

# LPG Gas Auto Booking By GSM and Leakage Detection with Auto Switchable Exhaust Fan

Badri Narayan Mohapatra, Aishwarya Dash, Dhiraj Kumar Chaubey

**Abstract**— The main objective of this research is automatic protection from the LPG (Liquefied Petroleum Gas) leakage or reduction of the hazards that can be caused due to unawareness of the user about the gas leakage and also providing an automatic gas booking facility by applying advance communication technology. If there is any gas leakage from storage tank, service station or from the automobile then a buzzer will turn ON and an alert message will be sent to a pre-set mobile number by using GSM(Global System for Mobile communication) technology. Sound from the alarm as well as message in the mobile number will give valuable suggestion to the users so that they can prevent themselves from dangerous effect of LPG gas leakage. Proposed model notifies alert to people before any leakage from the gas cylinder and also automatically books for refilling of gas from the gas booking center before the cylinder gets empty.

**Index Terms**— Microcontroller, Gas sensor, GSM (Global System for Mobile communication), LPG (Liquefied Petroleum Gas), Load cell, LCD(Liquid Crystal Display).

## 1) INTRODUCTION

LPG gases have been widely used in home appliances, industry and motor fuel (1). More than 50% of the heaters use LPG as cooking is well done using LPG (2). Most important task is detection and identifying LPV (linear parameter varying) model used in the gas industry (3). Leakage detection is used in household safety (4). The main causes of accidents in gas pipeline are corrosion, external interference, construction defects, ground movement and material failure. Transport, through the pipes is the safest but it does not mean that pipes are risk-free (5). Leakage detection is classified according to technical nature (6). Non-technical leakage detection like are hearing, smelling and seeing or looking. Sometimes trained dogs are also used (7). Technical nature means both hardware and software. Hardware methods mean acoustic, cable sensor, optical, soil monitoring. Software based means continuously monitoring the state of pressure, flow rate or other pipeline parameters (8). Low levels of LPG leak can avoid any possible accidents.

## 2) PROBLEM STATEMENT

During illegal filling of gas cylinder consumers are unaware about their safety. Problems arise when LPG

consumers worn out regulators, use old valves. Risks are added when there is lack of awareness of using gas cylinders (11, 12). Again in day to day life people having a busy schedule don not get time to check the gas available in the cylinder or usually forget to book for new cylinder(or refilling of gas).

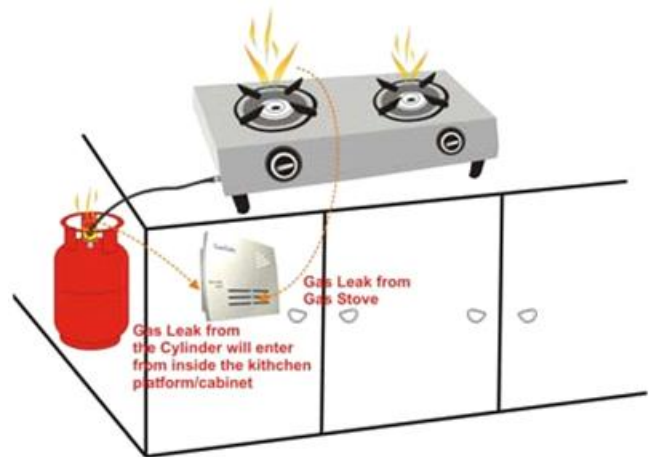


Fig 1. Practical Installation

The domestic implementation of the system is as shown in Fig 1. It is necessary to give a proper location to the gas sensor so that it can sense very quickly when the leakage just starts.

Table1. Specification of LPG sensor

1 minute	3%
5 minute	2.5%
15 min	2.0%
60 min	1%

## 3) METHODOLOGY USED

The below fig 2 indicates the basic building blocks of the whole system. The microcontroller plays the most important role to carry out all the required processes very smoothly with correct timing.

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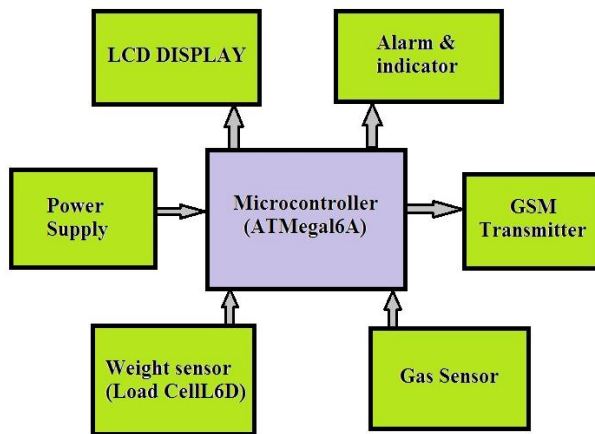


Fig 2. Basic Block diagram

### 1) Microcontroller

The ATMEGA16 is a 8-bit CMOS microprocessor with 16Kbytes of Flash programmable and erasable read only memory (EPROM). It exhibits high-performance with low-power consumption. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel ATMEGA16 provides a highly-flexible and cost-effective solution to many embedded control applications. The pin diagram of ATMEGA16 is shown in Fig 2.

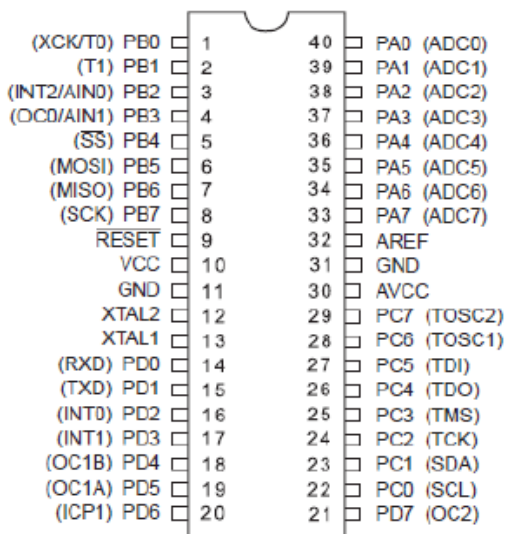


Fig 3. Pin Diagram

### 2) GSM

GSM network is divided like Operation and support system (OSS), Switching system (SS) and Base station system (BSS). Microcontroller sends a signal when there is a leakage of gas. That signal will come to the GSM module first. It consists one sim card and it has a unique identity number. The GSM module used is SIMCOM 300 which uses SIM memory to store the number of required members.

### 3) Gas Sensor

MQ-6 is tin dioxide and is a semiconductor type gas detecting type sensor. It has low sensitivity to alcohol, cigarette and cooking fumes but it can detect butane and propane. The material used in this sensor is SnO<sub>2</sub>. The principle is that the conductivity of SnO<sub>2</sub> increases with increasing concentration of air. So when the concentration of

air goes higher than the dangerous level due to leakage of gas, the conductivity of SnO<sub>2</sub> increases to a level which is sufficient to pass the current to send a pulse to the microcontroller as an interrupt signal.



Fig 4. MQ-6 Gas Sensor

Table 2. Specification of LPG sensor

Model No.	MQ-6 Sensor
Type	Semiconductor
Standard	Bakelite (Black Bakelite)
Concentration	300-1000ppm (Butane, Propane, LPG)
Detection Gas	Isobutene, Butane, LPG

### 4) Weight Sensor

The weight sensor used here is the load cell module. A load cell is a weight measurement device necessary for electronic scales that display weights in digits. However, load cell is not restricted to weight measurement in electronic scales. It is a passive transducer or sensor which converts applied force into electrical signals. Based on the principle of working, load cells are classified as follows-

- Fluid pressure based Load Cells
- Elasticity based Load Cells
- Piezoelectric effect based Load Cells

But the mostly used load cell is the strain gage-based load cell.

### 5) Power Supply

Power supply circuit is represented by Fig 5. The complete unit is getting power from a main supply by means of a step-down transformer to convert 230V AC primary into 0-12V, 500mA secondary. A full-wave bridge rectifier followed by a capacitor filter is used to provide the voltage to the 5-volt regulator (LM7805) whose output is used as the power supply requirements of microcontroller circuit.

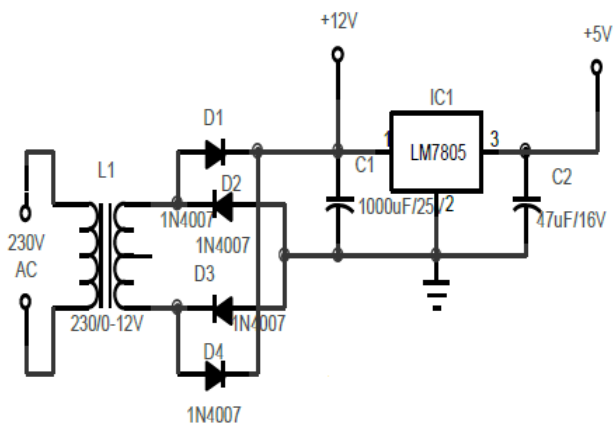


Fig 5. Power Supply Circuit

#### 6) Alarm & Indicator

A buzzer is set to produce audio alert about the leakage before turning ON the exhaust fan. It also rings to remind about the refilling of the cylinder when the gas level falls down below the threshold value.

#### 7) LCD Display

A 16X2 LCD (Liquid Crystal Display) display is used as the visual indicator. The reason behind using this LCD display is its cost effectiveness and easy programmability. It displays various messages such as leakage of gas, alert message for booking of cylinder etc. It also displays the actions carried out by the microcontroller.

### 4) WORKING OPERATION

#### 1) Leakage Detection

$\text{SnO}_2$  is the sensing material used as gas sensor. When  $\text{SnO}_2$  is heated at a certain high temperature in air, oxygen is adsorbed on the crystal surface with a negative charge. Then donor electrons in the crystal surface are transferred to the adsorbed oxygen, resulting in leaving positive charges in a space charge layer. Thus, surface potential is formed to serve as a potential barrier against electron flow. Electric current flows through the conjunction parts (grain boundary) of  $\text{SnO}_2$  micro crystals. At grain boundaries, adsorbed oxygen forms a potential barrier which prevents carriers from moving freely. The electrical resistance of the sensor is attributed to this potential barrier. In the presence of a deoxidizing gas, the surface density of the negatively charged oxygen decreases, so the barrier height in the grain boundary is reduced. The reduced barrier height decreases sensor resistance. Hence the corresponding pulse can reach the microcontroller as an interrupt signal and also can be fed to the buzzer and the exhaust fan so that they will be turned 'ON'.

#### 2) GSM Module

The GSM module works on simple AT commands which can be implemented by interfacing it to the microcontroller Rx and Tx pins. The GSM module used is SIMCOM 300 which uses SIM memory to store the number of system owner or housemates and distributor or to whoever the

messages have to be forwarded. It requires very less memory to send and receive text messages and operates on simple 12 Volt adapter.

#### 3) Automatic Gas Booking

The automatic Gas booking system continuously monitors the weight of the gas in cylinder and displays it on seven segment display. When the weight of the gas falls below the threshold value i.e. 10k.g., 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. At the same time, the message will be displayed on LCD as "Booking Cylinder". When the weight of the gas goes below 0.5 kg another logic high pulse is fed to another port of microcontroller through a relay circuit as discussed in truth table. As this port pin goes high, microcontroller will send an alert message through a GSM module to cell numbers of the required members and also an alert message is displayed on the LCD screen.

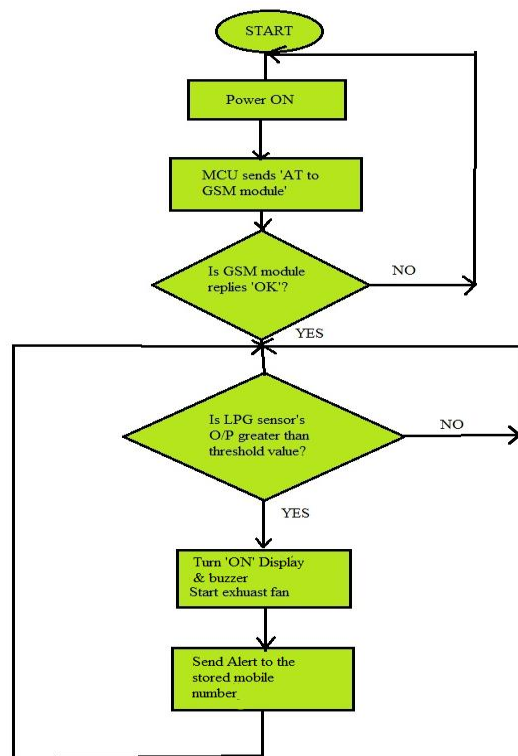


Fig 6. Flow Chart

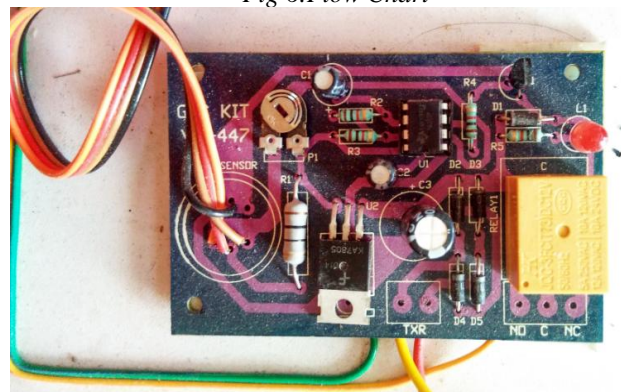


Fig 7. Design Assemble circuit

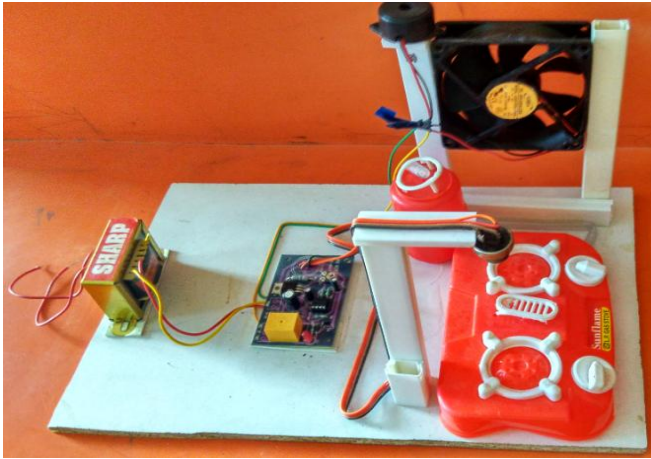


Fig 8. Prototype Model for Detection and Protection

## 5) RESULT

By testing the system prototype model it is found that when a small amount of LPG is introduced near the gas sensor the system detects the leakage and sends an alert message to the consumer by using the GSM module. Simultaneously the audio-visual indicator is activated and the exhaust fan is switched ON. The system prototype also monitors the gas level of the cylinder, books the new cylinder automatically and also sends an alert message to the consumer to remind about the refilling of the cylinder before the cylinder becomes empty.

## 6) CONCLUSION

The motive of designing a cost effective and reliable LPG leakage detector and automatic gas booking is successfully done by this paper. By testing the system prototype model it is found that when a small amount of LPG is introduced near the gas sensor the system detects the leakage and suddenly activates its indicators. Also when the level of gas falls below some predefined value it automatically dials the number of the booking center as well as informs the user.

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