ABSTRACT

Liquefied Petroleum Gas (LPG) is a main source of fuel, especially in urban areas because it is clean compared to firewood and charcoal. Gas leakage is a major problem in the industrial sector, residential premises, etc. Nowadays, home security has become a major issue because of increasing gas leakage. Gas leakage is a source of great anxiety with ateliers, residential areas and vehicles like Compressed Natural Gas (CNG), buses, and cars which are run on gas power. One of the preventive methods to stop accidents associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this paper is to propose and discuss a design of a gas leakage detection system that can automatically detect, alert and control gas leakage. This proposed system also includes an alerting system for the users. The system is based on a sensor that easily detects a gas leakage.

We use 8 bit microcontroller to perform the desired task by interfacing Gas sensor, Buzzer and LCD to display.

The output of the Gas sensor is in analog form which can be converted into digital form using MCP3201 which is an ADC (Analog to Digital Converter). Initially when there is a leak the Gas sensor detects it and gives voltage related to the amount of gas that is getting escaped from the apparatus. We create a set-point to the microcontroller so as if the Gas sensor gives the output above the set-point the controller drives the buzzer ON as an indication to the user.

This can be used as an application in chemical and hazardous industries where there is a continuous need of monitoring the gas leaks. By using different kinds of sensors for every gas we can almost identify leaks for every kind of gases.

Keywords: LPG (liquefied petroleum gas); gas sensor MQ-2; buzzer (alarm); LED (light)

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CHAPTER 1
INTRODUCTION

1.1 Background of Study

Gas detection of a hydrocarbon gas via infrared (IR) absorption requires the absorption of optical energy (IR) by the gas at the wavelength of interest . Different gaseous have different absorption spectrum. In this project, attention will be given to Liquefied PetroleumGas (LPG). which is an energy source primarily composed of propane and butane. Due to the unique absorption properties of gas to infrared radiation, leakage can be detected measuring and comparing the IR intensity at both source and detector. In order to enhance the effectiveness of the gas leakage detector, a circuit consisting of an alarm system will be implemented to the prototype to warn users when gas leakage occur

1.2 Problem Statement

In most industries, one of the key parts of any safety plan for reducing risks to personnel and plant is the use of early-warning devices such as gas detectors. These can help to provide more time in which to take remedial or protective action. They can also be used as part of total, integrated monitoring and safety system for an industrial plant Rapid expansion of oil and gas industry. leads to gas leakage incidents which are very serious and dangerous. Solutions need to be find out at least to minimize the effects of these incidents since gas leaks also produce a significant financial loss . The challenges are not only to design a prototype of the device that can only detect but also automatically respond to it whenever the leakage occurs.

1. The semiconductor principle of the gas detector

Principle: The semiconductor gas sensor is made by using some metal oxide semiconductor materials. At a certain temperature, the resistance changes with the change of the ambient gas composition. For example, the alcohol sensor is prepared by using the principle

when dioxide encounters alcohol gas at high temperature, the resistance will decrease sharply.

Advantages: low cost, simple manufacturing, high sensitivity, fast response speed, long life, low sensitivity to humidity and simple circuit.

Disadvantages: poor stability and greater environmental impact, especially the selectivity of each sensor is not unique, and the output parameters can not be determined. Therefore, it should not be used in places where measurement accuracy is required, mainly for civilian Use.

Figure 1

Damage that occurred due to LPG explosion

The Figure 1 above is an example of LPG explosion. Such accident might occur when it is not properly-monitored. In the four-season countries like Russia, the LPG is used as one of the heating sources to warm the citizens' houses during winter. There was no one was in the home at the time of the explosion. "This explosion has raised the roof and blew out the walls of the house, sending debris flying into neighbouring yards. The two-storey house which was owned by Steve Cook, was rendered uninhabitable and its three occupants temporarily made homeless.

The LPG is also one of the gasses which is difficult to detect by human's limitation of senses. "Cook said that natural gas caused the explosion, but he was unable to detect any gas fumes because a workplace accident had robbed him of his sense of smell. He happened to leave the house to pick up his daughter from school when the house blew up"

2. Infrared principle of gas detector

Principle: The non-split infrared principle NDIR sensor uses the Beer-Lambert infrared absorption law, that is, different gases absorb light at a specific wavelength, and the intensity of absorption is proportional to the concentration of the gas to achieve detection. It uses an optical filter to divide the infrared light into a required spectral line of a very small wavelength band, and the detected gas absorbs the spectral line of this very small wavelength band.

Advantages: high reliability, good selectivity, high accuracy, no toxicity, less environmental interference, long life, and no dependence on oxygen. Disadvantages: It is greatly affected by humidity, and the types of detection gases are limited.

1.3 Objectives

This project is the continuation based from the previous Final Year Project 2007 will improvise the unsuccessful transmitter circuit of infrared radiation. By the end of this project,student is expected to have built a working prototype which will be able to detect the gas leakage and automatically .Other than that, student must also add some of the safety actions which are the implementation of alarm system to alert users of the leakage occurrence. The alarm will trigger as soon as the infrared radiation has shown a positive detection when the leakage of LPG had occurred. Due to the trigger of the alarm, the air-valve is also activated to close the pipeline which in this prototype case, the plastic tube acted like one. Once the air valve has fully-closed, an alarm will be disabled.

1.4 Scope of Study

The scope of study for this project are To study on the characteristics of infrared (IR) and Liquefied Petroleum Gas (LPG) : Students need to study on the mechanism of infrared being emitted and absorbed. Since LPG is one of the gases that absorbs IR radiation at certain wavelength, the detection principle can be done by comparing the intensity difference before and after the absorption of the LPG. To understand the working principle of alarm system and design the circuit: Alarm circuit has to be constructed to automatically respond to the occurrence of leakage. Several conditions need to be considered in order to trigger the alarm .To design a working prototype of gas leakage detection equipped with automatic alarm system: A successful working prototype consisting of infrared emitter and sensor, alarm circuit and emergency shutdown valve is expected to function very well at the end of this project. To construct working circuit for infrared transmitter and detector :Transmitter circuit should be able to transmit infrared radiation at a desired frequency .Appropriate detector circuit need to be find to detect the presence of leakage and trigger the relay circuit .

CHAPTER 2
LITERATURE REVIEW

A number of reviews on the subject of gas leakage detection techniques were done in the past either as part of research papers/technical reports on a certain leak detection method and other gas related subjects.

G.A.Arun Kumar, K.Rajasekhar, B.V.V.Satyanarayana , K.Suryanarayana Murthy, 2012, "Implementation of Real time Detection of Gas leakage in Industries using ARM7 &ZigBee",September, pp 1-4. In this Paper hardware for gas leakage detection and accurate location identification system for the production safety in any risky Industries is proposed. The detection and location are implemented based on Wireless Sensor Networks (WSN). However, formerly the system was developed using Virtual Instrumentation. Based on ZIGBEE and ARM7, the system is easy to be deployed and overcomes the shortcomings on current systems. Using number of nodes at different places of risky areas, this system can detect the leakage of gas and immediately sends the details of that location to the observer. It is used to improve the rescue quality and shorten the time for rescue. Therefore it can compensate for the weaknesses of existing systems.

Zhao Yang, Ming liang Liu, Min Shao, and Yingjie Ji, 2011; in this paper they told about their research on leakage detection and analysis of leakage point in the gas pipeline system. In this paper they gave various model which used SCADA I/F Model: The SCADA system has the function of transferring the acquired data from a pipeline system to Transient Simulation Model every 30 seconds. This module communicates with SCADA. Dynamic parameters are collected every 30 seconds, such as pressure, flow and temperature. Transient

Simulation Model: Transient flow is simulated utilizing perfect numerical methods based on actual data. Pressure and temperature served as independent variables are provided in order to get average pressure and average temperature. Then all the parameters of the gas in the pipeline system can be acquired. Leakage Detection: The leakage detection is carried out by comparing the data acquired through the SCADA system with that by the Transient Simulation Model. This model could provide leakage point judgment and prompt warning based on transient simulation and volume balance.

Anusha, Dr. Shaik Meeravali, 2012 " Detection Of Gas Leak And Its Location Using Wireless Sensors", November, pp 1-8.

The aim is to develop a gas leak detection and location system for the production safety in Petrochemical Industry. The system is based on Wireless Sensor Networks (WSN); it can collect the data of monitoring sites wirelessly and sent to the computer to update values inthe location software. Consequently, it can give a real-time detective of the potential risk area, collect the data of a leak accident and locate the leakage point. However the former systems can not react in time, even cannot obtain data from an accident and locate accurately. The paper has three parts, first, gives the overall system design, and then provides the approaches on both hardware and software to achieve it.

S Shyamaladevi, V G Rajaramya, P Rajasekar and P Sebastin Ashok, 2014; In this research paper they told about their project ARM7 based automated high performance system for LPG refill booking and leakage detection and methodology to make their project. The paper is designed based on modular approach which is easy to analyze as LPG cylinder booking unit, gas leakage monitoring unit at the consumer end and server system unit at the distributor side. MQ6 placed in the vicinity of the gas cylinder. In the advent of leakage, the resistance of the sensor decreases increasing its conductivity. Corresponding pulse is fed to

microcontroller and simultaneously switches on the buzzer and exhaust fan. Microcontroller sends a message “EMERGENCY ALERT: LPG gas leakage found in your home” to required cell numbers via GSM module and the same will be displayed on LCD. In automatic Gas booking system, LCD continuously monitors the weight of the gas in cylinder and displays it on seven segment display. When the weight of the gas is less than or equal to 2 Kg, a logic high pulse is fed to a port pin of microcontroller. As this pin goes high, microcontroller will send a booking message to distributor of format, "AA01-RAJA-05-B". At the same time, the message will be displayed on LCD as “Cylinder Booking”. Hardware and Software Requirements are Load cell, Instrumentation amplifier, 2*16 LCD, LPG sensor, GSM modem, PC, Keil uvision4, Visual studio2008, Pro-load software.

Ch. Manohar Raju and N. Sushma Rani, 2008; they introduce an android based automatic gas detection and indication robot. They proposed prototype depicts a mini mobile robot which is capable to detect gas leakage in hazardous places. Whenever there is an occurrence of gas leakage in a particular place the robot immediately read and sends the data to android mobile through wireless communication like Bluetooth. We develop an android application for android based smart phones which can receive data from robot directly through Bluetooth. The application warns with an indication whenever there is an occurrence of gas leakage and we can also control the robot movements via Bluetooth Journal of VLSI Design and Signal Processing All Rights Reserved by using text commands as well as voice commands. The previous mobile robots are based on heterogeneous technologies like GSM, GPS, internet based etc., but the main disadvantage of those prototypes were the absence of communication in particular areas. So, with the rapid developments and tremendous changes in technology we have lots of techniques to eradicate previous problems. Wireless communication protocols play a vital role in present trends. Bluetooth, WI-Fi, Zigbee etc.,

Falohun A.S., Oke A.O., and Abolaji B.M. 2016; in this paper they proposed their dangerous gas detection using an integrated circuit and MQ-9. In this basically, they used an embedded design which includes typical input and output devices include switches, relays, solenoids, LEDs, small or custom LCD displays, radio frequency devices, and sensors for data such as temperature, humidity, light level etc. Embedded systems usually have no keyboard, screen, disks, printers, or other recognizable I/O devices of a personal computer, and may lack human interaction device. The amount and type of detectors and the type of fire alarm system that one chooses for property protection will depend on the owner's property protection goals, the value of the property and the requirements of the owner's insurance company. Generally, heat detection will be used in all areas that are not considered high value. Here again, one of the most common mistakes in fire alarm system application is to provide partial protection of a building and expect high performance from the installed systems of any kind.

2.1 Infrared Radiation

Infrared radiation is electromagnetic radiation of wavelength which is longer than the Visible light but shorter than the radio wave . There are many common sources of radiation emitting infrared such as sunlight, tungsten and lasers. Infrared light has range of wave lengths , just like visible light, which has wavelengths ranging from red to violet. IR light lies between the visible and microwave portions of the electromagnetic spectrum Infrared radiation is typically produced by objects whose temperature is above 10°K

2.2 Gas Detection Principle by Infrared Absorption

Certain gases in the atmosphere have the property of absorbing infrared radiation. The infrared radiation strikes a molecule such as propane and butane that causes the bonds to bend and vibrate . This is called the absorption of IR energy. The molecule gains kinetic energy by this absorption of IR radiation.

IR radiation does not have enough energy to induce electronic transitions as UV radiation. Absorption of IR is restricted to compounds with small energy differences in the possible vibrational and rotational states For a molecule to absorb IR, the vibrations or rotations within a molecule must cause a net change in the dipole moment of the molecule. If the frequency of the radiation matches the vibrational frequency of the molecule then radiation will be absorbed, causing a change in the amplitude of molecular vibration . The existing gas leakage detector in the industry is by using the catalyst detector. This new technology provides major advantages over the catalyst detector.

Some advantages ofusing infrared gas detectors are :

1) Immunity to contamination and poisoning.
2) Ability to operate in the absence of oxygen or in enriched oxygen.
3) Ability to operate in continuous presence of gas.
4) Can perform more reliably in varying flow conditions.
5) Even when flooded with gas, will continue to show high reading and sensor will not be damaged.

2.3 Liquiefied Petroleum Gas

LPG or LP Gas is Liquefied Petroleum Gas. This is a general description of Propane (chemical formula C3H8) and Butane (chemical formula C4H10), either stored separately or together as a mix [9]. LPG is a mixture of hydrocarbon gases which are propane and butane used as a fuel in heating appliances and vehicles .

Propane and butane are gaseous at normal temperature and can be liquefied under low pressure to provide easier packing.

The name LPG comes from the fact that these gases can be liquefied at normal temperature by application of a moderate pressure increase, or at normal pressure by application of cooling using refrigeration. LPG comes from two sources. It occurs naturally in oil and gas fields and is separated from the other components during the extraction process from the oil .LPG is also one of the by-products of the oil refining process.

.LPG is used as a fuel for domestic, industrial, horticultural, agricultural, cooking, Heating and drying processes. LPG can be used as an automotive fuel or as a propellant for aerosols, in addition to other specialist applications. LPG can also be used to provide lighting through the use of pressure lanterns.

The advantages of LPG gases are as follows Because of its relatively few components, it is easy to achieve the correct fuel to air mix ratio that allows the complete combustion of the product.

This gives LPG it's clean burning characteristics. Both Propane and Butane are easily liquefied and stored in pressure containers.These Properties make the fuel highly portable, and hence, can be easily transported in cylinders or tanks to end-users. LPG is a good substitute for petrol in spark ignition engines. Its clean burning Properties , in a properly tuned engine, give reduced exhaust emissions, and extended lubricant and spark plug life.

As a replacement for aerosol propellants and refrigerants, LPG provides alternatives to fluorocarbons which are known to cause deterioration of the earth's ozone layer.

The clean burning properties and portability of LPG provide a substitute for indigenous fuels such as wood, coal, and other organic matter.

This provides a solution to deforestation and the reduction of particulate matter in the atmosphere (haze), caused by burning the indigenous fuels Some of the characteristics of LPG are :

Colourless.

Flammable.

Heavier than air.

Approximately half the weight of water.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

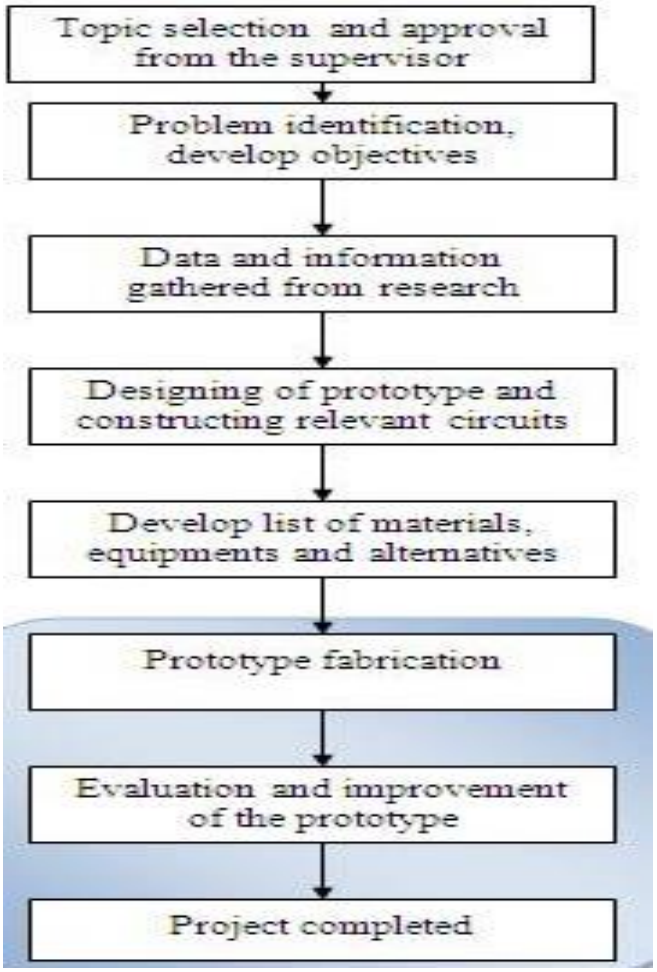


FIGURE 3.1 Procedure Identification

The sequential step by step procedure to be followed throughout this project. Until now student has reached into the prototype fabrication which is mainly to construct the infrared circuit.

3.2 Illustration of Infrared Gas detection Model

In this paper, semiconductor sensors are used to detect LPG gas. An MQ2 semiconductor sensor is used. Sensitive material of the MQ-2 gas sensor is SnO2, which has lower conductivity in clean air. When the target combustible gas exists, the sensor conductivity increases along with the rising gas concentration. The MQ2 gas sensor has a high sensitivity to Propane, Butane and LPG, and response to Natural gas. The sensor could be used to detect different combustible gasses, especially Methane; it has a low cost and is suitable for different applications. The MQ-2 can detect gas concentrations anywhere from 200 to10,000ppm . The sensor's output is an analog resistance. Figure 1 shows the block diagram of the gas leakage detection and alert system.

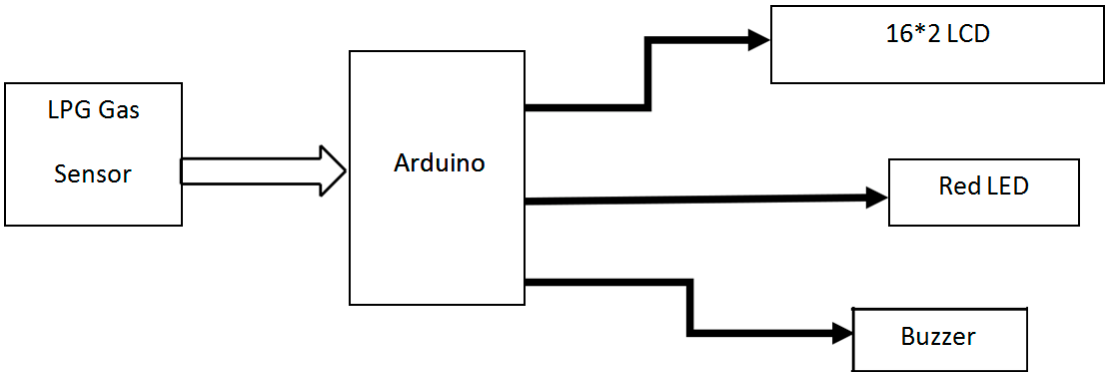


FIGURE 3.2

GAS DETECTION MODEL

This system is based on the arudino UNO R3 and MQ-2 gas sensor. When the sensor detects gas in the atmosphere, it will give digital output 1 and if gas in not detected the sensor will give digital output 0. Arudino will receive the sensor output as digital input. If the sensor output is high, then the buzzer will start tuning along with the LCD that will show that "Gas detected: Yes". If the sensor output is low then buzzer will not be tuning, and the LCD will show that "Gas detected: No". The buzzer most commonly consists of a number of switches or sensors connected to control unit that determines which button was pushed or

whether a preset time has lapsed, and usually illuminates a light on the appreciate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

Part I (Alarm System)

The first part of this project is to design alarm circuit to be equipped in the prototype.

Whenever the presence of gas leakage is detected by the receiver circuit, signals will be sent to the oscilloscope and relay circuit. The alarm system will automatically triggered to warn users of the leakage.

3.3 Circuit Construction

The study of circuit examples from the previous projects as well as the inventions available in the market have been done in order to choose the most appropriate IR circuit to be implemented in this project. After deciding, the most reliable circuit to be constructed, the simulation is done in PSPICE in order to obtain the rough idea on how the circuit will behave

3.3.1 Transmitter Circuit

Transmitter circuit will be used as the source of IR radiation in this project. Due to the fact that LPG gases absorbs IR at certain wavelength, the transmitter circuit needs to be designed to transmit desired IR frequency. Theory stated that LPG gases absorb IR radiation at the frequency of 3.4μm [2].

Frequency = speed of light/ wavelength……Equation 1Referring to equation 1

Frequency = (3.0 x 10^8) / 3.4μm

A = 88.2 THz

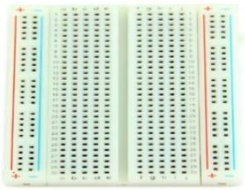
3.3.2 Alarm circuit

Alarm is a device that signals the occurrence of some undesirable event. When the alarm is triggered, it emits a loud sound designed to warn users of the leakage occurrence.

Basic alarm system circuit is shown in Figure 8 below :

Buzzer

16*2 LCD



Breadboard

Before jumping into our overview, here is a more in-depth analysis of the 3 main types of alarms you may be looking for: fire alarm, burglary alarm, and intrusion detection.

CHAPTER 4

BILL OF MATERIALS & COST ESTIMATION

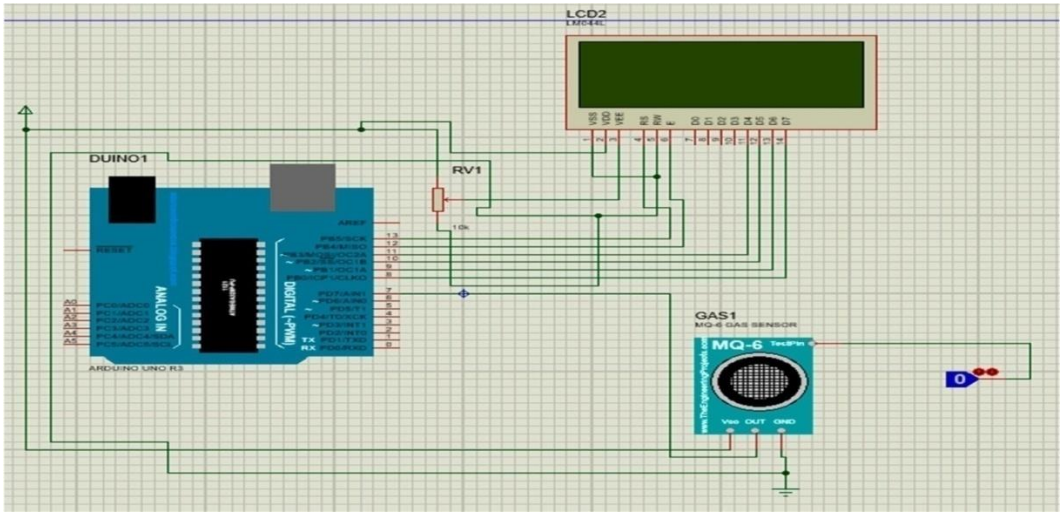
S.NO.	MATERIAL NAME	SPECIFICATION	QUANTITY	AMOUNT (in Rs.)
1	Mq2 sensor	Microcontroller:ATmegaP	01	
2	LED display	Power: 3 mA @ 5VDC	01	
3	GSM Module	0 to 50 °C with +-2 degrees accuracy.	01	
4	Breadboard	Dimension is 6.5*4,4*0.3 inch.	01	
5	Jumper wires	Diameter shall be 0.6mm with a tolerance of +0.01mm	As required	
6	Buzzer	Torque - 0.36 to 160mNm.	01	
7	Relay module	5V DC,70mA	01	
Total Amount				

CHAPTER 5
RESULTS AND DISCUSSION

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. shows the circuit diagram that was designed using Proteus libraries.

This system is based on UNO R3 and MQ-2 gas sensor. When the sensor detects gas in atmosphere, it will give a digital output of 1 and if gas is not detected the sensor will give a digital output of 0. It will take the sensor output as the digital input. If sensor output is high, then the buzzer will start tuning and the LCD will show that “Gas detected: Yes”.

If sensor output is low then the buzzer will not be tuning, LCD will show that “Gas detected: No”. The detector incorporates a MQ-2 sensor (with gas detection range of 300–10,000ppm) as the LPG gas sensor, PIC16F690 microcontroller as the control unit, LCD for displaying gas concentration, a buzzer as an alarm and a number of LEDs to indicate the gas leakage status. The microcontroller senses the presence of a gas when the voltages signal from the MQ-2 sensor goes beyond a certain level and gives an audiovisual alarm.



The circuit diagram of the MQ-2 gas sensor connected with Arduino

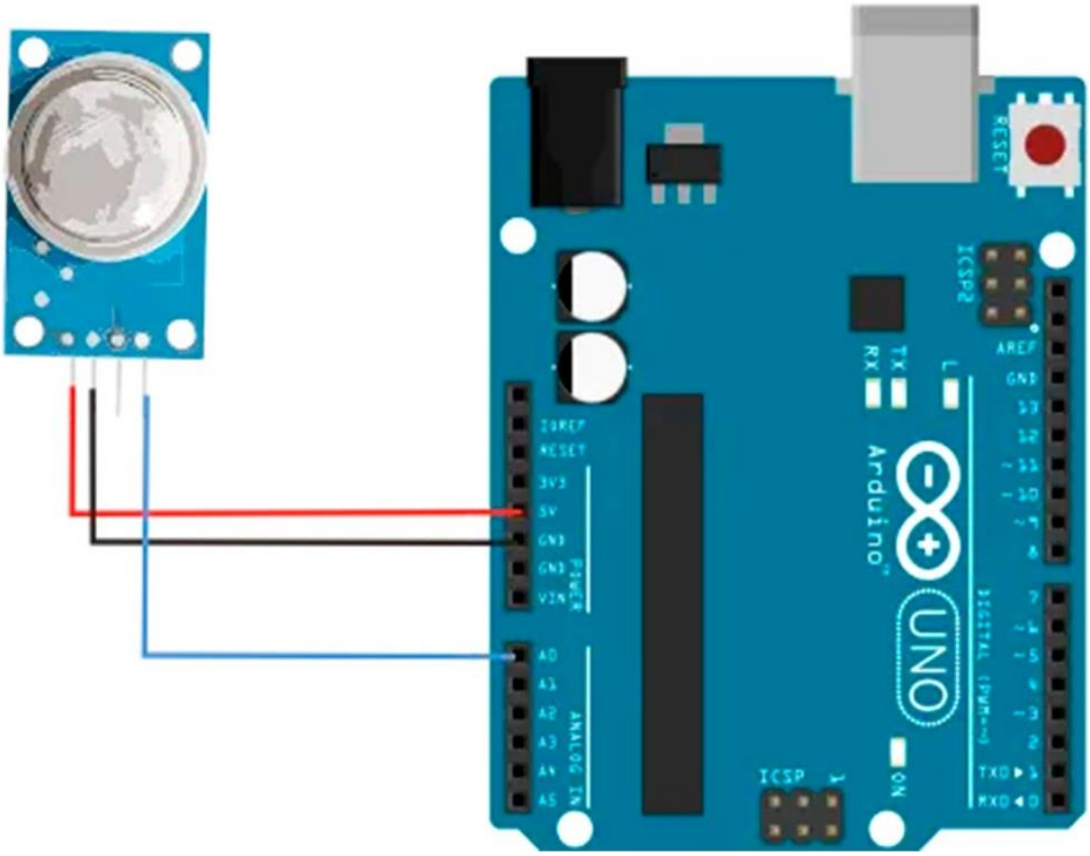


FIGURE 5.1

The circuit diagram of the MQ-2 gas sensor connected with Arduino.

If the system detects the level of gas in the air that exceeds the safety level it will activate the alarm which includes the buzzer to alert the users at home of the abnormal condition and to take any necessary action. The most tell-tale sign of a leak is the smell of gas in the home. However, in the case of a carbon monoxide leak, there are also particular physical symptoms you may suffer from if there is a leak. The output result of this paper is that the leakage will be detected and

stopped within 2 s after the leakage starts. This system can even detect the level of gas leakage. This is an efficient method for automatically detecting and controlling the gas leakage. Moreover, the fire accidents are also prevented by switching off the power supply. The idea for gas detection and control can be implemented at a large scale for various industries. This system can be installed in a kitchen, at a hostel cafeteria, and any other areas. This can be helpful in reducing accidents caused by gas leakage in household as well as in any similar commercial set up. In our country there are 180 million people, and due to its low

cost this product is affordable and will prevent many accidents and save many properties and human lives

Sensor.

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.

MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas. MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

5.2 LPG Experiment Result

In order to observe the voltage variation of the circuit, a diode and 100 ohm Resistor is place at the infrared LED receiver. This is for the purpose of smoothing the voltage and connecting the circuit to the oscilloscope.

The experiment is conducted in the confined area, thus the result is shown below:
Output voltage when there is NO LPG leakage= 8.9V
Output voltage when there is an LPG Leakage= 7.8V
The voltage reading is taken from the oscillator. From the graph obtained as shown in Figure
12, the time taken for the circuit to detect the leakage at the distance of 15 cm is 10 second.
This is obviously shown when there was a sudden drop in the voltage after the LPG gas was released into the chamber. The voltage began to be at its steady state value when the LPG started to disperse in the surrounding which had reduced its concentration.

To monitor the circuit performance, the experiment is then repeated by varying the distance of the infrared transmission. The distance of the first attempt is 15 cm. The distance is then varied up until 40 cm to see the sensitivity of the circuit using the same concentration of LPG gas.

5.3 Alarm Circuit and Triggering Relay

The relay is connected in parallel with the voltage supply. Therefore, as the 9V of supply is used, a 9V relay is chosen to make the relay operates as an electronic-switch. Normally-closed relay is to be put on the infrared detection circuit. The switch is basically closed and let the infrared detector circuit operated. Once the leakage had occurred, there will be a sudden drop of voltage making the switch of the relay to be automatically changed in to the other position thus activating the alarm to turn on.

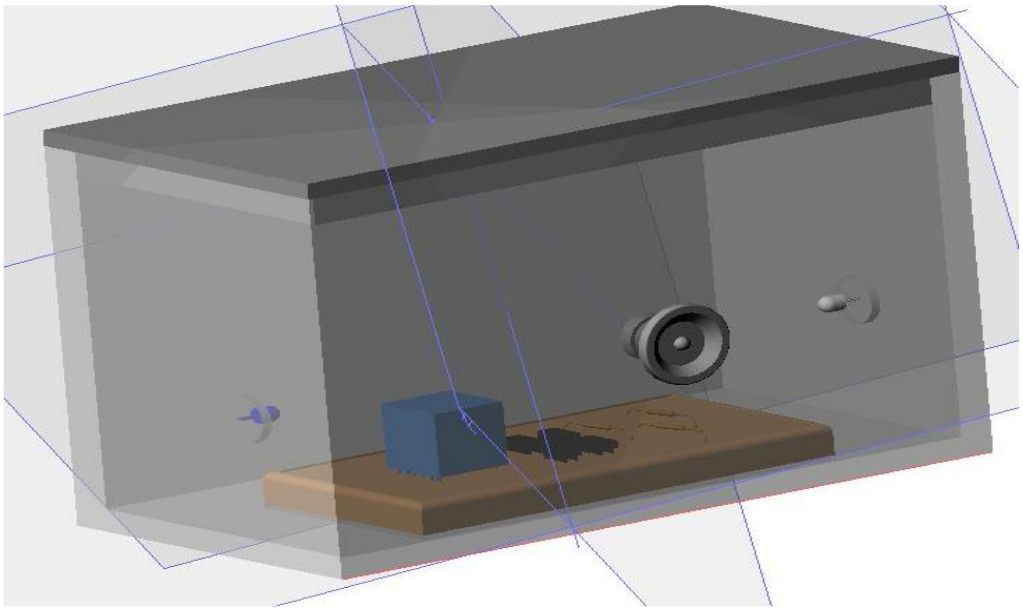


FIGURE 5.3

3D DESIGN

The 3D design of the prototype model. Some pieces of Perspex are used to provide invisibility through the chamber. This prospect is used because of the transparency, easy to cut and being joined together and air-proof material.

The ply wood is then used as a back-up if ever the PCB circuit is difficult to be pasted on the prospect. The student will screw the circuit onto this ply wood. Besides that, the darkcolour of this ply wood will increase the visibility of the LED to observer as it can be easily tonotice if the LED has turn on and blink for the alarm circuit.

5.4 Detecting the Excessive of LPG Leakage

In order to enhance the level of safety detection, the circuit in Figure 9 has been modified to detect the excess of LPG leakage. LM 3194n is used to indicate the value of voltage that has dropped based on the absorption of LPG using the infrared radiation.

The LM3914 is an integrated circuit that senses analog voltage levels and drives 10 LEDs,

providing a linear analog display. A single pin changes the display from a moving dot to a bar

graph. Current drive to the LEDs is regulated and programmable, eliminating the need forresistors.

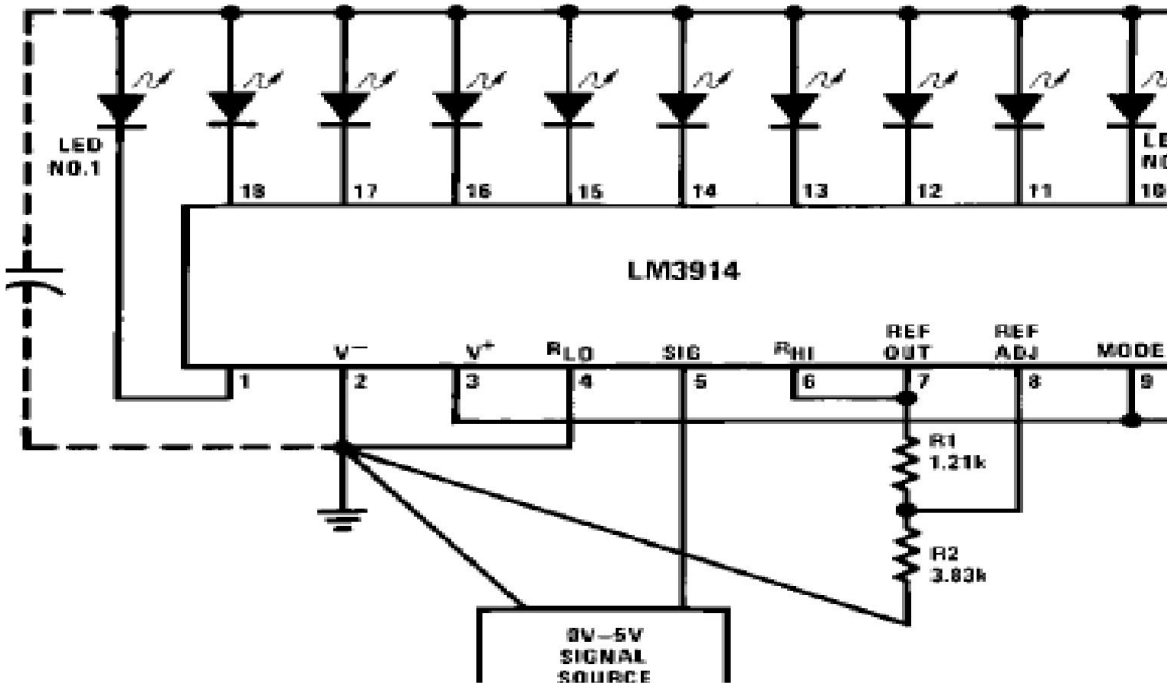


Figure 5.4

The configuration of IC LM 3914.

5.5 Advantage of Infrared in Detecting the Combustible Gas

Infrared technology is known for high reliability and simple installation. Of the many Hydro carbons that are found in industry today, most are detectable with a catalytic combustion sensor and many are detectable with an infrared sensor. It is important to consider the specific compounds to be monitored as there are some that do not readily lend themselves to detection with a general purpose infrared (IR) detector, such as hydrogen for example. For better explanation we will look at the basic principles of operation for infrared technologies.

The Infrared (IR) detection method is based upon the absorption of infrared radiation at specific wavelengths as it passes through a volume of gas. Typically two infrared light sources and an infrared light detector measures the intensity of two different wave lengths, one at the absorption wavelength and one outside the absorption wavelength. If a gas intervenes between the source and the detector, the level of radiation falling on the detector is reduced. Gas concentration is determined by comparing the relative values between the two wavelengths.

This is a dual beam infrared detector.

Infrared gas detection is based upon the ability of some gases to absorb IR radiation .Many hydrocarbons absorb IR at approximately 3.4 micrometers. As mentioned earlier, there are some hydrocarbons and other flammable gases that have poor or no response on a general purpose IR sensor. In addition to aromatics and acetylene, hydrogen, ammonia and carbon monoxide also cannot be detected using IR technology with general purpose sensors of micron specifications.

"The major advantages of IR gas detectors:

Immunity to contamination and poisoning.

Consumables (source and detector) tend to outlast catalytic sensors.

Can be calibrated less often than a catalytic detector.

Ability to operate in the absence of oxygen or in enriched oxygen

Ability to operate in continuous presence of gas.

Can perform more reliably in varying flow conditions.

Even when flooded with gas, will continue to show high reading and sensor will not be damaged.

Infrared point

This type of sensor is advantageous because it does not have to be placed into the gas to detect it and can be used for remote sensing. Infrared

point sensors can be used to detect hydro carbons and other infrared active gases such as water vapor and carbonoxide IR sensors are commonly found in waste-water treatment facilities, refineries, gas turbines, chemical plants, and other facilities where flammable gases are present and the possibility of an explosion exists. The remote sensing capability allows large volumes of space to be monitored.

Engine emissions are another area where IR sensors are being researched. The sensor would detect high levels of carbon monoxide or other abnormal gases in vehicle exhaust and even be integrated with vehicle electronic systems to notify drivers.

CHAPTER 6

Applications and Benefits of Using Gas Sensors

A human nose has around 400 different types of scent receptors that enable us to smell approx. 1 trillion different odors. But still, most of us cannot identify the type of gas present in the atmosphere. Hence, there are different sensors to measure accurate gas concentration in the atmosphere. Gas detection sensors are most commonly used to develop an powered system and identify the variation of toxic gases around an industrial facility. It helps benefit the factories and refineries by keeping them safe against any unexpected threats like explosions. Let's talk more about the applications and benefits of a gas monitoring solution:

6.1 Applications*:*

1. Gas leakage detector (Domestic)
2. Combustible gas detector (Industrial)
3. Gas detector (Portable)
4. Homes
5. Factories
6. LPG storage
7. Hotels etc. Harmful Gas Detection

The sensing of toxic gases such as H2S, Methane, and CO is of great importance in any industry to avoid unwanted leakage and consequences like poisoning or explosions. The presence of these gases can be easily detected in the industrial facilities and commercial buildings with the help of IoT-powered gas monitoring solution. Moreover, a gas detector or sensor device is a crucial part to carry out safe industrial operations. The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises.

Fire Hazard Prevention

The gas sensors help detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts. Also, it is an imperative solution to keep the plant workers and equipment safe from fire hazards. It effectively detects the presence of hazardous gases like propane and methane and alerts the plant authorities, preventing the premises from unexpected ignition. Moreover, a gas monitoring solution uses gas analyzers to generate alerts regarding the temperature increase. This allows the management to take immediate actions to curb harmful fire explosions.

Oxygen Level Measurement

Sensing the presence of gases is a necessity to conduct industrial operations as several pitmen had lost their lives due to lack of oxygen in the process of mining explorations. A sudden decrease in tBhe oxygen levels can result in dizziness, brain damage, or even death among the workers working in mines or close-packed industrial premises. A gas monitoring system significantly benefits the industries by maintaining proper oxygen levels that reflect the optimal performance of your workers. This system also creates alerts in real-time about the decreasing oxygen levels, which gives enough time to take necessary measures to evacuate the facilities much before the health gets affected.

6.2 Benefits

Get real-time alerts about the gaseous presence in the atmosphere

Prevent fire hazards and explosions

Supervise gas concentration levels

Ensure worker’s health

Real-time updates about leakages

Cost-effective installation

Data analytics for improved decisions

Measure oxygen level accuracy

Get immediate gas leak alerts

Benefits of the gas detection system state that the moment a gas detection system is installed you get the edge of tracking potential dangers present in your environment. This becomes necessary where natural gas is being transported. Where you have the potential for hazards ever y where . In addition to purchasing a gas detector, a risk assessment will normally be required to uncover the threats in both the unmanned and manned areas.

CHAPTER 7
ADVANTAGES OF SYSTEM

LOW POEWR CONSUMPTION VOLTAGE

The advantage this has over others is that it provides quick response rate and has faster diffusion of the critical situation than the manual methods .All the reviewed works aimed at developing systems capable of detecting gas leakages and sending an SMS alert to the user. The system enables monitoring of gas leakages in remote locations and thereby leads to a faster response time in the events of a leakage condition.

• Low maintenance and low operating costs.

• Reliable technology.

Gas	Advantages	Disadvantages
Catalytic	Simple, measures flammability of gases. Low cost proven technology.	Can be poisoned by lead, Chlorine and silicones that remains an unrevealed failure mode. Requires Oxygen or air to work. High power. Positioning critical.
Electrochemical	Measures toxic gases in relatively low concentrations. Wide range of gases can be detected. Very low power.	Failure modes are unrevealed unless advanced monitoring techniques used. Requires Oxygen to work. Positioning critical.
Point Infrared	Uses a physical rather than chemical technique. Less sensitive to calibration errors. No unseen failure modes. Can be used in inert atmospheres.	Flammable gas detection only in %LEL range. Measures concentration of flammable gases which have then to be related to the flammability of the gas. Positioning critical. High/medium power.
Open Path Infrared	Area coverage- best chance to see a leak. No unseen failure modes. Latest technology. Can detect low concentrations. Positioning not as critical. New toxic version as well as flammable.	Higher initial purchase cost. Not suitable for use in smaller areas. Detection path can be obscured.
Semiconductor	Mechanically robust, works well in constant high humidity conditions.	Susceptible to contaminants and changes in environmental conditions. Non-linear response effects complexity.
Thermal Conductivity	Measures %V/V concentrations of binary gas mixtures even with the absence of Oxygen.	High gas concentrations only. Limited range of gases. Cannot measures gases with conductivities close to air. Higher maintenance requirements.
Paper Tape	Highly sensitive and selective for toxic gases. Leaves physical evidence of the gas exposure. No false alarms.	Requires extraction system. May need sample conditioning.

CHAPTER 8
CONCLUSION AND RECOMENDATION

8.1 CONCLUCTION

When designing a combustible gas safety monitoring system for oil and gas Petro chemical or other application, a thorough analysis of application's unique field environment is needed to ensure optimal performance, safety, reliability and cost effectiveness.

A quick decision, of course, can lead to poor detector choices as well as safety , Performance , maintenance , and life-cycle cost consequences. As student is doing continuous Research on infrared technologies and its application, she believes that gas detection method using infrared is one of reliable method to be used as a precaution to danger that can be caused.. The implementation of automated safety systems such as shutdown valve andalarm system will enhance the effectiveness of this method to users.

The integrated infrared circuit has been constructed and tested until this period of time. Future works that has to be done in this project is to fabricate the gas chamber as well as combining the alarm circuit into the integrated infrared circuit. The analysis to measure the reliability of the infrared circuit also has to be improvised so that this gas detector become immune to any eternal noise and errors.

8.2 Recommendation

For improvement in the future, some additional feature could be added in order to make increase the performance and capability of the circuit. Some recommendations are briefly explained below:

8.3Various Gas Detection

This model can only detect various combustible gasses at certain distance. By applying the theory of infrared absorption, gassed like Sulphur, carbon Monoxide, Nitrogen Dioxide and other gasses which are toxic and poisonous can only be detected by infrared at certain wave length. The future improvement of this project will help to improve the functionality of this model.

8.4 Performance of the circuit

When the LPG has dispersed into the surrounding, its concentration will be decreased. Therefore, this model will not be able to detect the leakage appropriately. The design of this
model has to be improved so that it can detect the leakage just as the leakage had occurred.

This model can only detect various combustible gasses at certain distance. By applying the theory of infrared absorption, gassed like Sulphur, carbon Monoxide, Nitrogen Dioxide and other gasses which are toxic and poisonous can only be detected by infrared at certain wavelength. The future improvement of this project will help to improve the functionality of
this model.

CHAPTER 9
Future Work

Overall, software and hardware parts of the systems have been developed and tested by introducing a small amount of LPG near gas sensor module. The authors of this paper are currently working to include multi functions with this device. One of the notable future functions of this system is to add a sub system where wastage of gas and the uses of gas can be monitored using this system. The system is flexible as a greater number of sensors and relays can be added to it according to the whole LPG supply setup in those premises. The author is adding more software based intelligent functions with this system. This is an automatic gas detection, control and alert system. In future this system will have a feature where it can notify the emergency services if any accidents happen. A mobile app and web-based app for real time monitoring also will be added. In the user app for this system many smart features will be added. The overall features will make the system more safe for the users. The system will be optimized for use in many places like the car, the home, industries and many other places. After designing the final prototype with smart multifunctional features, the system will be implemented in real life scenarios as a pilot project. A survey will be done soon before using the system and another one will be done after implementing the system to discover the KPI. Summarizing all the results, finding and analyzing a research article will be done and author has plans to submit itto the MDPI *sensors* journal for review. In the future paper the features of this final product will be compared with the available gas detector systems presented in other article

CHAPTER 10

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In this Paper hardware for gas leakage detection and accurate location identification systemfor the production safety in any risky Industries is proposed. The detection and location areimplemented based on Wireless Sensor Networks (WSN). However, formerly the system wasdeveloped using Virtual Instrumentation. Based on ZIGBEE and ARM7, the system is easy to be deployed and overcomes the shortcomings on current systems. Using number of nodes atdifferent places of risky areas, this system can detect the leakage of gas and immediatelysends the details of that location to the observer. It is used to improve the rescue quality andshorten the time for rescue. Therefore it can compensate for the weaknesses of existingsystems.

Anusha, Dr. Shaik Meeravali, 2012 "Detection Of Gas Leak And Its LocationUsing Wireless Sensors", November, pp 1 -8

The aim is to develop a gas leak detection and location system for the production safety inPetrochemical Industry. The system is based on Wireless Sensor Networks (WSN); it cancollect the data of monitoring sites wirelessly and sent to the computer to update values inthe location software. Consequently, it can give a real-time detective of the potential riskarea, collect the data of a leak accident and locate the leakage point. However the formersystems can not react in time, even cannot obtain data from an accident and locateaccurately. The paper has three parts, first, gives the overall system design, and then provides the approaches on both hardware and software to achieve it.

Gas leakage is a serious problem and nowadays it is observed in many places like residences, industries, and vehicles like Compressed Natural Gas (CNG), buses, cars, etc. It is noticed that due to gas leakage, dangerous accidents occur. The Liquefied petroleum gas (LPG), or propane, is a flammable mixture of hydrocarbon gases used as fuel in many applications like homes, hostels, industries, automobiles, and vehicles because of its desirable properties which include high calorific value, less smoke, less soot, and meager harm to the environment. Liquid petro=leum gas (LPG) is highly inflammable and can burn even at some distance from the source of leakage. This energy source is primarily composed of propane and butane which are highly flammable chemical compounds. These gases can catch fire easily. In homes, LPG is used mainly for cooking purposes. When a leak occurs, the leaked gases may lead to an

explosion. Gas leakage leads to various accidents resulting in both material loss and human injuries. Home fires have been occurring frequently and the threat to human lives and properties has been growing in recent years. The risks of explosion, fire, suffocation are based on their physical properties such toxicity, flammability, etc. The number of deaths due to the explosion of gas cylinders has been increasing in recent years. The Bhopal gas tragedy is an example of accidents due to gas leakage.

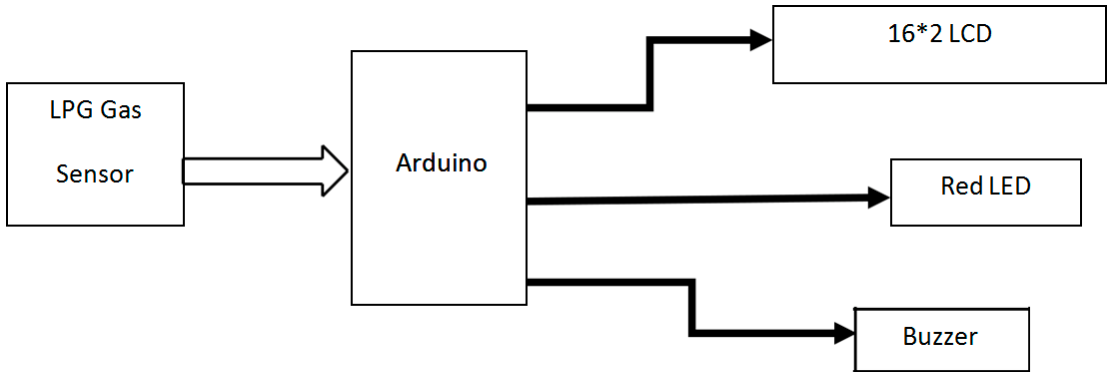
The reason for such explosions is due to substandard cylinders, old valves, no regular checking of gas cylinders, worn out regulators and a lack of awareness of handling gas cylinders. Therefore, the gas leakage should be detected and controlled to protect people from danger. An odorant such as ethane thiol is added to LPG, so that leaks can be detected easily by most people. However, some people who have a reduced sense of smell may not be able to rely upon this inherent safety mechanism. A gas leakage detector becomes vital and helps to protect people from the dangers of gas leakage. A number of research papers have been published on gas leakage detection techniques [1–8]. K. Padmapriya et al. proposed the design of a wireless LPG monitoring system. In this paper, the user is alerted about the gas leakage through SMS and the power supply is turned off [6]. Meenakshi Vidya et al. proposed the leakage detection and real time gas monitoring system. In this system, the gas leakage is detected and controlled by means of an exhaust fan. The level of LPG in cylinder is also continuously monitored [7]. Selvapriya et al. proposed the system in which the leakage is detected by the gas sensor and produce the results in the audio and visual forms. It provides a design approach on software as well as hardware [8]. In the existing method, different gas sensing technology is used.

In this paper a low-cost advanced sensor-based gas leakage detector, alert and control system is proposed and discussed. The system is very efficient, user friendly, portable, small in size and cost effective. It will cost only 917

Bangladeshi taka which is equivalent to ten USD.

2 .Method and Materials

In this paper, semiconductor sensors are used to detect LPG gas. An MQ6 semiconductor sensor is used. Sensitive material of the MQ-6 gas sensor is SnO2, which has lower conductivity in clean air. When the target combustible gas exists, the sensor conductivity increases along with the rising gas concentration. The MQ6 gas sensor has a high sensitivity to Propane, Butane and LPG, and response to Natural gas. The sensor could be used to detect different combustible gasses, especially Methane; it has a low cost and is suitable for different applications. The MQ-6 can detect gas concentrations anywhere from 200 to 10,000 ppm . The sensor's output is an analog resistance. Figure 1 shows the block diagram of the gas leakage detection and alert system.

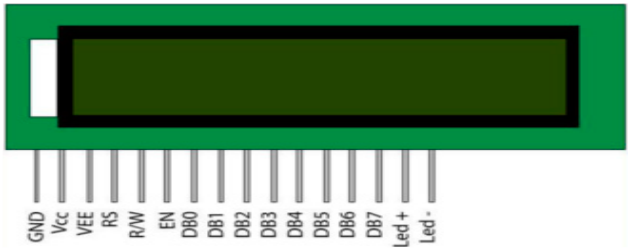


Block diagram of gas leakage detection and alert system.

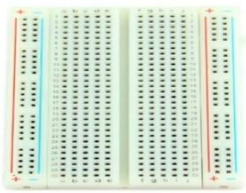
This system is based on the arudino UNO R3 and MQ-2gas sensor. When the sensor detects gas in the atmosphere, it will give digital output 1 and if gas in not detected the sensor will give digital output 0. Arudino will receive the sensor output as digital input. If the sensor output is high, then the buzzer will start tuning along with the LCD that will show that "Gas detected: Yes".

If the sensor output is low then buzzer will not be tuning, and the LCD will show that “Gas detected: No”. The buzzer most commonly consists of a number of switches or sensors connected to control unit that determines which button was pushed or whether a preset time has lapsed, and usually illuminates a light on the appreciate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

For the design of a sensor-based gas leakage detector and alarm system the following hardware components are required. Table 1 lists the list of required hardware opponents, quantity and price in Bangladeshi Taka. The gas detector system is very cheap and it will cost only 917 BD Taka. The device is portable, light weight, user friendly and efficient with multi-functional features. In some important components that are needed to design the gas leakage detection and alert system are presented.



MQ-2 Gas sensor LCD Pin Configuration



Buzzer 16*2 LCD Breadboard

principle

1.Infrared principle of gas detector

Principle: The non-split infrared principle NDIR sensor uses the Beer-Lambert infrared absorption law, that is, different gases absorb light at a specific wavelength, and the intensity of absorption is proportional to the concentration of the gas to achieve detection. It uses an optical filter to divide the infrared light into a required spectral line of a very small wavelength band, and the detected gas absorbs the spectral line of this very small wavelength band.

Advantages: high reliability, good selectivity, high accuracy, no toxicity, less environmental interference, long life, and no dependence on oxygen.

Disadvantages: It is greatly affected by humidity, and the types of detection gases are limited. At present, it is mainly used in methane, carbon dioxide, carbon monoxide, sulfur hexafluoride, sulfur dioxide, hydrocarbons and other gases.

2. The semiconductor principle of the gas detector

Principle: The semiconductor gas sensor is made by using some metal oxide semiconductor materials. At a certain temperature, the resistance changes with the change of the ambient gas composition. For example, the alcohol sensor is prepared by using the principle that when tin dioxide encounters alcohol gas at high temperature, the resistance will decrease sharply.

Advantages: low cost, simple manufacturing, high sensitivity, fast response speed, long life, low sensitivity to humidity and simple circuit.

Disadvantages: poor stability and greater environmental impact, especially the selectivity of each sensor is not unique, and the output parameters can not be determined. Therefore, it should not be used in places where measurement accuracy is required, mainly for civilian use.

3. The catalytic combustion principle of the gas detector

Principle: The catalytic combustion sensor is to prepare a high-temperature resistant catalyst layer on the surface of the platinum resistance. At a certain temperature, the flammable gas catalyzes combustion on its surface. The

combustion causes the platinum resistance temperature to rise, and the resistance changes. The change value is a function of the flammable gas concentration.
Advantages: Catalytic combustion gas sensor selectively detects flammable gas: the sensor does not respond to anything that cannot be burned. The response is fast, the service life is longer, and it is less affected by temperature, humidity and pressure. The output of the sensor is directly related to the explosion hazard of the environment, and it is a leading sensor in the field of safety detection.
Disadvantages: within the flammable gas range, no selectivity. The sensor is susceptible to poisoning, and most elemental organic vapors have a poisoning effect on the sensor .Note: Catalytic combustion detection is conditional. It must be ensured that the detection environment contains sufficient oxygen. This detection method may not detect any flammable gas in an oxygen-free environment. Certain lead compounds (especially tetraethyl lead), sulfur compounds, silicon compounds, phosphorus compounds, hydrogen sulfide, and halogenated hydrocarbons may poison or inhibit the sensor.

4. PID principle of gas detector

Principle: PID is composed of ultraviolet lamp light source and ion chamber. The ion chamber has positive and negative electrodes to form an electric field. Under the irradiation of the ultraviolet lamp, the gas to be measured is ionized to generate positive and negative ions. Amplify the output signal
Advantages: high sensitivity, no poisoning problems.
Disadvantages: non-selective, greatly affected by humidity, short life of UV lamp, and expensive.

5. The electrochemical principle of the gas detector

Principle: The electrolyte inside the sensor reacts with the target gas and generates an electric signal proportional to the gas concentration to work.
Advantages: wide operating temperature range, multiple ranges, high sensitivity, linear output, good selectivity

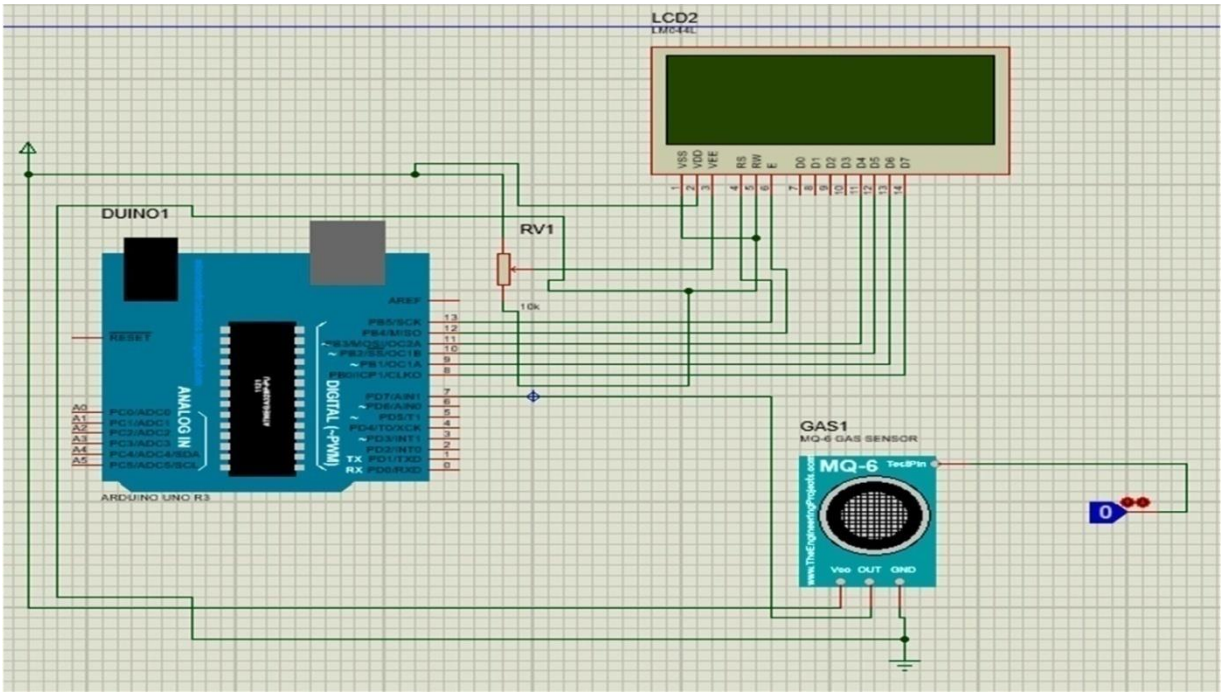
Disadvantages: short life, limited storage period, short life in extremely dry or high-concentration gas environment, non-specific type, easy to interference, and humidity affects accuracy.

Note: Most toxic gas sensors require a small amount of oxygen to maintain proper function. There is a vent on the back of the sensor for this purpose. High humidity and high drought will affect the service life of the sensor. Instantaneous pressure changes may produce a transient sensor output, or it may reach a false alarm state.

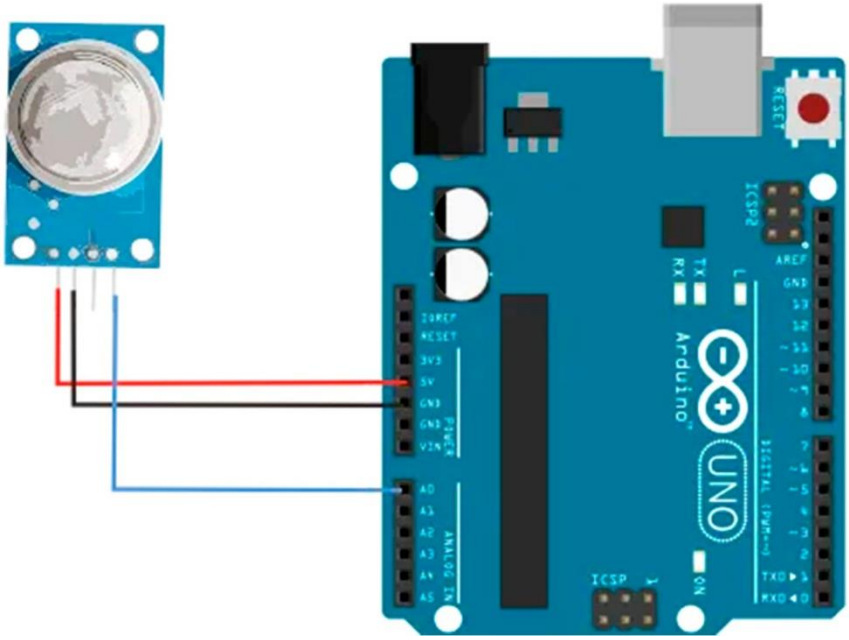
With the above information, you could find the most suitable sensor you need. There are many gas detectors with different sensors in AIYI Technologies for your choice, welcome to your support.

3 Results and Analysis

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. Figure 3 shows the circuit diagram that was designed using Proteus libraries. This system is based on Arduino UNO R3 and MQ-2 gas sensor. When the sensor detects gas in atmosphere, it will give a digital output of 1 and if gas is not detected the sensor will give a digital output of 0. Arduino will take the sensor output as the digital input. If sensor output is high, then the buzzer will start tuning and the LCD will show that “Gas detected: Yes”. If sensor output is low then the buzzer will not be tuning, LCD will show that “Gas detected: No”. The detector incorporates a MQ-2 sensor (with gas detection range of 300–10,000ppm) as the LPG gas sensor, PIC16F690 microcontroller as the control unit, LCD for displaying gas concentration, a buzzer as an alarm and a number of LEDs to indicate the gas leakage status. The microcontroller senses the presence of a gas when the voltages signal from the MQ-2 sensor goes beyond a certain level and gives an audiovisual alarm.



The circuit diagram of the MQ-2 gas sensor connected with Arduino.



If the system detects the level of gas in the air that exceeds the safety level it will activate the alarm which includes the buzzer to alert the users at home of the abnormal condition and to take any necessary action. The most tell-tale sign

of a leak is the smell of gas in the home. However, in the case of a carbon monoxide leak, there are also particular physical symptoms you may suffer from if there is a leak. The output result of this paper is that the leakage will be detected and stopped within 2 s after the leakage starts. This system can even detect the level of gas leakage. This is an efficient method for automatically detecting and controlling the gas leakage. Moreover, the fire accidents are also prevented by switching off the power supply. The idea for gas detection and control can be implemented at a large scale for various industries. This system can be installed in a kitchen, at a hostel cafeteria, and any other areas. This can be helpful in reducing accidents caused by gas leakage in household as well as in any similar commercial set up. In our country there are 180 million people, and due to its low cost this product is affordable and will prevent many accidents and save many properties and human lives

Sensor.

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.

MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas.

MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

Applications and Benefits of Using Gas Sensors.

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type of gas present in the atmosphere. Hence, there are different sensors to measure accurate gas concentration in the atmosphere. Gas detection sensors are most commonly used to develop an powered system and identify the variation of toxic gases around an industrial facility. It helps benefit the factories and refineries by keeping them safe against any unexpected threats like explosions. Let's talk more about the applications and benefits of a gas monitoring solution:

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Benefits

Get real-time alerts about the gaseous presence in the atmosphere

Prevent fire hazards and explosions

Supervise gas concentration levels

Ensure worker's health

Real-time updates about leakages

Cost-effective installation

Data analytics for improved decisions

Measure oxygen level accuracy

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the threats in both the unmanned and manned areas.

ADVANTAGES

Low power consumption and reliable.

The advantage this has over others is that it provides quick response rate and has faster diffusion of the critical situation than the manual methods .All the reviewed works aimed at developing systems capable of detecting gas leakages and sending an SMS alert to the user. The system enables monitoring of gas leakages in remote locations and thereby leads to a faster response time in the events of a leakage condition.

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4 Future Work

Overall, software and hardware parts of the systems have been developed and tested by introducing a small amount of LPG near gas sensor module. The authors of this paper are currently working to include multi functions with this device. One of the notable future functions of this system is to add a sub system where wastage of gas and the uses of gas can be monitored using this system. The system is flexible as a greater number of sensors and relays can be added to it according to the whole LPG supply setup in those premises. The author is adding more software based intelligent functions with this system. This is an automatic gas detection, control and alert system. In future this system will have a feature where it can notify the emergency services if any accidents happen. A mobile app and web-based app for real time monitoring also will be added. In the user app for this system many smart features will be added. The overall features will make the system more safe for the users. The system will be optimized for use in many places like the car, the home, industries and many other places. After designing the final prototype with smart multifunctional features, the system will be implemented in real life

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5 Conclusions

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed and discussed in this paper. This is a low-cost, low power, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere but also wastage of gases will hurt our economy. The proposed system will cost only USD 10 which is easily affordable even for poor people. In the open literatures it is noticed that much work has not been done for a smart gas detection system. In future, more advanced features will be integrated with this system which will provide users with more safety and relaxation. The proliferation of handheld devices has led to developments in the field of smart gas sensors, which has considerably widened their scope of application. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

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