REPORT DOCUMENT

Project Title

Gas Leakage Monitoring and Alerting System

CATEGORY: IOT

BY

Sri Venkateswaraa College of Technology

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

TEAM MEMBERS:

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Saranya G -- 412619106016

Project Report:

1. INTRODUCTION

1.1 PROJECT OVERVIEW:

The world has been evolving quickly to adopt the latest cutting-edge technologies and connect everything. LPG, carbon dioxide, ammonia, and other flammable gases are used by a variety of institutions, including hotels, canteens, and businesses, to provide the greatest hospitality services to their patrons. While using these gases has unquestionably improved technology, it also presents a risk component that endangers and harms human life. Safety consequently becomes a major concern. This makes it necessary to install a gas leak monitoring and warning system in places that are prone to accidents so that leaks of any kind can be continuously monitored and found regardless of human senses. The system's design continuously checks the environment for leaks.

1.2 PURPOSE:

An warning and control system-equipped sensor-based automatic gas leakage detector has been presented. This equipment for detecting gas is reasonably priced, uses less power, is lightweight, portable, safe, easy to use, effective, and has a straightforward system. The system has a MQ6 gas detector to keep an eye on this gas leak. This sensor measures the quantity of gas leakage that is present in the atmosphere around it. The effects of an explosion or gas leak can be prevented in this way.

2. LITERATURE SURVEY

2.1. EXISTING PROBLEMS:

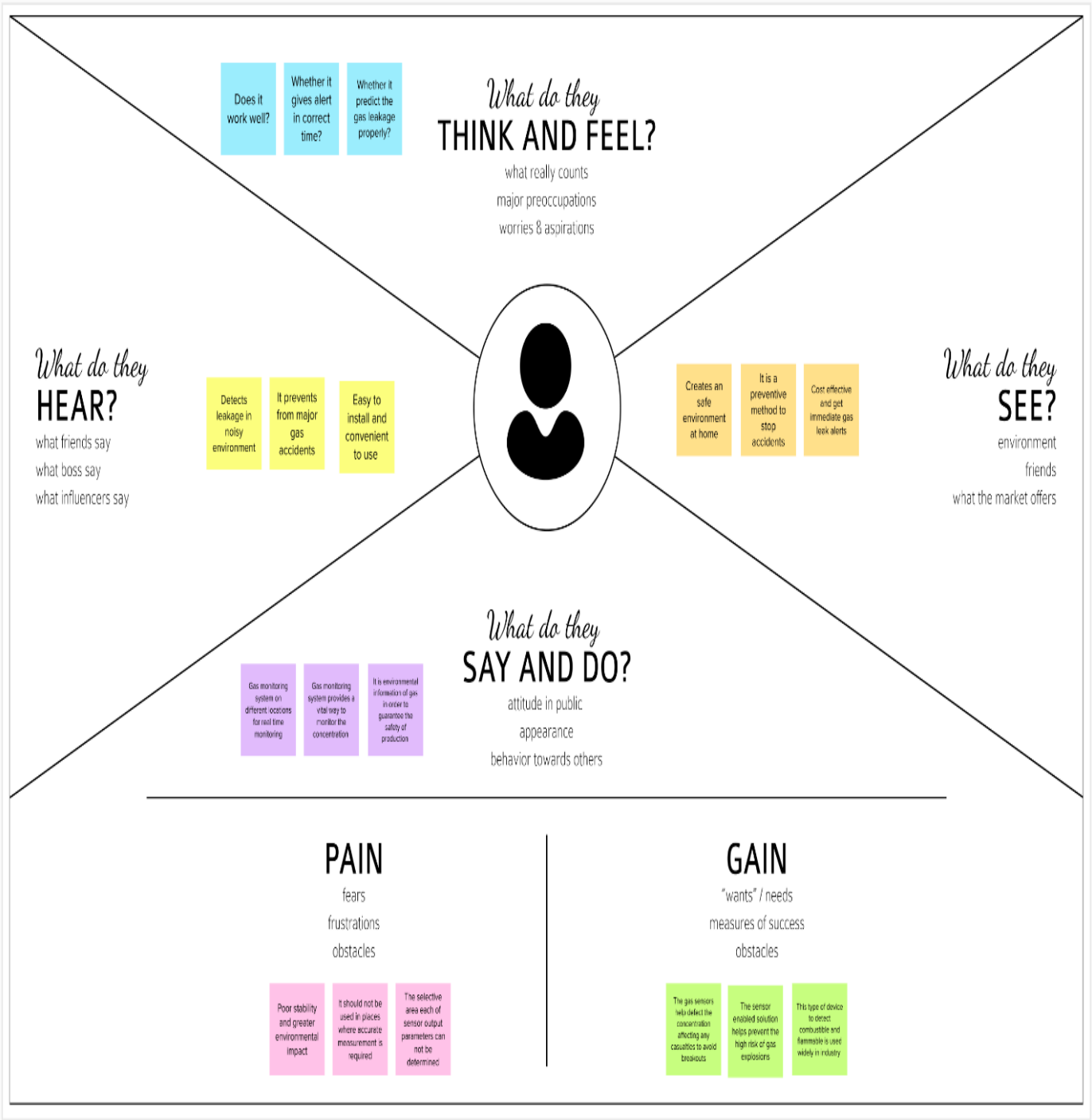
The main objective of the gas leakage monitoring system is to identify problems with the gas system in order to stop the buildup of gases and the subsequent explosion. Our gas detection system reduces the risk of fire by not only continuously monitoring the environment but also by halting additional gas leaking. The risk of fire is decreased by the gas detection system, which not only continuously monitors the environment but actively works to stop further gas leaks. IoT will advance thanks to this integrated system, which will surely help people satisfy their commercial needs. Today's society places a high priority on safety, necessitating the adoption of certain measures in both workplaces and homes. Working in dangerous environments or doing so while using oil or electricity.

2.3. PROBLEM STATEMENT DEFINITION

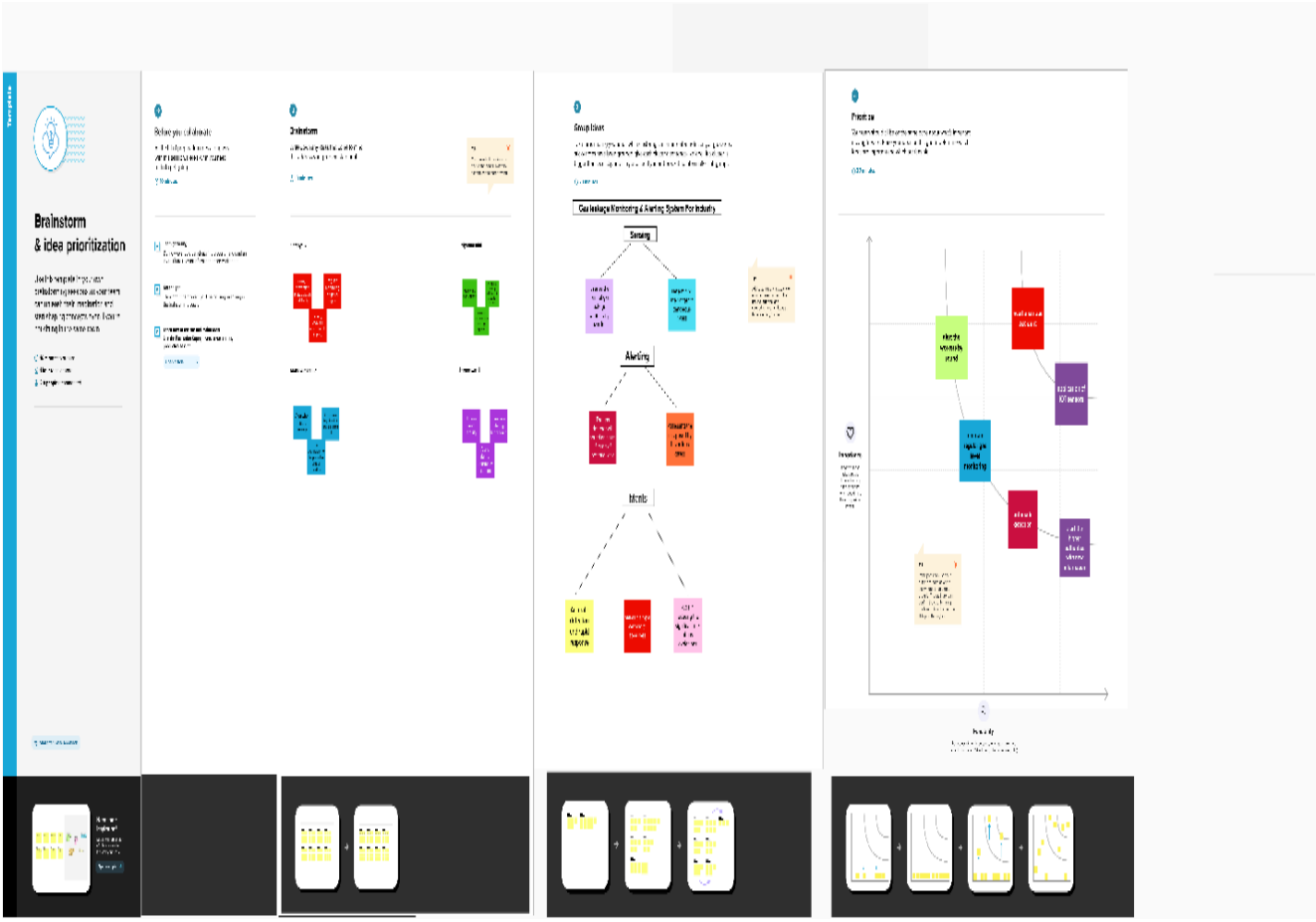
In most industries, one of the key parts of any safety plan for reducing risks to personnel and plant is the use of early-warning devices such as gas detectors. These can help to provide more time in which to take remedial or protective action. They can also be used as part of a total, integrated monitoring and safety system for an industrial plant. Rapid expansion of oil and gas industry leads to gas leakage incidents which are very serious and dangerous. Solutions need to be found out at least to minimize the effects of these incidents since gas leaks also produce a significant financial loss. The challenges are not only to design a prototype of the device that can only detect but also automatically respond to it whenever the leakage occurs.

3.IDEATION AND PROPOSED SOLUTION

3.1. Empathy Map Canvas



3.2 Ideation & Brainstorming:



Document an existing experience

Narrow your focus to a specific scenario or process within an existing product or service. In the **Steps** row, document the step-by-step process someone typically experiences, then add detail to each of the other rows.

Browsing, booking, attending, and rating a local city tour

Entice

How does someone initially become aware of the process?

Enter

What does the experience begin to look like?

Engage

In the core moments of the process, what happens?

Exit

What do people typically experience as the process finishes?

Extend

What happens after the experience is over?

Steps

What does the person (or group) typically experience?

Interactions

What interactions do they have at each step along the way?

- People: Who do they see or talk to?
- Places: Where are they?
- Things: What digital touchpoints or physical objects would they use?

Goals & motivations

At each step, what is a person's primary goal or motivation? (Hint: Ask "Why is that important?")

Positive moments

What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?

Negative moments

What steps does a typical person find frustrating, confusing, angering, costly, or time-consuming?

Areas of opportunity

How might we make each step better? What ideas do we have? What have others suggested?

PROJECT DESIGN PHASE 1

Proposed Solution:

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	❖ Create a system to identify gas leaks and notify users.
2.	Idea / Solution descripti on	❖ This technology can detect dangerous gases and trigger an alarm to notify workers. ❖ Administrators can view the sensor parameters on the web application. ❖ If a gas leak is discovered in any region, the administrators will be alerted along with the location.
3.	Novelty / Uniqueness	❖ Alert right away ❖ Simple to handle ❖ Environmental usage
4.	Social Impact / Customer Satisfaction	❖ Affordable and long-lasting ❖ Does not impact people's lives ❖ Simple installation and yield effective results
5.	Business Model (Revenue Model)	❖ The item is heavily promoted across all mediums. Due to its affordability, it even protects small-scale companies against disasters. ❖ Since everyone can understand how to utilise the product, it is simple for them to do so for their safest organisation.

6.	Scalability of the Solution	❖ Even when there is a greater gas leak, the product detects precise readings and successfully warns the workers. ❖ Since the product's cost is inexpensive, both businesses and homes can readily use it.

3.4 Problem Solution fit:

4. REQUIREMENT ANALYSIS:

4.1 Functional requirement:

Business Requirements	***User Requirements***	***Product Requirements***
The aforementioned system may be used in residences, hotels, industrial settings, LPG cylinder storage spaces, and other locations. This IOT and Arduino-based application's primary benefit is that it can Find the leakage, then deliver the data to the destination. It might be both vigilant and preventive Any calamity can be avoided with the right steps.	The gas leakage detection system can be upgraded with smoke and fire detectors to detect the presence of smoke and fire in addition as being optimized for detecting dangerous gases. Although ensuring worker safety is critical, adopting the appropriate technology is even more crucial.	Whatever your professional position or personal goal, gas detection is a need. Such IOT devices are what they are due to the technologies in use , therefore understanding these technologies and the functions they can serve is necessary if you wish to engage in IOT application development.

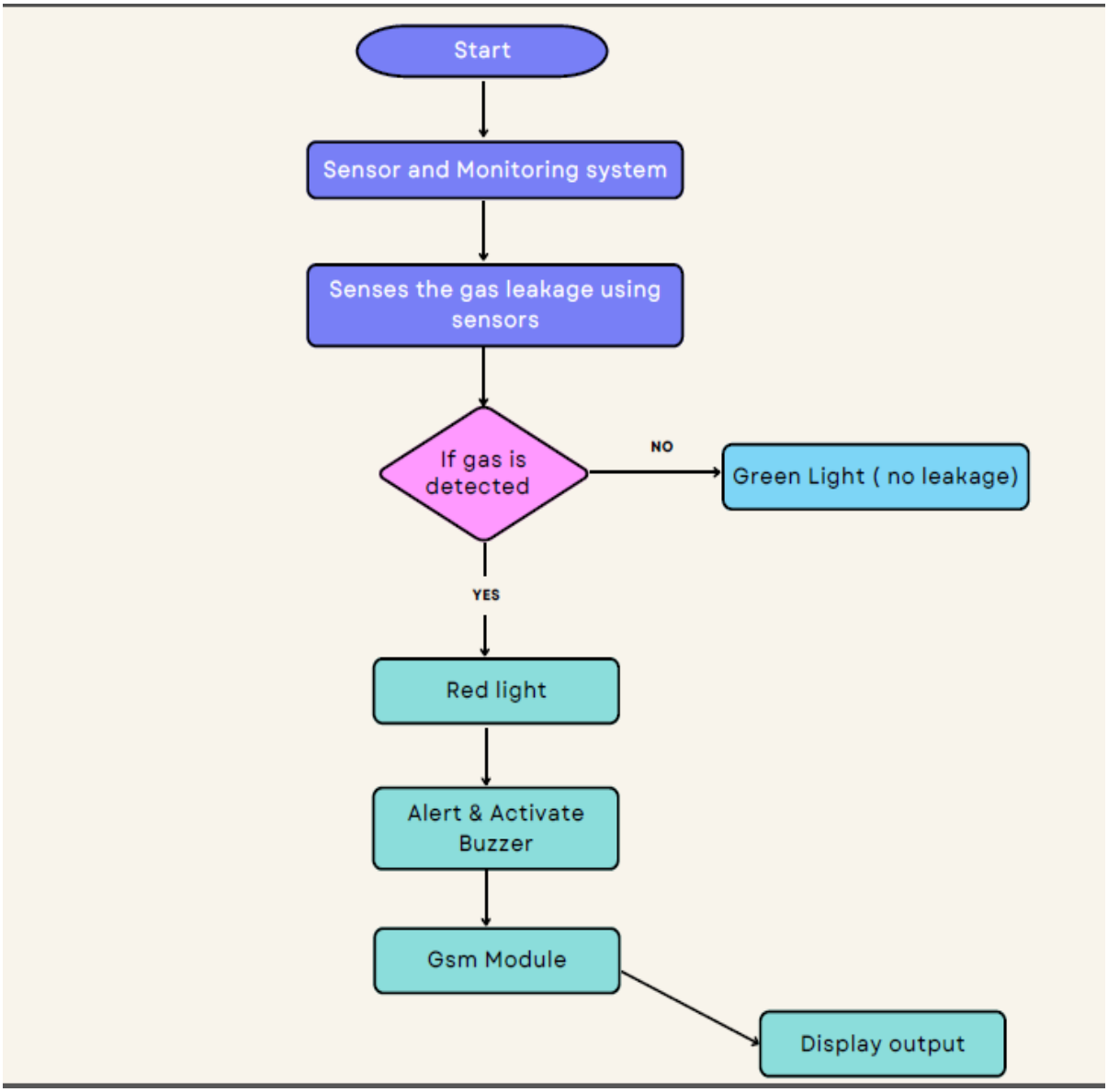
4.2 Non-Functional requirements:

FR No.	Non-Functional Requirement	Description
NFR- 1	**Usability**	1.Easy user interface with alerting notifications and location of the defect gas cylinder.
NFR- 2	**Security**	1. Secure Cloud database is used. 2. Notify only the registered and verified users. 3. Multiple deployments across the potential sources can help industries to avoid any industrial accident and protect workplace safely.
NFR- 3	**Reliability**	1. Gas exposure will measured with ± 25% of the true concentration of the target analyte with 95% certainty. 2. Robust device that can withstand harsh industrial conditions and provide real-time gas leakage detection.
NFR- 4	**Performance**	1. Accurate data monitoring system enables periodic analysis of the air quality. 2. Provides data on a real-time basis which enables safety managers to take timely corrective actions
NFR- 5	**Availability**	1. Through Suppliers. 2. With online shopping platforms.
NFR- 6	**Scalability**	1. Can be extended further from industrial application to domestic gas applications. 2. Deployment in petrol banks and vehicle fuel plants for gas leakage detection application.

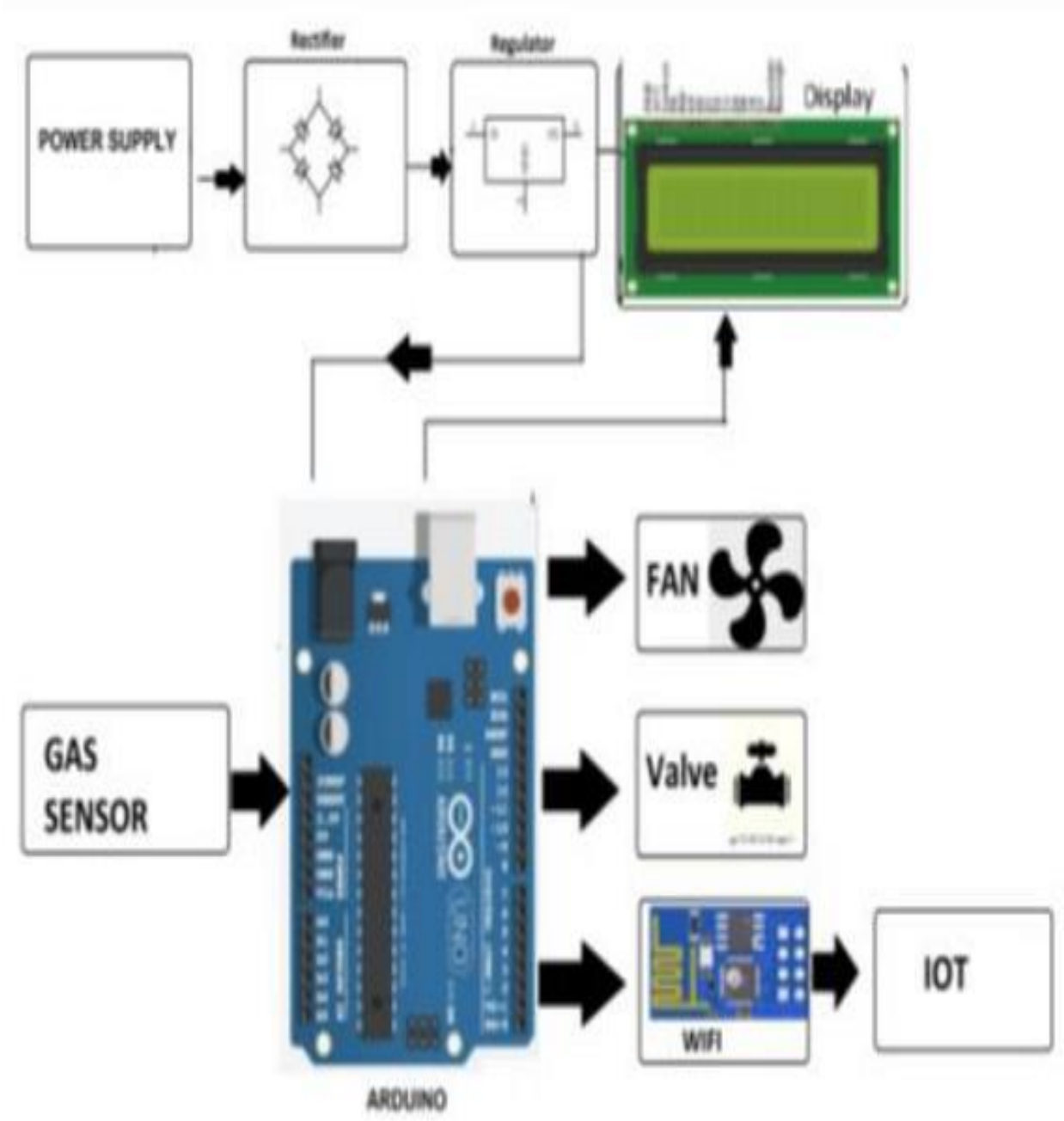
5.PROJECT DESIGN

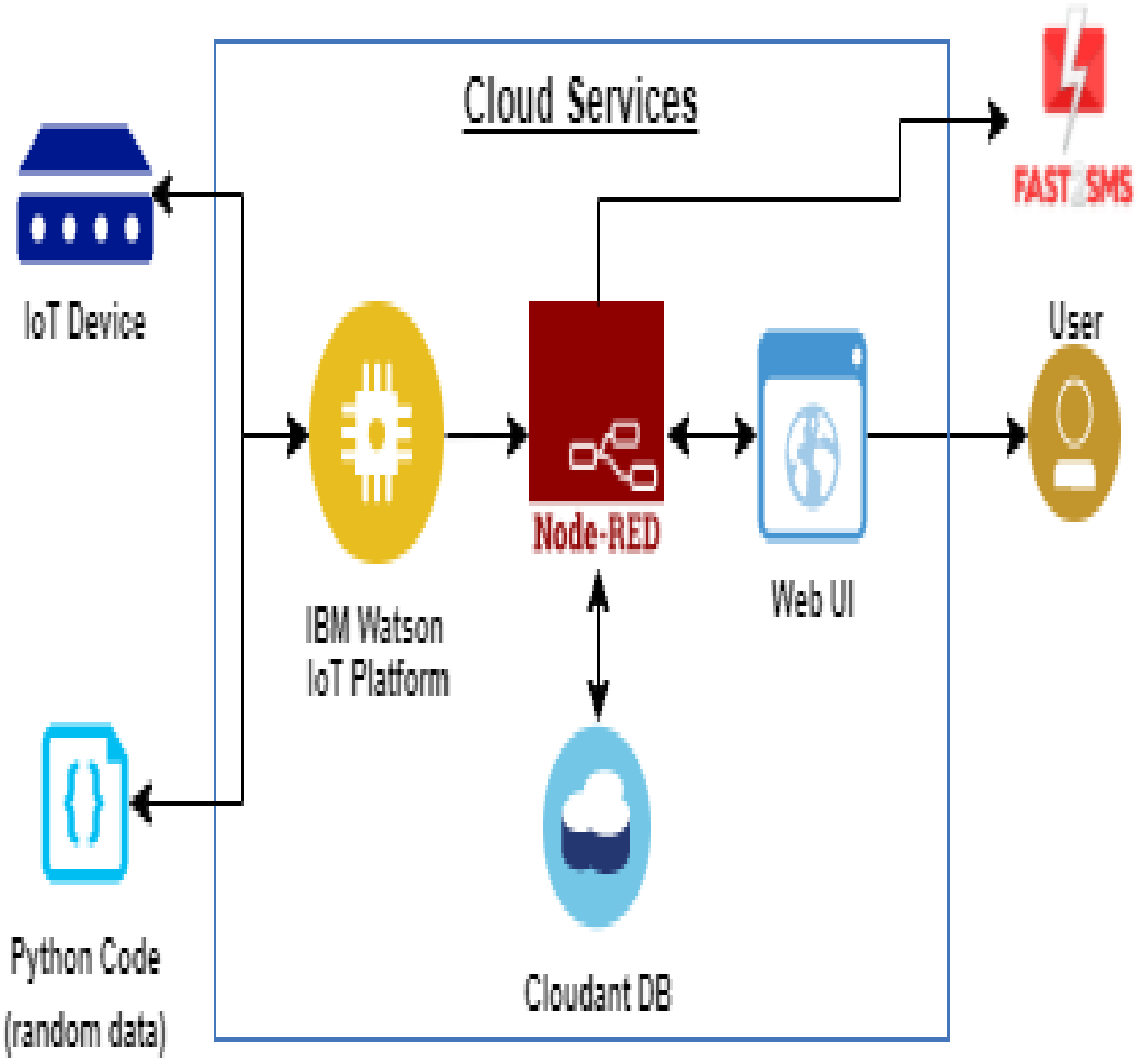
5.1 Data Flow Diagrams:

The classic visual representation of how information moves through a system is a data flow diagram (DFD). A tidy and understandable DFD can graphically represent the appropriate quantity of the system demand. It demonstrates how information enters and exits the system, what modifies the data, and where information is kept.



5.2 Solution & Technical Architecture:


Rectifier
Regulator
POWER SUPPLY
Display
FAN
GAS
SENSOR
Valve
WiFi
IOT
ARDUINO


Cloud Services
FAST SMS
IoT Device
User
Node-RED
IBM Watson
IoT Platform
Web UI
Python Code
(random data)
Cloudant DB

5.3 USER STORIES:

Functional Requirement (Epic)	User Story Number	User Story / Task	Story Point	Priority	Team Member
IDLE	USN-1	Installing the necessary applications, such as the Python IDLE	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
Checking the simulation with conditions	USN-1	Simulating the circuits and experimenting	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
Software	USN-2	IBM Watson IOT NODE-RED integration	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
Software	USN-2	Work flow	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
Application development	USN-3	Using MIT App Inventor create an App	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
Testing	USN-3	Testing the Application.	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
WEB UI	USN-4	User interface with the Software	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E

6.PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning and Estimation:

6.2 Sprint Delivery Schedule

Sprint	Functional Requirement	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resources Initialization	USN-1	Open APIs can be registered for, including the Open Weather Map API.	1	Low	Satheeswari E
Sprint-1	Local Server/Software Run	USN-1	Create a Python programme that responds to inputs like location and weather by producing outputs.	1	Medium	Priyadharshini T
Sprint-2	Push the server/software to cloud	USN-2	Put the code from Sprint 1 in the cloud so that anyone may view it.	2	Medium	Muthukumaran R
Sprint-3	Hardware initialization	USN-3	Integrate the hardware to enable input from and access to cloud services.	2	High	Saranya G
Sprint-4	UI/UX Optimization & Debugging	USN-4	Improve the user experience and optimise all the flaws.	2	Low	Saranya G

6.3 Milestone And Activity List

S.no	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Point	Priority	Team Member
1	IDLE	USN-1	Installing the necessary applications, such as the Python IDLE	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
2	Checking the simulation with conditions	USN-1	Simulating the circuits and experimenting	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
3	Software	USN-2	IBM Watson IOT NODE-RED integration	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
4	Software	USN-2	Work flow	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
5	Application development	USN-3	Using MIT App Inventor create an App	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
6	Testing	USN-3	Testing the Application.	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E
7	WEB UI	USN-4	User interface with the Software	2	High	Saranya G Muthukumaran R Priyadharshini T Satheeswari E

7.CODING AND SOLUTIONING:

- This is the code that was run in python idle version 3.7(64-bit), this code is used to

simulate the gas values, and acts as the input for the project.

- In this python code we simulate the levels of five gases Propane, carbon monoxide. LPG methane, Hydrogen, the units used is ppm.
- These values are integers and they are published as a d object to the website.

7.1Feature 1:

- A gas detection system is a fundamental requirement for safety in the oil and gas, hotel, and other sectors of the automotive industry as well as in locations where flammable gas is used frequently.

- Toxic gases including CO2, CO, and NOX are detected in industrial facilities using gas sensors driven by the Internet of Things (IoT).

- Particularly in the oil and gas sector, where a higher volume of gaseous products like propane, butane, and hydrogen are produced.

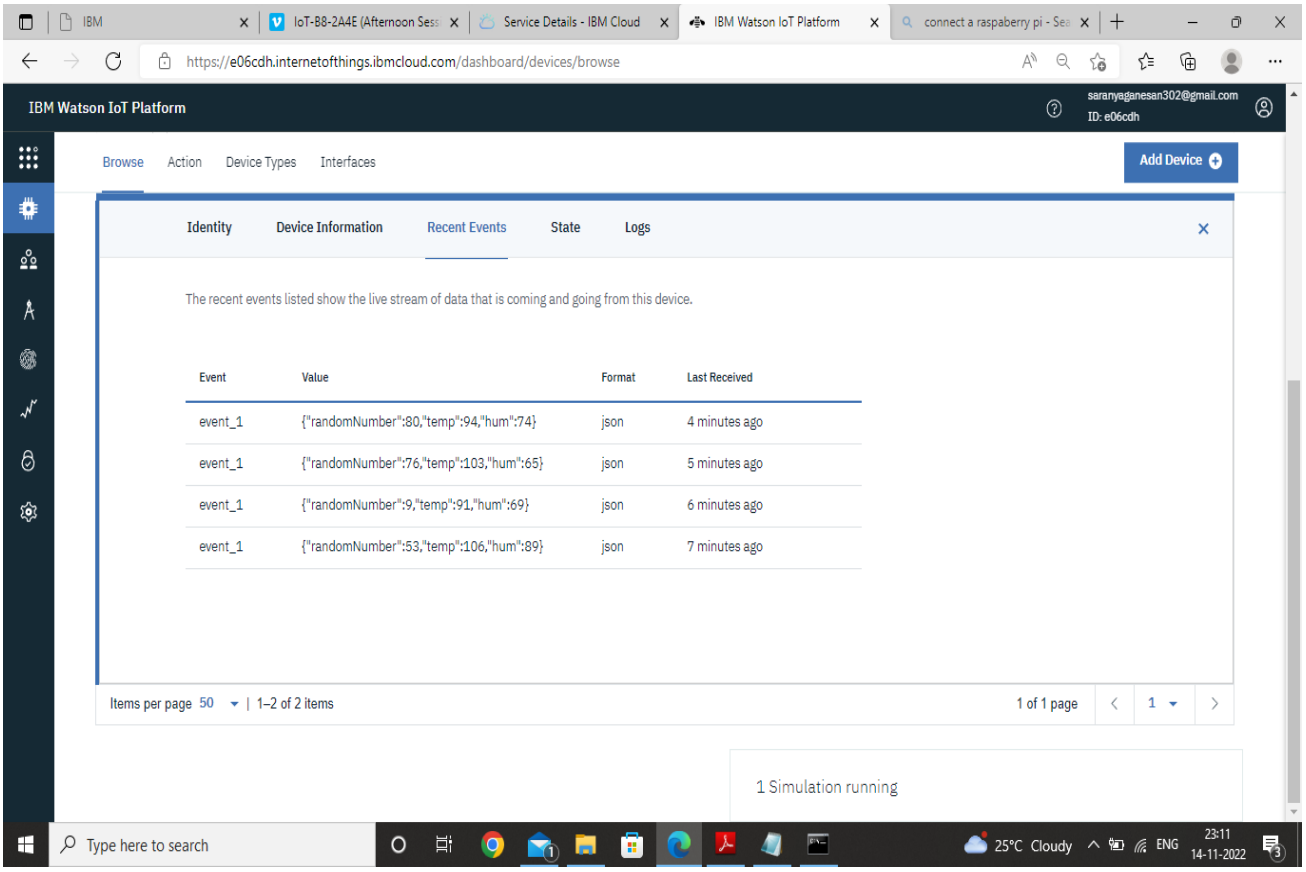
- As a result, there is a larger risk of gas explosion since these gases rapidly catch fire in an environment with lots of oxygen.

- In addition to these, poisonous gases like hydrogen sulphide (H2S) are created during the refining procedures, which could be harmful to the health of the workers.

7.2 Feature 2:

- ❖ This project aids businesses in keeping track of dangerous gas emissions from any place.
- ❖ The inspectors don't have to be present in the factory or plant to avoid being exposed to these dangerous fumes.
- ❖ In a number of industries, gas leaks can result in financial losses for the company, which can be reduced with the use of this technology.
- ❖ Administrators can view the sensor parameters and gas levels through the web application.

7.3Database Schema:




```
import time
import sys
```

```
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = &quot;s0uwr0&quot;
deviceType = &quot;weather_device&quot;
deviceId = &quot;vpsr_weather&quot;
authMethod = &quot;token&quot;
authToken = &quot;9mMbsPkwZ-NtBMUAPc&quot;

# Initialize GPIO
def myCommandCallback(cmd):
print(&quot;Command received: %s&quot; % cmd.data[&#39;command&#39;])
print(cmd)

try:

deviceOptions = {&quot;org&quot;: organization, &quot;type&quot;: deviceType,
&quot;id&quot;: deviceId, &quot;auth-
method&quot;: authMethod, &quot;auth-token&quot;: authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
#.....

except Exception as e:
print(&quot;Caught exception connecting device: %s&quot; % 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

Propane = random.randint(0, 2000);

Carbon_Monoxide = random.randint(0, 100);

LPG= random.randint(0, 2000);

Methane = random.randint(0, 1000);

Hydrogen= random.randint(0, 5000);

data = {"d":{

"Propane": Propane,

"Carbon_Monoxide":

Carbon_Monoxide, "LPG": LPG,

"Methane": Methane,

"Hydrogen":Hydrogen

}

}

#print data

def myOnPublishCallback():

print ("Published Propane = %s ppm" % Propane, "LPG = %s ppm" % LPG, "to

IBM Watson")

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,

on_publish=myOnPublishCallback)

if not success:

print("Not connected to IoTF")

time.sleep(1)

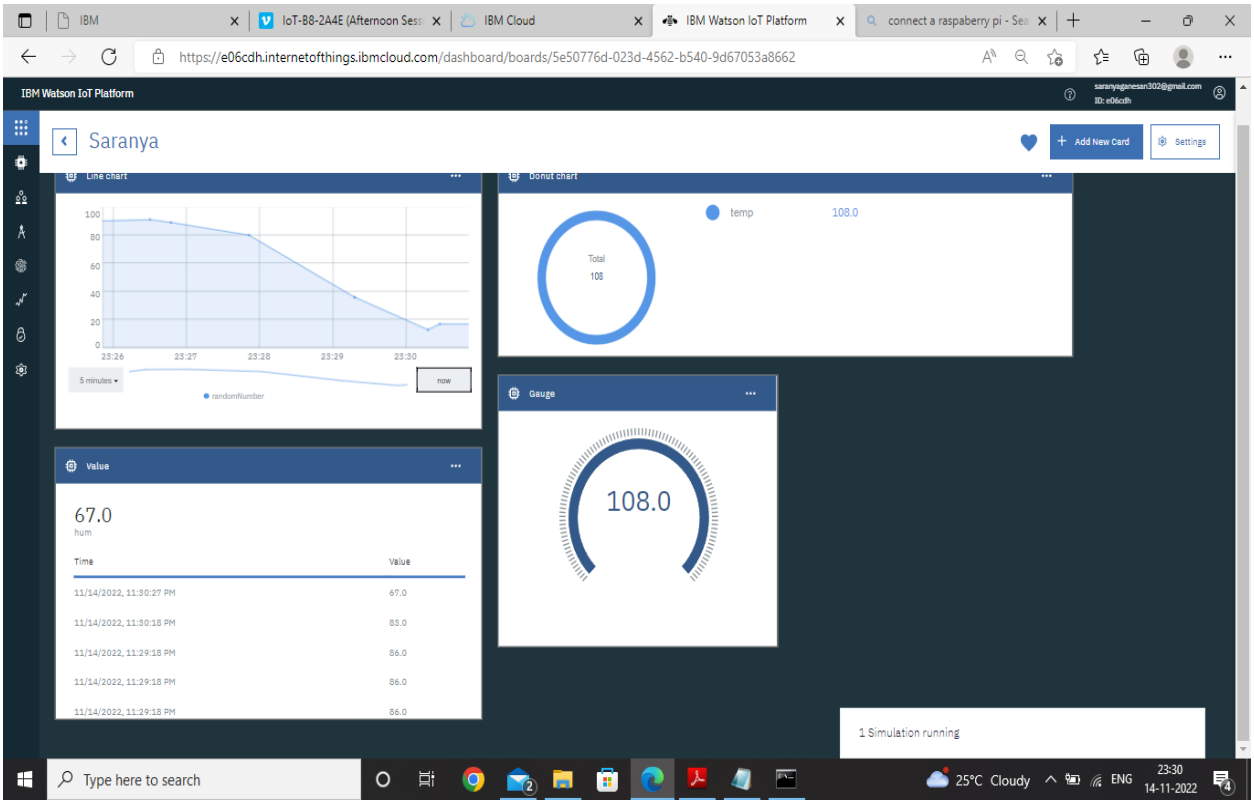
deviceCli.commandCallback = myCommandCallback

Disconnect the device and application from the cloud

deviceCli.disconnect()

8. RESULTS:

8.1Performance Metrics:



9. ADVANTAGES:

1. Receive instant notifications concerning the presence of gaseous substances in the atmosphere.

2. Prevent explosions and fire dangers.

3. Keep an eye on gas concentrations.

4. Observe worker well-being.

5. Current information about leaks.

6. Installation that is affordable.

7. Using data analytics to make better decisions**.**

8. Accurately gauge the oxygen level.

9. Obtain fast notifications for gas leaks.

10. Real time Application.

❖DISADVANTAGES:

1. It needs oxygen or air to function.

2. The heating of the wire causes it to react.

3. Lead, chlorine, and silicon can all make it toxic.

10.CONCLUSION:

- The SMS Gateway feature, which allows users to only receive warning information about gas leaks, and the alarm for the warning alert are both included in this gas leak detecting system. For example, the SMS Gateway has to be improved with features like alerting the user whenever the remaining credit amount is insufficient. These improvements can be applied to future development. Another area that can be improved is the sensor. The sensors in this module do not include any kind of notification for alerting the user whenever the sensor is malfunctioning or, in some cases, not connected to the micro-controller, so it is advised to include this feature in subsequent work for better improvement.

11.FUTURE SCOPE:

- We suggest constructing the system with an Arduino Uno microcontroller, an LCD display, and a MQ6 gas detection sensor.
- The gas sensor in this system is used to find any gas leaks. As soon as it detects a gas leak, the gas sensor sends a signal to the microcontroller.
- The micro controller analyses this signal, and an LCD message alerting the user to better refinement is displayed.

12.APPENDIX

12.1 Source Code:

```
#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);
}
```

12.2 GitHub:

https://github.com/IBM-EPBL/IBM-Project-3446-1658562278