Project Report

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A TECHNICAL REPORT

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

Submitted by

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NOVEMBER 2022

1 .INTRODUCTION

The usage of the gas brings great problems in the domestic as well as working places. The inflammable gas such as Liquidized petroleum gas (LPG), which is excessively used in the house and at work places. The leakage of the gas causes destructible impact to the lives and as well as to the heritage of the people. So, by keeping it in the concept of the project we have determined to develop an examining system which finds the leak of LPG gas and protects the workplaces by taking correct precautions at the correct time. This system provides the information such as when a gas leakage is noticed, sensors in the project are used to notice the gas leakage and immediately turns ON the buzzer for the danger indication. Buzzer is a clear indication of gas leakage. By the detection of the hazardous gas the alerting message reached the person who has control over it from the GSM. Detection of the gas leakage is important and halting leakage is important equally. The main objective of this project is that it is extremely accurate with a least cost, this project system is best to detect gas leakage and also warn people around by buzzer beep sound and an SMS is sent to the responsible person for preparatory safety calculations.

1.1 Project Overview

Gas Leakage Monitoring & Alerting System for Industries has all the features as explained below

Features:

- This project helps the industries in monitoring the emission of harmful gasses
- In several areas, the gas sensors will be integrated to monitor the gas leakage
- If in any area gas leakage is detected the admins will be notified along with the location
- In the web application, admins can view the sensor parameters.

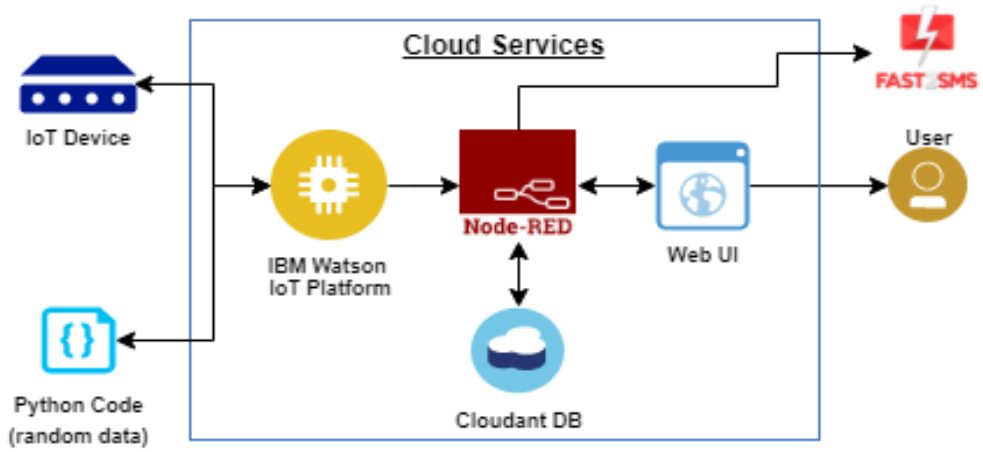

FIG NO:1_TECHNICAL ARCHITECTURE OF THE GAS LEAKAGE MONITORING AND ALERTING SYSTEM

1.2 Purpose

The gas detectors can be used for the detection of combustible, flammable and poisonous gasses and for loss of oxygen, and also to detect 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.

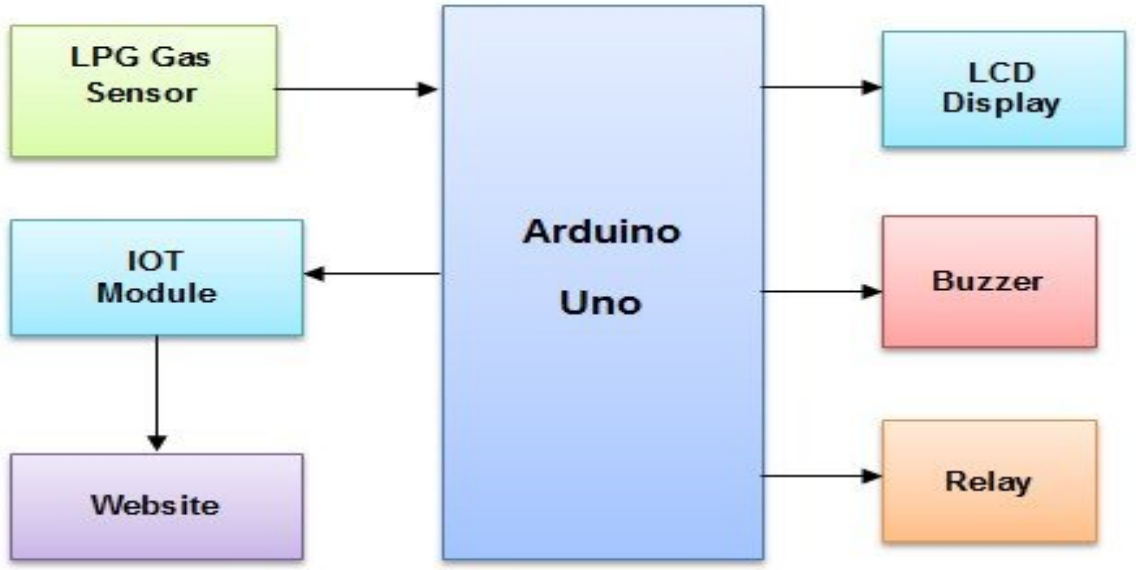

FIG NO:2_BLOCK DIAGRAM OF GAS LEAKAGE MONITORING AND ALERTING SYSTEM

2.LITERATURE SURVEY

1.IOT based gas leakage monitoring system using FPGA:

Journal of Xi'an University of Architecture and Technology.

Authors:

- Amatul Munazza, Department of ECE, GITAM School of Technology, Bangalore, India.
- Rupu Tejaswi, Department of ECE, GITAM School of Technology, Bangalore, India.
- Tarun Kumar Reddy, Department of ECE, GITAM School of Technology, Bangalore, India.
- MRs. Saranga Mohan (Guide), Assistant Professor, Department of ECE, GITAM School of Technology, Bangalore, India.

2.Sensor Based Gas Leakage Detector System:

Author:

- Mohammad Monirujjaman Khan

Department of Electrical and Computer Engineering, North South

University.

3. **Efficient Gas Leakage Detection and Control System using GSM:**

Authors:

A. Anurupa, M. Gunasekaran, M. Amsaveni, Assistant Professor,
Department of Electronics and Communication Engineering, RVS College of Engineering and Technology, Coimbatore, Tamil Nadu, India.

4. **Gas Leakage Detector and Monitoring System:**

Authors:

- Yekini N.
- Yaba College of Technology, Lagos Nigeria.
- Adigun J.
- Yaba College of Technology, Lagos Nigeria.
- Oloyede A.
- Yaba College of Technology, Lagos Nigeria.
- Akinade O.
- Yaba College of Technology, Lagos Nigeria.

5. **Automatic Gas Leakage Detection using IOT**

Authors:

Rajat Kumar Dwibedi, V. Vanitha, R.D. Sagar, Ganjikunta Yeshwanth

– Assistant Professor, Department of Electronics and Communication Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation, Chennai, India.

2.1 Existing Problem

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. The circuit contains a Microcontroller MQ2 gas sensor, buzzer, LCD display, and GSM module, when the sensor detects gas leakage it transmit the information to the Microcontroller while the microcontroller makes a decision and then forwarded a warning message to the user as SMS to a mobile phone for decision to be taken accordingly.

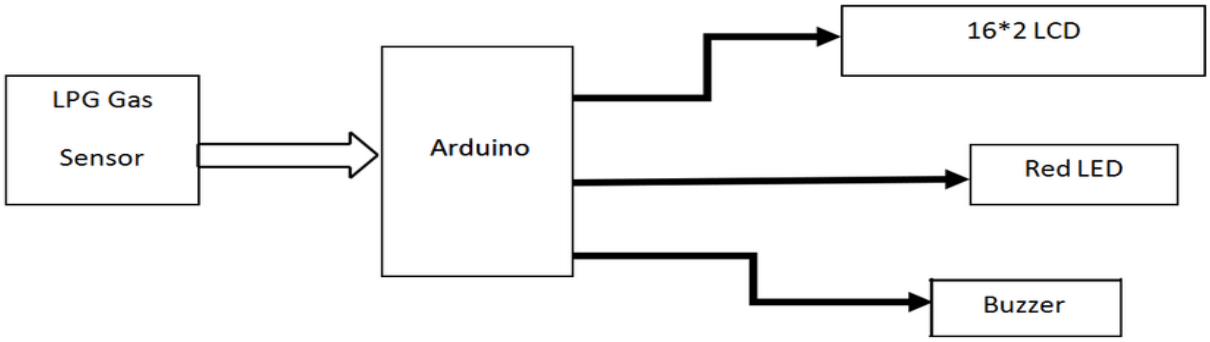

FIG NO:3_BLOCK DIAGRAM OF THE EXISTING SOLUTION OF GAS LEAKAGE MONITORING AND ALERTING SYSTEM

2.2 References

[1] 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.

[2] Hema, L. K., Murugan, D., & Chitra, M. WSN based Smart system for detection of LPG and Combustible gasses. In

National Conf. on Architecture, Software systems and Green computing-2013.

[3] Ramya, V., & Palaniappan, B. Embedded system for Hazardous Gas detection and Alerting. International Journal

of Distributed and Parallel Systems (IJDPS), 2012; 3(3):287-300.

[4] Priya, P. D., & Rao, C. T. Hazardous Gas Pipeline Leakage Detection Based on Wireless Technology. International

Journal of Professional Engineering Studies, India, 2014; 2(1).

[5] Jero, S. E., & Ganesh, A. B. 2011, March. PIC18LF4620 based customizable wireless sensor node to detect

hazardous gas pipeline leakage. In 2011 International Conference on Emerging Trends in Electrical and

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[6] Anusha, O., & Rajendra Prasad, C. H. Experimental investigation on road safety system at crossings. International

Journal of Engineering and Advanced Technology, 2019; 8(2):214–218.

[7] Pravalika, V., & Rajendra Prasad, C. Internet of things based home monitoring and device control using Esp32.

International Journal of Recent Technology and Engineering, 2019; 8(1 Special Issue 4):58–62.

[8] Sanjay Kumar, S., Ramchandar Rao, P., & Rajendra Prasad, C. Internet of things based pollution tracking and

alerting system. International Journal of Innovative Technology and Exploring Engineering, 2019; 8(8):2242–

2245

[9] 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

[10] Ramu, M., & Prasad, C. R. Cost effective atomization of the Indian agricultural system using 8051 microcontrollers.

International journal of advanced research in computer and communication engineering, 2013; 2(7):2563-2566.

2.3 Problem Statement Definition

Liquid Petroleum Gas (LPG) is a highly flammable chemical that consists of a mixture of propane and butane. LPG is used for cooking at home, restaurant, and certain use for industry. They have certain weaknesses that make the gas leakage occur. The leakage of gasses only can be detected by humans nearby and if there are no humans nearby, it cannot be detected. But sometimes it cannot be detected by humans that have a low sense of smell. Thus, this system will help to detect the presence of gas leakage.

Furthermore, gas leakage can cause fire that will lead to serious injury or death and it also can destroy human properties. This system was developed by using IoT to give real-time response to the user and the nearest fire station.

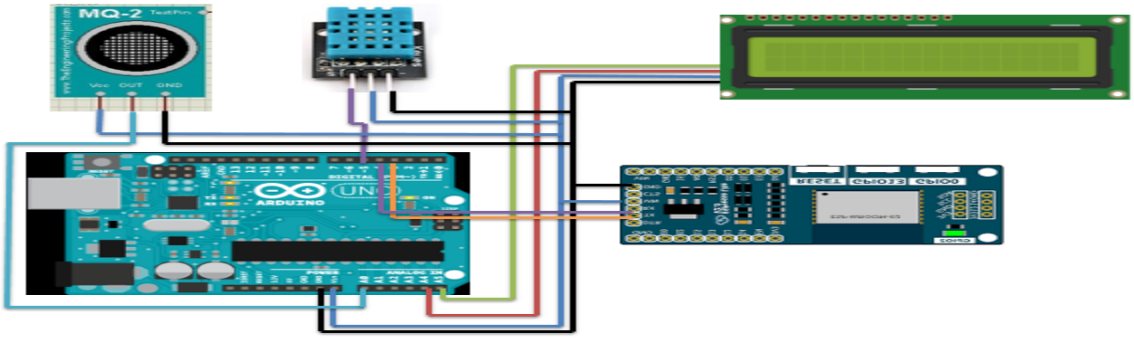


FIG NO:4_TINKERCAD SIMULATION OF THE PROJECT

3.IDEATION & PROPOSED SOLUTION

The proposed system takes an automatic control action after the detection of 0.001% of LPG leakage.This automatic control action provides a mechanical handle driven by stepper motor for closing the valve. The closing of the cylinder knob stops the flow of gas and prevents fire outbreak. We are increasing the

security for humans by using the combination of a relay and the stepper motor which will shutdown the electric power of the house. Also by using a GSM module, we are sending an alert message i.e SMS (Short messaging services) to warn the users about the LPG leakage and a buzzer is provided for alerting the neighbors in case of the absence of the users about the LPG leakage. The aim of this system is to reduce the probability of explosion due to gas leakage. The main advantage of this system over the manual method is that it does all the process automatically and has a quick response time.

3.1 Empathy Map Canvas

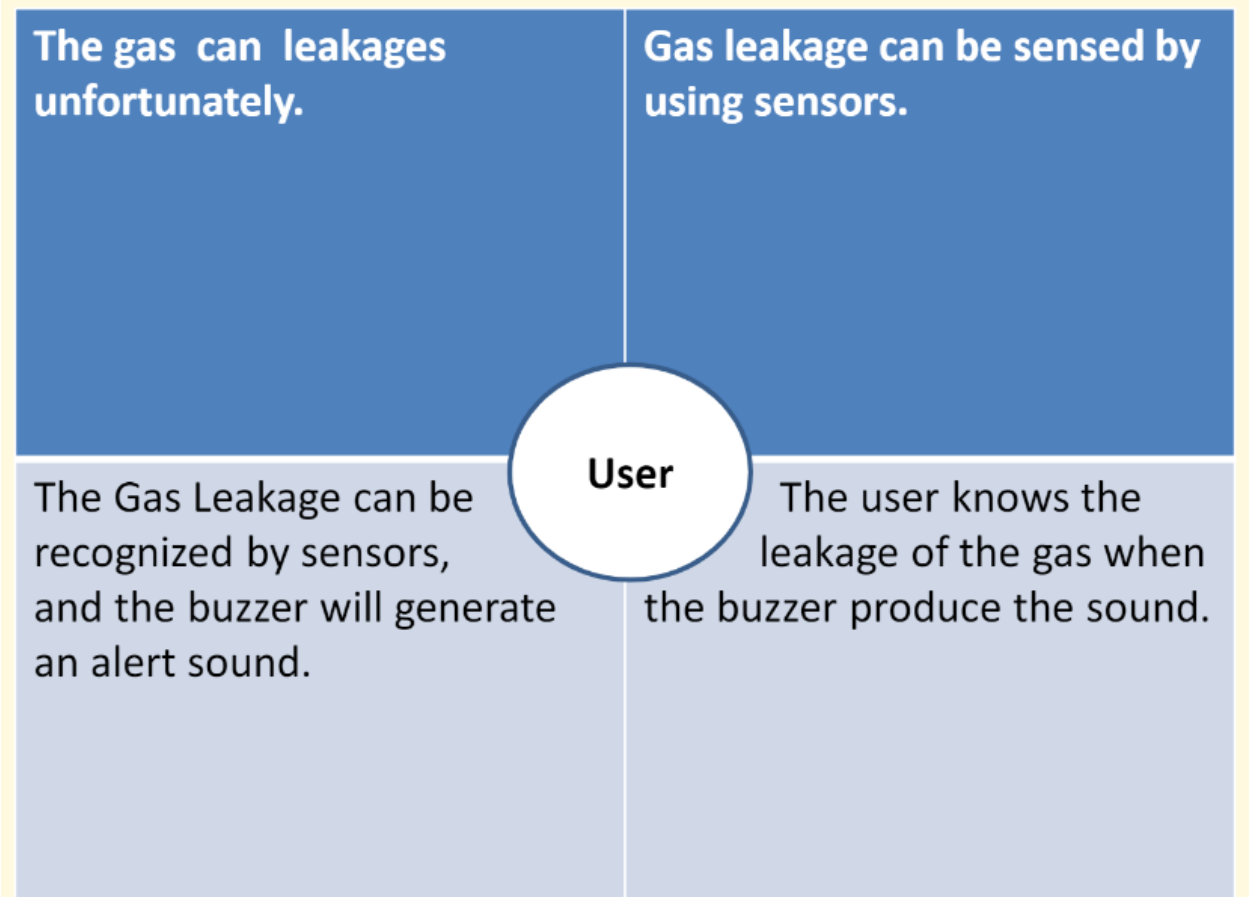


FIG NO:5_EMPATHY MAP CANVAS FOR THE GAS LEAKAGE MONITORING AND ALERTING SYSTEM

3.2 Ideation & Brainstorming

Person 1:(LAILA B G)

If the LPG sensor senses gas leak from industry, sensor output goes to active low and it is overlooked by Arduino UNO and gas leakage is noticed.

Person 2:(MAHALAKSHMI C)

If the gasses can be leaked in industries or homes, then it will be detected by using a gas sensor. After that it gives an alert sound to the people by using a buzzer.

Person 3:(RAJI SANTHOSHI T G)

We can propose to build the system using a MQS gas detection sensor and interface it with an Atmega 328 microcontroller along with an LCD Display.

Person 4:(DURGA DEVI G)

We can read gas leakage in industries at a time we can measure and upload it to a ThingSpeak cloud using FPGA and ESP8276 module**.**

By grouping the ideas of the team members, we have proposed a solution to the problem.

Ø The gas leakage monitoring system consists of Gas sensor, Buzzer, Arduino UNO, bread board and connecting wires.

Ø The leakage gas can be detected by using the gas sensor.

Ø It gives the alert sound when recognizing the leakage.

Ø So that people can be alert and huge exploitation can be avoided.

3.3 Proposed Solution

S.No.	**Parameter**	**Description**

1.	Problem Statement (Problem to be solved)	Gas leakage is a major problem in industries, residential premises and gas powered vehicles. If the leakage is not detected, it will lead to explosion and cause severe damages to life and environment. Even a small amount of heat can fire up the gas and explode. The leaked gas need to be ventilated and the leakage must be identified and service the fault immediately.
2.	Idea / Solution description	If the gasses can be leaked in industries or homes, then it will be detected by using a gas sensor. After that it gives an alert sound to the people by using a buzzer. In this way we avoid the huge explosion.
3.	Novelty / Uniqueness	In our design, we use 1 gas sensor and buzzer. If any gas can be leaked, then it gives the alert sound to the people.
4.	Social Impact / Customer Satisfaction	Our product is low cost and more convenient. So anyone can buy the product.
5.	Business Model (Revenue Model)	It is cost-effective.
6.	Scalability of the Solution	In our product, we use a buzzer and gas sensor. So it is user-friendly and eco-friendly since it

		prevents the huge explosion.

3.4 Problem Solution fit

	1. CUSTOMER SEGMENT(S) EM Industry peoples, the person who is using gases.	6. CUSTOMER CONSTRAINTS CC Continuous power supply.	5. AVAILABLE SOLUTIONS AS Gain alerts on multiple devices in the form of email, push notifications, SMS, or in app-messages about gas leaks. Reduce supervision costs by utilizing the capabilities of real-time gas detection and monitoring solutions to ensure workers safety and avert fire breakouts.	
	2. JOBS-TO-BE-DONE/ PROBLEMS J&P If the gases can be leaked then it gives the alert sound. Our product is low cost and more convenience so any people can use it. We use gas sensor and buzzer so it is eco-friendly.	9. PROBLEM ROOT CAUSE RC Gas leakage is a major problem in industries, residential premises and gas powered vehicles. If the leakage is not detected, it will lead to explosion and cause severe damages to life and environment. Even a small amount of heat can fire up the gas and explode.	7. BEHAVIOUR BE This system monitors the gas level whether it is normal or not. If the gas leakage crosses the normal criteria level it will activate the buzzer and the buzzer will produce sound.	
Identify strong TR & EM	3. TRIGGERS TR Explosions at home and industries because of gas leaks, and it is a major problem to be rectified. Situations like gas leakage are dangerous, which will cause a major accident. Even a small amount of heat can fire up the gas and explode. The leaked gas need to be ventilated and the leakage must be identified and service the fault immediately.	10. YOUR SOLUTION SL If the gases can be leaked in industries or home, then it will detect by using gas sensor after that it gives alert sound to the people by using buzzer. In this way we avoid the huge explosion.	8. CHANNELS Of BEHAVIOUR CH The gas leakage detecting sensor is used to detects the gas leakage in the atmosphere if leakage of gas exceed the limit then the device will turn on the buzzer.	
	4. EMOTIONS: BEFORE / AFTER EM If the gases can be leaked then it gives the alert sound. Our product is low cost and more convenience, so any people can use it. We use gas sensor and buzzer so it is eco-friendly.			

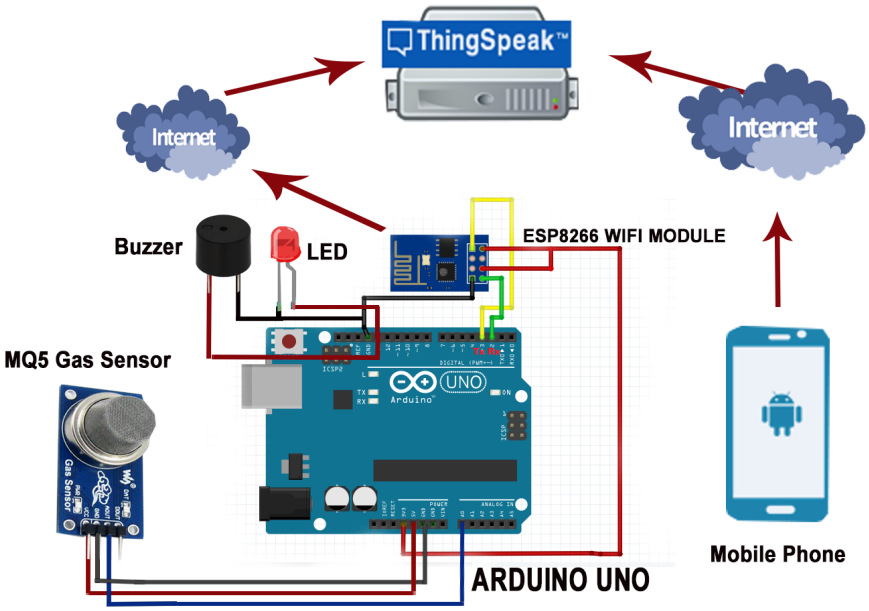


FIG NO:6_FUNCTIONAL DIAGRAM OF THE SIMULATION OF THE PROJECT

4. REQUIREMENT ANALYSIS

4.1 Functional requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration in the web application	Registration through (Google,Apple,Microsoft)or password registration.
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Account creation in the IBM Watson Cloud	Registration through (Google,Apple,Microsoft)or password registration.

FR-4	Account creation in Red Node	Registration through (Google,Apple,Microsoft)or password registration.
FR-5	Gas sensor,Raspberry PI board,Connections	Hardware Requirements for Gas leakage monitoring and alerting system.
FR-6	GSM Module	For sending FAST SMS to the user.

4.2 Non-Functional requirements:

FR No.	**Non-Functional Requirement**	**Description**
NFR-1	Usability	Gas Detectors can be used to detect combustible,flammable and toxic gasses,and oxygen depletion.This type of device is used widely in industry and can be found in locations,such as on oil rigs,to monitor manufacturing processes and emerging technologies such as photovoltaic.
NFR-2	Security	Gas detection and monitoring Systems are used as safety devices to alert workers of the potential danger of poisoning by toxic gas exposure,asphyxiation due to lack of oxygen or explosion caused by combustible gasses.
NFR-3	Reliability	The Flammability indicator shows the percentage within a safety range of 0-10% of the Lower Explosive Limit(LEL) and,ideally,should read 0%.Combustible gas detectors normally have two measuring ranges 0-100% LEL and 0-10%LEL.

NFR-4	Performance	If the gasses can be leaked in industries or homes, then it will be detected by using a gas sensor. After that it gives an alert sound to the people by using a buzzer. In this way we avoid the huge explosion.
NFR-5	Availability	The gas detectors can be used for the detection of combustible, flammable and poisonous gasses and for the loss of oxygen, and also to detect a gas leak or other pollutants. It makes the area where the leak occurs an warning sound and instructs operators to leave the area.

5. PROJECT DESIGN

5.1 Data Flow Diagram

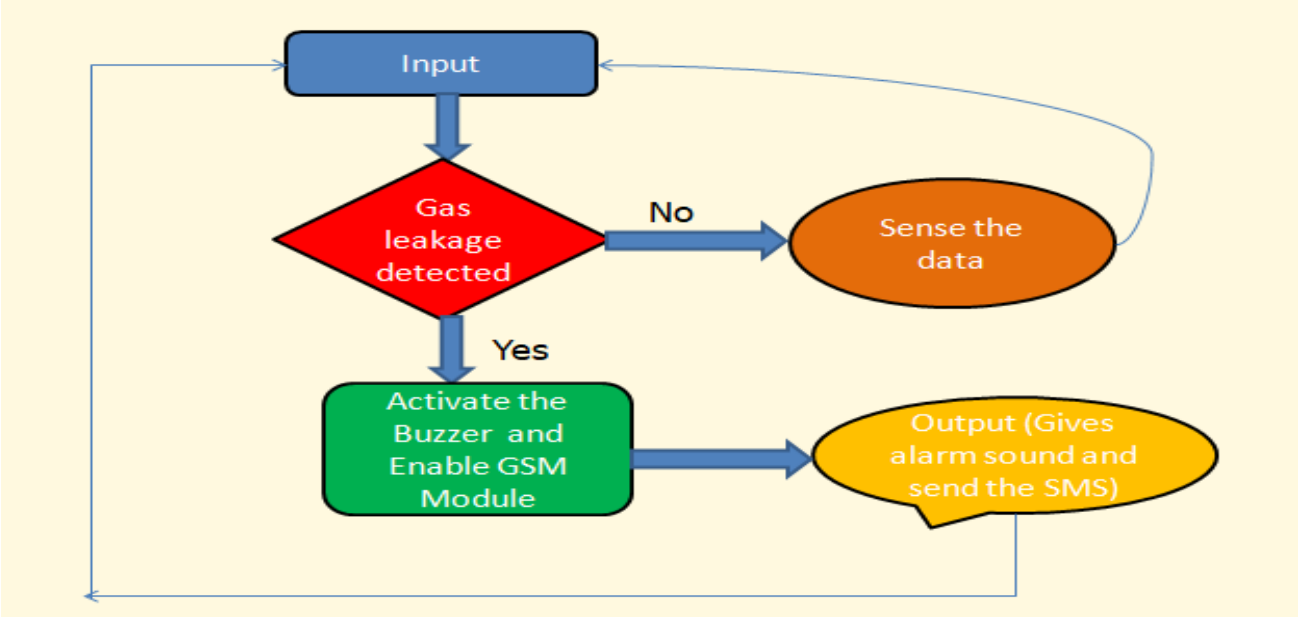


FIG NO:7_DATA FLOW DIAGRAM OF THE GAS LEAKAGE MONITORING AND ALERTING SYSTEM

5.2 Solution & Technical Architecture

Solution Architecture:

- Here we use Gas sensor to detect the gas leakage and it compares the detection level with the given Python code and stores it.
- Then the stored data is processed and sent to the IBM Watson Cloud platform in which analysis is done.
- Then the processed data is sent to Node Red in which the processed data is synthesized and stored in the cloud, the user can view this data with the help of Web application.
- If suppose any blast or emergency situation occurs, the user can immediately get the SMS.

Features:

- This system uses two sensors - gas and temperature - to keep the gas levels in check and monitor the temperature in an area accurately.
- This also has a buzzer, which will start buzzing if there is a leakage or fire.
- A web application will show the status of the environment.

Solution Specifications:

- Temperature Sensor
- Gas sensor
- IBM cloud
- Node-Red
- Cloudant DB
- Web application
- SMS Sending device (GSM module)

Solution Architecture Diagram:

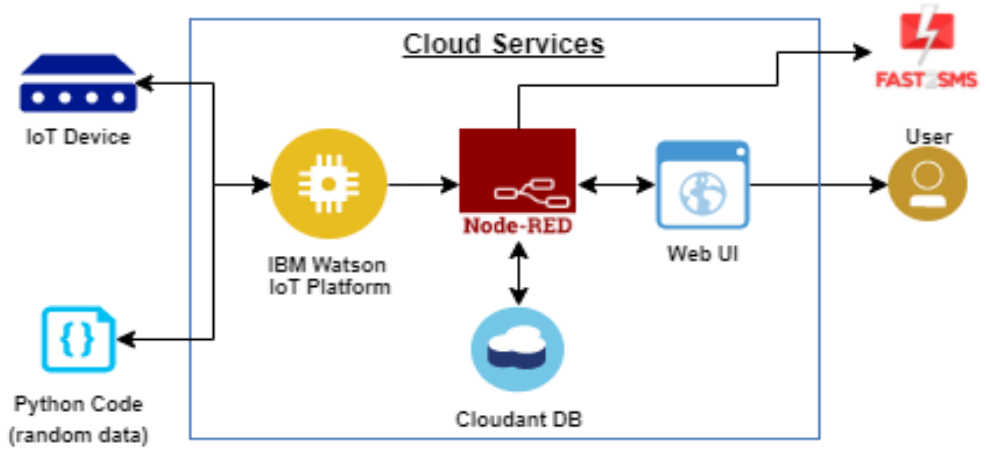


FIG NO:8_TECHNICAL ARCHITECTURE OF THE GAS LEAKAGE MONITORING AND ALERTING SYSTEM

Technical Architecture Diagram:

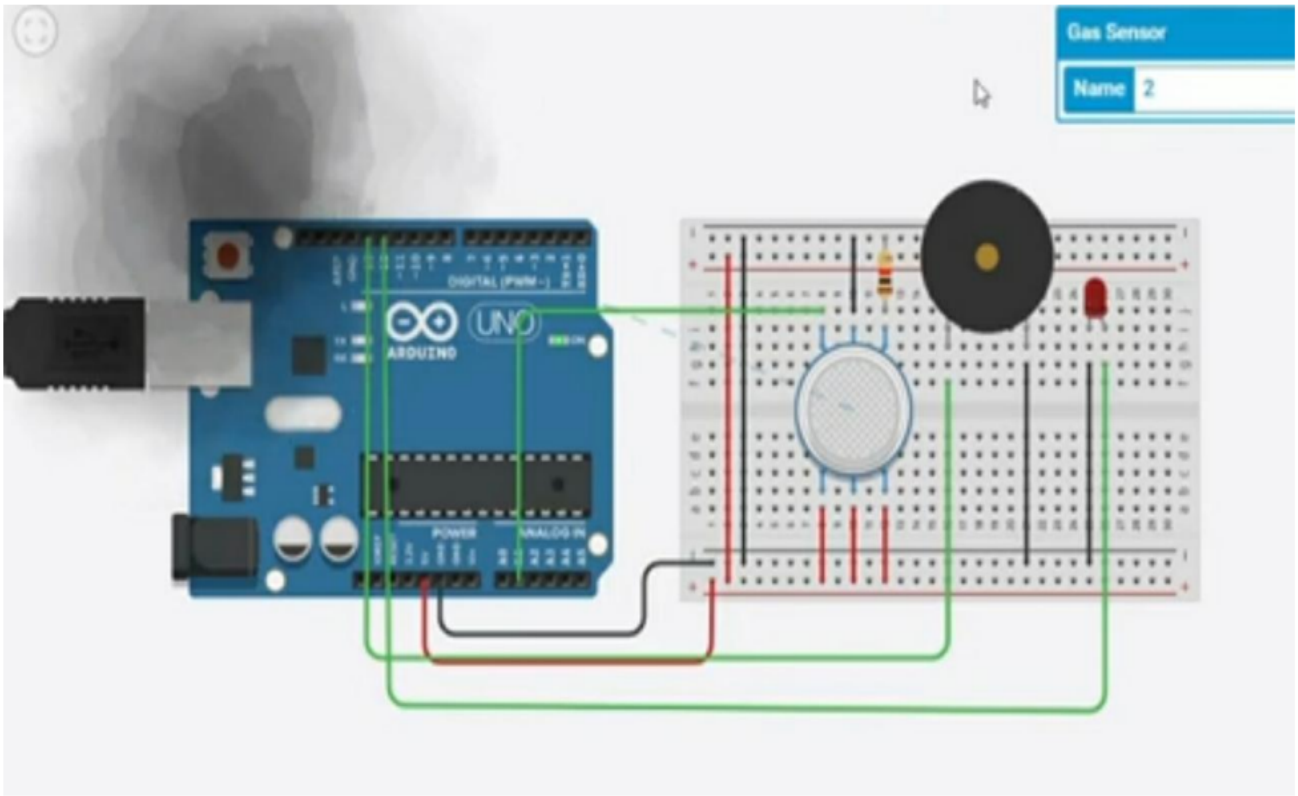
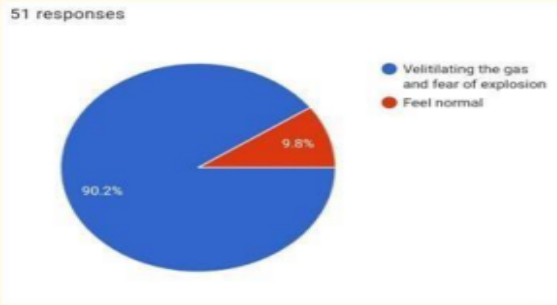


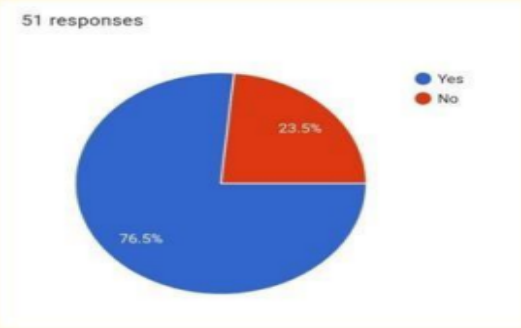
FIG NO:9_FUNCTIONAL AND TECHNICAL ARCHITECTURE OF THE GAS LEAKAGE MONITORING AND ALERTING SYSTEM

5.3 User Stories

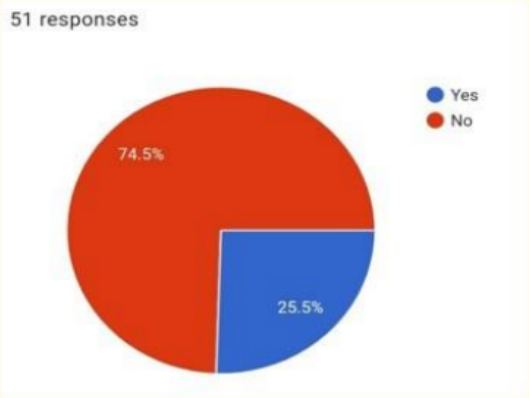
Q1. What are the difficulties you have faced during the gas leaking situations?



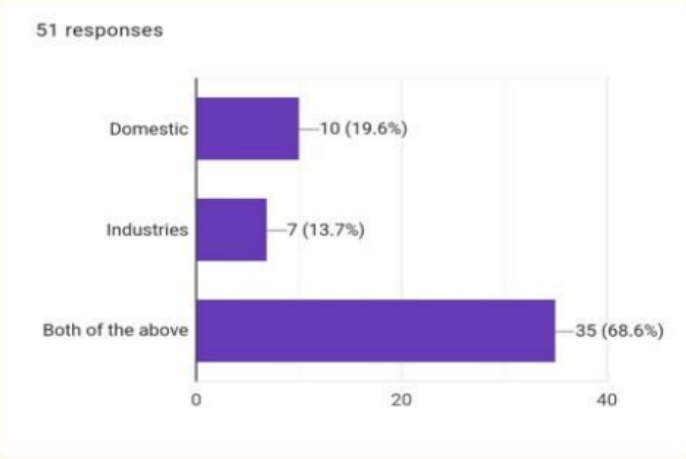
Q2. Do you need any device which will alert you when there is any gas leak and turns on the exhaust system and turns off the valve?



Q3. Have you ever seen any device like this?



Q4. In which places do this device is required?



6. PROJECT PLANNING & SCHEDULING

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	20 SEP 2022
Prepare Empathy Map	To prepare a Empathy Map Canvas in order to capture the user Pains & Gains, Prepare list of problem statements	23 SEP 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 4 ideas based on the feasibility & importance.	25 SEP 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	5 OCTOBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	10 OCTOBER 2022

Solution Architecture	To prepare a solution architecture document.	10 OCTOBER 2022

Customer Journey	To prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	15 OCTOBER 2022
Functional Requirement	To prepare the functional requirement document.	15 OCTOBER 2022
Data Flow Diagrams	To draw the data flow diagrams and submit for review.	20 OCTOBER 2022
Technology Architecture	To prepare the technology architecture diagram.	25 OCTOBER 2022
Prepare Milestone & Activity List	To prepare the milestones & activity list of the project.	1 NOVEMBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	To develop & submit the developed code by testing it.	WORKING ON IT...

6.1 Sprint Planning & Estimation

Sprint planning is an event in scrum that kicks off the sprint. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team.

Estimation is done by the entire team during the Sprint Planning Meeting. The objective of the Estimation would be to consider the User Stories for the Sprint by Priority and by the Ability of the team to deliver during the Time Box of the Sprint.

6.2 Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	IBM Watson IOT platform	USN-1	Creating devices and board and generating data	1	Medium	Mahalakshmi C Laila B.G Rajisanthoshi T.G Durga Devi G
Sprint-2	Storing Data usingnode-red	USN-2	Storing the data in IBM Cloudant DB through node-red functions	2	High	Mahalakshmi C Laila B.G Rajisanthoshi T.G Durga Devi G
Sprint-3	IoT device/ Microcontroller Board	USN-4	The board connect with the cloud and mode- red platform and send information about the gas leakage.	2	Low	Mahalakshmi C Laila B.G Rajisanthoshi T.G Durga Devi G
Sprint-4	Fast SMS	USN-5	Fast SMS sent SMS to the users.	1	High	Mahalakshmi C Laila B.G Rajisanthoshi T.G Durga Devi G

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	IBM Watson IOT platform	USN-1	Creating devices and board and generating data	1	Medium	Mahalakshmi C Laila B.G Rajisanthoshi T.G Durga Devi G
Sprint-4	Fast SMS	USN-5	Fast SMS sent SMS to the users.	1	High	Mahalakshmi C Laila B.G Rajisanthoshi T.G Durga Devi G

Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	07 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let us calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

7. CODING & SOLUTIONING

Sprint 1:

```
#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 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);
  }


}#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);
  }


}#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);
  }

}
```

8. TESTING

8.1 Test Cases

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	58	0	0	58
Security	5	0	0	5
Outsource Shipping	4	0	0	5
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	4	0	0	4

8.2 User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Gas Leakage Monitoring and Alerting System project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

9.RESULTS:

9.1. PERFORMANCE METRICS:

A device can be created in IBM IoT Platform and input has been given.

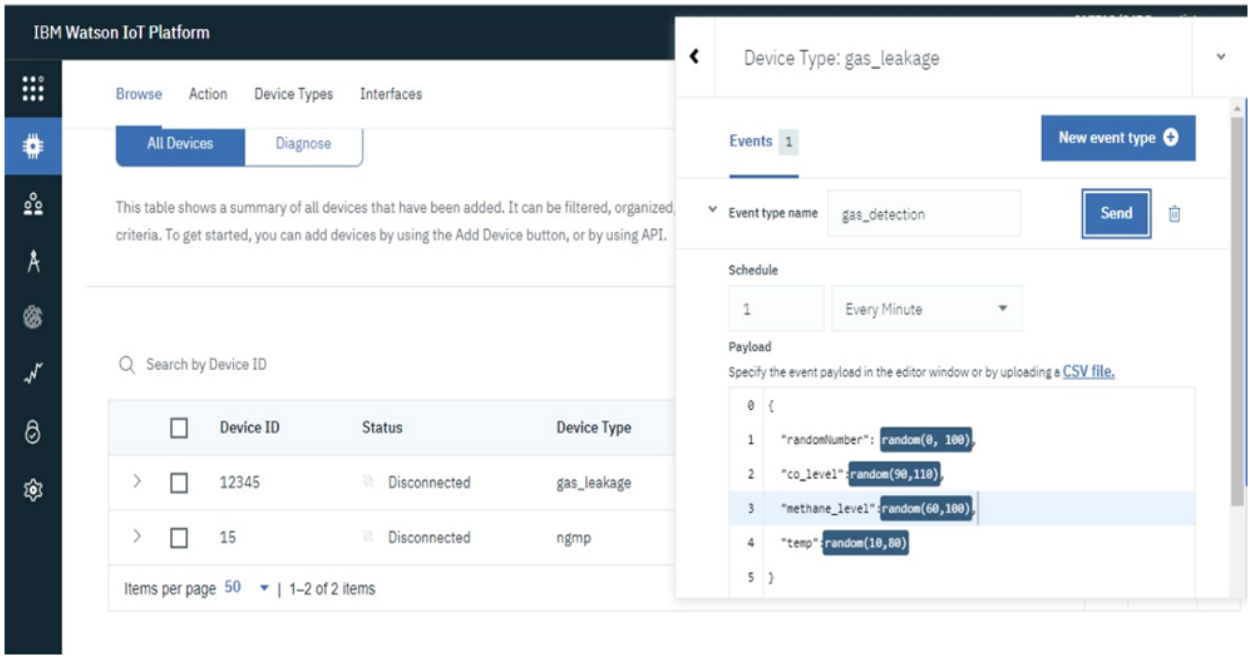


FIG NO:10_EVIDENCE OF CREATED A DEVICE IN IBM IOT PLATFORM

Node – red :

Circuit is designed in Node – red. If the gasses are leaking, then it will send the alert message.

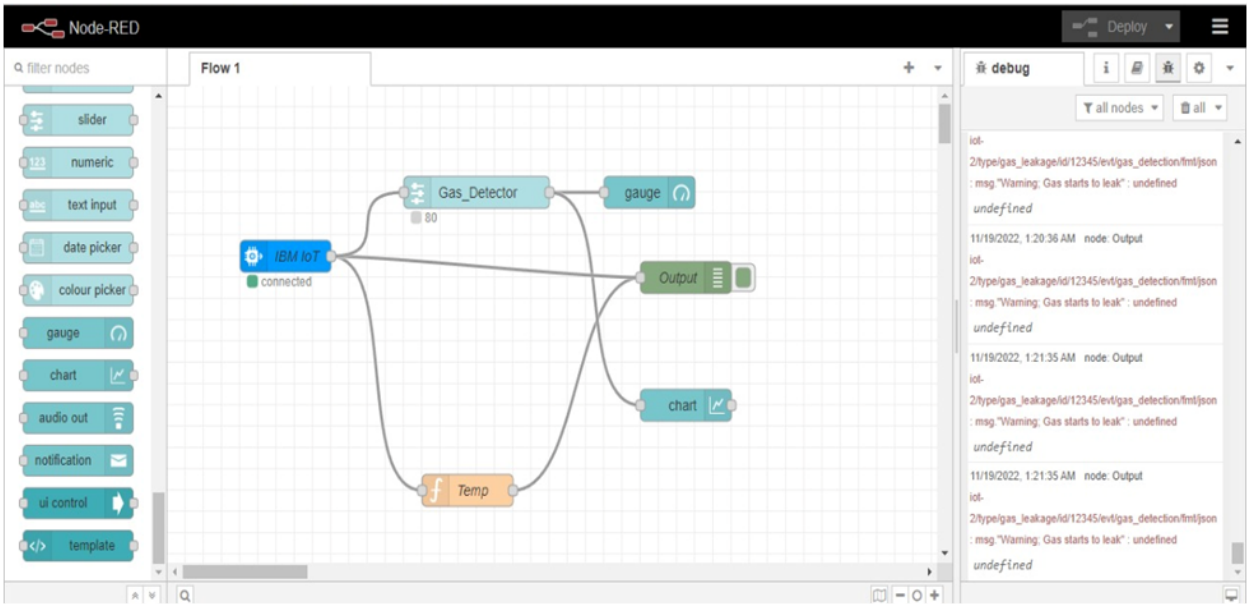


FIG NO:11_EVIDENCE OF DESIGNED CIRCUIT IN NODE-RED PLATFORM.

The gas leakage level can be shown in the graph.

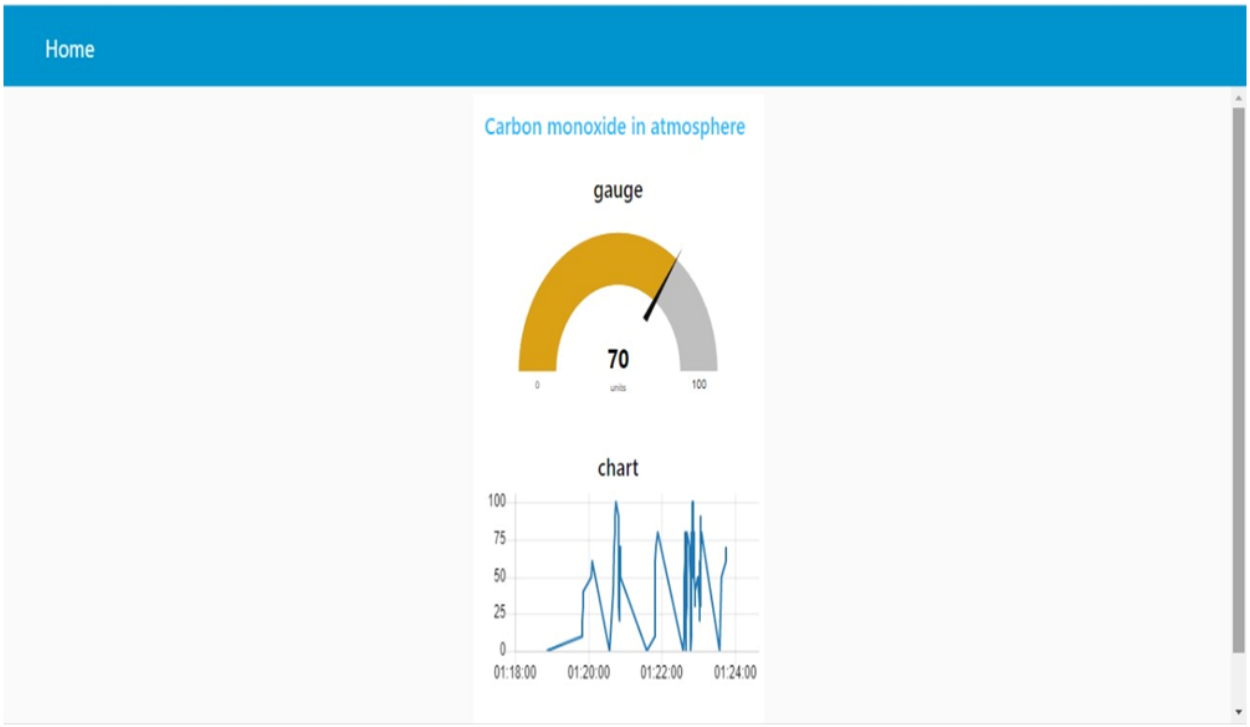


FIG NO:12_EVIDENCE OF THE OUTPUT OF THE PROPOSED SOLUTION

Gas Leakage detection using Mobile App

FIG NO:13_EVIDENCE OF THE OUTPUT IN OUR MOBILE APP

10. ADVANTAGES AND DISADVANTAGES:

ADVANTAGES:

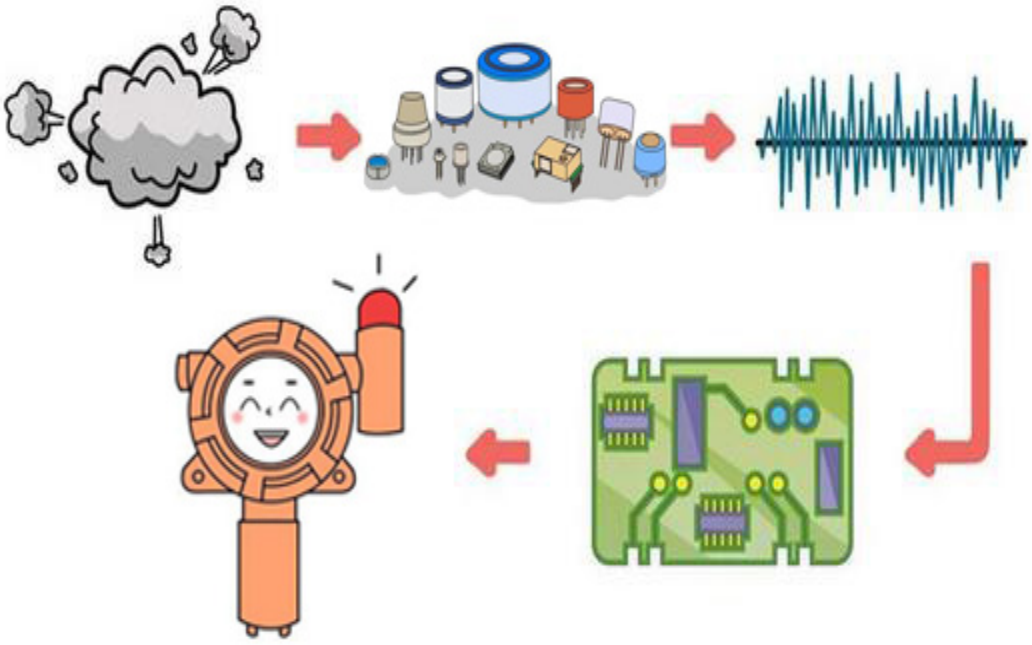
- If the gasses can be leaked in industries or homes, then it will be detected by using a gas sensor. After that it gives an alert sound to the people by using a buzzer. In this way we avoid the huge explosion
- In our design, we use 1 gas sensor and buzzer. If any gas can be leaked, then it gives the alert sound to the people.
- Our product is low cost and more convenient. So anyone can buy the product.
- It is cost-effective.
- In our product, we use a buzzer and gas sensor. So it is user-friendly and eco-friendly since it prevents the huge explosion.

DISADVANTAGES:

- Need of continuous power supply which is a major drawback.

- Only one gas can be measured with each instrument.
- Poor stability and greater environment impact.
- Cross interference from other gasses can cause a complete failure model,leading to inaccurate reading.

11. CONCLUSION:



The gas detectors can be used for the detection of combustible,flammable and poisonous gasses and for the loss of oxygen,and also to detect a gas leak or other pollutants.It makes the area where the leak occurs an warning sound and instructs operators to leave the area. If the gasses can be leaked in industries or homes, then it will be detected by using a gas sensor. After that it gives an alert sound to the people by using a buzzer. In this way we avoid the huge explosion.

12. FUTURE SCOPE:

Major cities of India are pushing Smart Home application, gas monitoring system is a part of Smart Home application. Enhancing Industrial Safety using IoT. IoT turns drones into gas detection sensors. Another

major future scope could be including an 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. This system can be used in industries involving applications such as Furnace, Boilers, Gas welding, Gas cutting, Steel Plants, Metallurgical industries, Food processing Industries, Glass Industries, Plastic industries, Pharmaceuticals, Aerosol manufacturing. As hospitals are required to provide maximum possible safety to patients, this system can be used to keep track of all the cylinders used in it. Some of the cylinders used are Oxygen cylinder, Carbon dioxide cylinder, Nitrous oxide cylinder. As many students are naïve, the risk of causing accidents is high. Hence, our system can also be used in schools, colleges. Many colleges have well established labs including chemistry lab and pharmaceutical labs where gas burners are used. Plenty of medical equipment requires gas cylinders.

13. APPENDIX:

SOURCE CODE:

https://github.com/IBM-EPBL/IBM-Project-27578-1664792200/tree/main/Project%20Development%20Phase

GITHUB AND PROJECT DEMO LINK:

https://github.com/IBM-EPBL/IBM-Project-27578-1664792200