Design of Iot-Enabled Early Warning System For Health Disease Diagnosis

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KEYWORDS

Health, IOT, Disease, security. EWS

ABSTRACT

Hospitals employ early warning systems as a scoring tool to evaluate a patient's health by periodically taking their vital signs. The EWS has the advantage of lowering medical costs, mortality rates, and irregular record-keeping, all of which improve patient diagnosis and prognosis. Vital signs are a reflection of a patient's health condition and are assigned a sub-score in EWS based on the degree of deviation from the value when compared to a healthy individual. Next, the sum of all subscores is used to estimate the overall score. EWS built on the Internet of Things (IoT) has changed dramatically in the last few decades. It has the power to drastically change the way that healthcare is delivered. The timely provision of healthcare services is increasingly dependent on the vital signs monitoring system. The paradigm has changed from computer-based electronic recording to traditional manual recording. In rural and isolated places without access to basic medical facilities, required infrastructure, or licensed medical professionals, IoT-based EWS is critical to the provision of healthcare services. The design of healthcare, real-time vital sign monitoring, remote health monitoring, and the interpretation of numerous vital signs for the prediction of health status and abnormality detection are the main areas of attention for this research.

1. Introduction

IoT-based EWS offers a range of medical services and remedies to address problems with the traditional healthcare system. The development of sensors and communication technologies is advancing the state of intelligence by establishing the newest trends and enabling IoT-enabled healthcare systems to be smarter [1]. To expound on the most recent developments in technology and methodologies, a thorough analysis of the works in question is conducted. A new method for developing and implementing symptom-based disease prediction, prognosis, early detection, diagnosis, treatment plan, and health record management has been created by combining these technologies and methodologies [2]. From connected, untidy, heavy, and bulky instruments to wireless, portable, and tiny gadgets, sensing technologies have come a long way. Improvements in integrated circuits and semiconductor devices made this breakthrough in sensing technology possible [3]. The most well-known and potent microcontrollers, such Arduino and Raspberry, have supported the development of sensing technologies by processing several medical signals of varying types and characteristics in high speed parallel [16]. Recent technological developments have demonstrated that the majority of medical sensors and microcontrollers, for example, are designed to work together. With the addition of communication technologies like Bluetooth and Wi-Fi, which completely outperform their competitors in terms of data storage and computing, fog computing and cloud computing are having an increasingly greater impact on these systems. For Internet of Things applications, fog computing is proven to be more appropriate than cloud computing [13]. Although the use of machine learning in healthcare has not been thoroughly investigated, recent developments indicate that medical data analysis and decision support systems heavily rely on machine learning algorithms for regression, classification, and clustering [5].The work is described as follows: Introduction part is portraying in section 1 as well as the studies of several research papers portrayed, part 2 highlights the suggested method and defines the performance metrics in part 3. Part 4 describes the results of the research and the work is completed in part 5.

2. Literature Review

The idea of remote health monitoring has been shown to provide elderly and underprivileged patients with more effective and dependable medical care services with the rise of IoT. [6] provides a succinct summary of IoT-based AAL systems and the uses of these systems in the healthcare industry. The notion of the Internet of Health Things (IoHT) was recently introduced by [7], who also offered IoT-based methods for health monitoring. They have taken into account the most current works in this field, noted the numerous technological developments, and discussed the difficulties and directions for the future. [14] have suggested the Elderly in Home Assistance (EHA) an ambient intelligence system. Its goal is to perceive, respond, anticipate, and act in reaction to the actions of the elderly. The context awareness is the main component of this effort. In [9], a communication architecture for health monitoring has been developed that uses sensor data and artificial intelligence to identify the patient's behaviour. demonstrates a context-aware system in [10] to forecast the patient's impending abnormal vital signs in the AAL setting. Using machine learning algorithms, their platform helps healthcare practitioners by identifying the early signs of sickness. In order to find the irregularities in the patient's daily activity sequences, they created the Hidden Markov Model (HMM). A novel architectural model (BDCaM) for individualised knowledge discovery in aided healthcare has recently been presented by [15]. They have expanded on their earlier work [12] in this work by integrating the learning and knowledge discovery process to assist the patients in the AAL environment.

3. Methodology

The creation of Internet of Things (IoT)-based health monitoring systems and applications will be the two main focusses of the planned research project. The creation of a smart health monitoring system is the main goal of this effort [8]. The suggested approach gathers vital indicators from the body using medical sensors, then transmits the data over a communication channel. Additionally, evaluate various protocols and communication technologies to determine which approaches are most suited for healthcare monitoring systems. Lastly, research several machine learning approaches for Internet of Things health care and contrast them to determine which approach and resources yield the best outcome. This system keeps track of the patient's present health condition and sends out alert notifications regarding it. Additionally, use patient data that is detected by the sensor and analysed by the microcontroller to forecast and predict diseases [4]. The microcontroller transmits the data to either local or cloud storage, where machine learning techniques are applied and stored to forecast the health state. Via mobile applications, this anticipated output will be forwarded to nearby carers and physicians so they can take the appropriate action. The main goal of the study is to suggest an Internet of Things (IoT) based architecture for the smart health monitoring system.

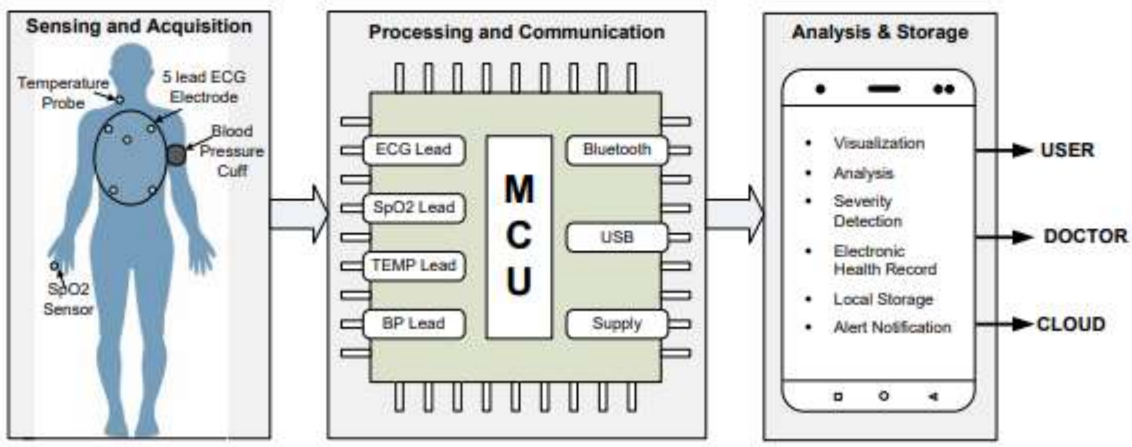

Figure 1: Overall, View of Proposed Work

The processed data are transferred over Bluetooth from the analysis and storage layer to the personal service application running on the smartphone. This layer's main purpose is to aggregate data for improved analysis and visualisation. It then records and stores data locally. The primary component of the system, the PSA serves as a conduit between the user or medical experts and the sensing system [11]. It serves as the entry point for transferring the data to the cloud for additional processing and archiving. Sensing network configuration (initialisation, sensor calibration, communication protocol, and operating modes), administration (communication channel sharing, time synchronisation, data encryption, and transmission), and coordination are all included in the data aggregation on personal service applications. In order to send data for the integration of the patient's medical record, the PSA can also set up a secure link with the outside party. Vital sign measurement and real-time processing are significantly aided by data aggregation and the sensing network. As a result, it streamlines the current solutions to fit into a compact, portable system with less resources that was previously only meant for PCs with powerful processing and infrastructure.

4. Results and discussion

Figure 2 displays the IoT Enabled VSMS experimental setup. With the primary goal of making the system portable and user-friendly, the work presented focusses on vital sign data gathering, management, and processing through Android devices while taking into account the state-of-the-art vital sign monitoring system as it stands. Here, a BerryMedPM6750 sensor that measures body temperature, SpO2, ECG, and blood pressure has been utilised.

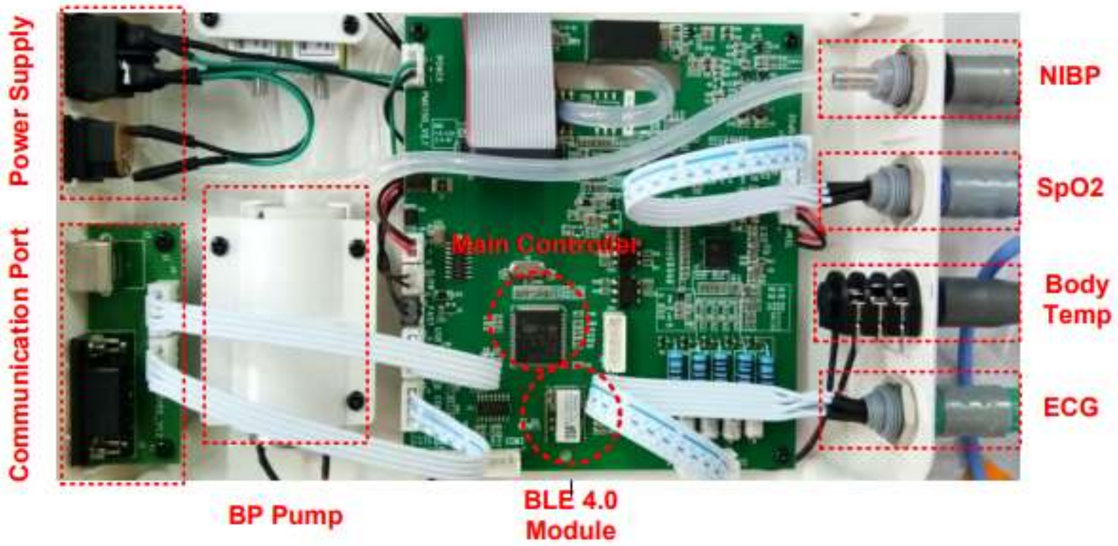

Figure 2: Experimental setup

Figure 3 displays a screen grab of the completed mobile application. As was previously said, the patient's age, sex, weight, and medical history all have a significant impact on the various vital signs. In order to properly prepare the digital health record, patient information should be provided on the mobile applications prior to beginning to monitor and measure vital signs. Fig. 3 displays a snapshot of various vital signs that have been measured and documented. In addition, as Fig. 3 illustrates, the captured data has been plotted and stored for improved clarity.

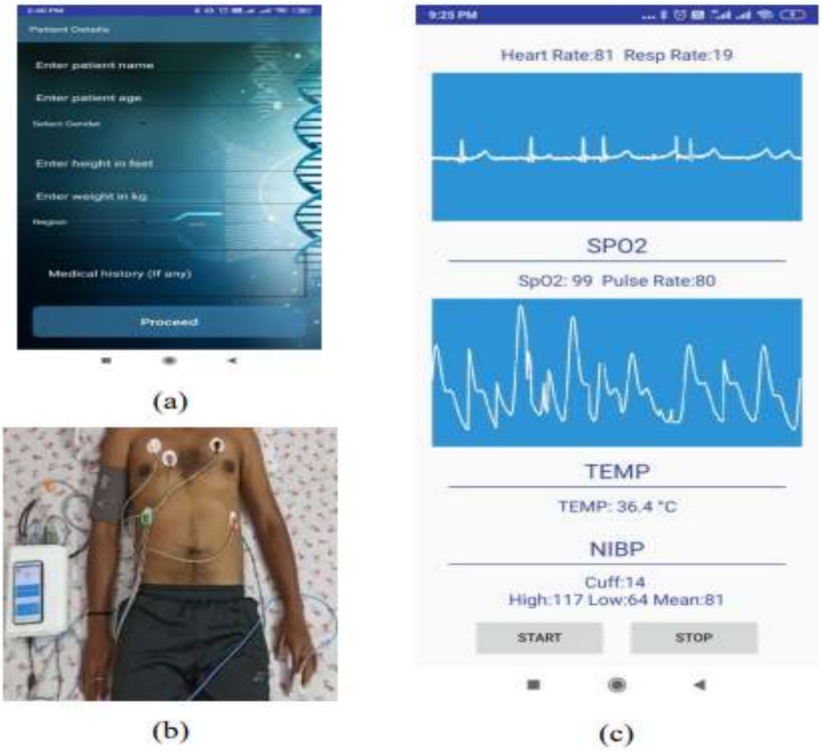

Figure 3: Snapshot of the (a)Patient information for health record, (b) Experimental setup of vital signs measurement and, (c) recording of the different vital signs on a smartphone

Fig. 4 illustrates how the various vital signs vary according to the various patients' health statuses. Every time one of these vital signs approaches either the minimum or maximum value, the installed system sends out alert signals. For every parameter, there exists a minimum threshold value (Min) and a maximum threshold value (Max). A healthy state is indicated by values between Min and Max, while values that fall outside of these ranges and suggest concerns or abnormal circumstances are shown by values above and below the limits. For additional analysis, the mean and median values of all forty subjects' vital signs have also been computed.

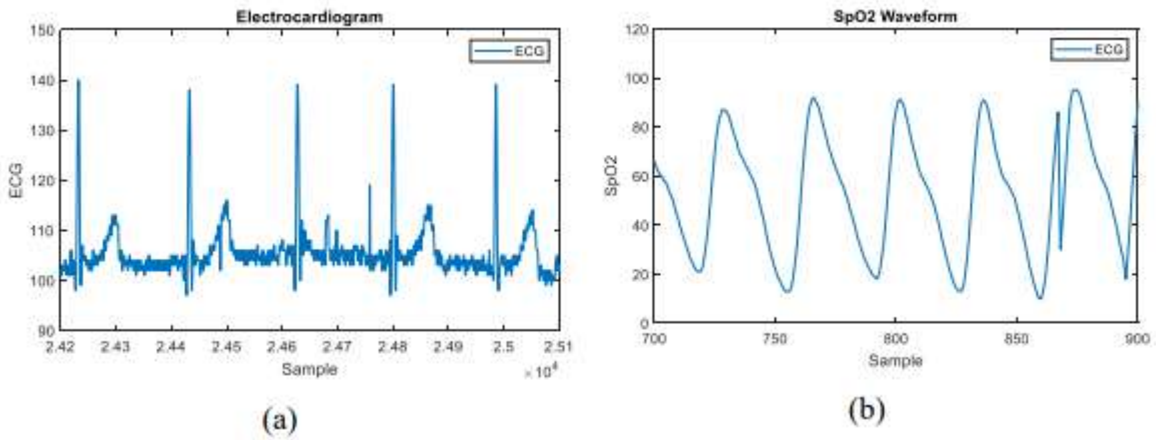

Figure 4: Plot of recorded data (a) ECG and (b) SpO2

By periodically monitoring the patient's vital signs, hospitals can employ an early warning system, a scoring tool for evaluating the patient's health status. The EWS has the advantage of lowering medical costs, mortality rates, and irregular record-keeping, all of which improve patient diagnosis and prognosis. The requirement to set up an automatic early warning system is pushing hospitals in the direction of automatic digital solutions. Vital signs are a reflection of a patient's health condition and are assigned a sub-score in EWS based on the degree of deviation from the value when compared to a healthy individual. Next, the sum of all subscores is used to estimate the final score.

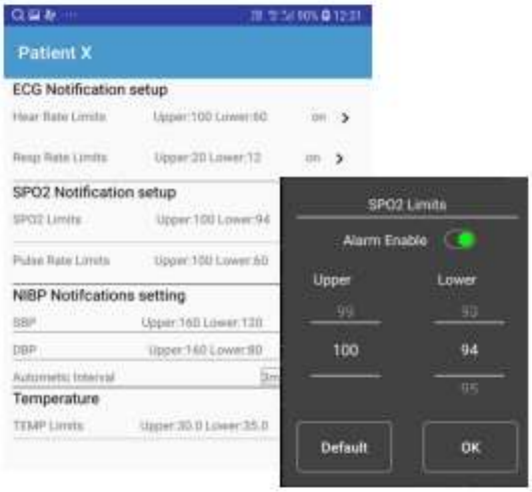

Figure 5: Snapshot of the abnormality detection and alert mechanism

In order to determine the score, the doctor or nurse should take the patient's vital signs, note them in the usual observation chart with a score based on their range. The patient's overall health status is indicated by the total score, with a greater number indicating the degree of irregularity in certain vital signs. The final score aids in the medical staff's modification of the diagnostic and treatment plan. An attempt has been made to automatically compute EWS from the many vital signals that the system under presentation monitors.

5. Conclusion and future scope

An IoT-based EWS and its components have been thoroughly examined in this study project, with a focus on current trends and technological advancements, as well as implementation-related problems and obstacles. It has been noted that the developing nation is only just beginning to use IoT-based healthcare services. It is expected that in the near future, this revolutionary technology will have a long-lasting effect on the provision of inexpensive, equitable healthcare services to the general public. As a result, an IoT-based vital sign monitoring system that is dependable and easy to use has been successfully deployed and certified. Real-time monitoring and recording of various vital indicators is possible with the deployed system. It combines IoT and cloud computing technologies to provide real-time remote patient monitoring that is dependable and satisfying.

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