

FINAL REPORT

Date	19 TH NOVEMBER 2022
Team ID	PNT2022TMID02371
Project Name	Project - Gas Leakage monitoring & Alerting system Industries

1. INTRODUCTION

1.1 Project Overview

Presently, the home safety detection system is playing an important role in the security of people. Since all the people from the home go to work on daily bases, it makes impossible to check on the appliances available at home especially gas cylinders, wired circuits, etc. since the last three years, there is a tremendous hike in the demand for liquefied petroleum gas (LPG) and natural gas. To meet this access amount of energy demand and replace oil or coal due to their environmental disadvantage, LPG and natural gas are preferred. These gases are mostly used on large scale in industry, heating, home appliances, and motor fuel. So Track this leakage gas, the system includes an MQ6 gas sensor. This sensor senses the amount of leak gas present in the surrounding atmosphere. Through this, explosions or getting affected by the leakage of gas could be avoided.

Purpose:

Leakage of any kind of gas has been a concern in recent years, whether it is in a residential setting, a business, a cafe, or a canteen. In this paper development of an IoT-based gas wastage monitoring, leakage detecting, and alerting system is proposed. This paper elaborates design of such an intelligent system that will help save gas and smartly prevent accidents. The system needs to be integrated with the cooker. The technology includes ultrasonic sensors that determine if the cooker is being utilized for cooking purposes or not. If it is discovered that the cooker is not in use, the system uses an automatic switching-off mechanism to cut off the gas supply. The moment gas leakage will probably be recognized, users will be informed via SMS through GSM, and so that user can solve the issue as soon as possible. The system will monitor flame and fire through the flame sensor. When a fire is detected, the buzzer begins to sound. Aside from that, the system also has a cloud storage capability. The usage of gas for each user each day may be tracked with the aid of this cloud storage solution. At the end of the day, this procedure will assist in detector-user natural gas usage. The system has been tested and it can monitor gas wastage, and leakage and sannd a SMS to the user. The resulting performance indicated its effectiveness toward saving a significant portion of the wasted gas in domestic.

2. LITERATURE SURVEY:

2.1 Existing Problem:

Materials tend to lose their properties with the environmental effects and aging, thereby causing degradation in the sensor response, which is known as the drift error. Most of the studies did not consider the aging effect (long-term stability) which is essential for sensor implementation in a real-world application.

2.2 References:

- i. Mahalingam, A., R. T. Naayagi, and N. E. Mastorakis. "Design and implementation of an economic gas leakage detector." *Recent Researches in Applications of Electrical and Computer Engineering*, pp. 20-24, 2012.
- ii. Attia, Hussain A., and Halah Y. Ali. "Electronic Design of Liquefied Petroleum Gas Leakage Monitoring, Alarm, and Protection System Based on Discrete Components." *International Journal of Applied Engineering Research*, vol. 11, no. 19, pp. 9721-9726, 2016.
- iii. Apeh, S. T., K. B. Erameh, and U. Iruansi. "Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shut off System." *Journal of Emerging Trends in Engineering and Applied Sciences*, vol. 5, no. 3, pp. 222-228, 2014.
- iv. T.Soundarya, J.V. Anchitaalagammai, G. Deepa Priya, S.S. Karthick kumar, "C-Leakage: Cylinder LPG Gas Leakage Detection for Home Safety," *IOSR Journal of Electronics and Communication Engineering*, vol. 9, no. 1, Ver. VI, pp. 53-58, Feb. 2014.
- v. Ashish Shrivastava, Ratnesh Prabhaker, Rajeev Kumar, Rahul Verma, "GSM based gas leakage detection system." *International Journal of Emerging Trends in Electrical and Electronics*, vol. 3, no. 2, pp. 42-45, 2013.

2.3 Problem Statement:

Workers who are engaged with a busy industry packed with gas either harmful or harmless needs a way to monitor their gas pipelines continuously and detect early if there is any leakage of gas in their surroundings so that they can work efficiently on major crises rather than worrying about monitoring or leakage of gas, this will indeed reduce the manpower of that industry and create a peaceful environment.

3. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP:



3.2 IDEATION AND BRAINSTORMING

Gas Leakage Monitoring and Alerting System

DIVYA V



1

Compact design +

2

Using safety standars +

3

Reduced cost +

4

Making use of IoT to make living better +

5

Easy instructions to use +

6

Checking for reliability +

BRAIN STORM



DHARANISHRI

1

Publishing the condition of the product +

2

Quick way to alert +

3

Fire hazard prevention +

4

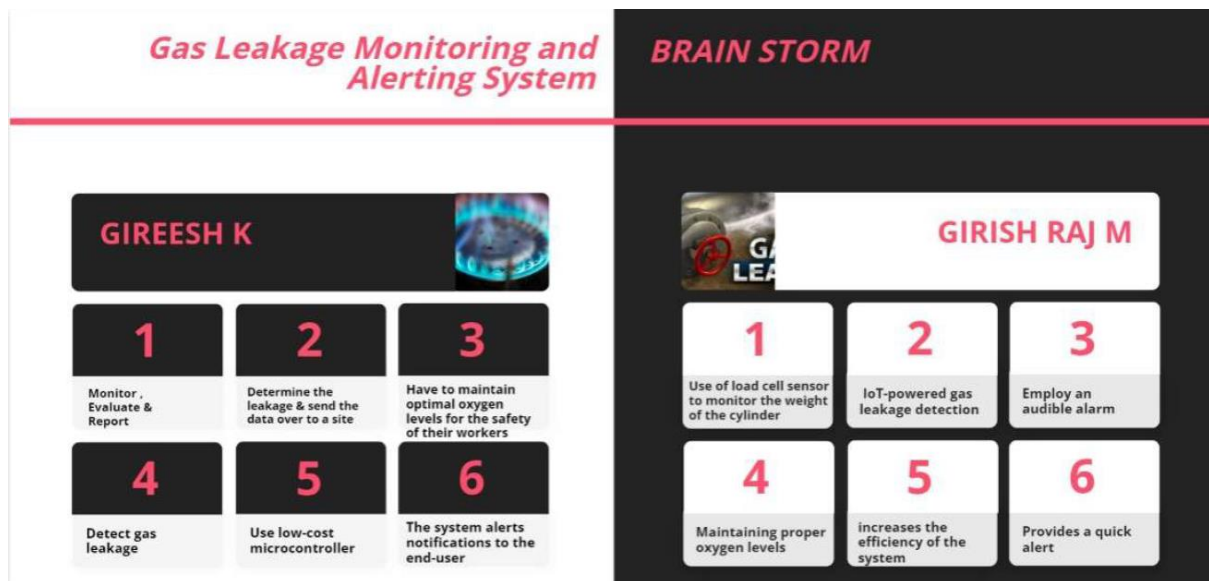
Oxygen level measurement +

5

Harmful gas detection +

6

Prompt gas leak alerts +



3.3 PROPOSED SOLUTION:

SNO	PARAMETERS	DESCRIPTION
1.	Idea/solution	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs a way to monitor the gas pipelines continuously and detect early if there is a leakage of gas in their surroundings so that they can work efficiently on major crises rather than worrying about monitoring or leakage of gas, this will indeed reduce the manpower of that industry and create a peaceful environment.
2.	Novelty/Uniqueness	Even though there are many existing solutions for this problem they failed to satisfy the needs of customer. Some of the solutions are only detecting some particular gas where some others failed to alert the main department and other solutions are with some delays. Our solution not only notify the industry person but also notify the fire fighters that can take control over the situation and our solution will alert the workers even there is a small leak of gases.
3.	Social Impact/ Customer Satisfaction	Our solution will be very helpful for the workers and the society which is associated or located nearby the industries. Our solution will prevent great disasters like Bhopal Gas Tragedy so that so many lives can be saved. Through this project the workers mental pressure will be reduced so that they can concentrate on other works or by relaxing them.
4.	Business model	The main target of our solution is Industries so we have planned to visit industries and explain them about the benefits of our products. So that they can aware of the importance of this solution and use it.
5.	Scalability of solution	Our solution can be integrated for further future use because the solution we have provided will be lay on the basic initial stage of any upgraded version.

3.4 PROPOSED SOLUTION FIT:

Project Design Phase-I - Solution Fit					
Project Title: Gas Leakage monitoring & Alerting system for Industries			Team ID: PNT2022TMID02371		
Define CS, fit into CC	1. CUSTOMER SEGMENT(S) <small>Who is your customer?</small> <p>Majority of Industry workers, those who are engaged with gas related productions.</p>	6. CUSTOMER <small>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connections, available devices.</small> <ul style="list-style-type: none"> ✓ It measures toxic gases in very low concentrations. ✓ It has ability to detect wide range of gases. ✓ It is difficult to know failure 	5. AVAILABLE SOLUTIONS <small>Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital monitoring</small> <p>Testbenches, Quick connectors (They enable a fast and tight "Connection" also on non-round and cast surfaces), Leak tester are some of the available solutions.</p>	Explore AS, differentiate	
	2. JOBS-TO-BE-DONE / PROBLEMS <small>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.</small> <p>Flammable gas leakage might lead to secondary accidents such as fire and explosion, while toxic gas dispersion mainly leads to poisoning casualties lead to death.</p>	9. PROBLEM ROOT CAUSE <small>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.</small> <p>Behind this gas leakage problem there could be many reasons like atomic reactions between gas molecules, material's quality...etc. Even though customers have to do this job then only we can get our end products or needful chemical solutions.</p>	7. BEHAVIOUR <small>What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer; calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)</small> <p>Have a check of where it has the sense of Harmful gases such as H2S, Methane, and CO.</p> <p>Will also check for temperature sensor that helps to detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts.</p>		
	3. TRIGGERS <small>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</small> <p>Constitution should bring gas leakage indicating system as a mandatory precaution in every factory and industries like fire extinguisher.</p>	10. YOUR SOLUTION <small>If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</small> <p>We are planning to fit in a sensor nearby the gas plants, which will detect if there is any leak of gas. When there is a leak, then message will be sent to admin department and also alarm will be set on so that the workers can know about the leak and could run to a safe place.</p>	8. CHANNELS of BEHAVIOUR <small>What kind of actions do customers take online? Extract online channels from #7</small> <p>ONLINE</p> <ul style="list-style-type: none"> ✓ In online, user can monitor each sensor and its rates, sensor like temperature, gas, humidity, oxygen level. ✓ Also have the statistical report. ✓ Precautions can be altered and users take care of the <p>OFFLINE</p> <small>What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.</small> <ul style="list-style-type: none"> ✓ The have to manually check the leakage of gases when the statistics changes. ✓ Handling the critical situation should be taken care of the safety officers. 		
Identify strong TR & EM	4. EMOTIONS: BEFORE / AFTER <small>How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure > confident, in control - use it in your communication strategy & design.</small> <p>While facing the problem people may get fatigue, dizziness, severe headache, loss of concentration, loss of consciousness. Afterwards people feel insecurity because of the health issues it's hard for them to lead a normal life.</p>			Extract online & offline CH of BE	

4. REQUIREMENT ANALYSIS:

4.1 FUNCTIONAL REQUIREMENT:

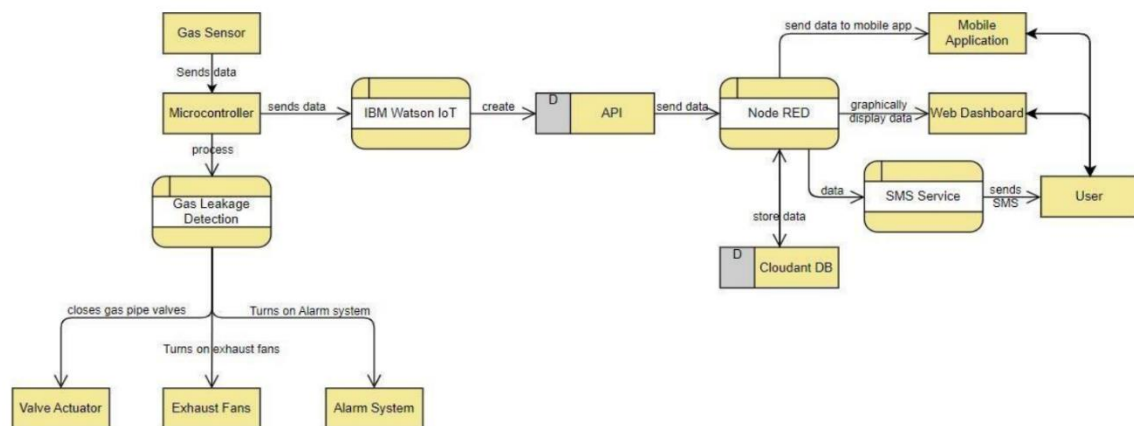
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Data fetch	The details of the gas leaked will be transferred to IOT system.
FR-2	Transferring to user	IOT, WIFI module
FR-3	Receiving in the user end	Gas level details will be displayed through LCD, an alarm will be beeps and the same data will be sent to the user mobile or pc.

4.2 NON-FUNCTIONAL REQUIREMENTS:

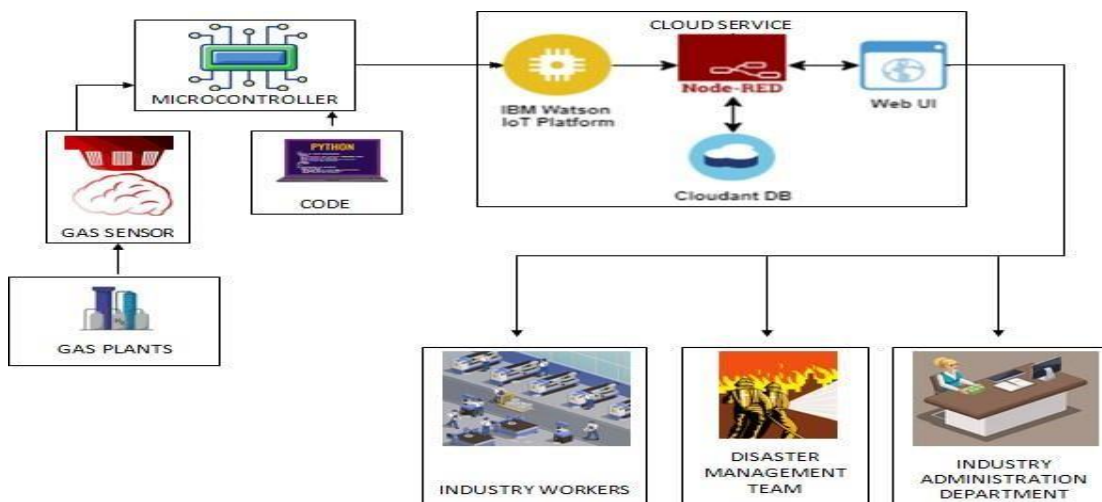
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Set of techniques for design and development are implemented.
NFR-2	Security	Strategical improvement of the process ensures less risk.
NFR-3	Reliability	Accuracy and consistency check is properly maintained.
NFR-4	Performance	Achieves the goal and contributes to the existing problem in the industry.
NFR-5	Availability	Information about the availability of resources are identified.
NFR-6	Scalability	Probability of performance is high.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS:



5.2 SOLUTION & TECHNICAL ARCHITECTURE:



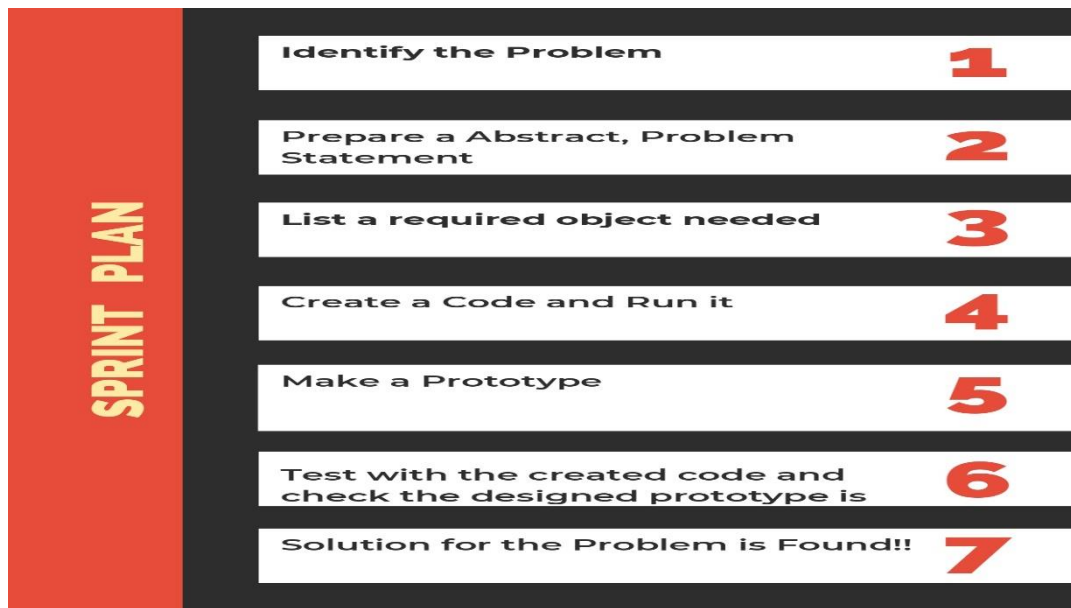


5.3 USER STORIES:

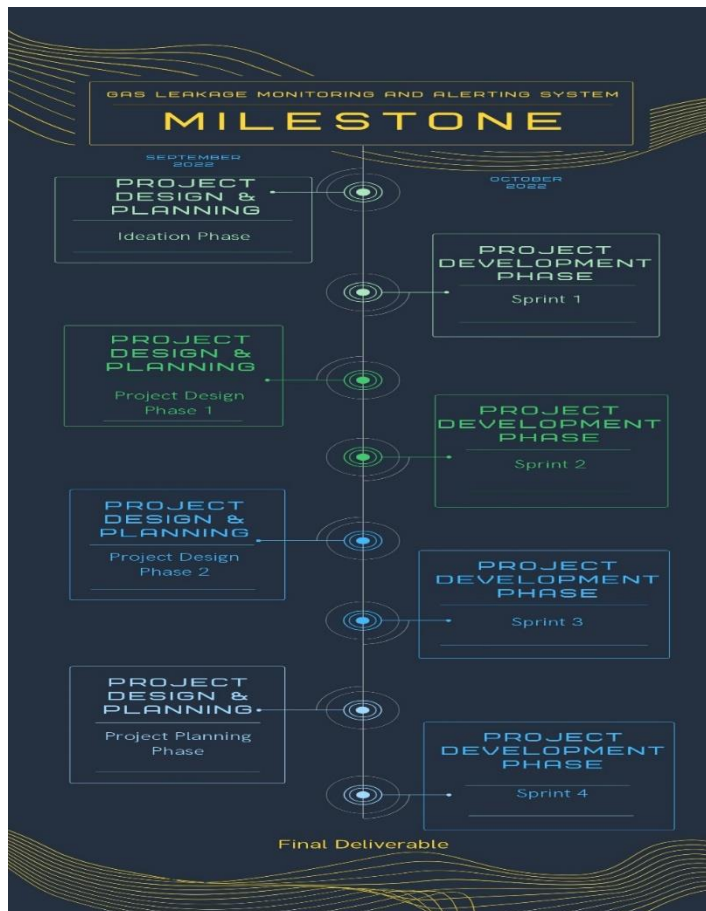
User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Industry owner)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
Customer (Industry Owner)	Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
Customer (Industry Owner)	Authorize	USN-3	As a user, I will enable the supervisor to monitor the gas leakage system status.	I can provide access to supervisor.	High	Sprint-1
Customer (Supervisor)	Login	USN-4	As a user, I can log into the application by entering email & password.	I can get access to dashboard.	High	Sprint-1
Customer (Supervisor)	Monitor	USN-5	As a user, I can monitor the status of the gas leakage system.	I can view the status of gas leakage system.	High	Sprint-1
Customer (Line Workers)	Notification	USN-6	As a user, I can get (alarm system) alert about gas leakage.	I can get alert about gas leak.	Medium	Sprint-2
Customer (Supervisor)	Notification	USN-7	As a user, I can get SMS notification & alarming alert about gas leakage.	I can get alert about gas leakage.	Medium	Sprint-2
Customer (Industry Owner)	Notification	USN-8	As a user, I can get SMS notification about gas leakage.	I can get alert about gas leakage.	Medium	Sprint-2
Customer (Industry Owner)	Sign-Up	USN-9	As a user, I can sign-up using Facebook login.	I can sign-up with the application using Facebook.	Low	Sprint-3
Customer (Supervisor)	Sign-Up	USN-10	As a user, I can sign-up using Facebook login.	I can sign-up with the application using Facebook.	Low	Sprint-3
Administrator	Service Request	USN-11	As a user, I can request for service in case of any issue with gas leakage monitoring system	I can get service from provider	Low	Sprint-3
Administrator	Increased service	USN-12	As a user, I can request for scaling up the gas leakage monitoring system.	I can get service from the provider.	Low	Sprint-4

6. PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION:



6.2 MILESTONE ACTIVITIES:



7. CODING AND SOLUTION:

```
#include
<LiquidCrystal.h>

LiquidCrystal lcd(6, 7, 8, 9, 10, 11);
float gasPin = A0;

float gasLevel;
int ledPin = 2;
int buttonPin = 3;
int buzzPin = 4;
int buttonState;
int fan = 5;

void setup(){
  pinMode(ledPin, OUTPUT);
  pinMode(buttonPin, INPUT);
  pinMode(gasPin,INPUT);
  pinMode(fan,OUTPUT);
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.setCursor(0,0);
  lcd.print(" Welcome");
  lcd.setCursor(0,2);
  lcd.print("GAS LEAKAGE SYSTEM");
  delay(500);
  lcd.clear();
}

void loop(){
  // Read the value from gas sensor and button
  gasLevel = analogRead(gasPin);
  buttonState = digitalRead(buttonPin);

  // call the function for gas detection and button work
  gasDetected(gasLevel);
  buzzer(gasLevel);
  exhaustFanOn(buttonState);
}

// Gas Leakage Detection & Automatic Alarm and Fan ON
void gasDetected(float gasLevel){
  if(gasLevel >= 300){
    digitalWrite(buzzPin,HIGH);
    digitalWrite(ledPin,HIGH);
    digitalWrite(fan,HIGH);
    lcd.setCursor(0,0);
```

```

    lcd.print("GAS:");
    lcd.print(gasLevel);
    lcd.setCursor(0,2);
    lcd.print("FAN ON");
    delay(1000);
    lcd.clear();
}
else{
    digitalWrite(ledPin,LOW);
    digitalWrite(buzzPin,LOW);
    digitalWrite(fan,LOW);
    lcd.setCursor(0,0);
    lcd.print("GAS:");
    lcd.print(gasLevel);
    lcd.setCursor(0,2);
    lcd.print("FAN OFF");
    delay(1000);
    lcd.clear();
}
}
//BUZZER
void buzzer(float gasLevel){
if(gasLevel>=300)
{
    for(int i=0; i<=30; i=i+10)
    {
        tone(4,i);
        delay(400);
        noTone(4);
        delay(400);
    }
}
}
// Manually Exhaust FAN ON
void exhaustFanOn(int buttonState){
    if(buttonState == HIGH){
        digitalWrite(fan,HIGH);
        lcd.setCursor(0,0);
        lcd.print("Button State:");
        lcd.print(buttonState);
        lcd.setCursor(0,2);
        lcd.print("FAN ON");
        delay(10000);
        lcd.clear();
    }
}
}

```

8. TESTING

8.1 TEST CASE CODE:

```
import
ibmiotf.applicati
n

import ibmiotf.device
import time
import random

#provide your ibm Watson Device Credentials

organization="ko3qfr"
deviceType="temp"
deviceid="4321"
authMethod="use-token-auth"
authToken="123456789"

#generate random values for random variables (temperature & humidity)
Temp=random.randint(0,100)
Humd=random.randint(0,100)
oxygen=30
lat=17
lon=18

def myCommandCallback(cmd):
    print("command received: %s"&cmd.data['command'])
    print(cmd)
    try:

deviceOptions={'org':organization,'type':deviceType,'id':deviceid,'authentication
method':authMethod,'authentication token':authToken}

        deviceCli=ibmiotf.device.Client(deviceOptions)
    except Exception as e:
        print("caught exception connecting device %s" %str(e))
        sys.exit()
```

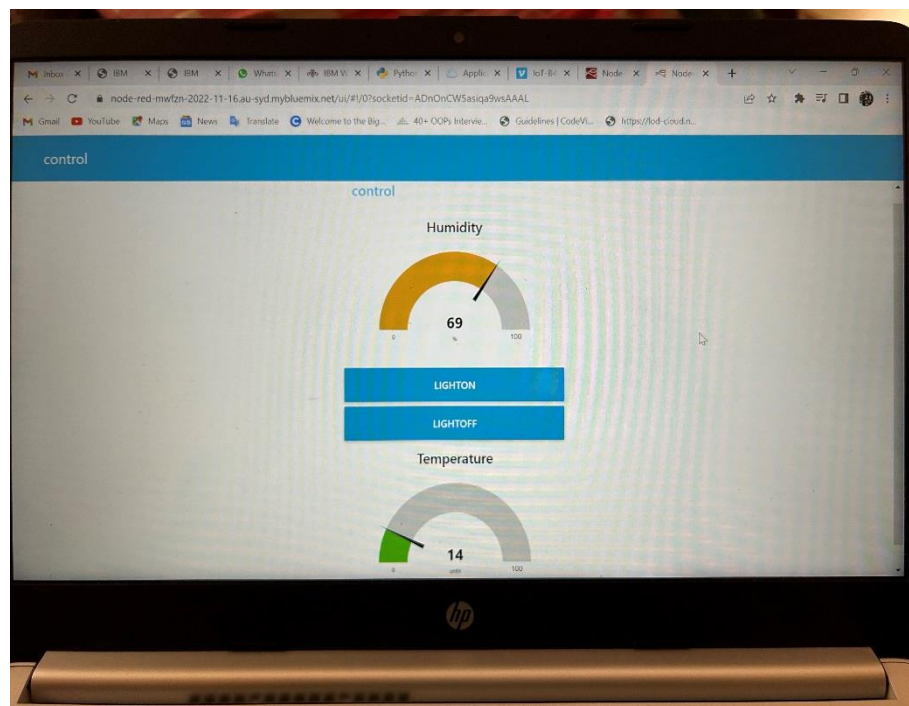
```

#connect and send a data point "temp" value with integer value into the cloud as
type event for 10 seconds
deviceCli.connect()
while True:
    data={"d":{"temp":Temp,'humid':Humd,'oxygen':oxygen,"lat":lat,"lon":lon}}
    print(data)
    def myOnPublishCallBack():
        print("published temperature: %s C" %Temp,"humidity:%s %%" %Humd)

success=deviceCli.publishEvent("IoTSensor","json",data,qos=0,on_publish=my
OnPublishCallBack)
if not success:
    print("not connected")
time.sleep(1)
deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()

```



IBM Watson IoT Platform

Device: GIRISH_1901852, Status: Disconnected, Last Seen: Nov 17, 2022 9:04 AM

Identity | Device Information | Recent Events | State | Logs

The recent events listed show the live stream of data that is coming and going from this device.

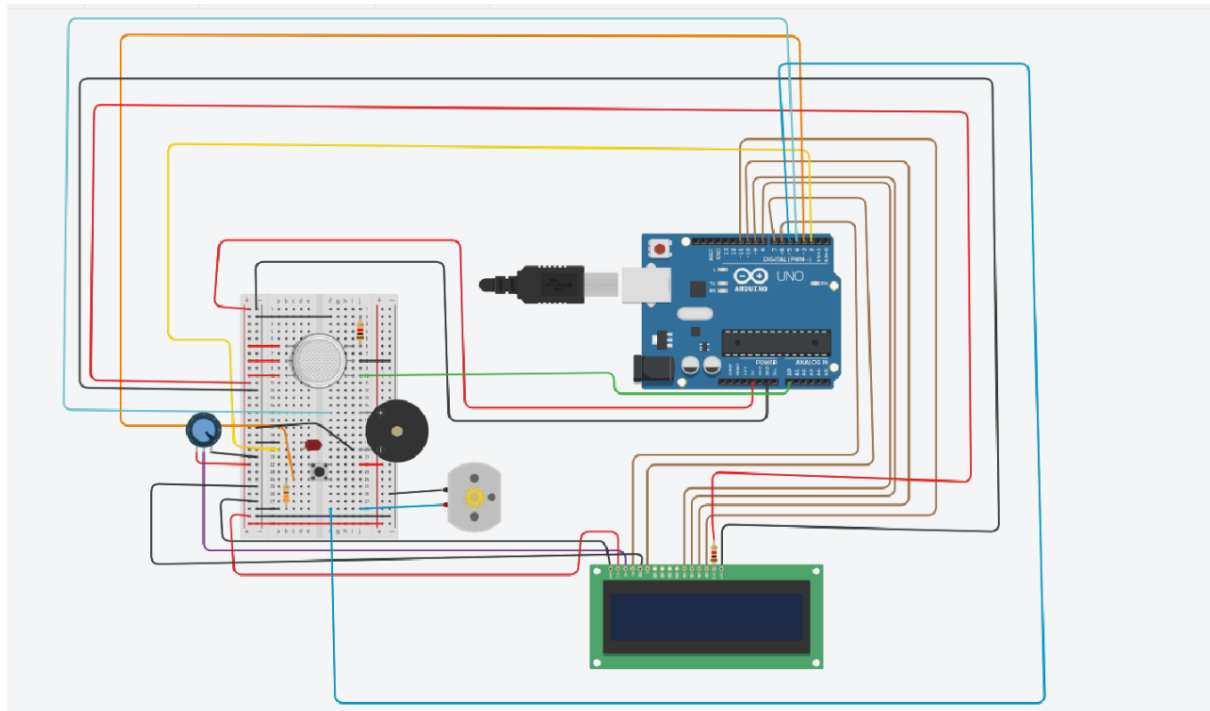
Event	Value	Format	Last Received
event_1	{"temperature":49,"humidity":76}	json	a few seconds ago
event_1	{"temperature":68,"humidity":100}	json	a few seconds ago
event_1	{"temperature":57,"humidity":49}	json	a few seconds ago
event_1	{"temperature":24,"humidity":53}	json	a few seconds ago
event_1	{"temperature":44,"humidity":20}	json	a few seconds ago

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1 of 1 page

1 Simulation running

9. RESULTS: PERFORMANCE METRICS:



10. MERITS:

Arduino UNO (Atmega-328) is the main unit of the system which performs 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 SMS to the in charge of the plant whose number is saved in SIM card by using GSM modem.

DEMERITS:

One of the drawbacks is that, The SMS received depends upon the leak of gas in the detection area of the sensor.

11. CONCLUSION:

The process of the project, marked the significance and the crucial part the problem plays in day to day lives. Applicable usefully in the industrial and domestic purpose. In danger situations we are able to save the life by using this system. An alert is indicated by the GSM module. A sensor node senses gases like CO₂, oxygen, propane. The estimated range of transmission and consumption of power is obtained. The simple procedures and Arduino UNO Micro controller area used to build the sensor.

12. APPENDIX:

GITHUB LINK: <https://github.com/IBM-EPBL/IBM-Project-30752-1660186585>