

A Novel Approach to Design a New Detector Unit to Detect Liquefied Petroleum Gas with Mobile alert and Auto Shut Down Facility

Tarak Das¹, Arani Bag², Shreya Das², Tapas Kr. Dawn²

¹*Department of Biomedical Engineering,*

²*Department of Electronics and communication Engineering*

Netaji Subhash Engineering College, Garia, Kolkata, India

ABSTRACT -In our modern day to day life we use many technologies in every field to make our life much easier, comfortable and prevent unpleasant occurring. Liquefied Petroleum Gas leakage detection system is one such device to prevent hazardous occurring. Microcontroller of Arduino Uno is the brain of the system. At its initial level if the MQ6 sensor senses any leakage of gas, it sends signal to Arduino. Arduino then sends signal to GSM module which then informs the owner at outstation. Arduino sends signal to buzzer, LED and driver circuit of Solenoid valve too. Thus, accordingly depending on signal of Arduino buzzer, LED and Solenoid valve works to prevent unpleasant occurring. Solenoid valve adds auto shut down facility to the system.

Key words: LPG; Leakage; MQ6 Sensor; Arduino Uno; Signal; valve.

INTRODUCTION

Liquefied Petroleum Gas [LPG] is the most common cooking fuel used throughout India. Besides being cheap and easily available, LPG serves as an ideal fuel for cooking purposes. With the increase in the number of people using this fuel, it is the necessary to provide some safety standards which are required to be implemented to lead an accident free life. Gas leakage leads to various accidents resulting in both material loss and human injuries even may death. The risk of explosion, firing, and suffocation is based on their physical properties such as toxicity, flammability, etc. The number of deaths due to explosion of gas cylinders has been increasing in recent years. The reason for such explosion is due to substandard cylinders, old valves, worn out regulators and lack of awareness in handling gas cylinders. Our system can deal with most of the factors and has proved to be a success in controlling gas leakage calamity. It has many features of its own like it sense gas, alerts people, alerts owner, and finally shuts the valve off reducing the risk factor merely to zero. This device is at its initial level of development and with modification in future this device will also trip off the mains supply to ensure better safety and surety. The Gas Leak detector device can find application not only at residential homes but also it is applicable to hotels, restaurants and even

in industries where LPG gas is used for some or the other purposes.

AIM OF THE WORK

The primary objective of the present work is to provide a novel means of safety by detecting any malfunction of a pressurized gas system in order to prevent accumulation of combustible gases so that damage or explosion due to such an accumulation of gases can be prevented. Another objective of the present invention is to provide a novel safety means for detecting the leakage of gas into the area of an appliance when the appliance is in a shutdown condition and not in operation. Yet another object of the present invention is to provide novel gas detection and monitoring system which is economical to manufacture and which may be readily installed in kitchen and industries which are normally dependent upon a stored supply of pressurized gas. This unit is one of Ideal sensor to be used to detect the presence of a dangerous LPG leak in our car or in a service station, storage tank environment. This unit can be easily incorporated with an alarm unit so as to alert people or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense iso-butane, propane, LPG.

PROCEDURE

The brain of the Gas Leak Detector unit is the Arduino Uno Microcontroller which controls the entire function of the circuit and the MQ-6 sensor is used to sense the leakage of gas. Moreover GSM module is used to alert owner at outstation and buzzer alerts people onboard thereafter LED blinks indicating emergency and as well as valve shuts off for safety. The block diagram of the system is depicted in Fig: 1.

The main working principle of any advanced system is mainly dependent on the microcontroller which controls the entire functioning of the device. In this case the Arduino Uno microcontroller acts like a conditional switch. It performs two set of action depending upon the condition present. It triggers the buzzer, LED, GSM module and valve driver circuit when the leakage of the gas is detected by the sensor. The other action is to maintain normal condition by keeping the valve open. If the sensor detects the presence the gas in the vicinity

the GSM module will send “Gas Leak” message to the relevant contacts.

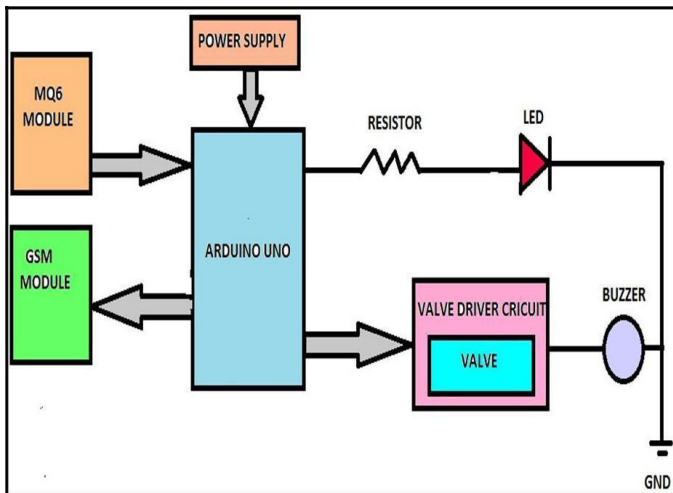


Fig. 1. Block diagram of LPG leakage detector unit

If no gas is detected by the sensor in the vicinity then the GSM module will not send any messages. GSM module is included in this device to make the stakeholders aware about the leakage of gas taking place at their house in their absence so that necessary actions can be implemented immediately to prevent an accident. Moreover if a gas leakage is sensed it alerts people nearby by triggering buzzer and LED. The valve is closed as soon as gas leakage is sensed and remains closed until and unless manual reset is done. The beauty involves the battery backup and makes the unit more users friendly. The flow chart of basic working principle of gas leakage system is shown in Fig. 2.

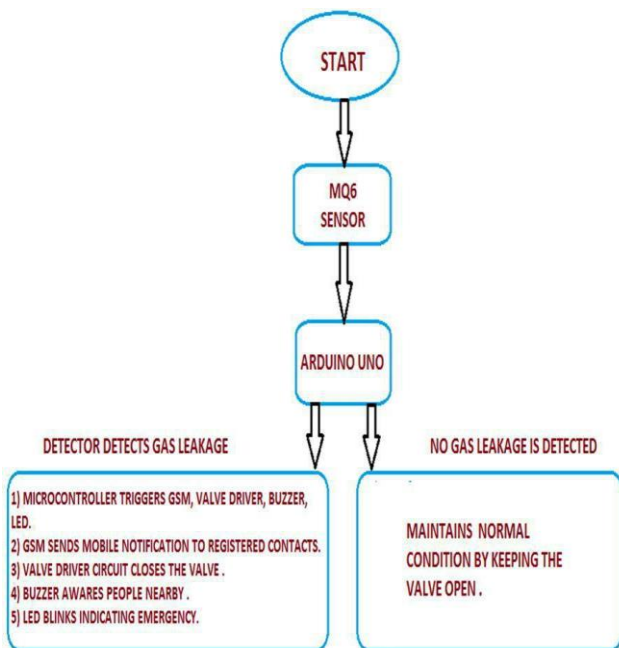


Fig. 2. Flow chart of gas leakage detection

The circuit design and software implementation is depicted in Fig. 3. The MQ6 sensor is fed with a 5v supply and its out pin is fed to Arduino (Pin A0) then GSM Module is connected with Arduino with its TX at Pin 9 and RX at Pin 10 and GND is fed to common ground line as Arduino UNO needs a supply of 5v. LED is fed to Arduino at Pin 13 then solenoid valve is fed to Arduino with its driver circuit at Pin 12 and is given a supply of 12v. Buzzer is connected across Solenoid valve as indicator.

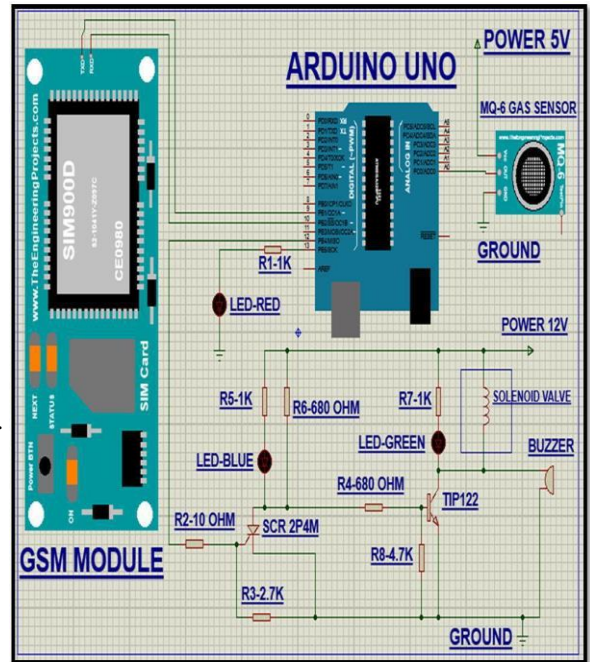


Fig. 3. Circuit diagram and software implementation in Arduino based gas leakage detector

Output of the MQ-6 gas sensor is connected to the analog input pin A0 of the Arduino Uno. Digital pin 12 used for controlling the solenoid gas valve and digital pin 13 is used for controlling LED blinking at the same time digital pin 9 and 10 controls GSM Module. Here the sensor threshold is set to be 400ppm. User can set the threshold point in the Arduino programming. When the threshold value is exceeded the Arduino will set digital outputs HIGH and LOW according to the program. When the concentration level of leaked gas in the air is below the threshold value, the output 12, 13, 9 and 10 will be low. Therefore, the proposed system does not trigger. When the concentration level of leaked gas in the air is above the threshold value, the output pins will become high. The transistor and thyristor operates and therefore the solenoid gas valve relay actuates and discontinues the passage of gas from cylinder or pipeline and audio indicator sounds loudly, as well as leakage notification reaches to owner’s mobile. The valve continues to be in closed position until manual reset is done. The ultimate module of the system is depicted in Fig. 4.

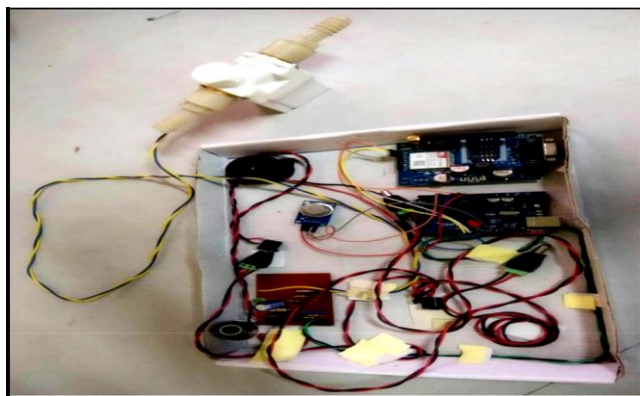


Fig. 4. The complete module of Gas leakage system

RESULT AND ANALYSIS

The testing of the proposed system was carried out using a lighter as a replicate of a LPG gas source. The lighter was held at a long distance to imitate low level concentration and was gradually brought closer to the gas sensor to imitate high level gas concentration. The proposed gas leakage detector showed an excellent performance and provides satisfactory results regarding the gas leakage for the period of testing. The test was carried out several times and the result was the same in almost all of the cases. The sensor takes some time around 30sec to get heated and ready to sense the gases. The sensing time is almost immediate once the sensor is ready to sense. Once the concentration of gas reaches the threshold value then the solenoid gas valve gets closed and audio alarm indicator goes off automatically. The system output result is given in Table: 1.

Sl. No.	Test Conditions	LED	BUZZER	Solenoid Gas Valve
1	No Gas Leakage	Off	Off	Off
2	Low level Gas	Glow	Sound	Activated
3	High level Gas	Glow	Sound	Activated

Table: 1. The output result of the developed system.

CONCLUSION

Gas leakage leads to severe accidents resulting in material losses and human injuries. Gas leakage occurs mainly due to poor maintenance of equipments and inadequate awareness of the people. Hence, LPG leakage detection is essential to prevent accidents and to save human lives. The main advantage of this simple gas leak detector is its simplicity and its ability to warn its stakeholders about the leakage of the LPG gas. The future aspects of this detector include a tripper circuit which increases the efficiency of the system and provides more safety to the users. The other advantage of this system includes its audio – visual warning systems. This detector is implemented successfully and is easy to use and

also a low cost product. Another advantage of this device is that even though if no one is there in the house and then gas leaks occurs, GSM module is there to send immediate messages to the stakeholders regarding the gas leak and thus it lowers the intensity of accidents. GSM module in this device ensures better safety.

FUTURE SCOPE

There are many ways in which this gas leak detector can be modified and made more complex by including more advanced features into it. The GSM module enables us to send the gas leak message to the relevant stakeholders and hence it increases the efficiency of this system. Usage of GSM module for this detector prevents the accidents from taking a hazardous turn. The other modification which can be implemented in this gas leak detector is using a tripper circuit which will trip off the main supply once the gas leak is detected. During a gas leak it is dangerous to switch any appliances as it may spark and this tripper circuit helps to reduce the electrical hazards that can be caused due to a gas leak. Along with the tripping off of the main supply it is very much necessary to turn off the gas regulator so that no further leakage of the gas occurs. A robot has been used in replacing human for handling various tasks in a hazardous and dangerous workplace where human life may be at risk. A mobile gas sensing robot can be constructed to sense the leakage of gas through pipelines as the robot can move on a track which is situated along the length of pipeline. This technique further increases the overall efficiency of the system and makes the system a perfect gas leak detector providing overall safety of the residents.

REFERENCES

- [1] Mahalingam, A., R. T. Naayagi, and N. E. Mastorakis. "Design and implementation of an economic gas leakage detector." *Recent Researches in Applications of Electrical and Computer Engineering*, pp. 20-24, 2012.
- [2] Attia, Hussain A., and Halah Y. Ali. "Electronic Design of Liquefied Petroleum Gas Leakage Monitoring, Alarm, and Protection System Based on Discrete Components." *International Journal of Applied Engineering Research*, vol. 11, no. 19, pp. 9721-9726, 2016.
- [3] Apeh, S. T., K. B. Eramah, and U. Iruansi. "Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shut off System." *Journal of Emerging Trends in Engineering and Applied Sciences*, vol. 5, no. 3, pp. 222-228, 2014.
- [4] T.Soundarya, J.V. Anchitalagammai, G. DeepaPriya, S.S. Karthickkumar, "C-Leakage: Cylinder LPG Gas Leakage Detection for Home Safety." *IOSR Journal of Electronics and Communication Engineering*, vol. 9, no. 1, Ver. VI, pp. 53-58, Feb. 2014.
- [5] AshishShrivastava, RatneshPrabhaker, Rajeev Kumar, Rahul Verma, "GSM based gas leakage detection system." *International Journal of Emerging Trends in Electrical and Electronics*, vol. 3, no. 2, pp. 42-45, 2013.