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Design of Advanced LPG Leakage Detection And Gas Leakage Accident Prevention With Alert System Using MQ-6 Sensor

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Abstract- *When it comes to cooking food in our homes, LPG (liquefied petroleum gas) has become the go-to choice for many households. However, the potential dangers associated with gas leaks have become a pressing concern. The threat of deadly flames caused by gas leaks is a major issue that can result in significant financial damage, personal injuries, or even worse, loss of life. Therefore, it is crucial to have a reliable system in place to detect and address these gas leakages promptly. Enter our groundbreaking project designed to provide foolproof detection of LPG gas leaks and instantly alert users through audio-visual indicators. Our cutting-edge system is purpose-built to not only detect LPG, but also four other highly dangerous gases, within a range of 200 parts per million (ppm) to 10,000 ppm.*

Key words: LPG (Liquefied Petroleum Gas), MQ-6 Sensor, LED, Buzzer (Alarm), LCD

1. Introduction

In our nation, where more than 80% of gas consumers rely on liquefied petroleum gas (LPG), it is crucial to address the issue of gas leaks. These leaks have been responsible for approximately 35% of gas-related incidents. However, the real concern lies in the potential for LPG spills. To effectively tackle this problem, a reliable gas spillage detection method is necessary. This article will explore a groundbreaking concept that provides an essential alert system for identifying and preventing gas leaks in both residential and commercial buildings.

The Gas Spillage Identification Method

Detecting and addressing gas spills requires a systematic approach. The current concept proposes an alert structure that can accurately identify potential leaks in buildings. The process involves the following steps:

1. Proportional Message Transmission

To efficiently communicate the presence of a gas spill, a combination of an LCD screen and a signal transmission system is utilized. This enables the delivery of proportional messages, alerting individuals within the building of any potential danger.

2. Partner Notification

The use of a GSM module allows for immediate notification of relevant partners, such as emergency response teams or gas service providers. This swift communication ensures prompt action can be taken to mitigate the risks associated with an LPG spill. Additionally, the main supply of LPG can be swiftly cut off to prevent further leaks.

3. Identification of Additional Components

Apart from detecting gas leaks, it is equally important to identify other potentially hazardous substances. One such component is liquor, which can pose its own set of dangers. With the help of an MQ Sensor, this technology can successfully identify the presence of liquor, ensuring a comprehensive approach to safety.

Understanding Liquefied Petroleum Gas (LPG)

Before delving further into gas spill detection, it is important to understand the characteristics of the fuel itself. LPG, short for liquefied petroleum gas, is widely used as an energy source for cooking in households. It is a versatile blend of unsaturated and saturated hydrocarbons, derived from commercial propane and butane.

Properties and Behavior

LPG has unique properties that impact its behavior in the event of a gas leak or spill. It is heavier than air, resulting in its tendency to accumulate in depressions and settle in low-lying areas, such as roads. This characteristic must be taken into consideration when developing effective detection and prevention methods. Additionally, LPG has a weight that is 1.5 to 2 times greater than that of air, making it important to address potential risks associated with its release.

Pressure and Melting Point

LPG is highly pressurized when used for household purposes. This pressure is necessary for its efficient storage and use. However, it also means that a minor leak can lead to significant spillage if not promptly addressed. Furthermore, the relatively low melting point of LPG makes it susceptible to melting easily under substantial pressure.

Figure 1: GSM Module

The Importance of Detecting LPG Leaks

LPG, or liquefied petroleum gas, is a highly flammable gas that poses significant risks if not handled properly. With a weight of approximately 14 to 15 kg/cm2, LPG is a powerful fuel source that can ignite with alarming speed. It is imperative to be vigilant when it comes to LPG leaks, as their detection can prevent potential disasters.

One of the challenges in identifying LPG leaks is the fact that its odor is incredibly weak. That's why odorants are added to LPG to improve its detectability. These odorants play a crucial role in helping us identify leaks and take prompt action. While LPG itself doesn't pose direct dangers in its vapor phase, it can lead to suffocation in high concentrations due to oxygen displacement. This underscores the importance of finding and addressing leaks promptly.

Every year, a significant number of accidents occur due to residential LPG leaks. Addressing this issue is paramount. While it may be impossible to completely eliminate LPG leaks, we can take measures to reduce their occurrence and mitigate the risks they pose. This is where the use of efficient leak detection systems becomes crucial.

An excellent sensor to employ in detecting LPG leaks is the LPG Gas sensor (MQ6). This sensor is designed to identify the presence of hazardous liquefied petroleum gas. Additionally, it showcases exceptional sensitivity to other natural gases like is-butane, propane, and butane. In fact, it can also detect flammable gases such as methane. This versatile device can be utilized in various settings, including homes, cars, service stations, and storage tanks.

One of the key attributes of the LPG Gas sensor (MQ6) is its ability to detect leaks at a concentration as low as 1000 PPM (parts per million). As soon as the local LPG concentration hits this threshold, the system emits a signal to alert users of a potential leak. This proactive approach allows individuals to take immediate action and prevent hazardous situations.

Moreover, the LPG Gas sensor (MQ6) can be easily upgraded to cater to industrial-scale requirements. Its adaptability makes it a valuable tool in ensuring safety across different sectors. By implementing this sensor, we can effectively minimize the risks associated with LPG leaks and secure a safer environment for all.

In conclusion, the detection of LPG leaks is crucial in mitigating accidents and maintaining a safe environment. The LPG Gas sensor (MQ6) proves to be an invaluable device, enabling efficient and effective leak detection. Let's prioritize safety and make use of advanced technology to safeguard ourselves, our homes, and our communities from the potential dangers of LPG leaks.

2. Survey of Literature

Numerous studies on the Liquefied Petroleum Gas (LPG) Detector system have been conducted. The article "C-Leakage: Cylinder LPG Gas Leakage Detection for Home Safety" was explained in the "IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)" by T. Soundarya, J.V. Anchitaalagammai, and two other authors. The LPG leak detection system based on microcontrollers is discussed in the paper. This paper's goal was to create a system with a ATMega 16A gas sensor, 16 x 2 display(s), GSM module (SIMCOM 300), and weight sensor (Load CellL6D). The sensor detects an LPG leak, and the user receives information via Short Message Service (SMS). A GSM module is used to simultaneously alert the customer and turn on the exhaust fan and alarm. An added benefit of the system is that it uses a weight sensor to continuously check the amount of LPG in the cylinder and a GSM module to automatically schedule the cylinder.

The "Embedded system for Hazardous Gas detection and Alerting system" was created by V. Ramya and B. Palaniappan. The primary goal is to create a toxic gas detection and alerting system based on microcontrollers. The created system sensed and displayed dangerous gases like propane and LPG. Every single second on the LCD screen. The system was able to send an alert message (SMS) to the designated person via the GSM and to generate an alarm as soon as these gases exceeded the normal level. The advantages of automated detection and alerting systems over manual methods were discussed in the paper. These advantages included rapid response times, precise emergency detection, and the ability to handle critical situations more quickly and effectively.

This paper's goal is to monitor for LPG leaks in order to prevent fire incidents and provide home safety features where security has been a key concern. The system that uses the gas sensor MQ6 to detect LPG leaks is described in the paper. The system notifies the customer of the gas leak by sending an SMS via the GSM module, setting off the exhaust fan and alarm at the same

time. Additionally, the system developed based on the paper offers automatic LPG regulator control. This system will use a relay to cut off the main power supply in order to prevent the blast.

3. Methodology Used

A. GSM Module

Global System for Mobile/GPRS (General Packet Radio Service) Module A TTL modems, also known as SIM900A (general) quad band band GSM/GPRS devices, operate on frequencies that are utilised for mobile network communication. It is extremely small in size and simple to use as a GSM modem that plugs in. The modem can run in the 5.2v–12v range and is designed with 3V3 and 5v DC Til Interfacing circuitry. This enables users to communicate directly with 5 volt microcontrollers, such as the Arduino and 8051 microprocessors.

The major accident associated with LPG use is caused by the gas's potentially dangerous spill. Gas barrels, which are used by every Indian family, have the potential to develop gas holes. The other possibility of a gas leak is from a gas pipeline because ageing pipelines often deteriorate and may eventually burst, providing a pathway for gas to escape. Since LPG is a combustible gas, the likelihood of a flame occurring is very high in the unlikely event that it releases. LPG From 0.72% of all kitchen accidents to 10.74% of all kitchen accidents, gas spills have increased in frequency.

A PC programme that can be used online to identify spillage areas has been started; it functions as the pipelines' programmed administrator in remote areas. Fundamental A simple device called a gas spill detector is used to determine whether or not there has been a gas leak.

B. Arduino Uno R3

The controller in this proposed system is an Arduino Uno R3. The Open-Source Prototype Platform Arduino is well-equipped and built on user-friendly hardware and software. It is quite simple to programme. With the use of appropriate sensors, Arduino boards can detect changes in the physical world and use that information to activate other modules, such as motors or publish any electrical components, either online or offline.

The Arduino software's user-friendly interface makes it ideal for novices. It will simplify the process of setting up a control environment by offering a versatile and standard board. This does not require PCB design in order to be programmed and connected to the system. This software is open source, extensible, hardware extensible, cross-platform, and inexpensive. It also has a simple programming environment. It has enough flexibility for power users. It is compatible with Mac, Windows, Linux, and all other operating systems. It serves as the primary learning tool and the foundation for automation.

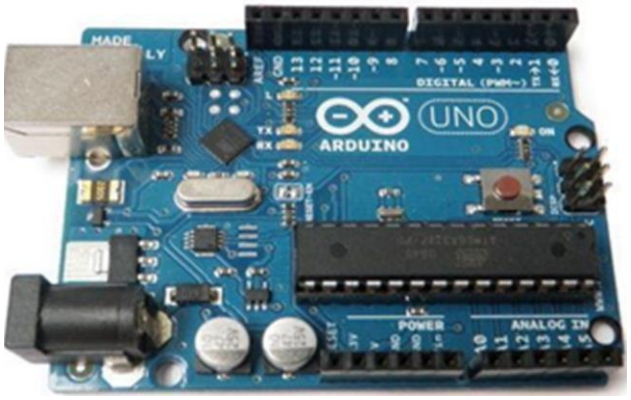

Figure 2: Arduino Uno board

C. Solenoidal valve

This apparatus is extremely safe for regulating the flow of flammable oil and gas, as well as any hazardous gas. It lessens the chance of a fire starting from a spark that could ignite an old rotatory valve through a motor or other moving component. Electromechanically driven solenoid valves transform electrical energy into mechanical energy.

Figure 3: Solenoidal valve

Electromechanically driven solenoid valves transform electrical energy into mechanical energy. Their primary function is to control the flow of gas or liquid, eliminating the need for an engineer to manually operate the valve and saving both money and time.

D Exhaust Fan

The exhaust fans are automatically turned on by the system if a leak is found. The gas is drawn out of the space using the exhaust. Exhaust fans are used to remove surplus moisture and offensive smells from a specific space. They are commonly found in industries and kitchens, where moisture can build up due to activities such as showering, washing, or cooking.

Figure 4 : Exhaust Fan

The warm air that is drawn out by an exhaust fan is then pulled through a ducting system and expelled outside. In other words, exhaust fans function by sucking hot or humid air out of a small , localised area and allowing fresh air to enter from elsewhere (perhaps a doorway or vent) in order to replace it.

E. MQ-6 Sensor

The MQ–6 Sensor is the essential component of this apparatus. It detects the presence of any other flammable gases in addition to LPG. This sensor's

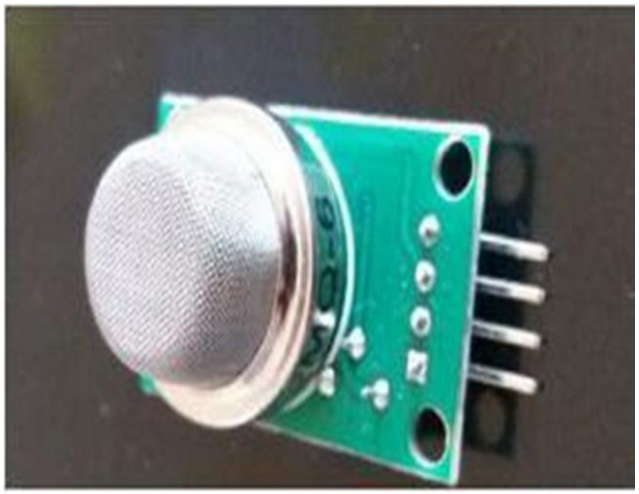

Figure 5 : MQ-6 Sensor

detection speed is extremely quick. Its life span is very long. It offers excellent sensitivity to propane and isobutane in addition to LPG. It is sensitive to smoke and alcohol. The sensor's basic dimensions are 23 ± 5% for height and 20 ± 5% for width, as stated in the manufacturer's specifications. The range of gas concentrations that the detector can identify is 200 p.m. to 10,000 p.m. When a gas is detected, the sensor feeds the output as high; otherwise, it produces a low turnout. The fundamental operation of the sensor can be summed up as follows: when the gas interacts with the detector, it ionises into tin di oxide, which is then occupied by the sensing element. The potential difference is altered by this absorption, and as a result, a current known as heating current flows through the connecting leads. Since the sensing gas value is in analogue single, resistance varies as current passes through the tin oxide filament to generate the analogue signal.

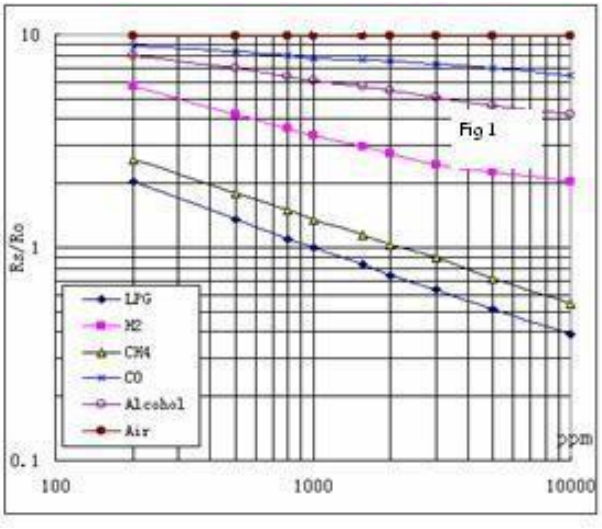

Figure 6: shows the typical sensitivity characteristics of the MQ-6

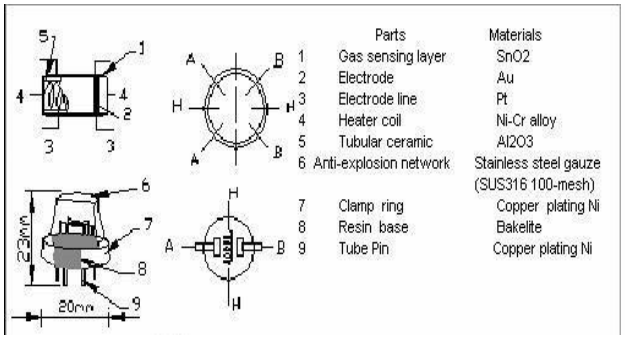

Figure 7 : structure and configuration of MQ-6

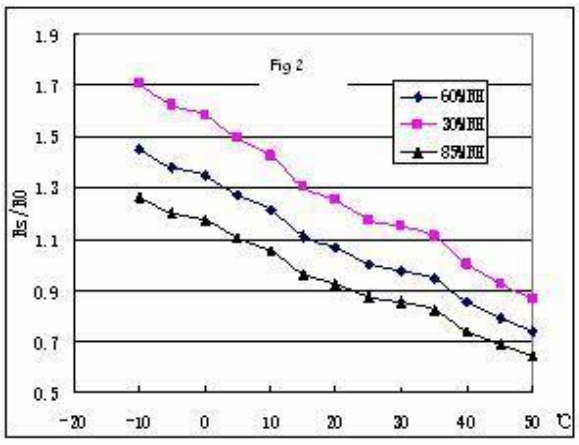

Figure 8 : Shows the typical temperature and humidity characteristics of MQ-6

G. Future Scope

The present gas spillage recognition framework can be additionally improved. These days, it is possible to create a flexible robot that can identify different types of gas fixations. The extension of a load cell can also be used as a weight sensor to detect the amount of gas in the chamber and, in addition, to identify high-weight gas in barrel pipes, displaying alarm messages on LCD displays and SMS.

The project's future scope calls for integrating this system with additional software-based intelligent features. This system automatically detects, controls, and alerts for gas leaks. This system will eventually have the ability to alert emergency services to any accidents that occur. Additionally, a web-based and mobile app for real-time monitoring will be added. This system's user app will have a lot of clever features added to it. Users will feel safer using the system overall thanks to its features. The system will be designed to be used in a variety of settings, including homes, cars, and workplaces. Once the ultimate prototype with intelligent multifunctional features has been designed, the system will be put into practise in a real-world setting.

4. Result

A tiny measurement of LPG gas was used in close proximity to the sensor to test this model. When the MQ–6 gas sensor detects the presence of LPG gas, a signal is sent to the microcontroller. Subsequently, with a solenoid valve's assistance. The model returns to its ready state to detect gas at the moment the reset button is pressed. During the testing period, the suggested gas leakage detector showed excellent performance and gas leakage execution results. Following numerous observations, the outcome was roughly the same in numerous instances. The gas sensor may detect a gas leak in a few seconds, but as soon as it does, it shuts the valve right away.

Figure 9 : Condition when there was no gas

Figure 10 : Condition when there was LPG gas detection

5. Conclusion

As evidenced by the fact that the number of fatalities brought on by gas cylinder explosions has increased recently. Here, we intend to suggest a model based on a microcontroller that uses a gas sensor MQ–6 to identify potentially dangerous gas spills. In order to indicate that there is no gas leak, the detector flashes a green LED. The LED flashes red and emits a buzzing sound when there is a gas leak. The project's primary goal is to provide a novel approach to security. The main goals of this straightforward gas leak detector are its ease of use and ability to alert its owner when LPG gas leaks. This framework's audio warning system is its other preferred feature. This system is inexpensive and well-executed. An additional advantage of this device is that, even in the event that a gas leak occurs while no one is home, the GSM module will notify the owner of the gas leak and lessen the severity of the incident by sending timely alerts. The test results verify the model's efficiency and productivity by identifying low and high gas spillage levels, automatically shutting off the gas supply, and alerting the customer with an audible alarm warning signal. In emergency situations, the suggested Arduino-based gas leak detector responds more quickly and accurately than a manual task. A system for distinguishing between the various gas spills at private homes, hotels, restaurants and other business and industrial areas to prevent endangering human life.

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