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# Gas Leakage Detection for Avoiding Accidents

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**Abstract**

Gas leakage in our homes, industrial sectors and gas-powered vehicle etc. is a disaster waiting to happen if we don't take the appropriate safety precautions. One of the preventive methods to stop accidents associated with gas leakage is to install a gas leakage detection device at vulnerable places. This project presents an alternative approach to develop a device that can automatically detect and control gas leakages and also monitor temperature in vulnerable areas. The system detects the leakage of the LPG (Liquefied Petroleum Gas) using a gas sensor and then also monitors the temperature using a temperature sensor. When the LPG concentration in the air exceeds a certain level, the gas sensor senses the gas leakage and the output of the sensor goes LOW, the system then opens the exit windows, and then uses a GSM module for an alert about the gas leakage. Also, when the temperature of the environment exceeds a certain limit, it then turns ON the LED (indicator) and make an alarm through the buzzer. An LCD (16x2) displays the current temperature and gas leakage status in degree Celsius and PPM respectively.

**Key words**: Gas sensor, LPG

## Introduction

In modern days, in industries and laboratories gas is used for diverse purposes. LPG is equally used in vehicles as fuel due to the soaring in the prices of petrol and diesel [1].According to the reports of some researchers, the leakage of LPG has become one of the fundamental issues in recent times. There are fire disasters that were heard of in the past which could have been avoided if gas leakage was detected. Example, the Bhopal gas tragedy in India has been recorded as world's worst gas leakage accident [2]. Going by the increasing level of patronage of LPG for cooking and heating applications, coming up with an alternative safety measures and methods of checkmating the impact of fire outbreak that may result from its leakage has attracted the attention of many researchers [3]. Before the development of house hold electronics gas detectors in the early 90s, chemically infused paper that changes its colour in response to exposure of the gas was used to detect the presence of LPG [4]. Since the introduction of electronic gas detectors, quite a number of devices have been developed.

## Literature

### 01. Gas leakage detection and smart alerting system using IoT

In this paper we use IOT technology for enhancing the existing safety standards. While making this prototype has been to bring a revolution in the field of safety against the leakage of harmful and toxic gases in

environment and hence nullify any major or minor hazard being caused due to them. We have used the IOT technology to make a Gas Leakage Detector for society which having Smart Alerting techniques involving sending text message to the concerned authority and an ability performing data analytics on sensor. This system will be able to detect the gas in environment using the gas sensors. This will prevent form the major harmful probe.

**02. Development of a Gas Leakage Detector with Temperature Control system**

With the increasing rate of fire disaster in tropical countries like Nigeria, this maniacal menace could be handled by having this project implementation in homes, industries, market shops or Malls for safety reasons. In United State of America, the United States Consumer Product Safety Commission has emphasized the need for gas detectors for building security and recommends at least one for each layer of building. This proves the need for gas detection alarm systems to be 100% reliable. A backup power supply can be included in the system design to augment for power failure condition. Also, calibration of the gas sensor can be done in other for a specific gas to be sensed instead of the LPG numerous gases it senses.

**03. A survey on gas leak detection and localization techniques**

A wide variety of leak detecting techniques is available for gas pipelines. Some techniques have been improved since their first proposal and some new ones were designed as a result of advances in sensor manufacturing and computing power. However, each detection method comes with its advantages and disadvantages. Leak detection techniques in each category share some advantages and disadvantages. For example, all external techniques which involve detection done from outside the pipeline by visual observation or portable detectors are able to detect very small leaks and the leak location, but the detection time is very long. Methods based on the mathematical model of the pipe have good results at high flow rates while at low flow rates a mass balance based detection system would be more suitable. If we consider the costs involved by the use of each detection system, the summary in Table 1 shows that most of the available techniques are expensive. This disadvantage is prone to disappear for some of these techniques due to forthcoming technological advancements. Combining several leak detection systems is a common practice and also a recommendation (Turkowski et al., 2007; El-Shiekh, 2010) in order to cope with the presented disadvantages. Hybrid systems benefiting from the real-time detection capability of a software based method and the high localization accuracy of a hardware based technique, along with other specific advantages of both approaches, seem to be the future 10 trend in gas leak detection. Selecting from the wide variety of commercial solutions available is ultimately an action that has to be taken after assessing the needs of the system in which gas leak detection is needed.

**04. Arduino based gas leakage control and temperature monitoring system**

There are several gas leakage control systems in existence today and each address or focused on a particular way of providing solution to the common problem. In other to contribute to this long disturbing problem, a careful analysis was carried out to identify the little gray area in the previously proposed designs. The three

monitoring and one control device incorporated enable it to address the delay in response time by automatic quick air control before the intervention of a personal despite being alerted using SMS. This idea reduces heavily the reliance on the action of a personal and increase the window of opportunity to avert disaster. In many similar designs like ours; Despite being cost effective; the system is not design to reduce the concentration of the gas by using air control system and that is what our system successfully incorporated with good response time of the ventilator. This project is built on GSM based monitoring system that utilizes the effective semiconductor gas sensor (MQ-6), it has the capacity to sense various natural gases not only butane and propane using tin dioxide (SnO2). Mainly this device is design to alert with a sound, SMS, provide a display on a screen and finally control a ventilator. It requires no analog input, which makes the design cost effective, efficient and also environmentally friendly. In our work we focused on time of gas detection with respect to distance and the delay in response of the control system, at the end our design shows an acceptable efficiency. In our future work, we aim to calibrate the gas sensor for a specific gas to be sensed by training instead of the numerous gases it senses

GSM-Based gas alert system has gained interest as a result of the rapid development in the communications devises and the level at which developing countries utilizes it advantages. In a design by [5], a microcontroller based low cost gas leakage detector with SMS alert, PIC16F877 was used as the main brain of the system, MQ-5 to sense gasses and SMS will be sent but the control of the environment is implemented by third party as the system only alert by alarm using buzzer. similarly, GSM based gas leakage detection system [6] uses AT89C51 and MQ-6 for microcontroller and gas sensor, this provide better accuracy than [5] but also require an external intervention to pre-control the environment. Another approach with a different microcontroller uses STC89C51RC [7] and for detection, different devices were used separately where the temperature was sense using DS18B20, the concentration of carbon dioxide adopts b-530 and humidity sensor db171. Hence, makes the design a little bit complex and not cost effective. Among other GSM based gas monitoring system our design utilizes very effective gas sensor (MQ-6), basic temperature sensor DHT 22 and an UNO Arduino Board which makes it fast, cost effective and at the same time help control the environment by allowing air into the environment to reduce the concentration of the leaked gas.

**Classifying leak detection technologies**

For the purpose of this research work , first look at classifying the available leak detection techniques. Several criteria are considered for classification, some of which are: the amount of human intervention needed, the physical quantity measured and the technical nature of the methods. If the degree of intervention needed from a human by each detection method is chosen to classify these methods, we distinguish three categories:

• **Automated detection** - complete monitoring systems that, can report the detection of a gas leak without the need of a human operator, once they are installed (e.g. fiber optic or cable sensors).

• **Semi-automated detection** - solutions that need a certain amount of input or help in performing some tasks (e.g. statistical or digital signal processing methods)

• **Manual detection** - systems and devices that can only be directly operated by a person (e.g. thermal imagers or LIDAR devices).

Most detection techniques rely on the measurement of a certain physical quantity or the manifestation of a certain physical phenomenon. This can be used as a rule for classification as we have several common used physical parameters and phenomena: acoustics, flow rate, pressure, gas sampling, optics and sometimes a mix of these. An example is available in relation to the optical detection methods. Because of the great variety of these detection solutions, leak finding technologies are sometimes classified into optical and non-optical methods (Sivathanu, 2003; Batzias et al., 2011). Some authors see the technology as fitting into two great categories direct and indirect or inferential methods (Folga, 2007; Liu et al., 2008). The direct detection is made by patrolling along the pipelines using either visual inspection or handheld devices for measuring gas emanations. Thanks to the technological advancements it is now common to use helicopter- or airplane-mounted optical imaging devices especially for very long pipelines (Liu et al., 2008). Indirect or inferential methods detect leaks by measuring the change of certain pipe parameters such as flow rate and pressure.

**Methodology**

LPG gas sensor module is used to detect LPG Gas. When LPG gas leakage sensed, it will give a HIGH pulse on its DO pin and Arduino constantly reads its DO pin.When Arduino receives a HIGH pulse from the LPG Gas sensor module it displays the“LPG Gas Leakage Alert” message on 16x2 LCD and stimulates buzzer which beeps again until the gas detector module doesn't recognize the gas in the environment. When Arduino gets a LOW pulse from the LPG Gas detector module, then LCD will show the“No LPG Gas Leakage” alert message.Arduino manages the complete process of this system like reading LPG Gas sensor module output, sending a message to LCD and stimulating buzzer. We can set the sensitivity of this sensor module by inbuilt potentiometer located on it.

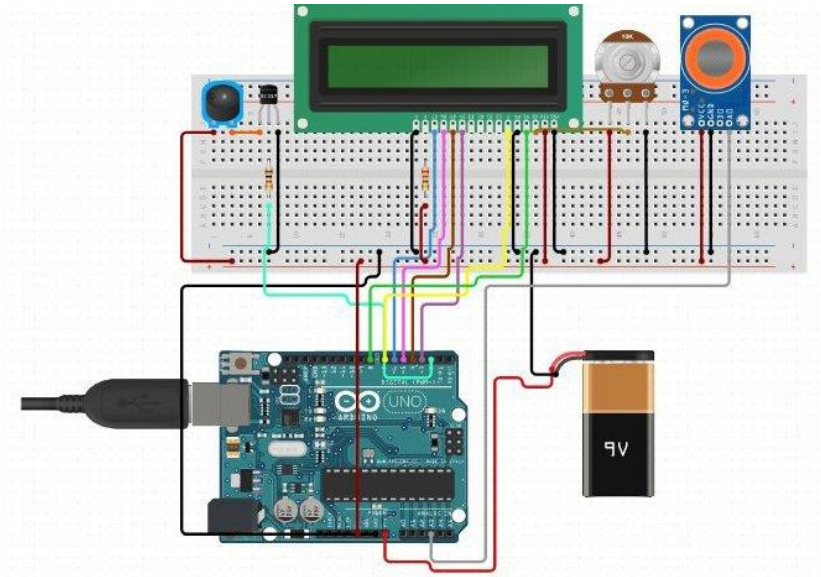


**Fig.1, Flow Diagram of Work**

**Parts of Model**

1. **MQ-6 Gas Sensor**

MQ6 is a semiconductor type gas sensor which detects the gas leakage. The sensitive material of MQ-6 is tin dioxide (SnO2). It has a very low conductivity in clean air. This Gas sensor not only has sensitivity to propane and butane but also to other natural gases, low sensitivity to cigarette smoke and alcohol. The MQ-6 gas sensor is shown in fig. 2. This sensor can also be used for detection of other combustible gas such as methane. The concentration range of MQ-6 gas sensor is 300- 1000 ppm. This sensor is available in 6 pins package, out of which 4pins are used for fetching the signals and other 2 pins are used for providing heating current. This sensor has fast response time.


**Fig.2, MQ-6 Gas Sensor**

2. **GSM Receiver**

GSM module is used to send an SMS to the user cell phone. When the gas leakage is detected by thegas sensor, microcontroller sends a signal to GSM module, in which one of the tasks is to send the text SMS. GSM module requires one SIM card. This module is capable to accept any network SIM card. This module has a unique identity number like mobile phones have. These module works on 12V DC supply. We can send SMS and also send a voice message. These SMS or voice messages are saved in the microcontroller memory. Multiple SMSs can also be sends to user, police and fire station etc.

3. **DHT 22 Temperature Sensor**

The DHT22 is a basic digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin, no analog input pins needed.

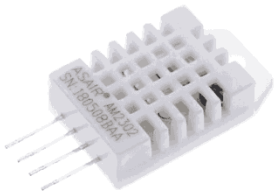

**Fig.3, DHT 22 Temperature Sensor**

### 4. DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. In this work it is used to drive the door of the prototype system open.

**Arduino Programme**

```
#include<LiquidCrystal.h>
Liquidcrystallcd(3,2,4,5,6,7)
#definelpg_sensor18
#sefine buzzer 13
Voidsetup()
{
pinMode(lpg_sensor, INPUT);
pinMode(buzzer, OUTPUT);
lcd.begin(16, 2);
lcd.print("LPG Gas Detector");
lcd.setCursor(0,1);
lcd.print("Circuit Digest");
delay(2000);
}
voidloop()
{
if(digitalRead(lpg_sensor))
  {
digitalWrite(buzzer, HIGH);
lcd.clear();
lcd.print("LPG Gas Leakage");
lcd.setCursor(0, 1);
lcd.print("     Alert     ");
delay(400);
```

```
digitalWrite(buzzer, LOW);
delay(500);
  }
else
  {
digitalWrite(buzzer, LOW);
lcd.clear();
lcd.print("  No LPG Gas ");
```

**Conclusion:**

With the help of this arrangement or set up researchers found that accidents due to gas leakage are minimum and safe maximum family from it. Arduino based systems are new in social sectors and it is very successful trend.

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