



Intelligent IOT Based Health Monitoring System and Emergency Assistance System : A Review

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ABSTRACT :

As technology advances and sensors become more compact, there have been efforts to integrate modern technology across various sectors to enhance human well-being. One significant area of focus is the application of technology in healthcare. In particular, people in developing countries often face prohibitively high healthcare costs. To address this issue, efforts are being made to tackle current healthcare challenges. The main goal of the project is to create a remote healthcare system, which is divided into three key components. The first part involves using sensors to monitor a patient's vital signs, the second part involves transmitting this data to cloud storage, and the third part allows the data to be accessed remotely. This enables healthcare providers or caregivers to track a patient's condition from a distance, even outside of a hospital setting. The Internet of Things (IOT) has become a crucial tool in connecting medical resources, offering patients smarter, more reliable, and efficient healthcare services. One application of IOT is in health monitoring for both active and assisted living, helping to improve the quality of life for patients.

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

INTRODUCTION :

A remote health monitoring system is an extension of medical technology that allows for the remote tracking of a patient's vital physiological conditions. Previously, such detection systems were mainly found in hospitals and were characterized by large, complex circuits that consumed significant amounts of power. However, continuous advancements in semiconductor technology have led to the development of smaller, faster, more energy-efficient, and cost-effective sensors and microcontrollers. This progress has made it possible to monitor critical health signs remotely, particularly for elderly patients. The remote health monitoring system can be used in situations such as when a patient has a medical condition that affects their body's regulatory systems, or when a patient begins taking a new medication.

The patient is at risk of heart attacks or has experienced one previously. Monitoring vital signs can help predict and notify of any changes in the patient's health condition.

A situation concerning a critical organ of the body. A condition that could result in the development of a life-threatening illness, particularly for individuals above retirement age who may be experiencing declining health.

Athletes in the midst of training need to identify which workout routines will produce the best results. Recently, new technologies have been developed to help with remote health monitoring. These systems utilize wireless detection technology to send sensor data to a remote server. Some companies have even implemented subscription-based service models. However, this poses a challenge in developing countries, where the high cost of these systems prevents some individuals from accessing them. Additionally, the need for internet connectivity, which is required for real-time remote monitoring, remains a significant issue in regions with limited internet access.

Many of these systems were initially introduced in wealthy countries with advanced infrastructure. In most cases, they have since been adapted to work in less-developed nations. To overcome some of the challenges, remote detection should be approached from the ground up, focusing on meeting the basic needs and resources currently available in developing countries.

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

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

B-Multi parameter monitoring system: This system is designed to track various critical physiological parameters in patients by transmitting essential data, such as ECG, breathing rate, and blood pressure. Due to its capabilities, a multi-parameter monitoring system is crucial in the field of medical devices.

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. **Banka et al (2018):** The authors' research on "Smart Healthcare Monitoring using IoT" concludes that they developed a prototype for an autonomous system capable of continuously monitoring various health indicators and predicting potential health issues, thereby reducing the need for frequent hospital visits. The proposed system could be implemented in hospitals to gather and store large volumes of data in an online database. An application could also allow users to access results from a mobile device. The technology could be further enhanced by integrating artificial intelligence to assist both clinicians and patients. Data mining could be applied to identify recurring patterns and relationships in diseases by analyzing medical histories, patient parameters, and their corresponding outcomes. For example, if a patient's health parameters exhibit similar changes to those of another patient in the database, the potential outcome could be predicted. Detecting such patterns would help doctors and medical researchers develop more effective treatments.
2. **Sathya et al (2018):** The authors' research on the "Internet of Things (IoT) based Health Monitoring System and its Challenges" highlights the significance and benefits of integrating IOT into remote health monitoring. Small IOT-enabled sensors are expected to greatly improve patients' lives by alleviating concerns about their health, even when they are away from home or their doctor. These sensors can collect data from patients' homes or workplaces. The study also addresses the challenges related to disease detection, data analysis, and prediction, and discusses potential solutions to enable smooth integration of IOT technology into the healthcare industry.
3. **Senthamilarasi et al (2018):** The authors' research on "A Smart Patient Health Monitoring System Using IoT" concludes that the proposed system would be highly valuable in emergencies, as it can continuously monitor, record, and store patient data on a daily basis. In the future, the IoT device could be integrated with cloud computing, enabling the database to be shared across hospitals for better intensive care and treatment.
4. **Ruman et al (2020):** The authors' research on the "IoT-Based Emergency Health Monitoring System" highlights several challenges, including the system's accuracy, the number of sensors, and its cost-effectiveness. Analyzing a patient's health condition based on only three parameters is highly complex, which means that more sensors are needed, and high-quality sensors are expensive. The accuracy of the sensors is a crucial factor in the system's success. Different sensors and methods for measuring health metrics can produce varying results, leading to discrepancies in the accuracy of the parameters. However, these accuracy issues can be addressed by using more precise, high-quality sensors. By employing a range of techniques and comparing their results, the method that yields the most accurate data can be selected for use in the system.
5. **Patil et al (2020):** The authors' research on the "IoT-based Patient Health Monitoring System" presents a simple, low-cost health monitoring solution with significant practical value for patients at risk of heart attacks, accidents, or other emergencies. The ATmega328P microcontroller was chosen for this application due to its multitasking capabilities and low power consumption. This system can easily be implemented in ambulances, where it can store large volumes of data, which is highly valuable for medical purposes. The team also learned embedded C software for simulation, which posed some challenges. Ultimately, the system simplifies the doctor's tasks while providing reliable results.
6. **Valsalan et al (2020):** The authors' research on the "IoT-Based Health Monitoring System" concludes that the Internet of Things (IoT) is a viable solution for remote monitoring, particularly in healthcare. It allows for secure storage of individual health data in the cloud, reduces the need for routine hospital visits, and, most importantly, enables doctors to monitor and diagnose diseases remotely. In this study, an IoT-based health monitoring system was developed to track parameters such as body temperature, heart rate, and room humidity and temperature using sensors, which are displayed on an LCD. The collected data is wirelessly transmitted to a medical server and then sent to a personal smartphone through an authorized IoT platform.
7. **Josephine Hope Halima (2020):** The author's research on "An IoT Framework for Healthcare Monitoring Systems" concludes that the Internet of Things serves as a vital solution for individuals in need of continuous health monitoring. This study makes significant strides in synchronizing sensor data with the cloud, allowing it to be accessed through a mobile application. The collected data is thoroughly analyzed, enabling the diagnosis of patients from different locations. The paper provides a detailed discussion of the IoT framework and its components.
8. **Begum et al (2020):** The authors' research on the "Smart Healthcare Monitoring System in IoT" concludes that remote health monitoring offers significant benefits for patients who are uncomfortable with frequent check-ups or long stays in clinics, as it helps reduce costs. It also enables patients to monitor their health and environmental conditions from the comfort of their own homes. The online application

facilitates the collection and retrieval of patient data from any location, at any time. The entire prototype system could evolve into a self-care service for clinical monitoring of parameters like body temperature, posture, ECG, heart rate, and environmental factors. These measurements can be displayed on an LCD screen in the patient's vicinity, while physicians can access the results via their server's web page or a mobile device.

9. **Anwasha Das et al (2021):** The authors' research on "An IoT-Based Health Monitoring System Using Arduino Uno" concludes that the proposed system, which allows for daily monitoring, recording, and storage of health data, is highly valuable in emergencies. In the future, IoT devices could be integrated with computer systems, enabling the sharing of this database across intensive care and treatment facilities. This health monitoring system is particularly important during epidemics, as it allows individuals to monitor their health at home, reducing the need for frequent hospital visits.
10. **Sumathy et al (2021):** The authors' research on the "Wearable Non-Invasive Health Monitoring Device for the Elderly Using IoT" concludes that the senior smart health monitoring system is designed to track essential vital signs such as body temperature, heart rate, and respiration rate. The system monitors the individual's vital parameters and conditions, which are processed using a sensor integration unit and a GSM wireless network. This wearable device helps protect patients with chronic organ conditions like heart, kidney, and respiratory diseases from dangerous situations. The data is shared with hospitals via IoT devices in a cloud environment for future treatment and intensive care. Patients can perform simple tests and regular check-ups at home, reducing the need for frequent clinic visits, particularly during the Covid-19 pandemic. As a result, patient mortality rates could decrease, and individuals in need of urgent care can receive timely treatment.
11. **Khan et al (2021):** The authors' research on the "IoT-Based Smart Health Monitoring System for COVID-19 Patients" concludes that timely and effective treatment can significantly reduce the mortality rate. To ensure optimal care, the system incorporates regular monitoring of pulse rate, SpO2 levels, and body temperature. However, the oxygen levels of COVID-19 patients tend to decrease over time, and without emergency intervention, the patient's condition can rapidly worsen. In response to this, an IoT-based smart health monitoring system was developed specifically for COVID-19 patients. During emergencies, the system, powered by an IoT-enabled smartphone app, can send alerts to both the doctor and the patient. This enables users to effectively utilize the technology in any setting. Additionally, since the system is built on IoT, there is potential for further features to be added in the future.

3. Proposed System Design:

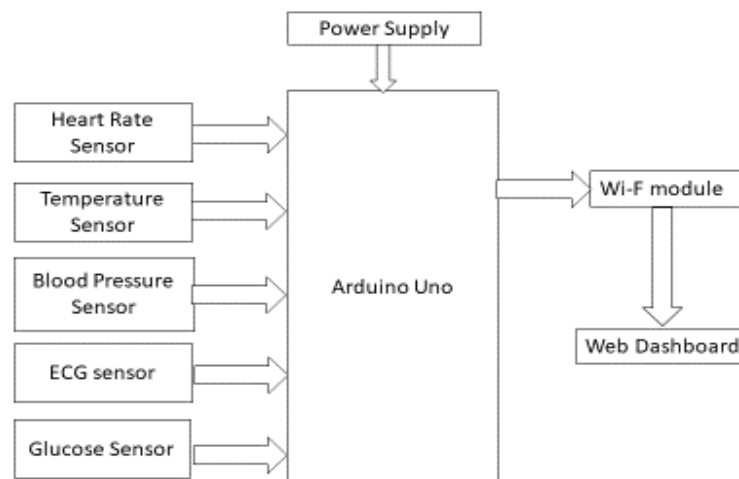


Fig. 3.1.1. Block diagram

This block diagram illustrates a health monitoring system using an Arduino Uno board.

Input: The system receives data from various sensors, including Heart Rate Sensor, Temperature Sensor, Blood Pressure Sensor, SpO2 Sensor (measures blood oxygen saturation), ECG sensor.

Arduino Uno: The Arduino Uno board acts as the central processing unit, collecting data from the sensors. It processes this data according to the programmed logic, which could include calculations, filtering, and decision-making.

Output: The Arduino can transmit the data via Wi-Fi to a web server or cloud platform and the data can be visualized on a web dashboard, allowing remote monitoring and analysis of the health parameters.

Functionality:

Health Monitoring: The system continuously monitors vital signs such as heart rate, blood pressure, temperature, and oxygen saturation.

Remote Monitoring: The data can be accessed remotely through the web dashboard, allowing healthcare professionals or caregivers to monitor the individual's health.

Alert System: The system could be programmed to trigger alerts when specific conditions are met, such as abnormal vital signs or a fall.

4. System Modules :

- a) Health Monitoring Section
- b) Emergency Alert Section
- c) Health Status Prediction System

a. Health Monitoring Section: This module contains the system's IOT enabled hardware and is responsible for capturing the patient's health data through various sensors. Since the Raspberry Pi only processes digital signals, it serves as the central server, connecting all sensors via GPIO pins or, if the sensor output is analog, through the MCP3008 analog-to-digital converter. The Pi collects real-time data and stores it in a MySQL database, which is then displayed on the web interface.

b. Emergency Alert Section: This module is designed to handle the procedures when a patient's health is found to be abnormal, such as alerting their family and the hospital. We have established specific threshold values within the system, and if these thresholds are exceeded, an email or SMS notification will be sent to the patient's family or doctor.

c. Health Status Prediction System: This is one of the most promising modules in our system. It leverages the patient's health data and reported symptoms to predict potential diseases or disorders. By asking a few simple questions and comparing the responses to an established knowledge base, it creates an efficient Expert System that utilizes effective data mining techniques.

5. Expected Results :

Real-time Data Collection: Continuous tracking of vital signs such as heart rate, blood pressure, and oxygen saturation without the need for invasive procedures.

Improved Patient Compliance: Patients may be more likely to use non-invasive devices regularly, leading to better health management.

Early Detection of Health Issues: Ability to identify potential health problems early, such as arrhythmias or respiratory issues.

Personalized Health Insights: Tailored recommendations based on individual health data, enhancing preventive care.

Reduced Healthcare Costs: Lowered need for hospital visits and interventions due to early detection and ongoing monitoring.

6. Conclusion :

Based on the literature review, several conclusions can be drawn. Wireless health monitoring for patients significantly reduces the time required to collect data and offers greater accuracy compared to manual methods. The smart health monitoring system revolutionizes healthcare by enabling real-time, remote monitoring of vital signs. This technology promises a more patient centered approach, ultimately improving health outcomes and quality of life. For high-risk patients, this can be life-saving in situations where immediate medical assistance is required. It helps to provide better treatment to people with healthcare at any time in any region.

Many patients who are in critical conditions doctor needs to monitor them continuously because small changes in patient body is very important to take next decision regarding patient's treatment. So we are developing this device..

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