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LPG Leakage Detection with Multiple SMS Alert System

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ABSTRACT: In this paper, proposed a system, which detects the LPG leakage and alerts the user multiple times based on the leakage concentration. If the leakage concentration increases or decreases the system enters into different stages and alerts accordingly. Since LPG is highly inflammable gas, it needs to be detect and alerted in early stages. This system can be used both in domestic and industrial levels**.**

KEYWORDS*:* LPG leakage, GSM, Gas sensor, Arduino, Alert system.

I. INTRODUCTION

Liquefied Petroleum Gas (LPG) consists mainly of propane, propylene, butane, and butylene in various mixtures, which are highly flammable used for domestic and industrial purposes. The number of deaths due to the explosion of gas cylinders by its leakage has been increasing in recent years. Since the LPG neither has odour nor have colour, it is hard to detect the leakage. Hence, there is a huge scope of detecting and alerting the user regarding it.

Several gas sensors were invented to detect the leakage of LPG and other flammable gases. MQ5 gas sensor is used in the proposed system. The working principle of the MQ-5 gas sensor is as follows: The sensor has a sensitive filament made of S_nO_2. In the presence of clean air, this filament tends to have lower electrical conductivity. When a combustible gas such as LPG is introduced, the filament's conductivity rises, and the amount of change in its conductance/resistance can be used to indicate the equivalent gas concentration [1][8].

A large amount of research has been going on based upon the monitoring and leakage detection of LPG, its feasibility and reliability. At the earlier stages, LPG leakage detection used 555 timer IC for timing process in the systems [2][3]. Later on, many systems used the microcontroller for programming and alerting the user. GSM technology was used additionally with the microcontroller base to alert the user using SMS [4][5]. By knowing the importance of preventing the leakage many systems evolved using a fan, solenoid valve, stepper motors, which can turn off the regulator knob [6][7].

The above research laid the important foundation for gathering the information for the proposed system. The paper discusses the need, implementation and application of the proposed system.
All these systems discussed above only alert the user once when the leakage starts and does not give the status of leakage or concentration after taking measures to stop the leakage. The proposed system alerts the user whenever the concentration of LPG increases or decreases. By this way, the user gets the clear knowledge on the leakage and their home or industry safety.

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II. METHODOLOGY

1. Functional Block and Working Procedure

The functional block diagram of the LPG leakage detection with multiple SMS alter system is as shown in Fig 1.

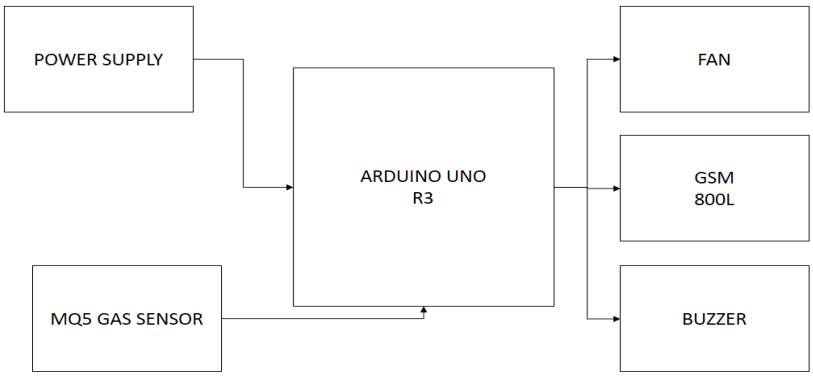

Fig 1. Functional Block Diagram of the system

The proposed system consists of Arduino, which is the main element to acquire the information from the sensor and controls the actuators like a fan, GSM module and a Buzzer.

MQ 5 gas sensor is used in the system in order to obtain the leakage concentration. It can sense from 200-10,000ppm of LPG [1]. Initially, the sensor needs to be calibrated in order to improve accuracy. The inbuilt Analog-to-Digital converter converts 0-5volts to 0-1023 scale. In order to obtain the voltage value, equation (1.1) is used.

$$\text{Voltage} = (\text{Analog input}/1024) \times 5 \qquad (1.1)$$

Based on the input voltage from the sensor, Arduino analyses the concentration of LPG gas leakage. Arduino drives the fan in order to diffuse the gas in the air since the LPG being heavier than air do not disperse easily [4].

SIM 800L GSM module is used to send the multiple SMS to the user. It supports quad-band *GSM*/GPRS network. It communicates with the Arduino using inbuilt Arduino's UART. Hence, it is relatively fast in sending SMS, which is the key point to the proposed system.

A buzzer is used to make a buzzing sound to alert the user if the user is nearby. Different types of buzzing sound are implemented for each level of concentration to give the user knowledge on the leakage level.

2. Algorithm Development

The proposed LPG leakage detection with multiple alert SMS system works according to the flow charts is as shown in Fig 2.

The Analog output of the MQ5 gas sensor is connected to the Analog port of the Arduino to take the Analog values. When the sensor is exposed to clean air the Analog reading ranges from 40-50, that results in 0.19-0.24 volts. When the LPG starts leaking the Analog value increases.

The proposed system uses 5 stages of gas leakage which is user-defined how fast their system should react. The stages are as follows:

A) ***Safe Stage:***When the input Analog voltage from the sensor is between 0V to 1.15V is referred to as a safe stage.

B) ***Conditional Stage:***When the input Analog voltage from the sensor is between 1.15V to 1.30V is referred to as conditional stage where the leakage is being controlled.

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C) ***Alert Stage:***When the input Analog voltage from the sensor is between 1.5V to 2.0V is referred to as Alert stage where the controlling action needs to be taken.

D) ***Danger Stage:***When the input Analog voltage from the sensor is between 2.0V to 3.0V is referred to as Danger stage where the concentration of LPG leakage is around 50%.

E) ***Extreme Stage:***When the input Analog voltage from the sensor is above 3.0V is referred to as Extreme Stage where the concentration of LPG leakage is around 80%.

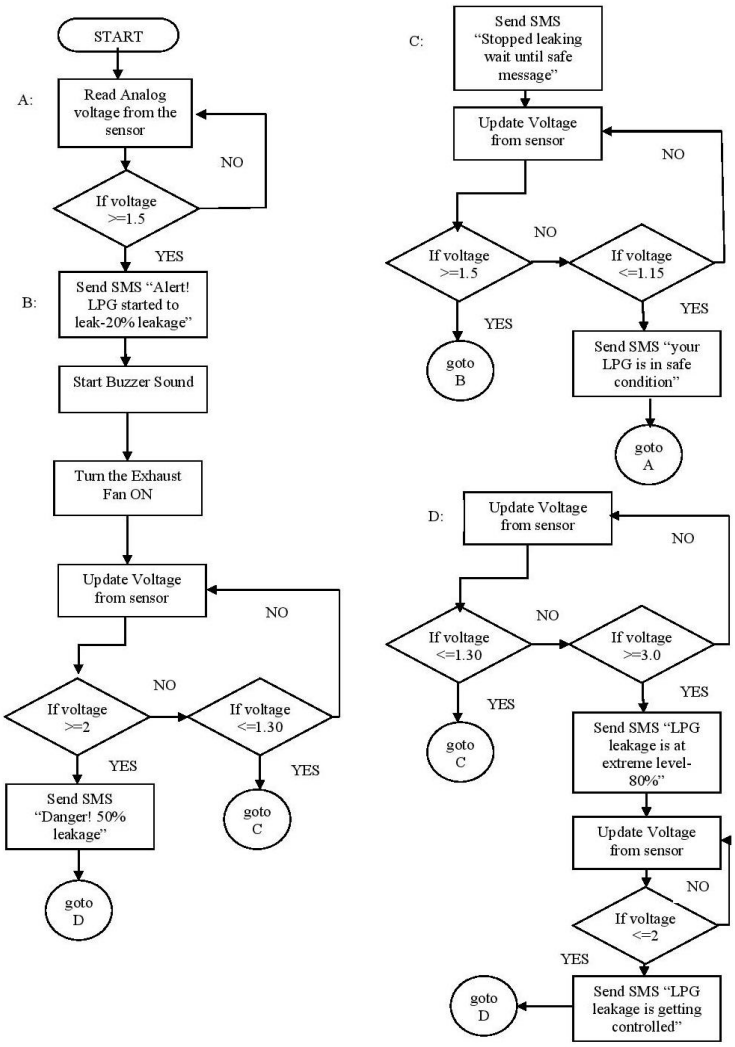

Fig 2. Flowchart of LPG leakage detection with multiple alert SMS system

When the system detects the LPG leakage it enters into Alert stage and alerts the user with "Alert! LPG started to leak-20% leakage" SMS with buzzing sound to alert nearby person and turns the fan ON to diffuse the leakage gas. At this level, if the user takes care of the leakage source, the concentration decreases and enters into conditional stage and the user gets the SMS saying "Stopped leaking wait until the safe message", at this level the user needs to take care of the LPG until they get the future message. If the concentration starts to increase from the conditional stage the user is alerted once more or if the concentration decreases from conditional stage, the system enters to safe stage and the user

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alerted saying "your LPG is in safe condition".

If the user does not take action in the Alert stage and the voltage level increases above 2V, systems gets into Danger stage and the user get the SMS saying "Danger! -50% leakage". Now if the user is able to control the leakage, the systems go into the stages down and the SMS are sent accordingly.

If the concentration increases and the input voltage increases above 3.0V, the system enters into Extreme Stage and sends the user with alert SMS saying, "LPG leakage is at extreme- 80%". Now, if the user takes action to control the leakage the voltage drops down, enters into respective stages, and alerts the user accordingly.

By this multiple alerting systems, user is able to visualize the leakage concentration and able to control accordingly. This system could be installed in both household and Industry levels. For Industry and for Apartments, more than one system could be used as nodes and get the information from each node. Say, leakage started from the region where node 1 was installed, then one can control the leakage from that region which makes more accurate in finding the leakage.

III. RESULTS

The proposed system was implemented and tested for some cases. Since actual LPG cannot be used for testing, small lighter gas was used for testing purpose. The following cases cover the working of the whole system.

1. **Case 1:**

In this case, LPG started leaking. However, the user controls at the initial stage itself. Hence, the system enters into Alert stage, Conditional stage and Safe stage as shown in fig 3.

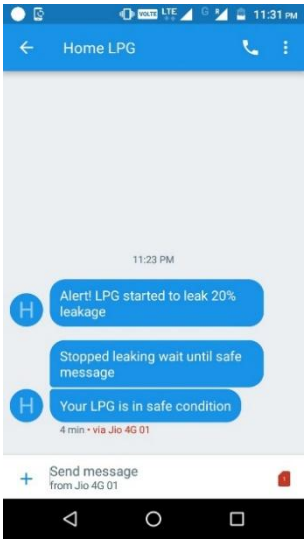

Fig 3. Results of Case 1

2. **Case 2:**

In this case, LPG leaks up to the extreme stage and then the user controls it and gradually comes to the safe stage as shown in Fig 4.

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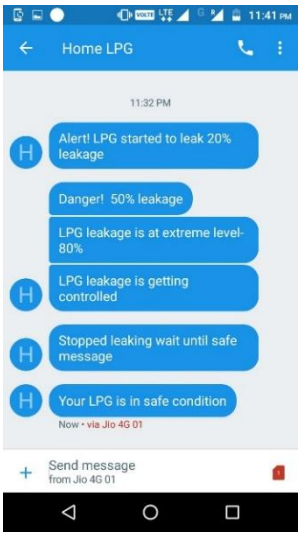

Fig 4. Results of Case 2

3. Case 3:

This is the worst case, where the system gets into a conditional stage but afterwards, the LPG concentration increases and hence moves to danger and extreme stages. Then, gradually comes to a safe stage as shown in Fig 5

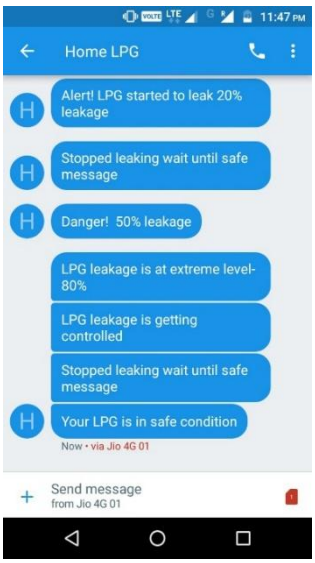

Fig 5. Results of Case 3

IV. CONCLUSION

LPG leakage results in serious damage for humans and for the environment. Hence, it needs to be detected in the early stages and to be controlled. The proposed system was designed and implemented successfully to detect and to prevent the LPG leakage. Along with the leakage detection, it also alerts the user multiple times about the leakage

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concentration. The cost involved in developing the system is relatively low. Hence, the system is also a cost-effective and efficient method of detection.

It is designed in such a way that the system can be made compatible for not only home safety but also in various industries and the gas leaks could be identified accurately using several nodes of the system.

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