# An Affordable and Reliable LPG Gas Detector without Arduino and Microcontroller

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in

Electrical and Electronics Engineering

by

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(DEEMED TO BE UNIVERSITY)

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## BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Lingadharan B (Reg.40140021) Sarathi S(Reg.40140031), Jayabreestlin J(Reg.40140016) who carried out the project entitled "AN AFFORDABLE AND RELIABLE LPG GAS DETECTOR WITHOUT ARNDINUO AND MICROCONTROLLER" under Our supervision from January 2023 to April 2023.

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is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

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# ABSTRACT

This paper proposes a low-cost LPG (Liquefied Petroleum Gas) detector without the use of microcontroller and Arduino. The detector is designed using a simple circuit consisting of basic electronic components such as a gas sensor, operational amplifier, and comparator. The gas sensor detects the presence of LPG and generates a voltage signal that is amplified by the operational amplifier.

The comparator compares the amplified signal with a reference voltage and triggers an alarm if the gas concentration exceeds a certain threshold. The proposed detector is reliable, low-cost, and easy to construct. The absence of microcontroller and Arduino simplifies the design, making it suitable for use in resource-constrained environments.

Experimental results show that the proposed detector is capable detecting LPG at concentrations as low as 200 ppm, which is well below the Lower Explosive Limit (LEL) of LPG. The proposed detector can be used in homes, industries, and other places where LPG is used, providing an affordable and effective solution for gas detection.

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# CHAPTER 1
# INTRODUCTION

## 1.1 GENERAL

Gas leakage leads to various accidents resulting in both material loss and human injuries. The risk of explosion, firing, suffocation are based on their physical properties such toxicity, flammability, etc. The number of deaths due to explosion of gas cylinders has been increasing in recent years. The reason for such explosion is due to substandard cylinders, old valves, worn out regulators and lack of awareness in handling gas cylinders.

The LPG or propane is a flammable mixture of hydrocarbon gases used as fuel in many applications like homes, hostels, industries, automobiles, vehicles because of its desirable properties which include high calorific value, less smoke, less soot, and meager harm to the environment. Natural gas is another widely used fuel in homes. Being heavier than air, these gases do not disperse easily. It may lead to suffocation when inhaled and may lead to explosion. Due to the explosion of LPG, the number of deaths has been increased in recent years. To avoid this problem there is a need for a system to detect the leakage of LPG.

Gas leak detection is the process of identifying potentially hazardous gas leaks by means of various sensors. Several designs of LPG detection and alert system have been proposed in the literature. Apehet al. designed kitchen gas leakage detection and automatic gas shut off system. T.Soundaryaet al. presented the cylinder LPG gas leakage detection system. Wireless and GSM Technology based gas detectors have also been proposed. This paper presents LPG leakage detection and alert system to avoid fire accidents and to provide house safety. The rest of the paper is organized as follows. Section 2 presents the LPG leakage detection and alert system and Section 3 concludes the paper.

## 1.2 LITERATURE SURVEY

This paper suggests a good way to control the system using ATMega328 microcontroller, load cell, and MQ-6 gas sensor to monitor the levels of LPG through the load cell and display the levels continuously and to book a refill automatically when the gas level reaches below the threshold value. The gas sensor detects the gas leakage and alert to user through a buzzer and turns off the gas supply by turning off the regulator knob.

This paper uses the MQ-6 gas sensor, AT89C51 microcontroller, stepper motor, LCD display module, and GSM module to build the gas leakage detection system. The gas leakage is detected by the MQ-6 gas sensor and it sends the signal to the microcontroller with the help of ADC, the microcontroller receives signal and activates buzzer and displays the message on the LCD display and also drives the stepper motor to turn off the regulator knob. This paper uses ARM microcontroller, MQ-6 gas sensor, solenoid valve, weight cell, buzzer, LCD display, and GSM module to build the control system. The gas sensor detects the gas leakage and sends a signal to the ARM microcontroller which then turns on the exhaust fan and turns off the regulator valve using a solenoid and then turns off the main power supply.

This paper uses a sensor, signal conditioning circuit, Analog to Digital converter (ADC), FPGA and a GSM module to build the gas detection system. The MQ-6 gas sensor detects the gas leakage and sends the information to the FPGA which then compares the received information with the threshold value and if the received data is greater than the threshold value then the leakage is detected and then a warning call is sent to the user through the GSM module. This system uses ARM microcontroller, MQ-5 gas sensor, stepper motor, Weight sensor, and GSM module. The gas sensor detects the gas leakage and the information is sent to ARM microcontroller which then activates the stepper motor to turn off the regulator knob. The weight of the cylinder is monitored by the load cell and is displayed in the LCD module when the weight of the cylinder reaches below the threshold value the microcontroller automatically books a refill through the GSM module.

## 1. 3 SCOPE OF THE PROJECT

The scope of a project for an LPG (liquefied petroleum gas) leakage detection system can vary depending on the specific requirements and objectives of the project. However, here are some general areas that can be included in the scope of such a project:

System Design: The project should include the design of a reliable and accurate LPG leakage detection system that can quickly detect any gas leaks.

Sensor Selection: The project should involve the selection of appropriate sensors that can accurately detect LPG gas leaks. The sensors should be able to detect even low concentrations of gas in the air.

Alert System: The project should include the development of an alert system that can notify the users of the system about the gas leak. The alert system can be visual, audible or a combination of both.

Integration with Other Systems: The project can include the integration of the LPG leakage detection system with other systems such as fire alarm systems, HVAC systems, and building management systems to provide a comprehensive solution.

Installation and Maintenance: The project should include the installation of the LPG leakage detection system and regular maintenance to ensure the system remains in good working condition.

Compliance with Regulations: The project should ensure that the LPG leakage detection system complies with all applicable regulations and standards.

Training and Support: The project should include training and support for the users of the system to ensure they can use the system effectively and efficiently.

Overall, the scope of a project for an LPG leakage detection system should aim to provide a reliable and effective solution for detecting gas leaks to prevent potential hazards and ensure the safety of people and property.

## 1.4 ADVANTAGES

- It is easily portable.
- Low power consumes.
- Low cost
- Affordable for everyone
- Less Maintenance

# CHAPTER 2

# THEORITICAL ANALYSIS

## 2.1 GAS SENSOR

Gas sensors have been utilized in various applications. Having inexpensive sensors with great sensitivity, short response time, steadiness and reproducibility are vital for their applications. Meanwhile the response of this kind of device is brought about by the interface of the gas to be recognized with a functional layer that is detected by the existence of the gas. This creates materials with a bigger surface-to-volume proportion because upgrading the gas–solid interaction is of significant interest to develop the sensors' performance. In this sense, the utilization of nanomaterials is a method drawing much interest among researchers working in this domain of gas sensing. In 2016, diabetes biomarkers were detected by a vague impedance-metric chemical sensor array. The sensor is a blend of materials dependent on graphene oxide (GO) and it involves synchronous examination of water and gas analyte multivariate systems.

It was discovered that the electrical impedance of uncovered graphene either oxidized or after decrease indicated high explicitness for ammonia. The GO composite with cerium oxide and cyclodextrin could be used in the ammonia of the uncovered and reducible GO, for identifying the acetone.

In ordered to sense several gas molecule, nanostructured materials have achieved a special attention among others. These incorporate semiconductor metal oxide nanowires, nanoribbons, nanorods, carbon and further nanotubes, diamonds, graphene, and blends of these which make more fascinating nanostructures. A significant fact of nanomaterials in that gas sensor application is a result of high surface area to volume proportion. This perhaps ponders high affectability due to the incredible adsorption of gas species on the accessible molecular binding site and therefore frequently builds sensing ability. In view of the materials, the accompanying gas sensors can be scrutinized for investigations and improvements. Semiconducting metal oxides are extensively used material in fabrication of nanostructured gas sensor. As the surface is visible to sensing gas, the electrical conductivity of semiconductor gets altered (Fig. 1.3). Owing to high surface activity and fashionable microstructure, the metal oxide thin film delivers extraordinary affectability. The sensing performance gets enhanced by the high adsorption of gas

species and the resultant catalytic activity. This phenomena decreases the reaction time in contrast to the environmental microstructure gas sensor. The metal oxide gas sensors have the benefit of working in the lower-temperature range with high affectability.

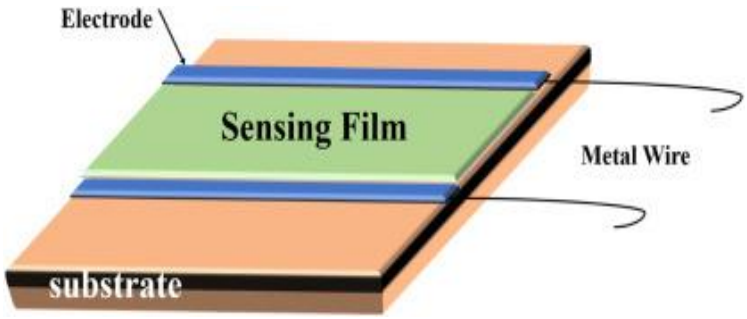


*Figure 2.1 Schematic diagram of metal oxide thin film gas sensor*

## 2.2 GAS LEAKAGE DETECTION

A low-cost LPG (liquefied petroleum gas) gas detection system typically uses a gas sensor to detect the presence of LPG gas in the air. There are several types of gas sensors available, including MQ series gas sensors and electrochemical gas sensors.

MQ series gas sensors operate on the principle of resistance change when exposed to a target gas. The resistance of the sensor changes in proportion to the concentration of the gas in the air. The gas sensor is typically integrated with a microcontroller or a circuit board, which processes the sensor's output and triggers an alarm or a visual indication when the gas concentration exceeds a pre-set threshold.

Electrochemical gas sensors operate on the principle of chemical reaction between the gas and a sensing electrode. The reaction generates an electric current, which is proportional to the gas concentration. The current is then measured and processed by a microcontroller or a circuit board to trigger an alarm or a visual indication when the gas concentration exceeds a pre-set threshold.

In a low-cost LPG gas detection system, the gas sensor is typically integrated with an in expensive comparator circuits to provide a low-cost solution. The system may also include a power source, such as a battery or ac supply and an output device, such as a buzzer or an LED, to alert the user of the gas presence.

The key advantage of a low-cost LPG gas detection system is its affordability and ease of use. It can be easily assembled and installed by non-professionals and provides a reliable and effective solution for detecting the presence of LPG gas in the air.

## 2.3 GAS ANALYSIS

- Blood gas analysis, a method that measures arterial oxygen tension, carbon dioxide tension, and other aspects of a blood sample.
- Breath gas analysis, a non-invasive method that measures volatile organic compounds present in the exhaled breath.
- Dissolved gas analysis, a method that measures dissolved gases in insulating fluids.
- Evolved gas analysis, a method that measures the gas evolved from a heated sample that undergoes decomposition or desorption.
- Breathing gas analysis, especially for breathing gas mixtures
- Trace gas analysis, as an application of mass spectrometry, ion-mobility spectrometry or a combination of the two methods.
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### 2.3.1 Gas analysers

- Infrared gas analyser.
- Residual gas analyser.
- Orsat gas analyser.
- Thermal and Evolved Gas Analyzer, a scientific instrument aboard the Phoenix spacecraft.
- Helium analyser, an instrument to measure the concentration of helium in a gas mixture.
- Electro-galvanic oxygen sensor, A device which consumes a fuel to produce an electrical output by a chemical reaction

### 2.3.2 Types of Gas

Gas is a state of matter with no fixed shape and no fixed volume. The other states of matter are solid, liquid, and plasma. Gases have varied properties from other states of matter. A pure gas may be made up of individual atoms (like Nitrogen, Oxygen, etc.) or a mixture of different atoms (like Carbon Dioxide, Sulfur Dioxide, etc.). Common examples of gases are Oxygen, Carbon Dioxide, Ammonia gas, Air(which is a mixture of gases), etc. Gases can be classified into various types based on the number of atoms, reactivity, compression process, origin, toxicity, etc. In this article, we discuss the 12 types of gases.

1. Monoatomic gases
2. Polyatomic gases
3. Elemental gas
4. Gas containing different elements
5. Inert gas
6. Toxic gas
7. Natural gas
8. Biogas
9. LPG
10. CNG
11. Real gas
12. Ideal gas

### Monoatomic gases

Monatomic gases as the name suggests are a combination of two words “mono” and “atomic” meaning a gas consisting of a single atom. The thermodynamic behavior of a monatomic gas is different from a polyatomic gas as monoatomic gases do not have rotational and vibrational power components at ordinary temperatures.

Examples of monoatomic gases:

- Helium
- Neon
- Argon
- Krypton
- Xenon
- Radon
- Oganesson

**Polyatomic gases**

Polyatomic gases as the name suggest mean gases that have two or more atoms. Examples include Hydrogen($H_2$), Oxygen($O_2$), Nitrogen($N_2$), Sulfur Trioxide ($SO_3$), Carbon Dioxide($CO_2$), etc. These gases are more reactive than monoatomic gases which are mostly inert. Polyatomic gases can be further classified into different types based on the number of atoms like Diatomic, Triatomic, Tetratomic, etc.

Examples of diatomic gases:

- Hydrogen ($H_2$)
- Nitrogen ($N_2$)
- Oxygen ($O_2$)
- Fluorine ($F_2$)
- Chlorine ($Cl_2$)
- Iodine ($I_2$)

Examples of triatomic gases

- Ozone ($O_3$)
- Carbon Dioxide ($CO_2$)
- Water vapor or steam ($H_2O$)

Examples of tetra atomic gases

- Sulfur trioxide ($SO_3$)
- Ammonia gas ($NH_3$)

**Inert gases**

An inert gas is a gas that does not undergo chemical reactions that easily, in other words, it is an extremely stable gas. Most of the inert gases are nobles gases from Group 18 of the periodic table(A chart of all the elements). Inert gases are used generally to avoid unwanted chemical reactions. They are colorless, odorless, tasteless, and non-flammable gases. But given the term inert gas, they are not always inert, they can be made to react under special conditions.

Examples of inert gas

- Helium
- Neon
- Argon
- Krypton
- Xenon
- Radon

**Toxic gases**

Toxic gases as the name suggests are gases that are toxic to human beings. These gases must be stored under continuous ventilation either in a fume hood or ventilated gas cabinet. The toxicity of the gases can be assessed by looking at the LC50 (median lethal dose) value. These gases are harmful to all living beings in general. Inhalation of toxic gases can affect the central nervous system, cause severe illness, or even death. Toxic gases must be labelled properly and handled at proper concentration and with proper care.

Examples of toxic gases

- Ammonia
- Arsine
- Boron Trichloride
- Boron Trifluoride
- 1,3-Butadiene
- Carbon Monoxide
- Chlorine gas
- Hydrogen Fluoride
- Sulfur Dioxide
- Vinyl Chloride

**Ideal gas**

An ideal gas is a type of gas that follows the ideal gas equation. An ideal gas can be described in terms of three parameters: the volume that it occupies, the pressure (Force per unit area) that it exerts, and its temperature. The biggest advantage that we get by treating real gases as an ideal gas is that we have a simple equation of state with only a single constant.

**Real gas**

A real gas is a non-ideal gas meaning it does not follow the ideal gas law. The term ‘real gas’ is usually used to comprehend the behavior of the gases with respect to compressibility effects, variable specific heat capacity, non-equilibrium thermodynamic effects, van der Waals forces, etc. For most cases, the ideal gas approximation may work to some extent.

**Elemental gas**

Certain elements are stable as gases like Nitrogen(N2), Oxygen(O2), and Ozone Ozone, (O3). With a change in temperature or pressure, the stability of the gases may vary.

**Gas containing different elements**

Most gases contain atoms from different elements like Carbon Dioxide ($CO_2$), Water vapor($H_2O$), Sulfur Oxides($SO_x$), Nitrogen Oxides($NO_x$), etc.

**Natural gas**

Natural gas also known as fossil fuels is a mixture of hydrocarbon gases (consisting mostly of alkanes and methane with other minor percentages of gases) that is formed beneath the Earth's surface. It is colorless and odorless and is a highly flammable gas. It is used widely in the manufacture of plastics and is necessary for a wide array of other chemical products, including fertilizers and dyes.

**Biogas**

Biogas is a renewable fuel produced by the breakdown of organic matter(any matter containing hydrocarbons) such as human or animal waste. It is a mixture of gases, primarily consisting of methane, carbon dioxide, and hydrogen sulfide. It can be used as a vehicle fuel, for cooking, and for electricity generation. It is a renewable power source.

**LPG**

The full form of LPG is Liquefied petroleum gas. It is a flammable mixture of hydrocarbon gases and is the liquefied state of petroleum gases. LPG is used as fuel gas for cooking purposes and as fuel for vehicles. It is also nowadays widely used as an aerosol propellant to replace the harmful chlorofluorocarbons to reduce the damage to the ozone layer.

**CNG**

The full form of CNG is Compressed natural gas (CNG). It is mainly composed of methane (CH4), compressed to less than 1% of the volume. It is an eco-friendly alternative to gasoline and the CNG engines of vehicles functions similarly to gasoline engine. It is stored and distributed in complex containers usually in cylindrical or spherical shapes. CNG is non-toxic and does not contaminate groundwater, and hence is considered a safer fuel alternative.

## 2.4 SENSOR DETECTION RANGE

2.1 Sensor detection range

| Sensor name | Detection range |
|---|---|
| Methane sensor | 300-1000 ppm |
| Carbon monoxide sensor | 10-10000 ppm |
| Carbon dioxide sensor | 0-100%(volume) |
| Ammonia sensor | 5-500 |
| Hydrogen sulfide sensor | 1-200 ppm |

# CHAPTER 3
# PROJECT DESCRIPTION

## 3.1 BLOCK DIAGRAM

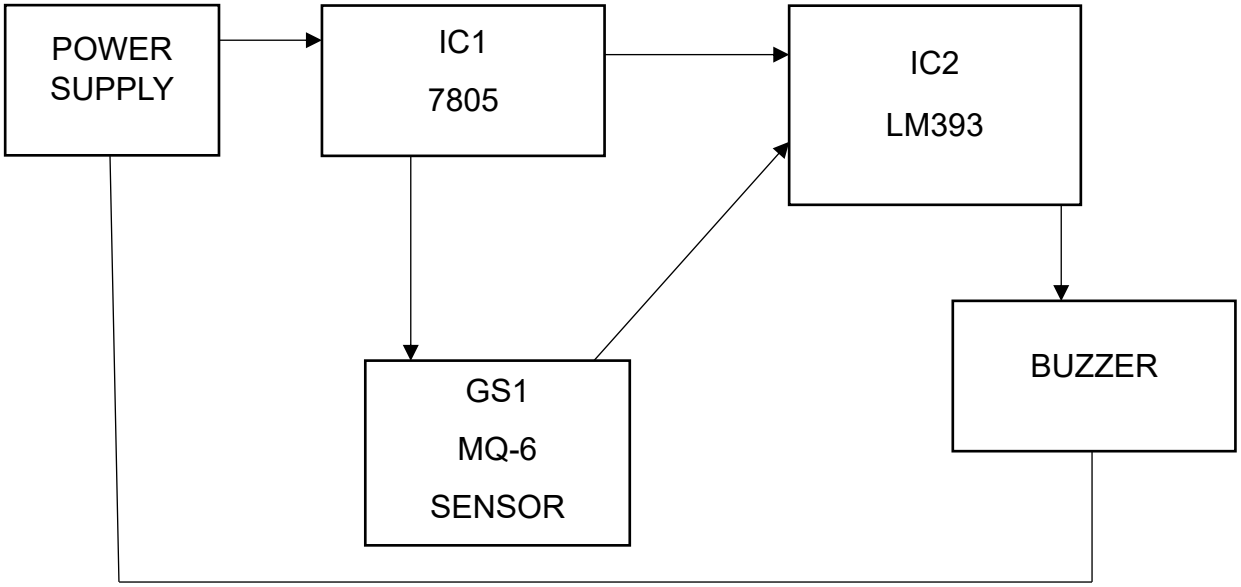



*Figure 3.1 Block diagram of proposed model*

## 3.2 PROJECT CONCEPT EXPLANATION

We are built an LPG Gas detector device and doesn't need the Arduino and Microcontroller.

A low-cost gas detection system is a device that is designed to detect the presence of a specific gas in the air and provide an alert when the gas concentration exceeds a pre-set threshold. The system typically uses a gas sensor that detects the gas concentration and triggers an alarm or a visual indication when the concentration exceeds a certain level.

The concept of a low-cost gas detection system is based on the need for affordable and effective gas detection solutions for various applications. Gas leaks can pose serious risks to health, safety, and the environment, and early detection is crucial to prevent accidents and minimize the impact of gas leaks. A low-cost gas detection system provides a cost-effective solution for gas detection in various settings, such as homes, offices, factories, and industrial sites.

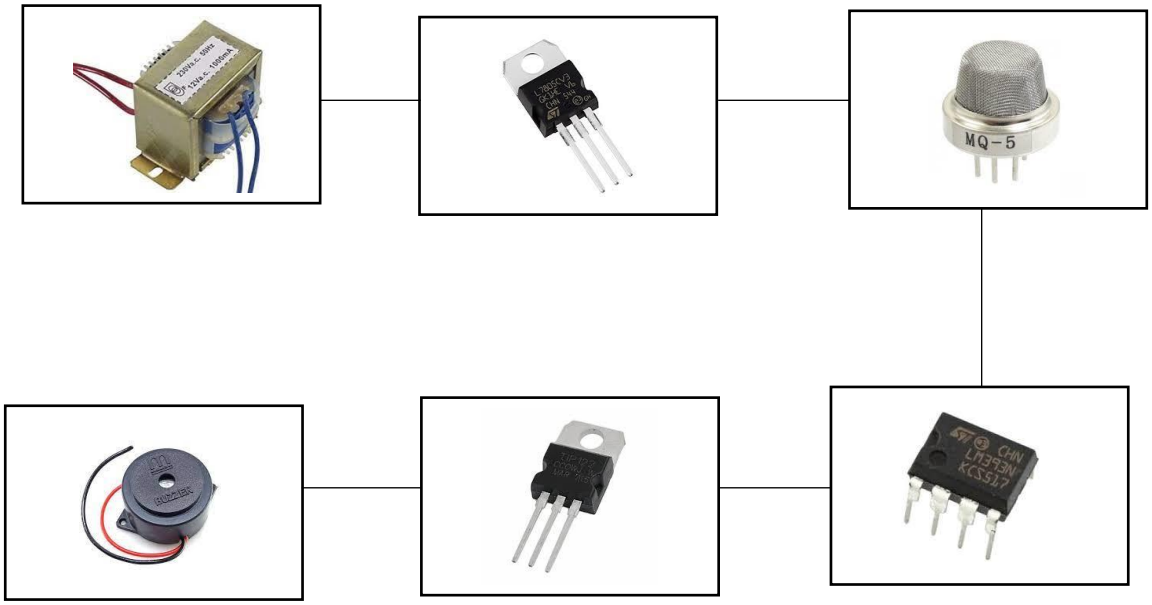
The system typically consists of a gas sensor, a microcontroller or a circuit board, a power source, and an output device. The gas sensor detects the gas concentration and converts it into an electrical signal. The microcontroller or circuit board processes the signal and triggers an alarm or a visual indication when the gas concentration exceeds a pre-set threshold. The power source provides power to the system, while the output device alerts the user of the gas presence.

The key benefits of a low-cost gas detection system include its affordability, ease of use, and versatility. It can be easily assembled and installed by non-professionals, provides a reliable and effective solution for gas detection in various settings. Additionally, the system can be customized to detect different types of gases, depending on the application.

Overall, a low-cost gas detection system is a valuable device that can help prevent gas-related accidents and promote safety in various settings. Its affordability and ease of use make it accessible to a wide range of users, while its reliability and effectiveness provide peace of mind and security.

### 3.3 EXISTING MODEL

*Figure 3.2 Existing model*



# CHAPTER 4
# PROPOSED SYSTEM

## 4.1 OUR PROJECT DESIGN

A low-cost LPG (liquefied petroleum gas) gas detection system can be designed and implemented without the use of an Arduino or a microcontroller. One possible way to achieve this is to use a gas sensor that has a built-in relay output.

A relay is an electromechanical switch that can be used to turn on or off a circuit. In a gas detection system, the relay can be used to trigger an alarm or a visual indication when the gas concentration exceeds a pre-set threshold.

To design a low-cost LPG gas detection system without an Arduino or a microcontroller, you would need to select a gas sensor with a built-in relay output. One example of such a sensor is the MQ-5 gas sensor, which has a built-in relay that is activated when the gas concentration exceeds a pre-set threshold.

To use the MQ-5 gas sensor for LPG gas detection, you would need to connect the sensor to a power source and a relay. The sensor typically requires a voltage of 5V to 12V DC and can be powered using a battery or a USB power supply. The relay can be connected to the sensor's output pins and to an alarm or a visual indication device, such as a buzzer or an LED.

When the LPG gas concentration exceeds the pre-set threshold, the MQ-5 gas sensor's output voltage will increase, triggering the relay to turn on. This will activate the alarm or visual indication device, alerting the user of the gas presence.

It is important to note that using a gas sensor with a built-in relay output may limit the flexibility and customization of the gas detection system. However, it provides a simple and low-cost solution for LPG gas detection without the need for an Arduino or a microcontroller.

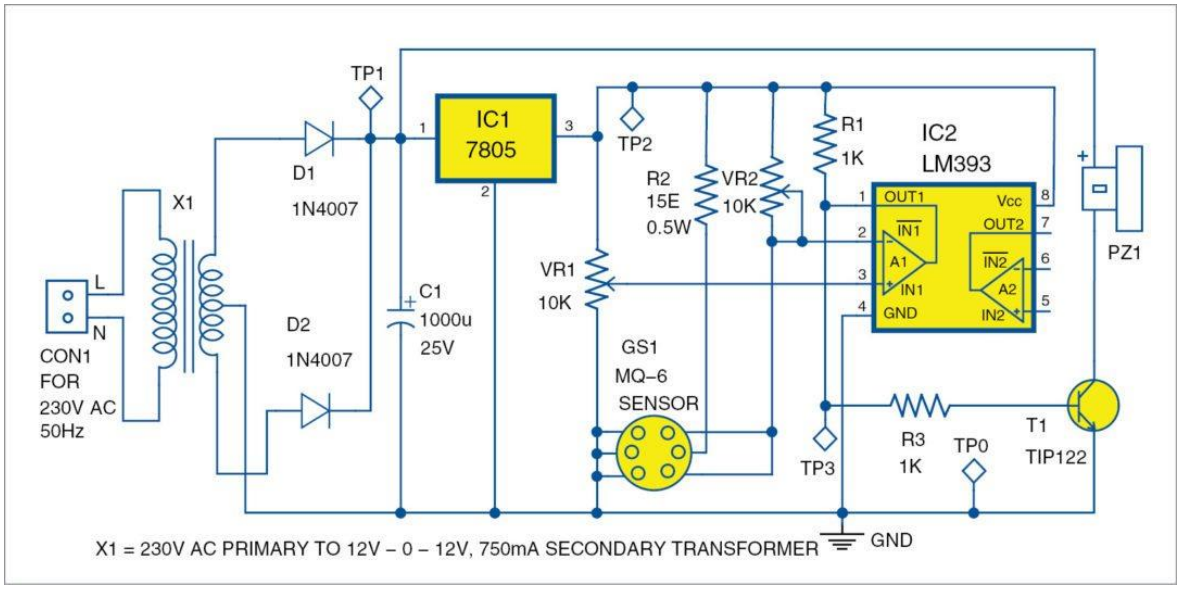



*Figure 4.1 circuit diagram of project*

Initially the supply from the main source is stepped down using a centre tapped transformer to 12 V. Then the 12V ac is converted to dc by rectifier diodes by such a arrangement. A capacitor is used to filter the voltage across Voltage regulator.

Volage regulator is used to maintain a constant dc voltage to the rest of the circuit. A potentiometer is used to vary the voltage or it is used for reference for comparator. A gas sensor is connected to supply by a arrangement such that when there is a leak of LPG gas, the sensor voltage is given as input to comparator according to that comparator gives output. The output of the comparator is given to base of Darlington transistor which is acting as a switch to the circuit. When the leak is detected by sensor, voltage is developed on the output of sensors, then comparator gives output according to the sensor voltage. Thus base gets supply thereby switching begins and the buzzer starts to beep till the sensor detecting the gas.

The following the chapters gives you a clear idea about the components used in the circuit.

## 4.2 COMPONENTS:

1. 7805 IC
2. TIP 122 IC
3. LM393
4. Potentiometer
5. Gas sensor
6. Buzzer

### 4.2.1 VOLTAGE REGULATOR 7805 IC

All voltage sources cannot able to give fixed output due to fluctuations in the circuit. For getting constant and steady output, the voltage regulators are implemented. The integrated circuits which are used for the regulation of voltage are termed as voltage regulator ICs.

The voltage regulator IC 7805 is actually a member of the 78xx series of voltage regulator ICs. It is a fixed linear voltage regulator. The xx present in 78xx represents the value of the fixed output voltage that the particular IC provides. For 7805 IC, it is +5V DC regulated power supply. This regulator IC also adds a provision for a heat sink. The input voltage to this voltage regulator can be up to 35V, and this IC can give a constant 5V for any value of input less than or equal to 35V which is the threshold limit.

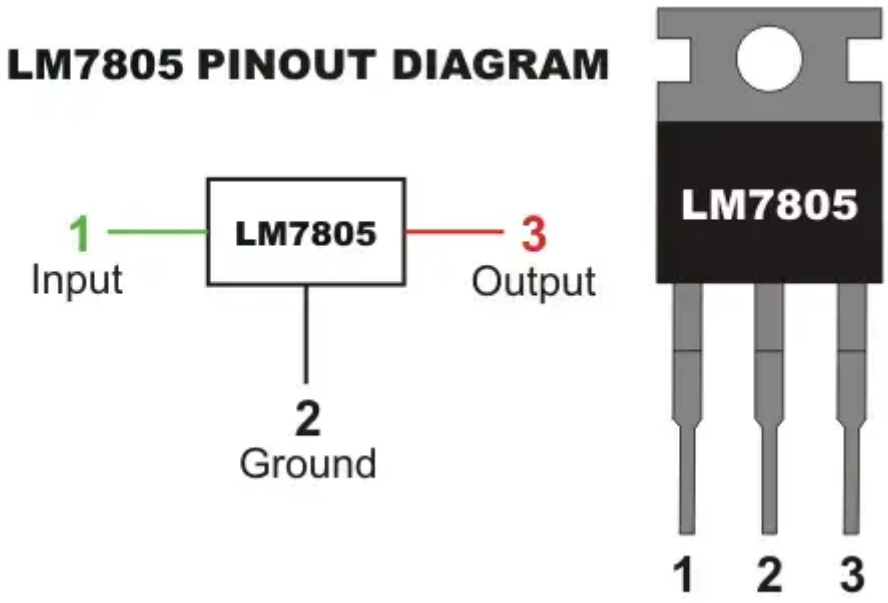



*Figure 4.2 Voltage regulator*

PIN1-INPUT: The function of this pin is to give the input voltage. It should be in the range of 7V to 35V. We apply an unregulated voltage to this pin for regulation. For 7.2V input, the PIN achieves its maximum efficiency.
PIN2-GROUND: We connect the ground to this pin. For output and input, this pin is equally neutral (0V).
PIN3-OUTPUT: This pin is used to take the regulated output. It will be 5V(4.8V-5.2V)
Heat Dissipation in IC 7805:

In IC 7805 voltage regulator, lots of energy is exhausted in the form of heat. The difference in the value of input voltage and output voltage comes as heat. So, if the difference between input voltage and the output voltage is high, there will be more heat generation. Without a heat sink, this too much heat will cause malfunction.
We call, the bare minimum tolerable difference between the input and output voltage to keep the output voltage at the proper level as dropout voltage. It is better to keep the input voltage 2 to 3V greater than the output voltage, or a suitable heat sink should be placed to dissipate excess heat. We have to calculate the heat sink size properly. The following formula will given idea of this calculation.
Now, we can analyse the relation of generated heat and the input voltage value in this regulator with the following two examples.

Internal Block Diagram of 7805 Voltage Regulator:

The internal block diagram of IC 7805 is represented in the figure below:

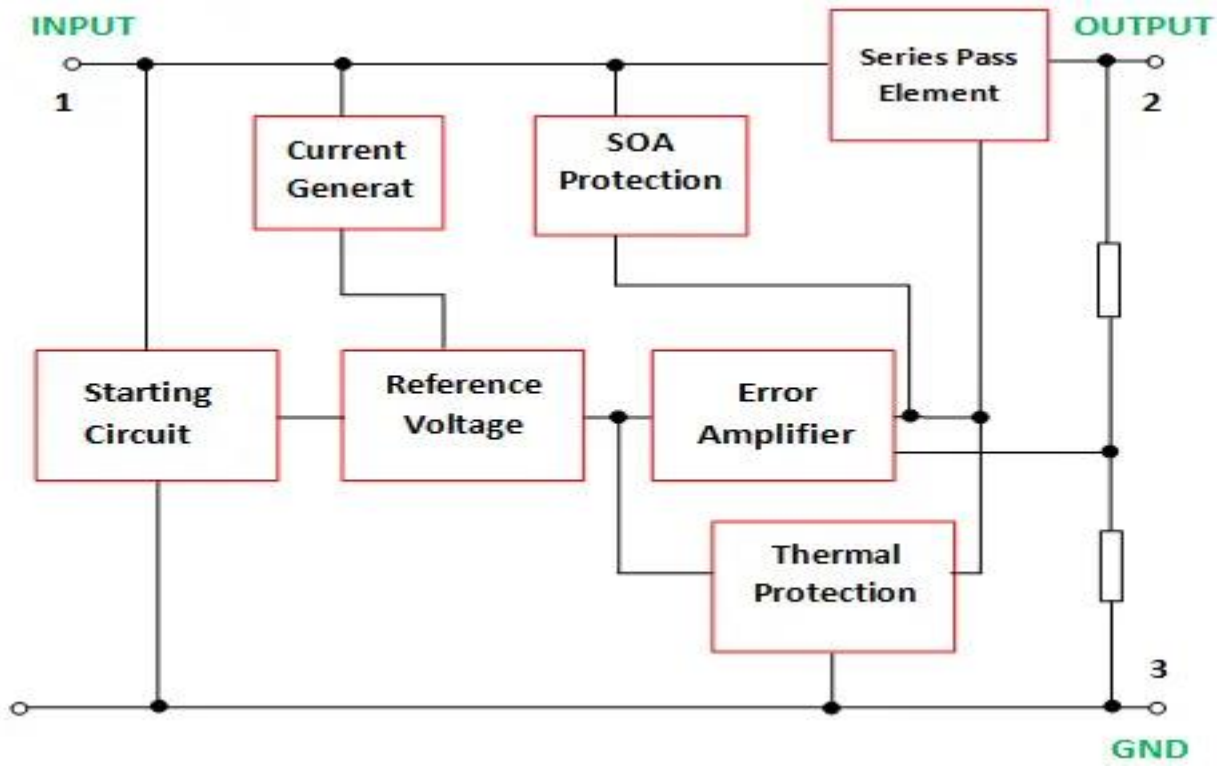



*Figure 4.3 Internal Block Diagram of 7805*

The block diagram comprises of an error amplifier, series pass element, current generator, reference voltage, current generator, starting circuit, SOA protection and thermal protection. Here the operating amplifier performs as an error amplifier. The Zener diode is used for giving the reference voltage. It is shown below.

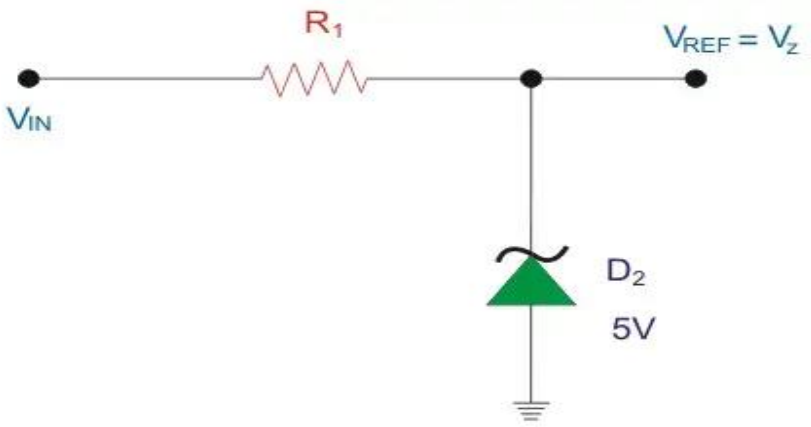



*Figure 4.4 reference voltage (Zener diode)*

Transistor is the series pass element here. It is used for dissipating additional energy in the form of heat. It controls the output voltage by controlling the current among the input and output. SOA is the Safe Operating Area. It is in fact the conditions of voltage and current in which the equipment is expected to work without any self-damage. Here for the SOA protection, bipolar transistor is implemented with a series resistor and an auxiliary transistor. Heat sink is implemented for thermal protection when there is high supply voltage.

Applications of Voltage Regulator 7805 IC

- Current regulator
- Regulated dual supply
- Building circuits for Phone charger, UPS power supply circuits, portable CD player etc
- Fixed output regulator
- Adjustable output regulator etc

### 4.2.2 TIP122 TRANSISTOR

The TIP122 is a Darlington NPN transistor and it is very popular for its high current gain & high current. As the name suggests, the term Darlington means when the two transistors are available in a single pack for enhancing the gain at the o/p. The manufacturing of this transistor can be done like a switch & amplification purpose.

*Figure 4.5 TIP 122*

Pin Configuration: The pin configuration of a TIP122 Transistor includes the following. This transistor includes three pins where each pin and its function are discussed below.

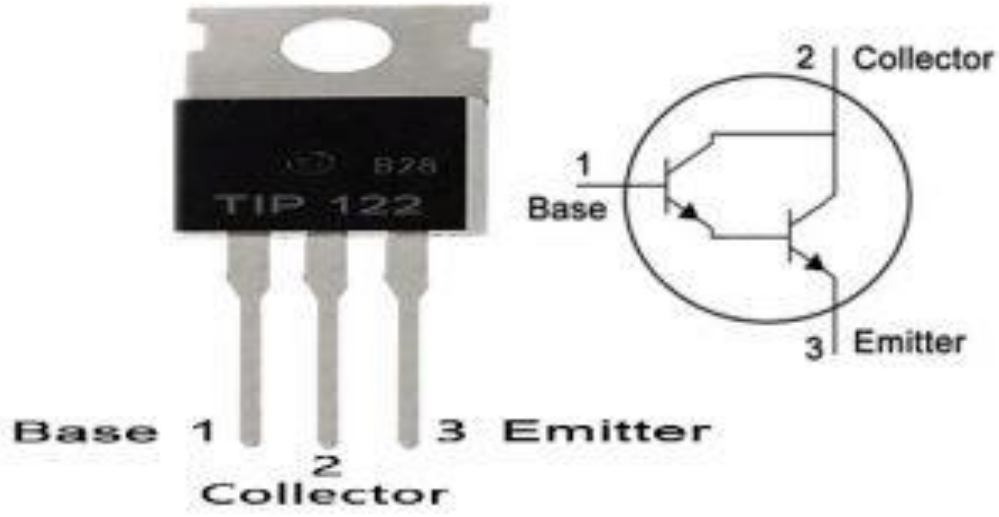



*Figure 4.6 TIP122 Pin configuration*

- Pin1 (Base):
  This pin controls the transistor biasing.
- Pin2 (Collector):
  The flow of current will be there throughout this pin
- Pin3 (Emitter):
  This pin is used to drain the current

Features & Specifications

The features & specifications of a TIP122 transistor include the following.

- This transistor is available in the TO-220 package
- This is an NPN Darlington type transistor
- Max Operating & Storage Temperature Ranges from -65 to +150 C
- Collector Current Max is 5A
- DC Current Gain (Max & Min) is1000
- Collector-Emitter Voltage Max is 100V
- Collector Dissipation Max is 65 Watt
- Collector-Base Voltage is 100V
- Max Emitter-Base Voltage is 5V
- Single configuration

- Quantity in a pack from the factory is 200
- Height is 9.4 mm
- Length is 10.67 mm
- ON Semiconductor Manufacturer
- Mounting type & style is through-hole
- The width is 4.83 mm

The TIP127 transistor is the complement transistor of the TIP122. NPN transistors from the same family are TIP121, TIP120, TIP122 whereas PNP Family transistors are TIP126, TIP125 & TIP127.

Where to use TIP122 Transistor/Applications?

This transistor can be used as a switch within different electronic circuits to drive different loads below 5A based on its features. The application circuits of this transistor mainly include a battery charger, power supply, motors driving, etc.
This transistor can also be used as an amplifier & audio pre-amplifier. This transistor EB voltage is 5V DC. This transistor can be connected to the microcontroller's o/p & logic devices for controlling below 5A loads.

This transistor is used for controlling high current loads & also used wherever high amplification is necessary This transistor is simply controlled through a microcontroller which is called a logic device but care must be taken to verify if the microcontroller can capable of 120mA.
This transistor can be controlled easily through a logic device for switching maximum power loads for amplifying max current. So this transistor is a perfect choice for your requirement.

Protect a TIP122 Transistor in a Circuit

To get good performance through this Darlington transistor, maximum ratings must maintain to below. This transistor shouldn't use when the circuit is operated above 100V and the load shouldn't provide above 5A. A base resistor must use for providing the required current on the base terminal.

From the overheating, this transistor can be protected by using a heatsink. Maintain the temperature from 65C to +150 C.

**Advantages & Disadvantages**

The advantages of the Darlington pair transistor include the following:

- It provides extremely high current gain as compared to a single transistor.
- As compared to phototransistor including exterior amplifier, this transducers provides less noise.
- The input impedance provided by this transistor is extremely high
- By using a current source with few mA, the designer can drive more power-based applications.
- It uses fewer components to make the circuit.
- It is extremely responsive to current.
- Signal amplification can be done for a long time

The disadvantages of the Darlington pair transistor **:**

- Once this transistor is within the saturation region, there is a voltage drop beyond BE terminals.
- The first transistor's leakage current can be amplified through the second transistor. So, the Darlington transistor's overall outflow current is higher.
- Less switching speed
- It provides max power dissipation because of high saturation voltage.
- Limited BW (Bandwidth)
- At certain frequencies, the phase shift can be introduced by this design within a negative feedback circuit.

**Applications**

The applications of the TIP122 Transistor include the following.

- This transistor is used to adjust high current based loads like 5 amperes
- It is used where high strengthening is desirable.
- It is used as a velocity controller within motors

### 4.2.3 MQ-6 GAS SENSOR

MQ6 Gas sensor is a Metal Oxide Semiconductor (MOS) type Gas Sensor mainly used to detect the LPG and Butane gas concentration in the air either at home or in industry.

This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless-steel mesh. Whenever gas comes into contact with the sensing element, the resistivity of the element changes. The change is then measured to get the concentration of the gases present.

Its sensing range is very suitable for gas leak detection in homes and places like hotels, restaurants where cooking is done using LPG cylinders. The combustion of LPG is highly exothermal means it will release a vast amount of heat if ignited which when used in controlled way is beneficial but if an accident occurs it will be devastating. It can be used in automobiles which are CNG powered, homes, restaurants to detect LPG gas leak.

*Figure 4.7 Gas sensor*

Specifications

- Operating Voltage is +5V
- Can be used to detect LPG or Butane gas
- Analog output voltage: 0V to 5V
- Digital Output Voltage: 0V or 5V (TTL Logic)
- Preheat duration 20 seconds
- Can be used as a Digital or Analog sensor

- The Sensitivity of Digital pin can be varied using the potentiometer

MQ-6 Sensors to Detect gas

Using a MQ sensor it detect a gas is very easy. You can either use the digital pin or the analog pin to accomplish this. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors have to be kept on for pre-heating time (mentioned in features above) before you can actually work with it. Now, introduce the sensor to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this particular concentration the digital pin will go high (5V) else will remain low (0V).

### 4.2.4 LM393 IC

The LM393 is a dual independent accuracy voltage integrated circuit operated with single or else split supply. These ICs comprises two independent voltage comparators to operate from an only power supply more than a wide variety of voltages. Working with two supplies is also achievable as long as the variation among the two supply voltages is 2 volts to 36 volts, & VCC is minimum 1.5 volts extra positive than the i/p voltage. The main features of this IC mainly include the following.

- Single voltage supply ranges from 2.0 Vdc toward 36 Vdc
- Split supply range will be from +1.0 Vdc or -1.0 Vdc to +18 Vdc or -18 Vdc
- Little Supply Voltage of Current Drain Independent is 0.4 mA
- The input bias current is low that is 25nA
- Input offset current is low that is 5nA
- Both the range of differential input as well as Power Supply Voltage is equivalent
- The output voltage is well-suited by ECL, MOS, DTL, TTL, & CMOS Logic Levels
- Electrostatic discharge bolts on the inputs to enhance the device roughness without troubling its performance

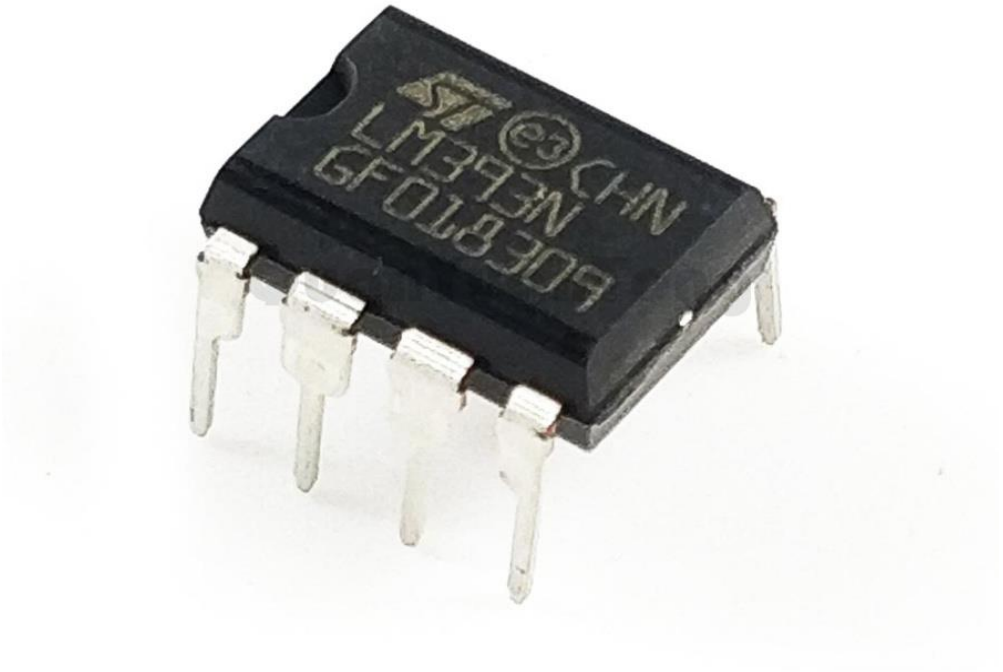



*Figure 4.8 LM393*

LM393 IC Pin Configuration

This IC includes 8-pins and every pin of this IC has a different features from each other. The eight pins of this IC are listed below.

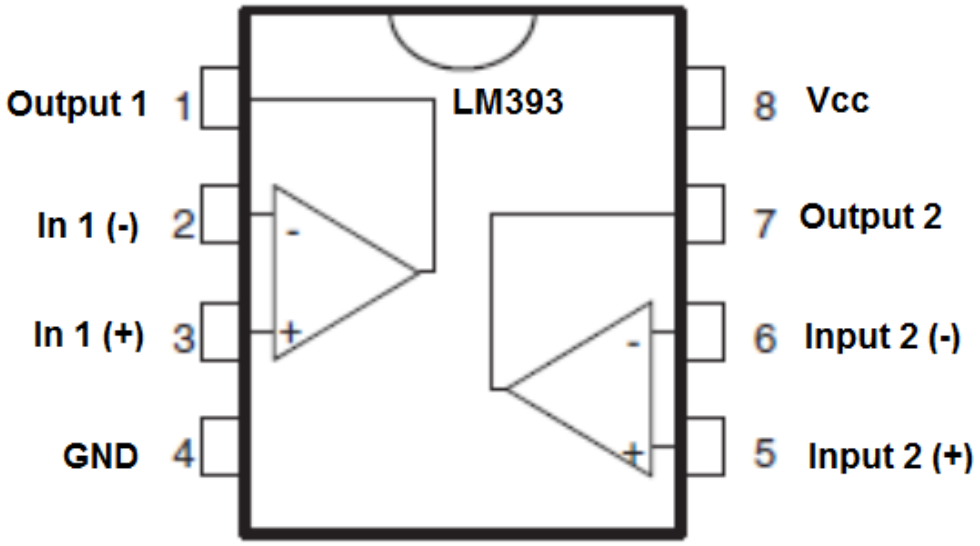



*Figure 4.9 LM393 pin diagram*

- Pin1 (OUTA): Output A
- Pin2 (In A-): Inverting input A
- Pin3 (In A+): Non-inverting input A
- Pin4 (GND): Ground
- Pin5 (INB+): Non-inverting input B
- Pin6 (INB-): Inverting input B
- Pin7 (OUTB): Output B
- Pin8 (Vcc): Voltage Supply

LM393 IC Package & Dimensions:

The Packages of LM393 has introduced for the different forms of a similar IC.

- The LM 393IC package is SOIC (8), and the part number is LM393N.
- These ICs are available in different packages with different dimensions for their easy separation
- The package and dimension of LM 393 IC will be SOIC (8) and 4.9 X 3.91

LM393 IC Ratings:

The ratings of the LM393 IC mainly include an amount of current, voltage & required power for that particular IC.

- The input voltage of this IC ranges from -0.3V to 36V
- Differential i/p voltage is 36V
- Lead temperature is 2600C
- Power Dissipation is 660mW
- Storage temperature is -65 0C/W to 150 0C/W

Working of LM393 IC:

The IC LM393 includes two op-amps internally and each op-amp has two inputs as well as one output. These ICs works independently to provide its own output. But, this circuit uses only one operational amplifier and the other op-amp will not be connected. Both the op-amps are necessary only when we use complex circuits for monitoring numerous levels. This circuit checks only one level so it uses one op-amp.

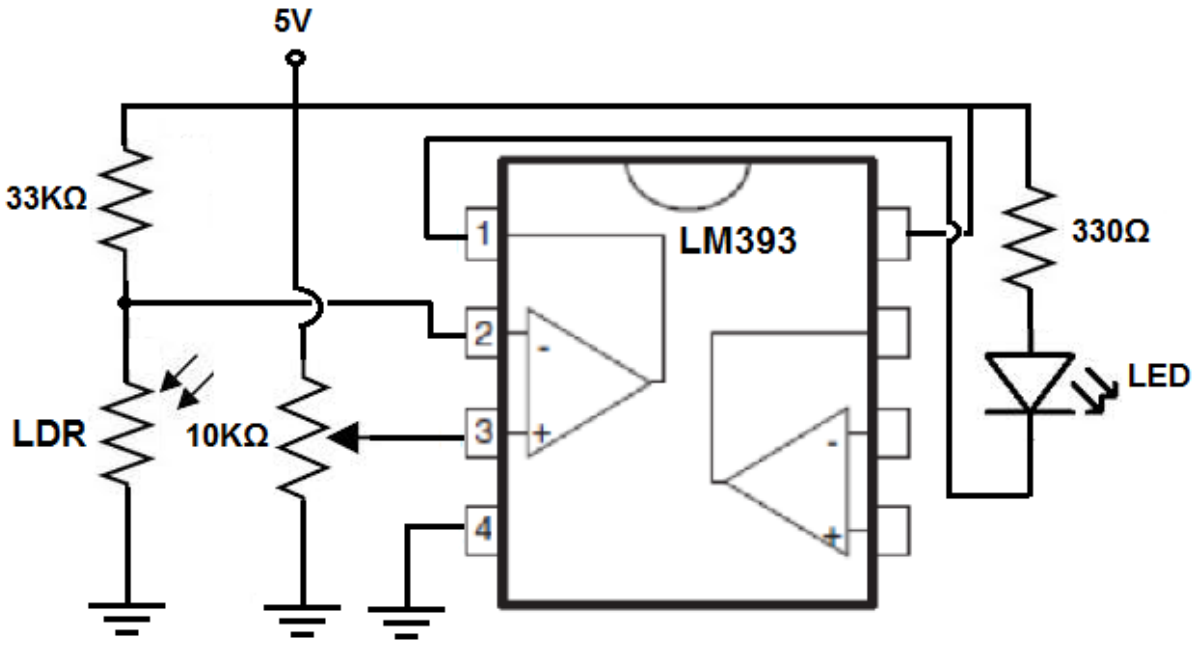



*Figure 4.10 LM393 Circuit diagram*

Once the power is applied to the IC, compare the voltage values. If the inverting terminal voltage is high than the non-inverting, then the op-amp output will befall to the ground, and the flow of current will be from positive supply to GND. Similarly, if

the voltage of the inverting terminal is low than the non-inverting, then the op-amp output will stay at the positive voltage supply (Vcc), and there is no flow of current because there is no potential difference across the load.

So, when the voltage of the inverting terminal is high then the load will be turned ON. When the voltage of the inverting terminal is low then the load will be turned OFF. Here the LED is used as a load. The night light circuit using LM393 is shown below. This circuit uses a LED as a load, and a photoresistor is used to detect light. The resistance of the photoresistor mainly depends on the light hits on the surface. When the photoresistor detects the darkness, the resistance of the photoresistor will be high, and when the photoresistor detects the bright light, its resistance will be decreased.

So if we connect a voltage divider circuit using a photoresistor as well as a fixed resistor. If it detects the darkness, then the photoresistor will utilize more voltage, because it has less resistance in dark. Similarly, if it detects to bright light, then the photoresistor will utilize less voltage.

If the op-amps non-inverting terminal's input is a good reference voltage, and the voltage of the photoresistor goes high than the reference voltage if exposed to the dark, and low than the reference voltage if exposed to light, we have designed a comparator circuit which acts differently for when there is night then there is light. So the LED will turn ON throughout darkness and OFF in bright light.

Thus, this is all about the LM393 IC and its application. The LM393 IC is a low-power, single-supply, low-offset voltage, double, differential comparators. Generally, a common comparator IC is a tiny voltmeter by included switches. It is used to calculate the voltages at two dissimilar terminals and contrasts the dissimilarity in voltage quantity. If the voltage of the first terminal has a high-voltage than the second terminal, the switch will activate. But, if the first terminal has a low-voltage than the second terminal, the switch will deactivate.

### 4.3 WORKING OF THE LPG DETECTOR

The circuit for an LPG leakage detector is readily available in the market, but it is extremely expensive and usually based on a microcontroller (MCU). Presented here is a low-cost circuit for an LPG detector that you can build easily.

Circuit diagram of the low-cost LPG detector is shown. It is built around step-down transformer X1, two rectifier diodes 1N4007 (D1 and D2), a 1000µF capacitor (C1), 7805 voltage regulator (IC1), MQ-6 LPG gas sensor (GS1), dual comparator LM393 (IC2), Darlington transistor TIP122 (T2), 12V high-gain siren/buzzer (PZ1) and a few other components.

The mains supply is stepped down by transformer X1, rectified by a full-wave rectifier comprising diodes D1 and D2, filtered by capacitor C1 and fed to regulator 7805 (IC1) to maintain constant 5V DC output, which is fed to the circuit.

At the heart of the circuit is dual comparator IC LM393 (IC2). It is used to compare two different voltages, namely, reference voltage and MQ-6 gas sensor output voltage. Reference voltage at non-inverting pin 3 of IC2 is set using potmeter VR1 to adjust voltage levels based on sensitivity requirements. LPG sensor (MQ-6) output voltage is fed to inverting pin 2 of IC2.If reference voltage (pin 3 of IC2) is less than sensor voltage (pin 2 of IC2), output goes low, which means there is no LPG leakage. With low output, T1 remains cut-off and there is no current flow through the buzzer; it does not sound and remains in silence mode.

If reference voltage is greater than sensor voltage, output goes high, which means there is LPG leakage. The high output switches on transistor T1 and the buzzer rings loudly to alert the people around. It is very easy to find gas leakages with this circuit, which uses low-cost components and an interactive way to adjust different sensitivity levels, based on customer needs, with the help of potmeter VR1.

## 4.4 PROJECT PROTOTYPE

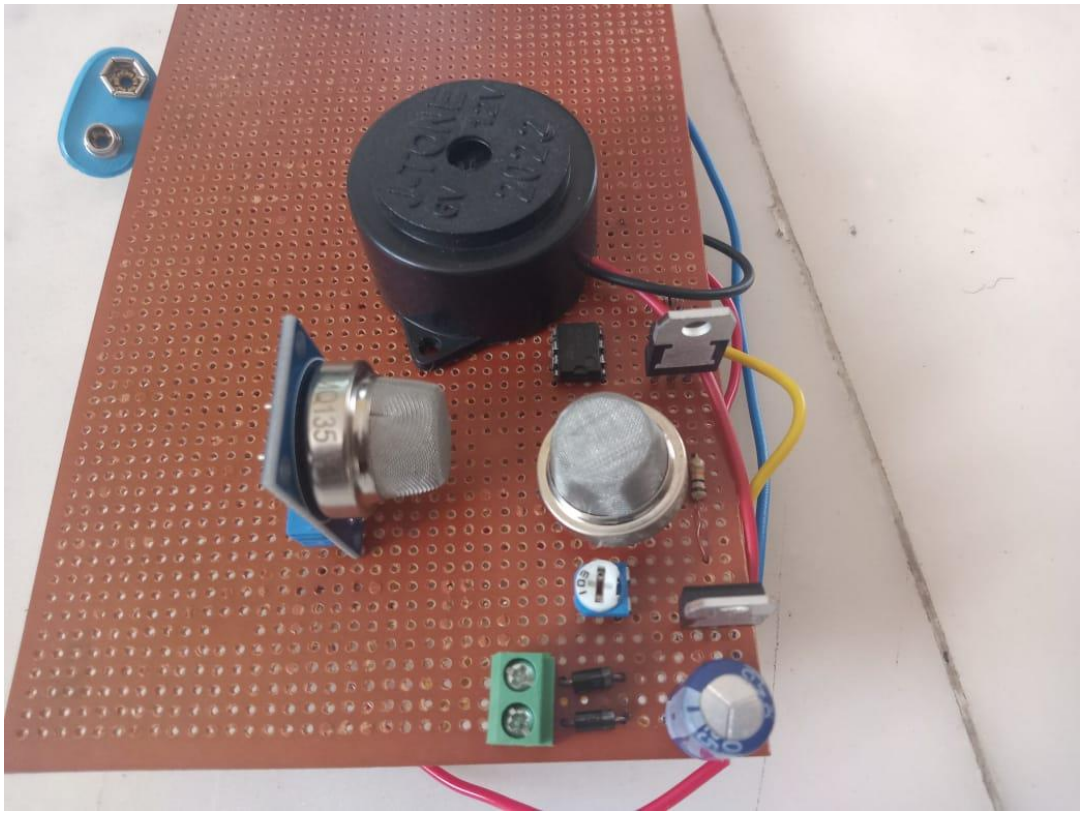


*Figure 4.11 Prototype*

# CHAPTER 5

# CONCLUSION AND FUTURE SCOPE

## 5.1 SUMMARY

We have designed a An Affordable and Reliable LPG Gas Detector without Arduino and Microcontroller. It will detect the LPG gas and it indicates during LPG leakage.

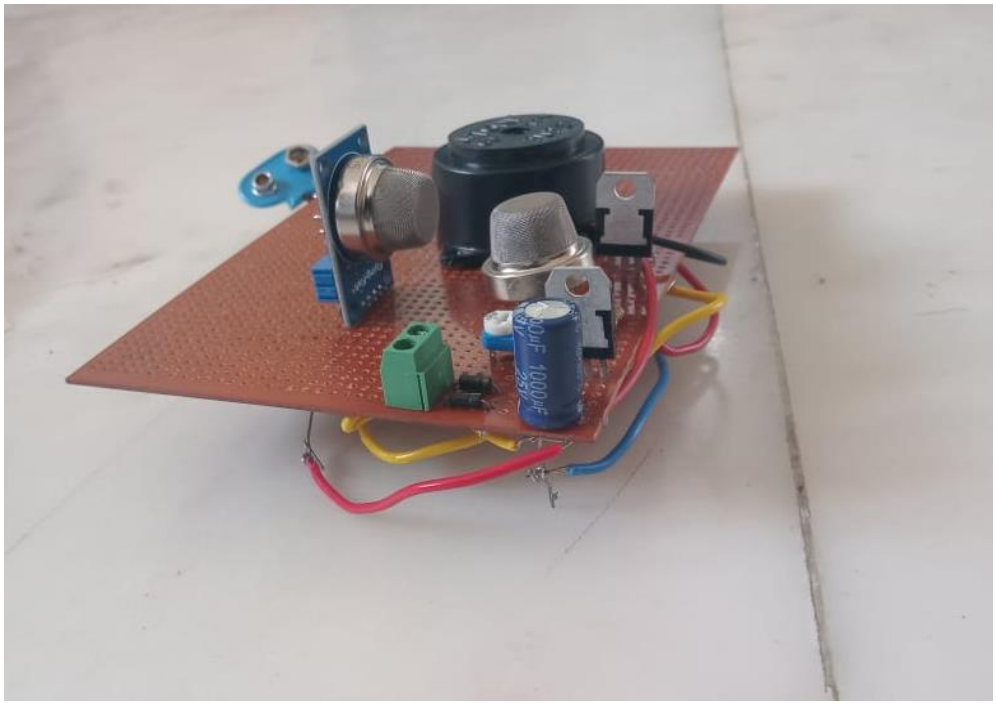



*Figure 5.1 Prototype front view*

## 5.2 FUTURE SCOPE

Another major future scope could be including a Automatic Shut-off device which will turn off the gas supply whenever it will detect any gas leakage. This system can be implemented in Industries, Hotels and wherever the LPG cylinders are used.

## 5.3 CONCLUSION

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.

## 5.4 REFERENCE

Pamarthi Kanakaraja is associate professor (R&D cell) in Usharama College of Engineering and Technology, Andhra Pradesh.

Link: https://www.electronicsforu.com/electronics-projects/lpg-leakage-detector-low-cost