

## DESIGNING A SAFETY SYSTEM FOR A LP GAS LEAKAGE

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### ABSTRACT

Liquefied Petroleum Gas (LPG) is an inevitable one in day-to-day life. LPG is used as a fuel in a range of applications including heating and cooking appliances, industrial applications, in vehicles and as a propellant and refrigerant. Due to leakage of LPG, it produces hazardous and toxic impact for human beings and also for other living creatures. Therefore a system was developed as a solution to detect the LP gas leakage and make alert the users and to take action to minimize the hazard. When the system detects the LPG concentration in the air that exceeds a certain level, it immediately alert the people by activating the alarm which includes the indicator bulb, buzzer simultaneously. Also it shuts off the main solenoid valve of the gas line and an exhaust fan will be switched on for exhausting leakage gas. Additionally, the location of the gas leakage is displayed on the LCD. The sensor has excellent sensitivity combined with a quick reaction time. The sensor can also sense hydrogen, iso-butane, propane and cigarette smoke. This paper provides designs of both software and hardware.

**Keywords:** LP gas leakage, MQ-2 sensor, Safety system, Detector, Solenoid valves.

### 1. INTRODUCTION

The LPG which is a flammable mixture of hydrocarbon gases used as fuel in many applications like homes, industries, automobiles, because of its desirable properties which include high calorific value, which produce the less smoke, produce less soot and does not cause much harm to the environment<sup>1</sup>. Natural gas is another widely used fuel in homes. Both gases burn to produce clean energy. However there is a serious problem about their leakage in the air. The gases being heavier than air do not disperse easily and may lead to suffocation when inhaled also when gas leakage into the air may lead to explosion<sup>2</sup>.

In general, most places that use LPG employees some form of safety system for the safety of people and property. Usually this system is a fire alarm. In this case, the user has the ability to know about hazard only after a breakout of fire. Even the current advanced off-the-shelf systems only have the ability to detect LPG leakage and notify users but are ineffective in decreasing the hazard. As a solution, this system was designed having three main function of identification of the LPG leakage, indication of risk to the user and to minimize the hazard.

## 2. EXPERIMENTAL

The block diagram of the proposed system is shown in the following Figure 1.

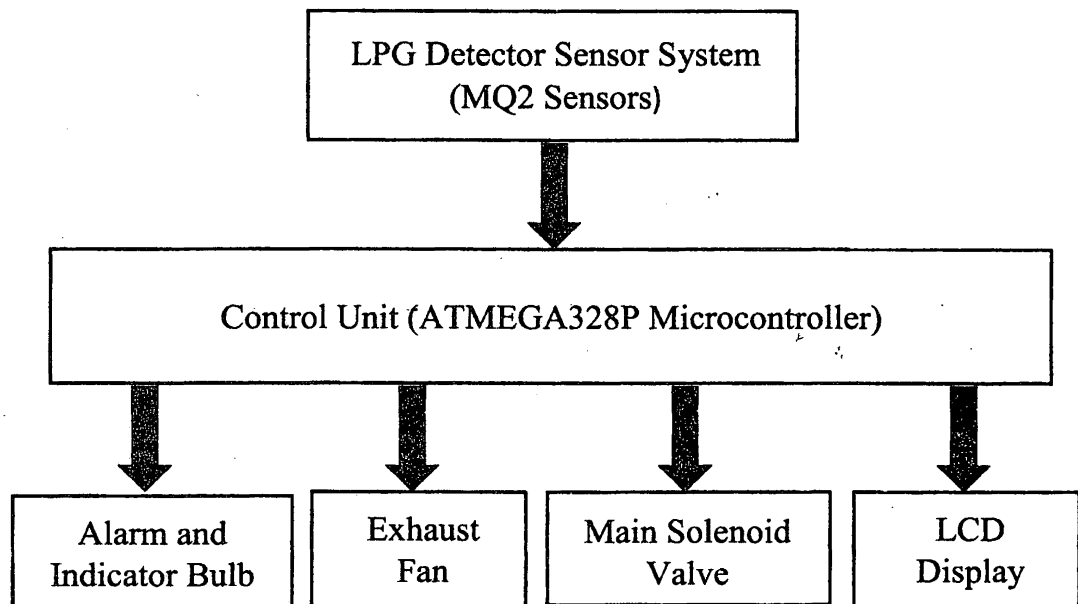


Figure 1: Block diagram of the system

MQ-2 combustible gas sensor was used as LPG detector sensor in the proposed system. Although MQ-6 sensor is suitable for this task, MQ-2 sensor was selected, because the latter is sensitive to other combustible gases and smoke in addition to LPG<sup>3</sup>. ATMEGA328P microcontroller was used to implement solution. LCD display was used as the interface which indicate the place of LPG leakage. Also an alarm and a bulb were utilized to indicate the gas leakage.

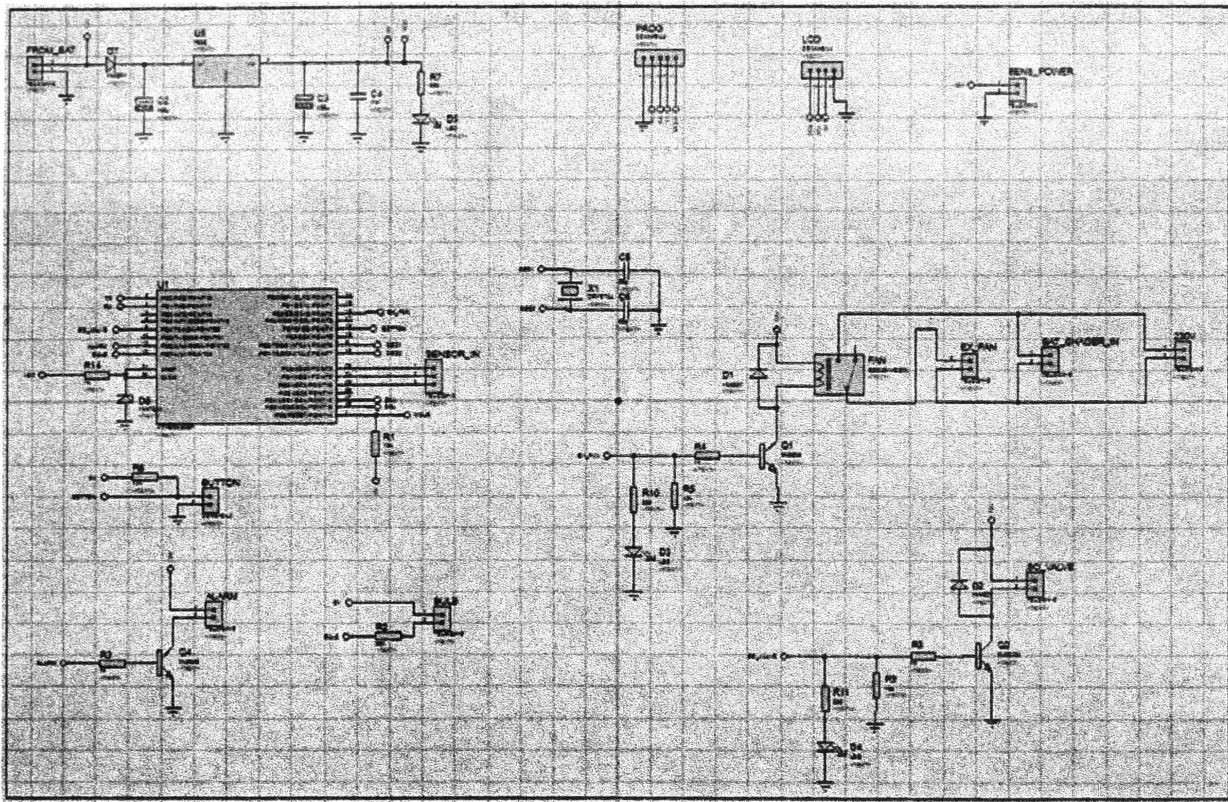


Figure 2: Circuit diagram of the controlling unit

Additionally, a solenoid valve was fixed to main gas line to cut off the gas supply if the system identifies a gas leakage and an exhaust fan was used to exhaust the leakage gas.

The main function of gas leakage detection module is to continuously detect the gas leakage in the air. For the gas leakage detection, a solid state gas sensor MQ2 was used. In gas sensors, Tin dioxide is the most common material, when any specified gases leak in the air, the electrical resistance in the sensor decreases. MQ2 gas sensor is less sensitive to air but high sensitive to combustible gases. When the target combustible gas exists in the environment, the sensor's conductivity increases, and resistance of the sensor changes with the concentration of combustible gases<sup>4</sup>. The microcontroller monitors this difference and identifies that risk. Then controlling unit provide the needed action for indicating risk and minimizing hazards. The controlling unit circuit design is shown in the Figure 2.

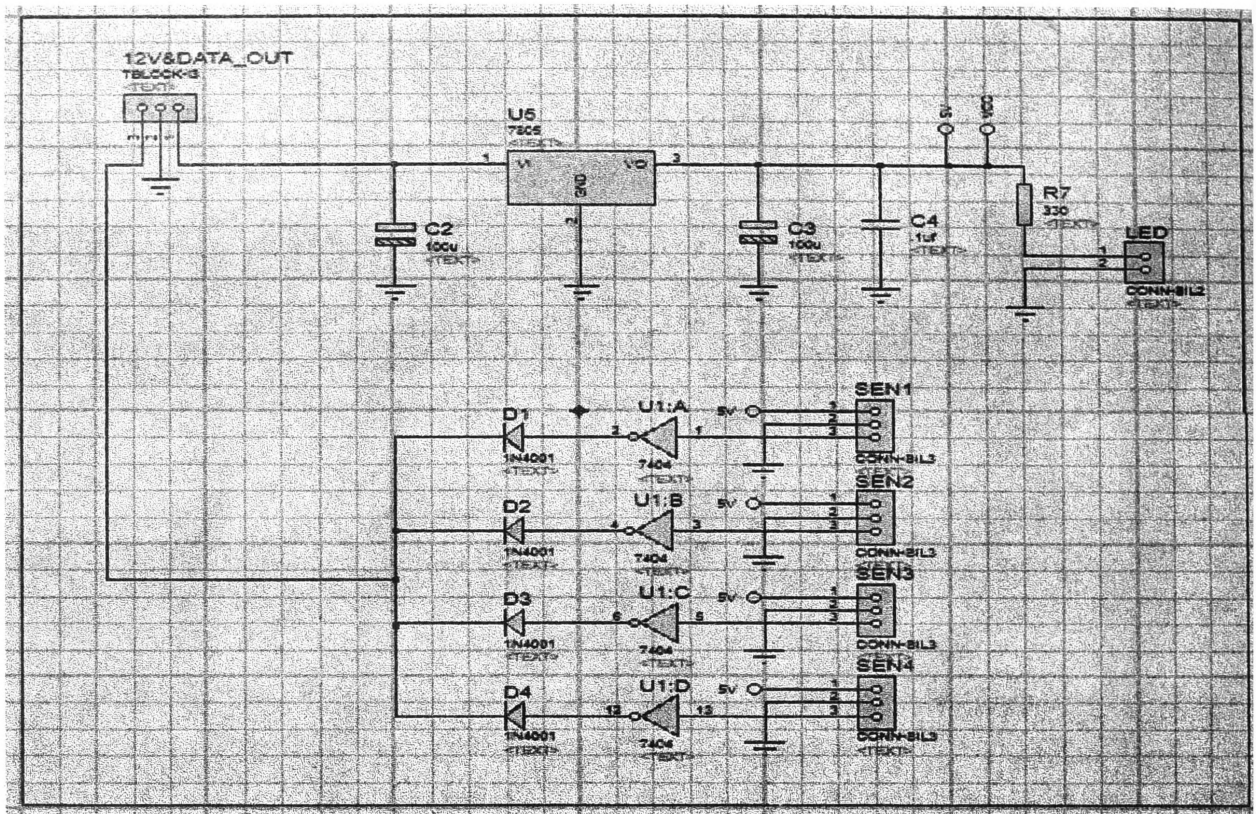


Figure 3: Circuit diagram of the sensor system

For high accuracy of the system, number of sensors are used in the same room or place which are working as a system. For this sensor system, external power has to be provided. Because 5V controlling unit power line is not sufficient to both the systems. The controlling system has the ability to identify the danger area using this sensor panel and indicate the user by an LCD. The sensor system circuit design is shown in the Figure 3.

### 3. RESULT AND DISCUSSION

Overall system was designed and tested by introducing a small amount of LPG near gas sensor module and was able to obtain the expected outcomes.

An ATMEGA328P ATMEL microcontroller was used with Arduino for controlling the unit. For this system, the Arduino UNO board can be used as the controlling unit, because ATMEGA328P microcontroller also use for the Arduino UNO board. But using the Arduino boot loader burned ATMEGA IC is more cost effective than the UNO board.

### 4. CONCLUSION

The aim of this project is to develop a device that can identify the LP gas leakage, indicate the risk to the user and minimize the hazard. Implemented system uses MQ-2 sensors for

identifying the LP gas leakage, a bulb and a buzzer as the alarm system and a LCD display to indicate the position of the gas leakage, thus allowing the system to identify a hazardous situation and convey usable information to the user immediately and accurately. In an event of a leakage, the system automatically shuts off the main gas valve and activates exhaust fans to mitigate fire risk.

This system can be used for LP gas leakage detection, but it was unable to find the threshold harmful LP gas level. Because it was difficult to find equipment to measure the LP gas ppm rate in the air to activate the system.

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