National Textile University, Faisalabad

Department of Computer Science

Name:	ARSH E NOOR
Class:	BSCS-5TH A
Registration No:	23-NTU-CS-1018
Course Name:	Embedded IoT
Submitted To:	Sir Nasir
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Server Room Safety System

1. Project Documentation

1.1 Problem Statement:

Modern server rooms host critical infrastructure where even a small environmental fault can lead to data loss , service downtime , or hardware damage. Factors such as gas leakage , fire , abnormal temperature , humidity imbalance , or unauthorized darkness pose serious risks.

The **Server Room Safety System** is an IoT based real time monitoring and alert solution designed to continuously observe environmental conditions inside a server room and immediately notify responsible personnel when unsafe conditions arise . The system combines multiple sensors with an ESP32 microcontroller and integrates cloud based monitoring using the Blynk platform.

This project emphasizes **automation , reliability , and remote accessibility** , making it suitable for modern data centers and IT environments.

1.2 Objectives

- To monitor critical environmental parameters inside a server room in real time.
- To detect hazardous conditions such as gas leakage , fire , abnormal lighting , and unsafe temperature or humidity.
- To trigger immediate local alerts using a buzzer.
- To provide remote alerts and live sensor data through a mobile application.
- To ensure continuous safety monitoring with minimal human intervention.

1.3 Hardware Components and Description

- **ESP32 Microcontroller**
  The ESP32 acts as the brain of the system. It reads sensor data , processes threshold conditions , controls the buzzer , and communicates with the Blynk cloud over WiFi. Its built-in WiFi capability makes it ideal for IoT applications.

- **MQ-2 Gas Sensor**
  The MQ-2 sensor detects smoke and combustible gases. It outputs an analog value proportional to gas concentration. A warm-up period is required to ensure accurate readings.

- **DHT22 Temperature and Humidity Sensor**
  The DHT22 provides precise temperature and humidity measurements. Maintaining proper temperature and humidity is essential to prevent overheating , corrosion , and hardware failure in server rooms.

- **Flame Sensor**
  The flame sensor detects infrared light emitted by flames. It provides a digital output , allowing instant fire detection even before smoke spreads.

- **LDR (Light Dependent Resistor)**
  The LDR monitors ambient light levels. Sudden darkness may indicate a power issue , unauthorized access , or lighting failure , which is critical in secured environments.

- **Buzzer**
  The buzzer provides an immediate audible alert when any dangerous condition is detected , ensuring on-site awareness.

1.4 Software and Tools Used

- Arduino IDE for programming the ESP32
- Blynk IoT Platform for cloud integration and mobile monitoring
- WiFi communication for real-time data transfer

1.5 System Architecture

The system follows a sensor to cloud architecture:

1. Sensors collect environmental data.
2. ESP32 processes the data and compares it with predefined thresholds.
3. Normal values are continuously sent to the Blynk cloud.
4. If a hazard is detected , alerts are triggered locally and remotely.

1.6 Working Principle

Initialization Phase

- ESP32 powers up and initializes all sensors.
- WiFi connection is established.
- Blynk cloud authentication is completed.
- MQ-2 sensor undergoes a 30-second warm-up phase.

Data Acquisition Phase

- ESP32 reads:
  - Gas concentration from MQ-2
  - Temperature and humidity from DHT22
  - Flame status from flame sensor
  - Light intensity from LDR

Decision and Alert Phase

- Sensor values are compared with predefined thresholds.
- If any threshold is crossed:
  - The buzzer is activated.
  - A critical alert event is sent to the Blynk app.
- If all values are normal:
  - The system continues silent monitoring.

Continuous Monitoring

The system runs continuously , updating the Blynk dashboard every few seconds , ensuring 24/7 protection.

1.7 Threshold Logic

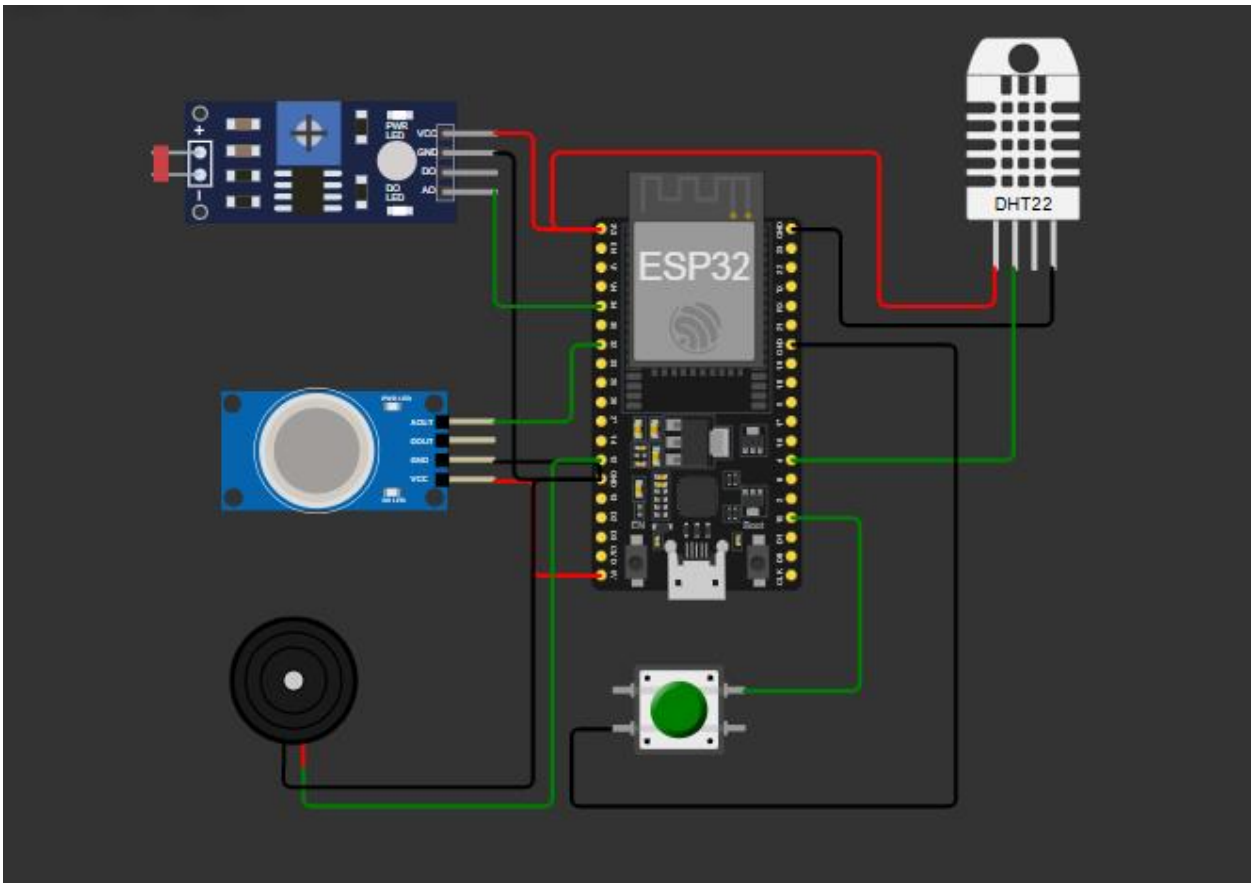
- Gas Level: Triggers alert when concentration exceeds safe limit.
- Light Level: Triggers alert when intensity falls below minimum threshold.
- Flame Detection: Immediate alert on flame detection.
- Temperature and Humidity: Displayed for preventive monitoring.

1.8 Cloud Integration (Blynk)

The Blynk app provides:

- Live sensor data visualization
- Instant push notifications during emergencies
- Remote monitoring from anywhere

1.8.1 Circuit Diagram

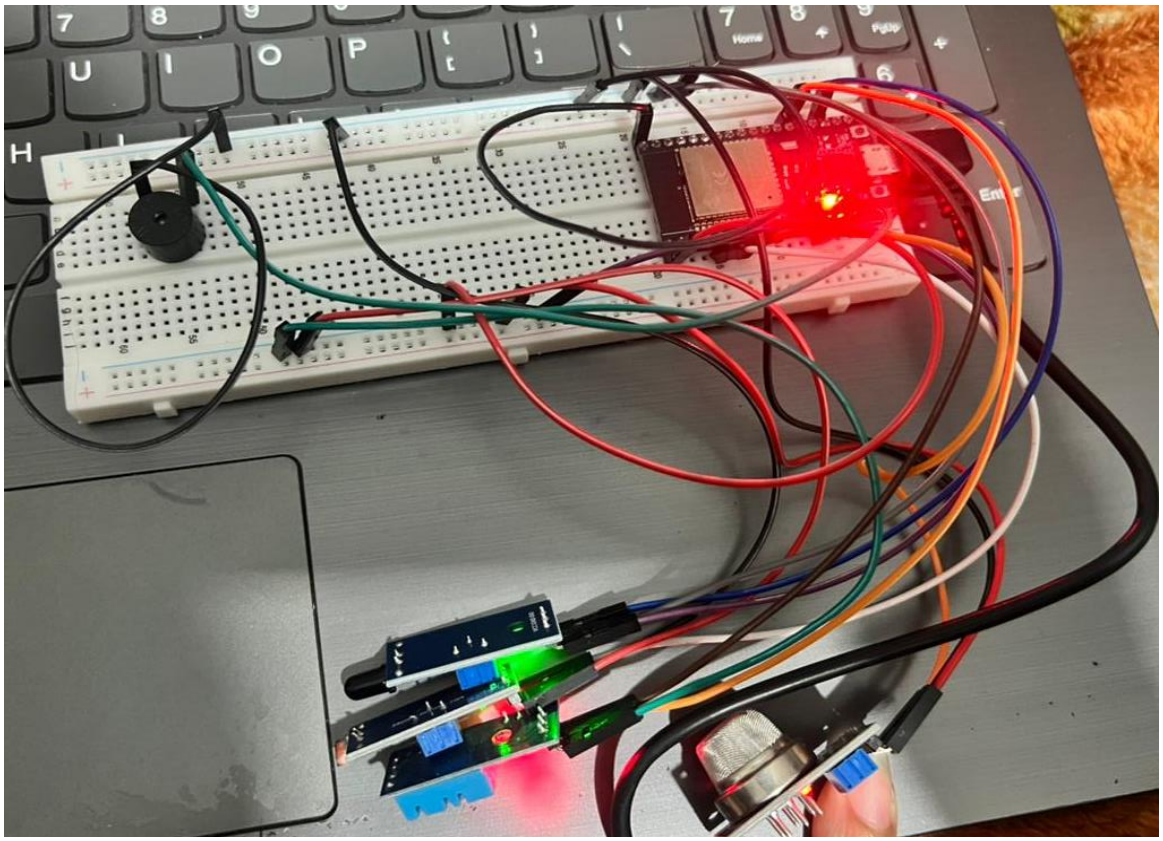


The circuit diagram of the Server Room Safety System represents the complete hardware interconnection between the ESP32 microcontroller and all peripheral sensors used in the project.

The ESP32 acts as the central control unit. The MQ-2 gas sensor is connected to an analog input pin of the ESP32 to detect smoke and gas concentration levels. The DHT22 sensor is interfaced through a digital GPIO pin to measure temperature and humidity of the server room environment. The flame sensor is connected to a digital input pin and is responsible for detecting fire or flame presence. The LDR is connected to an analog input pin to monitor ambient light intensity. A buzzer is connected to a digital output pin to provide an audible alert during emergency situations.

All components share a common ground, and proper power supply connections are maintained to ensure safe and stable operation of the system.

1.8.2 Physical Working Model



This section presents the physical working model of the Server Room Safety System. The images show the real hardware setup including the ESP32 microcontroller , sensors , wiring and power connections.

The MQ-2 sensor responds to gas or smoke , the DHT22 continuously measures temperature and humidity , the flame sensor detects fire instantly , and the LDR monitors light conditions. When any abnormal condition is detected, the buzzer is activated and an alert is sent to the Blynk mobile application in real time.

These images confirm the successful practical implementation and real-time working of the proposed system.

1.8.3 Project Demonstration (Working Video)

A short video demonstration of the project is provided showing the complete working of the system. The video includes system startup, live sensor monitoring , detection of abnormal conditions , buzzer activation , and real-time alert notification on the Blynk application.

This demonstration validates the functionality and reliability of the system in real-world conditions.

(The working video is attached and submitted with document)

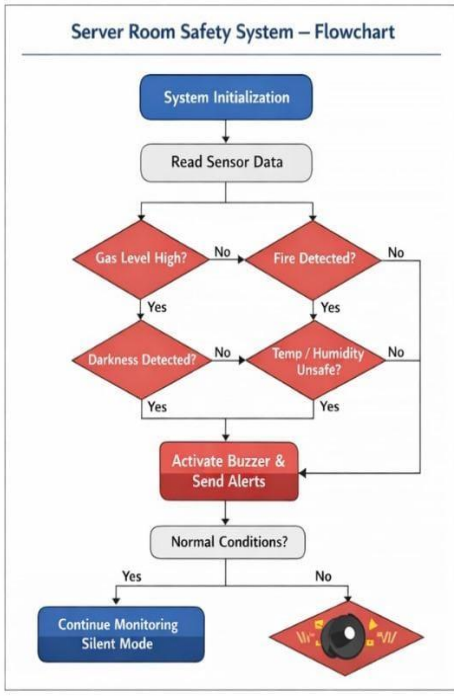
1.9 Advantages

- Real-time hazard detection
- Remote accessibility
- Low cost and scalable
- Quick response time
- Suitable for modern smart infrastructure

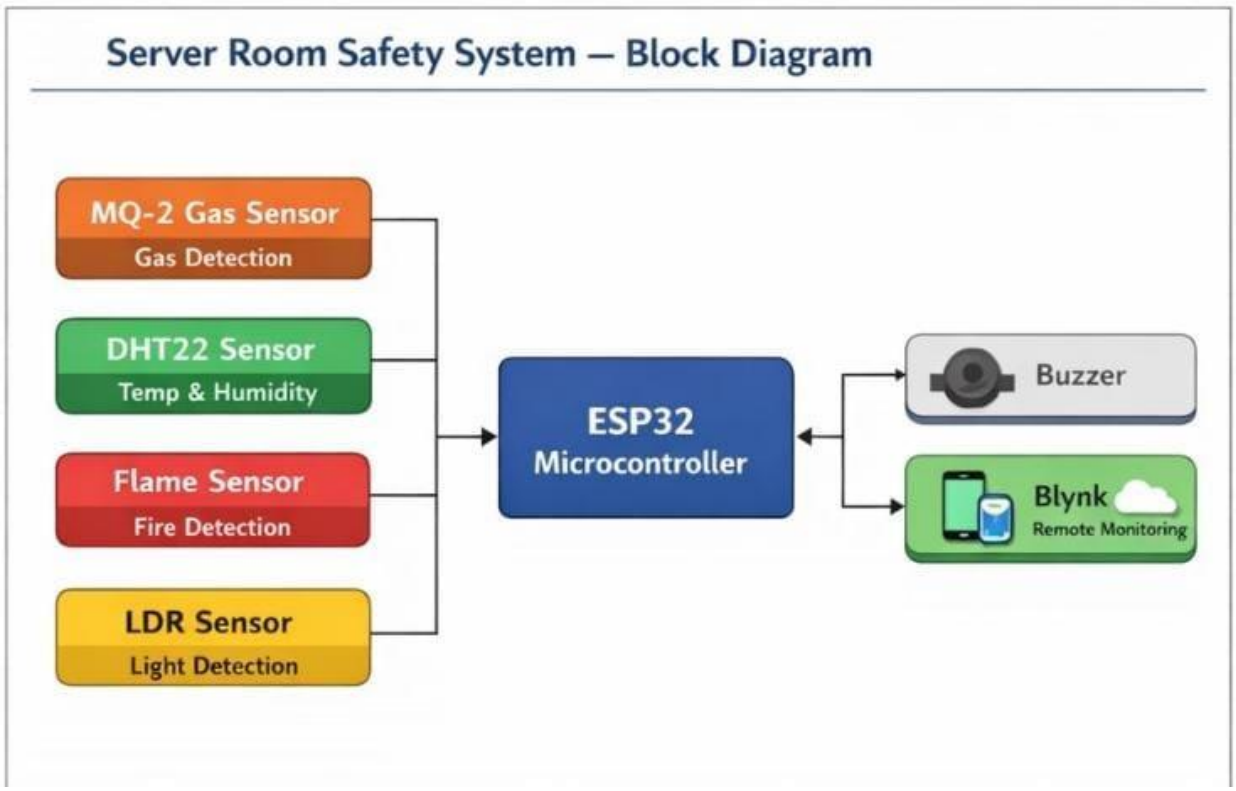
1.10 Future Enhancements

- Adding smoke density analysis
- Camera integration for visual verification
- SMS or email alerts
- AI-based anomaly prediction
- Data logging and analytics

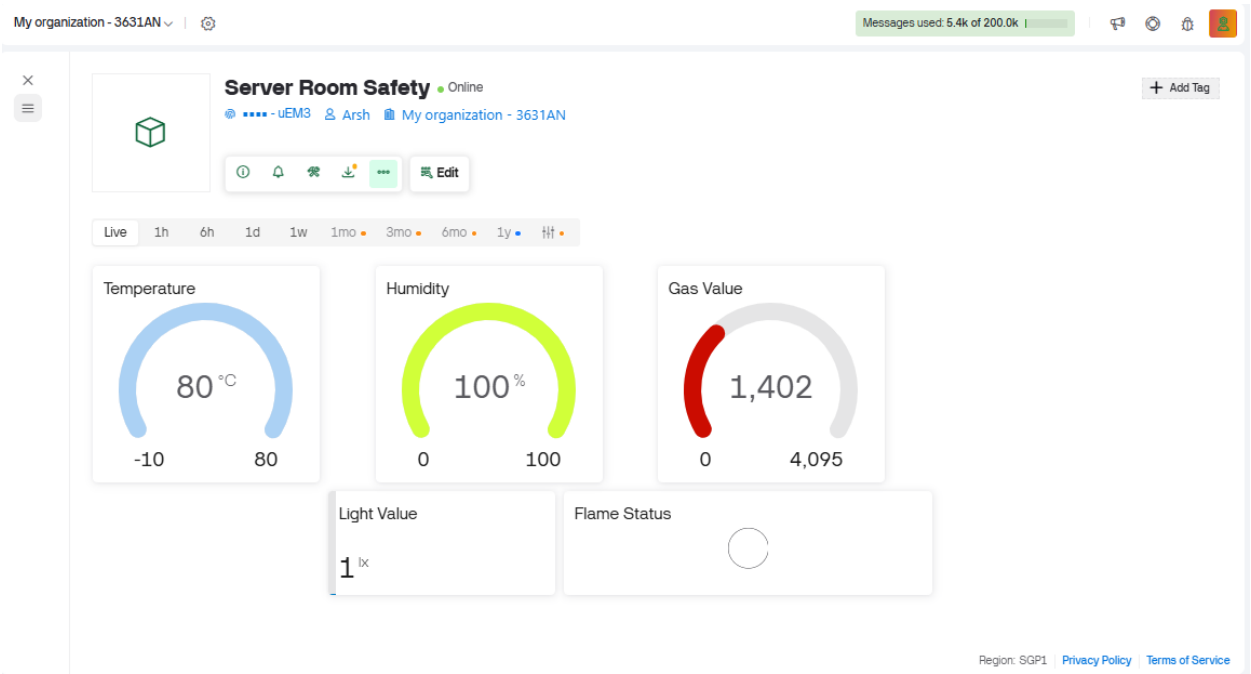
1.11 Flow Chart



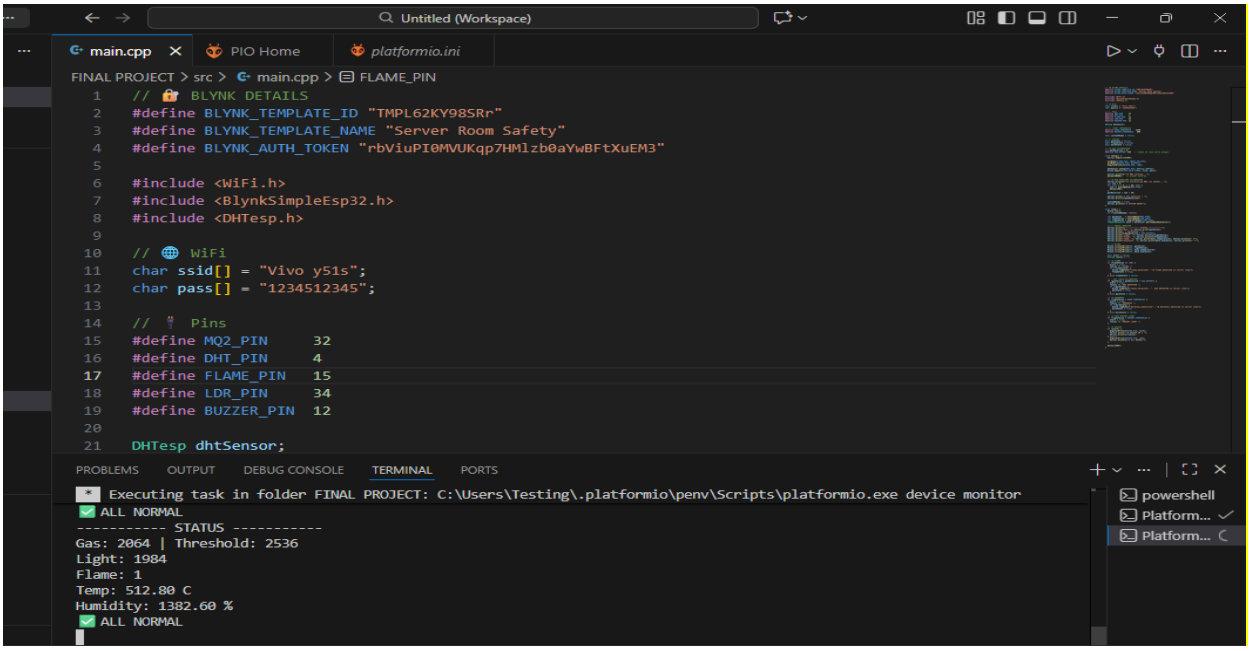
1.12 Block Diagram

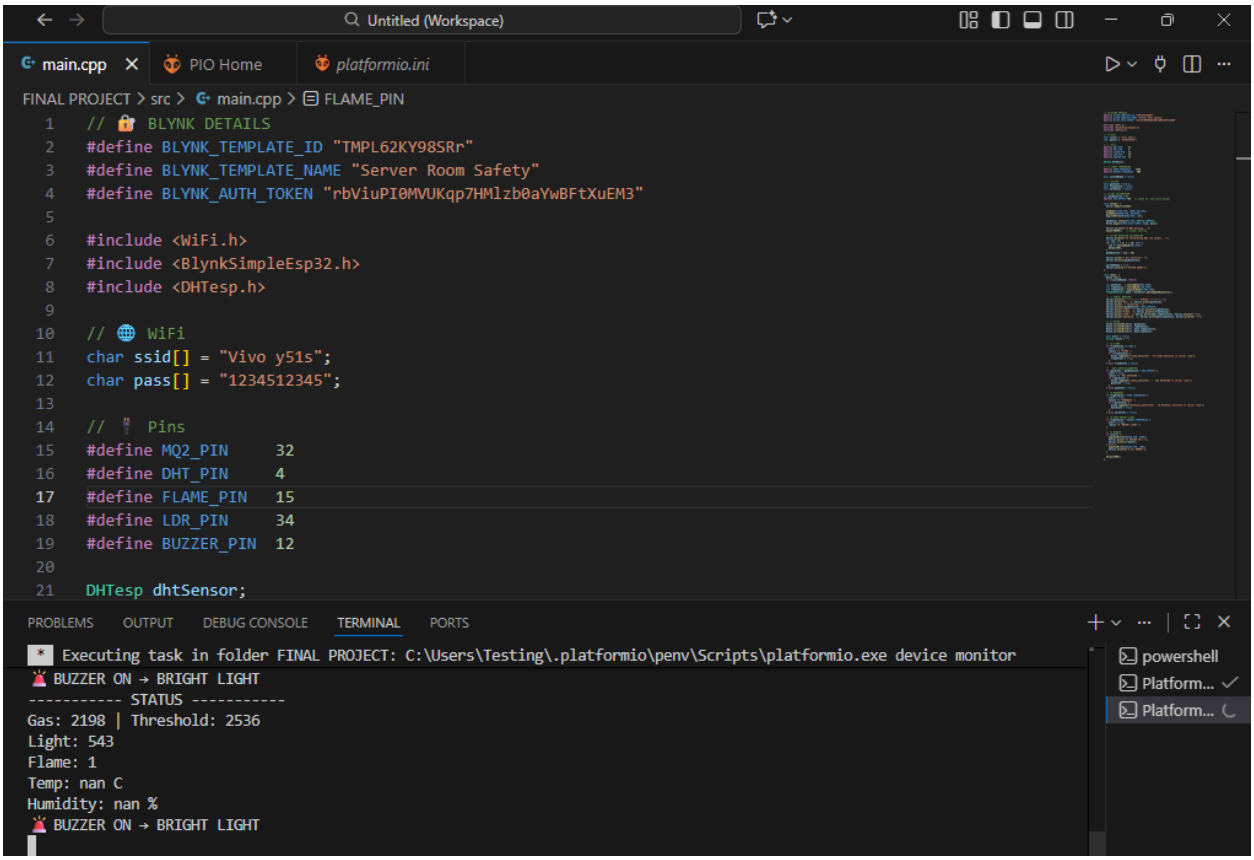


1.13 Blynk Dashboard



1.14 Outputs





1.15 Conclusion

The Server Room Safety System successfully demonstrates an effective IoT-based solution for monitoring and protecting critical server room environments. By integrating multiple sensors such as gas, flame, temperature, humidity, and light sensors with the ESP32 microcontroller, the system ensures continuous real-time monitoring of environmental conditions.

The use of the Blynk IoT platform enables remote access, live data visualization, and instant alerts, allowing timely response to hazardous situations such as gas leakage, fire, abnormal temperature, humidity imbalance, or sudden darkness. The buzzer provides an immediate on-site alert, enhancing overall safety.

This project highlights the importance of automation, reliability, and smart monitoring in modern data centers. Due to its low cost, scalability, and real-time performance, the proposed system is highly suitable for server rooms, data centers, and other critical infrastructure environments.