

Automatic Gas Leakage Controller and Alert Systems

N. Muthukumar¹, Muruges S.², Nishanth S.³ & Pradeep Kumar M.⁴

¹⁻⁴Department of Electronics and Communication Engineering, Francis Xavier Engineering College, Tirunelveli, India.



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ABSTRACT

Gas leakage detection is a method of identifying dangerous gases in the surrounding environment by the use of sensors, thereby leading to prevent further consequence. This system aims at proposing an automatic gas controller and alert unit using arduino uno and which detects the gas leakage and thereby closing the cylinder valve, and sending an alert call to the user using GSM. When a leakage of gas occurs, the sensor sends a signal to the microcontroller. LPG regulator fitted to the cylinder will be automatically turned off using a DC motor to avoid more leakage from cylinder and the alert buzzer will produce the sound. Simultaneously, GSM receives the command from the arduino to make a call to the sim number that is inserted into the GSM module and the user will receive the alert call that the gas leakage occurred.

Keywords: GSM, LPG, Gas sensor, DC motor.

1. Introduction

Gas is a leading source of energy used for heating and cooking purposes in our homes. The two major types of gas which serves these purposes are liquefied petroleum gas (LPG) and natural gas. These two gases are hydrocarbon gases. Natural gas is basically methane gas while LPG gas is a blend of butane and propane gas or purely butane or propane gas. Gas leakage detection is a method of identifying dangerous gases in the surrounding environment by the use of sensors, thereby leading to prevent further consequence. LPG is the most commonly used gas that serves the purpose of cooking. LPG is a highly flammable gas and if leaked it can lead to major destruction to life and property. The major characteristic of LPG is that the gas being heavier than air, it does not easily disperse and when inhaled it leads to suffocation. The ignition of these leaked gases may lead to explosion. The number of death reports caused by gas leakage explosions has been enlarged in recent years. The reason behind such explosions is mainly due to the old cylinder valves, drained out regulators, shortage of substandard cylinders, and lack of knowledge of using gas cylinders add to the danger. This system aims at proposing an automatic gas controller unit using arduino uno which detects the gas leakage and thereby closing the cylinder valve, a DC motor controls the cylinder knob which automatically turns off the burner and immediately sends an alert call to the user using GSM.

2. Existing System

The idea behind this system is to give a solution by power cut the gas provision as soon as a gas leakage is perceived apart from activating the sounding alarm. In addition to this, the authorized person will receive a message informing him about the leakage. The Arduino Software which is an open source (IDE) makes it simple to create code and upload it to the Arduino Uno board. It also needs a GSM module for the purpose of SMS alert, Buzzer or speaker for sound alarm, LCD module, and display, and Single relay to a triggered Solenoid valve for gas supply manipulation. The Advantage of this system are: It helps a lot in terms of preventing any danger caused by gas leakage and useful as part of safety to avoid the gas leak that can cause harmful result. It will also improve the safety of all users of Liquefied Petroleum Gas. Disadvantage: Applicable only as an indicator or alarming device.

3. Proposed System

The heart of the block diagram is ARDUINO UNO microcontroller as shown in Fig.1. The micro controller is interfaced with the following components such as GSM module 800 A, MQ2 Gas sensor module, L293 driver module, Buzzer module, DC motor. Gas sensor having three terminals in arduino supply power to the sensor (5v) it connects to sensor and the input pin of sensor connects to analog input of arduino pin no A0. Arduino interfacing GSM module 3 pins. RX (receiver), TX (transmitter), GND in TX of arduino connected to RX GSM module and RX of arduino connected to TX GSM. GND connected to GND. There are 4 INPUT pins, 4 OUTPUT pins and 2 ENABLE pin for each motor. The 4 input pins of driver module is connected to the digital pins D7, D6, D5, D4 of the Arduino UNO and two ENABLE pins are connected to the two terminals of the DC motor. The alert buzzer module having three terminals Gnd, 5V, I/P pins are connected to Gnd, 5V and D3 of the Arduino respectively. Thus the gas leakage and the alert system are connected.

The circuit for the controller system is developed as mentioned in Fig.1. When a leakage of gas occurs, the sensor sends a signal to the microcontroller. LPG regulator fitted to the cylinder will be automatically turned off using a DC motor to avoid more leakage from cylinder and the alert buzzer will produce the sound. Simultaneously, GSM receives the command from the arduino to make a call to the sim number that is inserted into the GSM module and the user will receive the alert call that the gas leakage occurred.

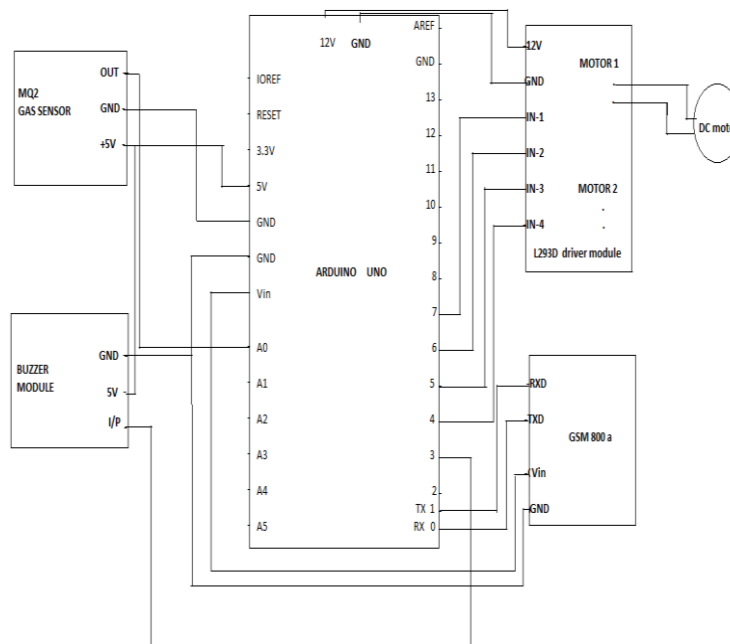


Fig.1 Block Diagram

4. Methodology

4.1 Interfacing of Gas sensor with Arduino

When the model is given the external supply of 12V it starts working. The detection of gas is performed by the sensing element MQ2 gas sensor. The MQ-2 sensor is sensitive to smoke and the flammable gases

such as LPG, Methane, and Propane. The resistance of the sensor is different depending on the type of the gas. The gas sensor has a built-in potentiometer that allows to adjust the sensor sensitivity according to how accurate we want to detect gas. The voltage that the sensor outputs changes accordingly to the smoke/gas level that exists in the atmosphere. The sensor outputs a voltage that is proportional to the concentration of smoke/gas. In other words, the relationship between voltage and gas concentration is the following: The greater the gas concentration, the greater the output voltage. The lower the gas concentration, the lower the output voltage. When the sensor senses the higher concentration of the gas, the output voltage is higher.

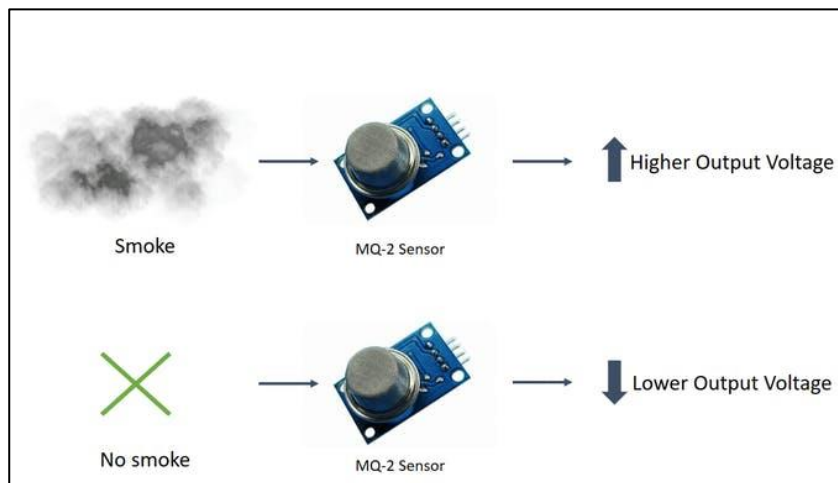


Fig.2 Working mechanism of MQ2 sensor

The output can be an analog signal that can be read with an analog input of the Arduino A0. The Arduino sends this command to the GSM module, Motor driver module and Buzzer module simultaneously.

4.2 Interfacing of GSM 800a with Arduino

The GSM module is enabled by providing 5V and GND supply with the Arduino. The SIM card is inserted to the GSM module. Initially, the blinking rate of the network LED will be high. After some time, observe the blinking rate of 'network LED'. The GSM module will take some time to establish a connection with the mobile network. Once the connection is established successfully, the network LED will blink continuously for every 3 seconds. The connection of the GSM module with the mobile will be established by making a call to the number of the SIM. If the user hears a ring back, the GSM module has successfully established network connection and the user will be getting the gas leakage alert.

4.3 Interfacing of L293D motor driver module

The L293D is a dual-channel H-Bridge motor driver capable of driving a pair of DC motors. The L293D motor driver IC actually has two power input pins viz. 'Vcc1' and 'Vcc2'. Vcc 1 is used for driving the internal logic circuitry which should be 5V. From Vcc2 pin the H-Bridge gets its power for driving the motors which can be 4.5V to 36V. And they both sink to a common ground. We are using only one DC motor, hence the first two input pins of the IC. These are connected to any two digital pins of Arduino 7 and

6. And two output pins of L293D are connected to a gear motor. E1 pin of L293D is then connected to any of the PWM pin 5 of Arduino. We can simply run the motor by giving a high signal at 7th pin, low at 6th pin and a high at the enable pin. The 7th and 6th pin of Arduino is used for controlling the direction of rotation and the 5th pin is for regulating the speed of the motor. The speed regulation is achieved by generating a PWM signal at the enable pin of the L293D IC. The valve connected lever in dc motor is rotated 90 deg clockwise automatically and lock the cylinder.

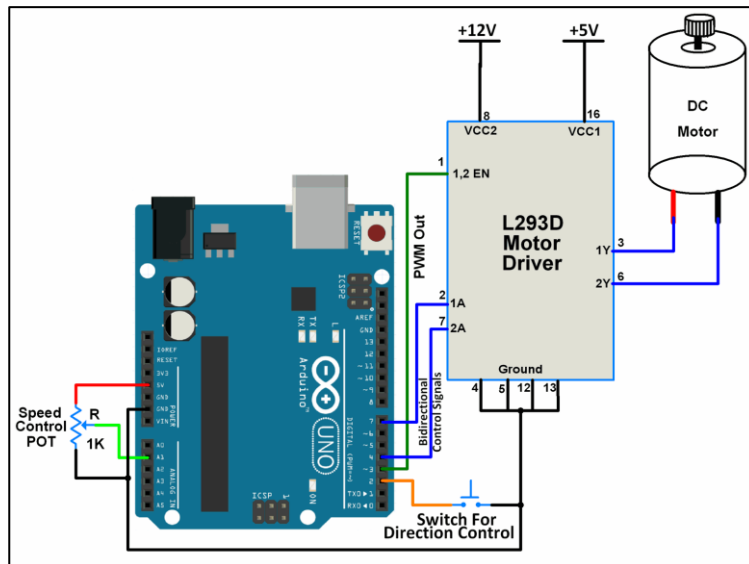


Fig.3 Interfacing of Motor driver with arduino

4.4 Interfacing of active buzzer with arduino

The buzzer can be enabled by powering it using a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval. The buzzer module receives the command from the arduino and it gives the beep sound to alert the user.

4.5 Circuit operation

The circuit for the controller system is developed as mentioned above. When a leakage of gas occurs, the sensor sends a signal to the microcontroller. LPG regulator fitted to the cylinder will be automatically turned off using a DC motor to avoid more leakage from cylinder and the alert buzzer will produce the sound. Simultaneously, GSM receives the command from the arduino to make a call to the sim number that is inserted into the GSM module and the user will receive the alert call that the gas leakage occurred.

5. Experimental Results

System implementation as shown in Fig.4 will generate result in the form of alert phone call through GSM and closes the valves of the cylinder by turning the knob. The Fig 5 shows the automatic controller system in which the cylinder knob is connected with the DC motor. When the DC motor receives the command from the controller, it automatically closes the valve by turning the cylinder knob thereby stops the gas supply. Once the gas concentration gets normal it opens the knob through the DC motor.

Fig.6 shows the sensing and alert setup that includes sensing element MQ2 gas sensor and the GSM module that sends the sms/call to alert the user and the active buzzer to alert the user. These all are interfaced with the heart of the system Arduino microcontroller. This setup is connected to the gas cylinder through the DC motor. Once the Gas concentration goes high it is sensed by the MQ2 gas sensor and sends the signal to the arduino micro controller. It then sends the command to the GSM, Active buzzer module and to the DC motor simultaneously. When the signal is received it sends the alert sms/call, makes the alarm sound and closes the cylinder knob respectively. The Fig.7 shows the output in form of the alert Phone call send by the GSM module when the gas leakage is detected.



Fig.4 System implementation



Fig.5 Cylinder knob setup

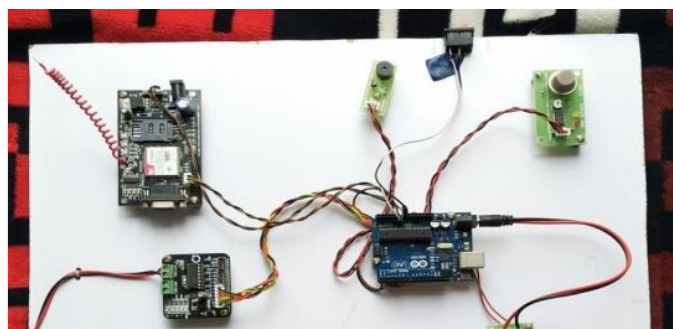


Fig.6 Sensing and alert setup



Fig.7 output in form of the alert Phone call

6. Conclusion and Future Work

The LPG detector was developed and tested and the results were satisfactory. This is an indication that the device can be installed in home and industrial kitchen to help forestall fire incidence that result from gas leakage that goes on undetected. This device when installed will efficiently help the user to know when there is gas leakage without relying solely on the sense of smell. Since the device can be powered from the mains and a battery, reliability of the system is guaranteed all the time. This system helps to secure house, industries by detecting the gas leakage before accident and send alert message to mobile. So, the users can take security precaution. It automatically locks the cylinder valve and helps to stop gas leakage. It has many other applications in automobiles, aircrafts, etc.

Based on the conclusion of the research, the proponents formulated several recommendations for the study. The group would like to recommend to the future researchers that they continue to develop this prototype device to find a way to include the automatic booking of the gas that will help the rural people and the device that opens all the windows and doors when the gas gets leaked it adds the additional preventive measures that avoids the gas leakage accidents.

Declarations

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Competing Interests Statement

The authors declare no competing financial, professional and personal interests.

Consent for publication

We declare that we consented for the publication of this research work.

Code availability

The programming code that we have used for this research is available and authors are willing to share when it is required.

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