

Lpg Gas Leakage and Fire Detection System

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Abstract—liquefied petroleum gas, or LPG, is frequently used for heating and cooking in homes and businesses. However, LPG gas leaks might result in hazardous circumstances like explosions and fire incidents. To avoid such risks, an effective gas leak detection and safety system is required. An LPG gas leak detection system utilising a gas sensor and fire detector with automated safety control is presented in this research. The system detects the presence of LPG gas in the surrounding environment using a MQ-2 gas sensor. To find flames or fire, a fire sensor is also utilised. An ESP32 microcontroller, which is connected to both sensors, keeps an eye on the sensor data all the time. The microprocessor instantly triggers an alarm system when the gas concentration beyond a safe threshold or when a fire is detected. To warn anyone in the vicinity of the risk, a buzzer is utilised. In order to clear the region of any leaking gas, a relay module simultaneously activates an exhaust fan. The LPG gas valve is also automatically closed by a servo motor to prevent additional gas leaks. By taking these precautions, the danger of fire and explosion is decreased. By taking these precautions, the danger of fire and explosion is decreased. The suggested system offers a low-cost, dependable, and automated way to identify fire risks and LPG gas leaks. By offering early warning and automated preventive measures, it enhances safety in homes, kitchens, labs, and industrial settings.

Index Terms—ESP32, MQ-3 gas sensor, servo motor, gas regulator control, 16x2 LCD display, exhaust fan, relay module, power supply, converter, adapter, LPG gas leak detection

like explosions and fires. Undetected gas leaks from defective cylinders or pipe connections are a common cause of accidents. An LPG Gas Leakage and Fire Detection System is created to address this issue. This system detects gas leaks using a MQ-3 gas sensor and fires using a flame sensor. After processing the signals, the ESP32 microcontroller turns on safety features such as an exhaust fan, buzzer alarm, and automatic gas servo motor-based regulator control. Additionally, the system uses a 16x2 LCD display to provide system status and a relay module to control devices. It is an easy, affordable, and dependable way to increase safety and reduce accidents. This technology responds quickly in an emergency and operates autonomously without human interaction. It is simple to install in hotels, factories, and kitchens. Accurate detection of fire dangers and gas leaks is ensured by the use of sensors. The exhaust fan aids in lowering environmental gas concentrations. The servo motor is crucial for quickly cutting off the gas supply.

As a result, the LPG Gas Leakage and Fire Detection System offers a practical way to identify and stop gas-related mishaps early on. By lowering reliance on humans, it increases safety and guarantees prompt action in emergency situations.

this solution can be included into IoT-based safety monitoring and smart home automation with future developments.

I. INTRODUCTION

Cooking and heating are two common uses for Liquefied Petroleum Gas (LPG) in households and businesses. But because LPG is extremely combustible, leaks can result in catastrophic events

II. METHODOLOGY

LPG gas leakage detection Module:

To find out whether LPG gas is present in the surroundings, utilise the LPG gas leak detection module. It measures the amount of gas in the air using a

MQ-3 gas sensor. The sensor alerts the ESP32 microcontroller when there is a gas leak. After that, the system initiates safety features like regulator control, exhaust fan, and buzzer alarm.



Fig 1: MQ-3 Gas Sensor

Working of MQ-3 Sensor:

- The MQ-3 sensor detects LPG gas by change in resistance. It gives an analog output to the ESP32. The microcontroller compares it with a threshold value. If gas is detected, it activates alarm, fan, and closes the regulator.
- The MQ-3 sensor continuously senses the surrounding air.
- When LPG gas is present, the sensor's resistance changes.
- This change produces an analog voltage output.
- The output signal is sent to the ESP32 microcontroller.

The microcontroller compares the value with a preset threshold.

If gas level is high, the system activates buzzer, fan, and closes regulator.

ESP32 Processing Unit:

The The ESP32 microcontroller acts as the main control unit of the system. It receives signals from the gas sensor and flame sensor and processes them according to the programmed instructions. The ESP32 performs the following tasks:.

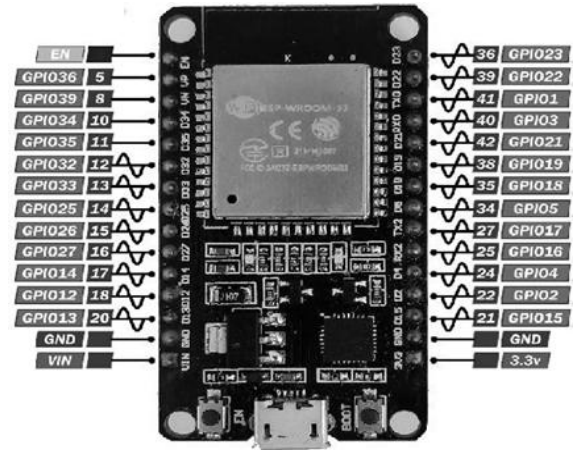


Fig 2: ESP32 Microcontroller

- Reads analog data from the MQ-3 gas sensor
- Detects fire signals from the flame sensor
- ompares sensor values with threshold limits
- Controls the relay module to turn ON/OFF the exhaust fan
- Therefore, the ESP32 microcontroller plays a very important role in the LPG Gas Leakage and Fire Detection System, as it controls the entire system operation.

Gas Regulator and Exhaust Fan Control System:

The gas regulator and exhaust fan control system is an important safety feature of the LPG Gas Leakage and Fire Detection System. This system helps to prevent accidents by automatically stopping the gas supply and reducing gas concentration when leakage is detected.

Working of Gas Regulator and Exhaust Fan:

- The ESP32 receives signals from the MQ-3 gas sensor.
- If gas leakage is detected, the ESP32 sends a signal to the servo motor
- The servo motor rotates and closes the gas regulator automatically.
- At the same time, the ESP32 activates the relay module
- The relay turns ON the exhaust fan to remove leaked gas
- A buzzer alarm is also activated to alert users.

Alert and Display System:

The alert system provides warnings when gas leakage or fire is detected. It consists of a buzzer alarm, LCD

display, and mobile notification through the Blynk app.



Fig 3: Buzzer

Alarm System: The buzzer produces a loud sound when gas leakage or fire is detected. This serves two purposes:

- Alerts the user about dangerous conditions
- Warns nearby people about gas leakage or fire

Examples of display messages include:

“System Safe”

“Gas Leakage Detected”

“Fire Detected”

“Fan ON – Regulator OFF”

This improves user awareness and provides clear information about the system operation.

Communication & Monitoring Module:

To enhance the monitoring capability of the LPG Gas Leakage and Fire Detection System, the system uses Wi-Fi communication and a mobile monitoring platform. In this project, the ESP32 connects to the internet and sends real-time data to the Blynk application installed on the user’s smartphone. The communication module allows the user to monitor the system remotely from any location. The sensor readings, system status, and emergency alerts are transmitted through Wi-Fi, which makes the system suitable for IoT-based safety monitoring applications. This feature helps users take immediate action when gas leakage or fire is detected.

Blynk App (Mobile Notification):

The Blynk mobile application acts as the user interface for monitoring the system. The ESP32 sends sensor data and alert signals to the Blynk cloud server, and the application displays this information on the user’s smartphone.

- The ESP32 connects to a Wi-Fi network or mobile

hotspot. Sensor data from the MQ-3 gas sensor is transmitted to the Blynk cloud server.

- The Blynk app displays real-time system information such as gas level and system status.
- When LPG gas leakage is detected, the system immediately sends a push notification to the user's mobile phone. If fire is detected, an emergency alert message is also sent through the app. The user can remotely monitor the system status and safety condition from anywhere.

- The app dashboard can show messages such as “Gas Detected”, “Fire Alert”, “Fan ON”, or “System Safe.”

When Gas Leakage is Detected:

- The MQ-3 gas sensor detects LPG gas concentration in the air. The sensor sends the signal to the ESP32 microcontroller.
- The microcontroller compares the sensor value with the predefined threshold. If gas leakage is detected the buzzer alarm is activated.
- The relay module turns ON the exhaust fan. The servo motor closes the gas regulator.
- A notification is sent to the mobile phone through the Blynk app. Warning message is displayed on the LCD display.

Power Supply Module:

All electronic components in the LPG Gas Leakage and Fire Detection System require a stable power supply for proper operation. The power supply unit provides regulated DC voltage to the system. It supplies the required power to components such as the ESP32, MQ-3 gas sensor, relay module, servo motor, LCD display, and buzzer. In this project, a DC adapter or converter is used to provide the necessary voltage for the system. The power supply system consists of the following components.

- Adapter / Converter
- Voltage regulator
- Filter capacitor

Working of Power Supply:

- The adapter converts AC mains power into low-voltage DC power.
- The filter capacitor helps to remove voltage fluctuations and noise.
- The voltage regulator provides a constant and stable DC output.
- This regulated voltage is supplied to the ESP32 and

other electronic components of the system for proper operation.

Overall System Operation:

The overall operation of the LPG Gas Leakage and Fire Detection System can be summarized as follows:

- The system is powered ON using an adapter power supply.
 - The MQ-3 gas sensor continuously monitors the surrounding air for LPG gas.
 - The sensor sends the signal to the ESP32 microcontroller.
 - The microcontroller compares the sensor value with the predefined threshold level.
 - If gas leakage is not detected:
 - The system remains in normal condition.
 - The LCD display shows the message "System Safe".
 - If gas leakage is detected:
 - The buzzer alarm is activated.
 - The relay module turns ON the exhaust fan.
 - The servo motor closes the gas regulator automatically.
 - A warning message is displayed on the LCD display.
 - A notification alert is sent to the mobile phone through the Blynk app.
- This automated process helps in detecting gas leakage quickly, preventing fire accidents, and improving safety in homes and industries.

Advantages of the Proposed Methodology:

The proposed methodology offers several advantages:

- Automatic detection of LPG gas leakage without human intervention.
- Provides instant alert through buzzer alarm and LCD display.
- Sends notification to the mobile phone through the Blynk app.
- Automatically closes the gas regulator using a servo motor when leakage is detected. Improves safety in homes and industries by preventing fire accidents.

Summary of Methodology:

The methodology of the LPG Gas Leakage and Fire Detection System involves integrating gas sensor technology, ESP32 programming, and communication modules to create a smart safety monitoring system. The system continuously monitors the surrounding environment to detect LPG gas leakage and fire hazards.

By combining gas detection, automatic gas regulator

control using a servo motor, alarm systems, and mobile communication through the Blynk app, the proposed approach provides an effective solution for preventing gas leakage accidents. This system improves safety by providing early warning alerts and enabling quick response to dangerous situations in homes and industries.

Detailed working of each component ESP32:-



Fig 4: ESP32 Microcontroller

The ESP32 microcontroller is used as the main control unit in the LPG Gas Leakage and Fire Detection System. It is a low-cost and low-power microcontroller developed by Espressif Systems and is widely used in embedded systems, Internet of Things (IoT), automation, and smart monitoring applications. The ESP32 has built-in Wi-Fi and Bluetooth capabilities, which make it suitable for real-time monitoring and communication-based applications. In this project, the ESP32 acts as the brain of the system and controls all operations such as reading sensor data, processing the information, activating alert systems, and controlling safety mechanisms like the gas regulator and exhaust fan. In the LPG Gas Leakage Detection System, the ESP32 reads the analog output from the MQ-3 gas sensor and converts it into digital values using its built-in Analog to Digital Converter (ADC). The microcontroller then compares the sensor value with a predefined threshold value stored in the program. If the gas level detected is below the threshold value, the system remains in normal condition and the LCD display shows a safe status message. If the gas level exceeds the threshold value, the ESP32 activates several safety actions. The microcontroller triggers a buzzer alarm to warn the user about gas leakage. It also sends a signal to the

relay module to turn ON the exhaust fan, which helps remove leaked gas from the environment. At the same time, the ESP32 controls a servo motor that automatically closes the gas regulator to stop further gas leakage. The system also sends a notification to the user's mobile phone through the Blynk application using Wi-Fi connectivity.

The ESP32 operates at 3.3V and has multiple GPIO pins and communication protocols such as UART, SPI, and I2C, which makes it easy to interface with sensors, LCD displays, relay modules, and servo motors. Due to its built-in wireless communication features, low power consumption, and high processing capability, the ESP32 is highly suitable for IoT-based safety monitoring systems.

Therefore, the ESP32 microcontroller plays a very important role in the LPG Gas Leakage and Fire Detection System, as it controls the entire system operation, processes sensor data, activates safety mechanisms, sends alert notifications, and ensures real-time monitoring for improved safety.

MQ-3 Gas Sensor: -



Fig 5: MQ-3 Gas sensor

The MQ-3 Gas Sensor is used in the LPG Gas Leakage and Fire Detection System to detect the presence of LPG gas in the surrounding environment. The MQ-3 sensor is a gas sensor designed to detect alcohol and other combustible gases and is commonly used in gas detection and safety monitoring systems. The sensor works on the principle of change in resistance of a sensing material when exposed to gas. When LPG gas comes in contact with the sensor, the resistance of the sensing element changes, which results in a change in output voltage. This output voltage is then sent to the ESP32 microcontroller for further processing.

In this project, the MQ-3 gas sensor is connected to the

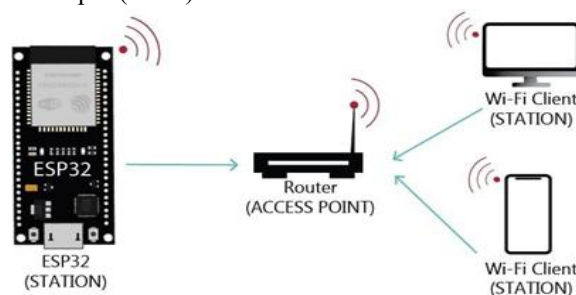
ESP32 microcontroller. The sensor continuously monitors the surrounding air for LPG gas leakage. It provides an analog output signal that is read by the Analog to Digital Converter (ADC) of the ESP32. The microcontroller compares this sensor value with a predefined threshold level stored in the program. If the gas concentration is below the threshold value, the system remains in normal condition and displays a safe status message.

if the gas concentration exceeds the threshold value, the system activates safety mechanisms. The ESP32 triggers a buzzer alarm to alert the user about gas leakage. At the same time, the relay module turns ON the exhaust fan to remove leaked gas from the environment, and a servo motor automatically closes the gas regulator to stop the gas supply. The system also sends a warning notification to the user's smartphone through the Blynk application.

The MQ-3 sensor requires a small heating element to operate properly, so it takes a few seconds to warm up before providing accurate readings. The sensor operates typically at 5V supply and can detect gas concentration within a specific range in the surrounding air. Due to its high sensitivity, simple interfacing, low cost, and reliable performance, the MQ-3 gas sensor is suitable for LPG gas leakage detection systems.

Therefore, the MQ-3 gas sensor plays an important role in the LPG Gas Leakage and Fire Detection System by continuously monitoring the environment, detecting gas leakage, and sending signals to the ESP32 microcontroller so that necessary safety actions can be taken to prevent accidents.

Hotspot (WIFI):-Connects ESP32 to Internet: -



In the LPG Gas Leakage and Fire Detection System, Wi-Fi hotspot connectivity is used to connect the ESP32 to the internet for monitoring and sending alert notifications. The ESP32 has built-in Wi-Fi capability, which allows it to connect to a mobile hotspot or wireless network without using an external Wi-Fi

module. In this project, a mobile hotspot or Wi-Fi router provides internet connectivity to the ESP32 so that the system can send gas leakage alerts and system status to the user. When the system is powered ON, the ESP32 connects to the available Wi-Fi network using the programmed SSID and password. Once connected to the internet, the ESP32 can transmit sensor data and alert messages through the Blynk application. If LPG gas leakage or fire is detected, the system immediately sends a notification to the user's smartphone. This allows the user to monitor the system remotely and take quick action.

The use of Wi-Fi connectivity makes the system more advanced and suitable for Internet of Things (IoT) applications. It enables real-time monitoring, remote alerts, and improved safety. Therefore, Wi-Fi hotspot connectivity plays an important role in enabling communication between the ESP32 microcontroller and the mobile monitoring application in the LPG Gas Leakage and Fire Detection System.

Blynk Monitoring Module:

The Blynk monitoring module is used to provide real-time alerts, system status, and remote control on the user's smartphone. In this project, the Blynk mobile application is interfaced with the ESP32 microcontroller through Wi-Fi connectivity, making the system IoT-enabled.

The ESP32 continuously reads data from sensors such as the MQ gas sensor and flame sensor. Whenever gas leakage or fire is detected, the ESP32 sends this data to the Blynk cloud server using an internet connection. The Blynk app then receives this data and displays important information such as gas level status, fire detection status, and alert messages on the user's mobile screen.

The application provides instant push notifications like "Gas Leakage Detected" or "Fire Alert," allowing the user to take immediate action. It also supports real-time monitoring by updating sensor values continuously on the app dashboard using widgets such as value display, LEDs, and notification panels.

In addition to monitoring, the Blynk module can also be used for remote control. The user can manually control devices like the exhaust fan or reset the system using buttons in the mobile app. This adds flexibility and improves system usability.

The data transmission is done over Wi-Fi, ensuring

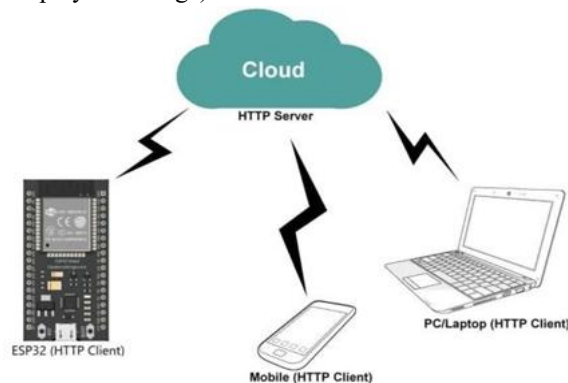
fast and reliable communication between the ESP32 and the mobile application. The system works even when the user is far away, as long as internet connectivity is available. The Blynk platform also stores recent data and system status, which helps in analyzing past events such as gas leakage occurrences or fire alerts. This feature enhances safety, supports preventive measures, and improves overall system reliability.

Converter:-



Fig 6: Converter

The converter is used in the LPG Gas Leakage and Fire Detection System to provide a stable and regulated power supply to all electronic components. A converter is an electronic device that converts electrical energy from one form to another, such as converting high voltage to low voltage or AC to DC. In this project, the converter ensures that components like the ESP32, sensors, relay module, and other devices receive the required voltage for proper operation. In this system, a DC-DC converter or voltage regulator module is used to step down the input voltage (such as 12V or battery supply) to a lower voltage like 5V or 3.3V. The ESP32 operates at 3.3V, while other components like the relay module and sensors may require 5V. Cloud Server (Data Display & Storage)



The Cloud Server is used in the LPG Gas Leakage and Fire Detection System for storing, displaying, and monitoring system data over the internet. The cloud server allows the system to store important data such as gas leakage status, fire detection status, sensor readings, alert messages, and overall system status in an online database. This data can be accessed from anywhere using a mobile phone, laptop, or computer through an internet connection.

The data sent to the cloud may include gas sensor readings (MQ-3), temperature/fire detection status, system status (ON/OFF), and alert notifications. The cloud server receives this data, stores it in a database, and displays it on a dashboard or mobile application such as Blynk. This helps the user to monitor the system remotely in real time. When gas leakage or fire is detected, the cloud server sends instant alerts to the user's mobile phone.

The cloud server also helps in maintaining records of gas leakage events and fire alerts for future reference and analysis. This feature is useful for safety monitoring, accident prevention, and smart home applications. By using cloud technology, the system becomes an Internet of Things (IoT) based smart monitoring system where data can be accessed and monitored from anywhere in the world.

Therefore, the cloud server plays an important role in improving safety, remote monitoring, and quick response in the LPG Gas Leakage and Fire Detection System.

BUZZER:



Fig 7: Buzzer

The buzzer is used in the LPG Gas Leakage and Fire Detection System as an alert or warning device. A buzzer is an electronic audio signaling device that produces sound when electrical power is applied to it. In this project, the buzzer is used to alert the user when gas leakage or fire is detected by the MQ-2 gas sensor

or flame sensor. The buzzer provides an immediate audio indication that the system has detected a dangerous condition. In this system, the buzzer is connected to the ESP32 microcontroller. When the MQ-2 sensor detects gas above the threshold level or when the flame sensor detects fire, the ESP32 sends a signal to the buzzer through a digital output pin. This activates the buzzer and produces a loud warning sound to alert nearby people.

The buzzer operates at low voltage, consumes very little power, and is easy to interface with the ESP32. It responds quickly and helps in providing instant alerts during emergency situations.

The buzzer works along with other safety components such as the exhaust fan, relay module, and Blynk notification system to ensure complete safety. While the Blynk app provides remote alerts, the buzzer gives a local audible warning, which is useful when people are present near the system.

16*2 LCD Display:



Fig 8: 16x2 LCD

In the LPG gas leakage and fire detection system, the 16x2 LCD display serves as an important output device that provides continuous visual feedback about the system's condition. It is interfaced with the microcontroller in 4-bit mode, which reduces the number of data lines required while still allowing efficient communication. At the start of operation, the microcontroller initializes the LCD by sending command instructions such as setting it to 16 columns and 2 rows, clearing the display, and positioning the cursor. After initialization, the microcontroller continuously reads input from the gas and flame sensors and compares the values with predefined threshold levels. Depending on these conditions, it sends corresponding data signals to the LCD. The Register Select (RS) pin is used to switch between

command mode and data mode, while the Enable (EN) pin ensures proper timing for data transfer. The LCD controller processes this data and displays characters on its screen in the form of messages.

The display updates dynamically whenever there is a change in environmental conditions. For example, under safe conditions, it shows normal status messages, while during gas leakage or fire detection, it immediately changes to warning messages. This real-time updating is achieved by clearing or overwriting previous data and printing new messages at specific cursor positions.

RELAY Module:



Fig 9: Relay Module

In the LPG gas leakage and fire detection system, the relay module functions as a key component for controlling external devices automatically and safely. It operates based on the principle of electromagnetism and acts as a bridge between the low-voltage control circuit (microcontroller) and high-voltage appliances like an exhaust fan or gas valve. Inside the relay, there is a coil, an armature, and a set of contacts known as Common (COM), Normally Open (NO), and Normally Closed (NC). Under normal conditions, the relay remains de-energized, and the circuit is connected through the NC contact, keeping the external device OFF. When gas leakage or fire is detected, the microcontroller sends a signal to the relay module, which activates a transistor driver and energizes the relay coil. This creates a magnetic field that pulls the armature and shifts the contact from NC to NO, thereby completing the circuit and turning ON the connected device such as a fan to ventilate gas or a safety mechanism to reduce risk.

Additionally, the relay module includes protective

components like a diode to prevent damage from back EMF and an LED indicator to show the relay status. The most important advantage of using a relay is that it provides electrical isolation, meaning the microcontroller is protected from high voltage and current.

Overall Architecture Of the system:-
(Block Diagram)

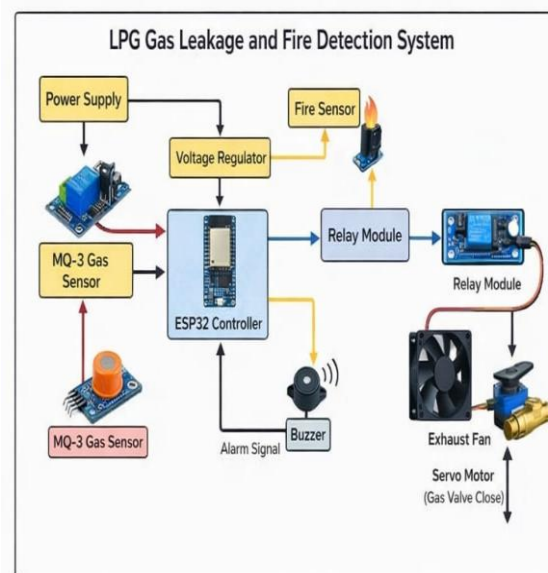


Fig 10: System architecture

This system uses an MQ-3 gas sensor to detect LPG gas leakage in the surrounding area. The MQ-3 sensor continuously monitors the gas concentration and sends the analog signal to the ESP32 microcontroller. The ESP32 reads and processes this signal to check whether the gas level crosses the preset safety threshold. If the gas concentration exceeds the safe limit, the ESP32 immediately activates safety measures. It turns on a buzzer alarm to alert people nearby and switches on the exhaust fan through a relay module to remove the leaked gas from the area. At the same time, a servo motor automatically rotates to close the gas valve, stopping further leakage. Additionally, the system can display gas levels and warning messages on the LCD screen for real-time monitoring. This automatic detection and control system helps prevent fire accidents, explosions, and ensures safety in homes, laboratories, and industries.

Real Life Implementation: -

The LPG Gas Leakage and Fire Detection System can be implemented in homes, kitchens, hotels, and industries to prevent accidents caused by gas leakage and fire. The MQ-3 Gas Sensor is installed near the gas cylinder or pipeline to detect the presence of leaked gas in the environment. A fire sensor is also placed nearby to detect flames or high temperature conditions.

Both sensors are connected to the ESP32 controller, which continuously monitors their readings and processes the data. If gas leakage is detected above a predefined threshold level, the system immediately activates a buzzer alert to warn people nearby. At the same time, the relay module is triggered to turn ON the exhaust fan, which helps in removing the leaked gas from the area.

Additionally, a servo motor is used to automatically close the gas valve, preventing further leakage. If fire is detected, the system also activates the alarm and can take similar safety actions. The system includes a 16×2 LCD display, which shows real-time status such as “System Normal”, “Gas Detected”, or “Fire Detected”, making it easy for users to understand the condition instantly.

Execution: -

The execution of the LPG Gas Leakage and Fire Detection System starts when power is supplied to the system. The MQ-3 Gas Sensor continuously monitors the surrounding air to detect the presence of gas, while the fire sensor detects any flame or high temperature. Both sensors send signals to the ESP32 controller, which processes the data and compares it with the predefined threshold values. If gas leakage is detected above the threshold level, the ESP32 immediately activates the buzzer alert and triggers the relay module. The relay turns ON the exhaust fan to remove the gas and also activates the servo motor to automatically close the gas valve.

Impact: -

The LPG Gas Leakage and Fire Detection System has a significant impact on safety, reliability, and accident prevention in real-life environments. It plays an important role in reducing risks associated with gas leakage and fire hazards.

Firstly, the system provides early detection of gas leakage and fire, which helps in taking immediate

action before the situation becomes dangerous. This early warning system can prevent major accidents such as explosions, fire outbreaks, and loss of life. Secondly, the system performs automatic safety actions like activating the exhaust fan and closing the gas valve using a servo motor. This reduces the need for human intervention and ensures quick response even when no one is present, thereby improving overall safety.

The inclusion of a buzzer alert and LCD display ensures that users are instantly informed about the system status. This improves awareness and allows people to react quickly in emergency situations. In terms of practical use, the system is cost-effective and easy to install, making it suitable for homes, restaurants, hotels, laboratories, and small industries. It can also be scaled and integrated into larger safety systems in commercial building.

Advantages of LPG Gas Leakage and Fire Detection System

1) Early Detection of Gas Leakage:

The system detects gas leakage at an early stage, helping to prevent dangerous situations like explosions.

2) Automatic Safety Actions:

The system automatically turns ON the exhaust fan and closes the gas valve using a servo motor without human intervention.

3) Fire Detection Capability:

The fire sensor detects flames instantly and alerts users, improving safety in emergency situations.

4) Immediate Alert System:

The buzzer alert and LCD display provide instant notification to users when gas leakage or fire is detected.

5) Reduces Risk of Accidents:

Helps in preventing fire hazards, explosions, and property damage caused by LPG leakage.

6) Real-Time Monitoring:

The system continuously monitors the environment and displays live status on the 16×2 LCD.

7) Low-Cost System:

Uses affordable components like ESP32, sensors, and relay modules, making it economical.

8) Easy Installation:

Can be easily installed in homes, kitchens, hotels, and industries without complex setup.

9) Useful in Multiple Areas:

Suitable for residential homes, restaurants, laboratories, and gas storage areas.

III. FUTURE SCOPE

Future improvements that can be made in the LPG Gas Leakage and Fire Detection System are: -

- 1) The system can be connected directly to automatic gas shut-off valves for faster response.
- 2) A mobile application can be developed for real-time alerts and monitoring.
- 3) IoT integration can be added to send notifications via internet to users.
- 4) More accurate gas sensors (like MQ-2) can be used for better LPG detection.
- 5) GSM module can be added to send SMS alerts without internet.
- 6) An emergency alert system can be developed to notify fire departments or authorities.
- 7) Cloud storage can be used to store data for analysis and safety records.
- 8) The system can be integrated into smart home automation systems.
- 9) The system can be implemented in large industries and commercial buildings for advanced safety.

IV. CONCLUSION

The LPG Gas Leakage and Fire Detection System is designed to improve safety by automatically detecting gas leakage and fire hazards in real time. The system uses the MQ-3 Gas Sensor to detect gas and a fire sensor to detect flames, while the ESP32 controller manages the alert system and safety actions.

When gas leakage or fire is detected above the threshold level, the system automatically activates the buzzer alert, turns ON the exhaust fan, and closes the gas valve using a servo motor. The 16×2 LCD display shows real-time status, making it easy for users to understand the situation instantly.

The system was successfully implemented and tested, and it helps in preventing accidents such as fire outbreaks and gas explosions. Thus, this system is a low-cost, reliable, and effective solution for improving safety in homes, industries, and commercial areas where LPG is used.

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