Microcontroller Based Liquefied Petroleum Gas (LPG) Detector And Controller

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Abstract: In today's busy lifestyle, we heard the news related to accidents due to LPG leakage. Now a days everyone is busy with their works. Everyone go to office for job purpose far away from the house. In such cases, if there is leakage of gas at home, no-one is there to pay attention and accidents take place. As well as in case of senior citizens, they may lost their smell sensation and if there is leakage of gas, accidents may occur. The rate of accidents due to leakage of gas is 52 per day in India. From the literature survey, it has been found that, many LPG leakage detectors are available in the market .The working principle of the device is based on sensing the leakage using LPG sensor . The gas sensors will sense the leakage of the gas and then signal send to the microcontroller. The audio as well as video alert is given to the user for taking the appropriate controlling action. It has been also found that there is no device available in the market which detects the LPG gas and also controls its leakage by its own. On the same note, this project is aimed at designing and developing an Innovative "LPG leakage detector and controller". For detecting the LPG leakage, gas sensor is used which sends signal to the micro-controller to operate the controlling circuit. The controller itself makes the supply of LPG OFF by its own, thus in turn provides safety though the home is locked. The main functions covered while developing the device are, to detect the leakage of LPG on a regular basis, to alert about any hazards that may occur due to LPG leakage by audio and video facility, to implementing controlling actions for LPG leakage, to stop the accidents related with gas leakage and to provide safety. The proposed LPG leakage detector is very useful for today's very busy schedule where there is no one at home for the whole day. It has following advantages,

- Compact device
- Easy to use and User-friendly
- Gas leakage detecting and controlling device
- Gives audio and video alert

Index Terms: LPG (Liquefied Petroleum Gas), Gas Sensor MQ-5, LED (Light Emitting Diode), Buzzer, Controlling action.

1. INTRODUCTION

Household safety is becoming an issue due to the increased use of LPG for water heating and cooking applications. Liquefied Petroleum gases (LPG) (consists mainly of propane and isobutene) are used to meet the increasing demand for energy and to replace oil or coal due to their environmental disadvantages. In our home, kitchen may be the least safe place. The numbers of accidents caused by gas cylinder and stove bursts in the country are increasing day by day. As well as in case of senior citizens, they may lose their smell sensation and if there is leakage of gas, accidents may occur. LPG and natural gas burn cleanly and are less harmful to the environment. There are many applications of LPG like in industry, heating, home appliances, and motor fuel. Even if LPG and natural gas are environmental friendly, they are prone to create major accidents in case of leakage. They are normally stored in pressurized steel cylinders in liquid form and vaporize at normal temperatures. LPG is heavier than air, therefore it flows along the floor and settle in low points which makes it difficult to disperse. Suffocation will happen if LPG or Natural gas leakage takes place as it boil into air and replace oxygen. It may also give rise to Fire hazards in case of explosion.

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Therefore, the detection of LPG leakage has gain more interest in recent years especially in fields of safety, industry, environment, and emission control. In developing countries like India, besides the huge use of LPG in household activities, It is also used in industries and vehicles. As a result, more and more safety is todays need. Hence, gas leakage detection and control is unavoidable. LPG consists of mixture of propane and Isobutene which is highly flammable chemical. It is odorless gas due to which Ethanethiol is added as powerful odorant, so that leakage can be easily detected. We can detect the presence of dangerous LPG leakage in the cars, industrial sectors and residential premises using an Ideal Gas Sensor. By integrating the LPG gas leakage detector with Audio-visual display, An LPG Gas detector and controller has been developed and tested successfully.

2 MARKET AND LITERATURE SURVEY

Many devices are available in the market to detect LPG Leakage, but there is no device available which and also controls its leakage by its own. From the survey of Times of India, it has been found that the rate of accidents due to leakage of LPG is 52 per day [1]. By studying many papers, it has been found that, many LPG leakage detectors are available in the market .The working principle of the device is based on sensing the leakage using LPG sensor [2, 3,4,5]. The gas sensors will sense the leakage of the gas and then signal send to the microcontroller. The audio as well as video alert is given to the user for taking the appropriate controlling action.

3 DEVELOPED HARDWARE SYSTEM

Figure 1 depicts the hardware implementation of the device. In the circuit, MQ-5 gas sensor is used for leakage detection. Sensor, LED and buzzer are interfaced with microcontroller. Here, microcontroller PIC12F508/509 is used. The limit of gas is given of 450ppm. When gas concentration in air cross

this limit, MQ5 sensor will sense it and output of sensor goes low. Then LED and buzzer will turn on simultaneously for alert purpose. After delay of few minutes, microcontroller give command to relay to turn off the solenoid valve.

A. Block Diagram

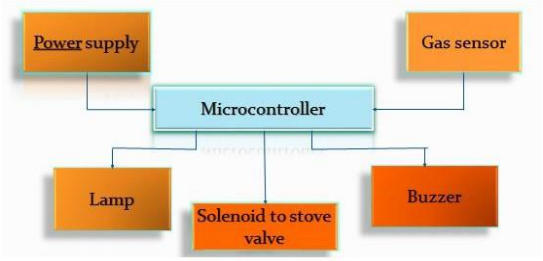

Figure 1: *Block Diagram of LPG Leakage Detector and Controller*

A 12V 2A adapter is used for operating the unit. 230 V A.C is converted to 12V D.C using the adapter. 7805 is used to regulate the 12V D.C to 5V D.C which will be the VCC for our PIC controller. A solenoid is used for allowing the gas to flow from cylinder up to the burner. On detection of leaked gas, the controller will sound the buzzer as alarm indication and stop the gas flow by closing the solenoid. A diode is connected across the solenoid to prevent the reverse current flow through the coil. A transistor is used as a driver for solenoid operation. An op-amp is used in comparator mode to compare the voltages required to detect the gas leakage. The reference voltage is set by using the potentiometer which will give the value of voltage at which the gas leakage will be detected.

B. Main Components

1. Gas Sensor-

Figure 2: *MQ5 Gas Sensor*

MQS Gas sensor have following main features

- High sensitivity to LPG, natural gas, town gas
- Small sensitivity to alcohol, smoke.
- Fast response.
- Stable and long life
- Simple drive circuit
- The MQ5 can detect the gas concentration in between 200 to 10000ppm.

2. Microcontroller

Figure 3: *Microcontroller PIC12F508*

PIC 12F508 have following main features

- Precision 4 MHz internal oscillator
- Baseline Core with 33 Instructions, 2 Stack Levels
- All single-cycle Instructions except for program branches which are two cycles
- 12-bit wide instructions
- 8-bit wide data path
- 25 mA source/sink current I/O
- Low power (100nA) sleep current
- One 8-bit timer (TMR0)
- Watchdog timer (WDT)
- In Circuit Serial Programming™ (ICSP™) capability
- In-Circuit debugging support
- Programmable code protection

4 WORKING PRINCIPLE

The sensor has a sensitive filament made of SnO2. In the presence of clean air, this filament tends to have lower electrical conductivity. When a combustible gas such as LPG is introduced, the filament's conductivity rises, and the amount of change in its conductance/resistance can be used to indicate the equivalent gas concentration. This effect tends to be particularly pronounced at higher temperatures, and resistive heating element is present as well. SnO2 is particularly sensitive to Methane, Butane and Propane, but is also sensitive to other combustible gases as well. The working of the MQ-5 sensor can be explained using Figure 6. The heating coil H is in contact with the SnO2 filament. In the presence of clean air, the resistance across the heating coil does not vary, but when a combustible gas is present, the resistance of the SnO2 filament drops, which results in a corresponding rise in Output Voltage (V-out), and this output voltage can be measured to indicate the concentration of any combustible gas that is present.

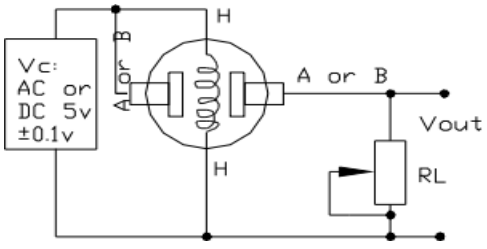

Figure 4: *Circuit diagram of Gas Sensor*

With the help of step down transformer of 230V AC primary to 0-12V, 500mA secondary power supply is taken from main supply. Full-wave rectifier and a capacitor filter provide the output voltage and then fed to 5-volt regulator

(LM7805) whose output is used as power supply for IC's and microcontroller. Furthermore, gas sensor is connected to the microcontroller. The Complete Connection Diagram consists of the Microcontroller Circuit, Power Supply, GAS Sensor Module, LED and buzzer. The output of the sensor goes low as soon as the MQ-5 Gas Sensor senses any gas leakage from the storage. This is detected by the microcontroller and the LED & buzzer are turned ON. After the delay of a few minutes, microcontroller gives command to relay to turn off the solenoid valve

5 PROCESS FLOW CHART

Sr.no.	Leakage Detected	LED Blink	Buzzer Turned ON?	Solenoid valve operated?
1	No	No	No	No
2	Yes	Yes	Yes	Yes

Table 1: *Observations during Testing of hardware*

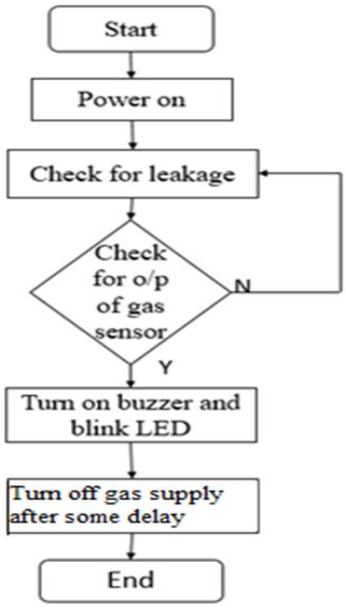

Figure 5: *Process Flowchart*

Algorithm for execution of process flowchart
1. Make power on.
2. Start.
3. To clear the required the port.
4. To initialize I/O ports.
5. Call delay 1.
6. To check gas leakage.
7. Call delay 2.
8. Go to step 5.
9. If leakage detected, make the buzzer on and LED on.
10. Call delay 3.
11. Cut the gas supply.
12. If reset is operated, then go to step 5.
13. Stop.

6 TESTING AND RESULTS

Figure 5*: Developed Hardware*

The hardware shown in Figure 5 has been developed and tested successfully. Table 1 depicts the observations during testing.

6.1 ADVANTAGES AND APPLICATIONS

ADVANTAGES

- The sensor has excellent sensitivity combined with a fast response time.
- The system is highly reliable, tamper-proof and secure.
- In the long run the maintenance cost is very less .
- It is possible to get instantaneous results and with high accuracy.

APPLCATIONS

- Protection from any gas leakage in cars.
- For safety from gas leakage in heating gas fired appliances like boilers, domestic water heaters.
- Large industries which uses gas as their production.
- For safety from gas leakage in cooking gas fired appliances like ovens, stoves etc.

7 CONCLUSIONS

- Developed product is compact in size and easy to install at residential and commercial application.
- It detects the LPG leakage with range 200 to 10000. Below level 200 the leakage is not abnormal and it is not hazardous.
- The complete product developed given alarm for alerting purpose and visual indication as well.
- The developed product is unique and innovations which not only detect LPG leakage but also take care to control the leakage and provide safety.
- The product is highly useful in present day lifestyle at residential purpose to avoid mainly accidents..

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