Iot Health Monitoring System Using Esp32 for Real-Time Patient Monitoring and Remote Healthcare

Jay S wakude[1], Manish R Biyani[2], Anand D Bagal[3], Prof. Gaikwad[4]
[1,2,3] *Student of E&TC, Shri shivaji polytechnic institute Parbhani*
[4] *Professor, dept of E&TC, Shri shivaji polytechnic institute Parbhani*

***Abstract*—Healthcare monitoring has become an important requirement for continuous observation of patient health conditions. This paper presents the design and development of an IoT based health monitoring system using ESP32 microcontroller integrated with Internet of Things (IoT) technology. The system is capable of acquiring real-time physiological parameters such as body temperature, heart rate, ECG signal, and patient location using multiple sensors.**

The acquired data is processed by the ESP32 and transmitted wirelessly to a cloud-based platform using Wi-Fi communication protocols. The system enables real-time monitoring, remote accessibility, and efficient data visualization through mobile applications. Compared to traditional health monitoring systems, the proposed system offers reduced cost, improved flexibility, and enhanced performance. The results demonstrate that the system is reliable, scalable, and suitable for applications in hospitals, home healthcare, elderly monitoring, and emergency medical services.

***Index Terms*—IoT, ESP32, Health Monitoring, Heart Rate Sensor, ECG Sensor, Temperature Sensor, Real-Time.**

I. INTRODUCTION

Health monitoring is defined as the continuous observation of physiological parameters of patients for diagnosis and treatment. It is widely used in hospitals, home care systems, emergency medical services, and elderly patient monitoring.

Traditional health monitoring systems required manual measurement of patient parameters which leads to delays and lack of continuous monitoring. These systems also require physical presence of medical staff which increases workload and reduces efficiency.

With the rapid development of IoT and wireless communication technologies, health monitoring systems have evolved into smart, automated, and real-time monitoring systems.

This project focuses on the design and implementation of an IoT based health monitoring system using ESP32. The system is designed to monitor multiple health parameters and transmit data wirelessly to a cloud platform. The proposed system provides real-time monitoring, data logging, and remote access capabilities.

II. LITERATURE SURVEY

Earlier research in health monitoring systems involved the use of microcontrollers such as Arduino and Raspberry Pi. Arduino based systems are simple and cost-effective but require additional modules for Wi-Fi communication. Raspberry Pi provides higher processing power but consumes more energy. Recent advancements have focused on using ESP32 due to its built-in Wi-Fi and Bluetooth features, low power consumption, and high efficiency. Researchers have implemented IoT health monitoring systems using cloud platforms such as Blynk, ThingSpeak, and Firebase for real-time data visualization. However, many existing systems lack integration of multiple sensors and real-time alert systems. The proposed system addresses these limitations by combining multiple sensing units with efficient wireless data transmission and alert notifications.

III. SCOPE OF THE PROJECT

The scope of the proposed health monitoring system includes:

Real-time monitoring of body temperature
Heart rate measurement using heartbeat sensor
ECG signal monitoring
Patient location tracking using GPS module
Wireless data transmission using Wi-Fi
Cloud-based monitoring and data visualization
Emergency alert using buzzer and notifications
This system can be applied in various fields such as:
Hospital patient monitoring
Home healthcare systems
Elderly monitoring
Remote patient monitoring
Emergency ambulance systems
Fitness monitoring

IV. METHODOLOGY

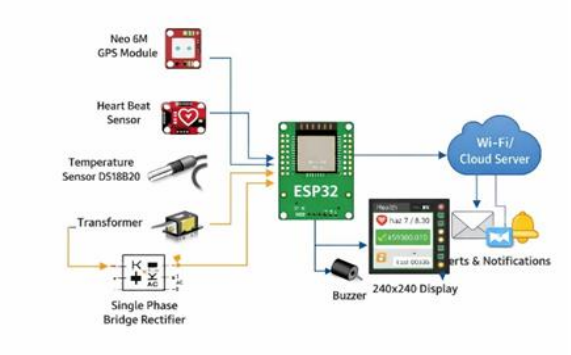
Selection of appropriate sensors and hardware components
Design of circuit connections and hardware implementation
Programming of ESP32 using Embedded C in Arduino IDE
Integration with IoT platform for remote monitoring
Testing, calibration, and performance evaluation

V. DETAILS OF DESIGN, WORKING AND PROCESSES

Hardware Design
The hardware system consists of ESP32 microcontroller interfaced with multiple sensors:
DS18B20 temperature sensor for body temperature measurement
Heartbeat sensor for pulse rate measurement
ECG sensor for heart activity monitoring
NEO-6M GPS module for patient location tracking
240x240 LCD display for real-time parameter display
Buzzer for emergency alert
All sensors are connected using communication protocols such as GPIO, I2C, and UART.

Software Design
The software is developed using Arduino IDE with Embedded C programming. The ESP32 is programmed to read sensor data, process it, and transmit it to the cloud platform.

VI. WORKING PRINCIPLE



The IoT Health Monitoring System works by continuously measuring patient health parameters using sensors and transmitting the data to the cloud using ESP32.

➢ Step-by-Step Working
1. Data Sensing
- Temperature sensor (DS18B20) measures body temperature
- Heartbeat sensor measures pulse rate
- ECG sensor monitors heart activity
- GPS module tracks patient location

➢ Signal Processing
- Sensors send analog/digital signals to ESP32
- ESP32 converts signals into readable values
- Data is filtered and processed
- Display Unit
- Processed values are shown on 240×240 LCD display
- Example:
- Temperature: 36.8°C
- Heart Rate: 78 BPM
- ECG: Normal

➢ Wi-Fi Communication
- ESP32 connects to WiFi network
- Data transmitted to IoT cloud server
- HTTP / MQTT protocol used

➢ Cloud Monitoring
- Data stored on IoT platform
- Doctor can monitor remotely using mobile or laptop
- Real-time graphs displayed

➢ Alert System
- If values cross threshold:
- Buzzer turns ON

- Notification sent to doctor
- Emergency alert generated

Communication Process

The system uses IoT communication protocols such as HTTP and MQTT for data transmission. These protocols ensure efficient and reliable communication between the device and the cloud server.

VII. RESULTS AND APPLICATIONS

Results

The system was tested with different patient conditions and showed accurate and stable performance. Sensor readings were consistent and reliable. Data transmission to the cloud was successful with minimal delay.

Applications

• Hospital patient monitoring
• Home healthcare
• Elderly monitoring
• Remote patient monitoring
• Ambulance monitoring system
• Fitness monitoring systems

VIII. CONCLUSION AND FUTURE SCOPE

Conclusion

The proposed IoT health monitoring system using ESP32 provides a reliable and cost-effective solution for real-time patient monitoring. The system integrates multiple
sensors and enables efficient wireless communication using IoT technology.

Future Scope

Integration of AI based health prediction
Addition of blood oxygen sensor (SpO2)
Cloud data analytics
Mobile app-based monitoring
Battery powered portable device
Integration with hospital database

REFERENCES

[1] ESP32 Datasheet
[2] Arduino Official Documentation
[3] Blynk IoT Platform
[4] Research papers on IoT Health Monitoring
[5] Sensor datasheets