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LPG Leak Detection and Prevention: A Smart Safety Solution.

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ABSTRACT

This project proposes designing and implementing an LPG gas leakage detection and alert system for households. The increase in deaths caused by LPG explosions has highlighted the need for a gas leak detection system to identify potential hazards. Various gas sensors are used. The gas sensor detects the presence of LPG gas in the environment, and the microcontroller processes the sensor data to trigger an alarm or shut off the gas supply. The system can also send a notification on a mobile app in case of gas leakage. The proposed system is intended to prevent accidents, fires, and explosions by providing an early warning and taking necessary actions to minimize the damage caused by gas leakage. The proposed LPG Gas Leak Detection Smart Tool effectively addresses the growing concern about LPG explosions and their catastrophic consequences[1].

Key words : Gas Leakage detection, LPG, IoT, ESP32, MQ6 gas sensor, Relay module, Solenoid valve, Blynk IoT application.

INTRODUCTION

The use of liquefied petroleum gas (LPG) as a fuel source has become increasingly popular in households due to its affordability and efficiency. However, the risk associated with LPG gas leakage cannot be overstated. LPG is highly flammable and explosive, and its leakage can lead to accidents, fires, and explosions that can cause fatalities and significant damage to property. Therefore, there is a growing need for an effective gas leak detection system that can identify potential hazards and provide early warning to prevent catastrophic consequences. To address this concern, this project proposes designing and implementing an LPG gas leakage detection and alert system for households. The system is designed to detect the presence of LPG gas using various gas sensors. These sensors can detect the concentration of LPG gas in the environment and send the data to a microcontroller for processing. The microcontroller processes the sensor data and triggers an alarm or shuts off the gas supply in case of a gas leak [1].

Additionally, the system is designed to send an SMS alert to a designated phone number in case of gas leakage, providing an early warning to prevent accidents, fires, and explosions.The proposed LPG Gas Leak Detection Smart Tool offers a reliable and effective solution to address the growing concern about LPG explosions and their catastrophic consequences. By incorporating gas sensors, microcontrollers,and an alarm system, the system provides enhanced house safety, preventing potential hazards and minimizing the damage caused by gas leakage.Overall, this project aims to develop a gas leak detection system that offers an effective solution to the increasing concerns of LPG gas leakage, providing an early warning to prevent accidents, fires, explosions, enhancing the safety of households and industries

SYSTEM COMPONENTS

The system comprises several components, each playing a specific role in ensuring the safety of the environment:

ESP32 Microcontroller: The heart of the system, responsible for collecting data from the MQ6 gas sensor, processing it, and communicating with the Blynk cloud for remote monitoring.[2].

MQ6 Gas Sensor: A sensitive sensor designed to detect LPG, methane, and other combustible gases. It is used to monitor the concentration of gas in the surrounding environment and provide an early warning in case of a leakage.

Relay Module: This module controls the solenoid valve. When the gas leakage exceeds a certain threshold, the relay triggers the valve to turn off the gas supply automatically [2].

Solenoid Valve: Installed in the gas pipeline, it gets activated or deactivated by the relay module, cutting off the gas flow in case of a leakage.

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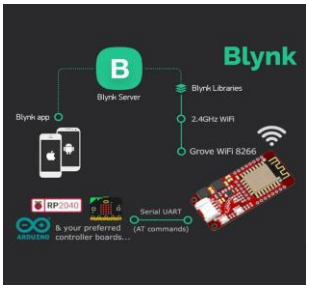
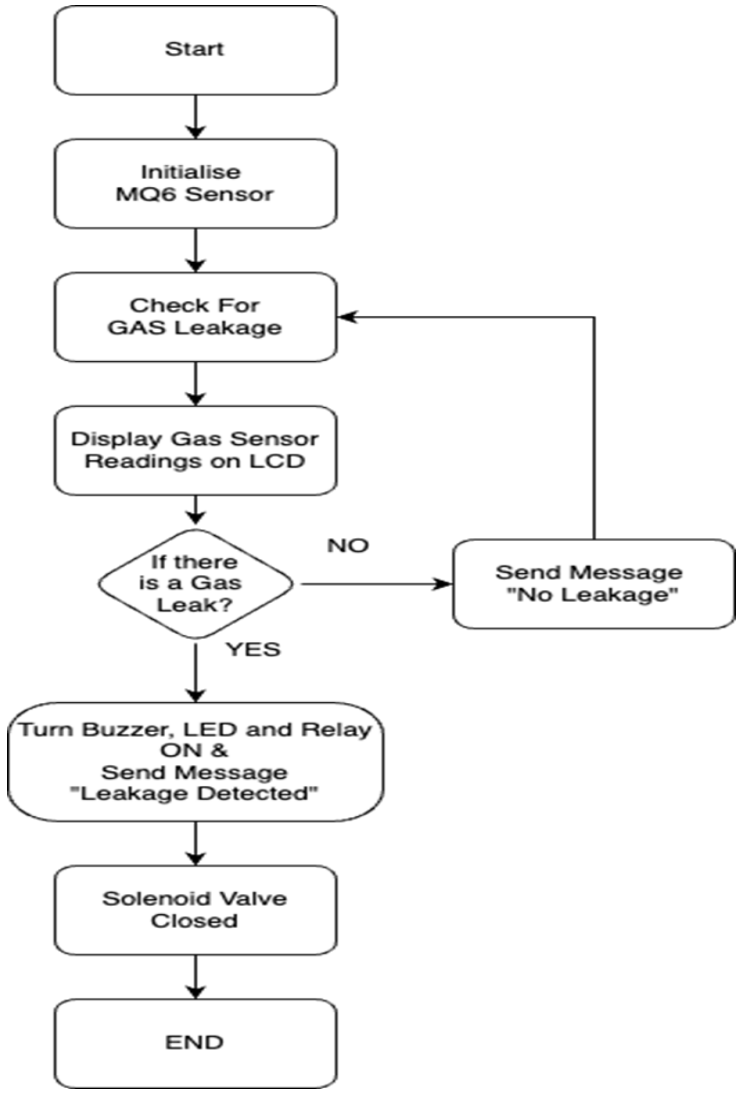
Buzzer: A local alarm that sounds when gas leakage is detected, providing an immediate alert to anyone nearby[2].

LED Indicator: A visual indicator to show the status of the system, such as normal operation, leakage detection, or valve action.





LCD Screen: A local display that provides real-time data about the gas sensor readings and the leakage status to the user.

Blynk IoT Application: A smartphone application that allows users to monitor the gas leakage status, view sensor readings remotely, and receive alerts.

WORKING MECHANISM:

- The MQ6 sensor constantly monitors the air for the presence of LPG or other gases.

- If the gas concentration exceeds a predefined threshold, the sensor triggers the ESP32 microcontroller, which processes the data and activates the relay module.
- The relay module controls the solenoid valve, shutting off the gas supply to prevent further leakage.
- Simultaneously, the system activates the buzzer and LED indicator to provide local alerts, while the LCD screen displays the sensor readings.
- The data is sent to the Blynk IoT application, where users can monitor the status and receive notifications in real time. The application displays whether the gas leakage is normal or excessive, based on the sensor values [4].

SYSTEM IMPLEMENTATION :

Hardware Setup:

Connections:

- Connect the MQ6 gas sensor to the analog input pin (A0) of the ESP32.Connect the buzzer to a digital output pin (e.g., D1).
- Connect the buzzer to a digital output pin (e.g., D1).
- Connect the LED indicator to another digital output pin (e.g.,D2).
- Connect the relay module to a digital output pin (e.g., D3).
- Connect the solenoid valve to the output of the relay module [6].

Power Supply :

- Connect the ESP32 and other components to a suitable power source (e.g., 5V) [2].
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App Installation :

Install Blynk library:

- Install the Blynk library for ESP32 using the Arduino IDE.

Create a Blynk project:

- Create a new Blynk project on the Blynk cloud platform.
- Add widgets to your project, such as gauges to display sensor values and buttons to control the system.

ARDUINO CONNECTIVITY :

Write the code in the Arduino IDE to:

- Initialize the ESP32, MQ6 gas sensor, buzzer, LED indicator, relay module, and solenoid valve.
- Connect to the Blynk cloud using your authentication tokenConnect the buzzer to a digital output pin (e.g., D1)..
- Read the sensor values from the MQ6 gas sensor.
- Process the sensor values to determine if a gas leak has occurred.
- Control the buzzer, LED indicator, relay module, and solenoid valve based on the detected gas leak.
- Update the Blynk widgets with the sensor values and system status.
- Display the sensor readings and leakage status on the on-site LCD.

TESTING AND CALIBRATION:

Calibrate the MQ6 gas sensor:

- Calibrate the MQ6 gas sensor by exposing it to different concentrations of LPG gas and recording the corresponding sensor values.
- Use this calibration data to determine the threshold values for normal and excessive leakage. [3]
- Normal range of gas is between 0 to 3000 it is considered as safe range.
- Sensor get activated when the gas range goes above 3000 to 4000 and send notification on the App.
- The range above 4000 is considered as major gas leak detection and automatic turn of the gas.

SYSTEM TESTING:

- Gas leaks by exposing the MQ6 gas sensor to LPG gas.
- Verify that the system correctly detects the leaks, activates the buzzer and LED indicator, and turns off the solenoid valve.
- Test the on-site LCD display to ensure that it accurately displays the sensor readings and leakage status.
- The values are divided into 3 specific ranges as below.
- The gas ranging from 0 To 3000 is considered a safe range.

- The gas leakage ranging from 3000 to 4000 , is the range where Sensor sense the Gas start to leak.
- When it crosses the value of 4000 then sensor detect the danger and give notification of “Major Gas leak” [5].

DEPLOYMENT:

Install the system:

- Install the ESP32, MQ6 gas sensor, buzzer, LED indicator, relay module, solenoid valve, and on-site LCD in the desired location.
- Connect the components as described in the hardware setup section.

System Configuration :

- Configure the Blynk project and code to match the specific requirements of your installation.

Monitor and maintenance :

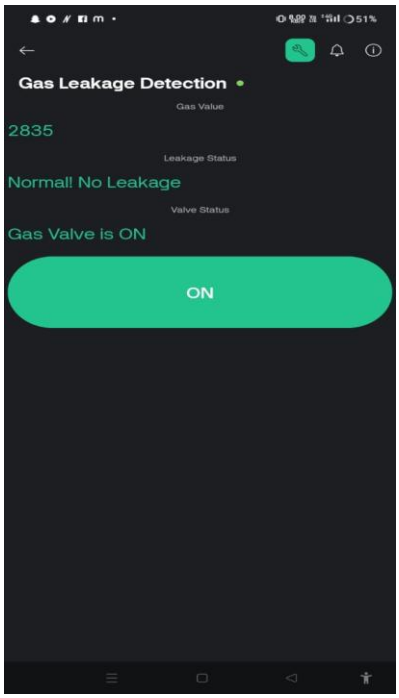
- Regularly monitor the system to ensure its proper functioning.
- Perform maintenance tasks as needed, such as calibrating the gas sensor or replacing components.

FUTURE SCOPE :

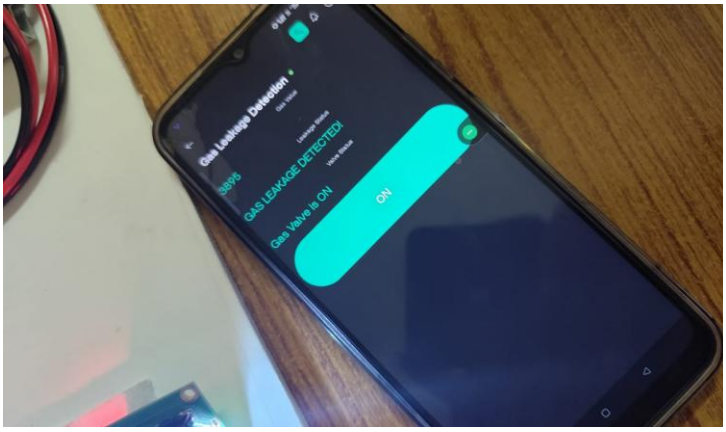
- **Calibration and Accuracy:** The MQ6 sensor was recalibrated to ensure more accurate gas concentration readings. Additionally, software filters were implemented to smooth out erratic readings caused by environmental fluctuations.
- **Secondary Gas Detection:** A secondary MQ2 sensor was added to the system to act as a backup detection method. This additional sensor helps improve the reliability of the gas leakage detection system.
- **Low Power Consumption Mode:** The ESP32 was programmed to enter a low-power mode during idle periods to conserve battery life, especially when running on a rechargeable power source.
- **Enhanced UI in Blynk:** The Blynk app was updated to include more intuitive controls and status indicators, such as a visual representation of the solenoid valve status and gas concentration levels.

RESULT :

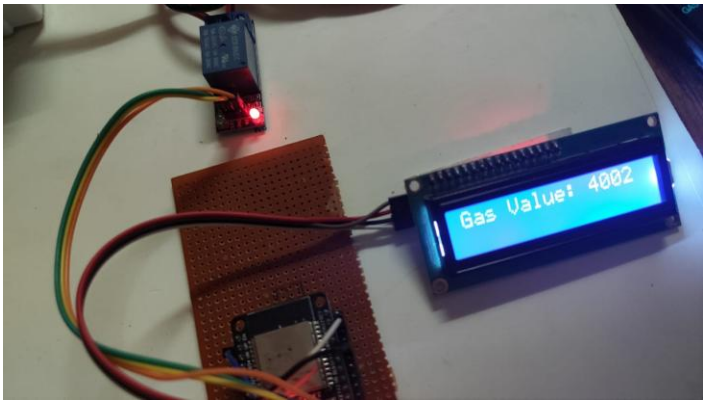
1) Where no gas is leak

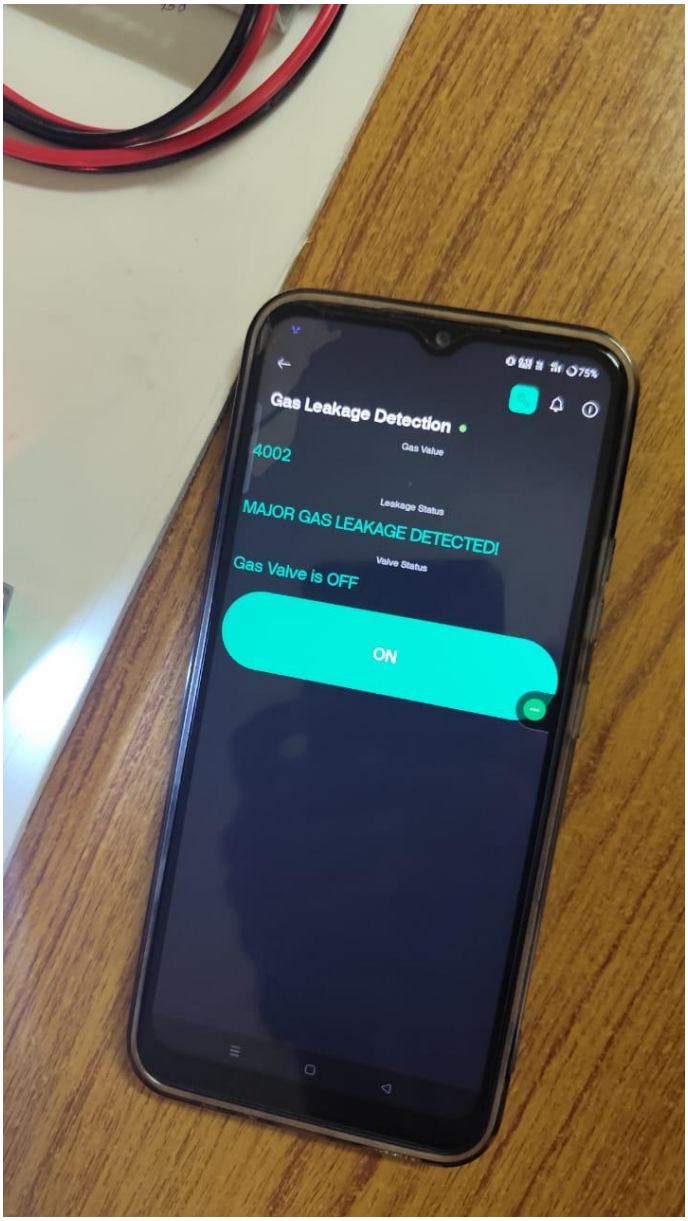


2) Gas Leak Detected:



3) Major Gas Leak Detected:





CONCLUSION

The Gas Leakage Detection and Prevention System using ESP32, MQ6 sensor, and IoT integration through Blynk has successfully addressed the need for a non-invasive, real-time, automated gas monitoring solution. By combining sensors, microcontrollers, cloud technology, and local alert systems, the project ensures the safety of users by detecting gas leakage early and preventing further hazards through automatic valve control. The continuous monitoring and remote accessibility via Blynk offer significant advantages over traditional gas leak detection systems. With ongoing improvements and calibration, this system has the potential to become a reliable and affordable solution for gas leakage prevention in homes and industries.

ACKNOWLEDGEMENT

An IoT-based gas leak detection and prevention system uses interconnected sensors to monitor the presence of hazardous gases in real time.These sensors detect gases like methane, carbon monoxide, and propane, alerting users when concentrations exceed safe levels. Data collected from these sensors is processed by a microcontroller and transmitted through IoT connectivity (Wi-Fi, Bluetooth, or cellular networks). The system triggers alarms, including visual and audible alerts, to warn nearby individuals of potential leaks. Additionally, automated safety measures like shutting off gas valves or activating ventilation systems can be initiatedRemote monitoring via a cloud platform allows users to check gas levels and receive notifications on their devices. This technology ensures faster response times, enhances safety, and reduces the risk of accidents. The system is crucial for homes, industrial sites, and commercial buildings, providing a proactive solution to prevent gas-related hazards. Overall, it combines real-time monitoring, early detection, and automated prevention for optimal gas leak safety.

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