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REAL-TIME HEALTH MONITORING SYSTEM FOR COMA PATIENTS

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ABSTRACT - *Coma patients require continuous and accurate monitoring of physiological parameters to prevent life-threatening conditions. Traditional observation methods rely on manual supervision, which is prone to delay and human error. This paper presents an IoT-based real-time health monitoring system that continuously tracks vital parameters, including heart rate, SpO_2, body temperature, and limb movement. The proposed system integrates MAX30102, DS18B20, Flex Sensor, and DHT11 with an ESP32 controller to collect data and upload it to the Thing Speak cloud for remote access. In case of abnormal readings, the system triggers alerts through a buzzer to notify caregivers. The show offers reliable data acquisition, low latency in cloud updates, and cost-effective operation suitable for hospital and home environments. This solution enhances patient safety and provides a scalable framework for continuous health surveillance.*

Keywords: IoT, Coma Patients, Health Monitoring, MAX30102, ESP32, Thing Speak, Real-Time Alerts.

INTRODUCTION

Monitoring coma patients poses unique challenges since these individuals cannot communicate symptoms or distress. Continuous supervision is critical to detect variations in vital parameters such as oxygen saturation, heart rate, and body temperature. Conventional hospital monitoring relies on periodic manual checks and expensive ICU-grade equipment, which are unsuitable for long-term or home-based care.

Recent advancements in the Internet of Things (IoT) have enabled remote and automated health monitoring through sensor-based systems. By integrating biomedical sensors with microcontrollers and cloud platforms, real-time data can be captured, analyzed, and transmitted to healthcare providers instantly.

The proposed Real-Time Health Monitoring System for Coma Patients is designed to provide 24/7 automated tracking of key physiological parameters. It uses low-power, affordable components to continuously collect data and transmit it over Wi-Fi to the cloud. Threshold-based alerts enable immediate action during critical health events, reducing response time and improving survival rates.
This system aims to bridge the gap between hospital-grade monitoring and affordable patient-centric healthcare by ensuring accessibility, mobility, and reliability.

I. METHODOLOGY

The development of the proposed system follows a structured methodology consisting of hardware design, software programming, and cloud integration.

Step 1 – Component Selection

The system employs the following key components:

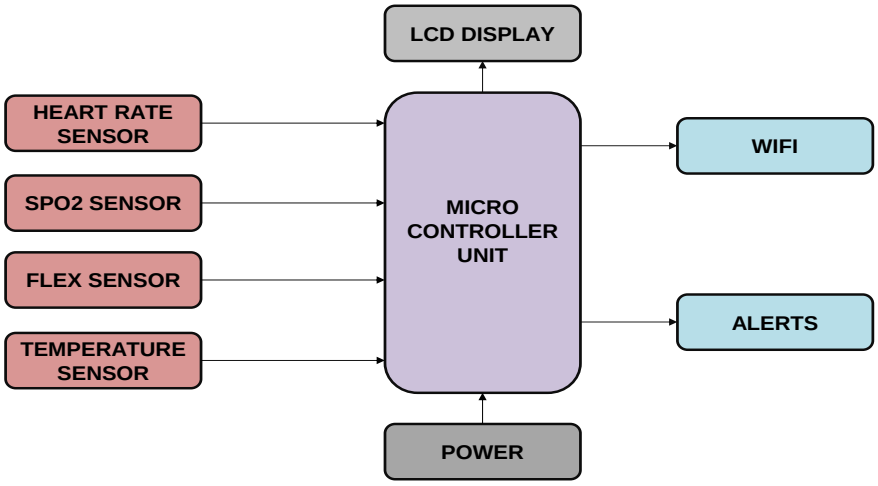
- **ESP 32:** Main microcontroller with Wi-Fi capability.
- **MAX30102:** Measures heart rate and SpO_2 using photo plethysmo grapy.
- **DS18B20:** Digital sensor for precise body-temperature measurement.
- **Flex Sensor:** Detects limb movements to indicate neurological activity.
- **DHT11:** Monitors ambient temperature and humidity.
- **I2C LCD:** Displays live sensor readings.
- **Alerts:** Generates audible alerts when thresholds are crossed.

Step 2 – System Design
All sensors are interfaced with the ESP 32, which processes signals and sends data to the Thing Speak cloud via Wi-Fi. Real-time readings are also displayed locally on the LCD for clinical reference.
Step 3 – Software Implementation
The system is programmed using the Adriano IDE**.** The code initializes each sensor, reads the input data, converts analog signals to digital values, and periodically uploads the information to the Thing Speak channel through HTTP APIs. Threshold conditions (e.g., temperature > 37.5 °C or SpO_2 < 90 %) activate the alerts and visual indicators.
Step 4 – Cloud Data Management
Thing Speak enables real-time visualization through dynamic graphs, providing caregivers and doctors with historical trends and instant updates from any location.
Step 5 – Testing and Validation
The prototype was tested with simulated patient conditions to ensure accuracy, reliability, and network stability. Sensor calibration was performed to minimize drift and environmental interference.

II. BLOCK DIAGRAM

The block diagram illustrates the integration of biomedical sensors with the ESP32, serving as the main controller. The MAX30102 measures heart rate and SpO_2, the DS18B20 records body temperature, the Flex Sensor detects limb movement, and the DHT11 senses ambient conditions. The acquired data is processed by the ESP32 and displayed on the I^2C LCD. Using its built-in Wi-Fi, the controller transmits data to the Thing Speak cloud for remote monitoring. A buzzer provides an alert whenever a parameter exceeds its set threshold.

Figure 1: Block Diagram



III. WORKING

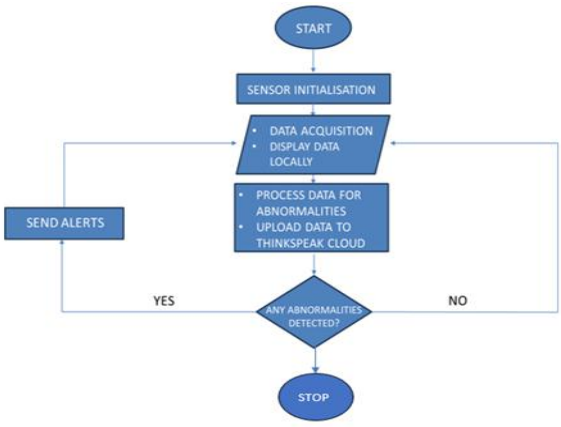


Figure 2: Flow ChartWhen powered on, the ESP32 initialises all connected sensors and connects to Wi-Fi. The MAX30102 uses red and infrared light to determine heart rate and SpO_2, the DS18B20 provides body temperature, the Flex Sensor detects patient movement, and the DHT11 records room conditions.

All sensor outputs are processed and displayed on the LCD. The microcontroller then uploads the values to the Thing Speak cloud at regular intervals for remote access. If any reading exceeds the present threshold, the buzzer is activated to alert caregivers. This process repeats continuously, enabling 24/7 automatic monitoring of vital signs and providing immediate response to abnormal conditions without manual intervention.

IV. DESIGN AND CIRCUIT DIAGRAM

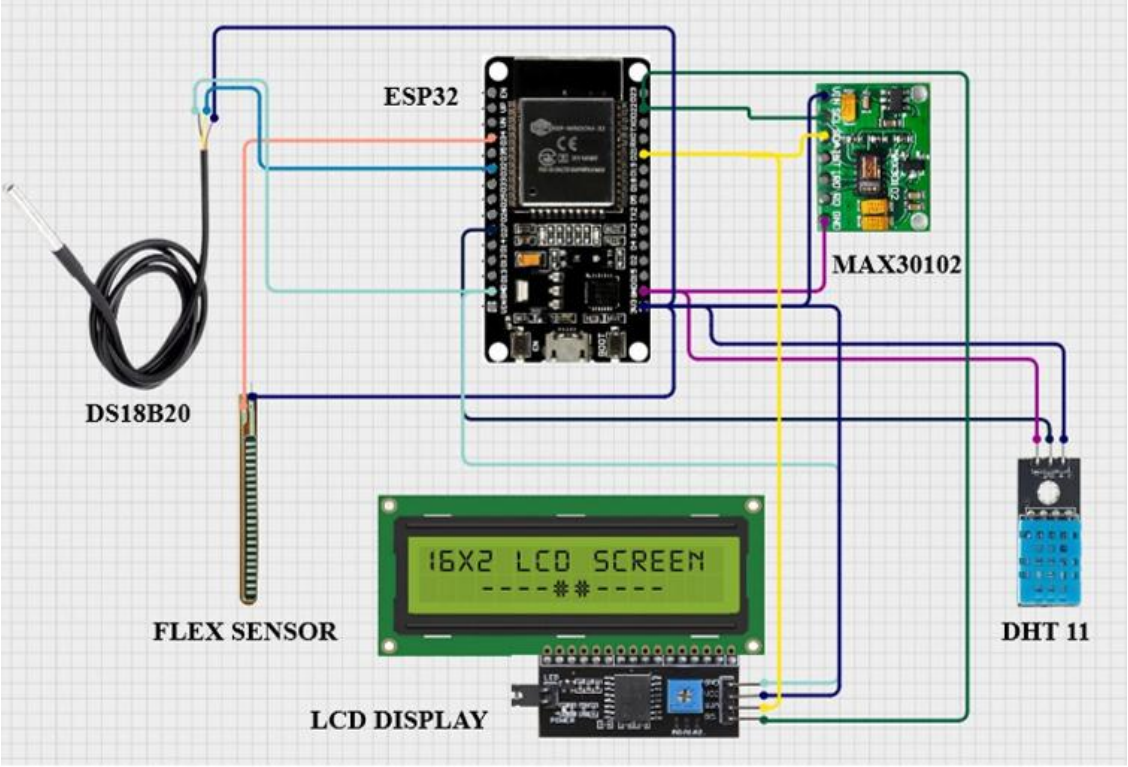


Figure 3: Circuit Diagram

Circuit Diagram of the hardware connection of the ESP32 with flex sensors and the 16×2 LCD module for measuring the extent of finger bend, each flex sensors are connected to the analog input pins of the respective ESP32 connections. The sensors are variable resistors which give different voltage outputs as a function of the position of the fingers. The ESP32 interprets these analog signals to recognize the corresponding gesture. The LCD is adjustable by a 10kΩ potentiometer. where the LCD data pins connect to ESP32 digital I/O pins for display control. The system is connected to the power via the ESP32's USB port , making it run stably. This is a text system that uses real-time feedback to provide interpretation of a gesture and then display the interpreted-text on an LCD screen.

V. RESULTS AND DISCUSSION

The prototype demonstrated efficient acquisition and transmission of vital-sign data with minimal latency.

- **Accuracy:** The MAX30102 and DS18B20 sensors provided consistent readings comparable to standard medical devices.
- **Real-Time Alerts:** The buzzer successfully activated when predefined thresholds were exceeded.
- **Remote Monitoring:** Continuous cloud connectivity enabled healthcare professionals to monitor data trends remotely via the Thing Speak dashboard.
- **Cost Efficiency:** The total hardware cost was significantly lower than existing hospital-grade systems, making it viable for home-care and rural setups.

The system effectively reduces manual workload and enhances reliability. However, its dependence on continuous internet connectivity remains a limitation, which can be addressed by incorporating edge-based data storage or GSM modules for backup communication.

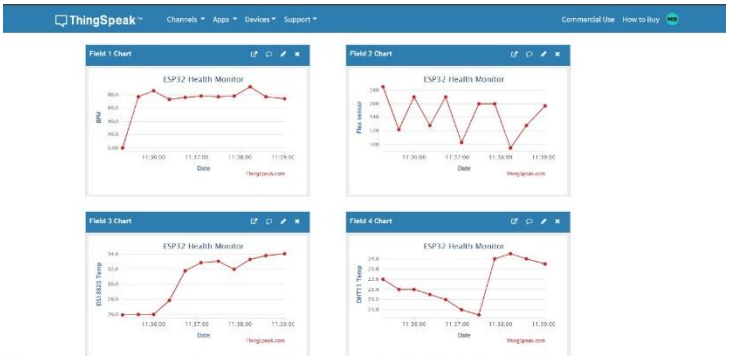


Figure 4: Results from Thing Speak

VI. CONCLUSION

In conclusion, the Real-Time Health Monitoring System for Coma Patients shows great promise for improving care quality, lowering healthcare risks, and offering more comfort and reassurance to families. Its ability to track health parameters continuously, send alerts during emergencies, and allow for remote monitoring makes it a valuable tool in managing coma patients. This ensures that medical interventions are prompt and effective. As technology progresses, the system will keep evolving, providing even more benefits for treating and caring for patients with severe health conditions. To enhance coma management worldwide, we need clear, evidence-based guidelines and a collaborative approach that unites different professionals in the field.

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