

Health Monitoring System in Emergency Using IoT: A Review

Chandramohan Dwivedi¹, Ms. Shweta Singh²

¹Master of Technology, Electronic and Communication Engineering, GITM, Lucknow, India

²Assistant Professor, Electronic and Communication Engineering, GITM, Lucknow, India

Abstract - As technology has developed and sensors have been miniaturized, there have been attempts to employ contemporary technology in a variety of fields to improve the quality of human life. One of the important areas of research that has been identified is the inclusion of technology in the healthcare business. People who require healthcare services find them unreasonably expensive, especially in developing countries. As a result, this effort aims to solve a current healthcare concern in society. The primary purpose of the project was to develop a remote healthcare system. It's broken into three parts. The first component entails using sensors to detect a patient's vitals, the second sending data to cloud storage, and the third delivering the observed data for remote viewing. The data may be seen remotely, allowing a doctor or guardian to monitor a patient's health state even while they are not in the hospital. The Internet of Things (IoT) has been widely used to connect readily available medical resources and give patients with intelligent, dependable, and effective healthcare services. Health monitoring for active and supported living is one of the paradigms that may use IoT benefits to improve the patient's lifestyle.

Key Words: Patient Monitoring, IoT, Smart Device, Smart Health Monitoring, Medical Services.

1. INTRODUCTION

A remote health monitoring system is a medical system extension that enables remote monitoring of a patient's essential physiological state. Detection systems were previously largely found in hospitals and were distinguished by huge, sophisticated circuitry that required a great deal of electricity. Continuous advances in semiconductor technology have resulted in sensors and microcontrollers that are smaller in size, operate faster, use less power, and are more cost-efficient. As a result, remote monitoring of patients' critical live signs, particularly those of the elderly, has advanced. The remote health monitoring system can be utilized in the following situations:

A. It is recognized that a patient has a medical problem involving an unsteady regulating body system. When a patient is given a new medicine, this is what happens.

B. The patient is prone to heart attacks or has had one in the past. The vitals may be checked to forecast and alert you to any changes in your body's condition.

C. Situation involving a vital bodily organ

D. The circumstance leads to the emergence of a potentially fatal ailment. This is for persons who are over retirement age and may have deteriorating health issues.

E. Athletes in the middle of a workout. To determine which training regimens will yield the best outcomes.

Several new technologies have lately been created to address the problem of remote health monitoring. The systems use wireless detection technology to wirelessly transmit sensor data to a remote server. Some businesses have even adopted a subscription-based service model. This is a concern in developing countries since some people are unable to use them due to the high cost. There is also the issue of internet access, which is required for some systems that require a real-time remote connection. Internet penetration is still an issue in developing countries.

Many of the systems were first implemented in wealthy nations with well-established infrastructure. In the vast majority of situations, the systems have been modified to function in poor nations. To address some of these issues, remote detection must be approached from the bottom up to accommodate the fundamental minimum requirements now accessible in underdeveloped nations.

These days' patient monitoring frameworks are accessible in two structures:

1-Single-parameter monitoring system: This system is used to take a person's blood pressure, monitor their ECG, and check their SPO2 (blood oxygen level), among other things.

2-Multi parameter monitoring system: This system is used to monitor a variety of important physiological indicators in patients by transmitting basic data such as ECG, breath rate, and blood pressure. A multi-parameter observation system plays a significant role in the field of medical devices for these reasons.

1.1.Existing IoT System

In a hospital, either the nurse or the doctor must physically move from one patient to the next for a health check, making it difficult to constantly monitor their conditions. As a result, unless a nurse or doctor analyses the person's health at the moment, any major concerns cannot be immediately discovered. This might put a strain on doctors who are in charge of a big number of patients at the hospital.

Furthermore, in the event of a medical emergency, the patient is usually unconscious and unable to press an Emergency Alert Button.

1.2. System Architecture

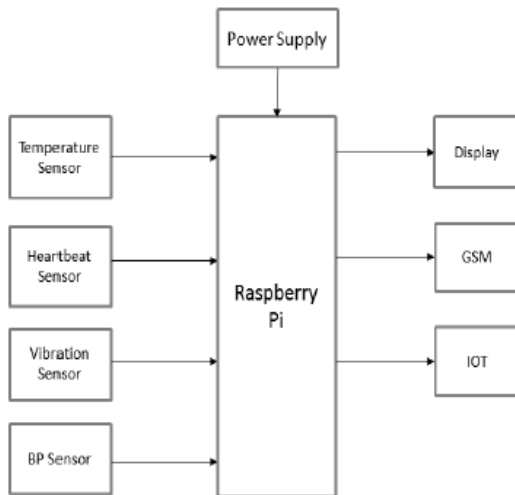


Figure 1. System Architecture

1.3. SYSTEM MODULES

1. Health Monitoring Section
2. Emergency Alert Section
3. Health Status Prediction System

1.3.1. Health Monitoring Section

This module houses the system's IoT-enabled hardware and is used to record the patient's health parameters via several sensors. Because the Raspberry Pi only works with digital signals, it acts as a central server to which all sensors are connected through GPIO pins or the MCP3008 analog-to-digital converter if their output is analog. The pi receives real-time data and saves it to a MySQL database, which is subsequently shown on the web interface.

1.3.2. Emergency Alert Section

This module focuses on the processes to be followed when a patient's health is discovered to be abnormal, such as notifying his or her family and the hospital. We've set up specified threshold figures in our program that, if surpassed, will send an email/SMS alert to the patient's family/doctor.

1.3.3. Health Status Prediction System

This is one of the most promising modules in our system. In this module, we use the patients' health data from our system, as well as any symptoms they may be experiencing, to predict if the patient has any disease or disorder by asking

a few simple questions and comparing it to the existing knowledge base, resulting in an efficient Expert System with proper data mining techniques.

2. LITERATURE REVIEW

The literature review, studied some research paper related to IoT in the health monitoring system, and a summary of the research papers are given below:

[1] Narasimha Rao Jasti Madhu (2010): The author researched the "IoT based Remote Patient Health Monitoring System" and the conclusion is that The developed system modules can be refined and manufactured as a single circuit. The fact that all of the circuit components utilized in the remote health detection system are readily available was also discovered during project design. Micro Electro Mechanical Systems (MEMS) and microcontrollers have grown more inexpensive, smaller, and power-efficient thanks to advancements in the integrated circuit industry. As a result, more embedded technologies are being developed and adopted by healthcare professionals. Smartphone technology has also incorporated these integrated systems. With rising internet penetration through mobile phones in most emerging nations, the Internet of Things (IoT) will be embraced at a quicker rate. The Remote Health Care system incorporates these ideas to create a system that improves people's quality of life.

[2] LIM SHENG KEONG (2017): The author studied "IoT-Healthcare Monitoring System With Capability To Detect Ecg, Blood Pressure And Temperature" and the conclusion are given that, The average accuracy for each sensor in measuring the health parameter is 99.21% for temperature measurement, 99.26% for pulse rate measurement, 99.17% for Systolic pressure and 98.72% for diastolic pressure. The measured data are transmitted to the IBM Bluemix Cloud platform with 1.53 milliseconds per sample of data. The DE1-SoC platform uses the onboard RJ45 port to connect to the Internet. A local web page is developed to allow the user to view the results from the measurement and finally perform the disease prediction. The IoT function of the proposed system can function once it is connected to Ethernet with an Internet connection. The IoT framework on the Internet is developed using the IBM Bluemix Cloud platform with API and Cloud supported by IBM. The results are stored in cloud storage according to the type of health parameter. These previous parameters will be remained inside the cloud and as a reference for doctors and users to know the current health trend. The stored health parameters are available to doctors and users through the web page developed on IBM Bluemix. The comment feature from the doctor has been successfully stored in the cloud and displayed on the web page once patients choose to view it.

[3] Usha Rani et al (2017): These authors' research regarding the "IoT Patient Health Monitoring System" and conclusion are given that, The reading of the patient's

different essential indicators, followed by an evaluation at cloud, and then a warning to the doctor or concerned persons about the patient's health status. It keeps track of vital indicators and detects any irregularities. These irregularities inform medical personnel, reducing the need for manual monitoring. The data is sent to the cloud platform using the MQTT connection. This communication protocol sends the readings of crucial patients' vital senses to a web interface, which then visually displays the data.

[4] Banka et al (2018): These authors research his work regarding the "Smart Healthcare Monitoring using IoT" and conclusion are given that, exhibited a prototype for an autonomous system that enables continuous monitoring of multiple health indicators as well as the prediction of any disease or issue, sparing the patient the agony of repeated hospital visits. The proposed method might be utilized in hospitals to collect and store massive volumes of data in an online database. An application can also be used to get the findings from a mobile device. The technology might be enhanced further by including artificial intelligence components to assist clinicians and patients. Data mining may be used to seek regular patterns and systematic relationships in disease, including the medical history of many patients' parameters and their associated outcomes. For example, if a patient's health parameters change in the same way as those of a previous patient in the database, the consequences might be predicted. If similar patterns are detected again, it will be simpler for doctors and medical researchers to devise a remedy.

[5] Sathya et al (2018): These authors research their work regarding the "Internet of things (IoT) based health monitoring system and challenges" and conclusion are given that, The importance and advantages of incorporating IoT into remote health monitoring systems. The Internet of Things-enabled little sensors will have a big impact on every patient's life, allowing them to reduce their fear of danger even while they are away from home and their doctor. Sensory data might be gathered at home or work. The challenges of sickness sensing, analytics, and prediction are also explored, as well as how they might be solved to allow a seamless integration into the medical business.

[6] Senthamilarasi et al (2018): These authors research his work regarding the "A Smart Patient Health Monitoring System Using IoT" and conclusion are given that, The suggested patient health monitoring system can be extremely useful in an emergency since it can be tracked, recorded, and saved as a database daily. The IoT gadget might be linked with cloud computing in the future, allowing the database to be shared across all hospitals for intense care and treatment.

[7] Ruman et al (2020): These authors research his works regarding the "IoT Based Emergency Health Monitoring System" and conclusion are given that, The accuracy, number of sensors, and cost-utility of the IoT-based Emergency

health monitoring system are among the system's shortcomings. Analyzing and determining a patient's health state based on only three characteristics is extremely difficult. As a result, a larger number of sensors is required, and a high-quality sensor is pricey. The precision of the sensors, on the other hand, is a critical aspect of this endeavor. Varied sensors and techniques for measuring health metrics provide different findings, and as a result, the parameters' accuracy varies. However, the system's lack of accuracy might be mitigated by employing more precise and high-quality sensors. It is possible to employ a variety of procedures and make appropriate comparisons, with the one that produces the most accurate result being used for the product.

[8] Patil et al (2020): These authors research his works regarding the "IoT based Patient Health Monitoring System" and conclusion are given that, This project presents a simple low-cost health monitoring scheme that takes into consideration the great practical value of an IoT-based live monitoring system for patients at risk of heart attack, unequal accidents, and emergency cases. Because of its multitasking capabilities and low power consumption, the ATmega328P is chosen for this application. This system may also be readily placed in all ambulances, and the database can contain a large amount of data. Furthermore, this information is quite valuable. We also learned software embedded C for simulation, which presented some challenges. It makes the doctor's job easier while also providing reliable findings.

[9] Valsalan et al (2020): These authors research his works regarding the "IoT Based Health Monitoring System" and conclusion are given that, The Internet of Things is now considered a feasible solution for any distant value tracking, notably in the realm of health monitoring. It permits the safe storing of individual health parameter data in the cloud, the decrease of hospital visits for routine tests, and, most crucially, disease monitoring and diagnosis by any doctor from anywhere. In this article, an IoT-based health monitoring system was developed. Body temperature, heart rate, room humidity, and temperature were all monitored using sensors and shown on an LCD. These sensor data are then wirelessly sent to a medical server. These data are then sent to a personal smartphone equipped with an authorized IoT platform.

[10] Josephine Hope Halima (2020): The author studied his works regarding "An IoT framework for healthcare monitoring systems" and conclusions are given that, For such folks, the Internet of Things is a lifeline. Significant efforts are undertaken in this study to synchronize data from sensors to the cloud, which can then be accessed via a mobile application. The information gathered is thoroughly examined, and patients from various geographical places are diagnosed as a result. All of the details about the IoT framework are discussed in detail.

[11] Begum et al (2020): These authors studied his research work regarding the “Smart Healthcare Monitoring System In IoT” and conclusions are given that, Patients who are uncomfortable with frequent health check-ups and a long stay in clinics might benefit from remote capabilities, which reduces costs. It also allows patients to follow environmental improvement from the convenience of their own homes. The online app allows for the collection and retrieval of patient data from any location and at any time. The entire prototype framework might be transformed into a self-care service for clinical monitoring of the patient's body temperature, posture, ECG, heart rate, and environmental parameters. The following features may also be visible on the LCD screen in the slave circuit, which is positioned near the patient. Physicians can view the findings on the webpage of their own server/mobile device.

[12] Anwasha Das et al (2021): These authors studied his research work regarding the “An IoT based Health Monitoring System using Arduino Uno” and conclusions are given that, Because the suggested patient health monitoring system may be observed daily, recorded, and saved as a database, it can be utilized extensively in emergencies. IoT devices may be combined with computer computers in the future, allowing the database to be shared across intensive care and treatment facilities. This health monitoring is also very important in this epidemic; we may avoid visiting the hospital frequently and merely check ourselves at home.

[13] Mamdiwar et al (2021): These authors research his works regarding the “Recent Advances on IoT-Assisted Wearable Sensor Systems for Healthcare Monitoring” and a summary of the research is given that, To integrate IoT in healthcare, sensors, communication, cloud services, and data processing and analysis are all required layers of the architecture. A thorough examination of data gathering, data transport, data processing, and computing paradigms follows. Data collection and transmission are handled by the patient's physical layer, which is generally a wearable device, whereas storage, calculation, and processing are handled by a virtual system that is extremely easy to access. It explains the different computing approaches, including parallel, cluster, grid, edge, fog, and cloud computing, and how they function. The report discusses all of the different technologies that have been utilized to communicate gathered data to the server and medical staff. ZigBee, Wi-Fi, Bluetooth, and LoRaWAN are among the technologies used. The most prevalent short- and long-range communication technologies utilized in an IoT-based healthcare system are listed below. These technologies have been thoroughly reviewed in terms of data transmission speed, communication range, power consumption, networking types, and the many devices that may be used to implement this technology. The technologies are compared in terms of the parameters described above, as well as frequency bandwidth, payload, and security. It offers us a better idea of what kind of technology to utilize based on the system. Interoperability is explored, as well as the

need for privacy and security in the implementation of such technologies.

[14] Sumathy et al (2021): These authors studied his research work regarding the “Wearable Non-invasive Health Monitoring Device for Elderly using IoT” and conclusion are given that, The senior smart health monitoring system is designed and applied to monitor fundamental vital body characteristics such as body temperature, heart rate, and some measurements of patient status such as respiration rate. The created system examines the person's vital parameters and indications, which are then processed utilizing a sensor integration unit and a GSM wireless network system. This wearable gadget, in turn, keeps patients with systemic organ disorders including heart, kidney, and respiratory ailments out of dangerous situations. The database is shared with the hospital for future treatment and intense care utilizing IoT devices in a cloud setting. Patients might benefit from sitting at home and doing simple tests and regular check-ups, as well as avoiding numerous visits to the clinic, especially during the Covid period. Positively, the death rate of patients might be reduced, and the needy could receive care at the appropriate time.

[15] Kadu et al (2021): These authors studied his research work regarding the “IoT Based Health Monitoring System” and the conclusion is given that, The Internet of Things is now considered a feasible solution for any distant value tracking, notably in the realm of health monitoring. In this article, an IoT-based health monitoring system was developed. Sensors were utilized in the system to detect body pulse rate and oxygen saturation, which were also shown on an LCD. These sensor findings are then sent to the App, which will produce an IP address if one is required. By entering these calculated figures onto the website, we may predict heart disease.

[16] Khan et al (2021): These authors studied his research works regarding the “IoT-Based Smart Health Monitoring System for COVID-19 Patients” and conclusions are given that, If effective therapy is given at the right time, the mortality rate can be reduced. To guarantee optimal therapy, many precautions have been taken, incorporating regular pulse rate, SpO2 level, and temperature monitoring. However, the oxygen level of a COVID-19 patient declines with time, and if emergency measures are not taken, the patient will die fast. Given the aforementioned, a smart health monitoring system based on IoT was developed for COVID-19 patients. During an emergency, the system, which is driven by an IoT-based smartphone application, may send alerts to both the doctor and the patient. As a consequence, consumers will be able to successfully employ this technology everywhere. Because the entire system is built on IoT, additional features can be added in the future.

3-CONCLUSION

After studying the above literature review, there are some conclusions found that The patient wireless health monitoring reduces the time consumption in gathering the patient's data, more accurately than the manual system. The transmitted data is stored and analyzed with the proper analytic tool, and based on the report, the prediction of the progress of diseases is done. In the future, more sensors can be attached to the Prototype of the health monitoring system device to enhance the capability of monitoring the patients with different prospective from different locations with ease, efficiency, and economical.

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