



# IOT BASED HEALTH MONITORING SYSTEM USING ESP 32

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**Abstract :** - In recent years, the integration of Internet of Things (IoT) technology into healthcare systems has opened new avenues for real-time health monitoring and improved patient care. This paper presents the design and implementation of an IoT-based health monitoring system utilizing the ESP32 microcontroller. The system is equipped with various biomedical sensors to continuously monitor vital signs such as heart rate, body temperature, and blood oxygen levels. These readings are transmitted wirelessly via Wi-Fi to a cloud server for remote access and analysis. The ESP32 serves as the core processing unit due to its dual-core performance, low power consumption, and inbuilt Wi-Fi capabilities, making the solution cost-effective and scalable. Real-time data visualization is achieved through a web-based dashboard, allowing caregivers and medical professionals to track patient health metrics and receive alerts in case of abnormal readings. This system aims to enhance patient monitoring outside of traditional clinical settings, particularly benefiting elderly patients and those in remote areas. The proposed solution demonstrates the potential for improving healthcare accessibility and responsiveness through IoT-driven innovations.

## 1. INTRODUCTION

In recent years, the integration of Internet of Things (IoT) technology into healthcare has significantly enhanced the efficiency, accessibility, and responsiveness of patient monitoring systems. With the global rise in chronic illnesses and the challenges posed by an aging population, there is an increasing demand for healthcare solutions that enable continuous, remote monitoring of vital signs. IoT provides a promising avenue by connecting biomedical sensors and medical devices to the internet, allowing for real-time tracking of patient health without the need for constant in-person supervision. (IoT) technology in healthcare has significantly enhanced the efficiency and accessibility of patient monitoring systems. As global health challenges grow—particularly with an aging population and the rise In recent years, the integration of Internet of Things of chronic illnesses—there is an increasing need for systems that can monitor patients remotely and in real time. IoT offers a solution by connecting medical devices and sensors to the internet, enabling continuous tracking of vital signs without the need for constant physical supervision.

This research focuses on the development of an IoT-based health monitoring system using the **ESP32** microcontroller, a powerful and energy-efficient device with built-in Wi-Fi and Bluetooth capabilities. The system is designed to monitor key physiological parameters such as heart rate, body temperature, and blood oxygen saturation (SpO<sub>2</sub>), using affordable biomedical sensors. These readings are transmitted wirelessly to a cloud-based platform, where they can be accessed by healthcare professionals or caregivers through a web or mobile interface. This research presents the design and development of an IoT-based health monitoring system utilizing the ESP32 microcontroller—an affordable, compact, and energy-efficient device with integrated Wi-Fi and Bluetooth functionality. The proposed system is capable of measuring key physiological parameters such as heart rate, body temperature, and blood oxygen saturation (SpO<sub>2</sub>) using commonly available biomedical sensors. These measurements are wirelessly transmitted to a cloud-based platform, from which healthcare providers or caregivers can remotely access and monitor the data via web or mobile applications.

The primary goal of this work is to deliver a cost-effective, real-time health monitoring solution suitable for both urban and rural settings. By leveraging the capabilities of the ESP32 and IoT technologies, the system minimizes the need for frequent hospital visits, enables early detection of potential health issues, and enhances the quality of care for patients. This solution has strong potential for integration into wearable devices or home-based health monitoring setups.

## 1.1 Objectives

The primary objective of this research is to develop an IoT-based health monitoring system utilizing the ESP32 microcontroller to continuously measure vital health parameters such as heart rate, body temperature, and blood oxygen saturation (SpO<sub>2</sub>). The system is designed to support real-time remote monitoring via cloud platforms, offering healthcare providers and patients seamless access to health data. It features an integrated alert mechanism to notify users of abnormal readings, enabling prompt medical response. Emphasizing cost-effectiveness and scalability, the system is particularly suited for deployment in remote or resource-limited environments.

- To develop an IoT-based health monitoring system using ESP32.
- To monitor vital parameters: heart rate, body temperature, and SpO<sub>2</sub>.
- To enable real-time remote monitoring via cloud platforms.
- To implement wireless data transmission using Wi-Fi/Bluetooth.
- To integrate an alert mechanism for abnormal health readings.

## 1.2 Target users

The proposed IoT-based health monitoring system is primarily intended for patients requiring continuous health supervision, especially those with chronic illnesses, elderly individuals, and post-operative patients. It is particularly beneficial for individuals residing in remote or rural areas with limited access to healthcare facilities. Additionally, the system is useful for healthcare professionals, caregivers, and family members who need to remotely monitor patients' vital signs in real time. Its low-cost and user-friendly design also makes it suitable for home-based care and small clinics lacking advanced monitoring infrastructure.

## 2. Literature survey

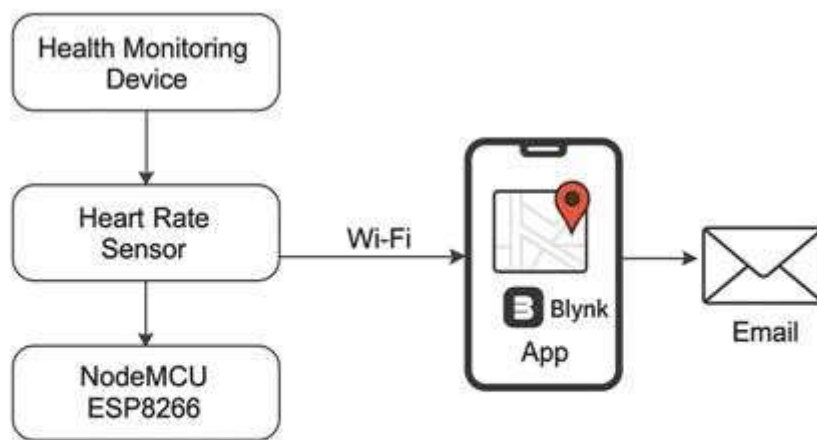
Numerous studies have investigated the application of Internet of Things (IoT) technologies in healthcare systems to address the growing need for continuous patient monitoring, particularly in chronic disease management. Gawande et al. [1] developed an IoT-based patient monitoring framework that emphasized real-time data collection and remote access via cloud platforms. Their work underlined the importance of continuous health tracking but was limited by its dependence on constant internet availability and lack of physical examination features. Islam et al. [2] proposed a smart health monitoring system utilizing five sensors for real-time data acquisition. While their contribution is significant, the study lacked comparative performance analysis and provided minimal technical implementation details. These limitations point to a need for more in-depth technical exploration and benchmarking in future research. Malasinghe et al.

[3] explored remote patient monitoring through both contact-based and contactless techniques, focusing on issues such as data security, adaptability, and sensor accuracy. They highlighted practical limitations such as patient comfort and the challenge of integrating sensors across diverse platforms. Although the study introduced valuable design considerations, its applicability remains constrained by limited device compatibility and system complexity. Li and You [4] introduced an intelligent mobile health monitoring system (Im-HMS) integrating Bayesian networks, agile learning, and decentralized computing. While their approach aligned with the trend toward wearable health devices, their system achieved an 82% reliability rate and faced challenges in multi-access monitoring, limiting its scalability and precision in individual diagnostics.

Other notable contributions include the LOBIN platform developed by López et al. and the wireless body area network (WBAN) framework by Yuce [5]. The LOBIN system incorporated e-textiles and wireless sensor networks in hospital environments, offering promising results for patient comfort and data reliability. Yuce's WBAN focused on wearable sensor integration and proposed a multihop communication model to extend network coverage, addressing connectivity issues in rural healthcare settings.

.Despite the progress made in these studies, there remains a significant gap in the literature concerning the deployment of **cost-effective, energy-efficient, and real-time alert-enabled systems based on microcontrollers like ESP32**. This work aims to bridge that gap by leveraging the advanced features of ESP32—such as built-in Wi-Fi, Bluetooth, and low power consumption—for a more responsive and accessible health monitoring system using the Blynk IoT platform.

### 3. Proposed System



Proposed Architecture health monitoring system  
with Blynk as IoT platform

The proposed IoT-based health monitoring system consists of a wearable health monitoring device integrated with the Blynk IoT platform. This system is capable of monitoring the user's pulse rate and real-time geographical location. The device employs the SEN0203 heart rate sensor, developed by DF Robot, which uses the photoplethysmography (PPG) technique to measure pulse rate by detecting variations in blood flow through the user's index finger [10].

The user's location is determined using the GY-NEO6MV2 GPS module, equipped with an MWC 2.5 antenna. This module provides real-time latitude and longitude coordinates. The system is controlled by an **ESP32 microcontroller**, which features built-in Wi-Fi and Bluetooth capabilities. The ESP32 collects data from the heart rate sensor and GPS module, processes the data, and transmits it to the **Blynk cloud platform** over a Wi-Fi network.

The caregiver can monitor the user's vital signs and location through the Blynk mobile application available on both Android and IOS platforms. Additionally, if the pulse rate falls outside predefined safe limits, the system automatically sends an **email alert** to the caregiver, facilitating timely intervention.

#### Proposed System Architecture – Key Points

- ❑ Health Monitoring Device includes biomedical sensors to measure patient vitals (e.g., heart rate).
- ❑ Heart Rate Sensor collects real-time physiological data from the user.
- ❑ NodeMCU ESP8266 acts as the core processing unit and handles Wi-Fi communication.
- ❑ Sensor data is sent via Wi-Fi to the **Blynk IoT App** on a smartphone or tablet.
- ❑ The **Blynk App** provides real-time data visualization and enables remote monitoring.
- ❑ The system includes an email alert feature that sends notifications when abnormal values are detected.
- ❑ The architecture supports cloud connectivity, mobility, and low-cost remote health monitoring.

#### 4. Algorithm

Step1: Initializes both transmitter and receiver section and establishes Bluetooth connection between the systems.

Step2: The AD8232 sensor collects the ECG values of the patient and the data is passed to the microcontroller ATmega 8 in the transmitter section. And the data is send to the receiver section via the already established Bluetooth connection.

Step 3 : Real time pressure value is sensed by the biometric pressure sensor BMP 180 which is a piezo resistive MEMS device. The data is collected by the microcontroller ATmega 328 and is serially printed in the TFT display.

Step 4: The atmospheric humidity is sensed with the help of DHT 22 sensor and the value is serially printed in the TFT display.

Step 5: Heart beat of the patient is obtained with the help of Max 30100pulse oximeter sensor. Also the amount of oxygen content in the blood is measured. Both the data is printed on TFT display.

Step 6: The real time temperature of the patient is monitored by using temperature sensor and the temperature value is serially printed on the TFT Display.

Step 7: All the data collected by ECG sensor AD8232, BMP 180, DHT 22, MAX 30100 and Temperature sensor are pushed to the IoT platform by the ESP 8266 IoT module.

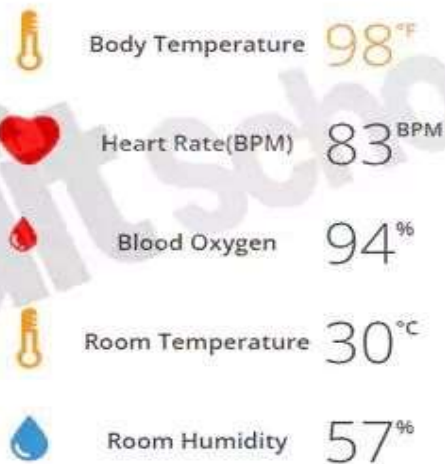
#### 5. RESULT





## ESP32 Patient Health Monitoring

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## 6. CONCLUSIONS

In conclusion, a prototype of an IoT-based health monitoring system for measuring heart rate and determining the user's location has been successfully developed. The device is capable of uploading real-time data to the Blynk cloud server and sending alerts to caregivers when an abnormal heart rate is detected. The data can be conveniently accessed through the Blynk mobile application on a smart phone, enabling remote health monitoring. However, one of the limitations of the current design is the placement of the heart rate sensor, which is restricted to the index finger. Additionally, the performance evaluation of the device was limited to a small number of test subjects. For future work, alternative sensor placement on other parts of the body should be explored to enhance measurement accuracy. A broader subject group should also be considered, including both healthy individuals and athletes, to validate the system's effectiveness across different physiological conditions. Moreover, the final hardware design should be optimized to function as a compact and comfortable wearable device.

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