

Low Cost Gas Leakage Detector

A PROJECT REPORT

Mini Project - I

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' MINI PROJECT – I '.

This Project Report entitled,

' LOW COST GAS LEAKAGE DETECTOR '.

is the bonafied work of them submitted to '**Mr. Anil S. Mohite**'
as a part of **ISE** of subject during Academic Year 2020-2021.

**20 APRIL
2021**

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ABSTRACT :

Liquefied Petroleum Gas (LPG) is a main source of fuel for many applications, especially in urban areas because it is clean compared to firewood and charcoal. From many decades, it has replaced conventional burning of solid organic materials and liquid fuels. LPG has very high calorific value which makes it efficient fuel over others. Also it is affordable to use for home applications as well as in industries.

But, 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 gaspower. 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 Gas Sensor that easily detects a gas leakage and a Buzzer that makes people aware.

KEYWORDS:

LPG (liquefied petroleum gas); gas sensor; buzzer (alarm); LED (light); Comparator IC LM393; Darlington Transistorized Circuits;

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A. INTRODUCTION :

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 petroleum 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 as 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.

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, easy to manufacture and commercialization, user friendly, portable, small in size and cost effective. It is designed without use of any microprocessor. It will cost only 400 INR which is equivalent to 6 USD.

1. PROBLEM STATEMENT

To make a circuit to accurately detect the leakage of LPG or other flammable gases and triggers the alert system.

2. PROBLEM OBJECTIVES

- i. The main objective of this project is to detect LPG anywhere, and to avoid the mishaps which can result after LPG leakage
- ii. To prevent the extreme losses of resources which can be caused by fire .
- iii. Also, to prevent the huge amount of energy present in fuels to be wasted.

- iv. To make the project as cheap as possible.
- v. It should be easy to manufacture .
- vi. It should not require any separate power supply that needs to be replaced time-to-time. In simple words, It should work on 230V~50Hz household power supply.

B. LITERATURE REVIEW

A number of research papers have been published on gas leakage detection techniques

- [1] 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
- [2] 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
- [3] 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
- [4] Mohammad Monirujjaman Khan Proposed Sensor-Based Gas Leakage Detector System in which the Similar type of Gas Sensor have been used, The sensor is controlled by Arduino Microcontroller which gives digital input and has ability to make decision whether the leakage is remarkable or less, buzzing subsequent alarms sounds

In the existing method, different gas sensing technology is used. In this Project, 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.

C. METHODOLOGY:

1. Components and Materials:

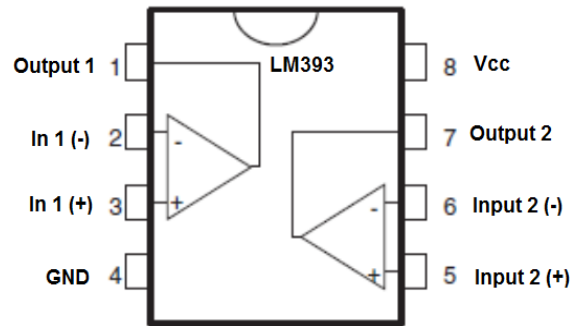
i. Gas Sensor

In this Project, 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



ii. Comparator IC LM393 (IC2)

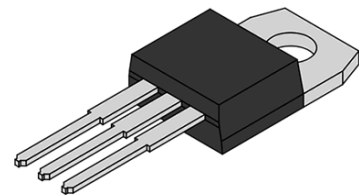
The LM393 IC can be considered as the equivalent comparator version of the most popular LM358 Op-Amp. While any Op-Amp can be made to work as a voltage comparator, the LM393 proves itself to be advantages by providing an open collector output making it suitable to drive loads.



The output transistor can drive loads up to 50V and 50mA which is suitable for driving most of the TTL, MOS and RTL loads. The transistor can also make the Load to be isolated from the system ground. So if you are looking for a Voltage comparator to drive loads of these specifications then this IC might be the right choice for you.

iii. 7805 as +5V Voltage Regulator

We require constant +5V power to drive the circuit. Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 Voltage Regulator, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). 7805 will provide a +5V output voltage. The output current of this IC can go up to 1.5A.



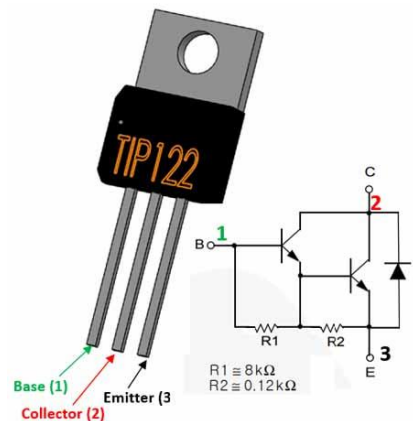
iv. 12V High-Gain Siren/Buzzer

A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.



v. TIP 122 – Darlington NPN Transistor :

The TIP122 is a Darlington pair NPN transistor. It functions like a normal NPN transistor, but since it has a Darlington pair inside it has a good collector current rating of about 5A and a gain of about 1000. It can also withstand about 100V across its collector- Emitter hence can be used to drive heavy loads. there are two transistors inside this package in which the emitter of the first transistor is connected with the base of the second transistor and the collector of both transistors are connected together to form a Darlington pair. This increases the current gain and current rating of this transistor.

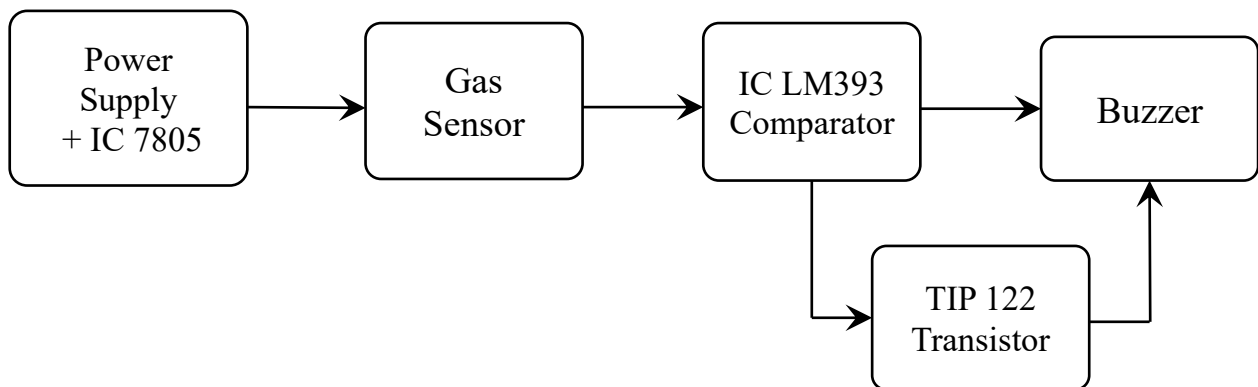


vi. Other Components

Resistors, Capacitors,
Rectifier Diodes,
Step Down Transformer,
Connecting Wires, PCB, etc.

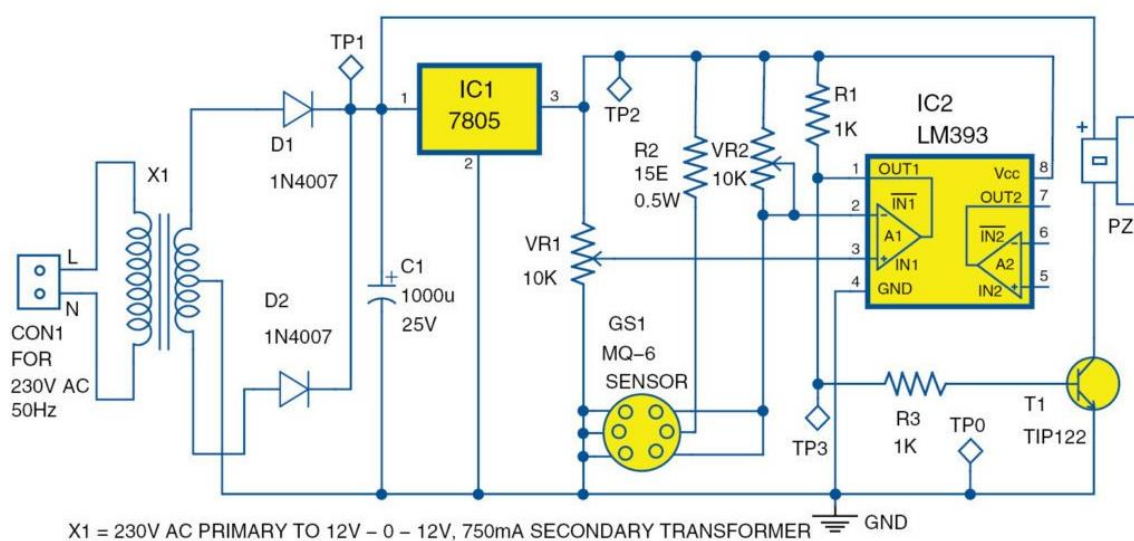


2. BLOCK DIAGRAM



Block Diagram of Low-Cost Gas Leakage Detector Circuit

3. CONSTRUCTION AND CIRCUIT DIAGRAM:



4. WORKING OF LPG GAS DETECTOR :

Circuit diagram of the low-cost LPG detector is shown in Fig. 2. It is built around step-down transformer X1, two rectifier diodes 1N4007 (D1 and D2), a 1000 μ F 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 potentiometer VR1.

D. ADVANTAGES :

1. Can detect even a low amount of leakage
2. Very easy to manufacture
3. Can be used in household mountings as well as Industrial use
4. Does not require separate power supply, works with regular AC supply
5. Versatile and Easily mountable
6. Very low cost, Hence Affordable
7. No major maintenance Required
8. Least chances of Failures
9. Does not require any kind of programming and Microprocessors
10. Can be manufactures and commercialized in Dynamic Packages

E. LIMITATIONS

1. No major Limitations to be used in household Applications.
2. Don't have ability to distinguish between minor and considerable gas leakages
3. Don't have ability of remote activities and interactivity

F. 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 it to 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 articles.

G. 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.

The proposed system will cost only USD 6 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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I. Approximate Expenditure of the work: **Rs. 400**

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