



ROLE OF IOT DURING COVID-19 PANDEMIC

Asmi Karnik

Billabong High International School

Email id-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 touchless 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 decreases 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 are 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 represent 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 all employees 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/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/ypsqyce47hXRYaw37>

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.

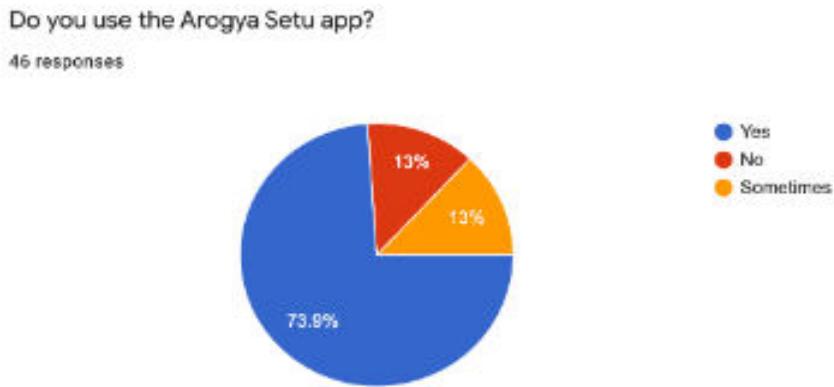


Fig.1 Screenshot of Pie chart taken from google forms



2. 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.

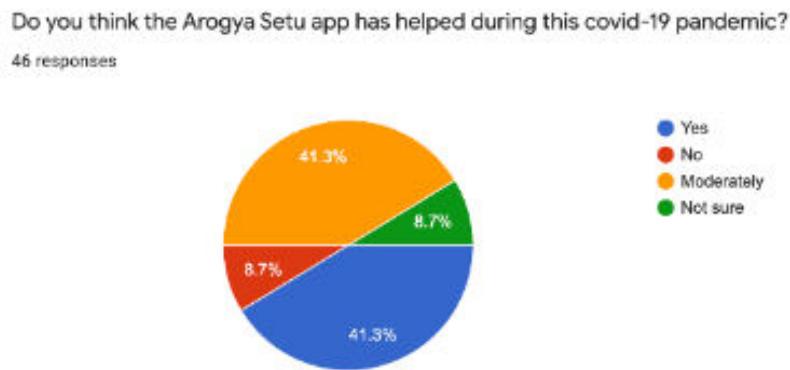


Fig.2 Screenshot of pie chart taken from google forms

1. Why do you think the Aarogya Setu app 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: -
 - a. **Has helped:** - “It has helped in warning its 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 it is used to track positive covid patients who have taken the test. These positive views highlight the benefit of using this application.
 - b. **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.



- 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/59ea1d4ba6fdcccef8b08cc3e/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/abs/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>



- 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

An International Multidisciplinary Research e-Journal

