

# GSM-Based Industrial Safety and Security Systems with Voice and Messages Alerts

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**ABSTRACT:** Humans are prone to various toxic gases and hazardous elements or chemicals or compound consisting in the atmosphere. People can fall into danger if the level of those gases exceeds human body tolerance limit or even can lead to death if the gas level is too high as against persistence. Gas detection systems that detect and quantify the quantity of harmful gases in human-inhabited locations such like industries and commercial locations are required to deal with this type of issue. In industrial areas, the amt of toxic gases is very high and therefore the probability of an accident from those gases, such as CO (Carbon Monoxide), CH<sub>4</sub> (Methane), and fuels for flaming reasons, are present as exhaust gases in these regions during manufacturing. Therefore, for safeguarding of human life, a gas monitoring system is required. It can be more feasible if we measure these gases from a distant safer place with wireless communication devices and components, so that a monitoring system is developed with MQ2 gas Sensor, SIM900A Wireless Transceiver Module and Arduino as a micro-controller Unit.

## 1. INTRODUCTION

Now a days the usage of gases and fuels at home and in industries has increased, So the number of accidents that occur as a result also increases. "A year ago in Visakhapatnam, Andhra Pradesh, there was one of its worst environmental disasters – the contamination of poison gas from a storage tank of LG Polymers Ltd, a South Korean company on the outskirts of the city, killed 12 people and taken to the hospital nearly 500 – villagers residing near the plant remain fearful. Though the plant has since been closed due to orders from the Andhra Pradesh high court, residents of Venkatapuram and four other villages surrounding the plant say the horror of the tragic incident haunts them to this day." [1]

Not only in venkatapuram we have also seen the Bhopal disaster, Chernobyl gas tragedy, which cost the whole area with effected air which contains harmful gas, people at that place get effected with harmful diseases and radiation. "There are approximately 20 gas disasters happened across various divisions of industries in India from 2014-2021, till date." [2]

## 1.1 Scope

While LPG is a necessity in every sector, its leakage might be disastrous. There are a variety of products available to detect gas leaks and prevent any mishaps. We've created an LPG gas detection alarm using Arduino. If a gas leak occurs, this system detects it and sounds an alarm by buzzing the circuit's buzzer. This system is simple to construct, and anyone can handle it. To detect danger, we used an LPG gas sensor module and a smoke sensor module. When LPG gas leaks, it sends a HIGH pulse to Arduino's DO pin, which Arduino reads continually. When the Arduino receives a HIGH pulse from the Gas module, it displays the message "Leakage Alert" on a 16x2 LCD and triggers the buzzer, which sounds repeatedly until the gas detector module detects no gas in the surroundings. When the gas detector module sends a LOW signal to Arduino, the LCD displays the message "No LPG Gas Leakage."

## 2. EVALUATION

### EXISTING SYSTEM

Devices that require invasive connections in order to obtain measurements. An Arduino-based system for detecting gas leaks exists. However, it only activates the alarm if it detects a gas leak. If the user is not at home, this would be an issue. As a result, the current system is inadequate.

**The disadvantages of the existing manual approach are as follows:**

The systems are not portable. If the user is not at home, this would be an issue. Difficult to operate complex system. Code that is difficult to read. Code that is inaccurate

## 3. IMPLEMENTATION

### PROPOSED SYSTEM

In this project, industrial safety and security systems (such as LPG) or any other petroleum-based gaseous substance can be detected using MQ5/6/9 Sensors, with MQ 6 being ideal for detecting LPG leakage. Create an

SMS-based Alert Mechanism and send SMS to a list of phone numbers. When a gas leak occurs, sound an alert, and then turn off the alarm after the gas leak is under control. A 16X2 LCD module is used to display status on an LCD.

**The following are the merits of the proposed system:**

Send an SMS to the user informing them of a gas leak at the location. It has overcome the disadvantages of the previous method. Even if the user is not at home, he will be aware of the situation. Sets off an alert and displays a message on the LCD screen. When compared to the current system, it has a high level of accuracy. Even if the user does not have access to the internet, the message will be delivered. It's small and portable, and it's simple to use.

**4. Working**

Approaches to Gas Measurement The measurement of a single gas or many gases necessitates the use of advanced methods. It is important to follow the essential methods to measure gas concentration in ppm and percentage units [3].

**i) MQ2 gas sensing graph analyses**

The study of the curve is the initial stage in gas measurement. That is, two points were picked from its curve in Figure 12 for detecting a specific gas: (x1, y1) and (x2, y2). A curve will be built with these two points that is roughly equivalent to the original curve of a particular gas. Then comes the procedure of determining the created curve's slope:

$$M = \frac{Y2 - Y1}{X2 - X1} \tag{1}$$

Now the process of forming a curve for analysis and matching of the gas comes. That is, the gas sensor will measure gases and will compare with the generated curve to match the exact gas for measurement. The curve formation is done in following way (x, y, m). Where x represents a point of x axis of the corresponding curve, y represents a point of y axis of the corresponding curve and m is the slope of the curve. Now the determination process of Rs/R0 ratio of gas is done and compared with the curve of a corresponding gas. It involves two steps; the first one is determination of R0 that is the resistance of the surrounding air

$$R0 = \frac{Rs \text{ of the surrounding air}}{Ro \text{ of the clear air}} \tag{2}$$

The Rs is determined using following equation:

$$Rs = \frac{Rl \text{ value} \times (1023 - \text{Sensed Raw Value})}{\text{Sensed Raw Value}} \tag{3}$$

Finally, the ratio that is Rs/R0 is determined by:

$$Rs/Ro = \frac{R2 \text{ of the gas}}{Ro \text{ that is previously determined}} \tag{4}$$

Where, Rs of the gas interprets the resistance sensed of gases in the air and determined also using the Equation (3)

**ii) Measurement in PPM and % percentage**

a) Measuring the concentration in PPM unit: To measure the gas concentration in ppm unit, there is need to use the following code in Sketch compiler of Arduino:

∴ Gas concentration (ppm) = pow (10, (((log (rs\_ro\_ratio) - pcurve [1])/pcurve [2]) + pcurve [0])) (Instructables, 2019)

b) PPM to % percentage: To determine the % percentage concentration of the gas, there is the need to divide the gas concentration, that is, determined in PPM unit by 10000:

$$\% \text{ percentage} = \frac{\text{Gas concentration in PPM}}{10000} \tag{5}$$

According to the figure, we can see that the minimum concentration we can test is 200ppm and the maximum is 10000ppm, in a other word, we can get a concentration of gas between 0.02% and 1%. However, because the relationship between ratio & concentration is non - linear, So, we cannot provide a formula. [3]

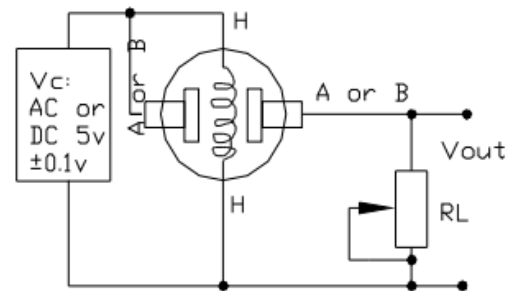


Figure7: gas sensor circuit diagram

**5. Algorithm:**

- 1) Firstly, check the Arduino uno, GSM sim module, gas module and lcd are working.
- 2) Using the Arduino interface code for the project and dump it in the Arduino uno using the USB2.0 cable.
- 3) Connect the Arduino to GSM module using the jumpers.
- 4) Using the female bug strip MQ5 gas sensor is soldered to the gsm module and is also connected to Arduino board.
- 5) Sim is inserted into the Sim900a of GSM module.

- 6) The message which is seen on the lcd screen, in phone are user defined.
- 7) When the gas is detected, the message is shown on LCD screen, a voice alert is snored and a message is sent to the phone handler.

### 6. Result

The result is observed by simply plug-in the receiver and monitoring ends MCU in laptop USB port via USB 2.0 A to B cable. The result is tested under one atmospheric condition, which is shown in the figure.

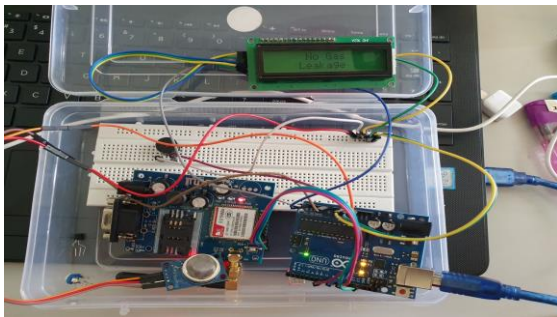


Fig1: the result is shown in lcd display

The above fig illustrates the connections of the project. We can see GSM module, SIM900A module, LCD display Arduino UNO, connecting wires and jumpers. The LCD screen shows no gas detected when it is in open air.

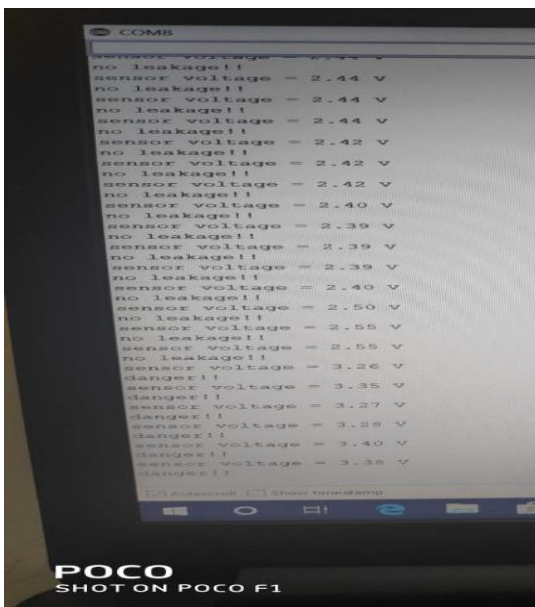


Fig2: the result in laptop

The above fig illustrates the output as Gas leaked when the gas sensor sensed the lpg gas. This message is shown in the output section of the user interface.

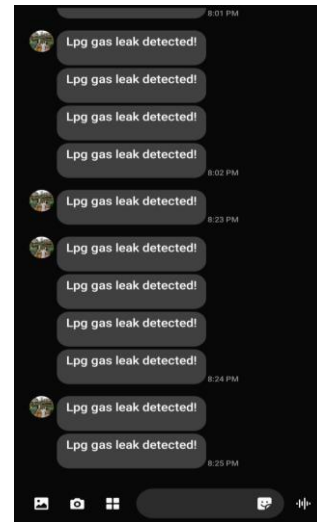


Fig3: the gsm module sent messages.

This figure shows the output when the gas sensor sensed LPG gas. The project sent the messages through the SIM900A module to a mobile phone. The continue messages were sent when LPG gas was kept open for 5 minutes.

### 7. Conclusion

The proposed method can calculate ppm and % gas concentrations. This system, including all of its codes and algorithms, can be utilised with various MQ series gas sensors with simple adjustments. The device will be incredibly useful for identifying dangerous and flammable gases in situations where human life is at stake. Furthermore, because it is a wireless monitoring device, the risk of serious injury or death is lowered as a result of its use and detection of gas concentrations from a safer length of time. This gadget can be utilised in both residential and commercial settings. In order to save valuable human lives, it is a more practical and effective monitoring and warning system for today's gas-related serious catastrophe.

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