IBM PROJECT

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

Batch: B8-2A4E

Team ID: PNT2022TMID21494

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Team Members:

- ARAVIND V
- KARTHICK S
- SURIYA B

CONTENTS

1. Introduction

1.1 Project Overview:

To Detect the leakage of toxic gas and to trigger an alert systemto activate the safety precautions using IoT devices and cloud services.

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 with exact location details. It also allows to monitor the gas levels continuously using the web UI.

1.2 Purpose:

Inhaling concentrated gas can lead to asphyxia and possible death.To overcome these disasters, we designed a system for monitoring and alerting the leakage of those harmful gases. This makes the industrialists get rid of the fear of any disasters caused bythe gases.

2. LITERATURE SURVEY

1, TITLE: Gas Leakage Detection System using IoT with integratednotifications using Pushbullet-A Review.

AUTHOR: M Athish Subramanian, Naveen Selvam, Rajkumar S,R Mahalakshmi, and J Ramprabhakar

This paper reviews the previous state of art and also have proposed a gas leakage detection system using MQ5 gas sensor and Arduino Uno controller is incorporated with a cloud storage for datacollection and also used for storing and analysing data. Gas leaked is converted from Parts per Million (PPM) to volts through the Arduino IDE and results in notifying the user when the threshold limit is crossed. The user is alerted via an application for quick notification through the internet and also through a buzzer /LED forphysical notification. The prime novelty of the proposal may be claimed as the usage of cloud storage for detection and notification.The system, though is simple and straight forward, can be very efficiently used for domestic purpose.

2, TITLE: Gas Leakage Detection Based on IOT

AUTHOR: Suma V, Ramya R Shekar, and Akshay Kumar A

The main idea of this paper is to carry out the literature review onIoT based gas detection techniques and to ensure the safety of peopleand surroundings. By presenting a simple yet reliable system, gas leakage detection system using MQ5 gas sensor and Arduino uno controller is incorporated with a cloud storage for data collection andalso used for storing and analysing data. Gas leaked is converted from Parts Per Million (PPM) to volts through the Arduino IDE andresults in notifying the user when the threshold limit is crossed. Theuser is alerted via an application for quick notification through the internet and also through a buzzer /LED for physical notification.

References:

[1] M Athish Subramanian, Naveen Selvam, Rajkumar S, R Mahalakshmi, and J Ramprabhakar Gas Leakage Detection Systemusing IoT with integrated notifications using Pushbullet-A Review. https://ieeexplore.ieee.org/document/9171093

[2] Suma V, Ramya R Shekar, and Akshay Kumar A Gas LeakageDetection Based on IOT.

https://ieeexplore.ieee.org/document/8822055

[3] Arun Manhas, Neeraj Chambyal, Manish Raina, Dr. SimmiDutta LPG Gas Leakage Detection Using IOT.

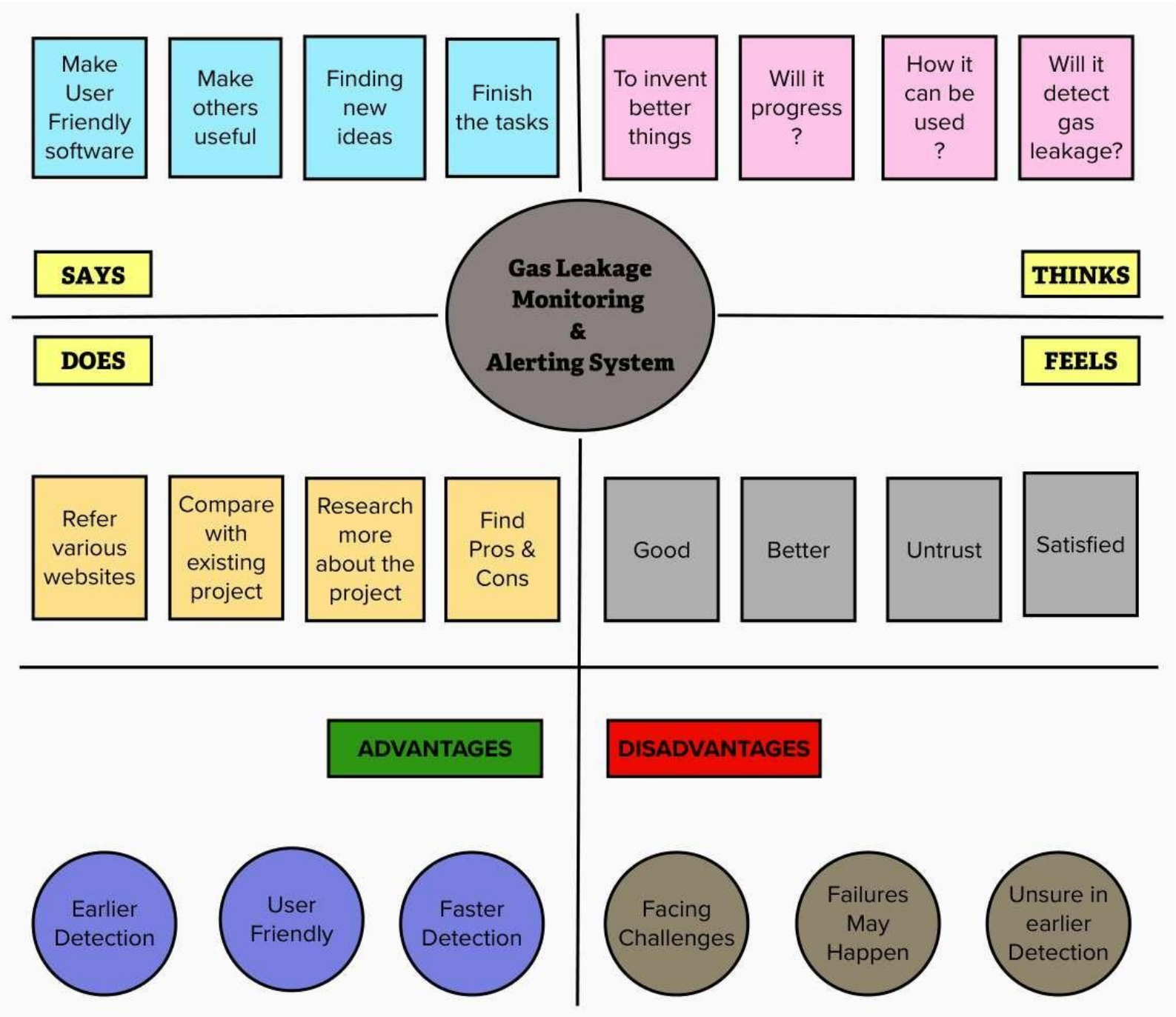
https://www.researchgate.net/publication/354309093_LPG_Gas_Leakage_Detection_Using_IOT

[4] LPG Gas Leakage Detection Using IOT Internet of Things (IOT)Based Gas Leakage Monitoring and Alerting System with MQ-2 Sensor.

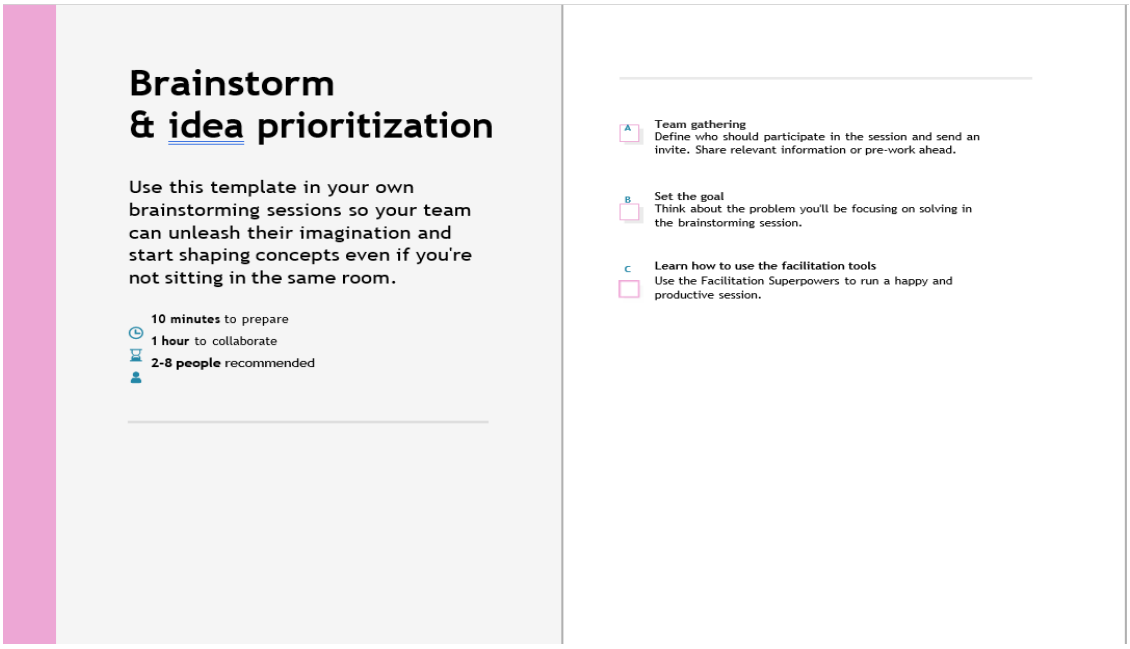
https://www.researchgate.net/publication/357768388_Internet_of_Things_IOT_Based_Gas_Leakage_Monitoring_and_Alerting_System_with_MQ-2_Sensor

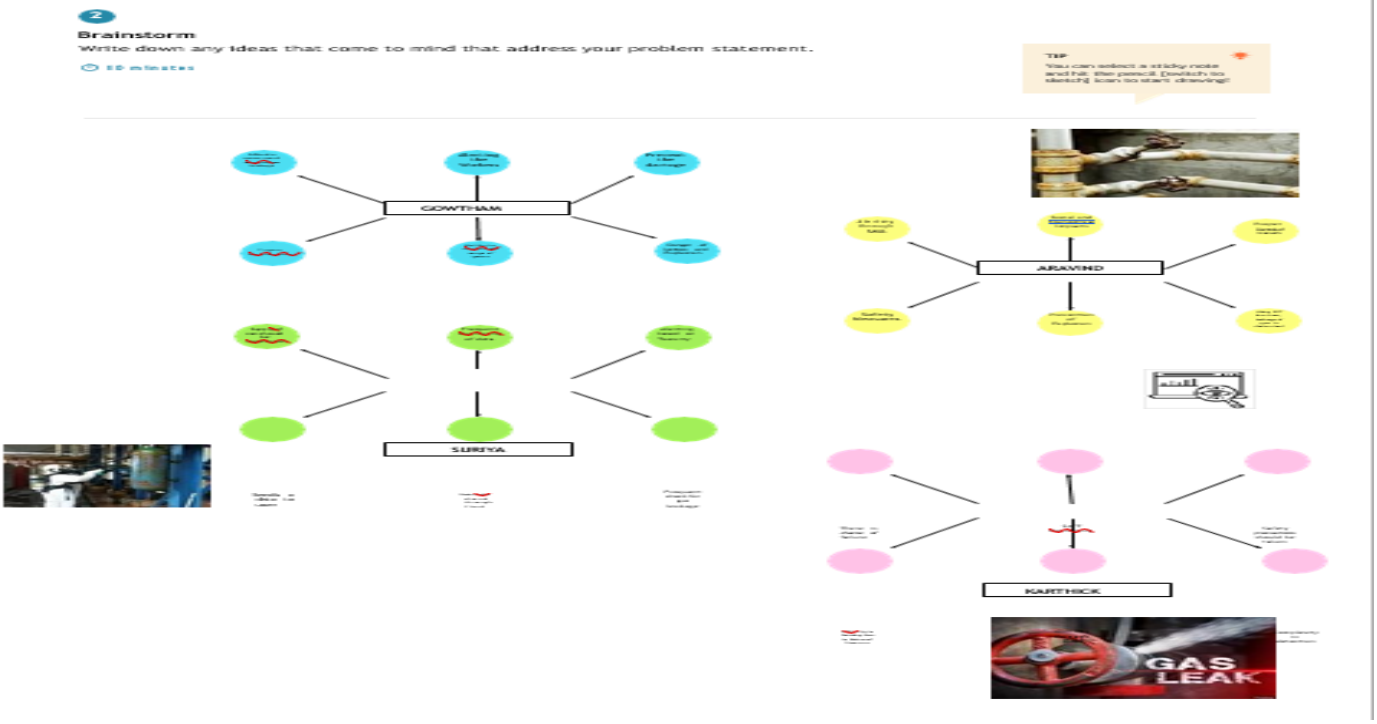
3. IDEATION & PROPOSED SOLUTION

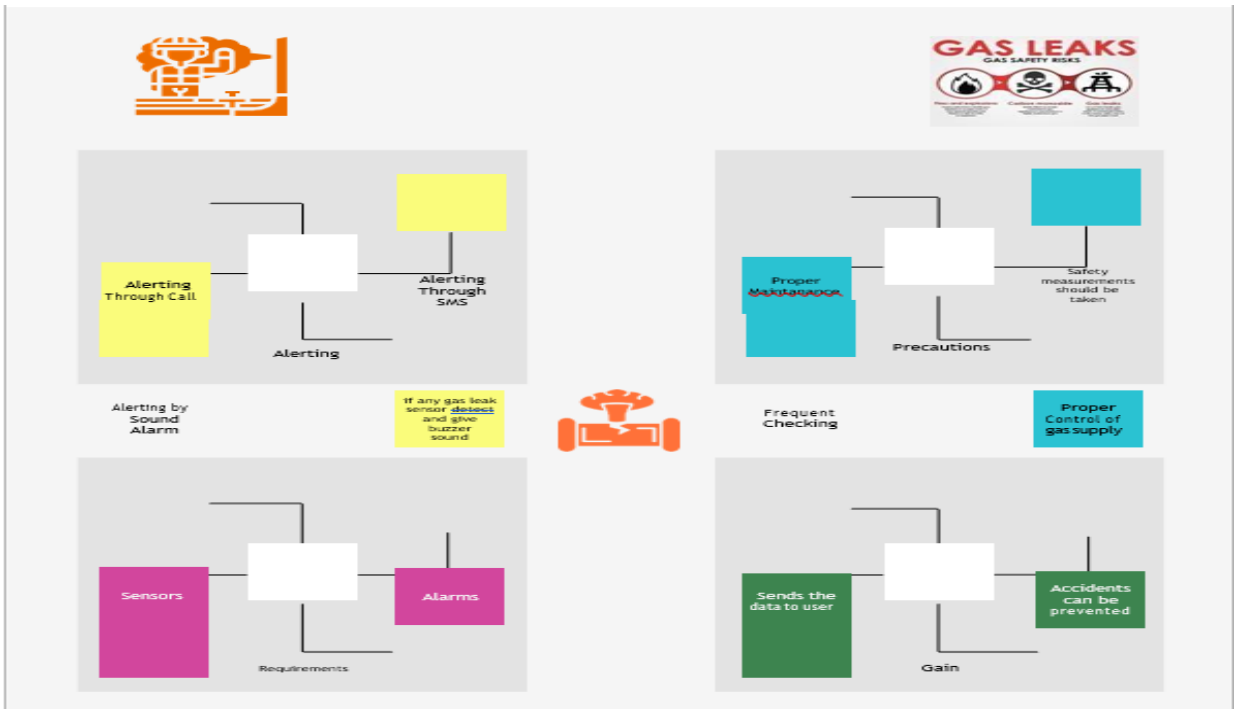
3.1 Empathy Map Canvas:

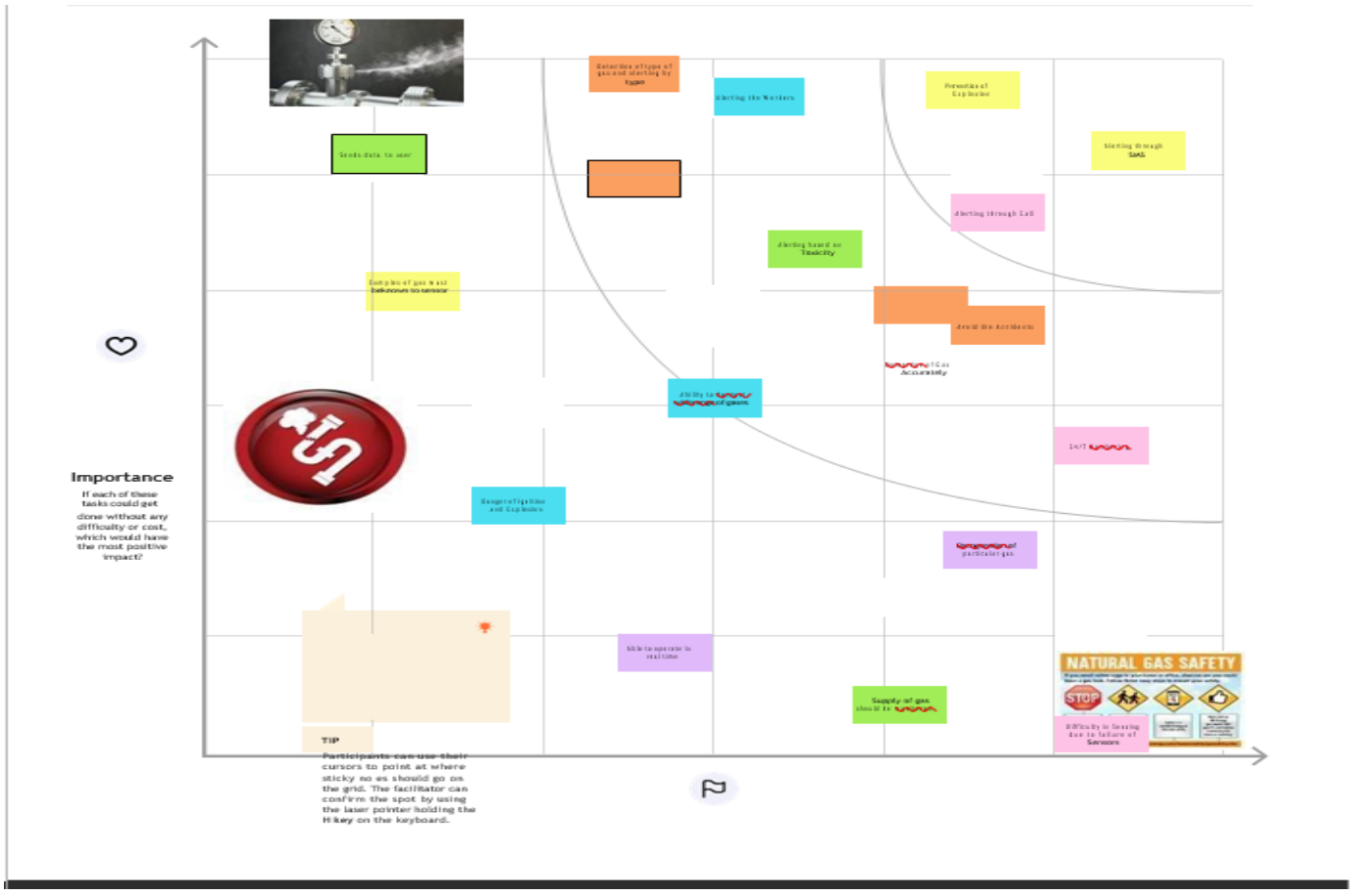


3.2 Ideation & Brainstorming:






GAS LEAKS
GAS SAFETY RISKS
Alerting Through Call
Alerting Through SMS
Alerting
Safety measurements should be taken
Precautions
Alerting by Sound Alarm
If any gas leak sensor detect and give buzzer sound
Frequent Checking
Proper Control of gas supply
Sensors
Alarms
Requirements
Sends the data to user
Accidents can be prevented
Gain


Importance
If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?
TIP
Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the H key on the keyboard.
NATURAL GAS SAFETY
STOP

3.3 Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To ensure the safety of workers in the industries, we develop an efficient system & an application to monitor the gas pipelines continuously and detect early if there is any gas leakage in thesurroundings. Generally in gas industries there aresome places that are too noisy. So,in those areas workers can't hear the siren sound when the gas leakage alerting system alerts.
2.	Idea / Solution description	□ If there is any gas leakage occurs inside the industry, the knob of the gas pipeline will automatically closed. □ If in any area gas leakage is detected the admins will be notified along with the readings. Through the MIT app. □ In the web application, admins can view the sensor parameters. □ The gas leakage level will be indicated by the LED lights. □ If the gas leakage is in critical level, the surrounding people will be notified through a siren/Buzzer. □ To detect the different harmful gases like methane, hydrogen sulphide, LPG, carbon monoxide etc, by using the required sensors.
3.	Novelty / Uniqueness	➢ Our solution not only notify the industry person but also notify the fire fighters ➢ Low latency ➢ The use of stepper motor helps to close the knob ➢ immediately if gas leakage is sensed

		➢ The position of the LED displays is placed on the conspicuous part ➢ It has the ability to detect various type of gases, not just of single type. Hence the system makes more efficient.
4.	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.
5.	Business Model (Revenue 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. ➢ They can't just installed and left they needed to get serviced.we can make profit by servicing ,upgrading, installing devices. ➢ No one wants to destroy their factory . so it's assured that our product will be sold and installed in every gas industries
6.	Scalability of the Solution	Alerting system over this methods offers quick response time and sends alert to people in short period of time.So that people can evaculate as fast as they can and also the workers in the industries can fix before the explosion as fast as they can.Even when the gas leakage is more, the product sense the accurate values and alerts the workers effectively

3.4 Problem Solution Fit:

PROBLEM-SOLUTION FIT

1. CUSTOMER SEGMENT(S)

For industry owner-Ensuring the safety of workers is the main thing Sometimes it is hard to identify from which area the leakage is occurring.
For homemakers-They are not able to identify whether the gas leakage is occurring due to external source or something.

6. CUSTOMER

1.Proper maintenance should be taken atleast once in a month and this prevents the customers from taking actions in gas Leakage problem.

2.The services can be done only by technicians, so it is difficult to set up gas leakage system in home/industries.

5. AVAILABLE SOLUTIONS

Usage of sensors to sense gas leakage.
GSM module helps us to get notification when there is gas leakage.

2. JOBS-TO-BE-DONE / PROBLEMS

Jobs-to-be-done:
Automatic nob closing
Switching off power supply
Problems:
If the cylinder is not maintained properly it cause problems.
Preferring cylinders under room temperature not in a hot area or cold places.

9. PROBLEM ROOT CAUSE

1.Sometimes sensor does not work properly which can cause the major problem.
2.It is difficult to identify difference between LPG gas and other gasses

7. BEHAVIOUR

1.Identifies the issues with the help of sensor.
2 Regular monitoring is done
3. Automatic registration when the cylinder is about to empty.

3. TRIGGERS

Identification of gas leakage will be done immediately and necessary measurements are taken incase of emergency.

4. EMOTIONS: BEFORE / AFTER

1.Customers feels safe by having this product in their environment.
2.Before, people worry about explosions and accidents occurs due to gas leakage but after using this product they can have a stressbest idea.

10. YOUR SOLUTION

1. Switching on/off of any electric device should be avoided.
2. Creating shortcuts in industries to evacuate everyone in case of gas Leakage.

8.CHANNELS of BEHAVIOUR

ONLINE:
Easy way to build relationship and interaction with people is done in a proper manner.

OFFLINE:
The customers prefer to visit professionals.
The products based on gas Leakage system is less.
Returning the product is easy.

4. REQUIREMENT ANALYSIS

4.1 Functional Requirement:

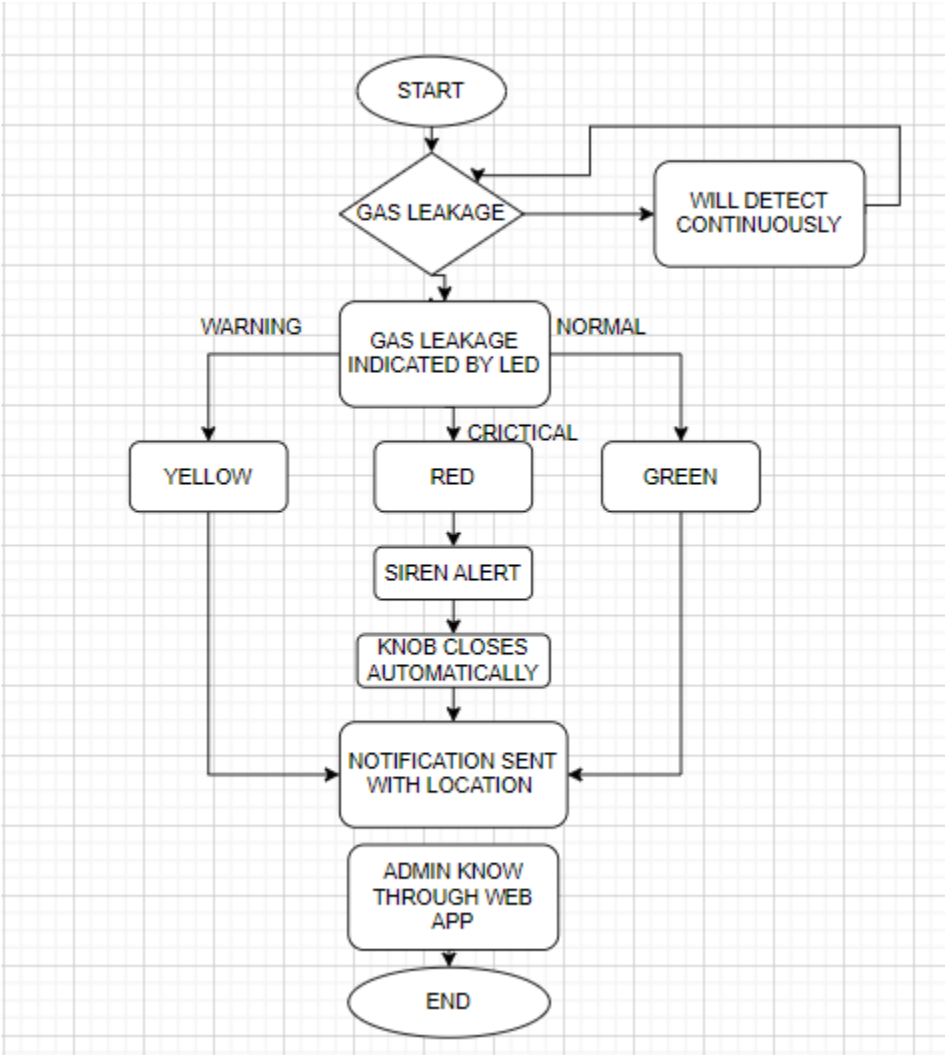
FR No.	Functional Requirement (Epic)	Sub Requirement (Story/Sub-Task)
FR-1	Objective	The purpose of the system is to detect early **gas leakage** in the industries through the **gas pipelines** and **alert** theuser with their location.
FR-2	Focus	To alert the user immediately if any gas leakage is **sensed**.
FR-3	Features	Gas leakage level will be indicated by the **LED lights**. It detects the different harmful gases like **methane, LPG** etc., byusing the required sensors. It updates the sensor parameters in web applications.
FR-4	Essentiality	To prevent the industry workers from being exposed to toxic gases.
FR-5	Gas leakage location sent	**Location sent to the web application** through GPS module.

4.2 Non-Functional Requirement:

FR No.	Non-Functional Requirement	Description
FR-1	Usability	The web application is **simple and easy** to use. Efficiency is high.
FR-2	Reliability	The application runs accurately.
FR-3	Availability	The application can be **accessed at anytime and anywhere**.
FR-4	Security	The web application is highly secure. Software is **protected from unauthorized access.**
FR-5	Scalability	Application is not limited to the users.

5. PROJECT DESIGN

5.1 Data Flow Diagrams:



5.2 Solution & Technical Architecture:

5.3User Stories:

User Type	Functional Requirement(Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirmingmy password.	I can access my account /dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation emailonce I have registered for the application	I can receive confirmationemail & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the applicationthrough Gmail	I will receive confirmationmail and access to dashboard.	Medium	Sprint-1
	Login	USN-4	As a user, I can log into the application byentering email & password		High	Sprint-1
Customer (Webuser)	Registration	USN-1	As a user, I can register for the application bygoogle.	I can access confirmation email.	High	Sprint-1
		USN-2	As a user, I can register for the application byfirebox.	I can access confirmationLogin.	low	Sprint-2
	Login	USN-3	As a user, I can register for the applicationthrough Gmail		Medium	Sprint-1
Administrator	Registration	USN-1	As a user, I can register for the applicationthrough web app.	I can access confirmationMy account	High	Sprint-1
		USN-2	As a user, I can register for the applicationthrough Mobile app.	I can access confirmationemail	low	Sprint-2

6. PROJECT PLANNING AND SCHEDULING

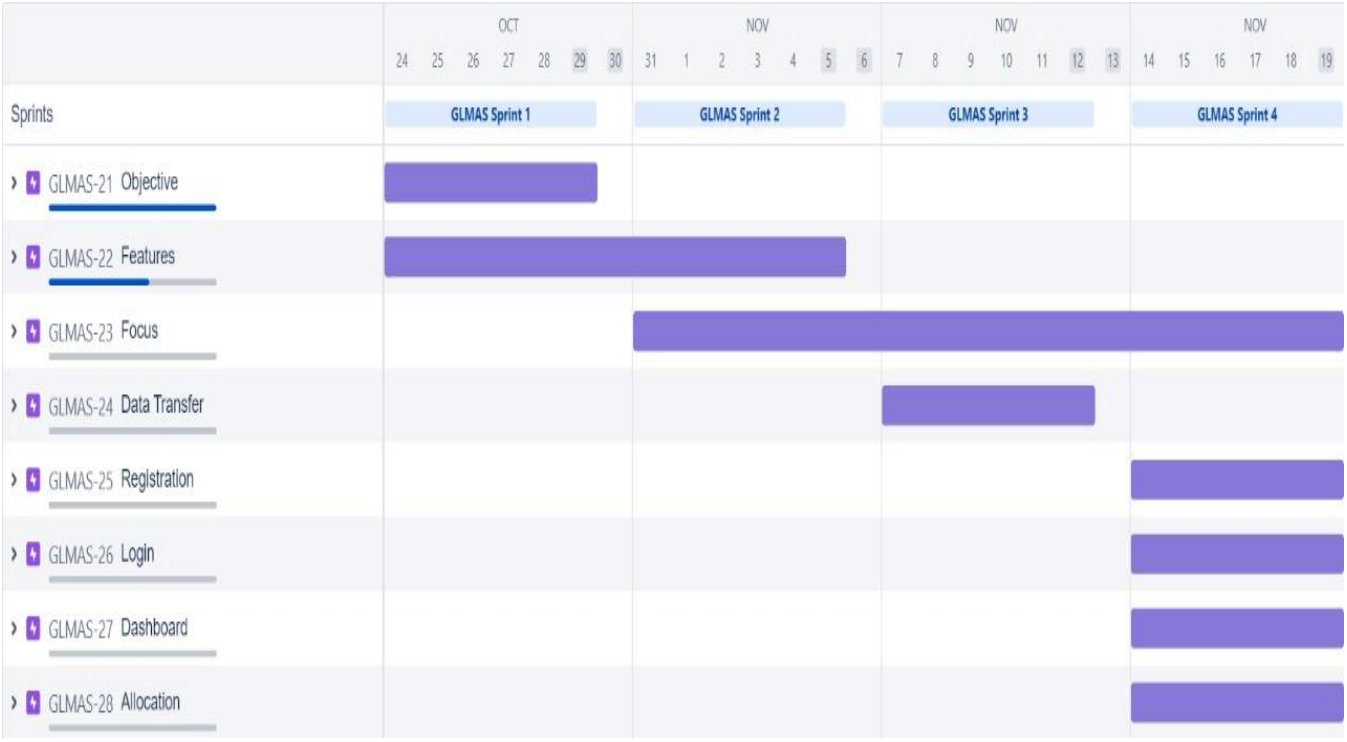
6.1 Sprint Planning & Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Features	USN-7	As a system, the gas leakage pipe should beclosed automatically once there it attains the threshold value	5	Medium	Karthick
Sprint-2	Features	USN-8	As a system, it will indicate that the gas leakagepipe is closed in the LCD screen and send SMS to the registered mobile number.	5	Medium	Suriya
Sprint-3	Data Transfer	USN-9	As a program, it should retrieve the API key of the IBM cloud to send the details of the system.	2	Low	Gowtham
Sprint-3	Data Transfer	USN-10	As a system, it should send the data of sensor values along with latitudes and longitudes to theIBM cloud	5	Medium	Aravind
Sprint-3	Data Transfer	USN-11	As a cloud system, the IBM cloud should sendthe data to Node Red	2	Medium	Suriya
Sprint-3	Data Transfer	USN-12	As a system, it should collect the data from the Node Red and give it to the backend of the mitapp.	3	Medium	karthick
Sprint-3	Data Transfer	USN-13	As an application, it should display the details of the gas level and other details to the userthrough the frontend of the mitapp.	8	High	Gowtham
Sprint-4	Registration	USN-14	As a user, I must first register my email andmobile number in the website	2	High	Suriya

6.2 Sprint Delivery Schedule:

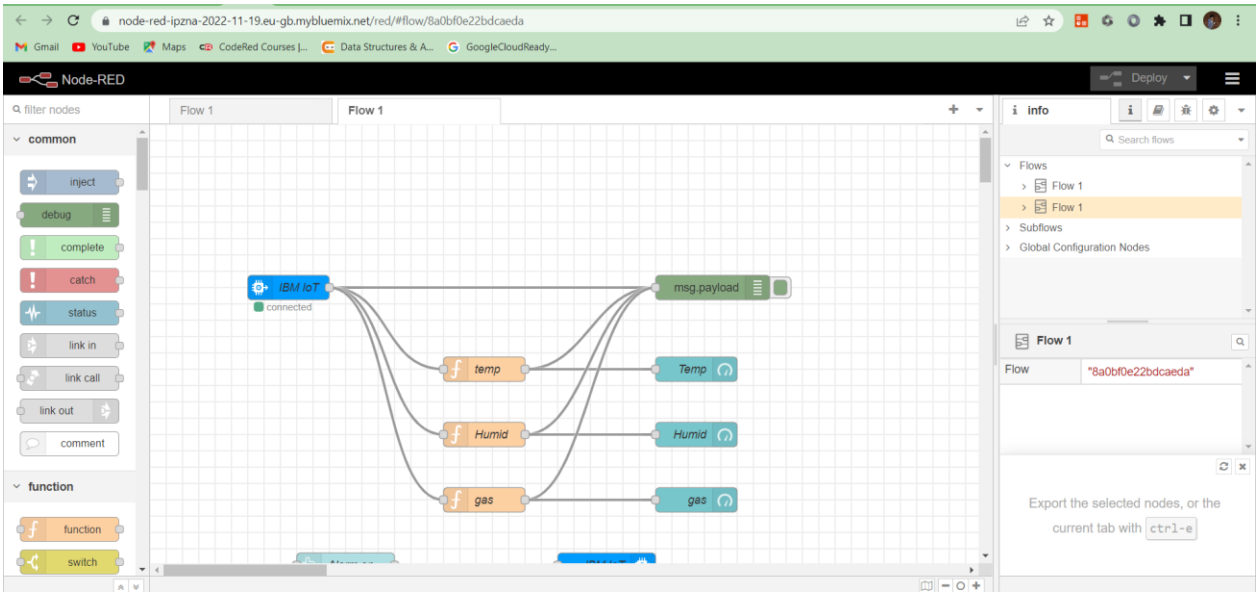
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	YES	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	NO	06 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	YES	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	YES	19 Nov 2022

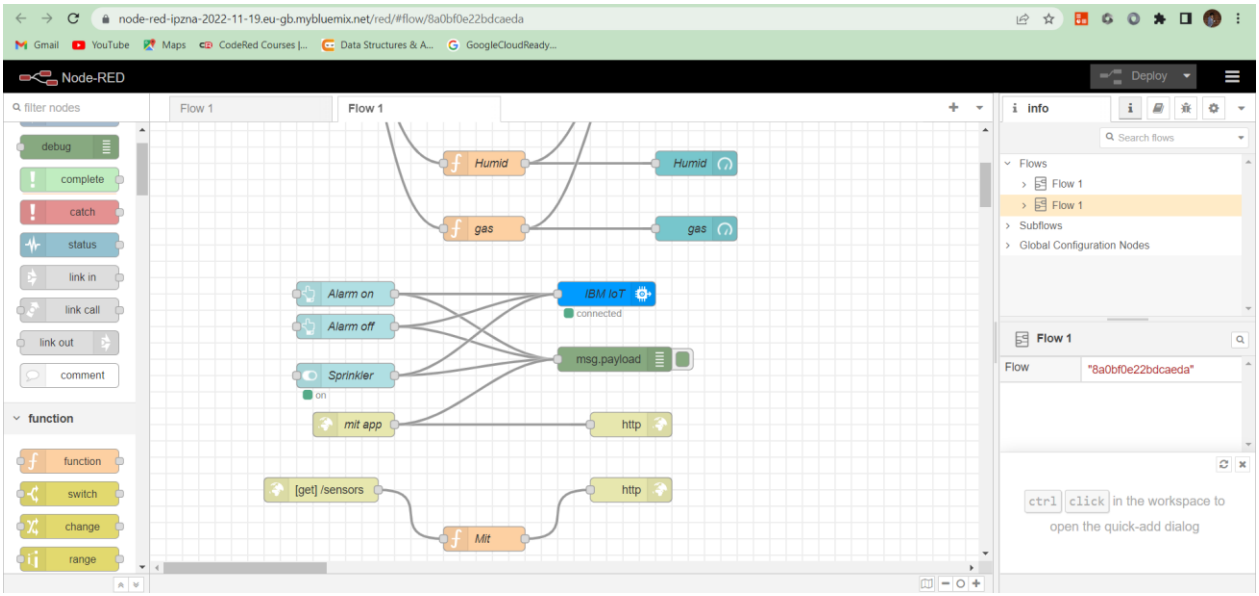
6.3 Roadmap:



7. CODING AND SOLUTIONING

7.1 Feature 1(Node Red Output)



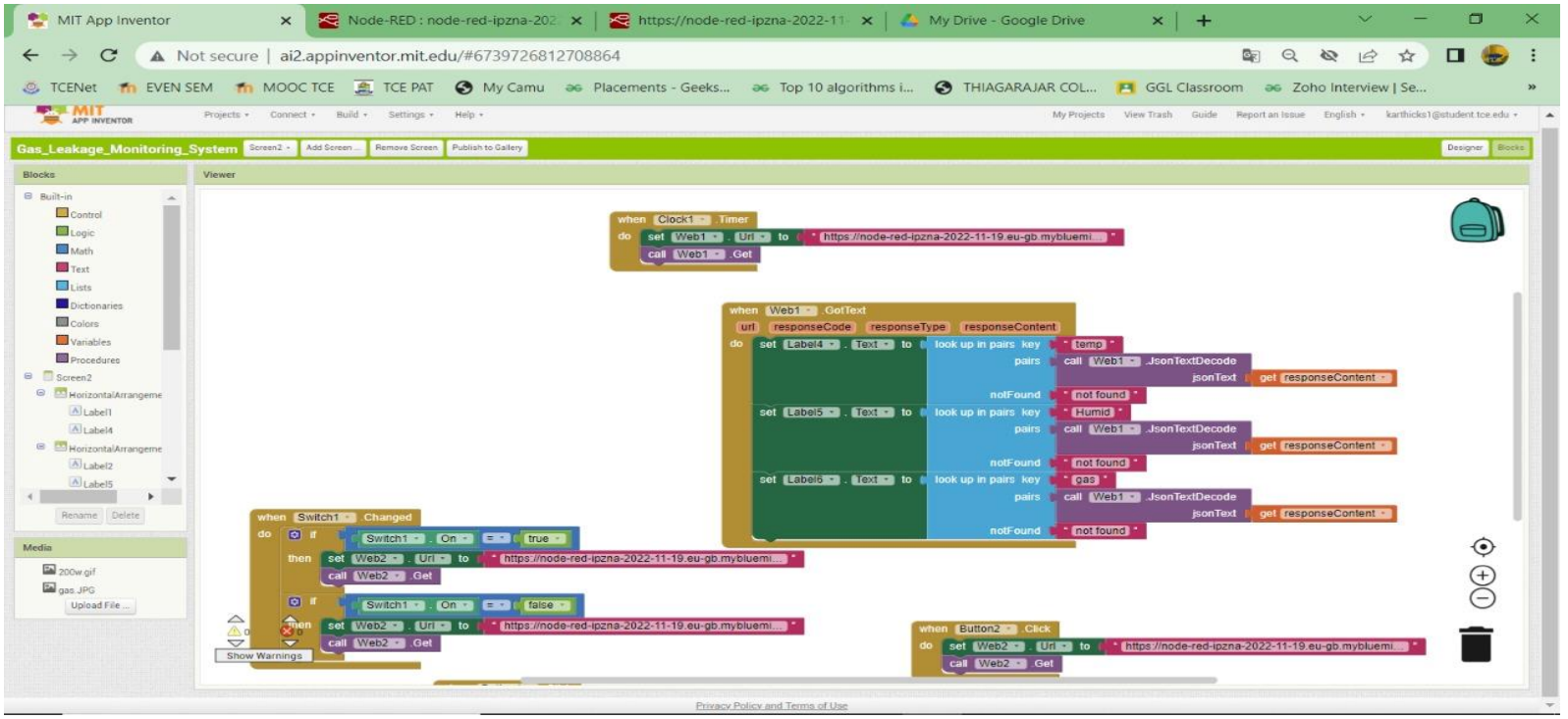


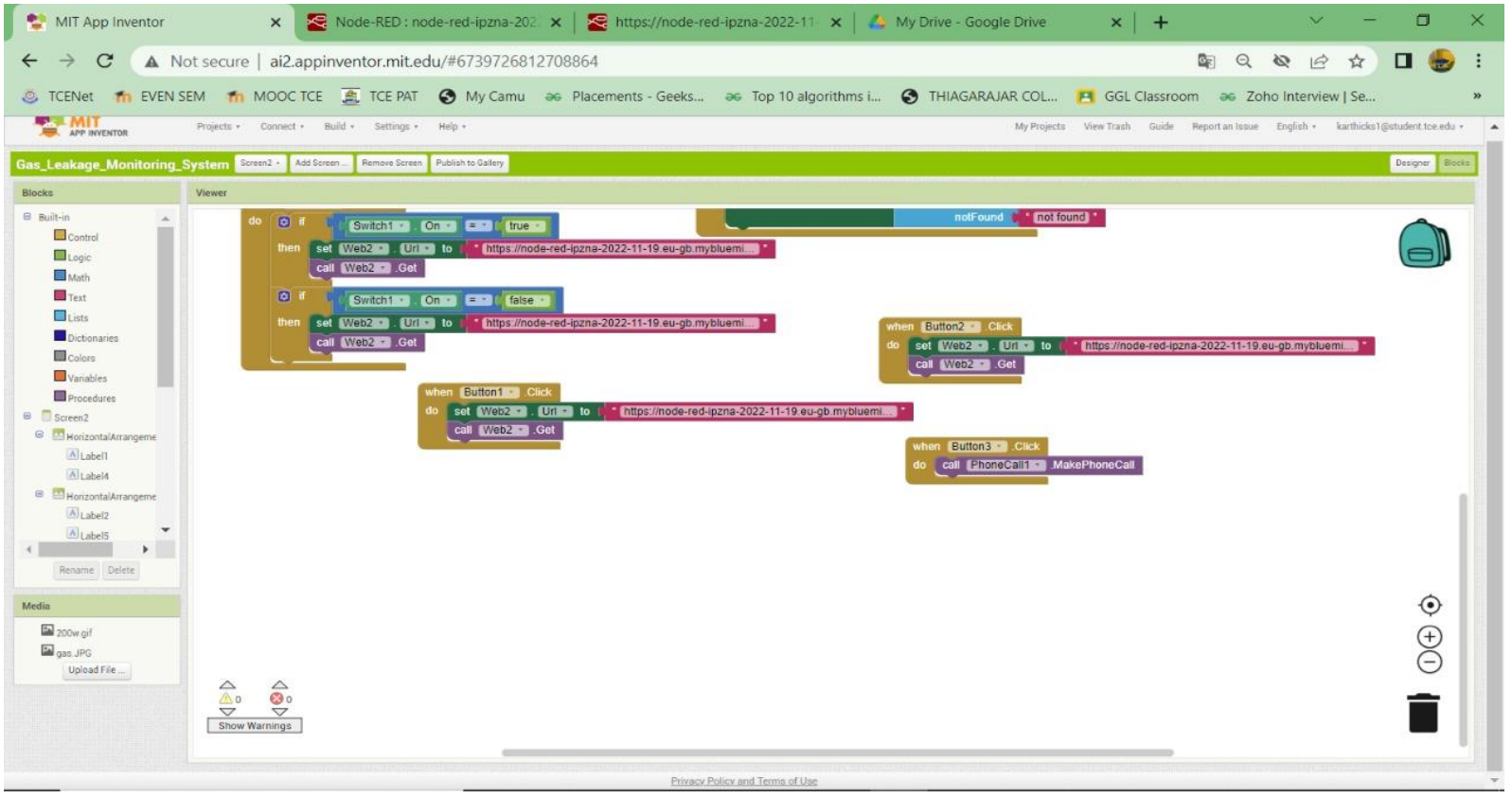
7.2 Feature 2: (Python code and Output)

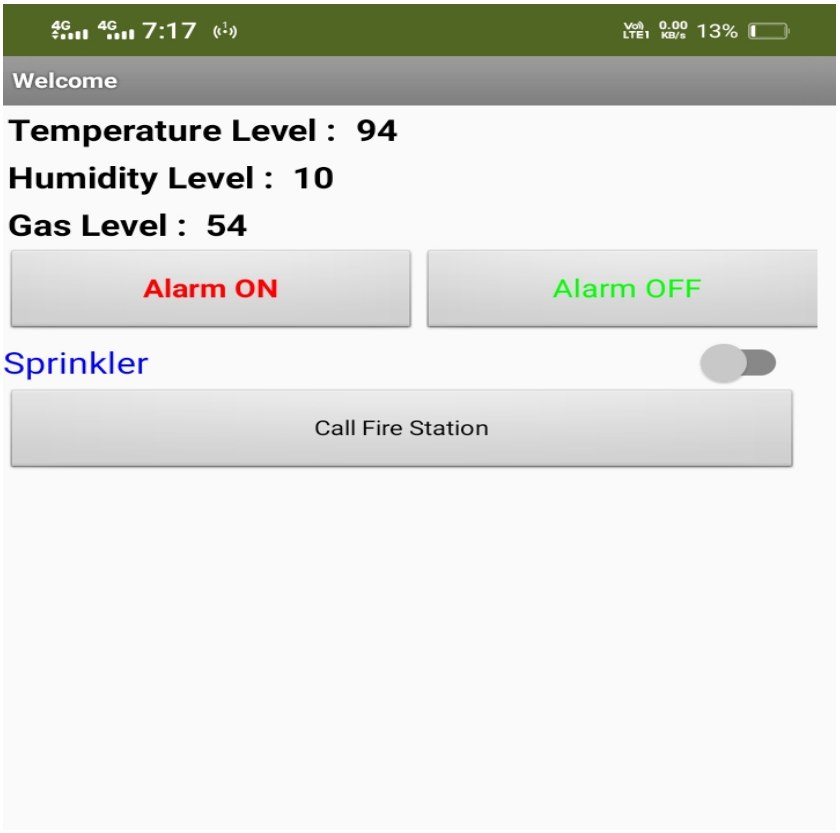
```python
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "0zi0vb"
deviceType = "gas"
deviceId = "11111"
authMethod = "-use-token-auth"
authToken = "54K5h+CW6(RXFZVFGX"
# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="alarmon":
        print ("Alarm is on")
    elif (status == "alarmoff") :
        print ("Alarm is off")

    elif status == "sprinkleron":
        print("Sprinkler is OFF")
    elif status == "sprinkleron":
        print("Sprinkler is ON")
     #print(cmd)
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 }
```

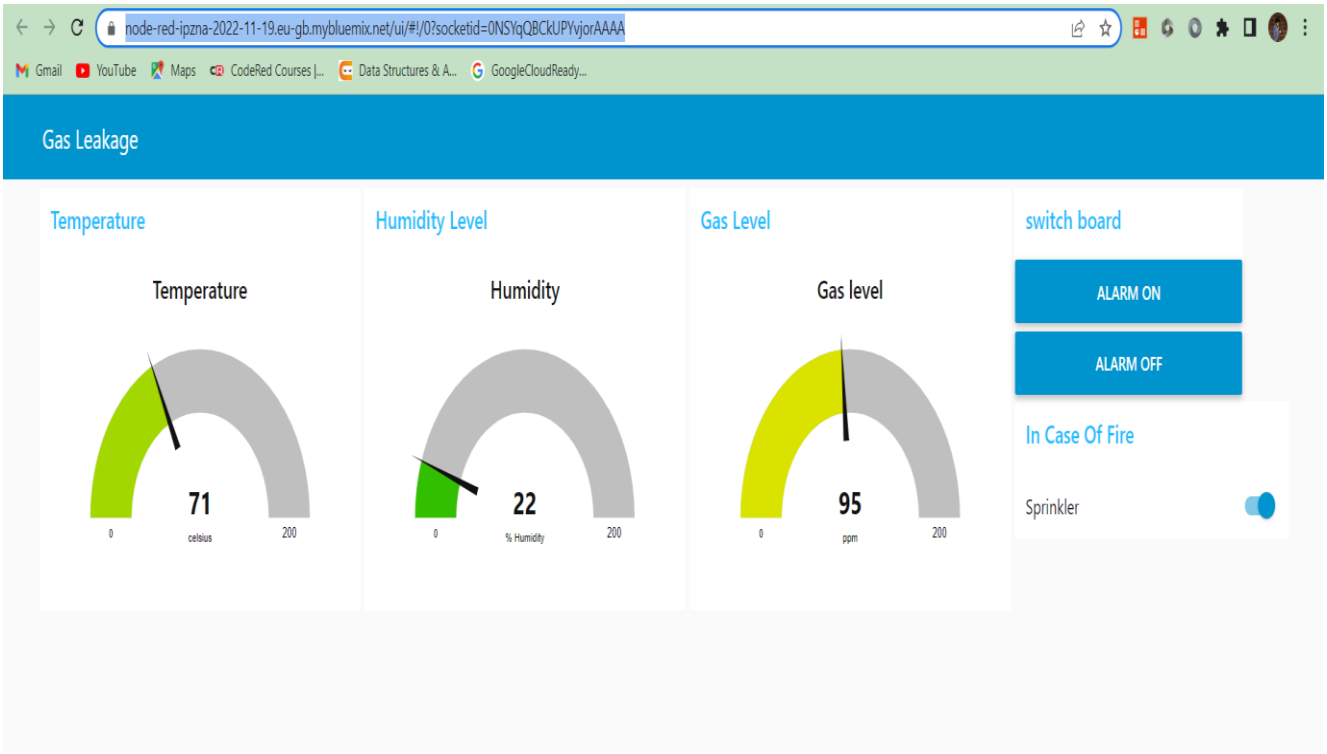
```
D:\sem7\New folder>python data.py
2022-11-19 12:51:50,886   ibmiotf.device.Client      INFO    Connected successfully: d:0zi0vb:gas:11111
Published Temperature = 36 C Humidity = 50 % Gas_Level =40 % to IBM Watson
Published Temperature = 22 C Humidity = 54 % Gas_Level =48 % to IBM Watson
Published Temperature = 0 C Humidity = 92 % Gas_Level =25 % to IBM Watson
Published Temperature = 38 C Humidity = 99 % Gas_Level =17 % to IBM Watson
Published Temperature = 64 C Humidity = 15 % Gas_Level =63 % to IBM Watson
Published Temperature = 76 C Humidity = 61 % Gas_Level =92 % to IBM Watson
Published Temperature = 14 C Humidity = 18 % Gas_Level =3 % to IBM Watson
Published Temperature = 44 C Humidity = 78 % Gas_Level =28 % to IBM Watson
Published Temperature = 31 C Humidity = 60 % Gas_Level =10 % to IBM Watson
Published Temperature = 87 C Humidity = 97 % Gas_Level =98 % to IBM Watson
Published Temperature = 69 C Humidity = 98 % Gas_Level =49 % to IBM Watson
Published Temperature = 67 C Humidity = 88 % Gas_Level =11 % to IBM Watson
Published Temperature = 60 C Humidity = 79 % Gas_Level =69 % to IBM Watson
Published Temperature = 75 C Humidity = 57 % Gas_Level =99 % to IBM Watson
Published Temperature = 68 C Humidity = 53 % Gas_Level =79 % to IBM Watson
Published Temperature = 11 C Humidity = 7 % Gas_Level =74 % to IBM Watson
Published Temperature = 40 C Humidity = 67 % Gas_Level =53 % to IBM Watson
Published Temperature = 86 C Humidity = 73 % Gas_Level =100 % to IBM Watson
Published Temperature = 61 C Humidity = 55 % Gas_Level =75 % to IBM Watson
Published Temperature = 63 C Humidity = 43 % Gas_Level =54 % to IBM Watson
Published Temperature = 51 C Humidity = 5 % Gas_Level =88 % to IBM Watson
Published Temperature = 10 C Humidity = 83 % Gas_Level =59 % to IBM Watson
Published Temperature = 85 C Humidity = 64 % Gas_Level =50 % to IBM Watson
Published Temperature = 58 C Humidity = 29 % Gas_Level =21 % to IBM Watson
Published Temperature = 70 C Humidity = 38 % Gas_Level =43 % to IBM Watson
Published Temperature = 74 C Humidity = 1 % Gas_Level =89 % to IBM Watson
```

7.3 Feature 3 : (UI - MIT app inventor and node red)






7:17
13%
Welcome
Temperature Level : 94
Humidity Level : 10
Gas Level : 54
Alarm ON
Alarm OFF
Sprinkler
Call Fire Station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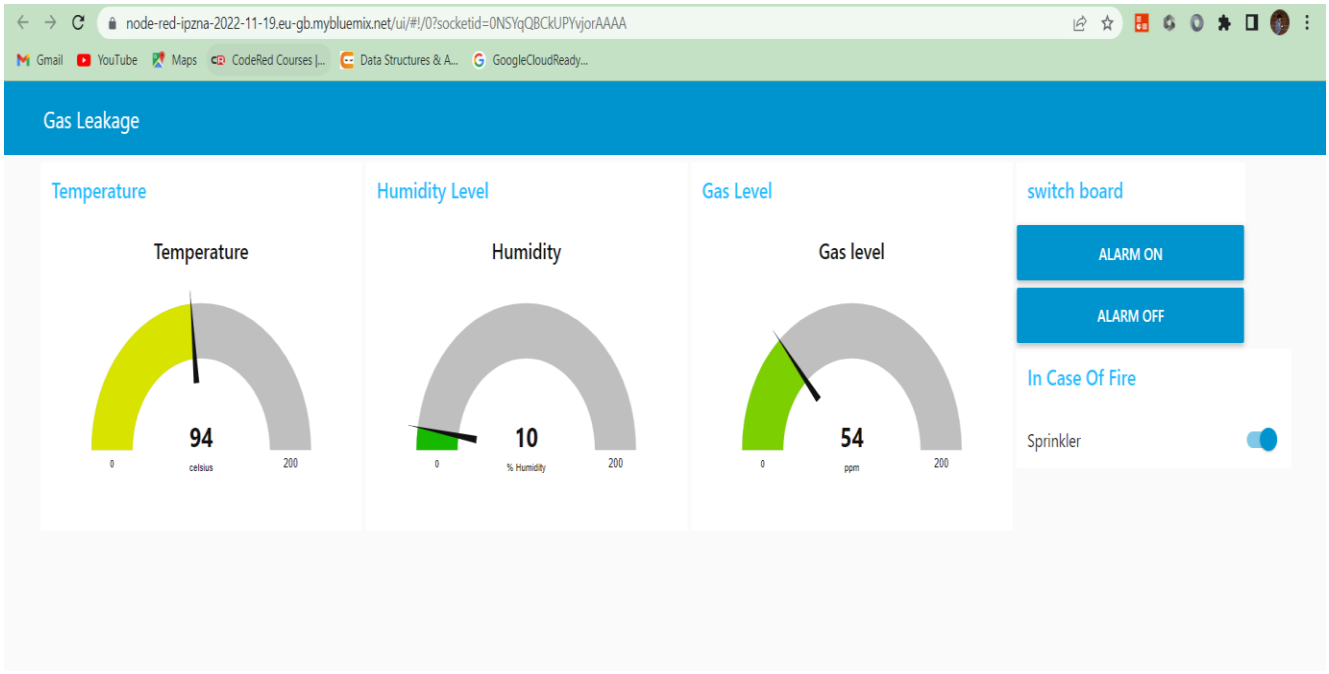
Gmail
YouTube
Maps
CodeRed Courses |...
Data Structures & A...
GoogleCloudReady...
Gas Leakage
Temperature
Temperature
71
0
celsius
200
Humidity Level
Humidity
22
0
% Humidity
200
Gas Level
Gas level
95
0
ppm
200
switch board
ALARM ON
ALARM OFF
In Case Of Fire
Sprinkler



8. TESTING

8.1 Test Cases:

https://drive.google.com/file/d/1BZ5PtlWAndxFK-ib3aTx_AmhKYWdUGyT/view?usp=sharing

8.2 User Acceptance Testing:

https://drive.google.com/file/d/1L5ydHnkSWOVEBkcU82J3tzUFalKvM7oi/view?usp=share_link

9. RESULTS

9.1 Performance Testing:

https://docs.google.com/spreadsheets/d/1KL8QzutbtyrB8QZnpFf5syc9swHtl_2e/edit#gid=191577308

10. ADVANTAGES AND DISADVANTAGES

Advantages:

- Detect the concentration of the gases
- The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises.
- Get real-time alerts about the gaseous presence in the atmosphere
- Prevent fire hazards and explosions
- Supervise gas concentration levels
- Ensure worker's health
- Real-time updates about leakages
- Cost-effective installation
- Data analytics for improved decisions
- Measure oxygen level accuracy
- Get immediate gas leak alerts

Disadvantages:

- Only one gas can be measured with each instrument.
- When heavy dust, steam or fog blocks the laser beam, the system will not be able to take measurements.

11 CONCLUSION

Gas leakage leads to severe accidents resulting in material losses and human injuries. Gas leakage occurs due to poor maintenance of equipment and inadequate awareness of the people. Hence, gas leakage detection is essential to prevent accidents and to save human lives. This paper presented LPG leakage detection and alert system. This system triggers buzzer and notification to alert people when gas leakage is detected. This system is basic yet reliable.

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. This system can be implemented in Industries, Hotels and wherever the gas 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 require 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 naive 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. Several medical equipment requires gas cylinders.

13 APPENDIX

Source Code:

- **Python code:**
  https://github.com/IBM-EPBL/IBM-Project-31373-1660199877/blob/main/DEVELOP%20A%20PYTHON%20SCRIPT%20TO%20PUBLISH%20AND%20SUBSCRIBE%20TO%20IBM%20IOT%20PLATFORM/data.py

GitHub and Project Demo Link:

- **GIT HUB:**
  https://github.com/IBM-EPBL/IBM-Project-31373-1660199877
- **PROJECT DEMO LINK:**
  https://drive.google.com/file/d/1tmbbX-RTm_obEljyaGDWEumujg1Vx9LS/view?usp=share_link