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Internet of thing based health monitoring system using wearable sensors networks

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ABSTRACT

Maintaining mental and physical health is becoming increasingly important for maintaining independent living, particularly as the population of people suffering from chronic illnesses like diabetes, heart disease, obesity, and other conditions rises and the average age of many societies keeps rising. Using sensors, monitoring health remotely, and ultimately recognising daily activities have all been proposed as potential strategies. In this work, fatigue threshold and environmental bounds are assessed and provided via an external interface to a microcontroller unit (MCU) in addition to the required restrictions. Rerouting the required boundaries into the long range (LoRa) and Bluetooth module, the MCU is responsible for editing and analysing the raw data to remove the oxygen immersion, pulse, and temperature data. These important restrictions are sent to many terminals, such as PCs and mobile devices, using the remote Bluetooth and LoRa module. For data storage and retrieval, any IoT platform may be used. With caution, the patient is discharged home after the medical experts have carefully evaluated the diseases in light of the new features. To telemonitor patients with heart conditions, the test results show that the framework is efficient and dependable for collecting, sending, and presenting electrocardiogram (ECG) data constantly.

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1. INTRODUCTION

One important tool for diagnosing heart issues is electrocardiogram (ECG) monitoring, which is often employed. One of the many very important applications enabled by the internet of things (IoT) is smart and connected health care. Our dwellings may be equipped with networked sensors, which can be worn on the body to gather extensive health data on our mental and physical well-being. If such information is consistently gathered, combined, and expertly mined, it might lead to a positive revolutionary change in the healthcare industry. Specifically, the new generation of intelligent processing algorithms coupled with the availability of data at previously unthinkable scales and temporal longitudes can: i) enable the evolution of medical practice from the current post facto diagnose-and-treat reactive paradigm to a proactive framework for prognosis of diseases at an incipient stage, coupled with prevention, cure, and overall management of health instead of disease, ii) enable personalisation of healthcare, and iii) improve care in order to realise this forward-thinking healthcare vision, we discuss the benefits and drawbacks of IoT in this research.

Some noteworthy contributions made by this paper are as follows: first, this work presents a novel way to measure personal health in real-time: the Wearable IoT-cloud-baSedhEalth monitoring system (WISE) [1]–[5]. WISE uses the body area sensor network (BASN) platform to provide real-time health monitoring. Among the many integrated wearable sensors are the blood pressure, body temperature, and pulse sensors. Second, in order to function as a gateway for data processing, visualisation, and transmission, the majority of wearable health monitoring devices now in use needs a smartphone. This will definitely have an impact on regular smartphone use. For simple access to real-time data in WISE, a lightweight wearable LCD might be included in place of the direct data transfer from the BASN to the cloud [6]–[10].

The demographic composition and size of the population have changed during the last 20 years, and these trends are anticipated to persist. Though they primarily affect health and healthcare, these demographic trends have a significant influence on almost every sector of society. Particularly in wealthier nations, life expectancy has increased dramatically. This is cause for celebration and should be seen as an opportunity for people to live better, longer lives [11]–[15]. The healthcare system and living conditions, however, both need to be significantly improved since elderly people often need more medical attention than younger people. Furthermore, chronic sickness affects older people more often as a natural byproduct of ageing. IoT technology have great potential in the individualised healthcare industry. The wireless body area network-composed of wearable sensors and communication units-is one of the main facilitators. Health statuses of patients may be accurately recognised in real time while being followed from a distance, emergencies can be appropriately identified, and relevant parties like doctors and family members can be informed as needed. Since there are still issues, these will be discussed in the part that follows. Nevertheless, a great deal of research has been done in this field. Even though biological signal monitoring often requires 24-hour operation, it is nonetheless uncomfortable and invasive for people to have many sensors continuously attached to different parts of their body. The complexity of the data analysis process is also dramatically increased by sensors, which often have inadequate processing and storage capacities while producing massive volumes of data, raising the memory and computing needs even more [16]–[20].

For the purpose of precisely obtaining the most crucial data, a more advanced sensor data filtering system is therefore required. In addition, a significant issue with many sensing devices-including smartphones-relates to their battery life, especially when connecting via Bluetooth and WiFi. The lowering of data transmission frequency without compromising or enhancing system performance may therefore be possible with a more sophisticated data transmission technology. As body area network (BAN) has been shown to be a workable solution for individualised healthcare, there is a growing need to prioritise the network's security, privacy, reliability, and resilience. Technologically, a BAN has to be more robust and tolerant in the event that a node malfunctions or is destroyed. Additionally, the network needs to ensure that communications between nodes are not interrupted in the event that certain nodes fail. Thanks to its ability to seamlessly integrate a broad variety of intelligent devices, such as smart TVs, smartphones, sensors, and many more, IoT has gained increased attention in recent years. Wearable IoT is a subset of IoT that focuses on the communication and connection of any wearable device [21]–[27].

2. PROPOSED METHOD

An increasing range of commercially accessible gadgets for activity awareness, fitness, and personal health care are now available thanks to the rise in popularity of wearable sensors. For the long-term recording, management, and clinical access to patient physiological data, researchers have considered using these technologies in clinical settings. Furthermore, the gadgets now on the market serve to a niche recreational fitness market. Predictably, given the state of technology today, there won't be too much time in the near future for your typical physical exam to be followed by two or three days of continuous physiological monitoring using reasonably priced wearable sensors. The sensors would continuously record signals related to your primary physiological traits throughout this period, sending the resulting data to a database linked to your medical background. When you visit for your physical examination, the doctor has access to the far more extensive longitudinal record provided by the sensors, in addition to the static measurements of your physiological and metabolic status that are normally collected in a clinic or lab. With the use of the available data and decision-support systems that can access a vast corpus of observation data for other individuals, the doctor can make a much more accurate diagnosis for your condition and suggest therapies, early intervention, and lifestyle modifications that are particularly beneficial in improving your health. A device like this might revolutionise healthcare systems globally, drastically reduce healthcare costs, and improve diagnostic accuracy and timeliness. In terms of technology, the idea stated in the previous paragraph has been plausible for some time. Wearable sensors haven't, however, significantly changed the way that clinical medicine is now practiced. In order to facilitate the integration of current and upcoming technologies into medical practice, we will examine the promise these technologies provide in the clinical context in this article, along with the challenges that must be overcome.

Wireless sensor networks (WSNs) have a more dispersed sensor deployment than our health monitoring system, however in order to achieve our goals, we could revisit existing WSN methods. The suggested energy-efficient sensing techniques distribute sensing jobs among the nodes according to their relative distance from one another and according to the energy availability at each sensor in order to detect the greatest quantity of physical information while using the least amount of energy. This minimises energy consumption and enables the perception of the greatest quantity of physical information possible. To use comparable techniques, our system may establish and employ a dynamic environment that depends on energy availability and the health of the patient. For instance, the utility of individually identified biomarkers varies depending on the kind of illness. When patient energy is very limited and a single biomarker is important due to their fragile condition, the other sensors should be disabled in order to maximise longevity. An IoT-based sensing architecture makes it simpler to implement such flexible solutions for boosting energy efficiency by allowing the dynamic utilisation of sensors based on context. Standard data collection systems, which depend on sensors to passively convey the information they gather, would not be able to provide such intelligence and flexibility. By outsourcing the decision-making process for sensing task assignment to the cloud, it is also possible to apply more sophisticated algorithms without requiring the patient to manually manipulate the sensors or the software on the data concentrator. The energy constraints of these devices necessitate the use of suitable low power communication protocols, since communication may make up a significant amount of a sensing device's power usage. Low-rate wireless personal area networks (LR-WPANs) use ZigBee over IEEE 802.15.4 to provide communication between low power devices inside a personal operating space (POS) of around 10 metres. ZigBee delivers reliable mesh networking and a longer battery life. Another wireless technology is called Bluetooth low energy (BLE), and it may be used for low-power, short-range applications like sports, home entertainment, and health monitoring. Figure 1 depicts IoT technologies.

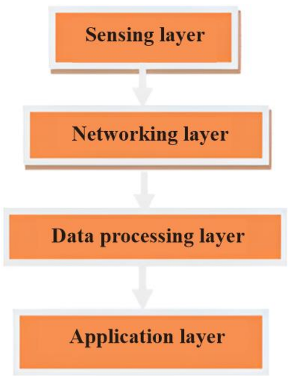

Figure 1. Overall framework of IoT technologies

IEEE 802.15.1, the original Bluetooth protocol, was developed to enable reasonably close-proximity communication for streaming applications such as music. BLE uses much longer sleep intervals in its design, which lowers overall energy consumption. In terms of data delivery per joule of energy, BLE outperforms other methods. An intermediate node, also known as a data concentrator, is necessary when employing the aforementioned communication protocols in order to make sensor data and control accessible electronically. It has been proposed to advance the IoT concept to provide a seamless link between energy-constrained wireless personal area networks (WPAN) devices and the internet using IPv6 via low power wireless personal area networks (6LoWPAN). 6LoWPAN suggests fragmentation strategies to accommodate IPv6 datagrams inside IEEE 802.15.4 constrained frame size, enabling low power and low complexity sensing devices IP access. An apparatus that can continually track a patient's health in order to identify illnesses early and stop them from progressing is called a WSN. Global effects have been felt as a result of the growing usage of smart and mobile devices for health-related reasons. The advantages that these technologies provide are being used by medical professionals more and more, which is greatly improving clinical health care. Figure 2 illustrates how many common people take use of the benefits of E-health (healthcare facilitated by ICT) and M-health (mobile health) apps to enhance, support, and aid their health.

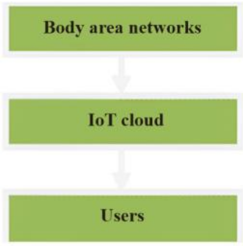

Figure 2. Proposed wearable sensor networks

3. RESULTS AND DISCUSSION

A WSN for real-world interaction consisting of several sensor nodes. Small, inexpensive, low-power sensors are able to detect wireless transmission. Human health monitoring is growing essential. Extended life expectancies pose difficult challenges for elderly adults whose cognitive and physical capacities are deteriorating. People may be actively encouraged to adopt healthy lifestyles by actively using ambient health monitoring (AHM). The focus of the ambient assisted living (AAL) programmes is on specific services, such as activity detection, food photography, and blood sugar monitoring. Portable medical equipment, such as vital sign monitors, pulse monitors, spirometers, and pulse rate metres, is essential. Previously, these devices' sensors were connected to the patient, which led to the patient's eventual bedridden state. It is also necessary to detach and then reconnect all monitors whenever a patient has to be transferred. Patients may be freed from their beds and instruments thanks to these wireless gadgets that use wireless technology, which also allows for the removal of all those laborious activities. Continuous and extensive medical monitoring is now feasible because to the availability of wireless healthcare systems and telemedicine services. WSN are becoming ubiquitous in order to monitor patients in the hospital environment as well as at home. Figure 3 illustrates how the absence of cables reduces expenses and boosts flexibility while also improving patient comfort.

WSN are essential to AAL because they gather data about users and their environment in order to provide personalised feedback. These clever systems are designed to satisfy user needs. WSN may make use of environmental sensors such as humidity sensors as well as vital sign sensors. The main goal of developing this kind of technology is to improve the quality of life for patients on a daily basis. We'll utilise Arduino to use the Esp8266. The Esp8266 is being used in this case to send data to a server and a mobile device. in particular, the Wi-Fi module. It establishes a hotspot connection to access the internet. In this case, the signal processing and interface sensors are handled by an Arduino UNO R3 microcontroller. The Arduino microcontroller is now a fantastic choice for IoT applications. It is quite sturdy and features an easy-to-use interface. Sensor readings are automatically stored on a server by a programme, allowing clinicians to access the data whenever they choose.

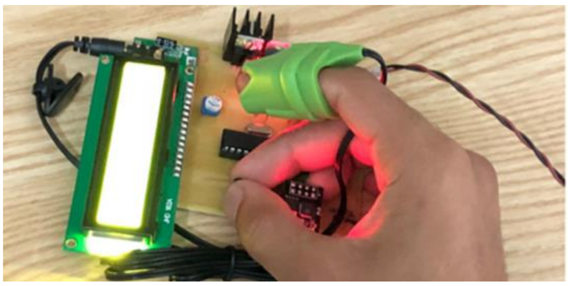

Figure 3. Hardware output of wearable devices

4. CONCLUSION AND FUTURE WORK

In this paper, we analysed the state of affairs and made projections about the use of remote health monitoring technology in clinical settings. The potential for observing and gathering data in home and professional environments for much longer periods of time than are now possible during office and lab visits is attractive when it comes to wearable sensors, particularly those with IoT intelligence. This data goldmine might dramatically save costs and enhance healthcare when it is evaluated and provided to physicians in easily understood visual aids. Several obstacles in sensing, analytics, and visualisation were identified and highlighted before solutions were designed for a smooth incorporation into clinical practice. This article describes the design and implementation of an IoT-based real-time health monitoring system, using the Esp8266. As of right now, the Esp8266 and Arduino combo has shown to be a stable and affordable solution to collect and send sensor data wirelessly to medical professionals. This is especially beneficial for patients who live far away. With an Arduino as its brain, the wireless recorder has intelligence, compactness, and reliability. Wiring and other external components are reduced thanks to its integrated CPU. Thus, the system is less complicated.

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