The Significance of IoT Wearables in Healthcare: A Survey-Based Study

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ABSTRACT
The rapid development in the field of the Internet of Things have commanded to the emergence of wearables that significantly impact healthcare services. IoT wearables in healthcare allow continuous monitoring of a patient's personal health status, provide time driven live data to healthcare professionals, and improve patient outcomes through timely interventions. This research paper investigates the significance of IoT-enabled wearable devices in healthcare by conducting a comprehensive survey. The study evaluates the functionality, benefits, challenges, and future potential of IoT wearables in the healthcare sector. Findings suggest that IoT wearables are integral to the future of healthcare, offering improved chronic disease management, early detection of health issues, and better patient engagement, despite facing challenges like data privacy and device accuracy.
Keywords: Internet of Things (IoT), Wearables, Healthcare services, Patient Monitoring, Data Privacy, Chronic Disease Management

1.0 INTRODUCTION

The Industry Revolution 4.0 gave birth to many advanced technologies Internet of Things is one of such advanced technologies which has transformed various sectors, with healthcare being one of the most significantly impacted industries. Healthcare systems are progressively using IoT wearables, which include gadgets like fitness trackers, smart clothes, biosensors, and smartwatches. These gadgets let people actively manage their health, give real-time data to medical specialists, and enable continuous monitoring of critical health markers. The significance of IoT wearables in healthcare cannot be overstated. The prevention, early identification, and management of chronic diseases are greatly aided by these devices, which track everything from blood pressure, heart rate, and oxygen levels to glucose levels and sleep patterns. This paper aims to explore the significance of IoT wearables in healthcare by analyzing a survey of healthcare professionals, patients, and technology experts. The study delves into the functionality of these devices, the benefits they offer, their challenges, and their potential to transform healthcare.

2.0 LITERATURE REVIEW

2.1 The Role of smart IoT in Healthcare domain
The integration of smart IoT enabled devices in healthcare enables real-time monitoring of patients' health related information. According to research proposed by Dinesh et al. (2019) and Namasudra, S. (2024), smart IoT-based systems can improve patient

personal care by making available continuous health data that can be used to predict and prevent diseases [1][13]. IoT devices help healthcare professionals track a patient's vital signs remotely, making it possible to detect abnormalities early and prevent complications.

Author Krishnamoorthy, S., et al. (2023) states the advancement in the field of IoT wearables has potential to cater the needs of 21st Century people. Study contributes to the next-generation healthcare services with the use of AI enabled technologies such as Edge Computing, Machine Learning, Cloud Computing and communication of devices with the help of Internet [2].

Bharadwaj, H. K., et al (2021) coined a new term where Healthcare is tightly coupled with the applications of IoT popularly known as HIOT. Statistical Analysis and data visualization are powerful tools in Machine learning use to analyze large amount of big data related to health care [3][13].

Babu, el.al (2016), By tying physical objects together to facilitate intelligent decision-making, the Internet of Things is anticipated to bridge disparate technologies and open up new applications [4]. Smart healthcare is essential to healthcare services because it incorporates sensors and actuators into patients and their medications for tracking and monitoring [5]. Clinical care uses the Internet of Things (IoT) to use sensors to monitor patients' physiological conditions, collect and analyze data, and then send the data to processing centers remotely so that the right measures may be made. Medical treatment can be enhanced via the   IoT. These include improved performance, precision, and efficiency at a lower cost. Healthcare systems may

now be optimally automated thanks to the advantages of
the Internet of Things.

2.2 Applications of Wearables in Healthcare

Wearable devices in healthcare can track a variety of health metrics which are physiological in nature, such as heart rate, body temperature, ECG, blood pressure, sleep pattern glucose levels, and many more. A study by Wang et al. (2020) highlighted the potential of IoT wearables in managing chronic diseases such as hypertension, diabetes and cardiovascular diseases. These wearables offer real-time monitoring and alerts, which enable healthcare providers to intervene before conditions worsen [6]. Smuck M. et.al. (2021) Considered wearables as a useful tool for the future of precision health. Wearables attempt to access various health parameters such as body temperature, oxygen level, Nutrition and stress level. By overcoming limitations, wearables are becoming a promising solution for measuring person-specific reports [7].

As per the study by Wu, M., & Luo, J. (2019), wearable technology is employed in disease and patient care. Wearable apps may have a direct influence on clinical decision-making. According to some, wearable technology, such as patient rehabilitation outside of hospitals, could reduce healthcare expenses while also enhancing the standard of patient care. [8].

Dunn.J. et.al. (2018) mentioned, there are already a numerous of studies that agrees the use of wearable sensors in conjunction with customized algorithms for ongoing, longitudinal monitoring, such as the identification of diabetes, hypertension, and abnormal heart diseases [9].

2.3 Challenges in IoT Wearables Adoption

Despite their potential, the widespread adoption of IoT wearables faces several challenges. A significant task is ensuring the report accuracy and personal reliability of the data collected by wearable devices (Jain et al., 2021)10].

In the study, Azodo et.al (2020) mentioned the challenges like user acceptance as it gathered personal sensitive data, sometimes produced false positive results, continuous monitoring not required in all cases [11].

As per Mercati, P., & Bhat, G. (2024), adoption of wearable IoT devices has been limited due to challenges such as energy consumption, sensor recorded data shift during real-world usage, missing of valuable data, privacy, and security [12].

Privacy, confidentiality and security concerns also persist, as personal health data is vulnerable to cyber-attacks. Moreover, there are issues related to user compliance, device cost, and limited battery life.

3. 0 METHODOLOGY

3.1 Survey Based Case Study Design:

A user awareness survey was designed to assess the perceptions of healthcare professionals and people regarding the significance of IoT wearables in healthcare. The survey consisted of questions that addressed the following areas:

- Usage patterns of IoT wearables
- Benefits of IoT wearables for healthcare
- Challenges faced in implementing and using these devices
- Future outlook and potential improvements

The survey was distributed in the format of google form to a diverse group of 100-150 participants, including doctors, nurses, healthcare administrators, patients and general users
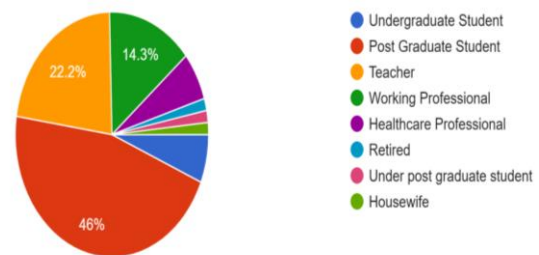

Fig1: Users Demographics

3.2 Data Collection from users and its Analysis

Data was collected over a period of two months. Responses were analyzed using descriptive statistics, and trends in the data were identified using thematic analysis. The findings were categorized based on the major themes: awareness, effectiveness, challenges, benefits, and future potential of IoT wearables in healthcare.
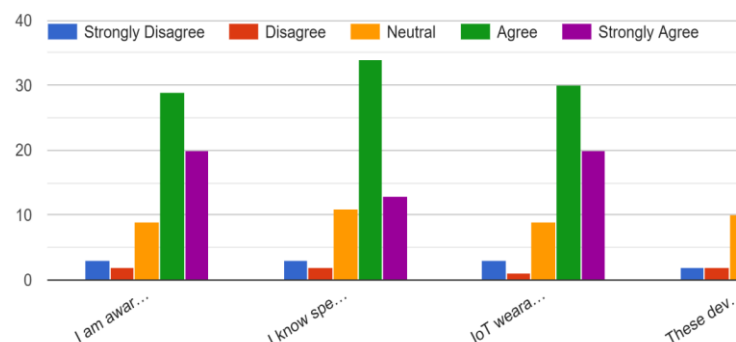

Fig 2: User awareness analysis

The awareness of users was checked with the help of following parameters on scale-based input format:

- I am aware with the concept of IoT wearable devices used in healthcare
- I know specific IoT wearable devices designed for healthcare purposes

●IoT wearable devices may improve patient monitoring and management. (potential)

●These IoT tools can help in early identification and anticipation of health issues

●IoT wearable devices can ease remote patient monitoring, minimizing the need for recurrent hospitalization in emergency.

●Healthcare professionals can utilize data from IoT wearables to personalize patient treatment plans.

Impression: Around 70% participants agree with the awareness parameters whereas 20% shows neutral response.
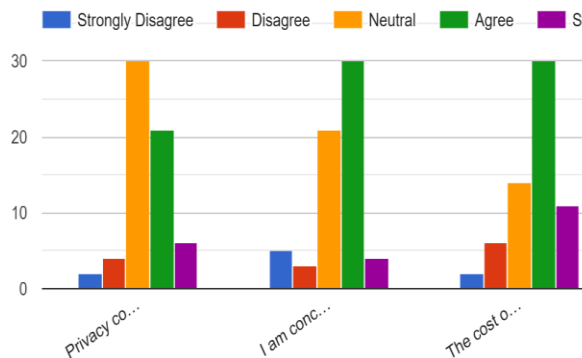

Fig3: Challenges faced by Users

The challenges faced by users were checked with the help of following parameters on scale-based input format:

●Privacy concerns related to the collection and sharing of health data deter me from using IoT wearable devices.

●I am concerned about the accuracy and reliability of health data collected by IoT wearables.

●The cost of IoT wearable devices is a substantial barrier to their extensive adoption in healthcare.

●Healthcare professionals may face challenges in interpreting and integrating data from IoT wearables into clinical practice.

●I worry about the security of my data collected by IoT wearables.

●Compatibility issues with other devices hinder my experience with IoT wearables.

Impression: Around 80% participants agree with the challenges mentioned in the questionnaire whereas 15% shows neutral response.
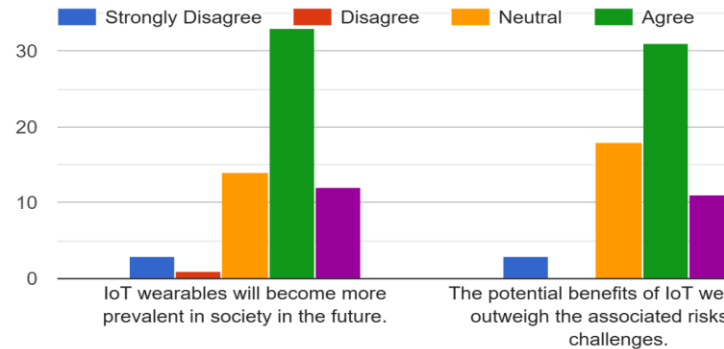

Fig4: Future Potential of IoT Wearables

The future potential/enhancements of IoT wearables in healthcare were checked with the help of following parameters on scale-based input format:

●IoT wearables will become more prevalent in society in the future.

●The potential benefits of IoT wearables outweigh the associated risks and challenges.

●I believe IoT wearables will continue to evolve and improve over time.

Impression: Around 80% participants agree with the acceptance of IoT wearables in healthcare in near future whereas 15% shows neutral response.

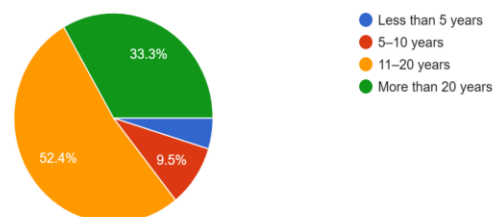## 4.0 ANALYSIS OF RESPONSES COLLECTED FROM HEALTHCARE PROFESSIONALS:

Fig5: Experience of Healthcare professionals in Years

The input received from healthcare professionals is analyzed on two important aspects first is essential features expected and second barriers in the implementation. Being healthcare professional, doctors, nurses and care providers were the participants of the survey.

Important section of the survey was to focus on expected features and barriers in the implementation. Many healthcare providers accepted that in spite of many prominent features like continuous monitoring, live health data, critical alert etc. the percentage of acceptance is very low. The only barrier is poor knowledge of technology and lack of training and awareness.

9. Rate the essential features expected in wearable device on the s
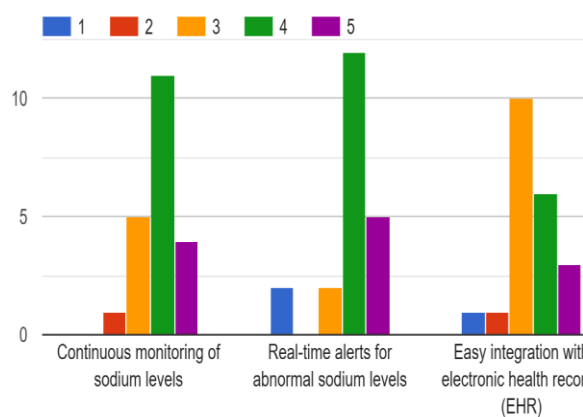

Fig 6: Expected Features in Wearables

Impression: Around 75% participants rated the highest scale to the enlisted features whereas 20% were not agreed with the mentioned features.

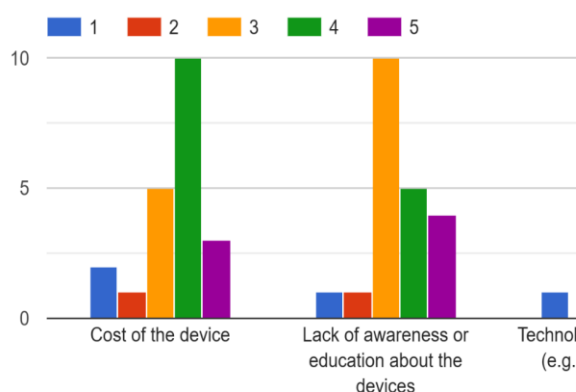10.Rate the barriers you foresee in the implementation o
5-Most Important)

Fig7: Barriers in Implementation

Impression: Around 80% participants feel that the enlisted challenges have higher impact on user acceptance and are considered as barriers in use.

5.0 DISCUSSION

The results of the survey suggest that IoT wearables hold significant promise in transforming healthcare, particularly in the management of chronic diseases, early detection of health conditions, and enhancing patient engagement. However, the widespread adoption of these devices is hindered by issues such as data privacy, device accuracy, and cost.

The challenge of data privacy is a critical concern for both healthcare professionals and patients. As personal health data is highly sensitive, ensuring robust encryption and secure data transfer protocols will be crucial for future adoption. Similarly, accuracy of data, especially for vital parameters such as blood pressure or glucose levels, must be improved to make these devices more reliable for clinical decision-making.

The cost of IoT wearables remains a barrier for many patients, especially those with limited financial resources. Efforts to reduce costs through technological advancements and mass production could improve accessibility and encourage greater adoption.

The future potential of IoT wearables lies in their ability to provide more personalized healthcare. As AI and machine learning technologies advance, wearables will be able to offer tailored recommendations based on individual health data, enabling more precise and effective treatments.

6. 0 CONCLUSION

IoT wearables are poised to significantly impact healthcare by providing live health monitoring, improving chronic disease management, and allowing patients to take control of their vital health signs. While challenges such as data privacy, accuracy, and cost remain, the future of IoT in healthcare looks promising. Patient care could be completely transformed by the incorporation of wearable technology into healthcare systems, becoming more proactive, individualized, and effective. To fully realize this potential, further advancements in technology, alongside regulatory frameworks to ensure data security, are necessary.

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