SENSOR-BASED LPG LEAKAGE ALERT SYSTEM

MOHAN K. V.
Lecturer in Electronics Engg.
Govt. Polytechnic College, Kannur, Kerala.

Abstract:
Home fires have become more common in recent years, posing a greater risk to human lives and property. Liquid petroleum gas (LPG) is highly flammable and can burn even far from the source of the leak. The majority of fires are caused by a poor-quality rubber tube or because the regulator is not turned off when not in use. As a result, developing a gas leakage alert system is critical. Gas leakage is a major issue in the industrial sector, residential buildings and so on. Because of rising gas leakage, home security has become a major concern. Gas leakage is a major source of concern in ateliers, residential areas, and vehicles such as Compressed Natural Gas (CNG), buses, and cars that run on gas power.

Keywords:
Liquid petroleum gas, LPG, Gas leakage, Compressed Natural Gas, CNG, LPG Leakage Detector, microcontroller,

Introduction:
There are numerous sensor-based projects available, and this is a low-cost Microcontroller-based project. Microcontroller-based LPG leakage detector with buzzer indication using MQ6 (LPG Gas) sensor has applications in a variety of fields, including industrial and domestic. This system is extremely useful in hotels, homes, automobiles, and LPG stations. This system meets the most stringent safety requirements. The most important feature is that it aids in the prevention of fire-related accidents. It can also be used to protect human life, wealth, and property.
To detect LPG leakage, we used a MQ6 (LPG Gas) sensor. This sensor has a fast response time and responds in a short amount of time. A Comparator receives the output of the MQ6 sensor. And the comparator IC's output is sent to the microcontroller 89s51. When MQ6 exceeds the threshold level, the LCD display displays a message. A buzzer is also activated to provide alert indications. We've included a potentiometer for adjusting the threshold level of the comparator, which determines the leakage condition's threshold level. [1-2]

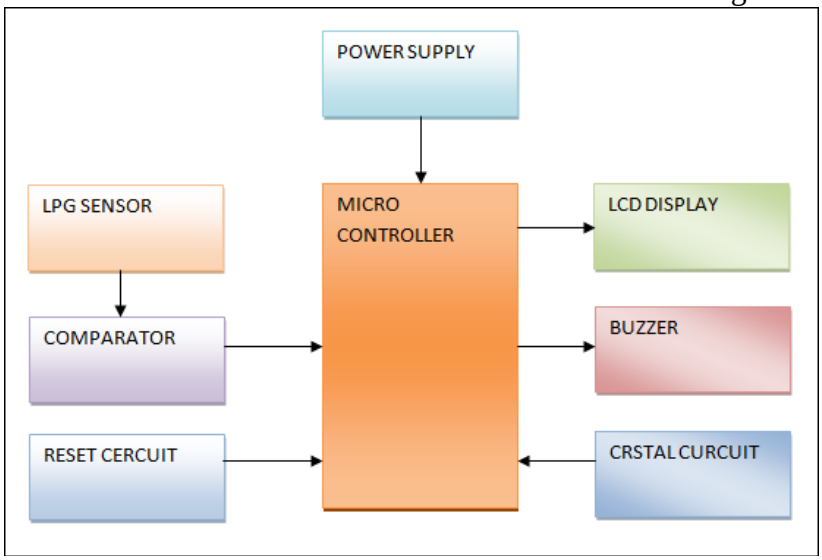

Figure 1: Block Diagram

Description in detail:

Components Needed: –

- Any microcontroller preferably Arduino Uno for beginners.
- A red led
- An MQ-3 Alcohol sensor
- A breadboard
- Jumper wires
- 220ohm resistor
- A buzzer

In most cases, liquid petroleum gas is used in homes and businesses. LPG is primarily used in homes for cooking. This energy source is primarily made up of the highly flammable chemical compounds propane and butane. LPG leaks can occur, albeit infrequently, inside a home, commercial premises, or in gas-powered vehicles. Leakage of this gas can be hazardous because it increases the risk of an explosion. LPG contains an odorant, such as ethanethiol, which allows most people to detect leaks. However, some people with impaired senses of smell may be unable to rely on this built-in safety mechanism. In such cases, a gas leakage detector is essential for protecting people from the dangers of gas leakage. A number ofresearch papers on gas leak detection techniques have been published. Advanced gas leak detection technology is used in this project. [3]

Gas leakage causes a variety of accidents that result in both material loss and human injuries. The risk of explosion, fire, and suffocation is determined by physical properties such as toxicity, flammability, and so on. The number of deaths caused by gas cylinder explosions has been rising in recent years. Substandard cylinders, old valves, worn out regulators and a lack of awareness in handling gas cylinders are the causes of such explosions. LPG or propane is a flammable mixture of hydrocarbon gases that is used as fuel in many applications such as homes, hostels, industries, automobiles, and vehicles due to its desirable properties such as high calorific value, less smoke, less soot, and minimal environmental impact. Natural gas is another popular home fuel. Both gases burn to generate clean energy, but there is a serious problem with leakage. These gases do not disperse easily because they are heavier than air. When inhaled, it can cause suffocation and explosion. [4]

The number of deaths has risen in recent years as a result of LPG explosions. To avoid this problem, a system to detect LPG leakage is required. The process of detecting potentially hazardous gas leaks using various sensors is known as gas leak detection. Several LPG detection and alert system designs have been proposed in the literature.

This paper describes an LPG leak detection and alert system for preventing fires and ensuring home safety. The remainder of the paper is structured as follows. Section 2 describes the LPG leak detection and alert system, and Section 3 wraps up the paper. [5]

Review of Literature:

Substandard cylinders, old valves, no regular checking of gas cylinders, worn out regulators and a lack of awareness of gas cylinder handling are the causes of such explosions. As a result, gas leaks must be detected and controlled to keep people safe. LPG contains an odorant, such as ethane thiol, which allows most people to detect leaks. However, some people with impaired senses of smell may be unable to rely on this built-in safety mechanism. A gas leakage detector becomes essential in protecting people from the hazards of gas leakage. A number of research papers on gas leak detection techniques have been published. K. Padmapriya and colleagues proposed the development of a wireless LPG monitoring system. In this paper, the user is notified of a gas leak via SMS, and the power supply is turned off [6].

The leakage detection and real-time gas monitoring system was proposed by Meenakshi Vidya et al. The gas leakage in this system is detected and controlled by an exhaust fan. The LPG level in the cylinder is also constantly monitored. [7]

Objectives:

1. Define various sensors and low cost Microcontroller.
2. Low-cost LPG leakage detector
3. Analysis gas leakage detection and alert system.
4. Sensor-Based LPG Leakage Alert System

Research Methodology:

Semiconductor sensors are used in this paper to detect LPG gas. The MQ6 semiconductor sensor is employed. The MQ-6 gas sensor's sensitive material is SnO2, which has a lower conductivity in clean air. When the target combustible gas is present, the sensor conductivity rises in tandem with the increasing

gas concentration. The MQ6 gas sensor is highly sensitive to Propane, Butane, and LPG, as well as responsive to Natural Gas. The sensor could be used to detect various combustible gases, particularly methane; it is inexpensive and suitable for a variety of applications. The MQ-6 can detect gas concentrations ranging from 200 to 10,000 parts per million (ppm). The output of the sensor is an analogue resistance. The block diagram of the gas leak detection and alert system is shown in Figure 1.

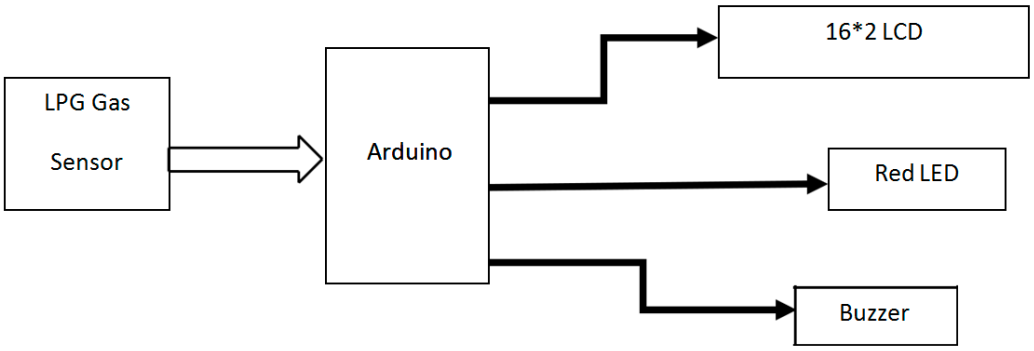

Figure 2: Block diagram of gas leakage detection and alert system.

This system is built around an Arduino UNO R3 and a MQ-6 gas sensor. If the sensor detects gas in the atmosphere, it will give a digital output of 1, otherwise it will give a digital output of 0. The sensor output will be received as digital input by Arduino. If the sensor output is high, the buzzer will begin to tune, and the LCD will display "Gas detected: Yes." If the sensor output is low, the buzzer will not tune and the LCD will display "Gas detected: No".

Result and Discussion:

As shown in Figure 1, the LPG leak detection and alert system presented in this section is simple but reliable. It is battery powered and thus portable. It is designed in such a way that it can also be used with an alternating current power supply. It has a bridge rectifier with a capacitor filter to support the latter case. This is followed by an IC7805-based regulator that provides +5V regulated power supply. [8]

Figure 3: LPG leakage detection and alert system

The MQ-6 gas sensor is used to detect LPG. This sensor can be powered up to +5V. This sensor has a high sensitivity and a quick response time. It can detect LPG concentrations ranging from 200 to 10,000ppm. This sensor's gas sensing layer is made of Tin Dioxide (SnO2) and gold (Au) electrodes. The gas sensor output is sent to the LM358 dual operational amplifier, where it is compared to the gas density threshold value, which is set using preset potentiometers, and amplified. If the sensed voltage exceeds the threshold voltage, the operational amplifier output activates the driver circuit for the LED and Buzzer. As a result, the LED will glow and the buzzer will begin to emit an alarm sound. [9-10] The Proteus Design Suite is a closed-source software tool suite primarily used for electronic design automation. Electronic design engineers and technicians primarily use the software to create schematics and electronic prints for the fabrication of printed circuit boards. Figure 3 depicts the circuit diagram created with Proteus libraries. This system is built around the Arduino UNO R3 and the MQ-6 gas sensor. If the sensor detects gas in the atmosphere, it will give a digital output of 1, otherwise it will give a digital output of 0. The sensor output will be used as the digital input by Arduino.

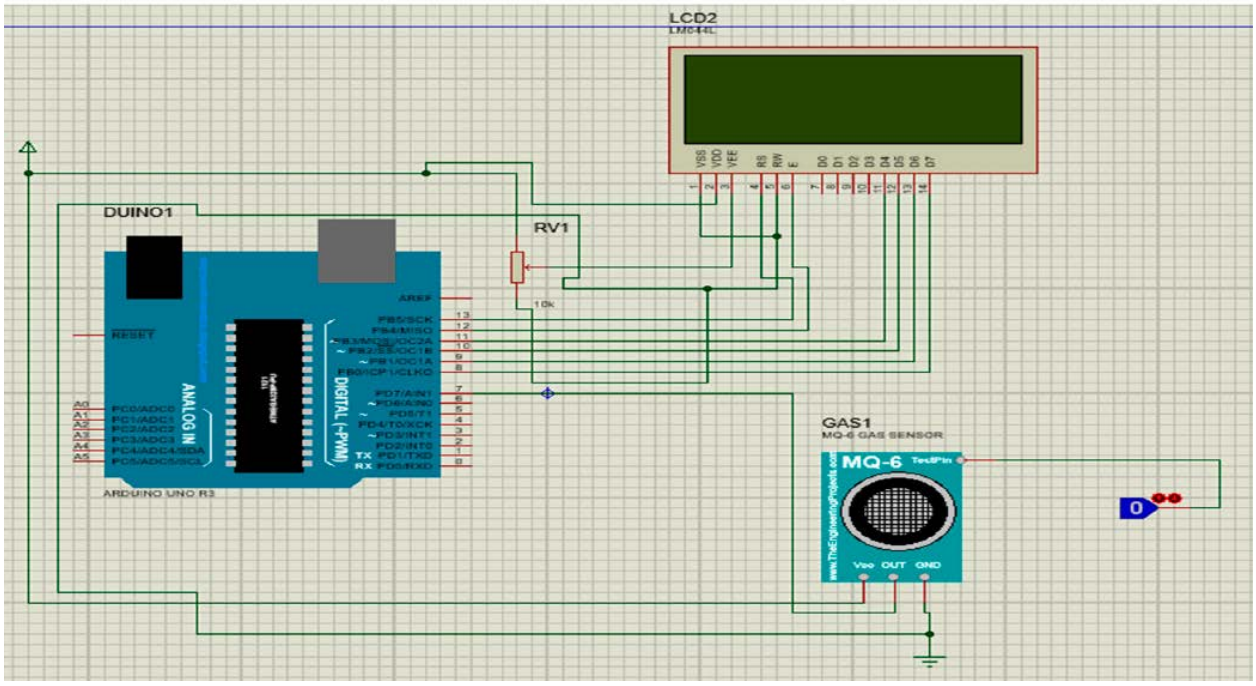

Figure 4: Circuit diagram that was designed using Proteus libraries.

The sensor outputs both digital and analogue data. The distinction between the two is straightforward: in digital output, only high or low values (either 1 or 0) are transmitted to the microcontroller, whereas in analogue output, a wide range of values ranging from 0 to 1023 is transmitted to the microcontroller, corresponding to the strength of the gas in the environment and increasing for more dense fumes. The sensor is constructed from an LM393 IC, which includes an amplifier that amplifies the voltage signal to detectable levels [11].

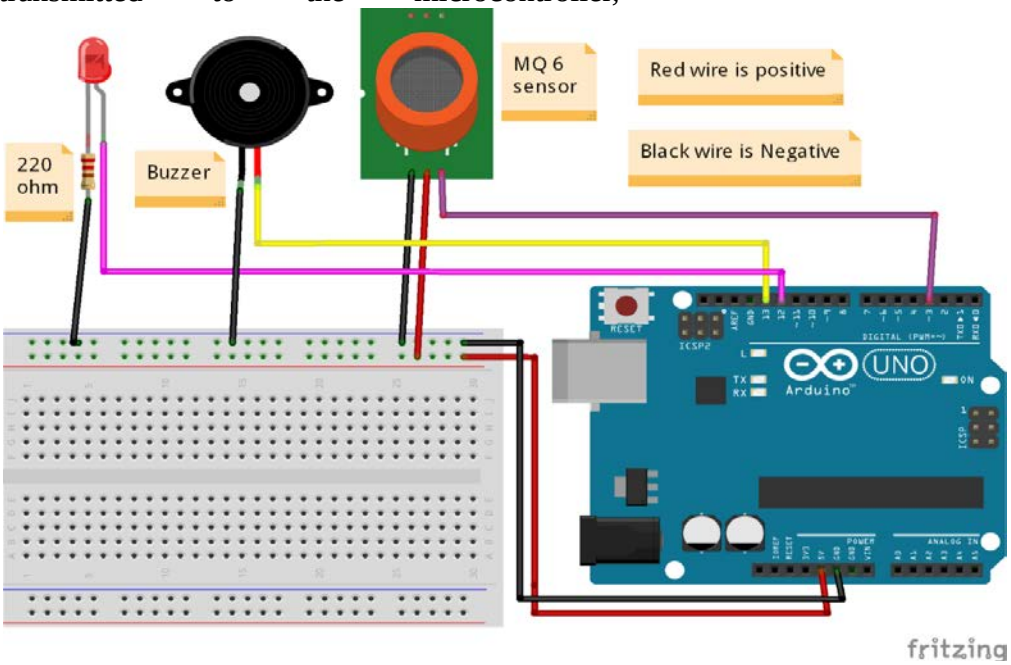

Figure 5: Circuit diagram of MQ-6 gas sensor connected with Arduino

If the system detects a level of gas in the air that exceeds the safety level, it will activate the alarm, which includes a buzzer, to notify users at home of the abnormal condition and prompt them to take any necessary action. The smell of gas in the home is the most obvious sign of a leak. [12]

Applications of Microcontroller based LPG Gas leakage system:

- We can use this project for safety in the home and hotel utility (kitchen) areas. LPG cylinder inspections are critical.
- Effective in domestic LPG water heaters

- Extremely useful in LPG/CNG-equipped vehicles to avoid major accidents.
- It prevents measurement errors in gas agencies (gas stations) where multi-cylinders are kept.

Hardware specification of LPG leakage detector with buzzer:

- 89s51 series microcontroller
- Transformer
- Voltage regulator
- Crystal
- Diodes
- Resistance
- Capacitors
- Buzzer
- MQ6 Sensor
- A 16*2 LCD display

Advantages:

• Quick sensor response

• Low sensitivity for MQ3 indicates that the alcohol sensor provides additional system features.

• The LPG sensor's high sensitivity

Future Development:

- With more sensors, we can monitor more parameters.
- We can also incorporate GSM into this project, making it an SMS-based LPG leak detection system.

Conclusion:

Gas leaks cause serious accidents that result in material losses and human injuries. Gas leakage is caused primarily by poor equipment maintenance and a lack of public awareness. As a result, detecting LPG leaks is critical for avoiding accidents and saving lives. This paper described a system for detecting and alerting on LPG leaks. When LPG leakage is detected, this system activates an LED and a buzzer to alert people. This system is simple but dependable. This is a reliable method for automatically detecting and controlling LPG gas leaks. Furthermore, fire accidents are avoided by turning off the power supply.

References:

1. Mahalingam, A., R. T. Naayagi, and N. E. Mastorakis. "Design and implementation of an economic gas leakage detector." Recent Researches in Applications of Electrical and Computer Engineering, pp. 20-24, 2012.
2. Ashish Shrivastava, RatneshPrabhaker, Rajeev Kumar, Rahul Verma, "GSM based gas leakage detection system." International Journal of Emerging Trends in Electrical and Electronics, vol. 3, no. 2, pp. 42-45, 2013.
3. B. D. Jolhe, P. A. Potdukhe, N. S. Gawai, Automatic LPG Booking, Leakage Detection And Real Time Gas Measurement Monitoring System, published in 2013.
4. V. Ramya, B. Palaniappan, Embedded system for Hazardous Gas detection and Alerting, published in 2012.
5. M. B. Frish, R. T. Wainner, B.D.Green, M.C.Laderer, M.G.Allen, Standoff Gas Leak Detectors Based on Tunable Diode Laser Absorption Spectroscopy, published in 2011.
6. R.Padmapriya, E.Kamini,Automatic LPG Booking, Leakage Detection and a Real Time LPG Measurement Monitoring System, published in 2013.
7. P.Meenakshi Vidya, S.Abinaya, G.Geetha Rajeswari, N.Guna ,Automatic LPG detection and hazard controlling published in April 2014.
8. LuayFriwan, KhaldonLweesy, Aya Bani-Salma and Nour Mani, A Wireless Home Safety Gas Leakage Detection System, IEEE, 2011.]
9. Boddu, R, Balanagu, P & Babu, N Zigbee Based Mine Safety Monitoring System with GSM. International Journal of Computer & Communication Technology., (2012)
10. Zhao Yang, Mingliang Liu, Min Shao, Yingjie Ji Research on leakage detection and analysis of leakage point in the gas pipeline system. In Open Journal of Safety Science and Technology; 2011.
11. J. Ding, J. Wang, N. Yuan and Q. Pan, "The Monitoring System of Leakage Accidents in Crude Oil Pipeline based on Zigbee Technology", 2011 IEEE Changzhou University.
12. G. Stewart, C. Tandy, D. Moodie, M. A. Morante and F. Dong, "Design of a fibre optic multi-point sensor for gas detection", Sensors and Actuators B: Chemical, vol. 51, no. 1, pp. 227-232, Aug. 1998.