

# Efficient Gas Leakage Detection and Control System using GSM Module

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**Abstract** - Gas leakage is a major problem with industrial sector, residential premises etc. One of the preventive methods to stop accident associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this project is to present such a design that can automatically detect, alert and control gas leakage. In this project, after the leakage of gas is detected, the valve is automatically closed, thereby stopping the leakage. Then the electric power supply is also shut down to prevent fire accidents. In particular, gas sensor has been used which has high sensitivity to gases like propane and butane. Gas leakage system consists of GSM module, which alerts the user by sending SMS.

**Index Terms** - GSM (Global System for mobile communications), LPG (Liquefied petroleum gas), Gas sensor MQ-6, Stepper motor driver IC (ULN2003A), PIC Microcontroller (PIC16F877A), Relay.

## I. INTRODUCTION

LPG consists of mixture of gases like propane and butane. These gases can catch fire easily. LPG is used as propellant, fuel and as a refrigerant. When a leak occurs, the leaked gases may lead to explosion. The number of deaths occurring due to explosion of gas cylinders has increased. So the leakage should be controlled to protect people from danger.

Bhopal gas tragedy is an example for accidents due to gas leakage. Gas leakage detection is not only important but controlling the leakage is also important.

Liquid petroleum gas is generally used in houses and industries. In homes, LPG is used mainly for cooking purpose. This energy source is primarily composed of propane and butane which are highly flammable chemical compounds. LPG leaks can happen, though rarely, inside a home, commercial premises or in gas powered vehicles. Leakage of this gas can be dangerous as it enhances the risk of explosion. An odorant such as ethanethiol 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. In such cases, 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 project, advanced gas leakage detection technology is used.

## II. LITERATURE SURVEY

Meenakshi Vidya et.al.<sup>[1]</sup> proposed the leakage detection and real time gas monitoring system. In this system, the gas

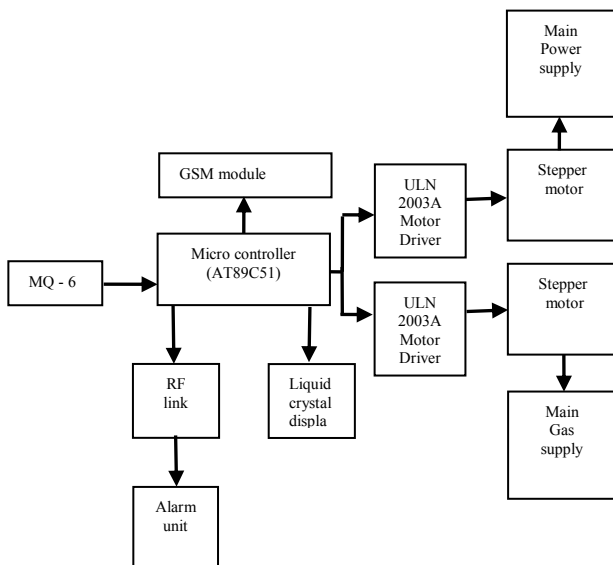
leakage is detected and controlled by means of exhaust fan. The level of LPG in cylinder is also continuously monitored. K.Padmapriya et.al.<sup>[2]</sup> proposed the design of wireless LPG monitoring system. In this project, the user is alerted about the gas leakage through SMS and the power supply is turned off. Selvapriya et.al.<sup>[3]</sup> 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. L.K.Hema et.al.<sup>[4]</sup> proposed the smart sensor technology. In this flexible reliable smart gas detection system is developed. In this, the leakage is detected and controlled by using exhaust fan. B. D. Jolhe et.al.<sup>[5]</sup> proposed the system in which two sensors are used for detecting the gas leakage and for monitoring the level of gas in the cylinder respectively. Ashish Shrivastava<sup>[6]</sup> et.al... proposed the system in which two types of gases namely LPG and CNG are detected for home safety as well for vehicles. R.Padmapriya<sup>[7]</sup> et.al... proposed the system which ARM7 processor and simulates using keil software to alert the user by sending SMS. V.Ramya<sup>[8]</sup> et.al... proposed the system that uses two different sensors for detecting the leakage and requires resetting manually after every situation. A.Mahalingam<sup>[9]</sup> et.al... proposed the system to meet UK occupational health and safety standards and also it alerts the user by SMS. M.B.Frith<sup>[10]</sup> et.al... proposed the system that uses trace sensing technology and also detects the leakage.

## III. EXISTING METHODOLOGY

In the existing method, different gas sensing technology is used. The LPG gas leakage is detected by the semiconductor sensor. Nowadays LPG accidents occur very common. The main reason of these accidents is due to the leakage of LPG. This leakage of LPG starts when we forget to close the main regulator valve. This is the basis of these kinds of accidents. Already there are some sorts of remedial measures such as when the leakage is detected, alert message

is sent to the fire station and the owner. The other remedial measure is that

when the leakage is detected, exhaust fan is switched on. The first mentioned method has the disadvantage that there is no control action taken, it needs a manual controlling which puts human into direct risk. The second method has the disadvantage that if the wiring of the exhaust fan is not proper then it will cause immediate explosion due to the flow of AC. In all these mentioned method above, there is only detection no control action is taken. Another method is also been employed which involves detecting as well as controlling of the LPG leakage. This process starts when the gas leakage occurs, the gas sensor senses it and gives an output to the micro controller. The micro controller used here is AT89C51 which converts this output into digital format and sends it to the GSM module, RF link, liquid crystal display(LCD) and to the motor driver. The GSM module sends an alert message to the user(s) and also to the fire station to alert them. The RF link is responsible for producing the alarm to alert the neighbors in case of absence of the user at home whereas the LCD displays the warning message. For the controlling purpose, stepper motors driven by motor drivers are used which closes the main power supply and the cylinder's valve to stop the flow of current and LPG gas.

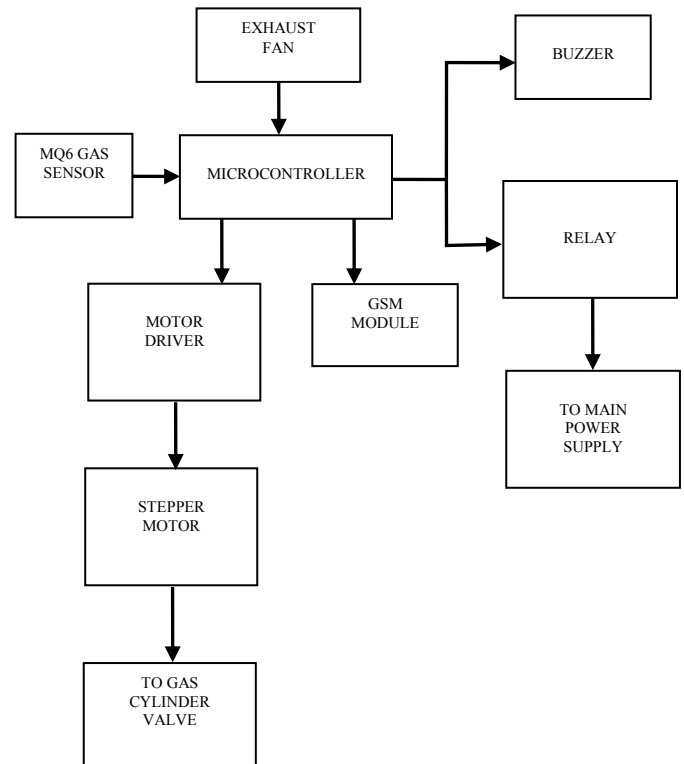


**IV. PROPOSED METHODOLOGY**

The proposed system takes an automatic control action after the detection of 0.001% of LPG leakage. This automatic control action provides a mechanical handle driven by stepper motor for closing the valve. The closing of the cylinder knob stops the flow of gas and prevents fire outbreak. We are increasing the security for human by using the combination of a relay and the stepper motor which will shutdown the electric power of the house. Also by using a GSM module, we are sending an alert message i.e SMS (Short messaging services) to warn the users about the LPG leakage and a

buzzer is provided for alerting the neighbors in case of the absence of the users about the LPG leakage. The aim of this system is to reduce the probability of explosion due to gas leakage. The main advantage of this system over the manual method is that, it does all the process automatically and has a quick response time.

**V. BLOCK DIAGRAM**



**A. GAS SENSOR:**

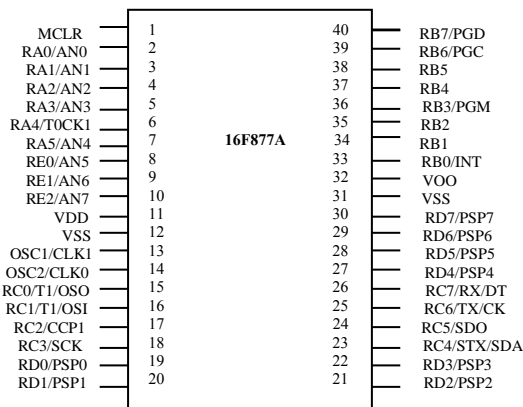
Generally, semiconductor sensors are used to detect LPG gas. MQ6 semiconductor sensor is used in this project. Sensitive material of MQ-6 gas sensor is SnO<sub>2</sub>, which with lower conductivity in clean air. When the target combustible gas exist. The sensor conductivity increases along with the rising gas concentration. MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane; it is with low cost and suitable for different application. The MQ-6 can detect gas concentrations anywhere from 200 to 10000 ppm. The sensor's output is an analog resistance.

**B. PIC MICROCONTROLLER:**

PIC microcontrollers are popular process developed by microchip technology with built-in RAM, memory, internal bus and peripherals that can be used for many applications. PIC originally stood for "Programmable Intelligent

Computer” but is now generally regarded as a “Peripheral Interface Controller”.

The PIC microcontroller consists of ADC, inbuilt in it. Thus, the analog output from the gas sensor is converted to digital format. The programmed instructions are fed into the microcontroller. It is connected to relay, GSM module, stepper motor driver, buzzer and exhaust fan. When the gas leakage is detected, the exhaust fan is switched on. Then, the stepper motor connected to the mechanical handle, closes the valve of the cylinder. So, the gas leakage is stopped. The relay is switched to shut down the electric power supply of the home or industry. The buzzer produces an alarm to indicate leakage. Through the GSM, a SMS is send to the user for alerting. The PIC microcontroller performs the controlling operation. It plays a vital role in this gas leakage detection process. The type used is 16F877A. It has totally 40 pins. Its memory size is 16 bits. Since various controlling tasks are employed, this microcontroller is used.



**C.RELAY:**

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (change over) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

**D.BUZZER:**

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

**E.GSM MODULE:**

Gas sensor detects the presence of gas, weight sensor gives the gas level in cylinder, and microcontroller will take corrective or necessary actions. The status of all these happening has to be conveyed to the owner of system or housemates. The technology making it very easy to send and receive messages using 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.

**F.STEPPER MOTOR:**

The stepper is driven by means of a drive circuit. It can be easily controlled for step by step rotation. It is connected to a mechanical handle, which is attached to the valve of the cylinder. When there is gas leakage, the microcontroller makes the motor to rotate. Therefore, the valve is closed, thus stopping the gas leakage.

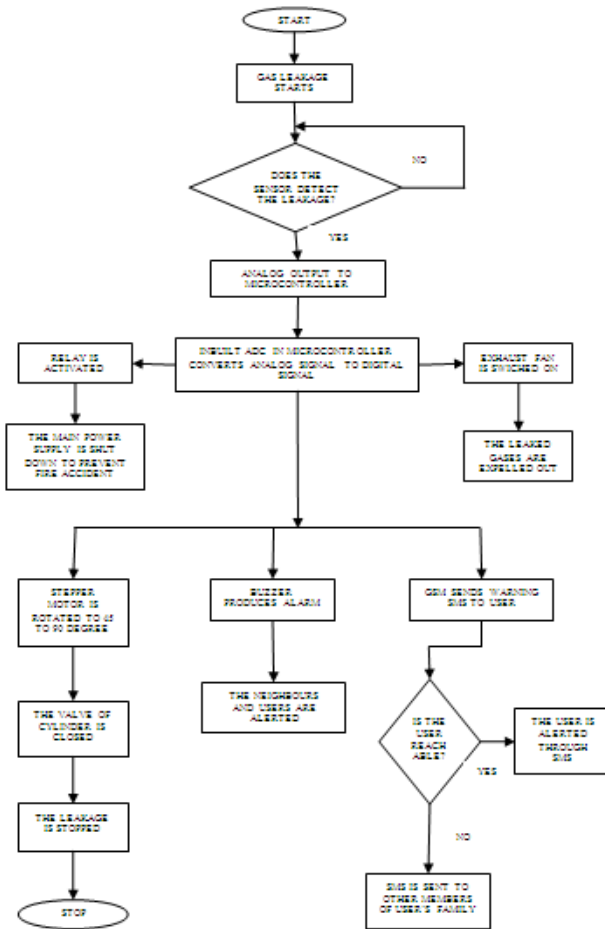
**VI.WORKING**

The leakage of LPG gas is detected by the MQ6 gas sensor. The analog output from the gas sensor is given to the micro controller, which converts it into digital form using its in-built ADC. It consists of predefined instruction set. Based on this, the exhaust fan is switched on. So, the concentration of gas inside the room gets decreased. Then, the stepper motors are rotated for closing the knob of the cylinder and the main power supply. Because of this process, the leakage of gas the flow of current are stopped. The relay is switched to off the power supply of the house. The buzzer produces an alarm to indicate the gas leakage. Then, the user is alerted by an SMS through the GSM module.

The algorithm used here is advance gas leakage detection and controlling which is given by,

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VII.RESULTS AND DISCUSSION

The result of this project is that the leakage is detected and stopped within 2 seconds, after the leakage starts. This system can detect even 0.001% of leakage.

VIII.CONCLUSION

This is an efficient method for automatically detecting and controlling the LPG gas leakage. Moreover, the fire accidents are also prevented by switching off the power supply.