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Remote Monitoring of Health Using Artificial Intelligence and Internet of Things in Smart Cities

Prof. Se-Jung Lim

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Abstract: Modern sensors and devices may connect to the internet and communicate with one another, thanks to the Internet of Things (IoT), a powerful technical development. Smart cities, smart homes, and smart healthcare are just a few of the fascinating application domains that end users can access through a stage. With the help of cutting-edge technology like the Internet of Things, healthcare monitoring systems can now be significantly improved. This study examines the architecture, functionalities, and fundamental principles of IoT-based healthcare monitoring systems and applications for poorly understood diseases. In order for the present apps and systems to better serve patients, a thorough investigation has been done in this paper to determine their efficacy, value, and suitability. Numerous healthcare monitoring systems have made utilization of the IoT to organize the various remote points of contact with the cloud-based healthcare administrations. Finding, obtaining, handling, storing, and learning more about patient information are some of these administrative duties. The numerous IoT healthcare apps will contribute to the creation of advantageous and efficient arrangements by gradually integrating these systems. The survey's findings seem to support the notion that faster development of healthcare arrangements beneficial for a range of healthcare issues and scenarios is occurring as a result of IoT-based healthcare monitoring applications.

Keywords*: Artificial Intelligence, Healthcare Monitoring system, Implementation, IOT*

1. Introduction

In every innovation-related advancement that humanity makes, wellbeing is typically a key concern. The way that medical services have developed to considerable relevance can be compared to the current Covid attack, which has partially wrecked almost every country's economy. It is always a better idea to screen these people using remote health monitoring technology in areas where the pandemic has spread. The ongoing solution is an IoT-based Web of Things (WoT) based wellbeing monitoring system [1].

Far-off Persistent Monitoring extends admission to human administration workplaces while cutting costs [2]. It involves patients' perceptions outside of typical healthcare venues (such as at home). The design and deployment of an innovative global positioning system for patient welfare that combines sensors to track patient health and the internet to alert their loved ones to potential issues was the major goal of this project. Monitoring systems attempt to 649minimize medical care costs by minimizing doctor visits, hospital stays, and analytical testing methods [3]. Our bodies use body temperature and heart rate to gauge our overall health. The sensors are linked to a microprocessor, which tracks the status and displays it on an LCD screen. The microcontroller also includes a remote connection for exchanging alerts. In the event that the system identifies any unexpected changes in the patient's understanding heart rate or internal heat level, the structure alerts the customer about the patient's status via IOT and also displays basic components of the patient's heartbeat and temperature live online. In order to present accurate estimations of tranquil prosperity and to continue time, the IOT-created open-minded prosperity monitoring structure uses the web correctly. There is a critical capacity between SMS-based patient flourishing survey and IOT-based patient seriously looking at structure. In an IOT-based structure, unassuming elements of the patient's progress should be apparent to a variety of clients [4]. This is done with the assumption that the material should truly be evaluated by going to a URL or webpage. Systems for SMS send the growing limitations via GSM when used in GSM-based patient assessments. Figure 1 shows the proposed system for Iot based tracking of an individual's health.

AI Liberal Arts Studies, Honam University, 120, Honamdae-gil, Gwangsan-gu, Gwangju-si, 62399, South Korea
limsejung@honam.ac.kr

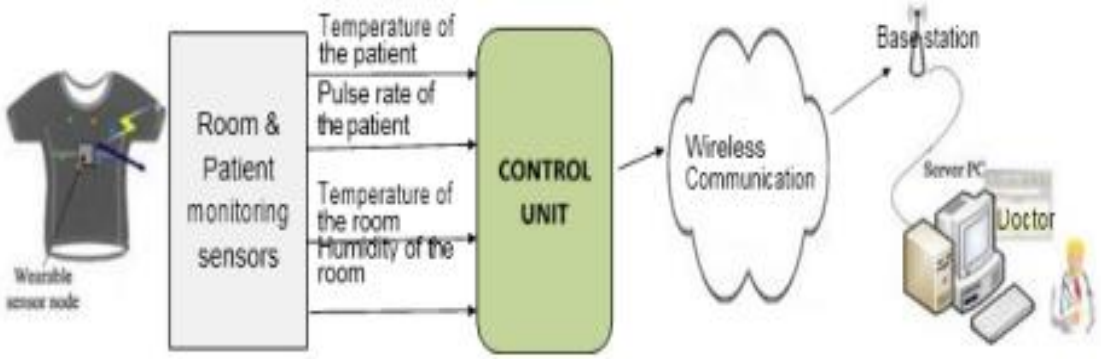

Fig. 1: Proposed System

1.1. Smart City and Healthcare Services

By implementing standard tools and equipment for cleverly organizing healthcare resources, many conventional urban cities seek to imitate the idea of smart city healthcare. Information and communication technology (ICT) and intelligent planning are crucial for advancing the delivery of high-quality healthcare services to citizens in smart urban areas [5]. Planning for delightful living, upholding the standard of healthcare administration, and creating better living conditions for inhabitants are among the core objectives of the smart city. For the creation and provision of innovative and practical healthcare administrations, a specific model must exist.

1.2. Sensing, Monitoring, and Controlling

Urban healthcare communities are anticipated to become more intelligent as a result of sensors, monitoring, and control. The input values from these sensors let healthcare suppliers automate leading monitoring and control. As computerization develops, the critical values of these sensors assist healthcare professionals with monitoring and control. Utilizing the IoT, remote sensor organizations, deep learning, and other advancements can help achieve these objectives [6]. Smart urban societies can quickly satisfy the healthcare requirements of many people by using continuous data. Healthcare professionals are capable of quickly and successfully making decisions. Because of IoTs, AI, and innovative thinking, the nature of healthcare has changed [7]. Sensors can be built inside the body or worn externally, like in trendy timepieces.

With the information provided, associations are made with healthcare suppliers through channels and remote 650 organizations [8]. For example, electrochemical glucose sensors are embedded sensors that help in diabetes detection and management [9]. Patients can also self-manage and customize their diabete patients with AI-based gadgets. Modern smart phones can collect data from sensors and can be used by diabetic to check their blood glucose levels [10]. Other high-level sensors are employed to monitor and treat rheumatoid arthritis, cranial strain, rest apnea, and heart arrhythmias [11]. The main restrictions on these devices are tasks and executives. The individuals in charge might not have the necessary training or they might neglect to charge the equipment. Zero impacts advances (ZETs) must be used in order to relieve the customer of the duties involved in operating and maintaining the sensor devices [12]. Early diagnosis of several infections, such as dementia and cardiovascular diseases, is made easier with remote detection. Conduct monitoring is a critical cycle in the management of these illness classes. One estimate states that in 2017, a startling 47 million people worldwide suffered from dementia. This country is expected to have 132 million residents by 2050 [13]. High level remote detecting systems, with help from the Internet of Things and artificial intelligence, would make it easier to monitor and regulate the conditions required to effectively treat these disorders.

2. Remote Healthcare Monitoring Architectures

Even though remote healthcare monitoring hasn't yet attained conventional clinical consideration, a variety of tasks were offered for scholastic exercises in a variety of clinical settings. The recent rapid development of ICT has had a substantial impact on how remote healthcare monitoring is conducted [14]. By gathering patient data and concentrating on the location of remote healthcare monitoring equipment, this section analyses the main engineering plans.

2.1. Body Sensor Network Architectures

Another eerie development is that ICT improvements have brought about a paradigm shift in the information flow and 650 utilizing 650 on of remote healthcare monitoring systems [15]. Body Sensor Organization (BSN), a revolutionary building configuration based on Body Region Organization (Boycott), was created in order to acquire bio-signals 650 utilizing numerous smart sensors connected to the corps [16]. BSNs include remote sensor networks with a constrained network range as well as frequently varying small patient equipment that is certainly nearby [17]. Reconnecting each device to the

internet in this scenario is not practical. Furthermore, due to their small size and close proximity inside the human body, they have harsh cutoff points for both the openness of force sources and their tolerated limits. In order to reduce clog or response issues in the situation of fragile correspondence, the BSN itself should be the subject of that correspondence module and a sensor like a cardioverter will be locked with the BSN's purpose in mind.

It's important to keep in mind that the wager articulations can be reasonable demands for the boycott for proper execution. The choice of transitional conveyance phases, such as movable doors, outer hubs, network organizers, and cross correspondence centers, provides a variety of organizational approaches and systems. These specifications, together with the information route that was chosen, are crucial factors for companies that offer cloud-based or medical services systems. This method assumes that a specific element, such as the body door, will coordinate all hardware. This portion acts as an interface to a baseband unit that sends data over a distant network utilizing RFID, Wi-Fi, Zig Bee over IEE 802.15.4, Bluetooth over IEE 802.15.1, or 3G/4G, often PDAs, which is the best method to handle the network association for remote monitoring [18]. A restricted responsibility can be altered to support a BSN design that employs a variety of gadgets and apps in healthcare settings.

3. System Architecture

Information security is achieved by using a variety of wearable sensors that operate on physiological biomarkers, including the ECG, skin temperature, respiration rate, EMG muscle activity, and step (pose). The sensors are connected to the organisation, but the organisation is also connected to a middle information aggregator or concentrator, which is often a PDA near the patient.

The system's information transmission components are in charge of safely and continuously transmitting patient records from the patient's home (or any other distant place) to the server farm of the Healthcare Association (HCO). The physical acquisition stage usually has a short-range radio, such as Zigbee or low-power Bluetooth, to transmit sensor data to the concentrator. Additionally, the concentrator's web network transmits the collected data to an HCO for long-term preservation, usually via a mobile phone's WiFi or cellular data connection. Since the information from each individual sensor can be accessible through the Web via the concentrator, a Web of Things (IoT)-based engineering is created around sensors [19][20].

It is frequently required to employ a capacity/handling device instead of a mobile client, also known as a cloudlet, when the local portable resources are insufficient to meet the requirements of the application [21]. The cloudlet is a local handling device (much like a personal computer) that the concentrator may directly access over WiFi. The cloudlet can be used to perform time-based basic actions on the patient's collected data in addition to provide short-term cloud storage for prior correspondence of data. The acquired data can also be sent to the cloud through the cloudlet in cases where the mobile phone is constrained, such as when there is a brief network outage or power outage.

Gathering, investigation, and perception are the three distinct parts of cloud handling. The technique is intended to offer symptomatic information to medical practitioners while also permanently recording patient biomedical data. The open issues and cloud-based clinical information archiving have been covered in great detail in the work [22] and[23]. Studies that combine sensor data with the increasingly common e-Wellbeing records can aid in making decisions and providing visualizations for a number of ailments and illnesses. Additionally, any such system must include representation because it is unrealistic to expect doctors to properly study the substantial data or analysis from wearable sensors. Perception strategies that make the data and tests available to users in an easily understandable format are crucial if wearable sensors are to have an impact on clinical practice.

3.1. Remote Healthcare Monitoring Systems Powered By IOT

Ingenious healthcare monitoring systems have developed during the past ten years and have the potential to change how healthcare is currently delivered. Although their clinical method competence is still in dispute, intelligent health monitoring systems may be able to automate patient monitoring activities while also improving patient technique. The competency, clinical viability, methodology, and suggestions for enhancing the continuing healthcare monitoring systems will also be thoroughly examined. Patients in their remote locations should have remote access to modern IoT-based healthcare monitoring. As a result, remote healthcare monitoring systems will be a major development in the healthcare industry. The design level of IoT-based healthcare monitoring systems has significantly improved, according to recent concerns voiced by the healthcare suppliers. This conclusion can lead us to believe that, when compared to other comparison systems, there may be difficulties in the field of healthcare monitoring.

The cloud, IoT channels, and information gathering devices are the typical three components of IoT-based solutions for remote healthcare monitoring. The primary task that primarily relies on the advanced hardware and sensors of the end-system customers is information acquisition. Patient data is collected via smart devices and sensors given by the client, which is then pre-processed in the IoT entry before being sent to the cloud. In the cloud, various information analysis techniques are equally used to gather and decipher important data. The information is then used by clinical specialists for additional analysis and study.

4. Discussion of Relevant Design Issues and Challenges

IoT-based remote healthcare monitoring systems address the foundation of clinical equipment that may collect and split information between one another for the dissemination of various healthcare applications and administrations. Dwivedi et al. claim that wearable Internet of Things technology is now being accepted by medical practitioners in order to speed up the healing process. However, a number of significant limitations and causes substantially obstruct its constant advancement. As a result, the following difficulties and problem areas for improvement are addressed:

4.1. Decision Assistance

The advancement of future savvy healthcare, including monitoring and decision assistance depends on transdisciplinary innovations and the management of insightful techniques. Artificial intelligence supply these. Current exploration attempts heavily rely on artificial intelligence help with navigation. Such examinations present significant chances to pinpoint many of the identified problems. While current developments in AI may not totally replace doctors, they will improve their capacity to succinctly and persuasively deliver critical information that a patient must often assess. Such advancements will not only improve dynamic assistance but also guarantee the reliability and respectability of the comparatively large number of parts that make up the ecosystem of intelligent healthcare monitoring.

- **Usability**

Systems for remote healthcare monitoring are utilised to make analysis and drug delivery simpler. Ease of use is always the most important usability aspect to improve patient health and the provision of medical services. Client input is often used to evaluate convenience, and execution issues are taken into consideration. The Internet of Things (IoT) can only address a fraction of the issue, despite the amazing amount of healthcare hardware. Requirements must be altered in order to integrate the organization's parts and enhance the convenience of remote healthcare monitoring systems. With the development of the Internet of Things (IoT), remote healthcare monitoring systems will one day predict and coordinate with the changing needs of patient encounters.

- **Accuracy and Reliability**

The accuracy and unwavering quality of healthcare data are fundamentally dependent on remote healthcare monitoring systems. Because misleading data could become inconsistent and problematic for patients, the accuracy and uncompromising quality components should be ensured over time. To combine and decode various sorts of clinical data in effective dynamic cycles in remote healthcare monitoring systems, for example, the IoT innovation has a really strong personal stake. As a result, medical professionals will examine each patient's state of wellness, and as a result, more effective treatments should be available. This has typically been achieved with analytical testing, where improved precision remained crucial for the patient's survival.

- **Security and Privacy**

Insightful healthcare requires a highly reliable evaluation process for wellbeing innovations. It is important to protect patient privacy as remote healthcare monitoring devices become more prevalent. Security flaws allow programmers to access user information, which leads to crimes including extortion and fraud, the availability of illegal substances, and fabricated financial records. The constant protections from diseases, necessity, and information obtained from implanted detecting devices have become major concerns for remote healthcare monitoring systems. Security flaws in the healthcare systems can then result in significant, and, surprise, occasionally fatal, mass losses to the patients. Organization verification is one of the key tenets for assuring the growth of remote healthcare monitoring systems. Some healthcare monitoring systems are unable to implement complex encryption computations due to a lack of resources and registering capacity [23]. Effective and low-power handling with current verification systems is essential for managing security threats.

- **Energy Savings**

Standard remote healthcare monitoring systems comprise flashing sensors and apparatus that might be used on the scene continually while using visible energy. According to all accounts, using environmentally friendly power for realistic healthcare monitoring practises is another challenge. The Internet of Things (IoT) has provided analysts the capacity to direct new technological developments to reduce the power consumption of various connected smart sensors and devices. Therefore, it has been demonstrated that a number of governing rules,

calculations, and methodologies prevent the organisation from using all of the energy required to run it. The volume of delivered information should also be regulated in order to further limit the amount of power consumed for handling and transmission. Remote healthcare monitoring systems with low energy consumption can produce significant power reserves and significantly cut energy consumption in medical offices. These elements also benefit the environment by minimizing electromagnetic influence.

6. Conclusion

In this study, we reviewed the current state of affairs and anticipated future developments for CEOs embracing remote wellbeing monitoring advancements in healthcare. Wearable sensors offer attractive choices for enabling observation and data collection in homes and offices for much longer periods of time than are currently possible just during visits to offices and research facilities, especially those with IoT intelligence built in. This informational gold mine has the ability to use artificial intelligence to dramatically advance healthcare and reduce costs when analysed and provided to practitioners in simple to comprehend forms. Before systems can be created for dependable integration into healthcare across the board, we identified a number of the issues in detecting, investigating, and portraying that need to be addressed.

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Declarations

Author declares that all works are original and this manuscript has not been published in any other journal.

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