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Design and Analysis of low-cost LPG (liquefied petroleum gas) detector

Mehedi Hasan[1], Md. Atiquen Nobi[2], Dr. Himani Goyal Sharma[3]

Student of Electrical Engineering Department ([1, 2])
Professor, Department of Electrical Engineering ([3])
University Institute of Engineering, Chandigarh University, Gharuan , Mohali, Punjab, India

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Abstract - *The growing popularity of LPG as an economical and environmentally friendly fuel means that inexpensive and dependable gas leak detection devices are needed to improve home and workplace safety. This work describes the development and application of a low-cost LPG gas leak detection system that balances affordability, accuracy, and sensitivity. A microprocessor is coupled with a gas sensor that has a high sensitivity to LPG in the suggested detector to process data in real time. When the system detects LPG concentrations over safe thresholds, it is intended to sound an audio and visual alarm to alert occupants in a timely manner. A greater variety of consumers can use the detector since easily available materials and components are used to reduce expenses. The efficiency of the detector in quickly detecting gas leaks is demonstrated by the results of studies that simulate different leakage scenarios. Furthermore, the device's low cost makes it appropriate for broad deployment, enhancing safety standards in settings where LPG is often used.*

***Key Words*: LPG, Arduino-Uno, Low cost, GSM, Sensor Technology, Alarm system, Detection system.**

1. INTRODUCTION

Liquefied Petroleum Gas (LPG) is widely used for cooking and heating in many households and industries. However, the improper handling or leakage of LPG can lead to hazardous situations, including fires and explosions. To ensure safety and prevent such incidents, the development of low-cost and efficient gas leakage detection systems has become essential. One cost-effective and popular solution is the use of an Arduino-based gas leakage detector in combination with the MQ-2 gas sensor and this is a widely available and affordable component known for its sensitivity to a variety of gases, including LPG, methane, propane, and even smoke. When LPG gas is detected in the environment, the sensor's resistance changes, and this change is monitored and processed by an Arduino microcontroller. The Arduino, a versatile open-source microcontroller platform, is programmed to interpret the sensor's data and trigger appropriate responses in case of a gas leakage. This can include sounding an alarm, sending alerts through various communication channels, and even shutting off the gas supply to prevent further leakage. The system offers real-time monitoring, early detection, and a timely warning mechanism to protect lives and property. The advantages of using Arduino and the MQ-2 sensor for LPG gas leakage detection include low cost, ease of customization, and a strong DIY (Do-It-Yourself) community that can help individuals design and implement their own gas detection systems. It is a practical and accessible solution for ensuring the safety of homes, commercial kitchens, and other places where LPG is used.

2. LITERATURE REVIEW

In past years many LPG gas detector have been proposed to detect leakage of LPG efficiently. Some use different sensors like MQ in place of MQ-2 gas sensor. There is a user who has designed the appliance that turns off the gas line by sending them a text message. Some even used buzzer and leakage detector system. This paper discusses about the cost and efficient as compare to market LPG gas detector and end of the time this project is user friendly and very less price. These detectors are essential for maintaining safety in environments where LPG (liquefied petroleum gas) is often utilized, such as homes and businesses. Traditional gas detection systems, such as electrochemical and catalytic combustion sensors, were the main focus of early research. But more recently, materials including metal oxides, polymers, and nanostructures have been used to create innovative sensing technologies. These developments have maintained or even improved detection sensitivity and accuracy while drastically lowering production costs. Owing to their high sensitivity to LPG and low cost, metal oxide-based sensors have been the subject of numerous investigations. Usually, these sensors detect changes in electrical conductivity when they come into contact with LPG gas. Additionally, the creation of nanostructured metal oxide materials has been made possible by advances in nanotechnology.

3. OBJECTIVES:

I. Affordable and reliable solution for detecting LPG gas leaks.
II. Ensures safety by promptly detecting and alerting for gas leaks.
III. Minimizes the risk of gas-related accidents and explosions.
IV. Accessible to households, small businesses, and community centers.
V. User-friendly installation and operation with minimal maintenance.

VI. Optimized sensor technology for accurate detection.
VII. Long lifespan, reducing replacement costs.

4. BLOCK DIAGRAM

In this paper following parts are gas sensor, ardunio-uno, piezo and led's. The main part is arduino that structure of Atmega328P (Advance virtual rise microcontroller) by using Arduino IDE.

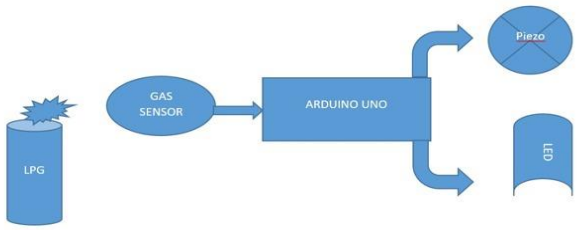


Figure-1: Block Diagram

5. Design implementation and selection:

Arduino Uno: An ATmega328P-based microcontroller board is the Arduino Uno. It features a 16 MHz ceramic resonator (CSTCE16M0V53-R0), 6 analog inputs, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button.

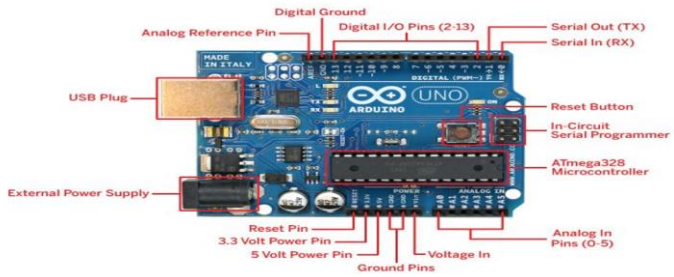


Figure-2: Pin explanation of Arduino Uno

It comes with everything essential to support the microcontroller, which means all you need to do is power it with a battery or an AC-to-DC adapter or connect it to a computer systems via a USB cable to get going. You can experiment with your Uno without too much fear of making a mistake; in the worst case, you can replace the chip and start over for a few bucks. The name Arduino Software (IDE) 1.0 was chosen with the meaning of "uno," which is one in Italian.

MQ-2 sensor: One of the most popular sensor models is the MQ2 sensor. Metal Oxide Semiconductor, or MOS, is the type of sensor it is. Since the sensing material's resistance changes when exposed to gases, metal oxide sensors are also referred to as chemiresistors.Utilizing about 800mW of power, the MQ2 gas sensor runs on 5V DC. The sensor has this appearance when the outer mesh is removed. Forming the star shape is the sensor element and six connecting legs that protrude beyond the Bakelite base.

Figure-3: MQ2 Gas Sensor

Figure-4: sesnitivity adjustment of MQ2

It can identify amounts of 200–10,000 ppm of carbon monoxide, hydrogen, methane into the alcohol, smoke, and propane. The MQ2 sensor is powered by a heater.. Consequently, rather of identifying which gas density is changing, the technique is best for sensing variations in a known gas density. Consequently, two layers of fine stainless steel mesh, described as an "anti-explosion network," are attached to it.

Pizeo buzzer alarm: The way attraction buzzers and piezo buzzers make sound is different from one another. Magnetic buzzers use an alternating current that functions inside the magnetic particle field.

Figure-5: Piezo burzzer alarm

Piezo buzzer alarm compounds reacted to alternating voltage by changing their form. The magnetic element of the buzzer creates a continuous field of magnetic attraction, which when combination with this enable the coil to vibrate freely and creates sound.

Table-1:

Operating voltage	5V
Load resistance	20 KΩ
Heater resistance	330 ± 5%
Heating consumption	<800mw
Sensing Resistance	10 KΩ – 60 KΩ
Concentration Range	200-10000ppm
Preheat Time	Over 24 hour

Technical Specifications: The MQ2 gas sensor is a multifunctional module that can identify various gases, such as smoke, LPG, and others. Its operating voltage range is 5V to 10V, and its normal current consumption is 150mA. To detect gasses, the sensor uses a coil that heats in combination with a semiconductor layer made of tin dioxide (SnO2). A potentiometer can be used to optimize its sensitivity to various gas concentrations. The MQ2 sensor performs quickly for the majority of cases usually in a matter of seconds.

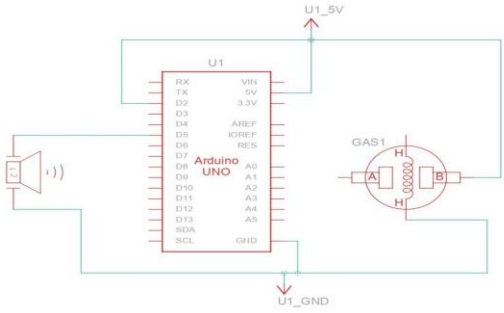


Figure-6: Schematic diagram(Low cost LPG)

In Arduino Uno, we have to connect with piezo positive pin with Digital Input (-5) and negative pin connected with Ground(GND). In the MQ-2 gas sensor part B1 Pin connected with 5V power then H2 pin connected with ground (GND) Of Arduino Uno. After thatB2 pin connected with digital input pin number (2).Finally our product detect LPG.

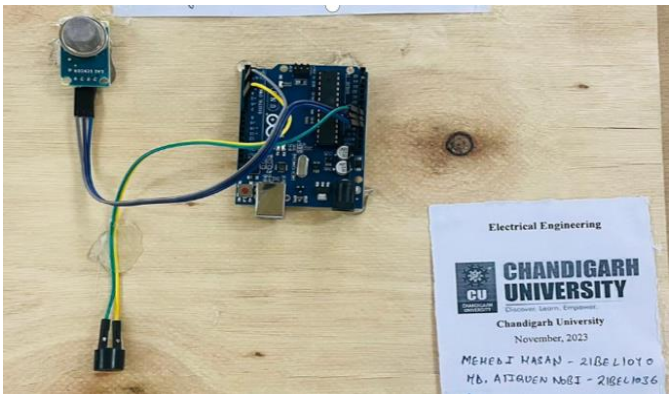


Figure-7: final hardware (LPG detector)

6.Methodology:

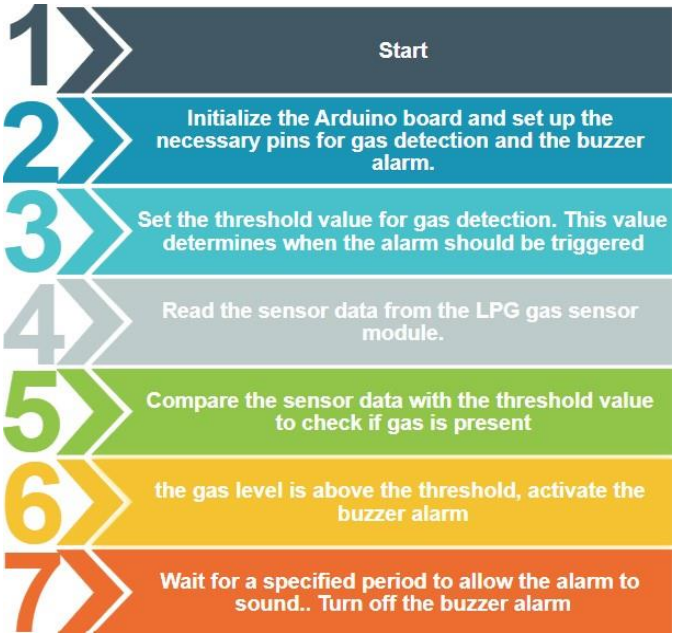


Figure-8: Flow chart of LPG gas detector

Table-2:

SN	Equipment	Quantity	Price
1	Arduino Uno	1	220
2	MQ-2 gas sensor	1	50
3	Buzzer	1	9
4	Connecting wire	5	2
5	Adaptor	1	70
		Total price	351

Total cost of our project: If we compare other LPG gas detector product with our product we see that the main difference is prices in market. We can make it with low cost and the size of our product is very small as we say user friendly anywhere we can set the detector of LPG. We can make it reasonable prices within 351 rupees in Indian

market. This prices will be also decrease if we bought all equipment from whole sell shop.

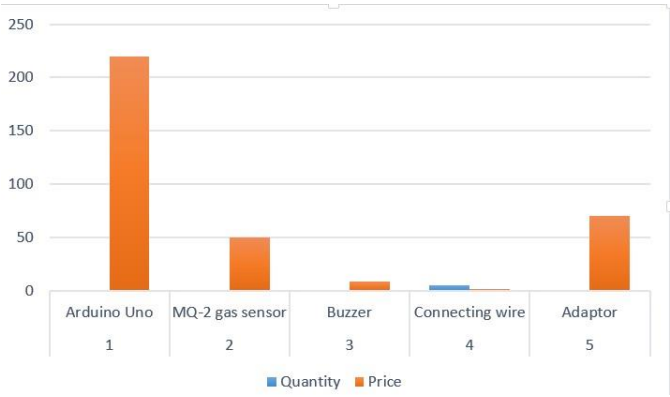
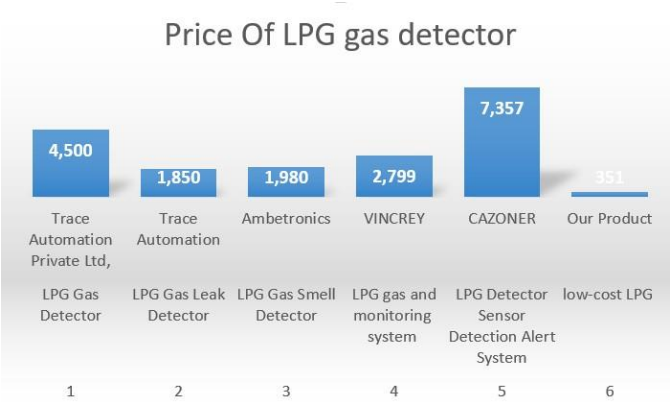


Figure-9: Bar graph (LPG detector)

RESULTS ANALYSIS AND VALIDATION:

The analysis of different market place prices of LPG gas detector:



In this analysis we have find out low cost LPG gas detector. In market LPG gas detector price is too much high as compare to our product. Here this type of product is minimum 2000 rupees but our product can be made very less price. We have to make our project under 350 rupees. If we will by equipment from wholesale market the product cost will be less. So we can our product is too much good for efficiency and price.

7. CONCLUSIONS:

The design and analysis of a low-cost LPG gas detector with an Arduino buzzer alarm provide a simple and effective solution for detecting and alerting the presence of LPG gas. By connecting an Arduino board, LPG gas sensor module, and buzzer, you can create a reliable gas detection system at an affordable cost. The implementation involves connecting the components correctly, writing code to read sensor data, comparing it with a threshold value, and activating the buzzer alarm when necessary. By continuously monitoring the gas level, the detector can quickly alert users to potential gas leaks, ensuring safety in homes or other environments where LPG gas is used. Remember to adapt the implementation to your specific requirements and consider additional features or error handling mechanisms as needed. Regular testing and maintenance are essential to ensure the proper functioning of the gas detector. With proper implementation and vigilance, this low-cost LPG gas detector can contribute to creating a safer environment.

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