

Automatic LPG Gas Leakage Detection System using Arduino

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Abstract

Liquefied Petroleum Gas (LPG) is widely used for domestic and industrial purposes, but leakage of LPG can lead to serious accidents such as fire and explosions. To overcome this problem, an Automatic LPG Gas Leakage Detection System using Arduino is developed to detect gas leakage at an early stage and provide immediate alerts.

This system uses a gas sensor (such as MQ-2 or MQ-6) to continuously monitor the presence of LPG in the environment. When the gas concentration exceeds a predefined safety level, the sensor sends a signal to the Arduino microcontroller. The Arduino then activates an alarm system, such as a buzzer and LED indicator, to alert users about the leakage. Additionally, the system can be integrated with GSM modules to send alert messages to users for remote notification.

Keywords-LPG Gas Leakage, Detection, Arduino, Gas Sensor (MQ-2), Safety System, Gas Leakage Alert

I. Introduction

An Automatic LPG Gas Leakage Detection System using Arduino is an important safety solution designed to prevent accidents caused by the leakage of liquefied petroleum gas (LPG), which is commonly used for cooking and heating in households and industries. LPG is highly flammable and colorless, making it difficult to detect without proper equipment. Even a small leakage can lead to dangerous situations such as fire hazards, explosions, and health issues. Therefore, there is a strong need for an efficient system that can continuously monitor gas levels and provide early warning to users.

This system is built using an Arduino microcontroller, which acts as the central processing unit. A gas sensor, typically the MQ-2 sensor, is used to detect the presence and concentration of LPG in the surrounding environment. The sensor is highly sensitive to gases like propane and butane, which are the main components of LPG. It continuously sends data to the Arduino, which processes the information and compares it with a predefined safety threshold.

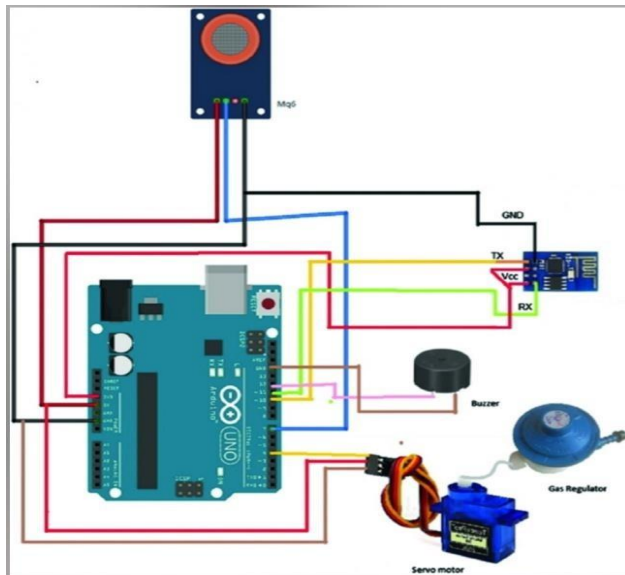
When the gas concentration exceeds the safe limit, the Arduino immediately activates warning mechanisms such as a buzzer or alarm to alert the users. In some advanced versions, the system can also display warning messages on an LCD screen, send notifications via GSM modules, or automatically turn off the gas supply using a relay system. These features help in minimizing the risk and ensuring a quick response to potential hazards.

The Automatic LPG Gas Leakage Detection System is cost-effective, easy to install, and highly reliable. It plays a crucial role in enhancing safety in homes, kitchens, laboratories, and industrial environments. By providing real-time monitoring and immediate alerts, this system helps prevent accidents, protect lives, and reduce property damage. Overall, it is a practical and efficient application of embedded systems and sensor technology in everyday safety management.

The design of this system is simple, cost-effective, and suitable for both residential and industrial applications. It requires minimal maintenance and can be easily installed in kitchens, gas storage areas, laboratories, and factories. The use of Arduino makes the system highly flexible and customizable, allowing users to modify and upgrade it according to their specific needs.

It uses a gas sensor to continuously monitor gas levels in the environment and sends the data to an Arduino microcontroller. When the gas concentration exceeds a safe limit, the system immediately activates a buzzer to alert users and can also perform additional actions like sending notifications or turning off the gas supply. This system is cost-effective, reliable, and helps ensure safety in homes and industries by providing early detection of gas leaks.

II. Circuit Diagram



III. Working Principle

The given diagram represents the working of an Automatic LPG Gas Leakage Detection System using Arduino, which is designed to detect gas leakage and take immediate safety actions to prevent accidents. This system integrates multiple components such as an Arduino Uno microcontroller, an MQ-6 gas sensor, a buzzer, a GSM module, and a servo motor connected to a gas regulator. All these components work together to provide continuous monitoring, alert mechanisms, and automatic control.

The working of the system begins with the MQ-6 gas sensor, which is highly sensitive to LPG gases like propane and butane. This sensor is placed in the environment where gas leakage is likely to occur, such as near a gas stove or cylinder. It continuously senses the concentration of gas in the air and converts it into an electrical signal. This signal is then sent to the Arduino Uno in the form of analog input. The Arduino, which acts as the brain of the system, reads this data and processes it according to the program stored in it.

Inside the Arduino, a threshold value is already defined to represent the safe level of gas concentration. As long as the detected gas level remains below this threshold, the system continues to operate normally without triggering any output. However, when the gas concentration exceeds the safe limit, the Arduino immediately recognizes it as a leakage condition and initiates a series of actions to alert the user and minimize danger.

The first action is activating the buzzer, which produces a loud alarm sound to warn people nearby about the gas leak. This immediate audible alert is crucial for quick human response. At the same time, the Arduino communicates with the GSM module using serial communication through the TX and RX pins. The GSM module then sends a text message (SMS) to a predefined mobile number, informing the user about the gas leakage even if they are not present at the location.

In addition to alerting the user, the system also performs an automatic safety operation using a servo motor. The servo motor is mechanically connected to the gas regulator knob. When a leak is detected, the Arduino sends a control signal to

the servo motor, causing it to rotate to a specific angle. This rotation effectively turns off the gas regulator, stopping the gas supply and preventing further leakage. This automatic shut-off feature is one of the most important aspects of the system, as it reduces the risk of fire or explosion without requiring manual intervention.

All components in the system are powered and interconnected through appropriate wiring. The Arduino supplies power to the sensor and other modules, while also managing input and output signals. The entire system operates continuously, ensuring real-time monitoring of the environment.

IV. Implementation & Results

The implementation of the Automatic LPG Gas Leakage Detection System using Arduino involves both hardware setup and software programming. Initially, all the required components such as the Arduino Uno, MQ-6 gas sensor, GSM module, buzzer, servo motor, and connecting wires are assembled according to the circuit diagram. The MQ-6 sensor is positioned in a location where gas leakage is most likely to occur, such as near the gas cylinder or stove.

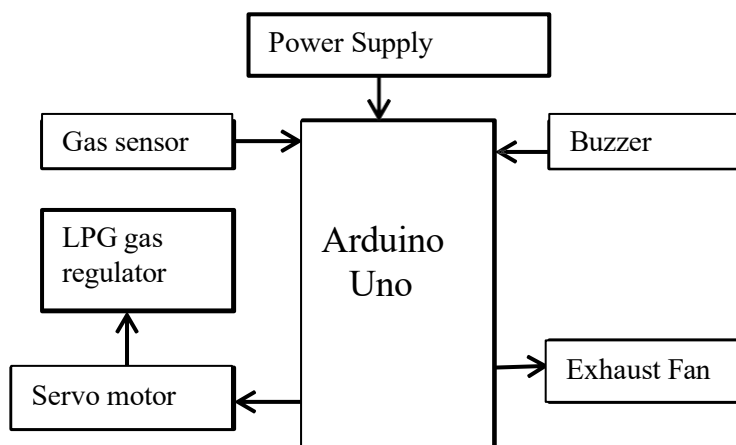
The sensor is connected to the analog input pin of the Arduino, allowing it to continuously send gas concentration data. The GSM module is interfaced with the Arduino using serial communication through the TX and RX pins, enabling message transmission. The buzzer is connected to a digital output pin to provide an audible alert, while the servo motor is also connected to a PWM pin to control the gas regulator mechanism.

On the software side, the Arduino is programmed using the Arduino IDE. The code is written to read the analog values from the gas sensor and convert them into meaningful gas concentration levels. A threshold value is defined in the program to distinguish between safe and unsafe gas levels. The program continuously compares real-time sensor data with this threshold.

When the gas concentration exceeds the predefined limit, the Arduino executes multiple actions simultaneously. It activates the buzzer to alert nearby individuals, sends commands to the GSM module to deliver an SMS alert to a registered mobile number, and signals the servo motor to rotate and turn off the gas regulator. The system is powered using a stable power supply to ensure continuous operation.

Before final deployment, the system is tested under different conditions by exposing the sensor to small amounts of gas (in a controlled manner) to verify accuracy and responsiveness. Adjustments are made to the threshold value to minimize false alarms and improve reliability.

V. Block Diagram



The given block diagram represents the functional flow of an Automatic LPG Gas Leakage Detection System using Arduino.

The system begins with the power supply, which provides the necessary electrical energy to all components in the circuit. A stable power source is essential for proper functioning of the Arduino, gas sensor, and output devices. It ensures that the system operates continuously without interruption.

The gas sensor (such as MQ-6 or MQ-2) is the primary input component of the system. It is responsible for detecting the presence of LPG gas in the surrounding environment. The sensor continuously monitors air quality and measures the concentration of gas. When LPG is present, the sensor produces an electrical signal proportional to the gas level. This signal is then sent to the Arduino for processing.

At the center of the block diagram is the Arduino microcontroller, which acts as the brain of the system. It receives input from the gas sensor and analyzes it based on the program stored in its memory. A predefined threshold value is set in the Arduino code to determine the safe level of gas concentration. The Arduino continuously compares the sensor readings with this threshold. If the gas level is below the limit, the system remains in a normal state. However, if the gas level exceeds the safe limit, the Arduino identifies it as a leakage condition and immediately initiates appropriate actions.

The buzzer is the output component connected to the Arduino. When a gas leak is detected, the Arduino sends a signal to activate the buzzer. The buzzer produces a loud alarm sound, alerting

people nearby about the danger. This immediate warning helps in taking quick action to prevent accidents.

In summary, the block diagram shows a simple yet effective process: the power supply energizes the system, the gas sensor detects LPG levels, the Arduino processes the data, and the buzzer provides an alert when necessary. This continuous cycle ensures real-time monitoring and quick response, making the system reliable for safety applications in homes and industries.

V. Applications

1. Used in residential homes and kitchens to detect LPG leakage and ensure family safety
2. Installed in hotels and restaurants where continuous gas usage increases risk
3. Applied in industries and factories that use LPG for production processes
4. Used in laboratories and research centers where gas cylinders are frequently handled
5. Helps in early detection of gas leakage, reducing chances of major accidents

VI. Advantages

1. Provides early detection of LPG leakage
2. Helps in preventing fire accidents and explosions
3. Gives quick response with buzzer and LED alerts
4. Can send remote alerts (SMS) using GSM module
5. Ensures safety of people and property
6. Low cost and affordable system
7. Easy to install and maintain

VII. Disadvantages

1. Gas sensors (MQ-2/MQ-6) may give false alarms due to smoke, alcohol, or other gases
2. Requires proper calibration for accurate results

VIII. Conclusion

The Automatic LPG Gas Leakage Detection System using Arduino is an effective and reliable solution for detecting gas leaks and ensuring safety in both domestic and industrial environments. The system successfully uses a gas sensor to continuously monitor LPG concentration and an Arduino microcontroller to process the data and trigger alerts when necessary. The immediate activation of buzzer and LED indicators helps in providing quick warning, allowing users to take timely action and prevent hazardous situations. References

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