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RELIABILITY OF WEARABLE SENSORS IN HEALTH CARE MONITORING

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Abstract
The main agenda of *wearable sensors* is to achieve home monitoring of people who are subject to chronic conditions, especially older adults. Currently, talking about walking with the trend, wearable technology in healthcare includes electronic devices that consumers can wear throughout the day, like fit bits or smart watches and keep monitoring themselves over a period of time. They help keeping a track of Enhance continuous glucose monitoring, measuring glucose levels in tears, improve patient safety and Internet of Medical Things (IoMT) and wireless sensor based system to capture daily activity at home. These sensors are widely used for patients in rehab to monitor them continuously and check their progress. This research paper focuses on how the upcoming devices of *wearable sensors*and their technologies are much more appealing than the older ones, along with how *wearable sensors* to monitor health are overall better and thus superior over the non-wearable ones.

These devices collect the personal data of healthcare and their exercises. A brief idea about these recent developments in the field of *wearable sensors* and systems that are relevant to the field of rehabilitation is explained in this research paper. To enhance the clinical development of *wearable sensors* and systems for the future, a followed up survey was personally carried out on a Google form and the results helped me reach those conclusions.

Keywords: Wearable sensors and systems, biosensors, Telemedicine

INTRODUCTION

Over the years, the need for *wearable sensors* was just a so called "want" for some people, but recently especially after Covid-19 spark and the pandemic hitting us like a huge iceberg, it has almost become a necessity. It has necessitated a planned approach to alleviate the battle with substandard lab infrastructure and a lack of adequate equipment. With improved disease surveillance, any country can handle health emergencies more efficiently with the help of *Telemedicine*.

Smart wearables are consumer-grade, connected electronic devices that can be worn on the body as an accessory or embedded into clothing. These include smart watches, rings and wristbands, to name a few, and they all have high processing power and numerous sophisticated sensors that can glean new health insights.

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Combining wearable device technology with smartphone, self-testing can be improved and real time monitoring of various parameters such as temperature, oxygen levels and pulse rate, reducing burden on healthcare and creating a vigilant environment. This helps us to reduce the death rates, as it automatically indicates the heath care ministry in case of an emergency with almost being very reliable with average delay of approximately 14s and low power consumption with estimated standing time of nearly 4 hr.

THEORY

Wearable sensors have weaved their way into the world. This includes electronic devices, that could be worn or so called accessorized by patients, designed to relatively collect one's data, and may even notify or alert a doctor or other healthcare expert in real time by sharing the user's health information.

Piloted by the hyped up demand of one to monitor their own health and keep track of their own viral signs has drastically shifted up the demands of wearable technology, making it not to double but to triple in the last four years, along with it to be projected to jump in the upcoming years.

Individuals may use the gadget to continually check their health without needing to contact a doctor or other health care provider. Wireless connectivity, such as that provided by an Internet Protocol Television (IPTV) set-top box, enables measurements to be taken and analyzed by a 'computerized' healthcare service provider. Measurements are forwarded to a service over the Internet for a more accurate assessment. Based on the features, the gadget talks with services in order to diagnose the individual.

- **Smart health watches**

The FitBit Flex was an early and popular wearable technology choice. Users were drawn to it because of its elegant appearance and ability to track their step progress throughout the day using the device's five indication lights.

Smartwatches, which were formerly solely used to count steps and indicate time, have now evolved into clinically effective healthcare instruments. In 2017, Apple released the Apple Heart Study app, which monitors users' heart rhythms and alerts them if they are having atrial fibrillation. In 2021, the business introduced the most recent Watch iteration. Apple's Series 7 model has a blood oxygen saturation monitor, native sleep tracking, a quicker FDA-approved

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electrocardiogram (ECG) sensor, improved heart health monitoring, and fall detection, which will instantly contact 911 if the wearer is not moving.

- **Wearable ECG monitors**

These are at the bleeding edge of consumer electronics, and their capacity to measure electrocardiograms, or ECGs, distinguishes them from some smartwatches. The Move ECG can do electrocardiogram measurements and email the results to the user's doctor, as well as identify atrial fibrillation. It can also track pace, distance, and elevation, as well as walking, running, swimming, and bicycling automatically.

- **Biosensors**

Biosensors are emerging wearable medical gadgets that differ significantly from wrist trackers and smartwatches. The Philip's wearable biosensor is a self-adhesive patch that allows patients to move while collecting data on their mobility, heart rate, respiration rate, and temperature.

According to Augusta University Medical Center research, this wearable gadget reduced patient progression into avoidable cardiac or respiratory arrest by 89%. This highlights wearable's capacity to enhance patient outcomes while potentially reducing staff effort.

Experimental

- On carrying out a survey personally, it was found that more than 80% of the people including all genders and generations preferred wearing a smart watch over any other *wearable device* such as chest strap monitors and ECG patches. All age groups were taken into consideration with their options kept in mind.

- After carrying out the survey, one issue popped up with the fact that people are yet not more comfortable with *telemedicine*, creating an urge to make that side of remote healthcare


monitoring to be explored more and make it much more appealing to the people, catering to all different types of age groups and gender to be specific. It needs to be made more handy and improvised in such a way that it can be easy to everyone.

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Telemedicine can be defined as the use of technology (computers, video, phone, messaging) by a
medical professional to diagnose and treat patients in a remote lo...
107 responses
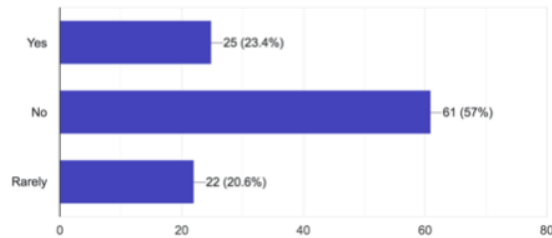
RESULT

To sum it up, it was found out that people prefer using wearable sensors, to remotely track themselves, and within the wide range of wearable sensors, smart watches, fit bits and wristbands are highly recommended and chose over the chest straps and ECG monitor patches.
On carrying out a personal survey, it was clearly evident, that more than 80% of the people recommend others onto using wearable sensors
Statistically it was proven that people preferred to wear and use wearable sensors.

Do you recommend others on using wearable sensors?
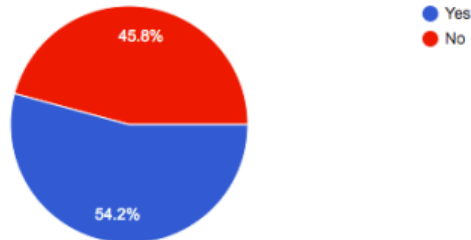107 responses
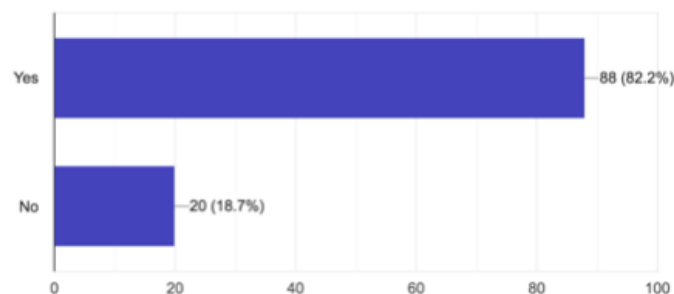
DISCUSSION
On carrying out a survey personally to find out more about peoples' views, knowing about *wearable sensors* and telemedicine, it was found out that people of various age groups know about *wearable sensors* and how they preferred *wearable sensors* to monitor healthcare over the non-wearable ones.
Furthermore, it was to be found out that more than 50% of the populations with mixed age groups wear a smart watch along with using it to track their health. Not only that but most of them rely on the results provided by smart watches to track their health.
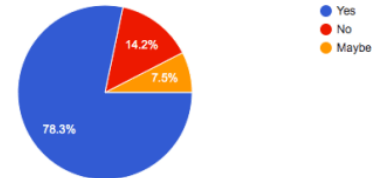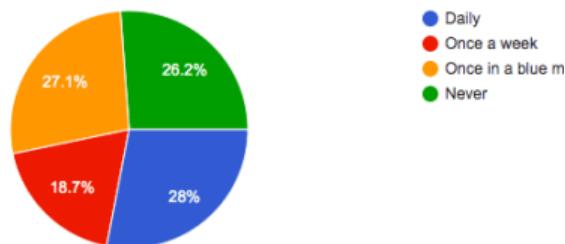
Do you wear a smartwatch?

107 responses

- Yes
- No

45.8%

54.2%

Do you know what wearable sensors are?(View at the start to get a jist of it)

106 responses

- Yes
- No
- Maybe

14.2%

7.5%

78.3%

How often do you use it to track your daily fitness, blood pressure and oxygen l

107 responses

- Daily
- Once a week
- Once in a blue m
- Never

27.1%

26.2%

18.7%

28%

• **JOURNEY OF WEARABLE SENSORS**

Over the times, wearables too have had a glow up!!
Today's wearables are mostly regarded as smart-by-definition gadgets. People often forget that "smartness" hasn't always meant processing data on a chip, but rather providing a better user experience. From the century until 2015, the following subsections provide an outline of wearable's development. For convenience of understanding, the progression is visually illustrated in the Fig.
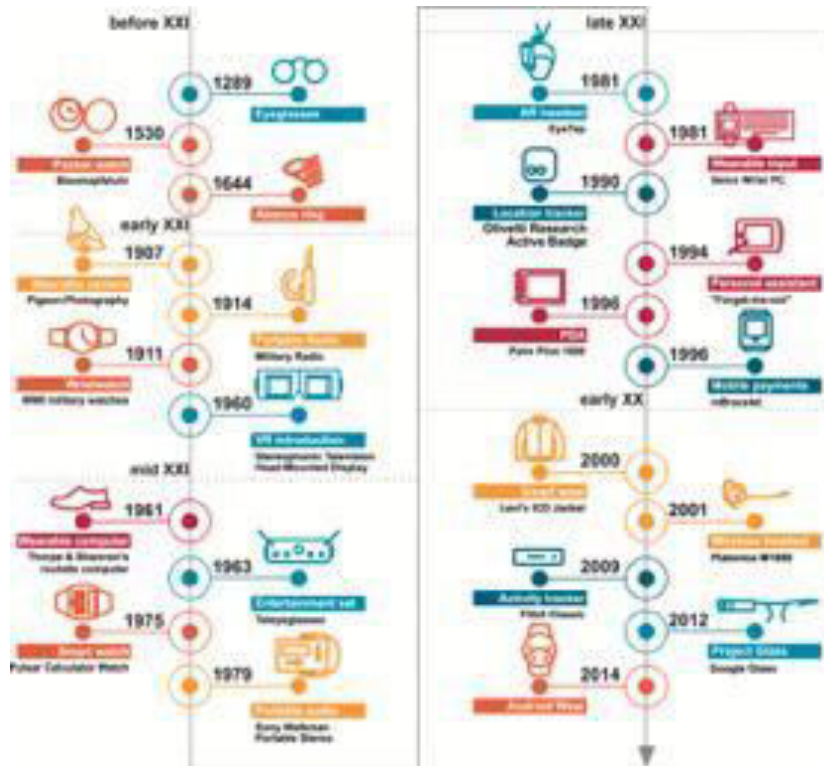
Wearables began with the introduction of eyeglasses in the nineteenth century. Later came the first pocket mechanical watch, which could be carried around, originates from the early the century, which were then considerably developed with the progress of miniaturization, which led to the notion of strapping the device to the wrist in the century. At that time, the improvements were mostly driven by military requirements. The next important milestone in the development of wearable technology comes after World War II's recovery.

Pushed through the race of technology, the later years may be defined as a boom in personal activity monitors. The most sophisticated gadget at the time, Basis, distinguished itself from other fitness devices by gathering data such as heart rate, calorie intake by exercise, numerous sleep phases, and perspiration and skin temperature using Body IQ technology. The market was confronted with several initiatives, and the number of individuals wearing those skyrocketed in only a few years.
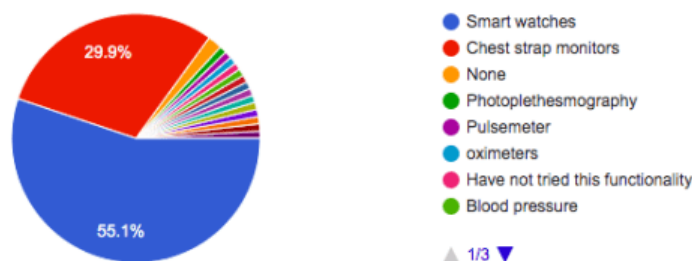
- **COMPARING**

    Wearable sensors have been updated and improvised as time passed, being much more advanced with the launch of technologies such as smart watches and fit bits which are not only more reliable but also more preferred than the regular *wearable sensors* like Chest-strap monitors and ECG patches due to it comfortable and stylish look with enhanced features that allows patients to do much more things rather than just monitoring themselves. This is clearly evident from the survey taken upon.

Do you prefer smartwatches or chest strap monitors to measure your heart rate?

107 responses

Legend:
- Smart watches
- Chest strap monitors
- None
- Photoplethesmography
- Pulsemeter
- oximeters
- Have not tried this functionality
- Blood pressure

29.9% 55.1%

1/3

Wearable system health monitoring applications commonly make use of a number of sensors, which are typically integrated into a sensor network that is either limited to body-worn sensors or includes both body-worn and ambient sensors. In the early days of body-worn sensor networks (also known as "body sensor networks"), the integration of *wearable sensors* was accomplished by threading "wires" through pockets built in clothing for this purpose. This technique is shown via the MIThril system.

Consequently as much as they are accurate, it is just not as feasible as the smart watches, which do not have multiple wires hanging through and make it much more easier for the patient to remotely track themselves along with a doctor's overview. Even though for working out, chest strap monitors are still the most precise, but heart rate monitor watches (and smart watches) are becoming fantastic possibilities.

Remote healthcare monitoring (RHM) based on IoT can make a healthcare easier and more efficient in terms of cost, accessibility, visibility, reliability, accuracy, affordability, continuity, and real time monitoring. For example, hospitalized patients cost a lot of money to the patients, healthcare facilities, and insurance companies. Furthermore, patients residing in distant places may not have easy access to hospitals and caregiver centers. As a result, individuals must travel considerable distances to get health treatment. IoT in RHM has the capacity to improve healthcare services through interoperability, communication and information sharing, and data transmission.

On the flip side, Significantly, the change toward sophisticated technologies, such as Augmented Reality (AR)/Virtual Reality(VR)/Mixed Reality(MR)/Extended Reality (XR) devices, low-end wearables and other monitoring devices, as well as a transition to Beyond Fifth Generation (beyond-5G) mobile networks, would provide a number of issues for device suppliers, network operators, and end-users. These difficulties are related to the paradigm shift from traditional Human-to-Human (H2H) connections to more Machine-to-Machine (MTC) interactions. This segment has radically different requirements than the H2H segment, such as completely different traffic patterns, higher reliability, lower latency, more mobile scenarios, strict security and privacy requirements, and higher energy-efficiency expectations.

At the same time, applications on phones not only enables low-power ECG sensors to communicate wirelessly with the phone but also apps with watches being connected to it, helps tracking and storing of records. Smart phones, with their expanding computing and storage capability and ubiquitous connection, are projected to genuinely enable continuous health monitoring.

All of the aforementioned factors result in an increase in power consumption and the need to recharge wearable/handheld gadgets on a daily basis, lowering their appeal and restricting their wearable applicability. Modern technology, such as energy harvesting and wireless charging, may help to alleviate the energy shortage, but the influence on the user's health has yet to be well investigated. Moreover, energy-harvesting technologies are still a long way from widespread implementation.

Even with smart watches being more costly ranging up to $40 to $400, it still counts for its worth.

CONCLUSION

From the standpoint of the users, the rise of the mobile device market delivers new and usable devices, multiple perks, and new apps. Wearable technology encourages proactive solutions for healthcare, fitness, ageing, disability, education, transit, enterprise, money, entrance systems, gaming, music, and a variety of other issues. Let us start with a healthcare example because wearables, as we know them today, were originally intended to be strictly medical gadgets. Unfortunately, people tend to react to potential health issues in a reactionary manner, such as scheduling a visit to their doctor when they are unwell or in pain. By continuously tracking one's health, a wearable gadget may be able to predict disease and even automatically notify a doctor so that action can be taken.
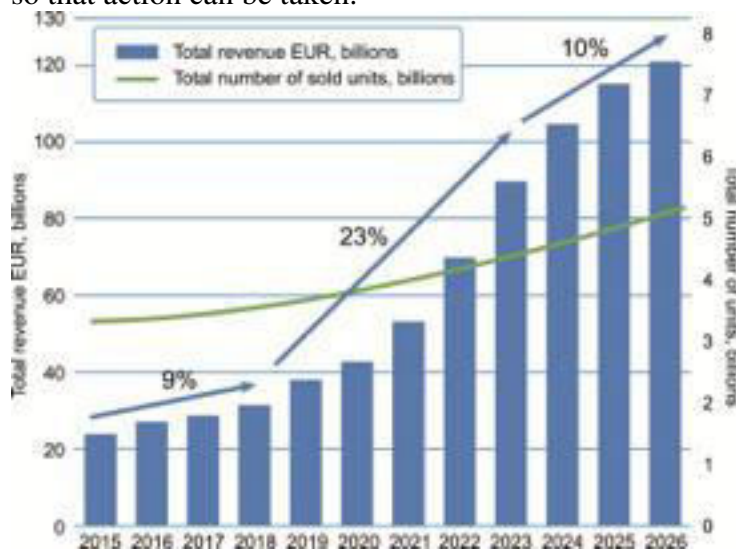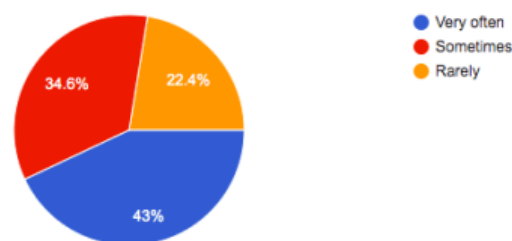
Even after the spark of covid 19, people used wearable sensors to measure various aspects such as blood pressure, temperature etc, as in such times of crisis, it wasn't feasible for everyone to step out of the house and this seemed the best way possible, and once again it proves the fact that wearable sensors help in remotely monitoring patients

During covid-19 how often did you use wearable sensors like thermometer, oximeter etc

107 responses

- Very often
- Sometimes
- Rarely

43%
34.6%
22.4%

Acknowledgements

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