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LPG Gas Leakage Detector With Exhaust Fan And SMS Alert

Prof. Yogi. P. G[1], More Rani Dashrath[2], Shaikh Afrin Javed[3], Yede Vaishnavi Panjab[4]
[1,2,3,4] Student of Diploma in Information Technology
Vishweshwarayya Institute of Engineering and Technology, Almala, Maharashtra, India

Abstract: *Liquefied Petroleum Gas (LPG) is widely used for domestic and industrial purposes due to its efficiency and convenience. However, LPG leakage poses a serious risk as it can lead to fire hazards, explosions, and health issues.*
This project presents an LPG Gas Leakage Detection System integrated with an exhaust fan and SMS alert mechanism to enhance safety and provide real-time monitoring.
The system uses a gas sensor (such as MQ-2) to continuously monitor the presence of LPG in the environment. When the gas concentration exceeds a predefined threshold, the system immediately triggers an alert. An exhaust fan is automatically activated to ventilate the area and reduce gas accumulation. Simultaneously, a GSM module sends an SMS notification to the user, informing them about the leakage so that prompt action can be taken even if they are not physically present.
The proposed system is cost-effective, reliable, and easy to install, making it suitable for homes, kitchens, and small industries. By combining detection, ventilation, and remote alert features, this project significantly reduces the risks associated with LPG leakage and improves overall safety.

Keywords*: Arduino-based radar system*

I. INTRODUCTION

Liquefied Petroleum Gas (LPG) is one of the most widely used fuels for cooking and heating in households and industries due to its efficiency, low cost, and ease of availability. Despite its advantages, LPG is highly flammable and poses serious risks if leakage occurs. Gas leaks can lead to fire accidents, explosions, and health hazards, making early detection extremely important for safety.

In many cases, gas leakage goes unnoticed due to the absence of proper monitoring systems, especially when people are not present at the location. Traditional safety measures are often insufficient to provide timely alerts or preventive actions. Therefore, there is a need for an automated system that can detect gas leakage and respond immediately.

This project presents an LPG Gas Leakage Detector with an exhaust fan and SMS alert system. The system is designed to detect gas leakage using a gas sensor and automatically activate safety mechanisms. When leakage is detected, an exhaust fan is turned on to remove the gas from the environment, and an alert message is sent to the user via GSM technology.

The main objective of this project is to enhance safety by providing a reliable, fast, and cost-effective solution for gas leakage detection and alerting. This system can be easily installed in homes, kitchens, and small industries to reduce the risk of accidents and ensure a safer environment.

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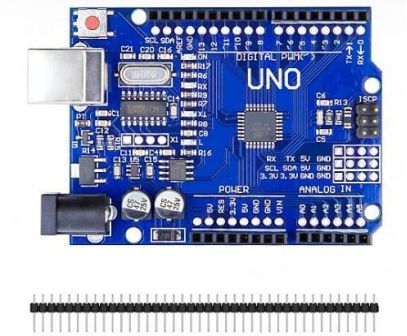
II. COMPONANTS USED

Power Supply

A power supply is a device that provides electrical energy to another device by converting electricity from a source, such as a wall outlet or battery, into the correct voltage and current required for operation. It plays a crucial role in all electronic systems, as most devices cannot use raw electrical power directly. There are different types of power supplies, including AC power supplies that deliver alternating current and DC power supplies that convert AC into direct current for electronics like phones and computers. Common types include switch mode power supplies (SMPS), which are efficient and widely used, and linear power supplies, which are simpler but less efficient. A typical power supply consists of components such as a transformer to adjust voltage, a rectifier to convert AC to DC, a filter to smooth the output, and a regulator to maintain a stable voltage. Understanding power supplies is important for safely and effectively operating electrical and electronic devices.

Arduino UNO



The Arduino Uno is a popular microcontroller board based on the ATmega328P, widely used for learning electronics and building projects. It can be programmed using the Arduino IDE, which supports a simple version of C/C++. The board has 14 digital input/output pins (with 6 capable of PWM) and 6 analog input pins, allowing it to interface with sensors, motors, LEDs, and other components. It operates at 5 volts and can be powered through a USB connection or an external power supply. The Arduino Uno also includes a USB interface for programming and communication with a computer, making it easy for beginners to use. Due to its simplicity, affordability, and large community support, it is widely used in robotics, automation, and embedded system projects.

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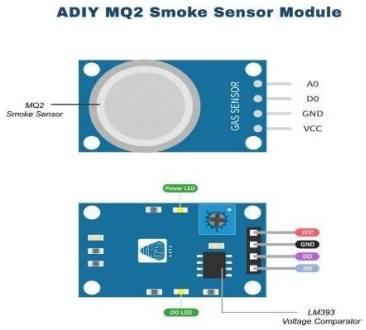
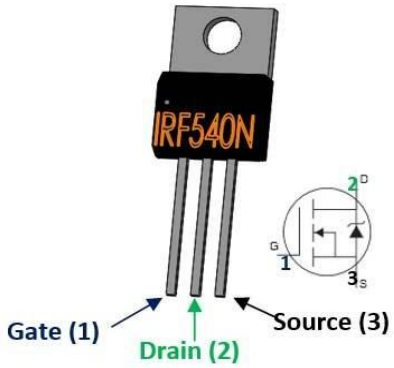
LPG Sensor



The MQ-6 Gas Sensor is a widely used electronic sensor designed to detect the presence of liquefied petroleum gas (LPG), such as propane and butane, in the air. It is commonly used in safety systems to identify gas leaks in homes, kitchens, and industrial environments. The sensor operates based on a sensitive material whose resistance changes when exposed to LPG, allowing it to measure gas concentration levels. It provides both analog and digital outputs, making it easy to interface with microcontrollers like the Arduino Uno. The MQ-6 sensor requires a heating element to function properly and typically operates at 5 volts. It is known for its fast response time, high sensitivity to LPG, and relatively low cost, which makes it ideal for gas leakage detection projects and alarm systems.

IRF540 MOSFET



The IRF540 MOSFET is a widely used N-channel power MOSFET designed for switching and amplification applications in electronic circuits. It can handle high voltages of up to 100V and currents of around 33A under ideal conditions, making it suitable for controlling high- power devices such as motors, lamps, relays, and LED strips. The MOSFET has three main terminals: gate, drain, and source, where a small voltage applied to the gate controls a much larger current flowing between the drain and source. It features low on-resistance, which helps reduce power loss and heat generation, improving efficiency. The IRF540 is commonly used in power supplies, inverters, DC motor control, and switching regulators. However, it is not a logic-level MOSFET, so it typically requires around 10V at the gate for full conduction, which means when using it with microcontrollers like the Arduino Uno, a driver circuit or gate driver may be needed for best performance. It also includes an internal body diode, making it useful in inductive load applications, and proper heat sinking is recommended for high-current operations to prevent overheating and ensure reliable performance.

12V DC Fan

A 12V DC Fan is an electrical device used for cooling and ventilation by converting electrical energy into mechanical rotation to move air. It operates on a 12-volt direct current (DC) power supply, making it commonly used in

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applications such as computers, power supplies, automotive systems, and small electronic projects. These fans typically consist of a motor, blades, and a casing, and they are designed to provide efficient airflow while consuming relatively low power. A 12V DC fan can be easily controlled using switches, relays, or electronic components like a IRF540 MOSFET for speed control through techniques such as pulse width modulation (PWM). They are available in various sizes and airflow capacities, and many models are designed to operate quietly and with long lifespan. Proper polarity must be maintained when connecting the fan, and it can be powered using batteries, adapters, or integrated circuits in systems like those built with an Arduino Uno.

III. LITERATURE SURVEY

Gas leakage detection systems have been widely studied due to the increasing risks associated with Liquefied Petroleum Gas (LPG) in domestic and industrial environments. Various researchers have proposed systems using gas sensors, microcontrollers, GSM modules, and automation techniques to improve safety and reliability.

Early research focused on semiconductor-based gas sensors such as MQ-2 and MQ-6 for detecting LPG gases like propane and butane. The MQ-6 sensor is particularly suitable for LPG detection due to its high sensitivity and fast response time. It operates based on changes in resistance when exposed to gas, making it reliable for leakage detection systems. Many studies highlight MQ-6 as more accurate for LPG compared to general-purpose sensors.

Microcontroller-based systems, especially using Arduino and ATmega series, have been widely implemented to process data from MQ-6 sensors. These systems continuously monitor gas concentration and trigger alerts when the gas level exceeds a predefined threshold. The use of microcontrollers improves system efficiency, accuracy, and real-time response.

To enhance safety, researchers have integrated GSM modules into gas detection systems. When leakage is detected by the MQ-6 sensor, the system sends an SMS alert to the user's mobile phone.

This feature is particularly useful when the user is away, allowing immediate action to prevent accidents.

In addition to alert systems, many studies include automatic control mechanisms such as exhaust fans and gas shut-off valves. When leakage is detected, the exhaust fan is automatically turned on to ventilate the area and reduce gas concentration. This helps in minimizing the chances of fire or explosion.

Recent advancements include IoT-based gas leakage detection systems, where MQ-6 sensors are connected to Wi-Fi-enabled modules like ESP8266. These systems provide real-time monitoring through mobile applications and cloud platforms, offering better control and continuous supervision.

Some modern systems also incorporate additional safety features such as fire sensors, automatic gas booking, and cylinder weight monitoring. These features enhance both safety and convenience for users.

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Overall, the literature indicates that MQ-6 sensor-based LPG leakage detection systems are reliable, cost-effective, and widely used. The integration of GSM alerts and exhaust fan mechanisms further improves safety by ensuring quick detection, immediate response, and remote notification, making the system highly effective for real- world applications.

IV. SCOPE OF THE PROJECT

Functional Scope

The functional scope defines what the system does and the main operations it performs.

1. The system continuously monitors the surrounding environment for the presence of LPG gas using the MQ- 6 sensor.
2. It detects gas leakage when the gas concentration exceeds a predefined safety threshold.
3. Once leakage is detected, the system immediately activates a buzzer or alarm to alert nearby people.
4. The system automatically turns ON an exhaust fan to ventilate the area and reduce gas concentration.
5. A GSM module is used to send an SMS alert to the user's mobile phone informing them about the gas leakage.
6. The system works in real-time and provides immediate response without human intervention.
7. It uses a microcontroller (such as Arduino) to process sensor data and control output devices.
8. The system can be installed in homes, kitchens, laboratories, and small industries for safety purposes.
9. It ensures continuous operation as long as power is supplied to the system.
10. The system can be calibrated to adjust sensitivity levels of the MQ-6 sensor.
11. It supports automatic activation of safety mechanisms without manual switching.
12. The system can be expanded to include additional features like gas valve control or fire detection.
13. It provides both local (buzzer) and remote (SMS) alert mechanisms.
14. It reduces the risk of fire accidents by taking preventive actions quickly.

Non-Functional Scope

The non-functional scope defines the quality, performance, and constraints of the system.

1. The system should be highly reliable and capable of detecting gas leakage accurately.
2. It must have fast response time to ensure immediate action during leakage.
3. The system should be cost-effective so it can be widely used in households.
4. It must be easy to install and user-friendly, requiring minimal technical knowledge.
5. The design should be compact and portable for convenient placement.
6. The system should consume low power to ensure energy efficiency.
7. It must provide continuous and stable performance over long periods.
8. The MQ-6 sensor should be properly calibrated to avoid false alarms.
9. The system should be durable and long-lasting, with minimal maintenance requirements.
10. It must operate effectively under normal environmental conditions (temperature, humidity, etc.).
11. The GSM module should provide reliable network connectivity for sending SMS alerts.
12. The system should ensure safety and fault tolerance, even in case of partial failure.
13. It should have quick recovery time after detecting and handling leakage.
14. The system should be scalable, allowing future upgrades like IoT integration.
15. It should maintain accuracy and sensitivity over time without frequent recalibration.

V. METHODOLOGY / APPROACH

The LPG Gas Leakage Detector with Exhaust Fan and SMS Alert is designed to provide a fully automated safety system using MQ-6 sensor technology, microcontroller- based processing, and remote alerting.

The methodology involves multiple layers of detection, response, and user notification to ensure safety and reliability.

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1. Gas Sensing Using MQ-6

The MQ-6 sensor is chosen for its high sensitivity to LPG gases (propane, butane). It operates using a tin oxide (SnO_2) semiconductor layer that changes resistance in the presence of gas molecules. The sensor provides an analog output voltage corresponding to the gas concentration.

Preheating: The MQ-6 sensor requires a preheating period for accurate readings.

Calibration: The sensor is calibrated by exposing it to a known concentration of LPG to define the threshold value for safe operation.

Sensitivity Adjustment: The microcontroller software allows sensitivity settings to reduce false alarms in environments with slight gas traces.

2. Microcontroller-Based Data Processing

An Arduino or ATmega microcontroller is used to read signals from the MQ-6 sensor. The microcontroller:

Converts analog data into digital values using an ADC (Analog-to-Digital Converter).

Continuously compares the gas concentration with the predefined threshold.

Triggers output devices (buzzer, exhaust fan, GSM module) based on the readings.

Additional programming features include:

Debouncing: To prevent false triggering from transient spikes.

Sampling Frequency Control: Reading sensor data at optimal intervals to balance performance and power efficiency.

Event Logging: Optional storage of gas detection events for future analysis.

3. Automated Safety Mechanisms Once leakage is detected:

1. Buzzer Activation: An audible alert warns nearby individuals immediately.
2. Exhaust Fan Control: Automatically switches on to reduce gas concentration in the area.

Optional Gas Valve Control: Advanced setups can include a solenoid valve to automatically shut off gas supply, preventing further leakage.

The system ensures automatic operation without human Intervention, reducing response time and risk.

4. Remote Notification via GSM

A GSM module (SIM800/900) is interfaced with the microcontroller to send SMS alerts. When gas leakage is detected:

The microcontroller sends a command to the GSM module.

The module sends an SMS to the registered mobile number with information about the gas leakage and location.

This ensures the user is informed even if they are away from the premises.

Future enhancements may include IoT integration using ESP8266/ESP32 for app-based notifications and cloud monitoring.

5. Power Supply Design

The system uses a regulated DC supply (5V–12V) for the microcontroller and sensors.

Safety features such as overcurrent protection, fuses, and voltage regulators are incorporated to prevent electrical hazards.

For critical applications, battery backup can ensure continuous monitoring during power outages.

6. System Testing and Validation

Controlled LPG leakage tests are performed to check accuracy, response time, and reliability.

The system is tested under various environmental conditions (humidity, temperature, airflow) to ensure robustness.

Multiple tests verify:

• Alarm activation

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- Exhaust fan operation
- SMS delivery
- Threshold sensitivity calibration

7. Approach and Implementation

Steps:

Hardware Setup:Connect MQ-6 sensor, microcontroller, buzzer, exhaust fan, and GSM module.
Software Development: Write firmware to:

- Read and process sensor data
- Compare values with thresholds
- Control output devices
- Send SMS alerts

Calibration: Adjust sensor sensitivity and test under safe LPG concentrations.
Integration:Combine all hardware and software components for seamless operation.
Testing and Deployment:Test system in controlled conditions and deploy in real environments.

8. Advanced Methodology Options

Multiple Sensor Network: Using more than one MQ-6 sensor for coverage in larger areas.
Sensor Fusion: Combining MQ-6 with MQ-2 or MQ-5 sensors to detect different gases and increase reliability.
Data Logging and Analytics: Recording sensor readings for predictive maintenance or leak pattern analysis.
IoT & Mobile App Integration: Real-time monitoring and control via a mobile application or cloud dashboard.

VI. ADVANTAGES

Real-Time Detection: The system continuously monitors LPG gas levels, providing instant detection of leaks.
Automatic Safety Measures: It automatically activates exhaust fan and buzzer without requiring human intervention.
Remote Alerts: The GSM module sends SMS notifications to the user, ensuring awareness even when they are away.
Cost-Effective: Uses affordable components like MQ- sensors and Arduino, making it economical for home and industrial use.
Easy Installation and Use: Simple hardware setup and user-friendly operation make it suitable for non-technical users.
Fast Response Time: Immediate activation of alarms and ventilation reduces the risk of fire or explosion.
Scalable and Expandable: Additional features like gas valve control, IoT integration, or multiple sensors can be added.
Low Power Consumption: Designed to work efficiently, consuming minimal energy while continuously monitoring.
Durable and Reliable: Provides long-term operation with minimal maintenance.
Improved Safety: Reduces accidents and hazards associated with LPG leakage, protecting life and property.

VII. APPLICATIONS

Residential Homes: Detects LPG leaks in kitchens, protecting families from accidents.
Restaurants and Hotels: Ensures safety in commercial kitchens with large-scale LPG usage.
Small Industries: Monitors gas leakage in workshops, laboratories, or factories using LPG.
Laboratories: Ensures a safe environment in chemistry or research labs using LPG or similar gases.
Gas Stations and Depots: Detects leaks in storage or distribution areas to prevent fire hazards.
Public Buildings: Can be installed in schools, hostels, or hospitals where LPG is used.
Remote Monitoring Systems: SMS alert feature allows users to monitor gas leakage from anywhere.
IoT-Based Smart Homes: Can be integrated with IoT platforms for remote control and monitoring via apps.
Industrial Safety Automation: Can be part of automated safety systems in industries handling LPG.

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VIII. CONCLUSION

The LPG Gas Leakage Detector with Exhaust Fan and SMS Alert is a reliable and efficient system designed to enhance safety in domestic and industrial environments. By using the MQ-6 gas sensor, the system can accurately detect LPG leakage and respond immediately. The automatic activation of the exhaust fan and buzzer ensures that gas concentration is reduced quickly, preventing potential accidents. Additionally, the GSM- based SMS alert feature notifies the user remotely, allowing timely action even when they are not present at the site.

This project demonstrates a combination of hardware and software solutions to address a critical safety concern.

The system is cost-effective, user-friendly, and easily deployable in homes, restaurants, laboratories, and small industries. Overall, it provides a practical solution for gas leak detection, improving safety, reducing risks, and protecting lives and property from potential hazards associated with LPG leakage.

XI.ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to everyone who supported me during the completion of this project, "LPG Gas Leakage Detector with Exhaust Fan and SMS Alert using MQ-6 Sensor."

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