FLAME DETECTION BASED HOME SECURITY

MINI PROJECT REPORT

Submitted By

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BONAFIDE CERTIFICATE

Certified that this Report titled "**FLAME DETECTION BASED HOME SECURITY SYSTEM**" is the bonafide work of **"SHARAN RAM M(2116210701242), SIDDARTH V(2116210701249) "** who carried out the work under my supervision. Certified further that to the best of my knowledge, the work reported herein does not form part of any other thesis or dissertation based on which a degree or award was conferred on an earlier occasion on thisor any other candidate.

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Submitted to Project Viva-Voce Examination held on _____

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ABSTRACT

This IoT project aims to enhance fire safety through the integration of a flame sensor, gas sensor, and NodeMCU microcontroller, combined with an automated water pump for fire suppression. The system is designed to detect fire hazards early and respond promptly to mitigate damage. The flame sensor detects the presence of flames, while the gas sensor continuously monitors the environment for combustible gases, which often precede or accompany fires. Upon detecting a fire or elevated gas levels, the NodeMCU processes the sensor data and triggers an alert system.

The NodeMCU, equipped with Wi-Fi capabilities, can also send notifications to a connected application, ensuring that users are promptly informed of potential fire hazards. In addition to alerting users, the system automatically activates a water pump to extinguish the flames, providing an immediate response to the detected fire. This dual approach of notification and automatic fire suppression significantly reduces the response time, potentially preventing the spread of fire and minimizing damage.

This project demonstrates the effectiveness of integrating multiple sensors with IoT technology to create a responsive and automated fire safety system. By combining real-time monitoring, instant notifications, and automated fire suppression, the system offers a comprehensive solution to fire hazards, enhancing safety in residential, commercial, and industrial settings.

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CHAPTER 1
INTRODUCTION

In In today's world, fire safety is a critical concern across various environments, including residential, commercial, and industrial settings. Traditional fire detection systems often rely on manual intervention and may not provide the swift response necessary to prevent significant damage or loss. To address these limitations, this IoT project introduces an advanced fire safety system that leverages modern sensor technology and automated responses to enhance fire detection and suppression capabilities.

The core components of the system include a flame sensor, a gas sensor, and a NodeMCU microcontroller. The flame sensor is designed to detect the presence of fire by identifying infrared light emitted by flames. Concurrently, the gas sensor monitors the environment for combustible gases, which can serve as early indicators of potential fire hazards. Together, these sensors provide comprehensive monitoring of fire-related threats.

The NodeMCU microcontroller acts as the brain of the system, processing data from both sensors. Equipped with Wi-Fi capabilities, the NodeMCU can send real-time alerts to a connected application, ensuring that users are promptly notified of any detected dangers. Additionally, the system is designed to automatically activate a water pump upon detecting a fire, delivering an immediate suppression response to extinguish flames and prevent the spread of fire.

This integrated approach not only enhances the speed and reliability of fire detection but also ensures an immediate and effective response, significantly improving overall safety and reducing potential damage in various environments.

CHAPTER 2
LITERATURE SURVEY

A literature survey of IoT-based fire detection and suppression systems reveals a significant body of research focused on improving safety through advanced sensor integration and automation. Traditional fire detection systems, such as smoke detectors and manual fire alarms, often suffer from delayed responses and require human intervention, limiting their effectiveness in rapidly evolving fire scenarios.

Recent studies have explored the use of flame sensors for their ability to detect infrared radiation emitted by flames, providing a direct and immediate indication of fire presence. For instance, research by Huang et al. (2018) demonstrated that flame sensors could reliably detect fire in various environmental conditions, making them suitable for diverse applications.

Gas sensors, on the other hand, have been extensively studied for their role in detecting combustible gases like methane and propane. These sensors offer early warning capabilities by identifying gas leaks that could potentially lead to fires. Studies by Kumar et al. (2019) highlighted the effectiveness of gas sensors in industrial safety systems, where early gas detection is crucial for preventing hazardous incidents.

NodeMCU, a popular IoT platform, has been widely adopted due to its low cost, ease of programming, and built-in Wi-Fi capabilities. Research by Singh and Sharma (2020) showcased the use of NodeMCU in various IoT applications, emphasizing its potential for real-time data processing and remote monitoring.

Additionally, automated fire suppression systems have gained attention for their ability to provide immediate response to fire detection. Combining these technologies, this project aims to develop an IoT-based fire safety system that integrates flame and gas sensors with NodeMCU for real-time monitoring and automated fire suppression using a water pump. This comprehensive approach is expected to enhance fire safety by providing rapid detection, notification, and suppression, thereby mitigating damage and improving overall safety outcomes.

2.1 EXISTING SYSTEM

This IoT project aims to enhance fire safety by integrating a flame sensor, gas sensor, and NodeMCU microcontroller to detect flames and combustible gases, providing an efficient early warning system. The flame sensor is designed to detect infrared light emitted by flames, offering immediate detection of fire. Simultaneously, the gas sensor monitors the environment for the presence of combustible gases, such as methane and propane, which can be early indicators of potential fire hazards.

The NodeMCU microcontroller serves as the central processing unit of the system. It collects data from both the flame sensor and the gas sensor, analyzing the information in real time. The NodeMCU's built-in Wi-Fi capability allows it to connect to a network and communicate with external applications, such as the Blynk app, for real-time monitoring and notifications.

When the flame sensor detects a fire or the gas sensor identifies high levels of combustible gases, the NodeMCU processes these signals and triggers an alert system. Notifications are sent instantly to users through the Blynk app on their smartphones or other connected devices, ensuring prompt awareness of the potential danger.

This integrated system offers significant advantages over traditional fire detection methods by providing early detection and real-time alerts, thereby improving the response time and potentially reducing the damage caused by fires. The use of IoT technology ensures that users are continuously informed about their environment's safety, enhancing overall protection in residential, commercial, and industrial settings.

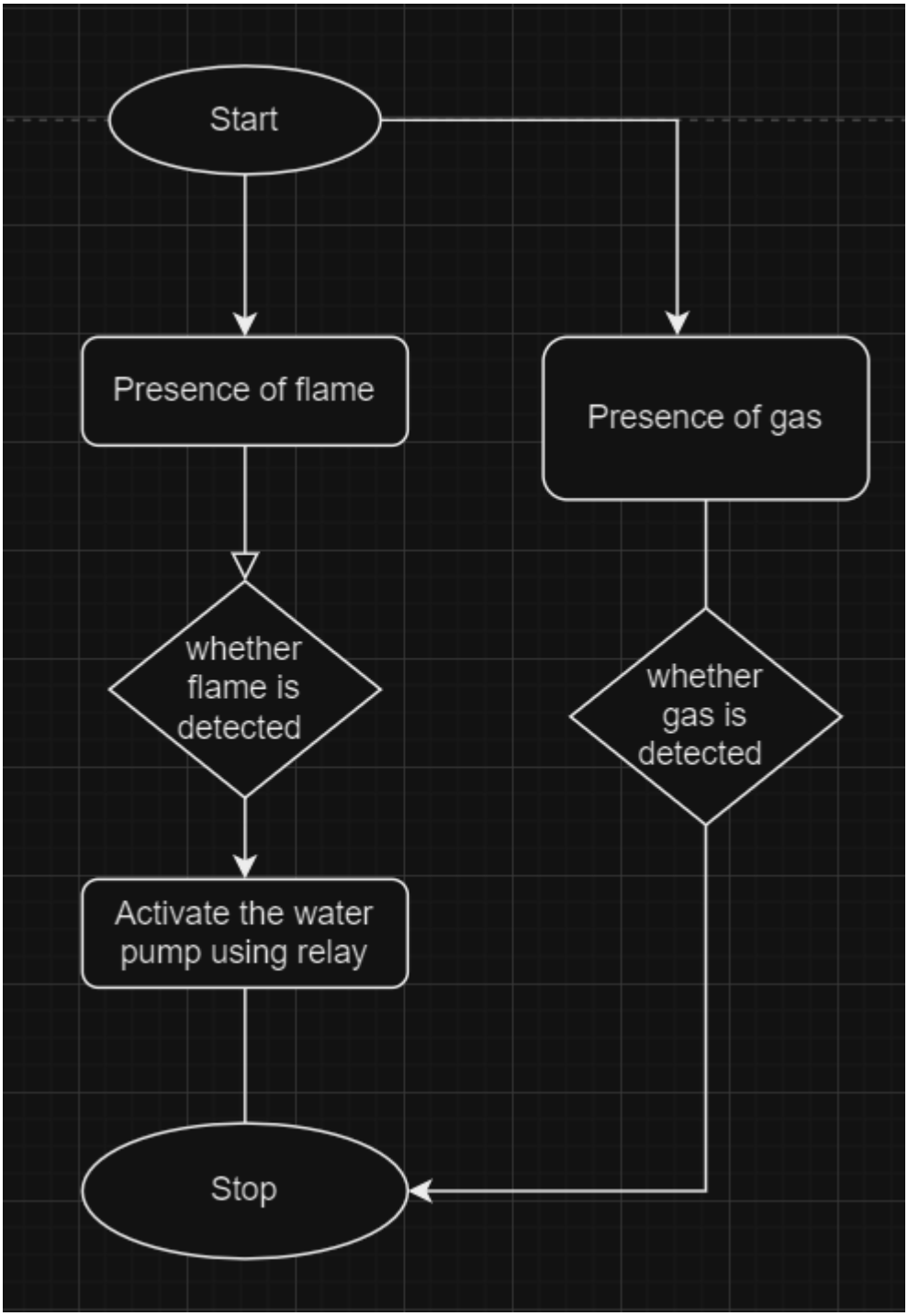
Here is one of the key drawback:

1. No Automated Fire Suppression:

- **Limitation**: This system does not incorporate an automated water pump to extinguish detected fires.
- **Impact**: Users are notified of the fire but must manually intervene to suppress it, which may lead to delayed responses and increased fire damage.

CHAPTER 3

PROJECT DESCRIPTION



The Flame detection based home security project comprises several distinct modules aimed at enhancing fire safety through early detection, human presence recognition, and automated fire suppression. The first module incorporates a flame sensor, specifically designed to detect the presence of flames within its range. Once a flame is detected, the sensor sends a signal to the NodeMCU microcontroller, which serves as the project's central processing unit.

The second module integrates a gas sensor, continuously monitoring air quality for the presence of combustible gases, which are often indicative of potential fire hazards. This sensor adds an additional layer of early warning, allowing for preemptive action before fires escalate.

The third module incorporates a Passive Infrared (PIR) motion sensor, tasked with detecting human presence near the identified fire hazard. This feature ensures that potential threats to human safety are promptly recognized and addressed.

Upon detection of a fire or human presence, the NodeMCU processes the data from all sensors and communicates with the Blynk app, facilitating real-time notifications to users on their smartphones or other connected devices.

The final module involves the activation of an automated water pump upon detection of a fire. This mechanism ensures swift fire suppression, minimizing damage and reducing the risk of further escalation. Together, these modules form a comprehensive fire safety system, leveraging IoT technology to provide early detection, human presence recognition, real-time notifications, and automated fire suppression, thus significantly enhancing safety in various environments.

PROPOSED SYSTEM

This project proposes a Flame detection based home security designed to revolutionize the driving experience by offering an intuitive and user-friendly interface. The system will consist of the following modules :

1. **Flame Detection Module:** The flame detection module incorporates a specialized flame sensor designed to detect the presence of flames within its detection range. When flames are detected, the sensor triggers a signal to the NodeMCU microcontroller, initiating further actions within the system.

2. **Gas Detection Module:** The gas detection module integrates a gas sensor that continuously monitors the surrounding air for the presence of combustible gases, such as propane or methane. Detecting elevated levels of these gases serves as an early warning sign of potential fire hazards, enhancing the system's overall effectiveness in fire detection.

3. **Fire Suppression Module:** The fire suppression module involves the activation of an automated water pump upon detection of flames. This mechanism ensures rapid fire suppression, mitigating damage and reducing the risk of fire escalation. The water pump activation is coordinated with the flame detection module, allowing for immediate intervention in fire-related incidents.

Some of the advantages of the system are :

1. **Early Detection and Warning:**
    - **Flame Sensor:** Provides immediate detection of visible flames, ensuring prompt response to fire incidents.
    - **Gas Sensor:** Detects combustible gases, offering an early warning system that can alert users to potential fire hazards even before a fire ignites.

2. **Automated Fire Suppression:**
    - **Water Pump Activation:** Automatically triggers a water pump to extinguish flames upon detection, significantly reducing response time and preventing fire spread without the need for human intervention**.**

REQUIREMENTS

- **Hardware:**
  - NodeMCU , Flame sensor, Gas sensor .
  - Additionally we have used water pump , relay.
- **Software:**
  - Arduino IDE..
- **Human-Computer Interaction (HCI):**
  - The output will be produced in the serial monitor.
- **Testing and Evaluation:**
  - User testing to assess usability, learning curve, and user experience.
  - Rigorous safety evaluations in controlled environments.

ARCHITECTURE DIAGRAM

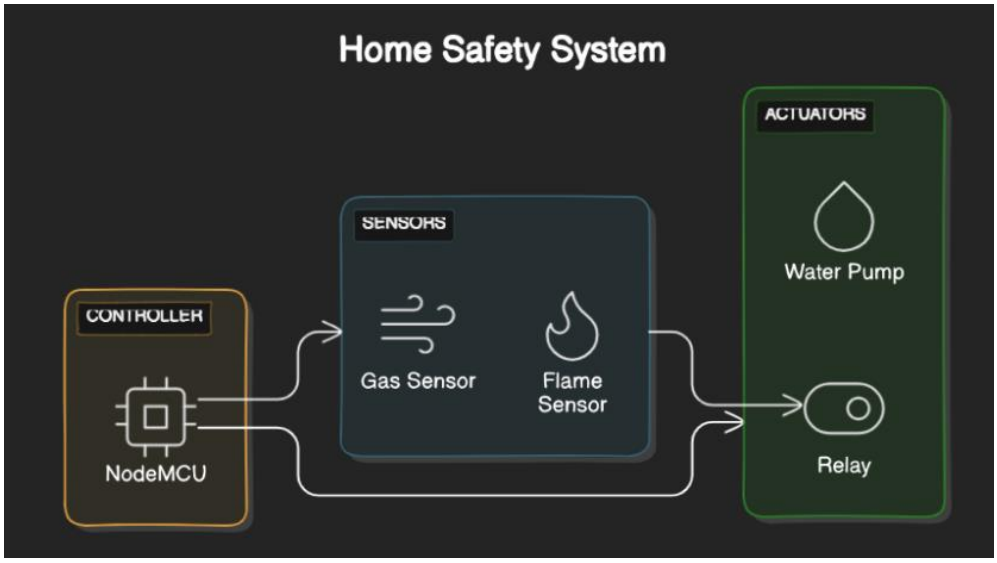


Figure 2

- **Sensors**: The system uses two sensors:
- **Gas sensor:** This sensor detects the presence of gas, which could be a sign of a fire.
- **Flame sensor:** This sensor detects the presence of a flame.
- **Node MCU**: This is the microcontroller unit (MCU) that controls the system. It receives signals from the sensors and sends a signal to the relay if a fire is detected.
- **Relay**: The relay is a switch that is controlled by the Node MCU. When the Node MCU detects a fire, it sends a signal to the relay, which turns on the water pump.
- **Water Pump**: The water pump pumps water to extinguish the fire.

OUTPUT

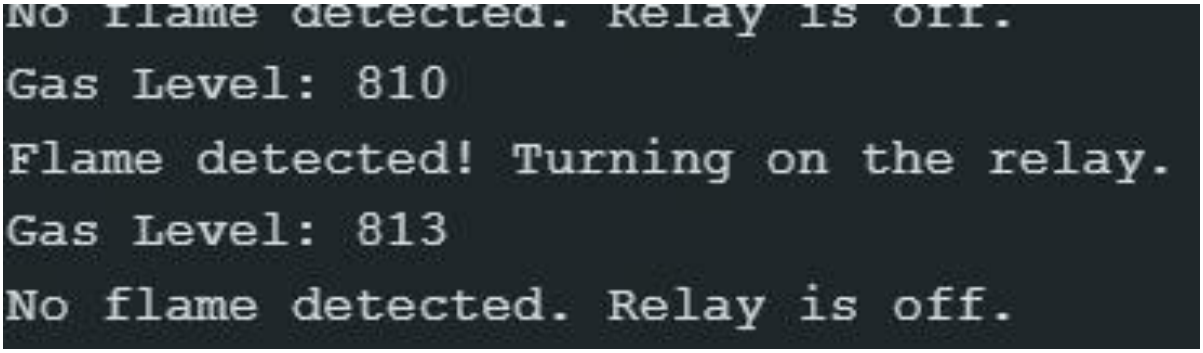


Figure 3

Figure 4 shows the output produced in the serial monitor when the flame and gas is detected and sets on the relay to activate the water pump.

CONNECTIONS:

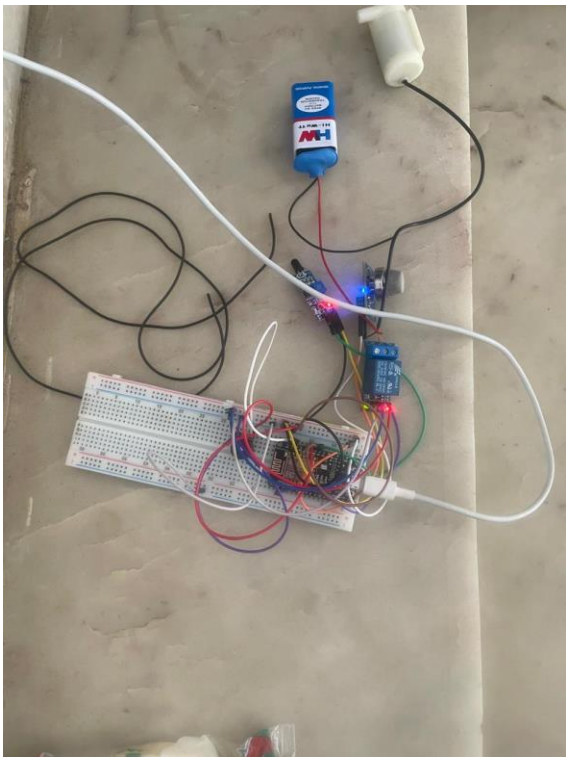


Figure 4

Figure 4 shows the connections made to the node mcu to interface with the sensors and the motor. The connections are provided as specified in the architecture.

CHAPTER 4
CONCLUSION AND FUTURE WORK

The IoT project integrating a flame sensor, gas sensor, and NodeMCU microcontroller, coupled with an automated water pump, presents a robust and efficient solution for enhancing fire safety. By combining real-time flame and gas detection with immediate fire suppression capabilities, the system provides comprehensive protection for various environments, including residential, commercial, and industrial settings. The use of the NodeMCU's Wi-Fi capability for real-time notifications through the Blynk app ensures that users are promptly alerted to potential hazards, allowing for swift and informed responses. This integration not only minimizes the risk of fire damage but also enhances overall safety by providing a reliable, automated response to fire incidents.

Future enhancements to this project could focus on several key areas. Firstly, integrating additional sensors, such as smoke and temperature sensors, would provide even more comprehensive monitoring and early warning capabilities. Secondly, implementing machine learning algorithms could enable predictive analytics, helping to identify fire risks based on historical data and sensor patterns. Expanding the system's communication capabilities to interface with other smart home devices and emergency services could streamline responses and improve coordination during emergencies. Moreover, incorporating battery backups and ensuring network reliability would maintain system functionality during power outages or connectivity issues. Finally, enhancing the Blynk app to offer detailed analytics, customizable alerts, and historical data tracking would give users greater control and insight into their fire safety systems, further improving the system's effectiveness and user experience.

APPENDIX I

```
 #include <ESP8266WiFi.h>

#define FLAME_SENSOR_PIN D5  // Digital pin D1 (GPIO 5)
#define RELAY_PIN D2         // Digital pin D2 (GPIO 4)
#define GAS_SENSOR_PIN A0    // Analog pin A0

void setup() {
  // Initialize serial communication for debugging
  Serial.begin(9600);

  // Set pin modes
  pinMode(FLAME_SENSOR_PIN, INPUT);
  pinMode(RELAY_PIN, OUTPUT);

  // Turn off the relay initially
  digitalWrite(RELAY_PIN, LOW);
}

void loop() {
  // Read the flame sensor state (digital)
  int flameState = digitalRead(FLAME_SENSOR_PIN);

  // Read the gas sensor level (analog)
  int gasLevel = analogRead(GAS_SENSOR_PIN);

  // Print gas level to serial monitor
  Serial.print("Gas Level: ");
  Serial.println(gasLevel);

  // If flame is detected
  if (flameState == LOW) {  // Assuming LOW means flame detected
    Serial.println("Flame detected! Turning on the relay.");
```

```
    digitalWrite(RELAY_PIN, HIGH); // Turn on the relay
    Serial.println("meow");
  } else {
    Serial.println("No flame detected. Relay is off.");
    digitalWrite(RELAY_PIN, LOW); // Turn off the relay
  }

  // Small delay to avoid spamming the serial monitor
  delay(1000);
}
```

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