

1. Abstract

The GSM-Based Gas Detection System is designed to detect gas leakage and send an SMS alert to the user's mobile phone. Gas leakage from LPG cylinders, pipelines, or regulators can cause fire, explosions, and other serious accidents.

In this project, an MQ-2 gas sensor detects combustible gases in the surrounding air. An Arduino Uno processes the sensor output and checks whether the gas level exceeds a predefined threshold. If the threshold is crossed, a GSM module sends an SMS notification to a registered mobile number.

The circuit is assembled using direct connections or a printed circuit board (PCB), without a breadboard or buzzer. The system provides a simple and affordable method of gas leakage notification without requiring Wi-Fi.

2. Introduction

Gas is commonly used in homes, hotels, laboratories, and industries. LPG is useful for cooking and heating, but leakage can become dangerous if it is not detected quickly.

Traditional gas detection systems may use a buzzer to alert people nearby. However, a person may not hear the alarm if they are far away.

To overcome this limitation, the proposed system uses GSM technology to send an SMS directly to the user's mobile phone. It combines gas sensing, microcontroller-based processing, and wireless communication.

The circuit is assembled using soldered connections or a PCB instead of a breadboard. This provides a more permanent physical arrangement for the student project.

3. Problem Statement

Gas leakage may occur due to damaged pipes, loose connections, faulty regulators, or improperly closed valves. Delayed detection can cause serious accidents.

A local alarm may not notify a person who is away from the location. Therefore, a system is required that can automatically detect gas leakage and notify the user remotely.

The proposed system aims to detect gas leakage, process sensor readings, and send an SMS alert using GSM technology without using a buzzer, breadboard, or Wi-Fi connection.

4. Objectives

1. To detect gas leakage using an MQ-2 gas sensor.
2. To continuously monitor gas sensor readings.
3. To process sensor data using an Arduino Uno.
4. To send an SMS alert through a GSM module.
5. To construct the circuit without a breadboard.
6. To eliminate the buzzer and use mobile notifications instead.
7. To develop a simple, affordable gas monitoring prototype.
8. To improve awareness of possible gas leakage.

5. Literature Review

Various methods are available for gas leakage detection, including manual detection, sensor-based systems with buzzers, Wi-Fi-based systems, and GSM-based systems. Manual detection depends on human observation, while buzzer-based systems provide only local alerts. Wi-Fi-based systems enable remote monitoring but require an internet connection. In comparison, GSM-based systems can send SMS alerts through a cellular network without requiring Wi-Fi connectivity.

The proposed system uses an MQ-2 gas sensor, an Arduino Uno, and a GSM module to detect gas or smoke and send an SMS alert to a registered mobile number when the sensor reading exceeds a predefined threshold. The system does not use a buzzer and focuses on remote notification. It offers a simple and cost-effective solution for gas leakage monitoring, provided that adequate power and cellular network coverage are available.

6. Proposed System

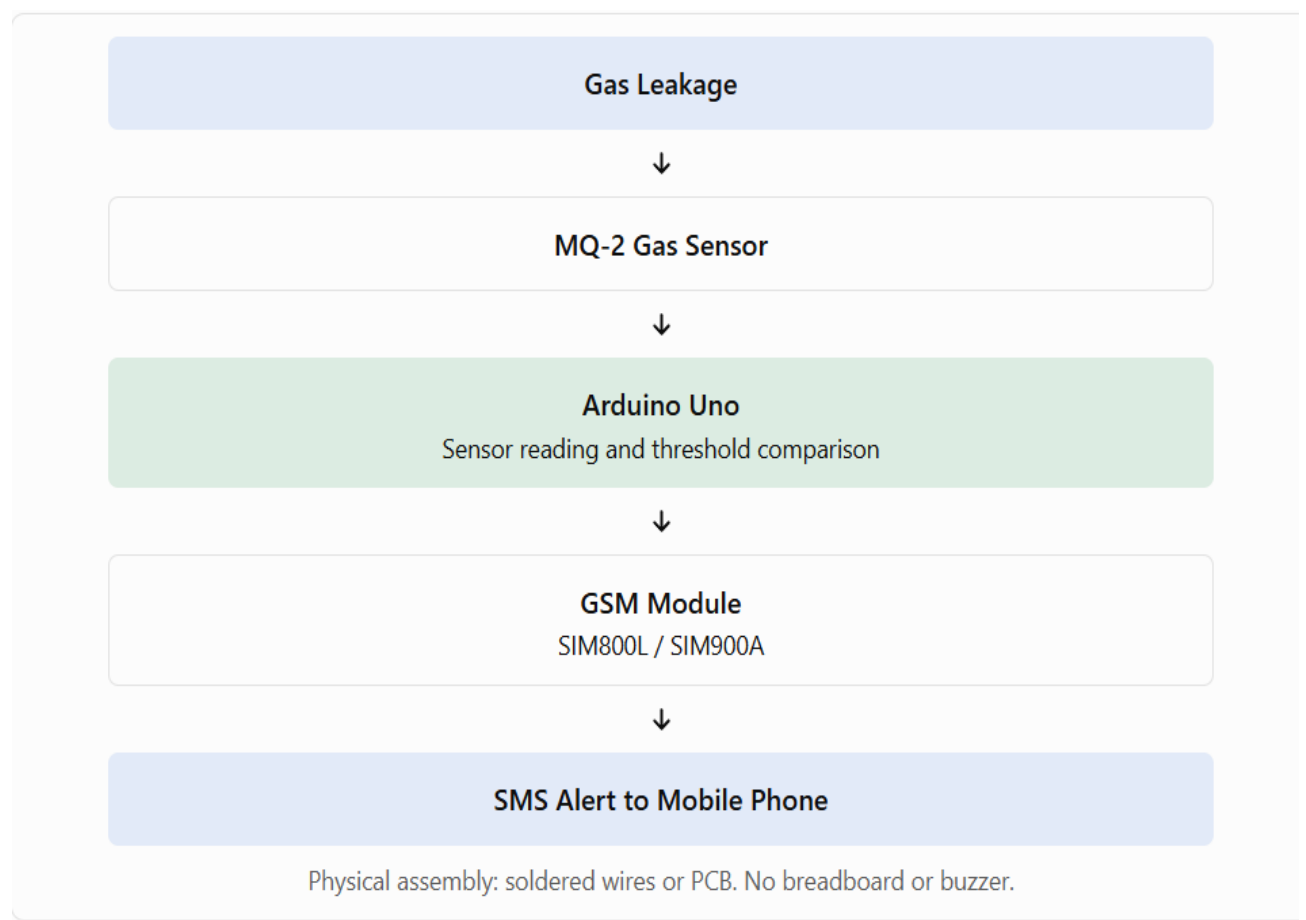
The proposed system consists of three main units.

- Gas detection unit: The MQ-2 sensor detects combustible gases and smoke.
- Control unit: The Arduino Uno reads the sensor output and compares it with a predefined threshold.
- Communication unit: The GSM module sends an SMS to the registered mobile number when the threshold is exceeded.

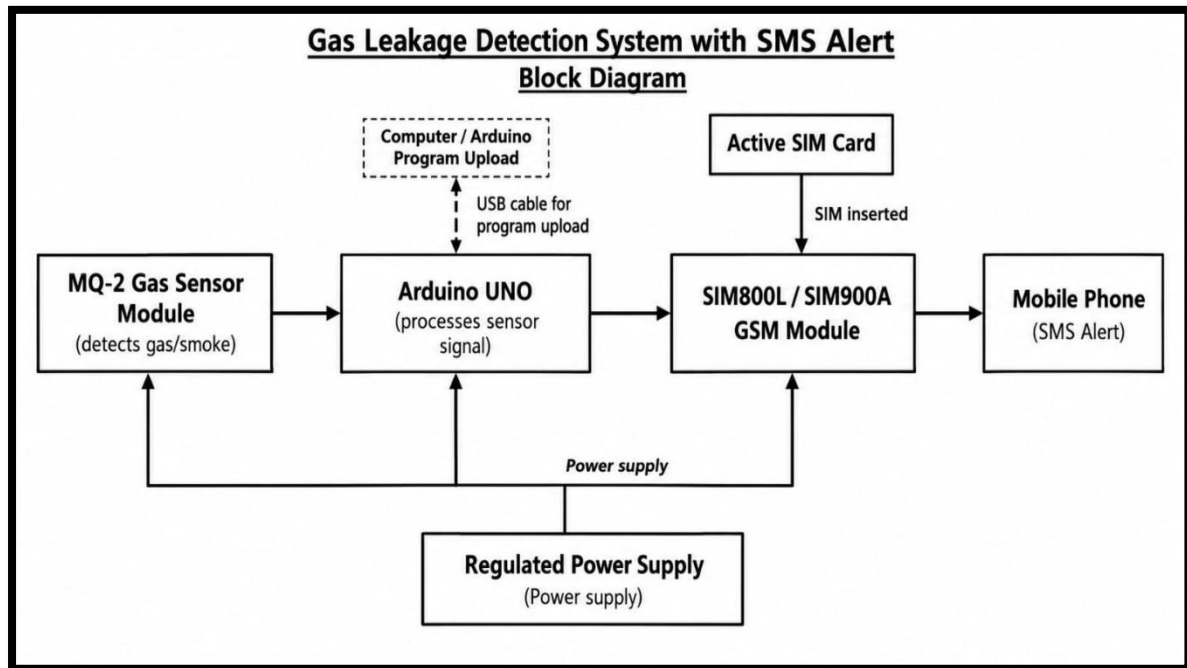
The components are connected using soldered wires or a PCB. No breadboard or buzzer is required.

When gas levels return below a reset threshold, the controller prepares for a new detection event.

7. Flow Chart



8. Block Diagram



9. Hardware Requirements

Sr. no.	Component	Purpose
1	Arduino Uno	Controls the system
2	MQ-2 gas sensor module	Detects combustible gases and smoke
3	SIM800L or SIM900A GSM module	Sends SMS alerts
4	Active SIM card	Provides cellular connectivity
5	Regulated power supply	Powers the circuit
6	Connecting wires	Makes electrical connections
7	Soldering iron and solder	Makes permanent connections
8	USB cable	Uploads the Arduino program
9	Mobile phone	Receives SMS notifications

9. Software Requirements

Software or technology	Purpose
Arduino IDE	Writes and uploads the program
Embedded C/C++	Programs the Arduino
GSM AT commands	Controls the GSM module
Serial Monitor	Displays sensor readings
Mobile SMS service	Receives leakage notifications

10. Working Principle

The proposed gas leakage detection system works on the principle of gas sensing and GSM-based wireless communication. It consists of an MQ-2 gas sensor, an Arduino Uno microcontroller, and a GSM module. The main purpose of the system is to detect the presence of combustible gases or smoke and send an SMS alert to a registered mobile number when the detected level exceeds a predefined threshold.

Initially, the MQ-2 gas sensor continuously monitors the surrounding air. When combustible gases or smoke are present, the electrical resistance of the sensor changes, producing an output corresponding to the detected gas concentration. The sensor module sends this output to the Arduino Uno, which acts as the main processing unit of the system.

The Arduino Uno reads the sensor output and compares the measured value with a predefined threshold. Under normal conditions, the system continues monitoring the surrounding environment. When the sensor reading exceeds the specified threshold, the Arduino identifies a possible gas leakage or smoke detection event and sends the required AT commands to the GSM module.

The GSM module uses a registered SIM card and an available cellular network to send an SMS alert to the user's mobile number. The message informs the user that the gas or smoke level has exceeded the set threshold and that the area should be checked immediately. This

allows the user to receive a warning even when they are away from the monitored location, provided that the GSM network and power supply are available.

After the gas or smoke level decreases below the reset threshold, the system returns to its monitoring state and becomes ready to detect another event. Suitable threshold and reset conditions help prevent repeated alerts caused by small fluctuations in sensor readings. The system does not use a buzzer or other local audible alarm because its primary notification method is SMS through the GSM module.

Thus, the proposed system provides a simple and economical approach to gas leakage monitoring by combining an MQ-2 sensor for detection, an Arduino Uno for processing, and GSM technology for remote notification. It can be used as an additional safety and warning system in homes, kitchens, laboratories, and other suitable environments. However, it should not replace certified gas detectors or established gas safety measures.

11. Methodology and Implementation

Step 1: Circuit assembly

Mount the Arduino, MQ-2 sensor module, and GSM module on a suitable base or enclosure. Use a soldered PCB or insulated direct wiring instead of a breadboard.

Step 2: Connect the gas sensor

Connect the MQ-2 module's VCC, GND, and analog output to the appropriate Arduino pins.

Step 3: Connect the GSM module

Connect the GSM module's serial communication pins to the Arduino. Provide a separate, suitable power supply if required by the module.

Step 4: Upload the program

Write the Arduino program to read the gas sensor, compare the reading with a threshold, and send an SMS when necessary.

Step 5: Configure GSM

Insert an active SIM card and verify that the GSM module can register with the cellular network and send SMS messages.

Step 6: Test the system

Check the sensor readings under normal conditions and verify SMS transmission under controlled testing conditions.

Step 7: Final assembly

Inspect all solder joints, insulate exposed wires, secure the components, and test the assembled system.

12. Circuit connections

These are example connections for an MQ-2 module and a compatible GSM module.

Component pin	Arduino connection
MQ-2 VCC	5V
MQ-2 GND	GND
MQ-2 AO	A0
GSM TX	Arduino pin 7 (software serial RX)
GSM RX	Arduino pin 8 (software serial TX), with suitable voltage-level interfacing
GSM GND	Common ground

Arduino Program

```
#include <SoftwareSerial.h>

SoftwareSerial sim800(10, 11);

// Arduino D10 = RX, D11 = TX

const int gasSensorPin = A0;

const int gasThreshold = 400;

// Replace with your mobile number
```

```
const char phoneNumber[] = "+919421338279";

bool smsSent = false;

bool networkReady = false;

void setup() {

    Serial.begin(9600);

    sim800.begin(9600);

    pinMode(gasSensorPin, INPUT);

    Serial.println("GSM Gas and Smoke Detector");

    Serial.println("Starting SIM800L...");

    delay(3000);

    // Check GSM module

    sim800.println("AT");

    delay(1000);

    // Set SMS text mode

    sim800.println("AT+CMGF=1");

    delay(1000);

    // Check SIM card

    sim800.println("AT+CPIN?");

    delay(1000);

    // Enable network registration messages

    sim800.println("AT+CREG=1");

    delay(500);

    // Check network registration

    sim800.println("AT+CREG?");
```

```
    delay(1000);

    Serial.println("System ready. Waiting for sensor readings...");
}

void loop() {

    // Display responses from SIM800L

    while (sim800.available()) {

        Serial.write(sim800.read());

    }

    int gasValue = analogRead(gasSensorPin);

    Serial.print("MQ-2 Value: ");

    Serial.println(gasValue);

    // Check network registration

    sim800.println("AT+CREG?");

    delay(500);

    String response = "";

    unsigned long startTime = millis();

    while (millis() - startTime < 500) {

        while (sim800.available()) {

            response += (char)sim800.read();

        }

    }

    if (response.indexOf("+CREG: 0,1") >= 0 ||

        response.indexOf("+CREG: 0,5") >= 0 ||

        response.indexOf("+CREG: 1,1") >= 0 ||
```

```
    response.indexOf("+CREG: 1,5") >= 0) {  
    networkReady = true;  
} else {  
    networkReady = false;  
}  
  
if (gasValue >= gasThreshold && !smsSent) {  
    Serial.println("Gas or smoke detected!");  
    if (networkReady) {  
        sendSMS();  
    } else {  
        Serial.println("Network not registered. SMS not sent.");  
    }  
    // Prevent repeated SMS messages  
    smsSent = true;  
}  
  
// Reset alarm after the reading falls below threshold  
if (gasValue < gasThreshold - 50) {  
    smsSent = false;  
}  
    delay(1500);  
}  
  
void sendSMS() {  
    Serial.println("Sending SMS...");  
    sim800.println("AT+CMGF=1");
```

```
delay(1000);

sim800.print("AT+CMGS=\"");

sim800.print(phoneNumber);

sim800.println("");

// Wait for SMS prompt

unsigned long startTime = millis();

bool promptReceived = false;

while (millis() - startTime < 10000) {

    if (sim800.available()) {

        char c = sim800.read();

        Serial.write(c);

        if (c == '>') {

            promptReceived = true;

            break;

        }

    }

}

if (!promptReceived) {

    Serial.println("\nERROR: SMS prompt not received.");

    return;

}

sim800.println("ALERT! Gas or smoke detected. Please check immediately.");

delay(500);

sim800.write(26); // Ctrl+Z to send SMS
```

```
startTime = millis();

String result = "";

while (millis() - startTime < 15000) {

    while (sim800.available()) {

        char c = sim800.read();

        Serial.write(c);

        result += c;

    }

    if (result.indexOf("+CMGS:") >= 0) {

        Serial.println("\nSMS submitted successfully.");

        return;

    }

    if (result.indexOf("ERROR") >= 0) {

        Serial.println("\nSMS sending failed.");

        return;

    }

}

Serial.println("\nNo SMS confirmation received. Check GSM network.");

}
```

13. Results

The following table shows the expected outcomes. Enter your actual observations after testing the prototype.

Test condition	Expected outcome
Normal air	No leakage SMS
Sensor reading above threshold	SMS alert triggered
Reading falls below reset threshold	System resets
GSM network unavailable	SMS may be delayed or fail

The project demonstrates gas detection and remote notification using GSM communication.

14. Applications

1. Home kitchens and LPG monitoring demonstrations.
2. Hotels and restaurants.
3. Laboratories.
4. Small workshops and industrial demonstrations.
5. Gas storage monitoring prototypes.
6. Educational electronics projects.
7. Remote gas leakage notification systems.

For actual safety installations, use certified gas detection equipment appropriate for the environment.

15. Total Cost

Component	Total cost
Arduino Uno-compatible board	₹350
MQ-2 sensor module	₹150
GSM module	₹350
Regulated power supply	₹60
SIM/recharge allowance	₹350
Wires and soldering materials	₹100
Total estimated cost	₹ 1360

16. Future Scope

- Send SMS alerts to multiple mobile numbers.
- Add a mobile application for monitoring.
- Store gas sensor readings in a database.
- Add battery backup.
- Include an automatic gas shut-off valve with appropriate safety controls.
- Use a calibrated sensor for more reliable concentration measurements.
- Add fault detection for sensor, power supply, and GSM network failures.
- Develop a compact PCB for permanent installation.

17. Conclusion

The GSM-Based Gas Detection System without a buzzer and breadboard is a useful electronics project for detecting possible gas leakage and sending an SMS alert to a registered mobile phone. The MQ-2 sensor detects changes in gas levels, the Arduino processes the readings, and the GSM module sends the notification.

Using a PCB or soldered wiring provides a permanent circuit assembly without a breadboard. Removing the buzzer makes SMS the primary notification method. The project is affordable and suitable for educational demonstrations, although it should not replace certified safety equipment.

18. References

1. GSM-Based LPG Gas Leakage Detection and Alert — Research paper discussing Arduino Uno, MQ-2 sensor, and GSM SMS alerts.
2. Gas Leakage Detection System Using Arduino and GSM Module Review — Research paper covering gas sensing, GSM communication, and SMS alerts.
3. Gas Leakage Detector System — Arduino Project Hub — Practical project reference with components, circuit information, and code.
4. Real-Time Harmful Gas Leakage Detection and Alert System Using Arduino and GSM Technology — Research paper describing an Arduino Uno, MQ-2 sensor, and GSM-based alert system.
5. Gas Leakage Detection and Alerting System Using Arduino Uno — Research paper discussing gas detection and GSM-based warning systems.
6. IoT-Based Gas Leakage Detection and Control Using GSM and Arduino — Reference for GSM communication and SMS notification.

19. Photographs

