A Course Mini Project Report on

Fire Detection and Gas Alert System using ESP32 & Blynk

Submitted in partial fulfillment of the requirements
for the award of the degree of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

by

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Under the Guidance of

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(Affiliated to JNTUA, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & Accredited by NBA (B.TECH ECE, EEE&CSE))

2025-2026

ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the project report entitled **Fire Detection and Gas Alert System using ESP32 and Blynk** is the Bonafide work carried out by **K.Sai Sujan** bearing Roll Number **224G1A0479** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology in Electronics and Communication Engineering** during the academic year 2025-2026.

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DECLARATION

We, **K.Sai Sujan** with reg no: **224G1A0479** student of **SRINIVASA RAMANUJAN INSTITUTE OF TECHNOLOGY**, Rotarypuram hereby declares that the dissertion entitled **Fire Detection and Gas Alert System using ESP32 and Blynk** embodies the report of our project work carried out by us during IV year Bachelor of our project Bachelor of Technology under the guidance of **Mr.B.Varun Kumar.M.Tech,Ph.d., Assistant Professor**, Department of ECE, Srrinivasa Ramanujan Institute of Technology and this work has been submitted for the partial fulfilment of the requirements for the award of the Bachelor of Technology Degree.

The results embodied in this project have not been submitted to any other University of institute for the award of any Degree or Diploma

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To become a premier Educational Institution in India offering the best teaching and learning environment for our students that will enable them to become complete individuals with professional competency, human touch, ethical values, service motto, and a strong sense of responsibility towards environment and society at large.

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M3: Strengthen industry institute interactions to enable the students work on realistic problems and acquire the ability to face the ever-changing requirements of the industry.

M4: Continually enhance the quality of the relationship between students and faculty which is a key to the development of an exciting and rewarding learning environment in the college.

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ABSTRACT

The *Fire Detection and Gas Alert System* is an IoT-based safety solution designed to detect fire and harmful gas leaks in real time. The system employs an ESP32 microcontroller interfaced with a flame sensor and gas sensor (MQ2) to continuously monitor environmental safety levels. When a fire or gas leak is detected, the system immediately sends alerts to the user's smartphone via the Blynk IoT platform, ensuring rapid awareness and preventive action. By integrating cloud-based monitoring and instant notifications, the system enhances home and industrial safety through smart, automated IoT technology. This cost-effective and scalable solution demonstrates how IoT can help prevent accidents and safeguard environments from fire and gas-related hazards.

Keywords: IoT, ESP32, Blynk, Flame Sensor, Gas Sensor (MQ2), Fire Detection, Gas Leak Alert, Smart Safety System, Real-Time Monitoring, Cloud-Based Notification

LIST OF CONTENTS

LIST OF FIGURES

CHAPTER-1

INTRODUCTION

The Internet of Things (IoT) has rapidly transformed various sectors by enabling everyday objects to connect to the internet, gather data, and perform actions automatically. This technological advancement has paved the way for innovative solutions in home and industrial safety. One of the most critical applications of IoT is in the development of real-time monitoring and alert systems to prevent potential disasters.

This project, the "Fire Detection and Gas Alert System," is an IoT-based safety solution designed to detect the presence of fire and harmful gas leaks in real-time. By leveraging the power of microcontrollers, sensors, and cloud platforms, the system provides an automated and immediate response to hazardous conditions. It is built to enhance the safety of various environments, including homes, kitchens, and industrial workplaces, where the risk of fire and gas-related incidents is a significant concern.

The core of the system is the ESP32 microcontroller, which interfaces with a flame sensor and an MQ-2 gas sensor. These sensors continuously monitor the environment for signs of fire or the presence of combustible gases. Upon detection of a hazard, the system instantly transmits an alert to the user's smartphone through the Blynk IoT platform. This ensures that users are notified immediately, regardless of their location, allowing for swift, preventive action to be taken. This project focuses on creating a reliable, cost-effective, and scalable solution that showcases the potential of modern IoT technology to prevent accidents and protect lives and property.

CHAPTER-2

LITERATURE REVIEW

A literature review on IoT-based fire and gas detection systems reveals a significant trend towards using low-cost microcontrollers for enhanced safety and remote monitoring. Early fire and gas safety systems were often standalone devices with localized alarms, such as beeping smoke detectors, which were ineffective if occupants were away from the premises.

The advent of the Internet of Things (IoT) has led to the development of connected safety systems. Many research papers focus on the use of the ESP8266, the predecessor to the ESP32, for its Wi-Fi capabilities. These systems typically pair a microcontroller with various sensors, such as the MQ series for gas detection and simple photodiodes or IR sensors for flame detection. The data is then sent to a web server or a dedicated mobile application for alerts.

More recent studies highlight the superiority of the ESP32 due to its dual-core processor, improved performance, and integrated Bluetooth, allowing for more complex applications. The use of platforms like Blynk, Firebase, and AWS IoT is frequently discussed for simplifying the cloud integration and mobile app development process. Blynk, in particular, is often cited for its user-friendly interface and rapid prototyping capabilities, which allow developers to create functional dashboards and notification systems with minimal coding. Research in this area consistently underscores the potential of IoT to revolutionize safety systems by making them more intelligent, responsive, and accessible, ultimately offering a significant improvement over traditional, non-connected alarms.

CHAPTER-3
EXISTING SYSTEM

The existing systems for fire and gas safety in most residential and small-scale commercial environments are typically non-integrated, standalone devices. These systems have several key limitations:

1. **Localized Alarms:** The most common existing systems are battery-powered smoke detectors and carbon monoxide alarms. When these devices detect a hazard, they trigger a loud, audible alarm. While effective at alerting people who are physically present, they are completely ineffective if the property is unoccupied. There is no mechanism to notify the owner or emergency services remotely.
2. **Lack of Integration:** Fire detection and gas leak detection are usually handled by separate, independent devices. A smoke detector will not detect a gas leak, and a gas detector will not detect a fire. This lack of a unified system means multiple devices must be installed and maintained.
3. **No Real-Time Data:** Traditional systems do not provide any data on the severity or specific location of the hazard. They operate on a simple binary principle (alarm on or off). Users have no way of knowing the concentration of gas or the intensity of a fire.
4. **Manual Intervention Required:** These systems are passive and rely entirely on human intervention after an alarm is triggered. They cannot perform automated actions, such as shutting off a gas valve or notifying emergency services. The responsibility for response falls entirely on anyone who hears the alarm.

In summary, the existing systems are limited by their inability to communicate remotely, their lack of data provision, and their reliance on local alerts and manual response.

CHAPTER-4
PROPOSED SYSTEM

The proposed Fire Detection and Gas Alert System using ESP32 and Blynk is a modern, IoT-based solution designed to overcome the limitations of existing systems. It creates a smart, connected, and responsive safety environment.

1. Core Technology: The system is built around the ESP32, a powerful microcontroller with built-in Wi-Fi. This enables the system to connect to the internet seamlessly and communicate with a cloud platform.
2. Integrated Sensing: It integrates multiple sensing capabilities into a single, unified system. A flame sensor is used for early fire detection, and an MQ-2 gas sensor is used to detect leaks of combustible gases like LPG and methane. The ESP32 continuously monitors the inputs from both sensors.
3. Real-Time Remote Alerts: The key innovation of the proposed system is its connectivity with the Blynk IoT platform. When either the flame sensor or the gas sensor detects a reading that exceeds a predefined safety threshold, the ESP32 immediately sends an alert to the Blynk cloud. The Blynk server then instantly pushes a notification to the user's smartphone. This ensures the user is alerted to the danger in real-time, no matter where they are.
4. Data Monitoring: The Blynk app provides a user-friendly dashboard where the user can monitor the status of their environment. While this project focuses on alerts, it can be easily extended to show real-time sensor readings.
5. Automation and Scalability: The proposed system is inherently scalable. It can be expanded to include more sensors (e.g., temperature, carbon monoxide) or control actuators (e.g., a relay to automatically shut off the gas supply).

By integrating real-time monitoring, remote control, and automated alerts, the proposed system provides a significant enhancement in safety, convenience, and peace of mind compared to traditional, standalone alarms.

CHAPTER-5
CIRCUIT DESIGN

The circuit for the IoT-based Fire and Gas Alert System is designed for simplicity and reliability, using a breadboard for easy assembly. The ESP32 development board serves as the central hub connecting all components.

1. **ESP32 Pin Connections:**

FIG:ESP32 PIN CONNECTIONS

- **Flame Sensor:** The VCC pin connects to 3.3V on the ESP32, GND connects to GND, and the digital output (DO) pin connects to a digital GPIO pin (e.g., GPIO 35). This pin will send a signal when a flame is detected.

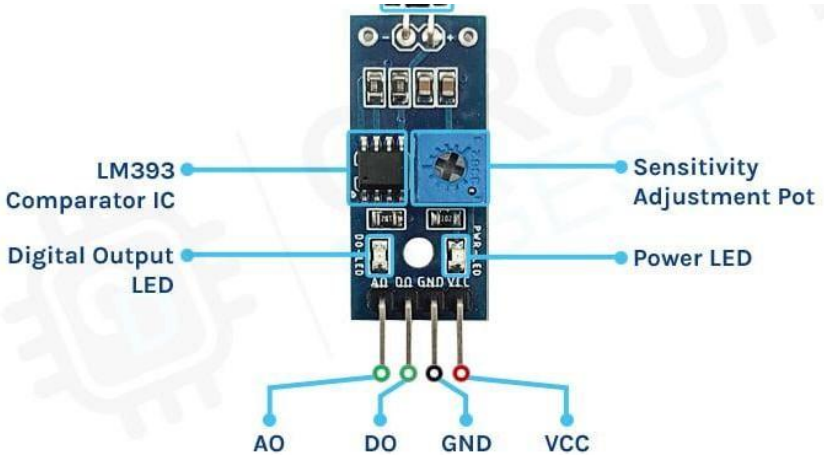


FIG:FLAME SENSOR

- **MQ-2 Gas Sensor:** The VCC pin connects to 5V on the ESP32, GND connects to GND, and the analog output (A0) pin connects to an analog-capable GPIO pin (e.g., GPIO 32). This pin will provide a variable voltage corresponding to the gas concentration.

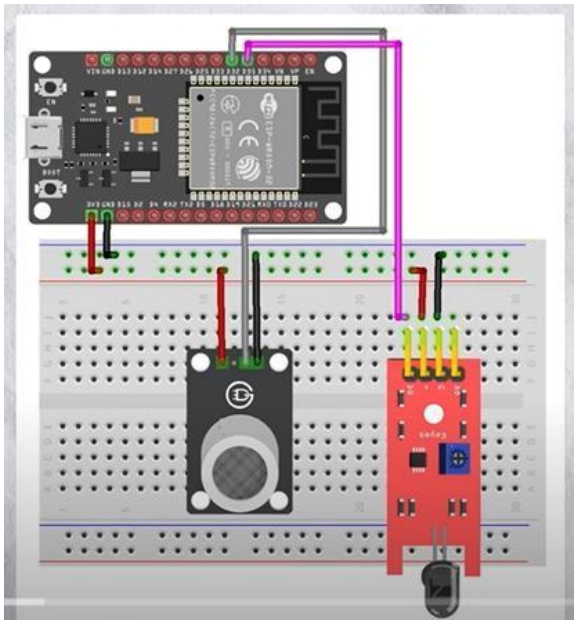
FIG: GAS SENSOR

- **Buzzer (Optional for local alarm):** An active buzzer can be connected to another digital GPIO pin (e.g., GPIO 27) and GND to provide an audible, local alert in addition to the mobile notification.

2. **Power Supply:**
   - The entire system can be powered directly through the ESP32's micro-USB port using a standard 5V power adapter or a computer's USB port. The ESP32 board has an onboard voltage regulator that provides the necessary 3.3V for its operation and for powering the sensors.

The design ensures that the ESP32 can continuously read from both the digital flame sensor and the analog gas sensor, process the data, and trigger an alert if necessary.

Fig: Circuit Diagram of the System



CHAPTER-6
SYSTEM DESIGN

1. **Data Acquisition Layer (Sensors):**
   - This layer is responsible for sensing the physical environment.
   - The **Flame Sensor** continuously scans for infrared (IR) radiation characteristic of a fire.
   - The **MQ-2 Gas Sensor** continuously monitors the air for the presence of combustible gases.
   - These sensors convert the physical phenomena (light from a flame, presence of gas) into electrical signals that can be read by the microcontroller

2. Data Processing and Communication Layer (ESP32):

- The ESP32 microcontroller is the core of this layer.
- It receives the electrical signals from the sensors via its GPIO pins.
- The firmware programmed onto the ESP32 contains the logic to interpret these signals. It checks if the flame sensor is triggered or if the gas sensor's value has crossed a critical threshold.
- Upon detecting a hazard, it uses its integrated Wi-Fi module to connect to the internet and communicate the alert to the cloud service.

3. User Notification Layer (Blynk Cloud and App):

- This layer is responsible for delivering the alert to the end-user.
- The Blynk Cloud acts as an intermediary, receiving the alert message from the ESP32.
- The cloud service immediately forwards this message as a push notification to the Blynk mobile application installed on the user's smartphone.
- The user receives an instant, clear message on their phone, informing them of the specific danger detected.

CHAPTER-7

Block Diagram & Hardware Components

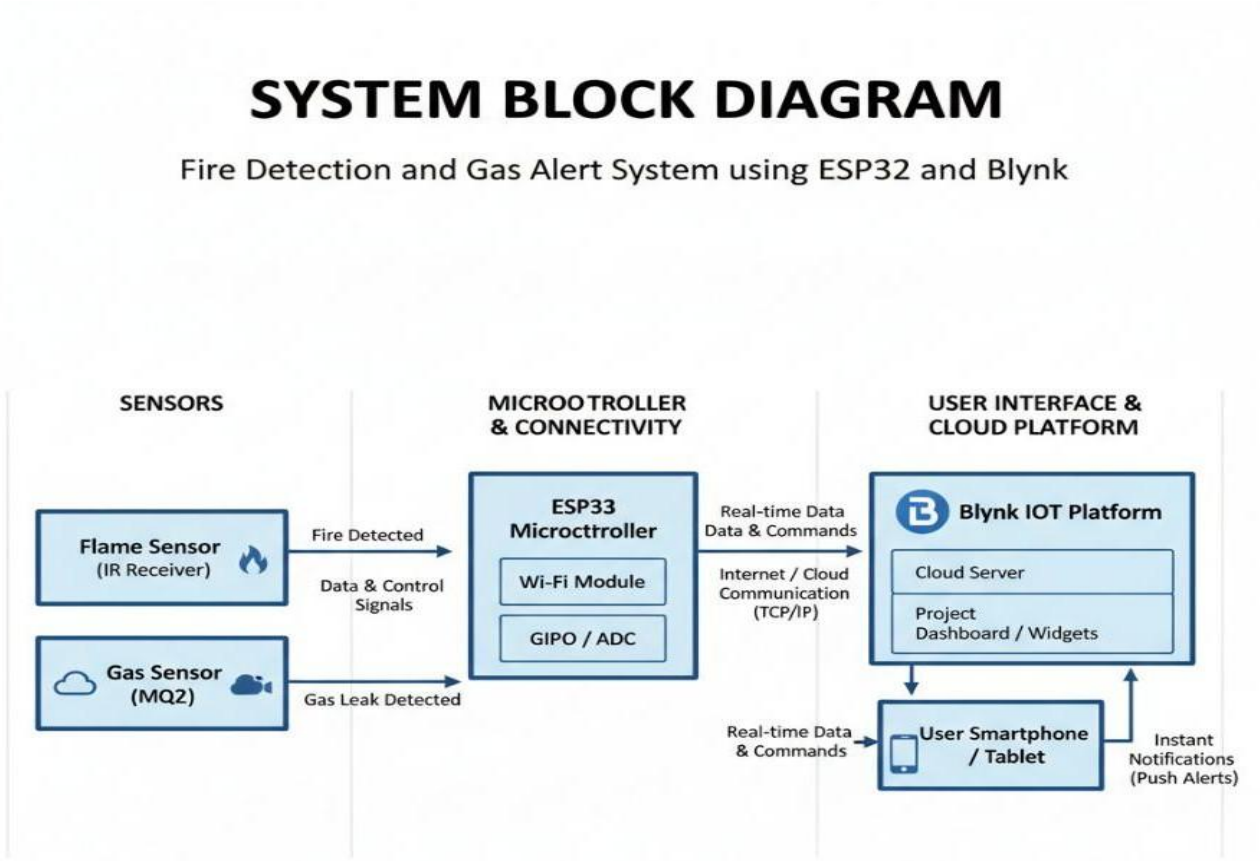


Fig:-Block Diagram

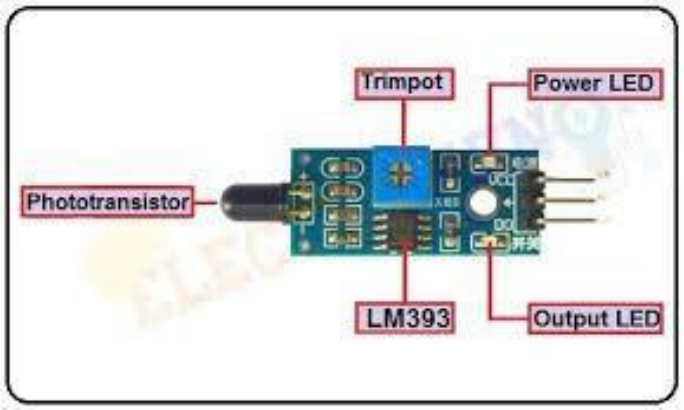
Hardware Components

1. **ESP32 Development Board:** This is the main controller of the project. It's a low-cost, low-power microcontroller with integrated Wi-Fi and Bluetooth. It reads the sensor data, processes it, and sends alerts over the internet.

Fig : ESP32 GPIO Pinout Diagram

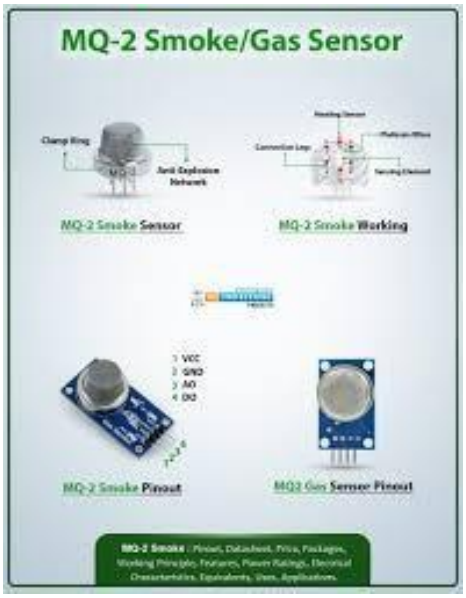
2. **Flame Sensor:** This sensor is used to detect fire. It is sensitive to infrared (IR) radiation emitted by flames. When it detects a flame, it outputs a digital signal to the ESP32.

Fig : Flame Sensor Module

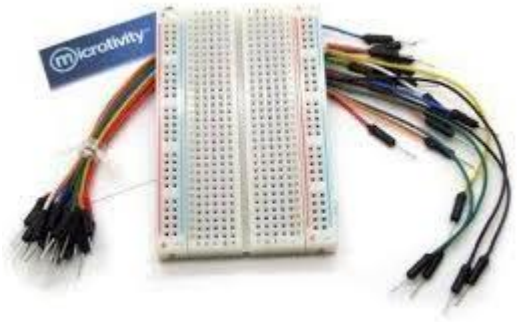


MQ-2 Gas Sensor: This sensor is capable of detecting combustible gases such as LPG, propane, methane, and smoke. It provides an analog output voltage that is proportional to the concentration of the gas in the air.

Fig : MQ-2 Gas Sensor



3. **Breadboard and Jumper Wires:** These are used for creating the prototype circuit without the need for soldering. They allow for easy connection and testing of the ESP32 and sensors.



4. **Power Supply:** A 5V power source, typically supplied via a micro-USB cable, is used to power the ESP32 board and the connected sensors.

CHAPTER-8

SOFTWARE REQUIREMENT

SOFTWARE REQUIREMENT

The software for this project consists of two main components: the firmware that runs on the ESP32 microcontroller and the mobile application for receiving alerts.

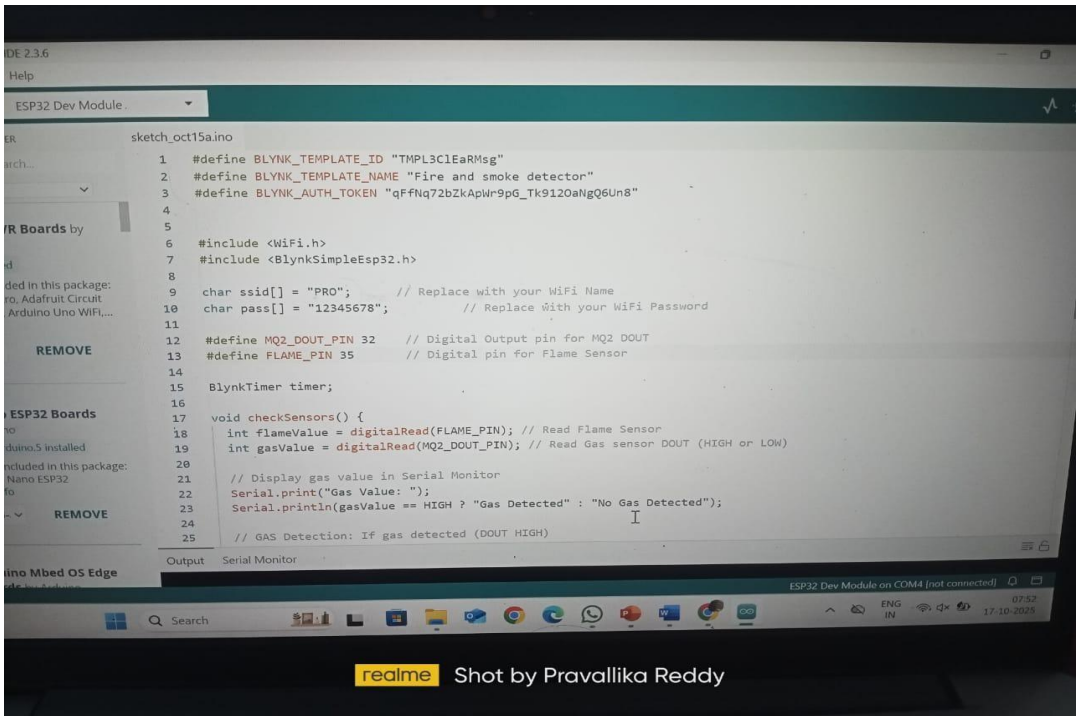
1. **Arduino IDE:** The Arduino Integrated Development Environment (IDE) is a free, open-source software used to write and upload code to microcontrollers like the ESP32.
    - **Programming Language:** The code is written in C.

```
#define BLYNK_TEMPLATE_ID "TMPL3ClEaRMsg"
#define BLYNK_TEMPLATE_NAME "Fire and smoke detector"
#define BLYNK_AUTH_TOKEN "qFfNq72bZkApWr9pG_Tk912OaNgQ6Un8"

#include <WiFi.h>
#include <BlynkSimpleEsp32.h>

char ssid[] = "PRO";      // Replace with your WiFi Name
char pass[] = "12345678";          // Replace with your WiFi Password

#define MQ2_DOUT_PIN 32    // Digital Output pin for MQ2 DOUT
#define FLAME_PIN 35       // Digital pin for Flame Sensor

BlynkTimer timer;

void checkSensors() {
  int flameValue = digitalRead(FLAME_PIN); // Read Flame Sensor
  int gasValue = digitalRead(MQ2_DOUT_PIN); // Read Gas sensor DOUT (HIGH or LOW)

  // Display gas value in Serial Monitor
  Serial.print("Gas Value: ");
  Serial.println(gasValue == HIGH ? "Gas Detected" : "No Gas Detected");

  // GAS Detection: If gas detected (DOUT HIGH)
  if (gasValue == HIGH) {
    Blynk.logEvent("gas_alert", "⚠ Gas Detected!");
  }

  // FIRE Detection: Flame sensor output is LOW when flame is detected
  if (flameValue == LOW) { // LOW = Flame Detected
    Blynk.logEvent("fire_alert", "🔥 Fire Detected!");
  }

  // Debugging (Optional)
```

```
  Serial.print("Flame Sensor: ");
  Serial.println(flameValue == LOW ? "Flame Detected" : "No Flame");
}

void setup() {
  Serial.begin(115200);

  pinMode(MQ2_DOUT_PIN, INPUT);  // Set the DOUT pin of MQ2 sensor as input
  pinMode(FLAME_PIN, INPUT);     // Set the flame sensor pin as input

  // Connect to Blynk
  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);

  // Set the interval for checking sensors (every 2 seconds)
  timer.setInterval(2000L, checkSensors);
}

void loop() {
  Blynk.run();    // Keep Blynk app running
  timer.run();    // Run the timer to check sensors periodically
}

```

- **ESP32 Board Support:** The IDE must be configured with the ESP32 board package, which allows it to compile and upload code specifically for the ESP32 chip.
- **Libraries:** Several libraries are required to interface with the hardware and services:
  - WiFi.h: For connecting the ESP32 to a Wi-Fi network.
  - BlynkSimpleEsp32.h: To handle all communication with the Blynk cloud platform.
  - Libraries for any specific sensor models if needed.
  -

Fig : Arduino IDE Interface



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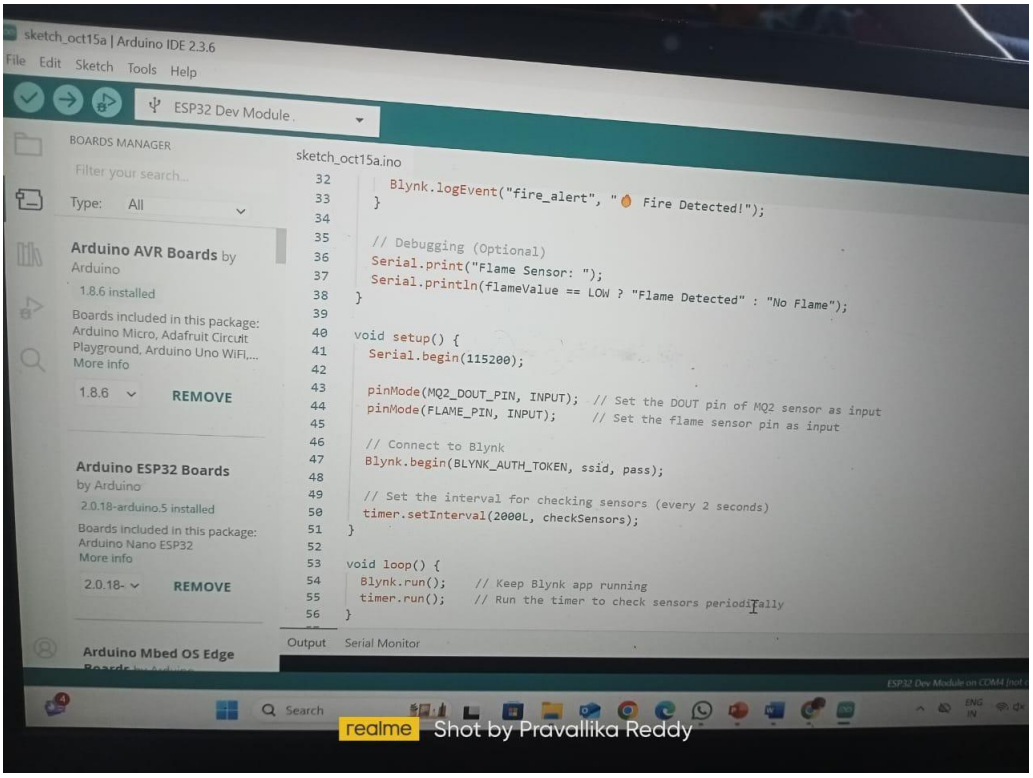
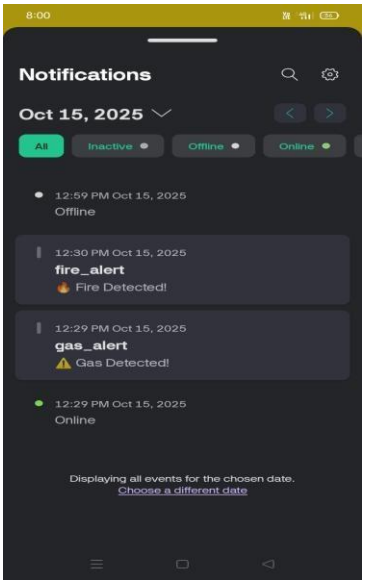


Blynk IoT Platform: Blynk is the cloud platform and mobile application that enables the remote notification feature.

- **Blynk App:** Available for both iOS and Android, this app is used to create a project dashboard and receive push notifications.
- **Project Setup:**
  - A new project is created in the Blynk app.
  - A "Notification" widget is added to the project dashboard.
  - An **Authentication Token** is generated by Blynk. This unique key is added to the Arduino code to link the ESP32 hardware to the specific project in the app.
- **Functionality:** When the ESP32 detects a hazard, it uses a simple Blynk command in the code (e.g., Blynk.logEvent("fire_alert", "Fire Detected!")) to send the alert. The Blynk server then sends this alert as a push notification to the phone.

Fig 5: Blynk IoT Platform Features



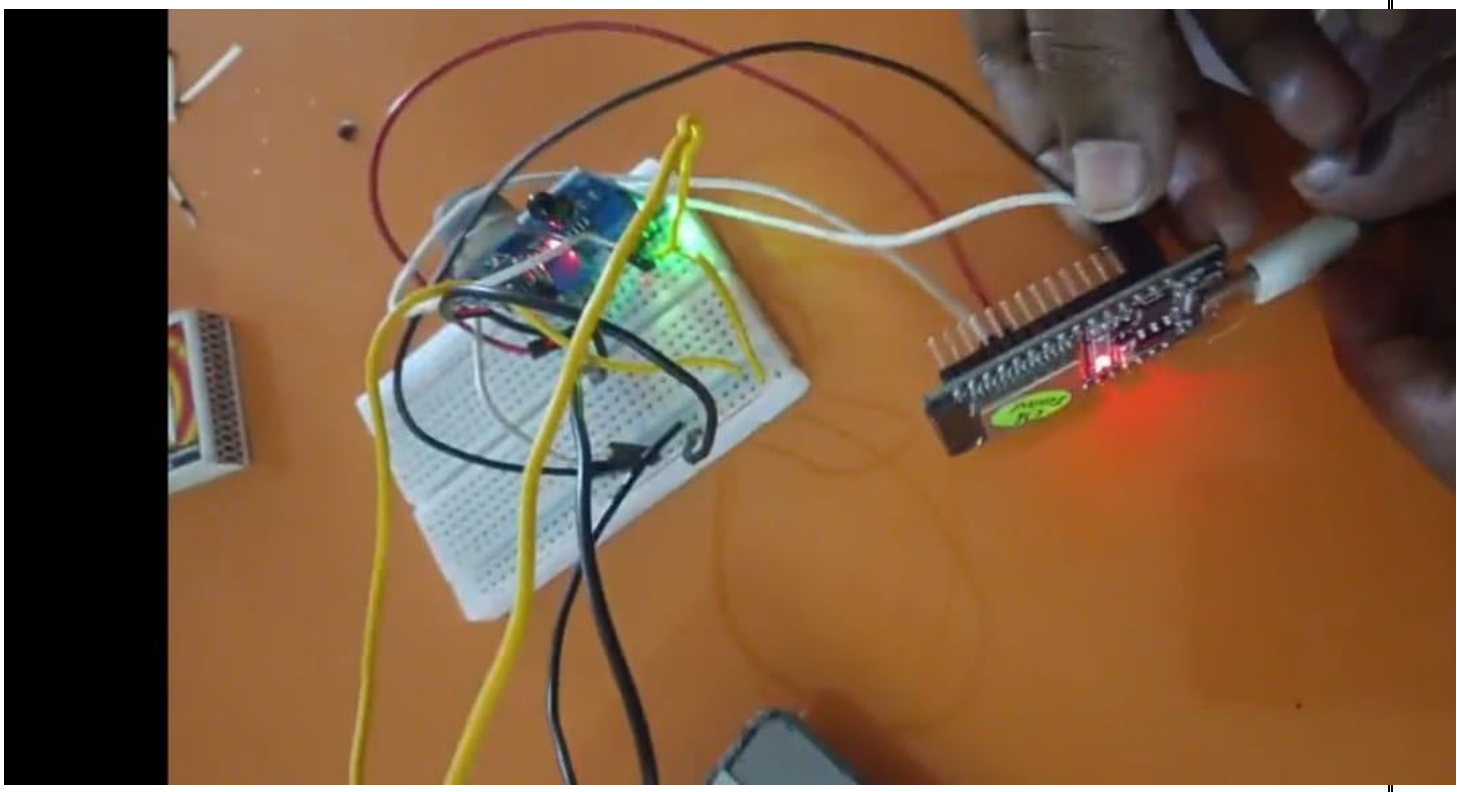


FIG:OUTUT OF FIRE AND SMOKE ALERT SYSTEM USING ESP32 AND BLYNK

CHAPTER-9
CONCLUSION

This project successfully developed and demonstrated an IoT-based Fire Detection and Gas Alert System that offers an effective and modern solution for enhancing safety. By integrating an ESP32 microcontroller with a flame sensor and an MQ-2 gas sensor, the system provides reliable, real-time monitoring of critical environmental hazards. The connection to the Blynk platform allows the system to send instant notifications to a user's smartphone, which is a significant advantage over traditional, localized alarms. This smart safety system is cost-effective, easy to implement, and plays a crucial role in preventing accidents by ensuring rapid awareness and enabling prompt action in response to the dangers of fire and gas leaks.

FUTURE SCOPE

The future scope for this project is extensive, with many potential enhancements that could further improve its functionality and effectiveness.

1. Integration of Actuators: The system could be upgraded to include relays or smart valves that can automatically take action in an emergency, such as shutting off the main gas supply when a leak is detected or activating a water sprinkler system in case of a fire.
2. Adding More Sensors: Additional sensors could be integrated to create a more comprehensive environmental monitoring system. This could include a DHT11/DHT22 sensor for temperature and humidity, and an MQ-7 sensor for carbon monoxide detection.
3. Data Logging and Analysis: The sensor data could be logged to a cloud database over time. This data could then be analyzed to identify patterns or potential long-term risks.
4. Machine Learning for False Alarm Reduction: A machine learning model could be implemented on the device or in the cloud to analyze sensor data and better distinguish between a genuine threat and a false alarm, improving the system's reliability.
5. Multi-User Alerts: The system could be configured to send alerts to multiple users simultaneously, such as all family members or a building's security office.

CHAPTER-10

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