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Research Paper

GSM based LPG gas leakage detection & alert

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ABSTRACT

To develop an efficient gas leakage detection system for vulnerable premises. The system utilizes a gas sensor with high sensitivity to propane (C3H8) and butane (C4H10) gases and incorporates a GSM module for sending warning SMS messages. This paper aims to present the design approach for both the software and hardware components of the system to ensure timely detection and prevention of gas leakage accidents.

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1. INTRODUCTION

The usage of LPG can pose significant risks, and gas leakage can have destructive consequences for both lives and property. The objective of the project is to create an accurate and cost-effective system that can detect gas leaks and promptly alert the appropriate personnel to take necessary precautions [1]. The proposed system utilizes sensors to detect the presence of LPG gas. When a gas leakage is detected, the system immediately activates a buzzer to provide a clear audible indication of the danger. Simultaneously, an alert message is sent via GSM (Global System for Mobile Communications) to the responsible person who has control over the system [2]. By promptly detecting gas leaks and providing audible warnings, the

system aims to alert people in the vicinity about the potential danger. Additionally, an SMS notification is sent to the responsible person. It offers an effective solution for gas leak detection, warning individuals through buzzer alerts, and notifying responsible personnel through SMS notifications [3]. Overall, the project aims to enhance safety by developing an efficient gas leak detection system that not only alerts people in real-time but also enables proactive safety measures to prevent potential hazards associated with LPG gas leaks [4].

2. RELATED WORK

Gas leakage detection system based on GSM (Global System for Mobile Communications) technology. The system utilizes a GSM module to wirelessly send alerts in the event of a gas leakage [5]. The implementation is described as efficient. Smart system for detecting LPG (liquefied petroleum gas) and combustible gases using WSN (Wireless Sensor Network) technology. The system is designed to work in flexible ways and employs recent techniques for gas detection. It aims to provide intelligent and adaptable gas detection capabilities [6]. An embedded system for the detection and alerting of hazardous gases. The system is designed to be compact and cost-effective, incorporating all the necessary hardware components onto a single embedded board. This approach ensures ease of use, low cost, and sustainability [7].

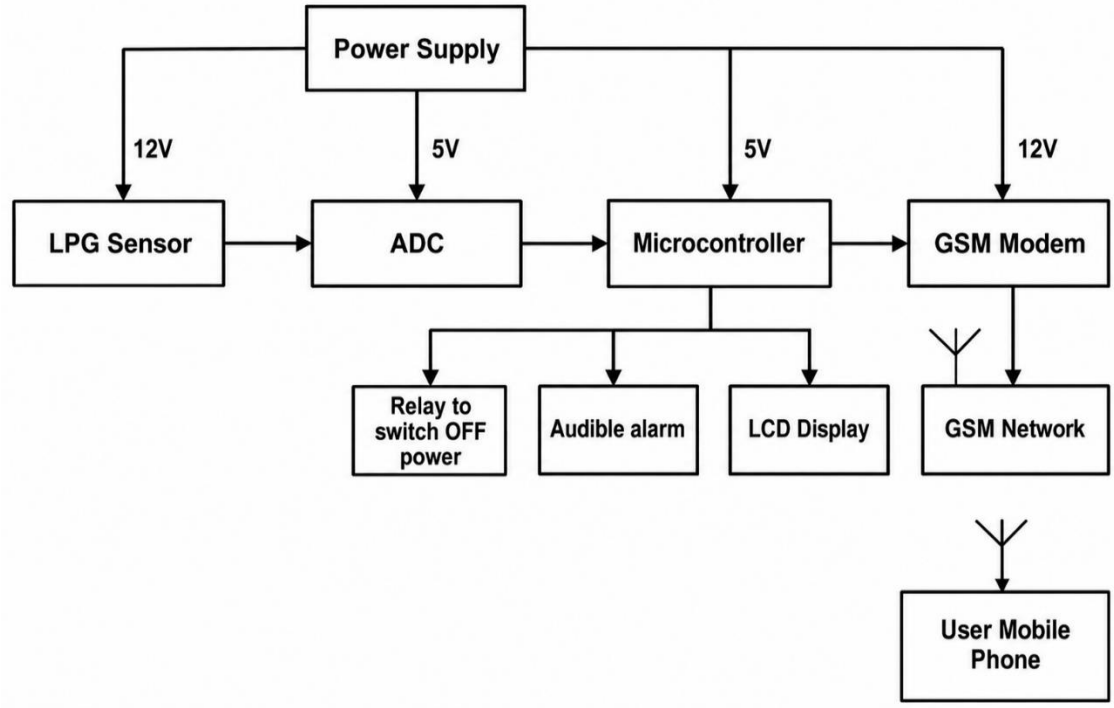


Figure 1. Block Diagram of Gas Leakage Detecting and Alert System

The block diagram describes a gas leakage detection and alerting system based on the Arduino UNO (Atmega-328) microcontroller. Which performs various tasks to detect gas leakage and provide alerts. Let's go through the different components and their functionalities [8]:

2.1 Gas Sensor

This is the primary input device that detects the presence of gas in the environment. The output signal of the gas sensor is used as an input to the Arduino UNO

2.2 Arduino UNO

Arduino UNO performs signal conditioning on the input signal from the gas sensor. This process may involve amplification, filtering, or any necessary adjustments to prepare the signal for further

2.3 Processing. Buzzer

In case of gas leakage, the Arduino UNO activates a buzzer to produce an audible beep or siren sound.

2.4 GSM Modem

The Arduino UNO is connected to a GSM modem, which allows it to send SMS messages. The system can save the phone number of the plant in charge or any desired recipient in the SIM card inserted into the GSM modem.

2.5 Alert SMS

When a gas leak is detected, the Arduino UNO triggers the GSM modem to send an alert SMS message to the designated recipient [9], [10].

This gas leakage detection and alerting system utilizes an Arduino UNO microcontroller to process the input from a gas sensor, produces audible alerts with a buzzer, and sends SMS alerts to a designated recipient via a GSM modem [11], [12]. The system aims to notify people of gas leaks in workplaces, factories, or homes, ensuring their safety and enabling timely actions to address the issue [13], [14].

2.6 Hardware Description

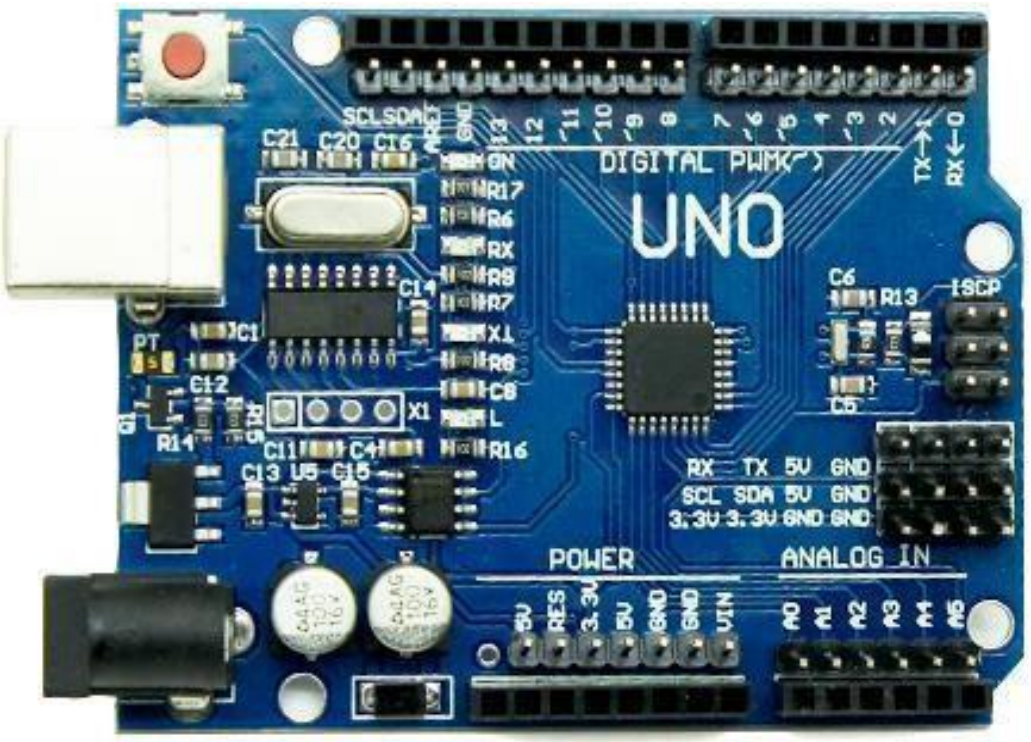


Figure 2. Arduino Uno

The Arduino UNO is a popular microcontroller board used for electronic prototyping and development. It is based on the ATmega328P microcontroller [15], [16]. The ATmega328P is an 8-bit microcontroller with a clock speed of 16 MHz the Arduino UNO board provides a central unit for the system, where all the components can be connected and programmed to work together. It has various pins and interfaces that allow you to connect and control external devices. The board has 14 digital I/O pins, which can be configure. Ured as either inputs or outputs [17], [18]. These pins can be used to interface with digital devices such as sensors, switches, LEDs, and relays. Arduino UNO has 6 analog input pins, labeled A0 to A5. These pins can measure analog voltage levels using the built-in analog-to-digital converter (ADC). They are often used to interface with sensors that provide analog outputs, such as temperature sensors or light sensors. Arduino UNO operates at 5 volts, which means it requires a 5V power supply. Most of the digital and analog pins on the board also work at 5V logic levels [19].



Figure 3. MQ-2 Gas Sensor

The MQ-2 gas sensor module is a commonly used sensor for detecting flammable gases and smoke concentration in the air. It provides both analog voltage and digital value outputs, making it versatile for various applications. The module requires a supply input voltage of 5V. The module typically consists of three pins: transmitter, receiver, and ground [20]. These pins allow the sensor to be connected to a microcontroller or other circuitry for data processing and analysis [21].



Figure 4. GSM Modem

The GSM module is used for information exchange, and the SIM card is taken from the GSM module to control a wireless node. The GSM module requires a 5-volt DC supply to function properly. GSM module with an Arduino controller (specifically an Atmega328), only three connections are needed: transmitter, receiver, and ground [22]. The Arduino microcontroller is connected to the receiver pin of the GSM module. The Arduino provides information to the GSM module. [23], [24] The GSM module, with a SIM card inserted into its SIM slot, sends an output to a phone number specified in the code to alert about the detection of gas leakage, whether it's LPG gas or any other gas sensed by the sensor.



Figure 5. Buzzer

A buzzer is a device that produces an audible sound to alert or warn people about potential danger or certain conditions. When the system detects a dangerous situation or condition, it activates the buzzer, which then emits the beep-beep sound as an output [25].

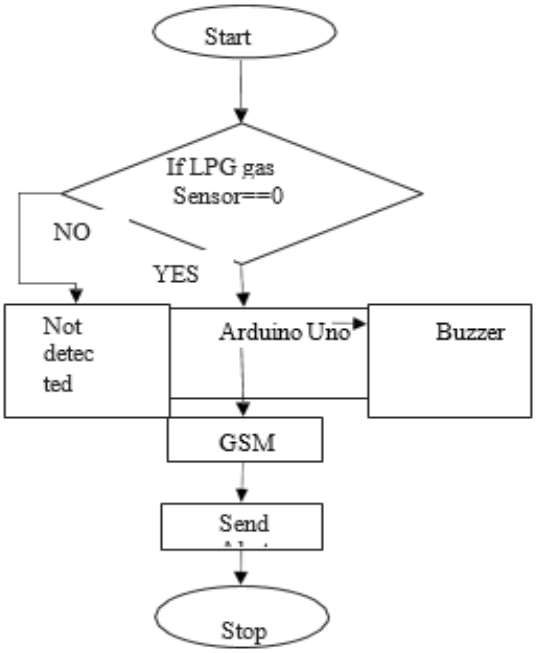


Figure 6. Flow Chart of Proposed System

2.7 The Step-By-Step Flow of the Implementation

Gas and smoke sensors are used to monitor the presence of gas or smoke in the environment. When the sensors detect the presence of gas, they send a low signal [26]. The low signal activates an Arduino UNO Microcontroller the Arduino UNO microcontroller is programmed to perform certain actions when the gas is detected. One of the actions is sending a message to the author, indicating that "GAS IS DETECTED." This could be done using a communication module or service connected to the Arduino, such as a GSM module. Another action is activating a buzzer to alert people nearby about the danger. Additionally, the system can use a GSM module to send alert messages to other designated recipients, such as emergency contacts or authorities [27], [28].

3. RESULTS AND DISCUSSION

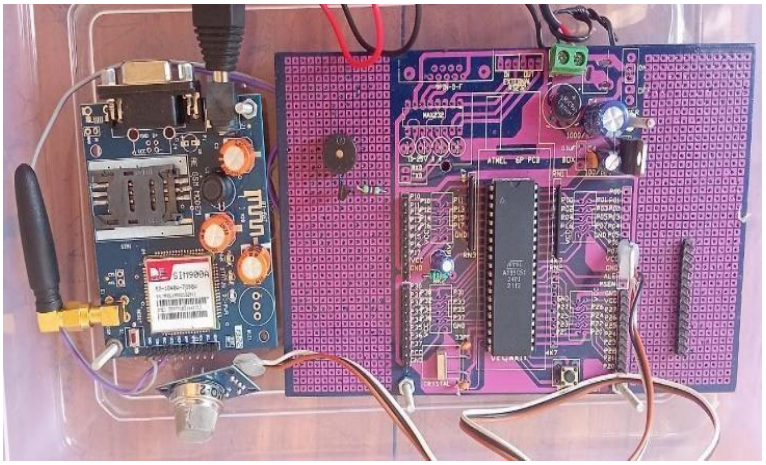


Figure 7. Schematic Diagram of Proposed System

Figure 7 shows a schematic diagram of a project that aims to detect gas leaks using a specific technique. The project utilizes an MQ2 gas sensor to detect the presence of gas and sends a signal to an Arduino Uno microcontroller once a gas leakage is detected [29]. The project utilizes an MQ2 gas sensor to detect the presence of gas and sends a signal to an Arduino Uno microcontroller once a gas leakage is detected. Once the Arduino receives the signal from the gas sensor, it triggers other externally connected devices, namely a buzzer and a GSM module [30], [31]. The buzzer produces a loud sound, typically a beep, to alert people in the vicinity about the potential danger posed by the gas leak [32], [33]. Simultaneously, the Arduino instructs the GSM module to send an SMS (Short Message Service) to a designated mobile number, providing information about the gas leakage event [34]. When the gas sensor detects a gas leak, the buzzer emits a loud sound to alert individuals in the area, drawing their attention to the potential danger. At the same time, the GSM module sends an SMS to a predefined mobile number, ensuring that the gasleak information reaches the appropriate individuals who can take necessary action [35], [36].

4. CONCLUSION

Overall, the inclusion of a GSM module in gas leakage detection systems enhances their effectiveness by enabling immediate notifications and ensuring prompt action can be taken to mitigate risks. This smart feature plays a crucial role in saving lives, protecting property, and preventing further damage in potentially dangerous situations.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Ms. Anjali T. Pawar	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	
Ms. Gauri B. Burande	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon

reasonable request.

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