Health Monitoring System

Project Report

# Table of Contents

1. 1. Introduction
2. 2. System Architecture

* 2.1 Hardware Layer
* 2.2 Communication Layer
* 2.3 Backend Layer
* 2.4 Frontend Layer

1. 3. Conclusion

# 1. Introduction

Monitoring home environmental conditions and personal health metrics remotely is becoming increasingly vital for ensuring safety, enhancing comfort, and enabling preventive health care. However, most existing solutions in the market are either prohibitively expensive, lack flexibility, or do not offer seamless integration between multiple sensor types and platforms.  
  
Our project introduces a cost-effective, IoT-based smart monitoring system that leverages a network of environmental and biometric sensors to provide real-time data acquisition, analysis, and visualization.

# 2. System Architecture

## 2.1 Hardware Layer

• ESP32 Microcontroller:  
 A powerful and energy-efficient microcontroller with built-in Wi-Fi and Bluetooth. It serves as the core controller, interfacing with all connected sensors and managing data transmission.  
  
• Connected Sensors:  
 - Temperature & Humidity Sensor: For indoor climate monitoring.  
 - CO and CO₂ Sensors: For air quality analysis and gas level detection.  
 - Heart Rate Sensor: For monitoring basic health vitals.  
  
• LCD Display:  
 Displays live sensor values and messages triggered from the web interface.

## 2.2 Communication Layer

• MQTT Protocol:  
 The system uses MQTT, a lightweight messaging protocol ideal for IoT. The ESP32 publishes sensor data to a cloud MQTT broker, enabling real-time communication.

## 2.3 Backend Layer

• Node.js Server:  
 Acts as the core data processor:  
 - Subscribes to MQTT topics to receive sensor data.  
 - Provides a RESTful API to serve data to the frontend.  
 - Accepts control commands and relays them to the ESP32 via MQTT.

## 2.4 Frontend Layer

• Web-Based Interface (HTML/JavaScript):  
 A responsive application allowing users to:  
 - View real-time sensor data via charts or tables.  
 - Access historical data (future feature).  
 - Send commands to the ESP32, shown on the LCD screen.

# 3. Conclusion

In an age where environmental awareness and health monitoring are essential, the proposed IoT-based smart monitoring system provides a practical, accessible, and scalable solution. By combining affordable hardware with efficient communication protocols and an intuitive web interface, users can monitor vital conditions in real time from anywhere.  
  
The system supports personal safety, improves home conditions, and has potential applications in elder care, home automation, and remote health diagnostics—paving the way for smarter living.