Design and Implementation of IOT Based Patient Health Monitoring System

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Abstract **- The "Patient Health Monitoring System through IoT" is a comprehensive solution designed to enhance healthcare by leveraging Internet of Things (IoT) technology. Humans are facing various issue and untimely death due to multiple illness, due to a lack of medical treatment for patients. To overcome this issue a real time health monitoring system has proposed based on IOT. The proposed system consists of mobile application for continuous wireless monitoring of patients. The main aim is to create a dependable patient management system based on IoT so that healthcare professionals can monitor their patients who are either hospitalized or at home using an IOT based integrated healthcare system to ensure quality patient care. Sensors are used to track vital parameters, and the data collected by the sensors is sent to the cloud via a Wi-Fi module. A wireless healthcare monitoring system has created that can provide real time online information about a patient's conditions. In the proposed work, a Mobile Application is developed, and it is compatible of Bluetooth and Wi-Fi. A Wi-Fi module ESP32. The system is made up of sensors, a data acquisition unit, a microcontroller, and software. The patient's temperature, heartrate and SPO2 are regularly monitored, displayed, and stored by the system and the same has been sent to the doctor's mobile containing the application. Thus, IOT based real time health monitoring system systematically monitor the condition of patient's health and save their life on time.**

1. INTRODUCTION

This paper is evaluated using this intelligent method. Doctors play an important role in health check-ups in the conventional process. This treatment necessitates a considerable period for registration, consultation, and then observation. Reports are also created later. Working people prefer to ignore or delay observation as a result of the lengthy procedure. This cutting-edge technique cuts down on the amount of time it takes to complete the mission. For many decades, medical scientists have been working in the fields of innovation and science to improve health care and happiness in people lives. Their contribution to the medical field is important to us and cannot be overlooked. The roots of today automotive systems can be found in yesterday fundamentals. Furthermore, these advances allow for the early detection of chronic diseases. The most important factors such as body temperature, heart rate, blood pressure, and respiration rate are used to determine the severity of the disease. The communication channel is Bluetooth, which will later connect to the server through Wi-Fi. The system is made up of a portable terminal, a Smartphone, and a remote server. Maintaining one body temperature is a vital part of maintaining one health, particularly for the elderly or disabled person. Because, if their body temperature rises, they can experience a stroke.

Furthermore, the temperature of a human body can be increased at any moment. So, a computer is implemented which can continuously track their temperature and pressure and quickly alert the Caretaker. For efficient control, the device makes use of IoT and wireless sensor technology. Every 30 s, data from the sensor technology is collected and visualized on the webserver. The device is set up such that if the sensor data cross those thresholds, a warning is sent to the doctor. Besides, a switch would be fixed in the patient hand to call for assistance if the patient requires assistance. This article presents an overview of IOT based health monitoring system.

Design of IoT-Based Patient Health Monitoring System: To develop effective health monitoring systems, we need sensors that automatically detect physiological parameters. These parameters are then sent to the cloud, where real-time artificial intelligence processes the data and presents it to doctors in the form of infographics. Patients can access their own health parameters through a mobile app, and doctors can examine patients based on real-time data. This system enhances healthcare by enabling remote monitoring and timely interventions.

The main contribution of this research paper is to highlight IoT-based healthcare-monitoring systems in detail so that future researchers, academicians, and scientists can easily find a roadmap to understand the current healthcare- monitoring systems and can easily provide solutions and enhancements for such critical applications. In this research paper, we provide a general idea of IoT-based healthcare- monitoring systems in a systematic way, along with their benefits and significance, and a literature review. Moreover, we discuss the concepts of wearable things in healthcare systems from an IoT perspective. The paper also provides a classification of healthcare-monitoring sensors, addresses security and protocols for IoT healthcare-monitoring systems, and details challenges and open issues. We also suggest solutions to overcome these challenges and issues in the future.

2. LITERATURE REVIEW

In recent years, the integration of Internet of Things (IoT) technologies into patient health monitoring systems has garnered considerable attention in healthcare research and practice. This literature review focuses on IoT-based patient health monitoring systems utilizing a range of sensors including pulse sensor, LM35, MAX30100, and DHT11. These sensors offer diverse functionalities, enabling comprehensive monitoring of various physiological parameters and environmental conditions crucial for patient well-being. The pulse sensor provides real-time monitoring of heart rate, while the LM35 facilitates temperature sensing, crucial for detecting fever or hypothermia. Additionally, the MAX30100 sensor enables non-invasive monitoring of blood oxygen saturation levels, vital for assessing respiratory health. Moreover, the DHT11 sensor measures ambient temperature and humidity, offering insights into environmental conditions affecting patient comfort and health.

Integration of these sensors into IoT platforms enables continuous and remote monitoring of patient health status, facilitating early detection of anomalies and timely interventions. Studies demonstrate the effectiveness of IoT-based patient health monitoring systems in improving healthcare delivery, enhancing patient outcomes, and reducing healthcare costs. However, challenges such as data security, interoperability, and scalability persist, necessitating further research to address these issues and realize the full potential of IoT in revolutionizing patient care. Patient health monitoring systems leveraging Internet of Things (IoT) technologies have emerged as transformative tools in modern healthcare.

This literature review delves into the advancements and applications of such systems, highlighting their impact on patient care. IoT-enabled devices, such as wearable sensors and remote monitoring equipment, facilitate real-time data collection of vital signs, activity levels, and medication adherence, enabling continuous patient monitoring outside clinical settings. Studies indicate the potential of these systems in chronic disease management, early detection of health deteriorations, and proactive interventions, thereby reducing hospital readmissions and healthcare costs However, challenges such as data privacy, interoperability, and reliability remain significant barriers to widespread adoption.

3. PROPOSED WORK

The proposed work entails the development of an Internet of Things (IoT) based patient health monitoring system, employing a variety of sensors including a pulse sensor, LM35 temperature sensor, MAX30100 pulse oximeter sensor, and DHT11 humidity and temperature sensor. These sensors are seamlessly integrated with an ESP32 microcontroller board, enabling efficient data acquisition and transmission. The gathered sensor data, encompassing vital physiological parameters such as heart rate, body temperature, blood oxygen saturation, as well as environmental factors like temperature and humidity, will be transmitted to the cloud- based IoT platform, ThingSpeak, for real-time monitoring and analysis.

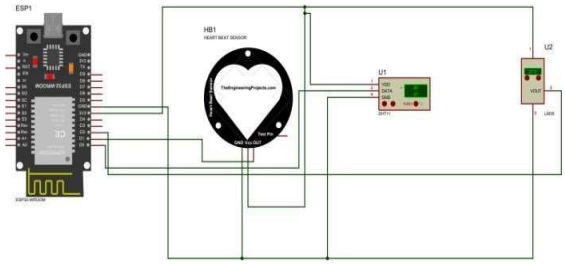


Fig. 1. Circuit Diagram.

3.1. Pulse Sensor:

Continuous monitoring of heart rate, crucial for assessing cardiac health and detecting irregularities in heart rhythm.

3.2. LM35 Temperature Sensor:

The temperature sensor (LM35) measures the heat generated from the body in the range of □55 □C to 150 □C. If the body heat increases by 1 then the output will be 10 millivolts.

3.3. MAX30100 Pulse Oximeter Sensor:

The pulse oximeter sensor (MAX30100) estimates the oxygen saturation level and heart rate of the human body. It passes two lights red and infrared within a finger, toe, nostril, or earlobe. Based on the light absorption changes it measures the percentage of oxygen level in the body.

3.4. DHT11 Sensor:

Measurement of ambient temperature and humidity, providing environmental context for patient good health

3.5. ESP32 Microcontroller:

Interface for integrating and processing data from sensors, facilitating efficient transmission to the cloud platform.

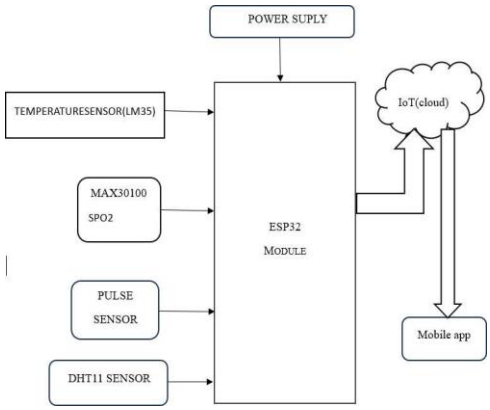
3.5. ThingSpeak IoT Platform:

ThingSpeak is a cloud based IoT analytics application that lets you compile, visualize, and analyze live data streams. ThingSpeak offers real-time visualizations of data sent to ThingSpeak by your computers.

3.6. Arduino IDE:

Development environment for programming and configuring the ESP32 microcontroller to interface with sensors and transmit data to ThingSpeak.

The ESP32 microcontroller acts as the central hub for data processing and transmission, collecting data from the integrated sensors and transmitting it to ThingSpeak via Wi-Fi Connectivity. ThingSpeak offers a user-friendly interface for real-time visualization of patient health parameters, enabling healthcare providers to monitor trends and identify anomalies promptly. Moreover, ThingSpeak's compatibility with data analytics tools facilitates advanced analysis and predictive modeling, enhancing the system's ability to detect health issues early and provide proactive interventions, thereby improving patient outcomes and quality of care.



In conclusion, the proposed IoT-based patient health monitoring system, comprising integrated sensors interfaced with ESP32 and connected to ThingSpeak, presents a promising solution for remote patient monitoring and healthcare management. By harnessing the capabilities of IoT technologies and cloud-based platforms, the system aims to improve healthcare delivery, enhance patient outcomes, and contribute to the advancement of personalized and proactive healthcare solutions tailored to individual patient needs.

4. RESULTS AND ANALYSIS

The vital parameters for the patient are obtained in the proposed model as shown in Fig.1 & 2 by adding sensors to the patient's body. The Wi-Fi module sends the data to the cloud. The sensors are connected to the ESP32 processor. If the patient desires, he or she is free to move. The data collected by the sensors is analyses by the processor, and the processed data is sent to the cloud via a Wi-Fi module.

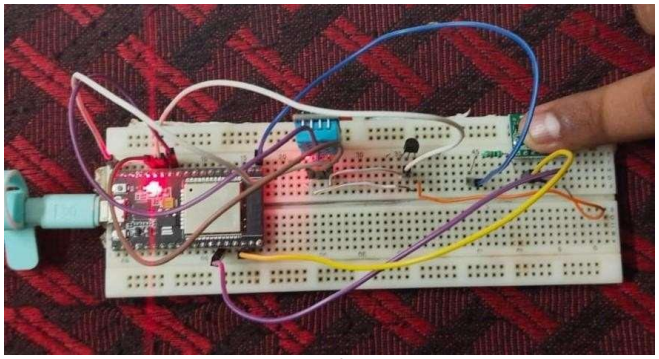


Fig. 3. Overview of the kit

On a mobile device, the processed data can be viewed on a webpage. Every 30 s, the critical parameters are calculated in real time. The device is set up in such a way that if the parameter data exceeds the threshold values, an alert message is sent to the doctor. For monitoring, the sensors are attached to a patient.

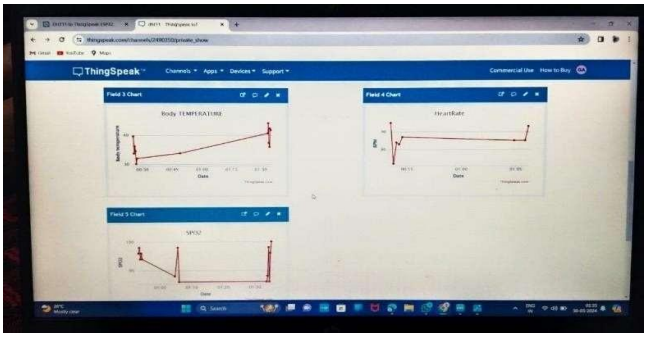


Fig. 4. Spo2, Body Temperature and Pulse output waveforms

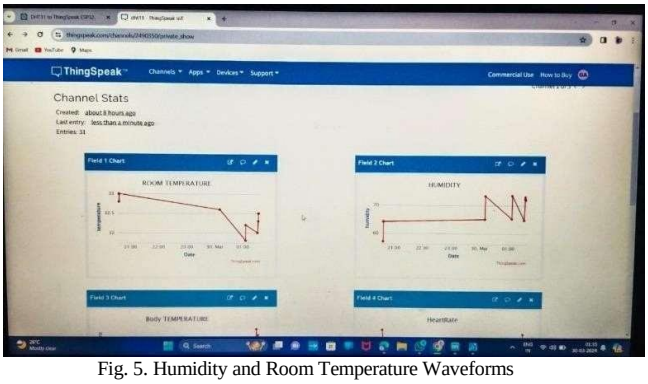


Fig. 5. Humidity and Room Temperature Waveforms

The ESP32 saves a patient's continuous monitoring data to an IOT cloud as well as a website's database. Both are being used so that one can serve as a replacement to the other if one of them fails. As previously said, ThingSpeak is being used as an IoT cloud in conjunction with a custom website.

5. CONCLUSION AND FUTURE WORK

Overall, the IoT-based Patient Health Monitoring System represents a paradigm shift in healthcare delivery, empowering patients to take charge of their health while enabling healthcare providers to deliver more proactive, personalized, and efficient care. By harnessing the power of IoT technology, this project has the potential to improve patient outcomes, reduce healthcare costs, and ultimately enhance the quality of life for individuals with chronic conditions or those in need of continuous monitoring.

The future scope for the IoT-based Patient Health Monitoring System is rich with possibilities, driven by ongoing advancements in technology and healthcare. One significant area of development lies in the refinement of predictive analytics and machine learning algorithms. By analyzing large volumes of patient data collected over time, these algorithms can identify subtle patterns and correlations that may signal impending health issues. This predictive capability not only enables early intervention but also supports preventive healthcare strategies aimed at reducing the risk of chronic conditions and improving overall wellness.

REFERENCES

[1] Asmita Tirkey, A. Jesudoss," A Non-Invasive Health Monitoring System for Diabetic Patients", in: International Conference on Communication and Signal Processing, India, 2020.

[2] Alvee Rahman, Jia Uddin, Nawab Haider Ghani, Sazzad Hossain, Tahsinur Rahman," IoT Based Patient Monitoring System Using ECG Sensor", International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), 2019.

[3] Jai Mangal, ''A Smart Wear based Portable Health Monitoring System", IEEE International Students' Conference on Electrical, Electronics and Computer Science, 2020.

[4] Kai Zhang, Wenjie Ling," Health Monitoring of Human Multiple Physiological Parameters Based on Wireless Remote Medical System", Scientific Research of Institutions of Higher Learning in Henan Province under Grant 20A890009,2020.

[5] Asmita Tirkey, A. Jesudoss," A Non-Invasive Health Monitoring System Diabetic Patients", in: International Conference on Communication and Signal Processing, India, 2020

[6] Ali Chekima, Hoe Tung Yew, Jamal A. Dargham, Ming Fung Ng, Seng Khea Chung, Soh Zhi Ping," IoT Based Real-Time Remote Patient Monitoring System", in: 16th IEEE International Colloquium on Signal proess Applications (CSPA 2020),2020.

[7] Alvee Rahman, Jia Uddin, Nawab Haider Ghani, Sazzad Hossain, Tahsinur Rahman," IoT Based Patient Monitoring System Using ECG Sensor", International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), 2019.

[8] T.R. Aditya, G. Jagadamba, U. Karthik Bhat, P. Manjunath, S. Sanath Pai, Real time patient activity monitoring and alert system, Proceedings of the patient activity monitoring and alert system, International Conference on Electronics and Sustainable Communication Systems (ICESC),2020.

[9] Kai Zhang, Wenjie Ling," Health Monitoring of Human Multiple Physiological Parameters Based on Wireless Remote Medical", Scientific Research of Institutions of Higher Learning in Henan Province under Grant 20A890009,2020.

[10] Deshmukh, V., et al. (2018). "IoT-Based Patient Health Monitoring System with Real-time Analysis." International Journal of Advance Research in Computer Science and Management Studies.

[11] Mishra, A., et al. (2017). "Design of IoT-Based Patient Health Monitoring System Using Arduino." International Journal of Engineering and Technology

[12] Hasan, M., et al. (2020). "A Review on IoT-Based Patient Health Monitoring System." International Journal of Scientific & Engineering Research

[13] Jha, P., et al. (2018). "IoT-Based Patient Health Monitoring System Using Raspberry Pi." International Journal of Engineering Research & Technology.

[14] Ahmed, S., et al. (2019). "A Review on IoT-Based Patient Health Monitoring System." International Journal of Advance Research in Science and Engineering.

[15] Ali, M., et al. (2020). "IoT-Based Wearable Health Monitoring System for Elderly Patients." Journal of Sensors.