore the accessibility of medical resources in many countries around the world, golf shot up a high death rate [4]. Many studies used massive amounts of knowledge for sentiment analysis, like Reference [5]. Similarly, the authors of Reference [6] had studied however the management responding to client satisfaction online review affects the selection of the shoppers for a few facilities or hotels. It showed correlational statistics between the response and client satisfaction. The authors of Reference [7]

had surveyed varied papers regarding mathematical models to enhance the potency in detecting and predicting COVID-19. Their survey recommended the exploitation of computer science toIt intended to discover COVID-19 cases, huge knowledge to trace cases, and nature-inspired computing (NIC)to select appropriate options to extend the accuracy of detection.

Some studies related to heart diseases suggested some recommendations and guidelines, such as Reference [8], to help in the better understanding of heart failure causes, symptoms. They declared that heart failure can increase in the patient's injuries, especially the ones with serious illnesses.

The authors in Reference designed a prediction model referred to as Conscious-based Susceptible-Exposed-Infective-Recovered (C-SEIR) model to confirm the utility of the lockdown and protecting countermeasures in decreasing the influence of the pandemic in urban center towns. The projected model consisted of 2 classification teams, namely the quarantined suspected infection cluster (P), and therefore the segregated diagnosed infection cluster (Q), beside a blue/green curve with a solid line for daily patients and a broken line for cumulative patients. It showed that the results of the prediction may be a double drop-down or increase supporting the towns imprisonment precautions in urban centers. The authors conjointly gave steering for protection against COVID-19, like being educated concerning the virus, social distancing, and imprisonment.

Some authors also came to a conclusion about the symptoms and the causes in the sector of radiology.



The pattern of the paper is as follows:

Section B represents this massive knowledge analytics application for COVID-19. Section C shows knowledge of privacy. Section 3 discusses massive knowledge analytics within the care sector from totally different aspects and analyzes the challenges which will hinder its application, then provides our future predictions in terms of mistreatment of massive knowledge within the care field, additionally to many recommendations. Finally, Section 4 concludes the paper

### B) Applications of Data Analytics in COVID-19

The unfolding of the world pandemic, COVID-19, has generated a large and varied quantity of knowledge, that is increasing chop-chop. This knowledge will be employed by applying massive knowledge analytics techniques in multiple areas, as well as the designation, estimate, or predict risk score, attention decision-making, and pharmaceutical business [9]. We also show the theory used in the RAMSES II project for each study in Table 2.

### The Theory of Scaling applied to the RAMSES II project

Table

1

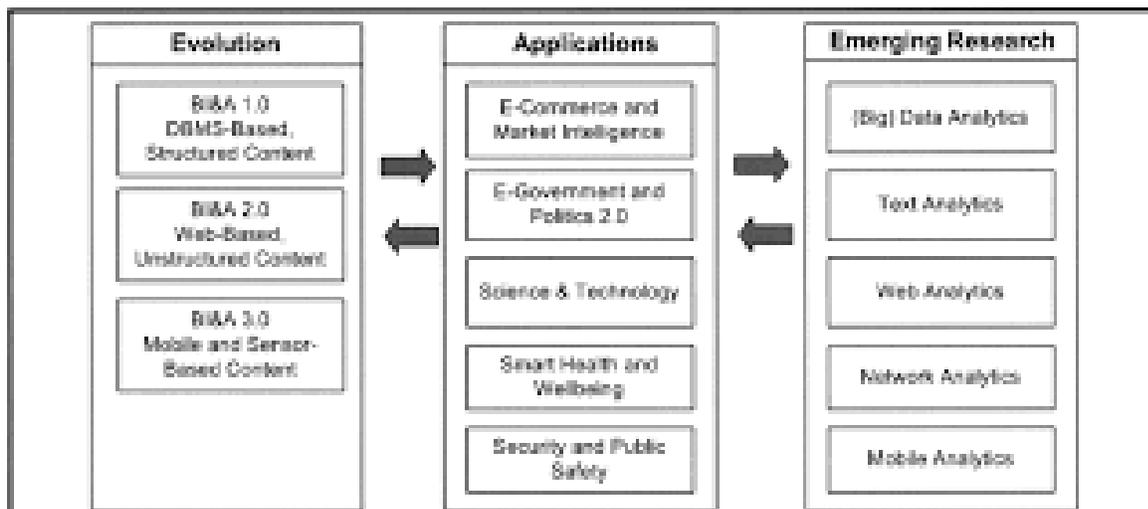
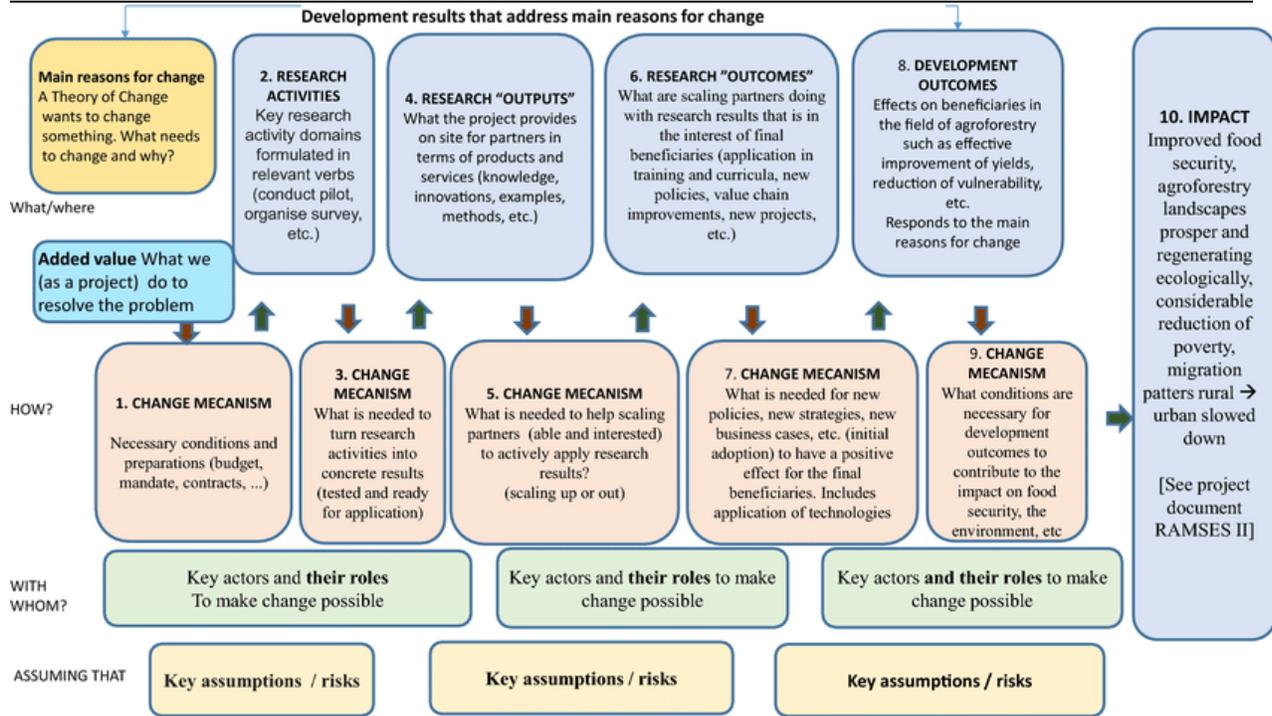


Figure 1. BI&A Overview: Evolution, Applications, and Emerging Research



Figure1 shows the evolution, application, and emerging research related to big data.

The authors in Reference [10] have planned a model to differentiate between COVID19 and four various agent chest diseases. The model utilizes several body sensors to collect info and monitor the patient's health condition, alongside temperature, force per unit area, heart rate, metastasis looking at, aldohexose detection, and others. The collected knowledge is unbroken on a cloud info base containing AI-enabled versatile systems that facilitate identification symptoms of patients infected or suspected of obtaining COVID-19 to check the acceptable procedure to upset them. However, it is not clear whether or not the patient's health info area is given to the hospital staff. Moreover, the authors in Reference [11] had surveyed varied papers relating to mathematical models to reinforce the efficiency in detection and predicting COVID-19. Their survey suggested exploitation AI to observe COVID-19 cases, large info to trace cases, and nature-inspired computing (NIC) to pick out acceptable choices to increase the accuracy of detection.

Another study [12] provided an Associate in Nursing degree analytical model for predicting patient census and estimating ventilator needs for a given hospital throughout the COVID-19 pandemic. Through this study, it completely was detected that the estimation of the bed and ventilator needs is influenced by the length of hospital keep, and thus the variability of days of inmate ventilator use. Also, there was no relationship between the age of hospitalized patients and thus the possibility of needing a ventilator, or between the inmate gender and thus the length of keep. They recommended that each hospital depends on its internal info for proper resources to come up with. what's a lot of, the Institute for Health Metrics and analysis (IHME) COVID-19 health service utilization prediction team conducted a study to predict the expected daily use of health services and thus the variability of deaths because of COVID-19 for succeeding four months from the date of the study for each state at intervals the U.S. [13]. Table a pair summarizes the very important signs and externally measurable symptoms thought of by the reviewed studies, wherever the distributions of important signs and symptoms within the reviewed studies area unit conferred in Figures a pair of and three severally.

Figure2

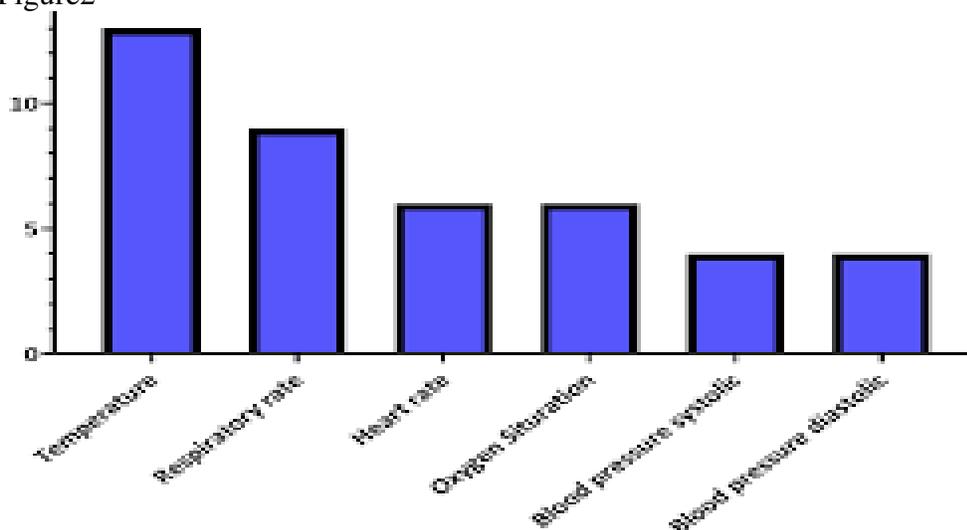
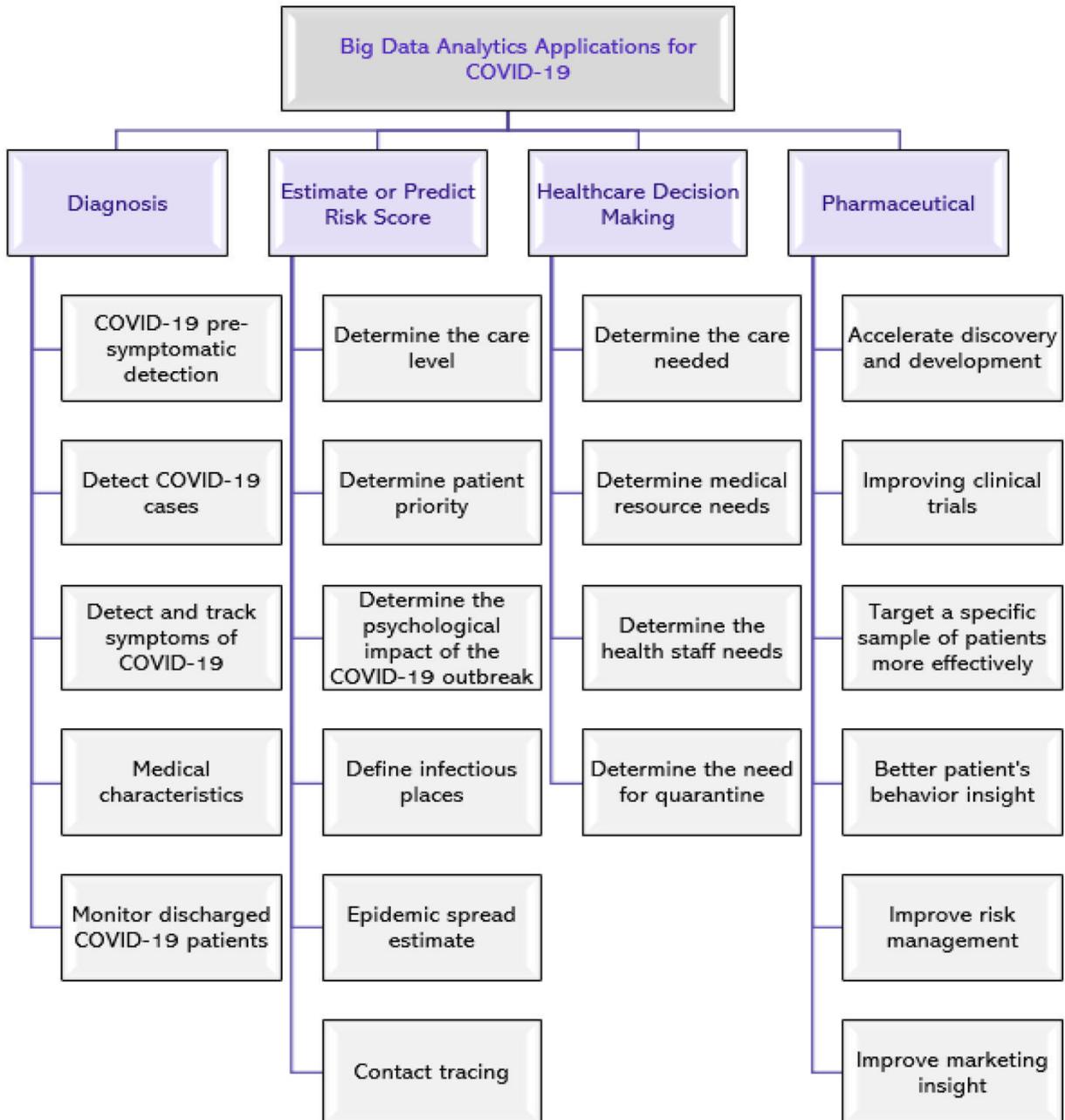


figure3



### C) About knowledge privacy

Data had become Associate in Nursing inevitable in the vicinity of the technological world. Data privacy focuses on correct handling of information. Knowledge privacy is targeted around but data needs to be collected, stored, managed and shared with third parties furthermore as



compliance with the applicable privacy laws. Challenges with the quality and consistency of information stay a priority. Lack of official standards and inconsistencies in government coverage statistics across countries produce world comparisons that are unit hard. an oversized amount of personal data we have a tendency to tend to unit of measurement emotional, as a result of we wish to fight Covid-19, {and we have a tendency to tend to}and that we have a tendency to} have opened the door to allowing our data to be surveilled in some ways in which we ne'er would have been allowed at intervals in the past.

It is vital to create certainty that the private knowledge is employed for the right purpose and knowledge ethics is maintained throughout the proceedings.

### **CONCLUSION**

In the future massive knowledge can play a vital role in analyzing knowledge regarding several viruses, new diseases, and trailing human action. Technologies like massive knowledge, machine learning, and computing are often effectively wont to assist researchers in obtaining ready for future pandemics. massive knowledge is helpful in guiding policy, however additionally it's vital to ascertain the privacy policies.

### **ACKNOWLEDGEMENTS**

I would wish to acknowledge all the factors, nurses and workers WHO have worked onerous and WHO have additionally sacrificed themselves to avoid wasting people. I might like to dedicate this work to the survivors WHO are plagued by COVID-19 already.

### **REFERENCES**

1. Lee, I.-K.; Wang, C.-C.; Lin, M.-C.; Kung, C.-T.; Lan, K.-C.; Lee, C.-T. Effective Strategies to Prevent Coronavirus Disease-2019 (COVID-19) Outbreak in Hospital. *J. Hosp. Infect.* 2020, 105, 102–103. [CrossRef] [PubMed]
2. Iacobucci, G. Covid-19: Emergency Departments Lack Proper Isolation Facilities, Senior Medic Warns. *BMJ* 2020, 368, m953. [CrossRef] [PubMed]
3. Worldometers Coronavirus Cases. Available online: <https://www.worldometers.info/coronavirus/> (accessed on 30 December 2020).
4. Da'Ar, O.B.; Haji, M.; Jradi, H. Coronavirus Disease 2019 (COVID -19): Potential Implications for Weak Health Systems and Conflict Zones in the Middle East and North Africa region. *Int. J. Health Plan. Manag.* 2020, 35, 1240–1245. [CrossRef]
5. Valenzuela, S. Unpacking the Use of Social Media for Protest Behavior. *Am. Behav. Sci.* 2013, 57, 920–942. [CrossRef]
6. Sheng, J.; Amankwah-Amoah, J.; Wang, X.; Khan, Z. Managerial Responses to Online Reviews: A Text Analytics Approach. *Br. J. Manag.* 2019, 30, 315–327. [CrossRef]
7. Agbehadji, I.E.; Awuzie, B.O.; Ngowi, A.B.; Millham, R.C. Review of Big Data Analytics, Artificial Intelligence and NatureInspired Computing Models towards Accurate Detection of COVID-19 Pandemic Cases and Contact Tracing. *Int. J. Environ. Res. Public Health* 2020, 17, 5330. [CrossRef]



## An International Multidisciplinary Research e-Journal

8. Ponikowski, P.; Anker, S.D.; Alhabib, K.F.; Cowie, M.R.; Force, T.L.; Hu, S.; Jaarsma, T.; Krum, H.; Rastogi, V.; Rohde, L.E.; et al. Heart Failure: Preventing Disease and Death Worldwide. *ESC Hear. Fail.* 2014, 1, 4–25. [CrossRef]
9. PEX Process Excellence Network 6 Ways Pharmaceutical Companies are Using Big Data to Drive Innovation & Value. Available online:
10. <https://www.processexcellencenetwork.com/tools-technologies/whitepapers/6-ways-pharmaceutical-companies-areusing-big-dat> (accessed on 28 December 2020).
11. Abdel-Basset, M.; Mohamed, R.; Elhoseny, M. A Model for the Effective COVID-19 Identification in Uncertainty enVironment using Primary Symptoms and CT Scans. *Heath Inform. J.* 2020, 1–18. [CrossRef]
12. Agbehadji, I.E.; Awuzie, B.O.; Ngowi, A.B.; Millham, R.C. Review of Big Data Analytics, Artificial Intelligence and NatureInspired Computing Models towards Accurate Detection of COVID-19 Pandemic Cases and Contact Tracing. *Int. J. Environ. Res. Public Health* 2020, 17, 5330. [CrossRef]
13. Epstein, R.H.; Dexter, F. A Predictive Model for Patient Census and Ventilator Requirements at Individual Hospitals During the Coronavirus Disease 2019 (COVID-19) Pandemic: A Preliminary Technical Report. *Cureus* 2020, 12, e8501. [CrossRef]
14. IHME. COVID-19 Health Service Utilization Forecasting Team Forecasting COVID-19 Impact on Hospital Bed-Days, ICU-Days, Ventilator-Days and Deaths by US State in the Next 4 Months [PRE-PRINT]. *Medrxiv* 2020. [CrossRef]
15. Role of Big Data in Monitoring and Tracking COVID 19. Soumya Koshy<sup>1</sup> , Akshara Aji<sup>2</sup> , Cini Joseph<sup>3</sup> , Naveen Thomas Joseph<sup>4</sup> ( <sup>1</sup>Assistant Professor, Kristu Jyoti College of Management and Technology, Kottayam, Kerala, India) ( <sup>2</sup>MCA, Kristu Jyoti College of Management and Technology, Kottayam, Kerala, India) ( <sup>3</sup>Assistant Professor, KristuJyoti College of Management and Technology, Kottayam, Kerala, India) ( <sup>4</sup>MCA, Kristu Jyoti College of Management and Technology, Kottayam, Kerala, India)
16. Applications of Big Data Analytics to Control COVID-19 Pandemic Shikah J. Alsunaidi <sup>1</sup> , Abdullah M. Almuhaideb <sup>2,\*</sup> , Nehad M. Ibrahim <sup>1</sup> , Fatema S. Shaikh <sup>3</sup> , Kawther S. Alqudaihi <sup>1</sup> , Fahd A. Alhaidari <sup>2</sup> , Irfan Ullah Khan <sup>1</sup> , Nida Aslam <sup>1</sup> and Mohammed S. Alshahrani <sup>4</sup>



## A DEVELOPING DATA SCIENCE FOR INFORMING THE RESPONSE TO EMERGING PATHOGENS

**Naisha Gurbani**

Euro School, Airoli

[gurbaninaisha@gmail.com](mailto:gurbaninaisha@gmail.com)

### Abstract

Transmissible and infectious diseases denote a major challenge for health systems worldwide. More recently, with the increase in cases related to these problems, combined with the recent global pandemic of COVID-19, the need to study strategies to treat these health disrupts, is even more. So by taking the recent global pandemic in concern, in this research paper I have described some significant ways in which Data Science plays a vital role during these pandemics. We incorporate essential questions like what is Data science, how it helps improve similar situations and what measures should be taken during a pandemic.

Keywords: Severe acute respiratory syndrome (SARS); Center for Disease Control and Prevention (CDC); Host/healthy cells; Data science; Artificial intelligence; Pathogens.

### Introduction

A pandemic occurs when a disease spreads, which people are not immune to. Similarly this new virus which has boomed into our lives and has become a global crises causing immense suffering. Yes the coronavirus. What is Coronavirus? Coronaviruses are a troop of viruses that can cause illness in humans as well as animals. Severe acute respiratory syndrome (SARS), and the common cold are examples of coronaviruses. SARS spread rapidly in 2002–2003 but recently In December 2019, scientists identified a coronavirus outbreak in Wuhan, China. Specialists named the newly identified virus severe acute respiratory syndromecoronavirus 2 (SARS-CoV-2) and the illness that it causes coronavirus disease 19 (COVID-19).The virus has spread to all the continents worldwide.

China took the first few cases lightly and assumed it's a normal spread of some disease until it realized the disruption it caused. China delayed in informing the world health organization about this new virus spread. When the whole world realized the immense destruction the virus caused finally on 11 March, 2020 the World Health Organization declared COVID-19 as a pandemic. Anytime you have the emergence of a novel disease, in this case it's a novel virus, it's important to understand the structure of the virus, how is it spreading, who all are getting infected and what are the symptoms. These are the questions we have to keep in mind while analyzing a pandemic.



### Theory

Analyzing each and every problem is important and easy in today's generation, as we have technology with us. Speaking of analyzing we cannot miss the key term, Data Science. Data science is the study of pandemics and such outbreaks, it keeps collecting minute data and information about the outbreaks. They continuously research till they find effective solutions. Thankfully, data collection today is much easier than it was 15-20 years ago. Before people would have to hand distribute survey papers to individuals, who would then give it back for data to be collected. So the reason this outbreak seems to be moving so quickly is not just that it is infectious, but because of how interconnected we are digitally. We are kept up to date and aware on the current state of the pandemic. So if we keep the searching, analyzing, and testing going we will be able to respond much more quickly, because we know how many people are being affected and how.

### Literature

The number of people infected changes daily. One of the organizations that collect this information, are the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), they are gathering information and continuously learning more about this outbreak.

### How Does Coronavirus Attack Your Body?

The virus first enters the body by transmission. Once inside, the coronavirus hijacks host cells and takes control. It then starts multiplying itself, creating more and more copies. Eventually, it kills some of the host cells.

### How Does Coronavirus Move Through Your Body?

Once inside, the virus moves through our respiratory track the Trachea, which goes through our mouth, eyes, nose and lungs. If your immune system is good it might stay there for about 3-5 days without causing much damage to your body. But if it infects the lungs there is threat to your body. Our immune system may respond with symptoms like:

Fever, cough, Shortness of breath or trouble breathing, Fatigue, Chills, Body aches, Headaches, A sore throat, Congestion or Runny nose, Loss of taste, Loss of smell, Nausea or Vomiting, Diarrhea.

Our lower airways have more of ACE2 receptors than rest of the respiratory tract. Hence the virus is most likely to go deeper than the normal cold. Our lungs might become inflamed, making it tough for us to breathe. If a doctor does a CT scan of the chest, they'll find patchy area which indicates the virus has started damaging our cells. The patchy areas are known as "ground-glass opacity". For most us, the symptoms might end with just a normal cough and a fever. But for some, the infection gets more critical. After 5 to 8 days of the symptoms, they can have shortness of breath which is known as (dyspnea).

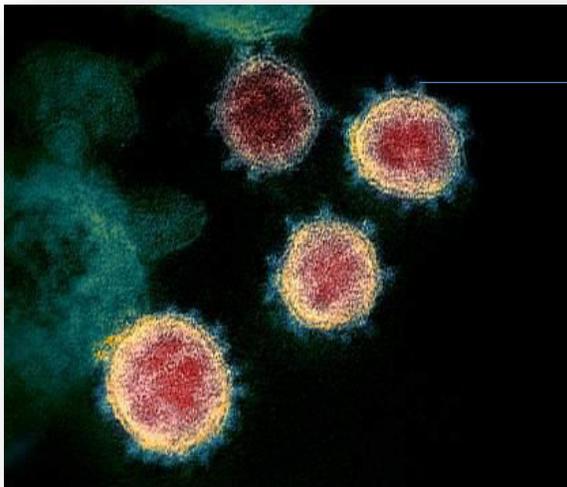
Who is most at risk for getting COVID-19?

- The people who have recently travelled to hotspot places. Where there is an active spread of the virus.

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- The person who has been in contact with a detected COVID patient. Close contact is well-defined as being within six feet of an infected person between a range of 15 mins or over 24 hours.
  - People over age 60 who have pre-existing medical illnesses or a weak immune system.
- What is the structure of the coronavirus like?

The virus is spherical in shape, covered in a protein coat called capsid. The genetic material inside the virus is (RNA). They have spikes all over the surface which bolt on to human cells. The spikes even help it, to break through our cell membrane and fuse in.



Protein spikes

How many people are infected with COVID-19?

As of writing 05/11/2021, more than 159,000,000 people in the world have been infected. Over 3,300,000 people have died. Some 192 countries and territories, and all continents (except Antarctica) have reported cases of COVID-19. [1]

Country	People infected	Deaths
U.S.	32,000,000	580,000
India	23,000,000	250,000
Brazil	15,200,000	420,000
France	5,800,000	5,000,000
Russia and		
England	4,400,000	400,000
Italy	4,100,000	126,046
Spain and		
Germany	3,500,000	168,330
Argentina and		
Columbia	3,000,000	100,000
Poland and		



Iran	2,600,000	50,000
Mexico	2,300,000	75,000

This was all the detailed information on the virus, Data science uses the same technique to simplify outbreaks.

After the first case of coronavirus in Wuhan, China, it has spread to at least 100 other countries. As China initiated its response to the virus, it inclined on its strong technology sector along with Artificial Intelligence, Data Science, and Technology to track and fight the pandemic while tech leaders, have accelerated their company's healthcare initiatives. As a result, tech startups are closely involved with clinicians, academics, and government entities around the world to activate technology as the virus continues to spread too many other countries.

Here are some effective ways Artificial Intelligence, Data Science, and Technology are being used to manage and fight COVID-19.

1. AI to help diagnose the virus, track and forecast outbreaks.
2. Process healthcare claims
3. Drones deliver medical supplies
4. Robots sterilize, deliver food and supplies and perform other essential tasks.
5. Develop drugs.
  - All the scientist have come up with effective medicines as an tempory solution to the virus.
6. Avanced fabrics offer protection.
  - Scientists and companies have come up with clothing that offer protection along with protective sheilds to protect the front line workers from direct contact with the infected people.
7. AI to identify non-compliance or infected individuals.
8. Apps to share information.
  - We need people to be aware of the current situation and thus Data science and technology have come together to form apps that have all information related to covid, so they have just one place to look for.  
Eg:- Aarogya setu app
9. Supercomputers working on coronavirus vaccine.

### Discussion



The COVID-19 pandemic has led to a dramatic loss of human life worldwide and offers an exceptional challenge to public health, food sector and economic sector. The economic and social sectors are hit severely. Tens and millions of people are at risk of falling into extreme poverty, while the number of undernourished people is increasing day by day.

Millions of enterprises are facing an existential risk. Nearly half of the workforce of the world are at risk of losing their livelihood. Many of them lack social protection, access to good quality healthcare facilities along with food and security. During the lockdown they earned nearly less than half of the income and to them no money = no food.

### Conclusion

The year 2020 will go down in history as the year that was drastically shaped by a virus, which as of late October had infected more than 40 million people worldwide. Scientists have compared what is happening today to the pandemic of 1918. But what's unlike today is how technology has allowed us to see, almost in real time. Where the virus is spreading, how is it transmitting and what effect is it causing on the economy. This detailed view of COVID-19 is made possible thanks, to a new generation of huge datasets, hundreds of genomes, millions of tweets along with advances in computing power and the analytical methods to study them. Data science and technology has made this pandemic going. Yes, the pandemic is getting worst but the major part of it is being handled by Data science which we fail to notice. They make us aware of things going on around the world at our leisure and space. [2]

### References

- <https://royalsocietypublishing.org/doi/10.1098/rstb.2018.0276>
- <https://www.medicalnewstoday.com/articles/coronavirus-causes>
- <https://www.tableau.com/about/blog/2020/3/why-are-data-and-analytics-important-understanding-outbreaks>
- <https://my.clevelandclinic.org/health/diseases/21214-coronavirus-covid-19>
- <https://www.webmd.com/lung/coronavirus-covid-19-affects-body#1>
- <https://www.nih.gov/news-events/nih-research-matters/novel-coronavirus-structure-reveals-targets-vaccines-treatments#:~:text=Like%20other%20coronaviruses%2C%20SARS%2DCoV,fuse%20with%20the%20cell%20membrane.>
- <https://www.forbes.com/sites/bernardmarr/2020/03/13/coronavirus-how-artificial-intelligence-data-science-and-technology-is-used-to-fight-the-pandemic/?sh=b07b4645f5fc>
- <https://www.sciencedirect.com/science/article/pii/S0048969720335531>
- <https://www.who.int/>
- <https://covid19.who.int/>
- <https://penntoday.upenn.edu/news/role-data-world-reshaped-covid-19>



### SUSTAINABLE AND SECURED SMART CITIES USING IoT

**Arya Vithal Sherekar**

Bombay Cambridge International School (East)  
sherekararya@gmail.com

#### Abstract

What is a **SMART** city?

**Self-Monitoring Analysis and Reporting Technology** (Smart) are the devices that can monitor, communicate, analyze and react based on sensor data. Similarly, Smart Sustainable Cities (SSC) use the most advanced sensors, meters, actuators, and analysis tools to bring infrastructure, smart solutions, sustainable and efficient environments, subsidized and safe cities. Smart cities support different types of technologies, including information and communication technology (ICT), the Internet of Things (IoT), and geographic information system (GIS). This document focuses on security, privacy, and risks in smart cities, and focuses on threats related to information security. And the challenges faced by smart city infrastructure in managing and processing private data.

**Keywords:** *Information and communications technology, Internet of Things network, Geographical information systems, Privacy*

#### INTRODUCTION

According to the latest United Nations estimates, the average population of India is 1.35 billion (as of May 20, 2018). 70% of the total population live in rural areas and 30% live in cities. Mumbai, Chennai, Delhi, Kolkata, Hyderabad, Bangalore, Pune and Ahmedabad are all metropolitan areas in India. Obviously, less than 30% of capital cities in India have chronically low quality of life in their cities. The country urgently needs to improve the quality of life of citizens in metropolitan and rural areas. India faces several major obstacles that continue to hinder the development of urban infrastructure: complex governance structures, land valuation issues, capacity gaps and lack of funding are part of the urban challenges that severely hinder India's exciting new economic growth. India is a latecomer, more crowded and complicated. On the other hand, India needs a more efficient and sustainable solution to serve urban areas and can benefit from technology and learn best practices from other parts of the world. Therefore, India is building a world-class smart city, a self-sufficient environment with minimal pollution, improving recycling, optimizing energy supply and adequate public transportation.



In 2015, the Indian central government added a new dimension to urbanization and urban development policies and introduced smart city theory. As part of the contract, the Ministry of Urban Development (MoUD) developed a “Draft Concept Note on Smart City Scheme;”. Smart cities are those cities that have physical, social, institutional, and financial infrastructure. It is expected that such a "smart city” will provide ordinary people with opportunities to meaningfully realize their resources and benefits.

**I) Vision:** With the growth of urban population and the rapid expansion of territory, operators are looking for innovative ways to solve complex problems, increase efficiency and improve the quality of life. This creates a need for cities that control and integrate infrastructure; better optimize equipment and maximize services for citizens.

**II) Mission:** The mission of City IA is to promote the development of sustainable and inclusive cities and provide its citizens with core infrastructure and a decent life. The availability of high-quality public services such as water and energy is one of the core infrastructure elements of smart cities.

2) Reliable public transportation system

3) Provide residents with work and resources.

4) Provide sufficient conditions for people's entertainment and safety. Health status and learning opportunities are also needed.

5) Reduce waste by improving energy efficiency, reducing water conservation and proper waste management.

Smart city developers use advanced technologies such as mobile cloud computing, electronic objects, networks, sensors and machine learning technologies to enable the various components of the smart city to interact and interact with the norms. The city is to process and manage the information related to the existing data in the city database, and to connect the knowledge with the new systems and sensors that have an impact on security and privacy in the smart city. However, the smart city network infrastructure has brought new user security and privacy challenges, in which sensitive data is vulnerable to third-party attacks.

**Table 1 Smart City Data Landscape Suggested**

Sector	Domain	Kind of Data	Application
Infrastructure	Transport and asset management, built environment	Monitoring data, registration data, geo data	Traffic and congestion patterns, real time dashboards



<b>Sustainability</b>	Energy usage, water, environment, weather	Sensor and monitoring data, civic measurement data	Air quality monitoring and pollution warnings
<b>Health</b>	Health, quality of life, well-being, life expectancy	Health data, survey data, life logging	Location specific noise levels and social or health problems in specific neighbourhoods

Because there is little concrete empirical research yet about how people experience their privacy in smart cities, the actual placement of smart city technologies and data in one of the four quadrants in this framework is based on extrapolating and combining the research about people's privacy concerns discussed in the previous paragraph and the smart city data landscape suggested in

**Table 1.**

### 1.1 Smart Power Systems

All aspects of the smart city power system are critical to the entire security and data protection infrastructure, because third parties connected to the grid can track usage patterns and predict consumer behaviour. Smart cities, this will make the network vulnerable. A methodology for enhancing privacy within smart power systems-The proposed method uses demand models for different consumers connected to the network to provide new consumption patterns. The new pattern hides individual consumer attributes through the particle swarm optimization process. In the research process, the proposed method has been tested against genetic algorithms on many real-world consumption patterns, which shows that the proposed method is effective.

### 1.2 Smart Healthcare

Smart healthcare is a practical method for the intelligent management of patient flow systems in the healthcare industry. The introduction of smart medicine reduces costs, which is a very good disease. However, maintaining privacy and security is becoming an issue for the scalability of portable medical devices. Many design issues need to be resolved. The main security and privacy issues when designing IoT architectures in healthcare applications have highlighted the increasing use of sensors in medical and healthcare applications over the past decade. The importance of heart rate and blood pressure and overall system integration safety solutions. In a study, a solution was developed that enables data owners to authorize external healthcare providers to use attribute-based encryption (ABE) and identity-based transfer encryption (IBBE) to analyze data. This solution uses encryption and decryption processes, effectively entrusting most of the computing costs to the cloud. As a result, the computational workload of mobile devices with limited resources is reduced, thereby improving safety and efficiency.



### 1.3 Structures, Models, Algorithms, and Protocols for Improving Security and Privacy

As smart cities face various security and privacy issues, some studies have proposed various structures, models, and algorithms to improve these aspects. Integrate safe algorithms in smart city systems. Similarly, an encryption method provides a scheme called Complete Confidentiality and Recall Data-Based Transmission Encryption (FPPRIB). The proposed system should respect the confidentiality of data and the confidentiality of the identity of recipients and withdrawn users. Only authorized users can access the data. The revocation procedure does not provide any information about the content of the data or the identity of the recipient, and the identity of the recipient and the identity of the revoked user are not known to the public. These characteristics lead to smart city applications that need to protect personal data. As part of the research, an encryption protocol was developed to manage large amounts of personal data generated in a scalable and interoperable manner through electronic participation, and to ensure the privacy of smart city citizens. It is important to develop sufficient security or access to IoT systems to prevent attackers from controlling IoT devices or leaking sensitive information stored at the facility or node level. Protect user privacy while ensuring scalability and efficiency. The proposed platform effectively

Provides decentralized access control for IoT devices based on users' privacy preferences. SMARTIE aims to integrate privacy and user-centric privacy and governance within IoT applications in a scalable and efficient mode. The role of software in smart cities is very important, but it also brings some privacy and security issues, such as personal data, access to data centre information, and the impact of other applications and economic pressure. A mobile smart city application protocol that solves user privacy issues by integrating a pseudonym-based signature scheme and the signature delegation scheme into the OAuth2.0 protocol process (an authorization platform is a protocol that allows users to grant access to third-party websites or applications to access users' protected resources without revealing their long-term credentials or even their identity.). This product enables users to automatically generate pseudonyms for specific users and applications. It also provides enhanced data protection for user authentication on the service provider side.

### 1.4 Operational Security Vulnerabilities for Smart Cities

Data in smart city applications must withstand modification, manipulation, inspection, unauthorized access, disclosure, and destruction. Basic security and confidentiality requirements include confidentiality, integrity, availability, non-repudiation, access control, and confidentiality. Privacy issues are caused by security vulnerabilities in smart city applications, but without perceived security and privacy precautions, the public may be reluctant to use smart city mobile applications. Methods of collecting and processing personal data. They usually do not provide facilities and consent mechanisms to the community. For smart cars, the issue may be related to physical threats, communication interception, data security, and DoS. For IoT sensors, security threats may include data protection, secure communication, data management, data storage, sensor failure, and remote use. Finally, security threats to cloud platforms may include data leakage, malicious insider threats, insecure APIs, DoS, malware injection attacks, system and application vulnerabilities.



### 1.5 Social Media

Data collected from social networks on the Internet (such as Facebook, Instagram, LinkedIn) provide social, economic, and cultural information that can be used by governments, politicians, authorities, and companies. This can help them better understand the market trends and behaviours that affect personal dynamics, through open data sources. However, online social media may pose a threat to privacy. Disclosing on the Internet the risks, threats, and personal behaviours associated with social media to improve data protection, security, and social participation challenges in smart cities. The use of the Internet poses risks of endangering personal identity, anonymity, personal space, privacy and communication, as well as security threats from third parties. And implement appropriate guidelines, taking into account all stages of individual behaviour on social media.

### Theory

**Table 2 Books Related to Issues In Smart City.**

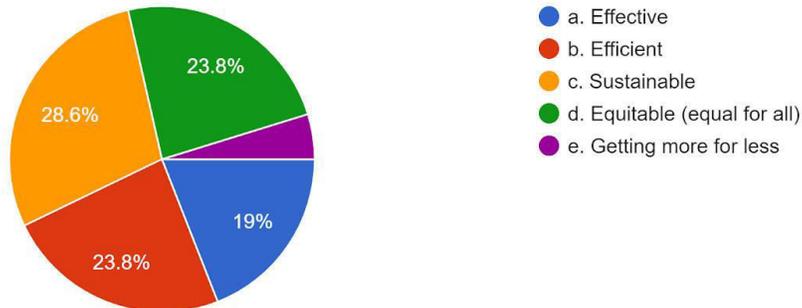
Book Name	Author
From Smart Grids to Smart Cities: New Challenges in Optimizing Energy Grids	<u>Massimo La Scala</u> et al.
Block chain Technology for Smart Cities (Block chain Technologies) 1st ed. 2020 Edition	<u>Dhananjay Singh</u> et al.

This book studies various algorithms and applications based on optimization theory to achieve multi-standard goals. The author showed in detail how the best network system for the transmission tower (i) corresponds to the load, (ii) minimizes energy costs, and (iii) ensures the stable and reliable operation of the grid. It can be formalized with limited general nonlinear optimization problems. Because these design goals contradict each other, there is no single solution to the optimal energy flow problem, and a suitable compromise must be found between the goals. Provide a comprehensive overview of all aspects of smart city development to ensure safe, reliable and reliable data transmission, put forward theoretical concepts and empirical research, as well as examples of smart city plans and their ability to create added value for citizens. These materials outline the most important aspects of the development and implementation of smart cities in various fields such as health, education, and transportation.

### Experiment

What is your interpretation of “Smart” in a Smart City?

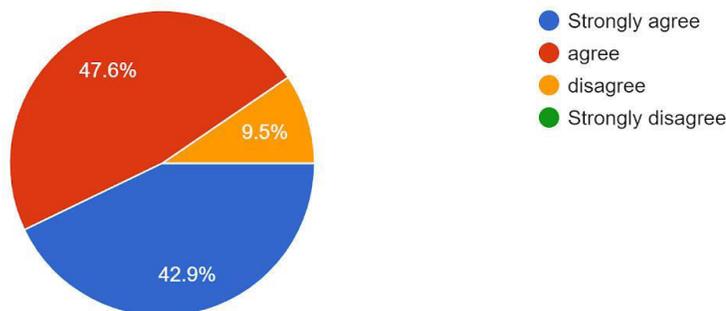
21 responses



Most of the people chose Sustainable which is correct, as it is referred to an eco-city, the smart city targets to enhance the high-satisfactory of city services or lessen its costs. ... Their primary purpose is to reconcile technological innovation with the economic, social, and ecological demanding situations of the city of tomorrow.

Do you think being 'smart' is essential to the future of cities

21 responses



It's true! Smart is essential to future cities as a smart metropolis must offer urban surroundings that offer an excessive first-class lifestyle to citizens. This will become more and more vital within side the mild of the future population increase in city areas, wherein extra green use of infrastructure and belongings could be required. Smart metropolis offerings and programs will permit those enhancements to cause a better quality of lifestyles for residents. We need smart cities in India to have well organised and developed country



### Discussion

Significant developments in wireless and sensor technologies have paved the way for the widespread adoption of IoT technologies in smart city environments. Smart cities require the integration of key technologies such as the Internet of Things, big data, sensors, machine learning, and GPS. All these applications pose a major threat to the security and integrity of citizen data. The system must be technically rigorous and have sufficient security mechanisms to prevent data leakage and identify weaknesses. Smart grids, building automation systems, unmanned aerial vehicles (UAV) and electric vehicles (electric vehicles) have been largely ignored. Poor system quality the fragmented nature of smart city data can negatively affect the efficiency and accuracy of key business systems. These factors create additional risks associated with the large-scale deployment of systems and equipment from different manufacturers using the latest technology. The key factors related to privacy and security risks in smart cities highlight the threats caused by the imprecise roles and responsibilities of different parties. Inf Syst FrontContent is provided by Springer Nature and the terms of use apply.

The key factors are the lack of common understanding of key security requirements that are not shared between parties, flexibility of privacy policies, anonymity, and data sources. Users interact with mobile applications and interact with smart city infrastructure. However, solving the privacy problem in the smart city environment seems to be a major technical challenge facing system designers and developers. The privacy protection system must be closely related to ongoing security requirements, and the implementation of security requirements is critical to the trust and well-being of smart cities. The focus of the concept usually comes down to questions about when cities can use technology to reduce crime, improve the efficiency and sustainability of road transportation, reduce energy consumption and ensure a healthier and more fulfilling life. Technology seems to be a starting point, not a mechanism to solve problems and bring benefits to urban participants. The use of technology is regarded as a key element of smart cities, but integrating ICT into urban infrastructure (if a city is social capital) does not make it smart, as are general economic policies and urban development management. After consideration. The reality of the smart city plan effectively creates an innovative ecosystem that enables citizens and communities to interact with the government and knowledge developers, which shows that “people, not technology, are the real contributions to urban intelligence. The basic elements of people-centeredness show that, in the context of the security and privacy of smart cities, when determining the outcome, special attention should be paid to assessing the benefits and risks from a human perspective.

### Results

The developments of smart cities around the world enables citizens to communicate with authorities at all levels, obtains services, and improve the efficiency and effectiveness of system interaction, thereby bringing greater economic prosperity and quality of life. Look at confidentiality, security, and risk from the perspective of many stakeholders. The literature emphasizes how these multiple issues affect citizens' interests and identify vulnerabilities that can be exploited by external organizations. Although the smart IoT



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environment has considerable capabilities and advantages, security and data protection are key factors that seriously endanger the safe operation of smart city infrastructure. Technological progress and the transition to an integrated digital society may affect many cultural characteristics. And social aspects. In daily life, maintaining interpersonal communication, a sense of belonging and identity is an indispensable part of a person (Monzón 2015). The literature shows how these factors may limit future development and threaten the realization of citizens' interests. And general stakeholders. ; May not consider interaction and related human factors.

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### References

1. *Smart City - What is a smart city?* (n.d.). <https://www.wien.gv.at/Stadtentwicklung/Studien/Pdf/B008403j.Pdf>. Retrieved June 21, 2021, from <https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008403j.pdf>
2. H. M. Tah Et Al., J. (2017, March 23). *Smart cities*. A Review of Smart Cities Based on the Internet of Things Concept. <https://www.mdpi.com/1996-1073/10/4/421/pdf>
3. Granell, C. (2019, November 20). *Internet of Things*. SpringerLink. [https://link.springer.com/chapter/10.1007/978-981-32-9915-3\\_11](https://link.springer.com/chapter/10.1007/978-981-32-9915-3_11)
4. *Metro Cities Of India*. (n.d.). World Atlas. Retrieved May 24, 2021, from <https://www.worldatlas.com/articles/metro-cities-in-india.html>
5. *Issues and Challenges to Urban Infrastructure in India*. (2016, October 30). GK TODAY. <https://www.gktoday.in/topic/issues-and-challenges-to-urban-infrastructure-in-india/>
6. NASSCOM. (n.d.). *Smart Cities Executive Overview*. Smart Net. Retrieved May 27, 2021, from <https://smartnet.niua.org/sites/default/files/resources/Integrated-ICT-Geospatial-Technologies-2015%20%28Nasscom-Accenture%29.pdf>
7. INDIAai. (n.d.). *Smart Cities Mission*. Retrieved May 27, 2021, from <https://indiaai.gov.in/missions/smart-cities-mission>
8. N., J. (n.d.). *Threats and Security Issues in Smart City Devices*. Research Gate. Retrieved May 30, 2021, from [https://www.researchgate.net/publication/332647109\\_Threats\\_and\\_Security\\_Issues\\_in\\_Smart\\_City\\_Devices](https://www.researchgate.net/publication/332647109_Threats_and_Security_Issues_in_Smart_City_Devices)
9. *Privacy concerns in smart cities*. (n.d.). Research Gate. Retrieved May 30, 2021, from [https://www.researchgate.net/figure/City-data-landscape-Sector-Domain-Kind-of-data-Example-of-application-Infrastructure\\_tbl1\\_304746305](https://www.researchgate.net/figure/City-data-landscape-Sector-Domain-Kind-of-data-Example-of-application-Infrastructure_tbl1_304746305)
10. Springer. (2020, July). *Security, Privacy and Risks Within Smart Cities: Literature Review and Development of a Smart City Interaction Framework*. Reserch Gate. [https://www.researchgate.net/publication/343123843\\_Security\\_Privacy\\_and\\_Risks\\_Wit](https://www.researchgate.net/publication/343123843_Security_Privacy_and_Risks_Wit)



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- hin\_Smart\_Cities\_Literature\_Review\_and\_Development\_of\_a\_Smart\_City\_Interaction\_Framework
11. OECD. (n.d.). *Smart Cities and Inclusive Growth*. OCED. Retrieved June 12, 2021, from [https://www.oecd.org/cfe/cities/OECD Policy Paper Smart Cities and Inclusive Growth.pdf](https://www.oecd.org/cfe/cities/OECD_Policy_Paper_Smart_Cities_and_Inclusive_Growth.pdf)
  12. Telecom Regulatory Authority of India (TRAI). (n.d.). *White Paper*. TRAI. Retrieved June 21, 2021, from [https://www.trai.gov.in/sites/default/files/White Paper 22092020pdf.pdf](https://www.trai.gov.in/sites/default/files/White_Paper_22092020pdf.pdf)
  13. GOOGLE. (2021, June 10). *Google Form (survey)*. Google Forms. [https://docs.google.com/forms/d/1flnnGL4ly48O3mG\\_fm1o1ka-eadAI1ne9EtgP9j6Jcs/edit](https://docs.google.com/forms/d/1flnnGL4ly48O3mG_fm1o1ka-eadAI1ne9EtgP9j6Jcs/edit)

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Email:- [misaconference@gmail.com](mailto:misaconference@gmail.com)