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Wearable Health Technologies: Monitoring Chronic Conditions

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ABSTRACT

Chronic illnesses such as cardiovascular disease, diabetes, and cancer are major contributors to mortality worldwide, requiring novel strategies to control and track these disorders. Wearable health technology have become a very promising platform for ongoing and distant monitoring, facilitating the gathering of data in real-time and providing individualised treatment. A comprehensive analysis of wearable health technologies is presented in this study, with a specific emphasis on their use in the management of chronic diseases. This review examines many categories of wearable gadgets, their capabilities, and their influence on the provision of healthcare services. The review also discusses the difficulties associated with incorporating these technologies into healthcare systems and proposes potential avenues for enhancing their effectiveness and acceptance by users.

Keywords: Wearable health technologies, chronic disease monitoring, remote healthcare, smart fabrics, continuous monitoring, diabetes management.

INTRODUCTION

Chronic diseases, including heart disease, stroke, cancer, and diabetes, are the leading causes of death and disability in the United States. Cardiovascular disease and cancer are the two most common causes, responsible for over 50% of all deaths. Cardiovascular diseases contribute to 70% of the deaths from Americans every year. Diabetes is also a major health problem for self-managed care is the usual mode of treatment. More than 18 million Americans have diabetes, and the numbers continue to increase every year. All these diseases share common risk factors such as high blood pressure, elevated serum cholesterol, obesity, smoking, physical inactivity, poor eating habits, etc. and are affected by the same preventive and treatment processes associated with these factors [1]. Recently, there has been a growing trend to personal mobile and wearable health technologies to enable continuous monitoring and management of chronic conditions, including using such devices for detection and prevention purposes. The focus of this study is to review wearable and mobile technologies for remote monitoring of chronic conditions, from its physiological magnetism characteristic, and their applications on health care monitoring scenarios. The work has found that there is a slow increment of mobile and wearable health conditions to aid on wireless, human-centric instruments for patient monitoring. This paper reviews the currently available wearable and mobile technologies suitable for remote monitoring of chronic conditions, including the three physiological sensors, mobile platforms, and networking paradigms, and their applications on health care monitoring scenarios. Also, the fast advancement of commercial-off-the-shelf wireless physiological signs is scarce. The study is believed that the results have presented opportunities on wearable and mobile health monitoring technologies and have opened myriad issues to discuss further comprehensive research on this area [2].

BACKGROUND AND SIGNIFICANCE

A need for ubiquitous personalized health monitoring systems for chronic care management and increasing wearer compliance (i.e., adoption) with this new breed of technologies has been recognized by researchers, industry, and healthcare professionals to address an increasingly economy-challenging healthcare problem. The term "ubiquitous health" aims to equip everyday environments, objects, and

apparel with technologies to provide health services whenever needed. One of the aspects of such solutions involves fabric sensors (or electronic textiles), wearable chemical sensors and biosensors, and instruments for other health- and wellness-relevant measurements incorporated into textile- and clothing-integrated systems, popularly referred to as smart fabrics or expanding on a broader wearable health technology concept. Researchers are studying the use of these for smart hospital garments, military and sports clothing, consumer everyday wear, and many variations thereof [3]. The most recent studies, other than pure technology development demonstrations, point to an increasing research interest in exploring consumer perspective as an important aspect for long-term success in realizing the potential that the wearable health technology field offers. Such choice and taste, fashion, and individual expression concerns are appreciated, yet we observe that the work focuses on these aspects from an intelligent fabric perspective and questionable health benefits. While wearable health technologies are appreciated as rather personal, contact with the fabric, length of wear, ease of use, comfort, fit, size, and obtrusiveness seem to take priority. Textile issues, proper cleaning and care, and transparency with personal health information are most important. Other aspects discussed by the articles include the importance of individual product fashion styling, unusual occurrences, discretion, garment style and comfort, size or fit, cost, and device protectiveness from moisture and unclean environments [4].

TYPES OF WEARABLE HEALTH TECHNOLOGIES

A variety of technologies exist that can be deployed as wearable health technologies. These all offer different features and capabilities and are likely to be appropriate for a different and varied range of applications and instances of chronic diseases. The main types of wearable health devices currently in use or under development are described in the following sections. The term 'wearable health technologies' describes the use of mobile electronic devices that are worn on the body and can detect and record data related to health. Wearable health sensing technologies monitor health status and the surrounding environment and perform analytics enhancing personalized care and outcome as well as reducing healthcare cost. [5]. These devices are worn on different parts of the body, including the torso, wrist, and head. Often they are equipped with body sensors and get information about bodily processes; others can also provide feedback to the user through built-in actuators. However, perhaps the defining quality of a wearable health technology is its ability to support continuous monitoring by being non-invasive and unobtrusive, and capable of providing an unencumbered and natural interface between the user and devices without interrupting daily activities. This is unlike many existing fixed and portable health technologies, which often require the connection of intrusive sensors and other devices directly to the body, thereby interrupting activities and even everyday life [6].

WEARABLE DEVICES FOR VITAL SIGNS MONITORING

Wearable devices are promising as low-cost, simple to use, portable, and real-time tools for chronic disease monitoring. Moreover, compared to traditional hospital examination, continuous health information can be easily collected by wearable device sensors from people under real-life conditions without spatial and temporal limitations. Portable wireless devices provide caregivers with immediate patient data. As the technology progresses and hardware and software costs decrease, the motivation to develop and use wearable devices for health becomes stronger. Compared to the traditional professional-grade medical devices, these less expensive tools allow more numerous measurements, thereby improving the quality of information about patient status and disease activity [7]. Physical, physiological, and biochemical parameters such as blood pressure, body temperature, oxygen saturation, and glucose can be easily monitored with wearable devices. Preferably, these measurements include ecological and medically relevant situations, since human biological parameters are influenced by activity and environment. These devices are lightweight, comfortable to wear, and can send collected data directly to personal electronic devices. A variety of different types of wearable sensors have been developed to monitor a variety of health and disease conditions. At present, although wearable sensor technology has entered an important growth stage, there is still scope for the development of energy conservation, data analytics, and wearable technology standards, as well as for the improvement of sensor-related accuracy, better signal processing, and data security. With the help of Internet of Things (IoT) technology, physiological signals can be uploaded to the cloud for diagnostic purposes, where the physician can monitor the patient in real time [8].

APPLICATIONS IN MONITORING CHRONIC CONDITIONS

The use of wearable tech to monitor various kinds of health data is an increasingly important trend in healthcare. The goal of this shift in care is twofold: empower patients to take primary responsibility for their own healthcare, while at the same time developing data that can be used to predict and head off health crises needing professional intervention before they occur. Using data before people get sick might even predict some illnesses before they could be detected by a regular check-up. Many treatments for

chronic care could become an ounce of prevention, rather than the pounds of cure required when patients only access professional care after they get sick [9]. These changes in the way people will access healthcare increase the availability of information to healthcare providers by orders of magnitude, so much so that the vast growth in data presents problems unlike those found in any other form of large-scale data collection. The 3 Vs, a principal impediment to value extraction from the analysis of big data, are Volume (amount of data) and Variety (range of different data sources – from many different physiological and physical kinds of monitoring, as permitted and encouraged by wearable devices) and the issue of data flow Velocity, which refers to the speed at which data can be acted upon. Any existing measure of vital signs – heart rate, respiratory rate, even blood glucose – is a static measure of a dynamic property of physiology. Data to be useful needs to be gathered continuously – and where possible, analyzed for trends in real time [10].

DIABETES MANAGEMENT

Diabetes mellitus is a chronic metabolic disorder characterized by chronic elevation in blood glucose level. The prevalence of diabetes has been increasing at an alarming rate globally, not only in developed countries but also in developing countries. Diabetes management involves regular blood glucose monitoring, insulin self-injection, diet and exercise, and monthly or yearly visits to healthcare professionals. In developing countries, lack of widespread medical infrastructure and limited access to healthcare professionals can lead to poor diabetic management. As a result, diabetes becomes a significant public health problem associated with high morbidity and mortality. A continuous blood glucose monitoring device may help diabetic patients manage their condition well without frequent visiting to doctors. Several wearable devices have been developed to monitor blood glucose levels [11]. proposed a compact noninvasive capacitive blood pressure sensor with low noise and low power consumption for continuous monitoring and wireless communication, and demonstrated by evaluating in a human patient study. Their results show that the sensor can be used in wearable blood pressure monitoring systems. Glucose monitoring due to sweat is noninvasive and provides a comfortable wearing experience for diabetic patients. There are several challenges in terms of the bandgap energy needed to filter the sweat, the time-dependent variation of sweat, and the skin temperature [12].

CHALLENGES AND FUTURE DIRECTIONS

When developing wearable solutions for monitoring chronic conditions, there are a few key challenges that we must bear in mind. Chronic conditions often either already or are likely to develop multiple comorbidities. This can often result in certain data points used for monitoring a single condition being confounded by other symptoms, such as a resting high heart rate being a common factor of both diabetes and chronic kidney disease. Therefore, it is worth striving to include as many measurements as possible when monitoring a condition in order to track the true progression of a disease state. This often results in a multitude of sensors being required, particularly for the periodic condition monitoring format, as opposed to monitoring continuous biomarker data from the skin [13]. When integrating wearable sensors into systems, the design process requires adaptation for comfort, ergonomics, and motion insensitivity. Wearability is a challenge as uncomfortable wear patterns result in low device usage. To address this challenge, a more empathic design approach is needed, involving users from the start to tailor solutions to their preferences. It is important to consider if data can be passively monitored or gathered with minimal response, and if it aligns with the driving aim. Additionally, wearable medical devices should adhere to standards for reliable and fair data comparison. Engaging with stakeholders such as healthcare professionals, regulators, manufacturers, and caregivers is crucial for successful design processes. Providing information on device use and benefits is essential for adoption [14,15].

CONCLUSION

Wearable health technologies represent a significant advancement in the management of chronic conditions, offering patients and healthcare providers unprecedented access to real-time data and insights. These technologies have the potential to transform traditional healthcare models by enabling continuous monitoring and proactive management, ultimately improving patient outcomes and reducing healthcare costs. However, several challenges remain, including the need for more accurate sensors, better integration with healthcare systems, and increased user compliance. Future research should focus on addressing these challenges, with an emphasis on developing user-friendly, reliable, and secure wearable devices that can be seamlessly incorporated into everyday life. As these technologies evolve, they hold the promise of significantly enhancing the quality of life for individuals with chronic conditions.

REFERENCES

1. Amini M, Zayeri F, Salehi M. Trend analysis of cardiovascular disease mortality, incidence, and mortality-to-incidence ratio: results from global burden of disease study 2017. BMC public health. 2021. springer.com

2. Channa A, Popescu N, Skibinska J, Burget R. The rise of wearable devices during the COVID-19 pandemic: A systematic review. Sensors. 2021. mdpi.com
3. Guo Y, Liu X, Peng S, Jiang X, Xu K, Chen C, Wang Z, Dai C, Chen W. A review of wearable and unobtrusive sensing technologies for chronic disease management. Computers in Biology and Medicine. 2021 Feb 1; 129:104163. nih.gov
4. Tikkanen H, Heinonen K, Ravald A. Smart wearable technologies as resources for consumer agency in well-being. Journal of Interactive Marketing. 2023 May;58(2-3):136-50. hanken.fi
5. Vijayan V, Connolly JP, Condell J, McKelvey N, Gardiner P. Review of wearable devices and data collection considerations for connected health. Sensors. 2021 Aug 19;21(16):5589. mdpi.com
6. Khoshmanesh F, Thurgood P, Pirogova E, Nahavandi S, Baratchi S. Wearable sensors: At the frontier of personalised health monitoring, smart prosthetics and assistive technologies. Biosensors and Bioelectronics. 2021 Mar 15; 176:112946. [HTML]
7. Sharma A, Badea M, Tiwari S, Marty JL. Wearable biosensors: an alternative and practical approach in healthcare and disease monitoring. Molecules. 2021. mdpi.com
8. Cheng Y, Wang K, Xu H, Li T, Jin Q, Cui D. Recent developments in sensors for wearable device applications. Analytical and bioanalytical chemistry. 2021 Oct;413(24):6037-57. researchgate.net
9. Greiwe J, Nyenhuis SM. Wearable technology and how this can be implemented into clinical practice. Current allergy and asthma reports. 2020. springer.com
10. Bresciani S, Ciampi F, Meli F, Ferraris A. Using big data for co-innovation processes: Mapping the field of data-driven innovation, proposing theoretical developments and providing a research agenda. International Journal of Information Management. 2021 Oct 1; 60:102347. [HTML]
11. Robert AA, Al Dawish MA. The worrying trend of diabetes mellitus in Saudi Arabia: an urgent call to action. Current diabetes reviews. 2020. researchgate.net
12. Lakshmi GS, Rao KS. Design of capacitive pressure sensor for continuous glucose monitoring system. Microsystem Technologies. 2024. [HTML]
13. Tomisa G, Horváth A, Sánta B, Keglevich A, Tamási L. Epidemiology of comorbidities and their association with asthma control. Allergy, Asthma & Clinical Immunology. 2021 Dec; 17:1-4. springer.com
14. Ates HC, Nguyen PQ, Gonzalez-Macia L, Morales-Narváez E, Güder F, Collins JJ, Dincer C. End-to-end design of wearable sensors. Nature Reviews Materials. 2022 Nov;7(11):887-907. nature.com
15. Ugwu Okechukwu Paul-Chima, Alum Esther Ugo, Okon Michael Ben, Egba Simeon Ikechukwu and Uti Daniel Ejim. Integrating Wearable Health Monitoring Devices with IoT for Enhanced Personal Health Management: A Comprehensive Review. Research Output Journal of Engineering and Scientific Research. 2024 3(1):6-10.

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