Gas Leakage Monitoring And Alerting System For Industries

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GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Gas leakage detection systems are an integral part of a safety system, providing the first line of defense against the possible disasters of gas leakage. It detects the gas leakage and triggers an alert system to activate safety precautions. Some leakages are too small to be smelled or are of an unscented gas, so it'sa necessary investment to install a gas leakage detection system. The use of gas in both industrial and residential environments is ever-increasing. Gas is mainly used for energy generation and as a process requirement in manufacturing industries. The aftermath of a gas leak can be devastating irrespective of the scale of leakage. The main objective of this research is automatic protection from the LPG (Liquefied Petroleum Gas) leakage or reduction of the hazards that can be caused due to unawareness of the user about the gas leakage and also providing an automatic gas booking facility by applying advance communication technology. If there is any gas leakage from storage tank, service station or from the automobile then a buzzer will turn ON and an alert message will be sent to a pre-set mobile number by using GSM (Global System for Mobile communication) technology. Sound from the alarm as well as message in the mobile number will give valuable suggestionto the users so that they can prevent themselves from dangerous effect of LPG gas leakage. Proposed model notifies alert to people before any leakage from the gas cylinder and also automatically books for refilling of gas from the gas booking Centre before the cylinder gets empty.

1.2 PURPOSE

The system will give a warning when the sensor detects fire and other components that may cause fire specifically gas leakage and smoke. The system is very helpful for homeowners in monitoring the surrounding in order to avoid disaster and maintain home safety. LPG consists of mixture of propane and butane which is highly flammable chemical. It is odorless gas due to which Ethanol is added as powerful odorant, so that leakage can be easily detected. LPG is one of the alternate fuels used now days. Sometimes Liquefied petroleum gas is also known as LPG, LP gas, Auto gas etc. This gas is commonly used for heating appliances, hot Water, cooking, and various

other purposes also. LPG is also used as an alternate fuel in vehicles due to soaring in the prices of Petrol and diesel. Some people have low sense of smell, may or may not respond on low concentration of gas leakage. In such A case, gas leakage security has systems become an essential and help to protect from gas leakage accidents. Anumber of Research papers have been published on gas leakage security system.

Embedded system forHazardous gas detection and Alerting has been proposed in literature. Where the alarm is activated immediately, if the gas concentration exceeds normal Level. Bhopal gas tragedy was an example of gas leakage accident in India. This was world's worst gas leakage industrial Accident. Gas leakage detection is not only important but stopping leakage is equally essential. This paper provides a cost Effective and highly accurate system, which not only detect gas leakage but also alert (Beep) and turn off main power and gas Supplies, and send an SMS. GSM moduleis used which alert the user by sending an SMS. In order to provide high accuracy Gas sensor MQ-6 has been used. Toxic and inflammable gases are widely used in industry, heating systems, home appliances and vehicles. This includes combustible gases like propane, ethane, butane, methane, ethylene etc. Liquefied Petroleum Gas (LPG), also referred to as propane or butane are normally stored in pressurized cylinders in liquid form and vaporize at normal Temperatures. A leakagecan ignite and cause explosion. Therefore, the leakage detection of gases has gained more interest in Recent years especially in fields of safety, industry, environment, and emission control. A conventional gas leakage system Uses on-site alarms as a warning to indicate the leakage.

The drawback of the conventional leakage system is that it becomes Ineffective in the absence of first response team on-site.Therefore, there is a need for a system to detect the leakage and send the information to the first response team through wireless media. A leakage detection system that initiates a warning call or SMS will be more effective in the absence of people on-site. Arduino UNO (Atmega-328) is The main unit of the system whichperforms the following tasks. A signal conditioning of the Arduino UNO is done by output signal of the sensor, provided input to Arduino. The detection results displayed on LCD Indicates the people of danger in work place, factory, home. Buzzer activity with beep(siren) sound is made. Also send alert SMSto the in charge of the plant whose number is saved in SIM card by using GSM modem. The SMS Received depends upon the leak of gas in the detection area of the sensor.

2 LITERATURE SURVEY

2.1 EXISTING PROBLEM

The gas detectors can be used for the detection of combustible, flammable and poisonous gases and forloss of oxygen, and also to detected a gas leak or other pollutants. It makes the area where the leak occurs an warning sound and instructs operators to leave the area. The system proposed is planned, built and sent an SMS warning system for detection of gas leakages. Infrared imaging sensors have recently been used for a number of applications in industrial plants and refineries.

2.2 REFERENCES

- Shrivastava, A., Prabhaker, R., Kumar, R., & Verma, R. GSM based gas leakage detection system. International Journal of Emerging Trends in Electrical and Electronics (IJETEE-ISSN: 2320-9569), 2013;3(2):42-45.
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- Deepak, N., Rajendra Prasad, C., & Sanjay Kumar, S. Patient health monitoring using IOT. International Journal of Innovative Technology and Exploring Engineering, 2018; 8(2):454–457.https://doi.org/10.4018/978-1-5225-8021-8.ch002
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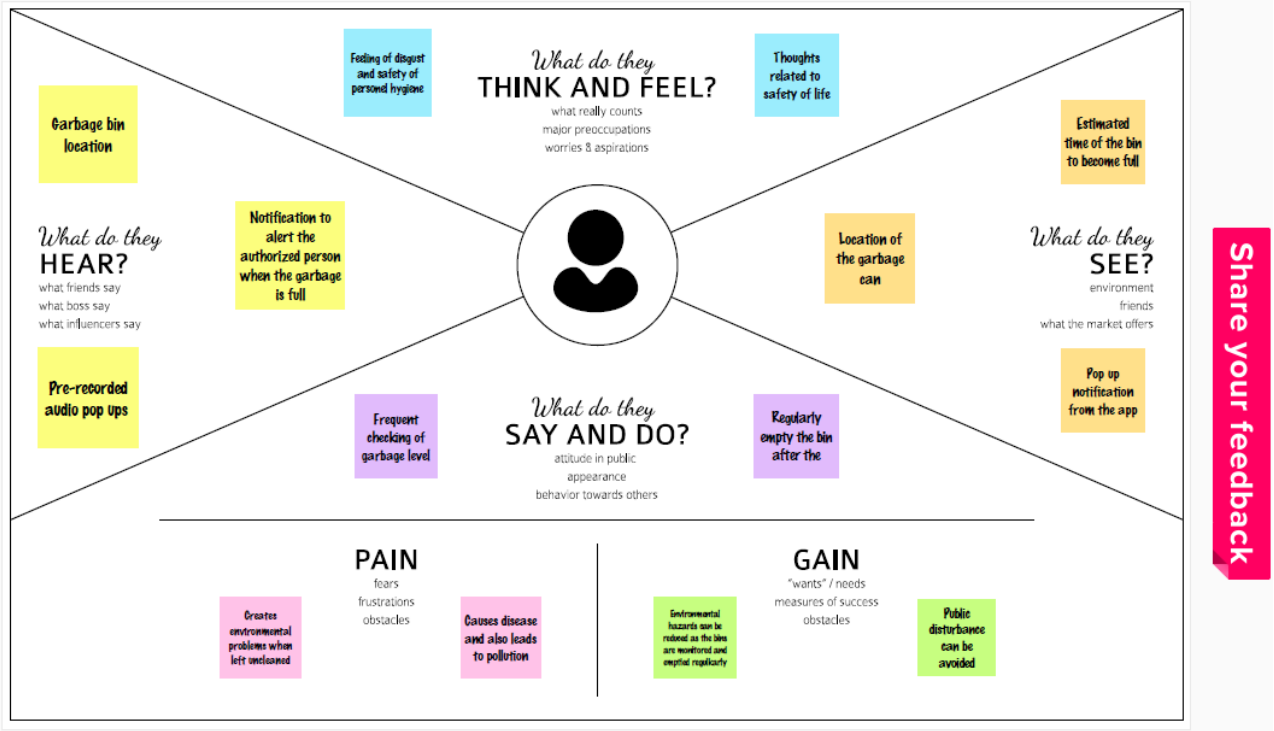
2.3 PROBLEM STATEMENT DEFINITION

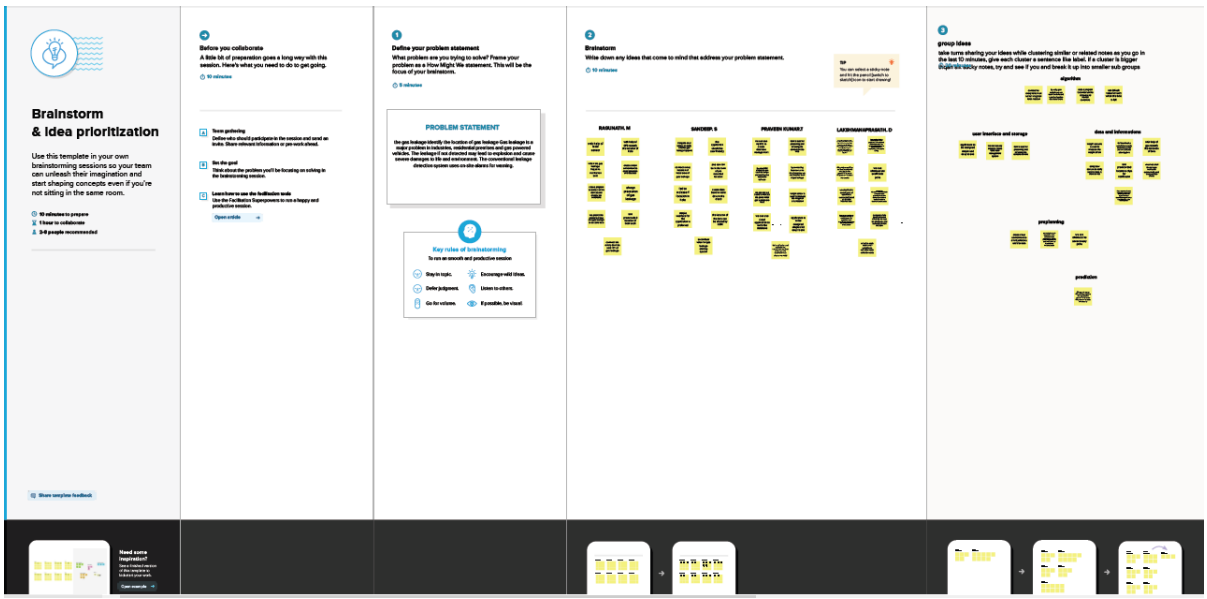
The LPG leakage detection and alert system presented in this section is a simple as Shown in Figure 1,yet reliable. It is battery operated and hence portable. It is designed In such a way that it can also be operated with ac power supply. To support the latter Case, it has a bridge rectifier with a capacitor filter. This is followed by a regulator Designed with IC7805 which provides +5V regulated power supply. To detect the LPG, MQ-6 gas sensor is employed. This sensor can be operated at+5V. The sensitivity of this sensor is very high and it has quick response time. It can Detect the LPG concentration in the range of 200-10000ppm. The gas sensing layer of This sensor is made of Tin Dioxide (SnO2) and gold (Au) electrodes. The output of the Gas sensor is given to LM358 dual operational amplifier where it is compared with the Threshold value for gas density which is set using preset potentiometers and amplified.If the sensed voltage is greater than the preset threshold voltage, the operational Amplifier output fires the driver circuit for LED and Buzzer. As a result, the LED will Glow and the buzzer starts to produce alarm sound.

3 IDEATION AND PROPOSED SYSTEM

3.1 EMPATHY MAP CANVAS



3.2 IDEATION AND BRAIN STORMING



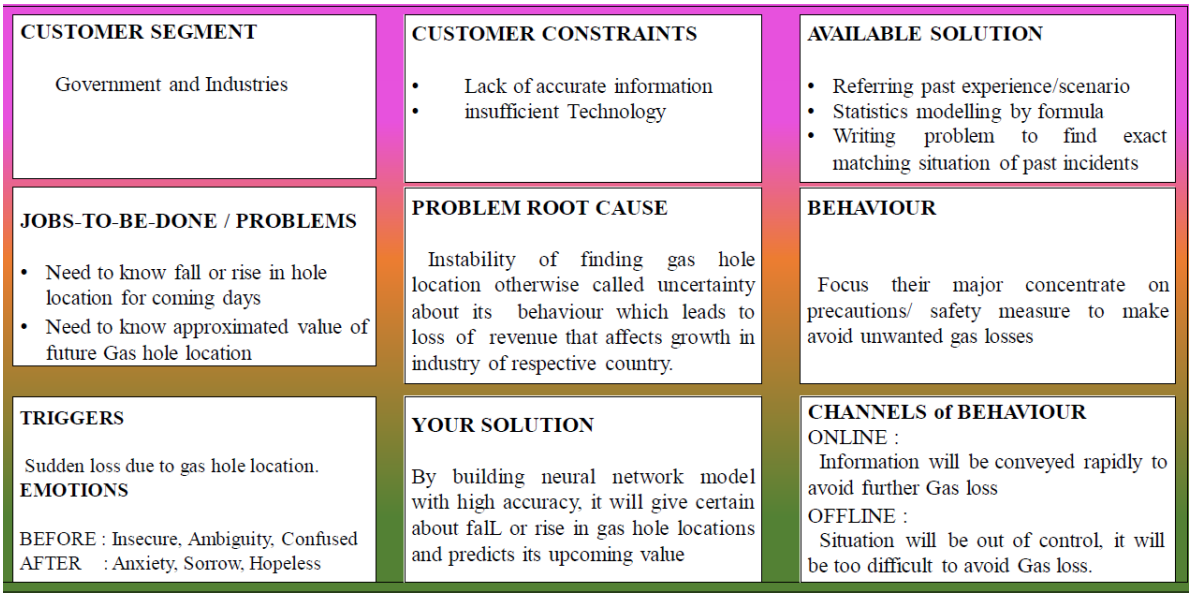
3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1	Problem Statement (Problem To Be Solved)	The Sensor Near A Hole Location Will Help Us To Identify And Alert The User Whether It Needs Any More Hole Occurs At That Moment Monitored Through Application. Thus Increasing Difficulties In Industry Leads To The Way Of Inventing Many New Technologies That Will Help The Members To Take Some Precautions To Avoid Losses In Gas
2	Idea / Solution Description	Gas Leakage Is Characterized By The Usage Of Technology In Order When It Comes To Managing Gas. This Makes It Possible To Plan More Efficient Routes For The Gas Collectors Who Empty The Pipeline, But Also Lowers The Chance Of Any Gas Being Full For Over A Week.
3	Novelty / Uniqueness	A Gas Monitoring Solution Not Only Detects Toxic Gases But Also Identifies Changes In Air Quality. It Can Also Be Used Commercially In In-House Buildings To Detect The

		Presence Of Carbon Dioxide And Other Combustible Gases.
4	Social Impact / Customer Satisfaction	The System Is Short Message Service (SMS) Based And Uses Wireless Technology For Providing Security Against Gas Leakage To Users Hence Cost Effective And More Adaptable. The System Comprises Of Sensors For Detecting Gas Leak Interfaced To Microcontroller That Will Give An Alert To User Whenever There Is A Gas Leakage, Display Warning Information By Using Liquid Crystal Display (LCD), Sending SMS To The User For Notification Wherever He/She Might Be And Turning Off Electric Power With The Help Of Magnetic Relay. This Will Enable The User To Take Precaution Of Explosion Disaster Which May Result On Liquefied Petroleum Gas (LPG) Cookers Like Loss Of Properties, Injury Or Even Death. GLDS Provides Ideal Solution To Gas
5	Business Model (Revenue Model)	Leakage Of Gas Is A Major Issue In The Industrial Sector, Residential Buildings, And Gas-Powered Vehicles, One Of The Preventive Methods To Stop Accidents Associated With Gas Leakage Is To

		Install Gas Leakage Detection Devices. The Focus Of This Work Is To Propose A Device That Can Detect Gas Leakage And Alert The Owners To Avert Problems Due To Gas Leakages. The System Is Based On A Microcontroller That Employs A Gas Sensor As Well As A GSM Module, An LCD Display, And A Buzzer. The System Was Designed For Gas Leakage Monitoring And Alerts With SMS Via An Arduino Microcontroller With A Buzzer And An MQ2 Gas Sensor.

3.3 PROBLEM SOLUTION FIT



4 REQUIREMENTS ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Call Emergency Helpline or call the Fire Department You should make sure no one is operating equipment or machinery around the pipelineExtinguish all smoking materials (lighters, matches) Make sure there are no vehicles parked around the area. If there are any vehicles, please contact theowners and let them know Do not roam around in the area. Please leave from that area

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Online Payment for the service
FR-2	User Access	Access the details using web browser Access the details using mobile application
FR-3	User alert	Gets alert as an SMS message Gets alert alarm in the working area.

4.2 NON FUNCTIONAL RREQUIREMENT

Turn on any equipment, machinery in that area Use your vehicles in the area or park around the areaOperate an automobile near the release Ignore the smell or unauthorized digging anywhere Close any valves without direction Attempt to operate any pipeline-related equipment.

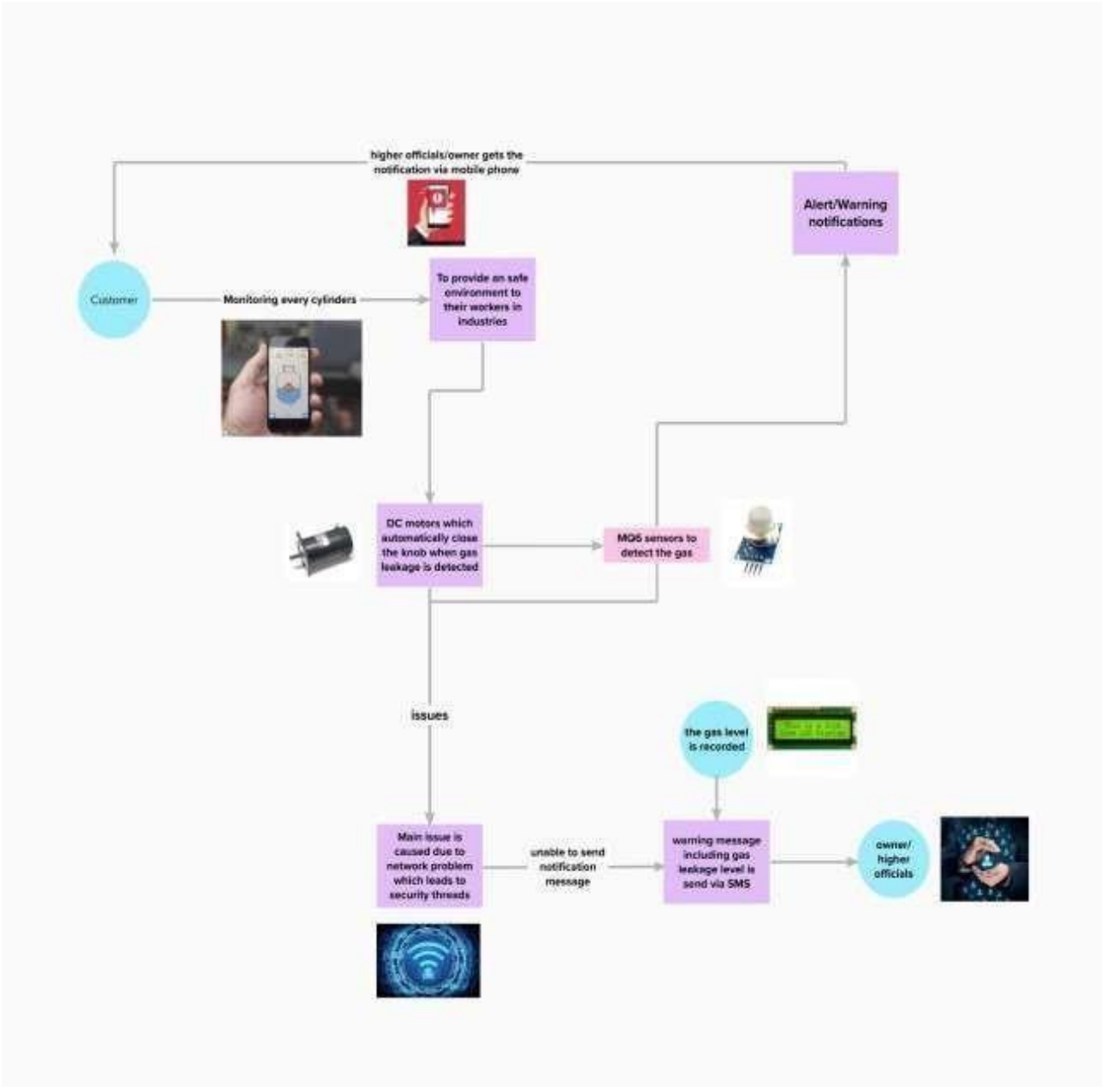
Non-Functional Requirements:

Following are the non-functional requirements of the proposed solution.

NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	The device must be usable by the customer anywhere
NFR-2	Security	Data from the sensors are stored securely and away from other data
NFR-3	Reliability	Data can be retrieved anytime and no data is discarded without customer knowledge
NFR-4	Performance	No performance delay in case of large number of data or more parameters
NFR-5	Availability	The device doesn't fail even under harsh conditions. Device continues to send parameters, even after an alert situation.
NFR-6	Scalability	Device must be capable of measuring conditions even in a larger industry

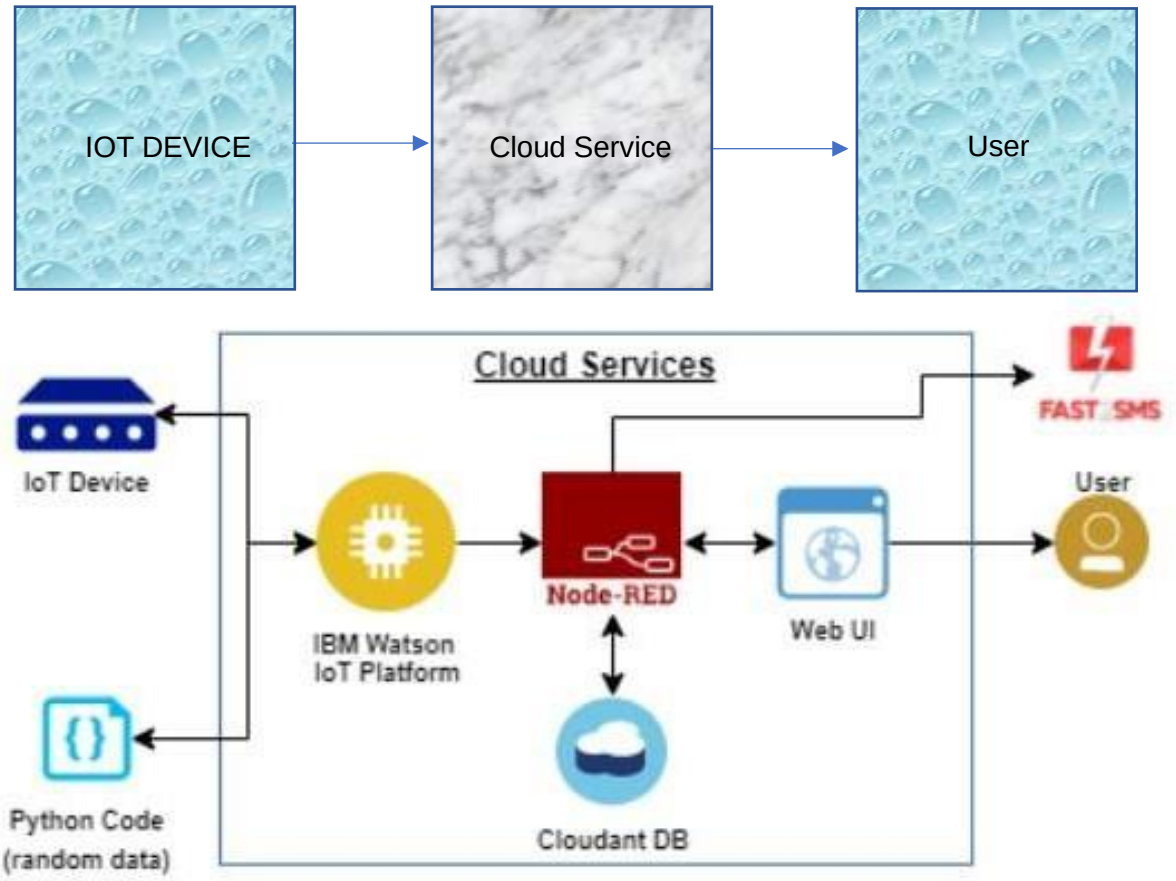
5 PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

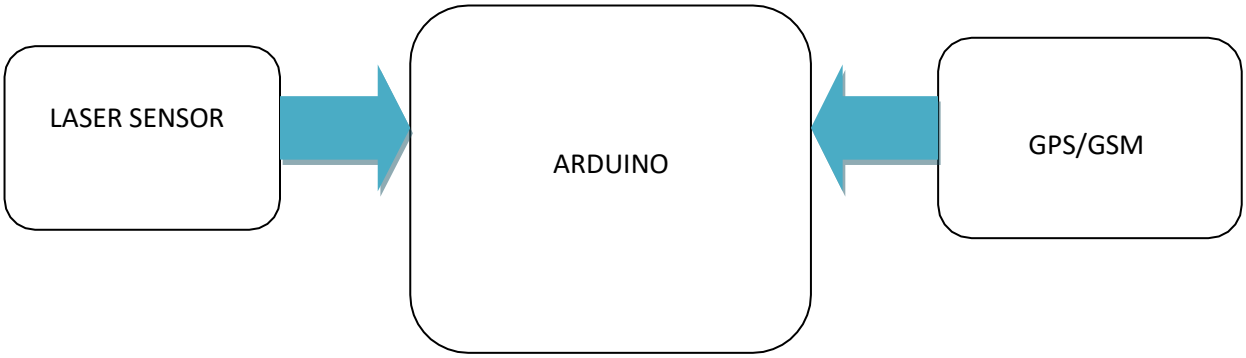


5.2 SOLUTION AND TECHNICAL ARCHITECTURE

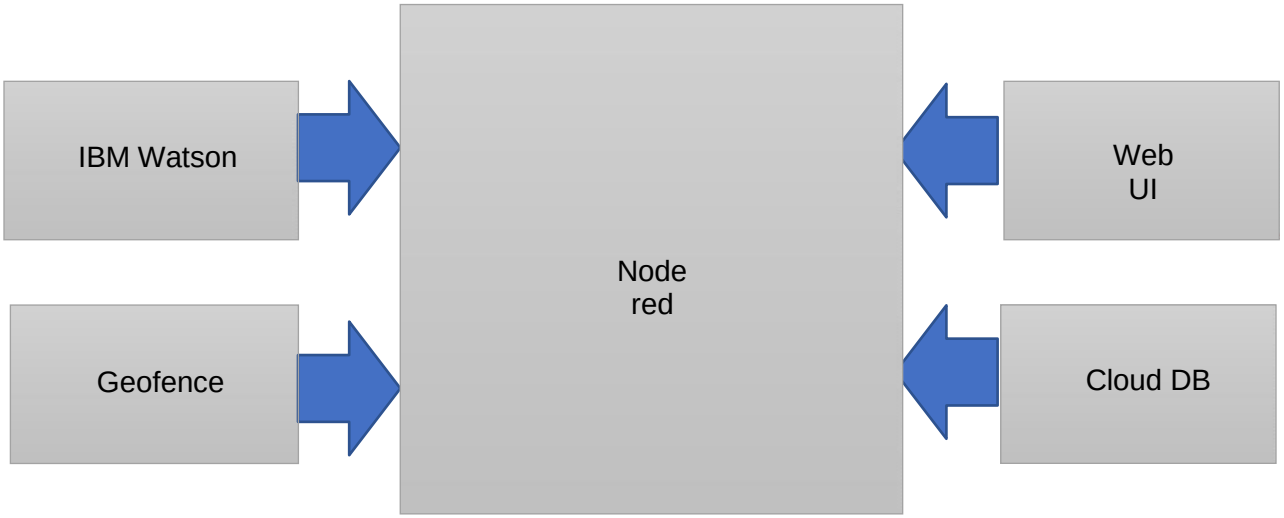
BLOCK DIAGRAM



IOT DEVICE



CLOUD SERVICE



5.3 **USER STORIES**

Gas leakages results a serious problem in household and other areas where household gasis used, therefore the proposed gas leakage detection and monitoring system is developed.There are many methods available for booking a Gas Refill, methods include online booking, telephonic booking etc. It will be difficult situation for the one who uses LPG gas for cooking regularly. The aim of this paper is to present a new system automatically books a cylinder when the gas is about to empty is by sending a notification to the gas agency using wifi using Internet of Things approach. In addition to that sensor is used to detect gasleakage at home. If the gas leakage is sensed automatically it will send SMS to the user. wifi is one of the most used networks across the world. Hence, load cell has been used to monitor the weight of the LPG gas regularly. The values are next fed to the microcontroller. If the gas in the cylinder indicates a value where the remaining percentage level is crossed below the threshold level set for gas to be indicated as getting emptied, then a notification will be delivered to gas enterprise automatically to book the new cylinder. Subsequently, reply notification will be sent to the customer about the booking status. At the same time, application software is developed in the gas enterprise to inform and record the booking.

This, work this helps the society to specifically indicate gas leakage and also helps bothcustomers and the agency to get the gas booking made automatically using the IOT technique.

6 PROJECT DELIVERY AND SCHEDULING

6.1 SPRINT DELIVERY AND ESTIMATION

6.1 SPRINT 1

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
#Provide your IBM Watson Device Credentials
organization = "lcft5g"
deviceType = "Final"
deviceId = "Hello"
authMethod = "token"
authToken = "8300113450"
# Initialize GPIO
try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method":
authMethod, "auth-token": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
#.....................................
except Exception as e:
print("Caught exception connecting device: %s" % str(e))
sys.exit()# Connect and send a datapoint "hello" with value "world" into the cloud as an event of
type "greeting"
10 times
deviceCli.connect()
while True:
#Get Sensor Data from DHT11
temp=random.randint(0,100)
Humid=random.randint(0,100)
```

```
Gas=random.randint(0,100)
data = { 'temp' : temp, 'Humid': Humid, 'Gas':Gas }
#print data
def myOnPublishCallback():
print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "Gas
Concentration = %s"%Gas "to IBM Watson")
success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
if not success:
print("Not connected to IoTF")
time.sleep(10)
deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

SPRINT 2

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(5,6,8,9,10,11);
int redled = 2;
int greenled = 3;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 400;
void setup()
{
pinMode(redled, OUTPUT);
pinMode(greenled,OUTPUT);
pinMode(buzzer,OUTPUT);
pinMode(sensor,INPUT);
Serial.begin(9600);
lcd.begin(16,2);
}
```

```
void loop()
{
int analogValue = analogRead(sensor);
Serial.print(analogValue);
if(analogValue>sensorThresh)
{
digitalWrite(redled,HIGH);digitalWrite(greenled,LOW);
tone(buzzer,1000,10000);
lcd.clear();
lcd.setCursor(0,1);
lcd.print("ALERT");
delay(1000);
lcd.clear();
lcd.setCursor(0,1);
lcd.print("EVACUATE");
delay(1000);
}
else
{
digitalWrite(greenled,HIGH);
digitalWrite(redled,LOW);
noTone(buzzer);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("SAFE");
delay(1000);
lcd.clear();
lcd.setCursor(0,1);
lcd.print("ALL CLEAR");
delay(1000);
}
}
```

SPRINT 3

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(5,6,8,9,10,11);
int redled = 2;
int greenled = 3;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 400;
void setup()
{
pinMode(redled, OUTPUT);
pinMode(greenled,OUTPUT);
pinMode(buzzer,OUTPUT);
pinMode(sensor,INPUT);
Serial.begin(9600);
lcd.begin(16,2);
}
void loop()
{
int analogValue = analogRead(sensor);
Serial.print(analogValue);
if(analogValue>sensorThresh)
{
digitalWrite(redled,HIGH);digitalWrite(greenled,LOW);
tone(buzzer,1000,10000);
lcd.clear();
lcd.setCursor(0,1);
lcd.print("ALERT");
delay(1000);
lcd.clear();
lcd.setCursor(0,1);
```

```
lcd.print("EVACUATE");
delay(1000);
}
else
{
digitalWrite(greenled,HIGH);
digitalWrite(redled,LOW);
noTone(buzzer);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("SAFE");
delay(1000);
lcd.clear();
lcd.setCursor(0,1);
lcd.print("ALL CLEAR");
delay(1000);
}
}
```

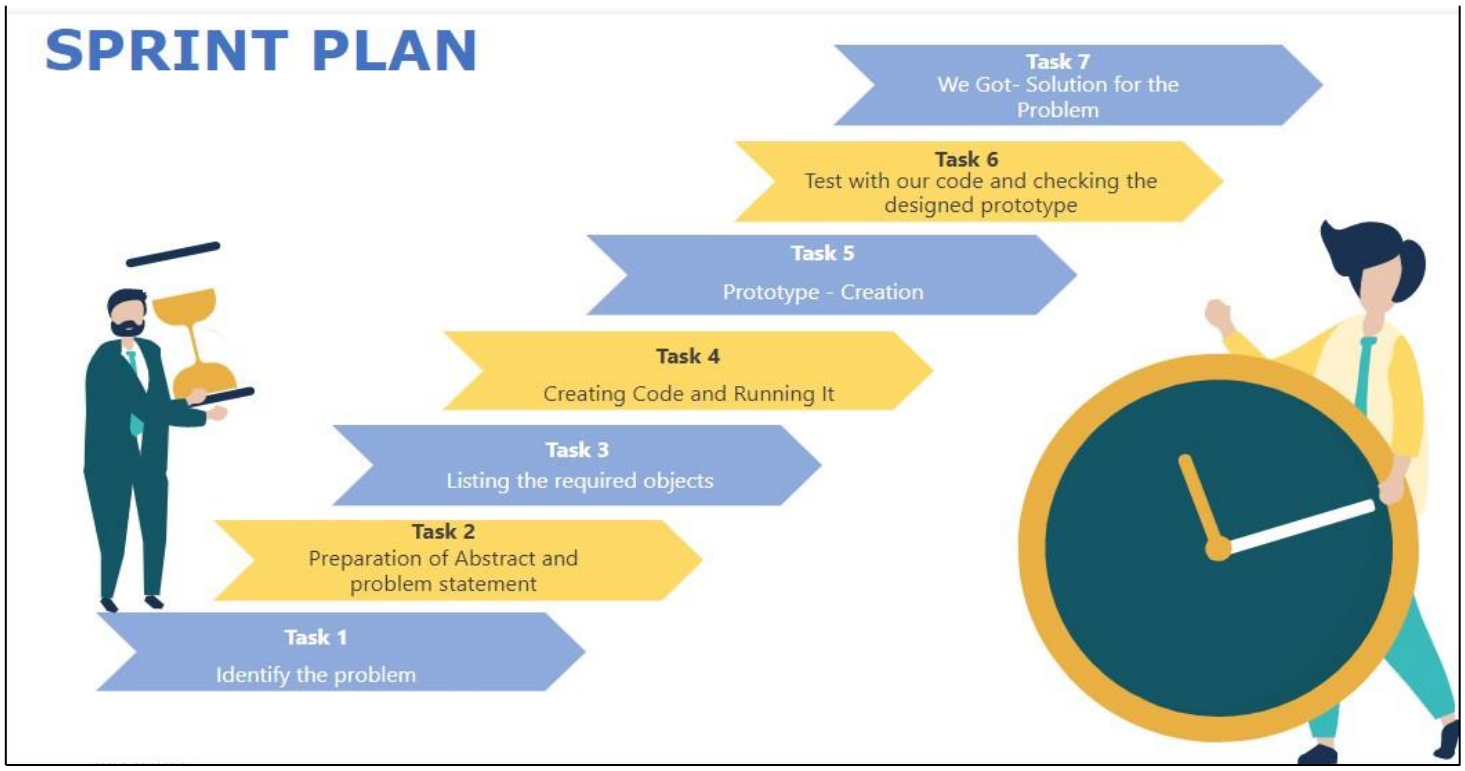
SPRINT 4

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(5,6,8,9,10,11);
int redled = 2;
int greenled = 3;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 400;
void setup()
{
pinMode(redled, OUTPUT);
pinMode(greenled,OUTPUT);
pinMode(buzzer,OUTPUT);
```

```
pinMode(sensor,INPUT);
Serial.begin(9600);
lcd.begin(16,2);
}
void loop()
{
int analogValue = analogRead(sensor);
Serial.print(analogValue);
if(analogValue>sensorThresh)
{
digitalWrite(redled,HIGH);
digitalWrite(greenled,LOW);
tone(buzzer,1000,10000); lcd.clear();
lcd.setCursor(0,1);
lcd.print("ALERT");
delay(1000);
lcd.clear();
lcd.setCursor(0,1);
lcd.print("EVACUATE");
delay(1000);
}
else
{
digitalWrite(greenled,HIGH);
digitalWrite(redled,LOW);
noTone(buzzer);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("SAFE");
delay(1000);
lcd.clear();
lcd.setCursor(0,1);
```

```
lcd.print("ALL CLEAR");
delay(1000);
}
}
```

6.2 SPRINT DELIVERY SCHEDULE



6.3 REPORT FROM JIRA

In this prototype, gas leakage detection has been given a highest priority. MQ6 placed in the vicinity of the gas cylinder. In the advent of leakage, the resistance of the sensor decreases increasing its conductivity. Corresponding pulse is fed to microcontroller and simultaneously switches on the buzzer and exhaust fan which we can reset by a manual reset switch. Also a logic high pulse (+5 V) is given as an Interrupt to INT0 pin of ATMega16 Microcontroller.

Microcontroller sends a message “EMERGENCY ALERT: LPG gas leakage found in your home” to Required cell numbers via GSM module and the same will be displayed on LCD.

7 CODING AND SOLUTION

7.1 FEATURE 1

If the gas sensor detects a gas leak, it will sound an alarm by means of a buzzer and will send SMS messages to the registered mobile numbers with the help of the GSM module. Aliquid crystal display is used in the study to display the presence or absence of gas leakage.

7.2 FEATURE 2

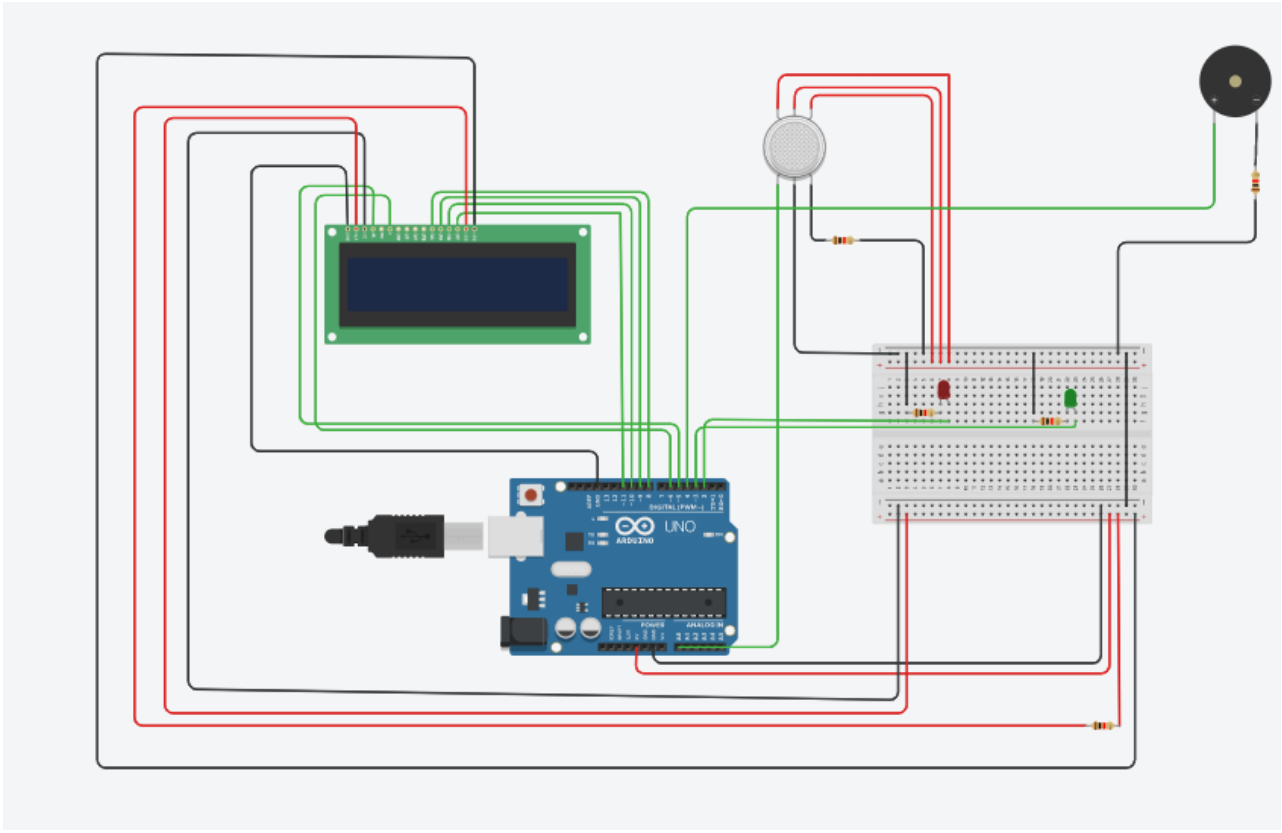
If it detects a gas leak, the red LED will light up, the buzzer will activate, then the system willsend a notification message stating that there has been an LPG gas leak. If no LPG gas leak is detected, the system will continue to detect the gas level through the LPG gas sensor until it detects an LPG gas leak.

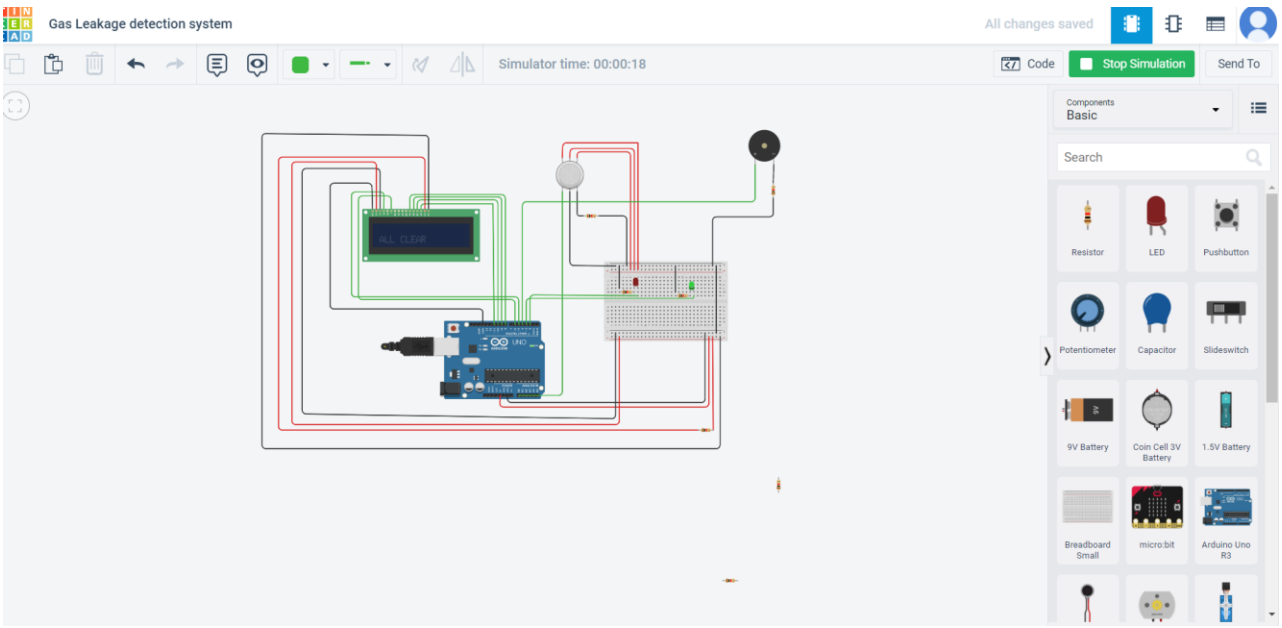
7.3 DATA BASE SCHEMA

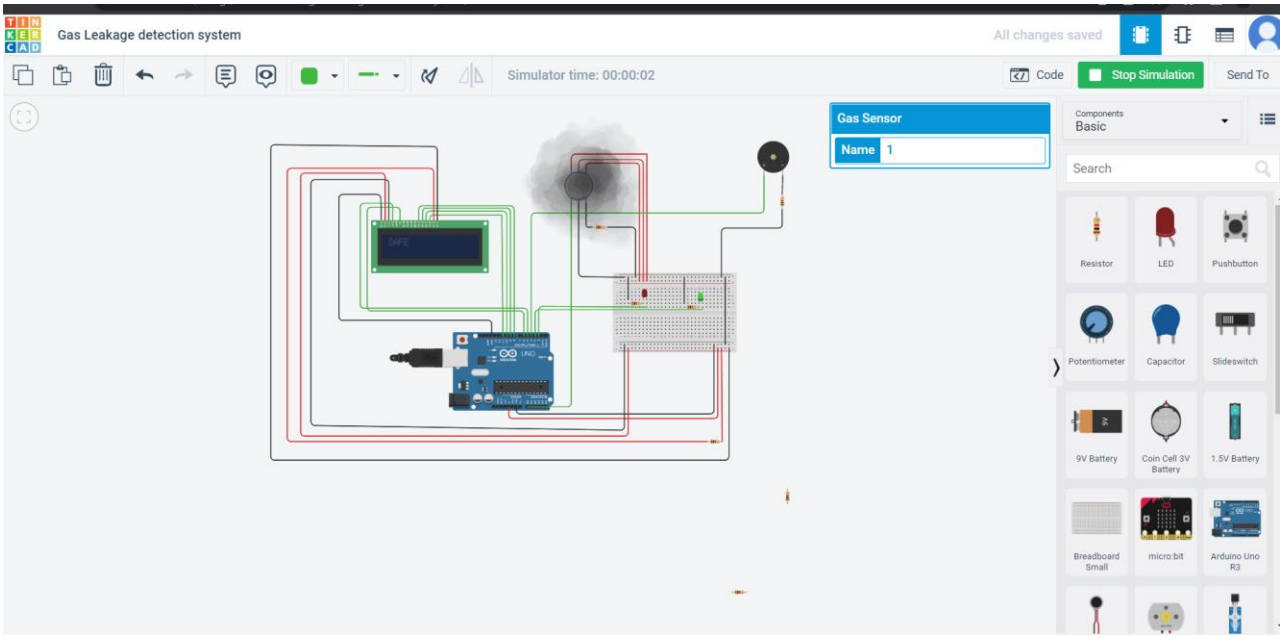
To design a gas detection system that will automatically detect gas leakage and send an alert. This device is expected to be used in household security where heaters and gadgets that make use of natural gas and LPG may be a cause of danger. This gas detector system can likewise be used for other functions in factories or plants that depend on LPG or naturalgas for their operation. The gas leakage detector system will send a notification message tothe registered mobile phones. An Arduino microcontroller is used as the brain of the system.The gas detector system is controlled and monitored through the web application ADAFRUIT. Once a leak is detected, the power supply is automatically cut off, and the buzzer is turned on. Using this web application, the system can be further controlled by the user, for example by switching on the fan or water pump [4]. This smart gas detection system is proposed for use in various hospitals. If there is a sudden leakage of gas, the gassensor used in the design will send a signal to the Arduino. The Arduino will process the signal and then send a notification to other external gadgets involved in the design, such as the liquid crystal display, the magnetic buzzer, and the GSM module which stores the phonenumbers of the individuals who are responsible for fighting fires in the hospital; the alarm will be sent repetitively until an acquiescent reply message is received. The gadget was designed to be mounted either on the ceiling or wall. Once the system is mounted in a suitable place with a supply of electrical energy, it will be ready to automatically send a notification using short message service (SMS) or by calling the owners if there is a gas leakage. The detection system comprises an Arduino microcontroller, a MQ-5 gas sensor.

8 TESTING

8.1 TEST CASES







8.2 GAS CONCENTRATION

(ppm) LCD Screen Status Buzzer SMS notification

58 – Not buzzing Not received

117 – Not buzzing Not received

256 “GAS BOCOR” Buzzing Received

291 “GAS BOCOR” Buzzing Received

243 – Not buzzing Not received

8.3 USER ACCEPTANCE TESTING

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 , a microcontroller based low cost gas leakage detector withSMS 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 thesystem only alert by alarm using buzzer. Similarly, GSM based gas leakage detection system uses AT89C51 and MQ-6 for microcontroller and gas sensor, this providebetter accuracy than but also require an external intervention to pre-control the environment. Another approach with a different microcontroller uses STC89C51RC 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 Boardwhich 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.

9 RESULT

The system prototype is constructed and when a small amount of LPG is brought near the system, the System sensor detects the leakage and sends the SMS toHousemates and activates the alarm and switches on the exhaust fan. Also system prototype continuously Monitors the LPG level of the cylinder and books the Cylinder automatically.

9.1 PEFORMANCE METRICES

The Leakage Detection Unit consists of the Arduino Nano microcontroller, gas sensor module, and interfaced with control circuits system. This will enable a process to be shutdown automatically. The gas sensor detects the concentration (in ppm) of leaked gasin the surrounding area, this output value is converted to a digital signal through the inbuilt analog to the Arduino Nano microcontroller's digital convertor. The MQ-5 device gas module controls the reading the LPG Gas device module, output, sending message to the LCD and activating of the buzzer. While the function of the circuit once it is in 'ON' position,it initiates the microcontroller and the show of LCD digital display alphanumeric display, andalso begins the reading of the analog voltage rom the MQ-5 device. Has four pins.

10 ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

The sensor has good sensitivity combined with a quick response time at low cost. If leakage is detected, message to the authorized person or family member using cellular network called GSM is sent automatically. It also provides a feature to measure weight of LPG cylinder with its value on LCD display.

10.2 DISADVANTAGES

Poor stability and greater environmental impact; in particular, the selectivity of each sensor is not and the output parameters cannot be determined. Therefore, it should not be used inplaces where accurate measurement is required.

11 CONCLUSION

- The integration of fire detection and alarm systems with other building systems should increase fire safety in the building.
- The fire detection system will be able to communicate with other building systems, correctly discriminate between fire and Non-fire threats, identify the exact location of a fire in the building and provide continuous estimates on smoke and fire.

12 **FUTURE SCOPE**

IoT turns drone into gas detection sensor. Another major future scope could be including a Automatic Shut-off device which will turn off the gas supply whenever it will detect any gas leakage. This system can be implemented in Industries, Hotels and wherever the LPG cylinders are used.

```
Serial.begin(9600);
lcd.begin(16,2);
pinMode(gasValue, INPUT);
lcd.print (" Gas Leakage ");
lcd.setCursor(0,1);
lcd.print (" Detector Alarm ");
delay(3000);
lcd.clear();
}
void loop()
{
data = analogRead(gasValue);
Serial.print("Gas Level: ");
Serial.println(data);
lcd.print ("Gas Scan is ON");
lcd.setCursor(0,1);
lcd.print("Gas Level: ");
lcd.print(data);
delay(1000);
if ( data > 500)
{
SendMessage();
Serial.print("Gas detect alarm");
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Gas Level Exceed");
```

```
lcd.setCursor(0,1);
lcd.print("SMS Sent");
delay(1000);
}
else
{
Serial.print("Gas Level Low");
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Gas Level Normal");
delay(1000);
  }
lcd.clear();
  }
void SendMessage()
{
Serial.println("I am in send");
mySerial.println("AT+CMGF=1");
delay(1000);
mySerial.println("AT+CMGS=\"+91900xxxxxxx\"\r");
delay(1000);
mySerial.println("Excess Gas Detected. Open Windows");
delay(100);
mySerial.println((char)26);
delay(1000);
```

GitHub and project demo link : https://github.com/IBM-EPBL/IBM-Project-7304-1658852290