GAS LEAKAGE MONITORING AND ALERTING SYSTEM

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

REPORT

Submitted by

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CONTENTS

CHAPTER-1

INDRODUCTION

The home safety detection system is becoming very crucial for people's protection. Since everyone in the household works every day, it is impossible to check on the household appliances, particularly the LPG gas cylinder, wired circuits, etc. Liquefied petroleum gas (LPG) and natural gas demand has significantly increased during the past three years. LPG and natural gas are recommended to meet this high level of energy demand and to substitute oil or coal due to those fuels' negative environmental effects. Large-scale applications for these gases include industry, heating, home appliances, and motor fuel. The system has a MQ6 gas sensor to monitor this leakage gas. This sensor detects how much leak gas is there in the environment around it. Explosions or being harmed by gas leaks could be avoided in this way.

1.1 PROJECT OVERVIEW

The Internet of Things (IOT) is a network of gadgets, automobiles, and home appliances that include the hardware, software, actuators, and networks required for interoperability, cooperation, and information exchange. IOT requires extending the Internet network to a wide range of physically flawed or non-web capable physical devices and ordinary things in addition to more conventional devices like workspaces, workstations, smartphones, and tablets. Remote monitoring and control are possible thanks to these contemporary technologies' ability to connect to the Internet and communicate with one another. The aid of this programme in monitoring hazardous gas emissions benefits the industries. In order to stop the release of gases in various areas, the gas sensors will be integrated to track gas leakage.

1.2 PURPOSE

This project aids businesses in keeping an eye on gas emissions that are dangerous. To track gas leaks, the gas sensors will be integrated in a number of locations. The administrators will be contacted and given the location if a gas leak is found in any region. The web application's admin panel allows users to view sensor parameters. The usage of gas detectors includes the detection of combustible, flammable, and toxic gases as well as the loss of oxygen. They can also be used to identify other contaminants or gas leaks. It emits a warning sound in the region where the leak happens and tells users to get out of there.

CHAPTER -2

LITERATURE SURVEY

2.1 EXISTING PROBLEM

In industries, the current the issue with gas monitoring is that there isn't an effective system for keeping track of gas leaks, and the good systems are expensive and difficult to install. Additionally, the system's cost is considerable, it occasionally causes disasters, there are an unpredictably large number of sensors, and the equipment is improperly positioned.

2.2 REFERENCES

CASE STUDY – I

TITLE: Methane Leakage Monitoring Technology For Natural Gas Stations And Its Application

AUTHOR: B. Han, Q. Fu, Y. Huang and H. Hou

YEAR: 2001

ABSTRACT:

Leakage monitoring methods are crucial in natural gas stations for quickly discovering gas leaks and limiting the different losses they generate. Taking into account the drawbacks of the current leakage monitoring technologies used for the natural gas stations, such as the high false alarm rate, poor stability, easy to be interfered by background gas, etc., the Fiber Bragg Grating (FBG) sensing technology is applied to monitor key areas and equipment in natural gas stations that may suffer methane leakage. Monitoring the leaking vibration and methane concentration simultaneously can significantly lower the false alarm rate. Laboratory testing results show that the monitoring method suggested in this work has high reliability, low cost, and is simple to install. It may be widely used to monitor methane leakage in natural gas stations and valve chambers of long-distance and collection pipelines.

CASE STUDY – II

TITLE: GSM based LPG leakage detection and controlling system.

AUTHOR: Prof.M.Amsaveni, A.Anurupa, R.S.Anu Preetha, C.MalarvizhiM.Gunasekaran

YEAR: 2015

ABSTRACT:

Gas leakage is a major problem with industrial sector, residential premises etc. One of the preventive methods to stop accident associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this project is to present such a design that can automatically detect, alert and control gas leakage. In this project, after the leakage of gas is detected, the valve is automatically closed, thereby stopping the leakage. Then the electric power supply is also shut down to prevent fire accidents. In particular, gas sensor has been used which has high sensitivity to gases like propane and butane. Gas leakage system consists of GSM module, which alerts the user by sending SMS.

CASE STUDY – III

TITLE: Implementation of Ammonia Gas Leakage Detection & Monitoring System using Internet of Things

AUTHOR: J. Vijayalakshmi, G. Puthilibhai and S. R. L. Siddarth.

YEAR: 2019

ABSTRACT:

The Internet of things is the way we connect various components with internet connectivity and achieve communication. Through an embedded computing system, everything is uniquely identified and can form a world-wide interactive network which performs various functionalities. This paper implements the ammonia gas leakage detection via a monitoring system with the help of ammonia gas sensor (MQ135), using the concept of the Internet of Things. Ammonia Gas sensor (MQ135) sense and detect a large amount of ammonia gas present in the lab, industries, factories, health care, etc, High concentration of Ammonia results in blindness, lung damage or death. Whenever ammonia gas reaches a threshold level provided in the MQ135 Sensor, the buzzer in the Ammonia Gas Sensor goes

off alerting the officials. The Electrochemical principle on which the system operates. Electrochemical sensors measure the partial pressure of gases under atmospheric conditions. The ambient air is monitored and diffused with the help of a membrane by the liquid electrolyte in the sensor. The system we implement collects data about the various levels of ammonia gas at various times daily and also it is possible to generate graph whenever is needed with the data sensed. The system we propose can be easily made a working model anywhere. The model we propose is much cheaper and efficient as combined with leading IT technology. This paper implements the use of a gas monitoring system in labs to detect the ammonia levels present in the air, processed and notified through the Internet Of Things.

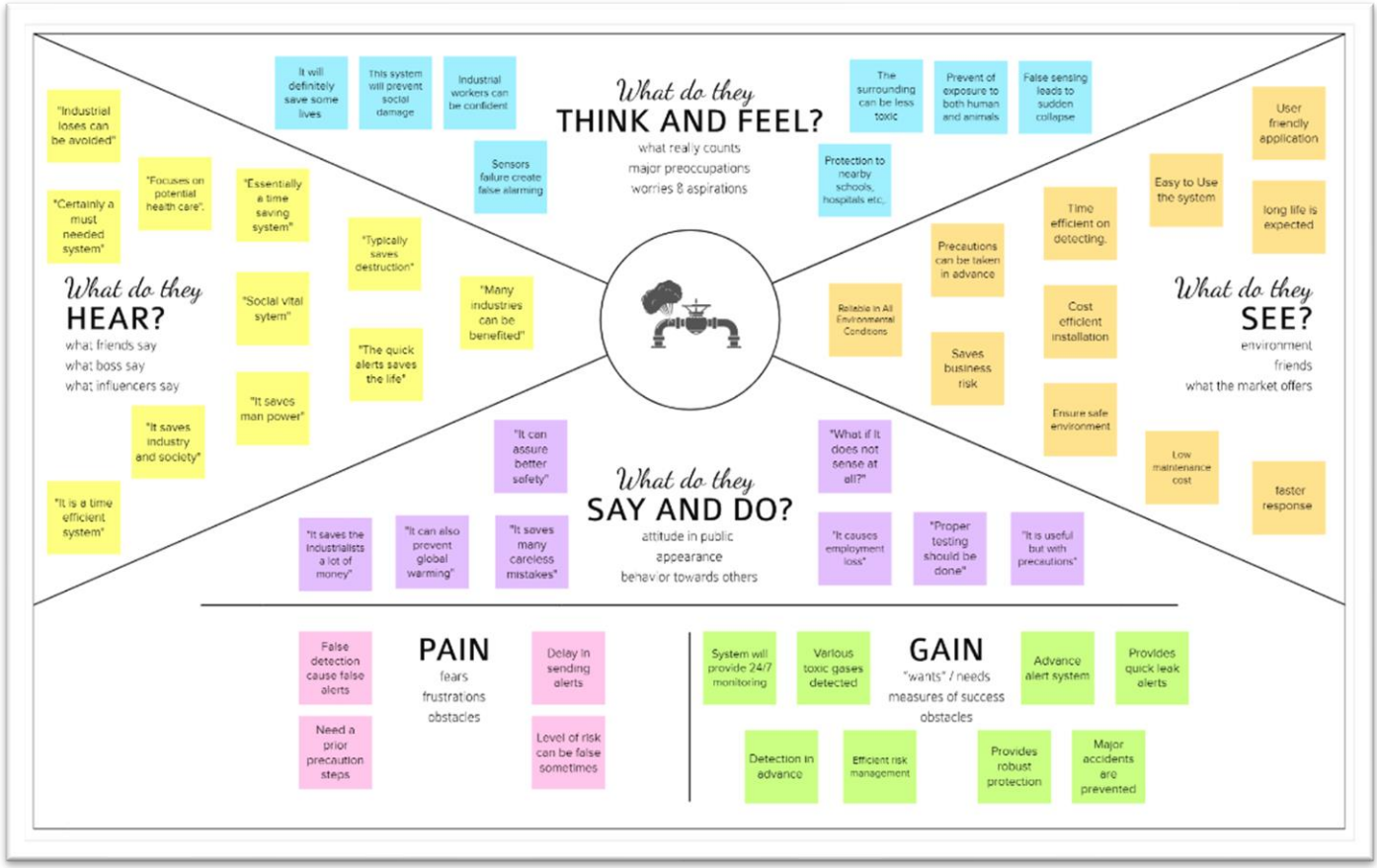
2.3 PROBLEM SOLUTION DEFINITION

The industrialists feel uneasy handling the gases since the quantity of sensors is uncertain. Additionally, the expense of the goods and the difficulty of implementing the systems are both significant. Customers occasionally feel let down by this. We develop a system for monitoring gas leakage in the industry and control the leakage, making the installation proposal simple.

CHAPTER 3

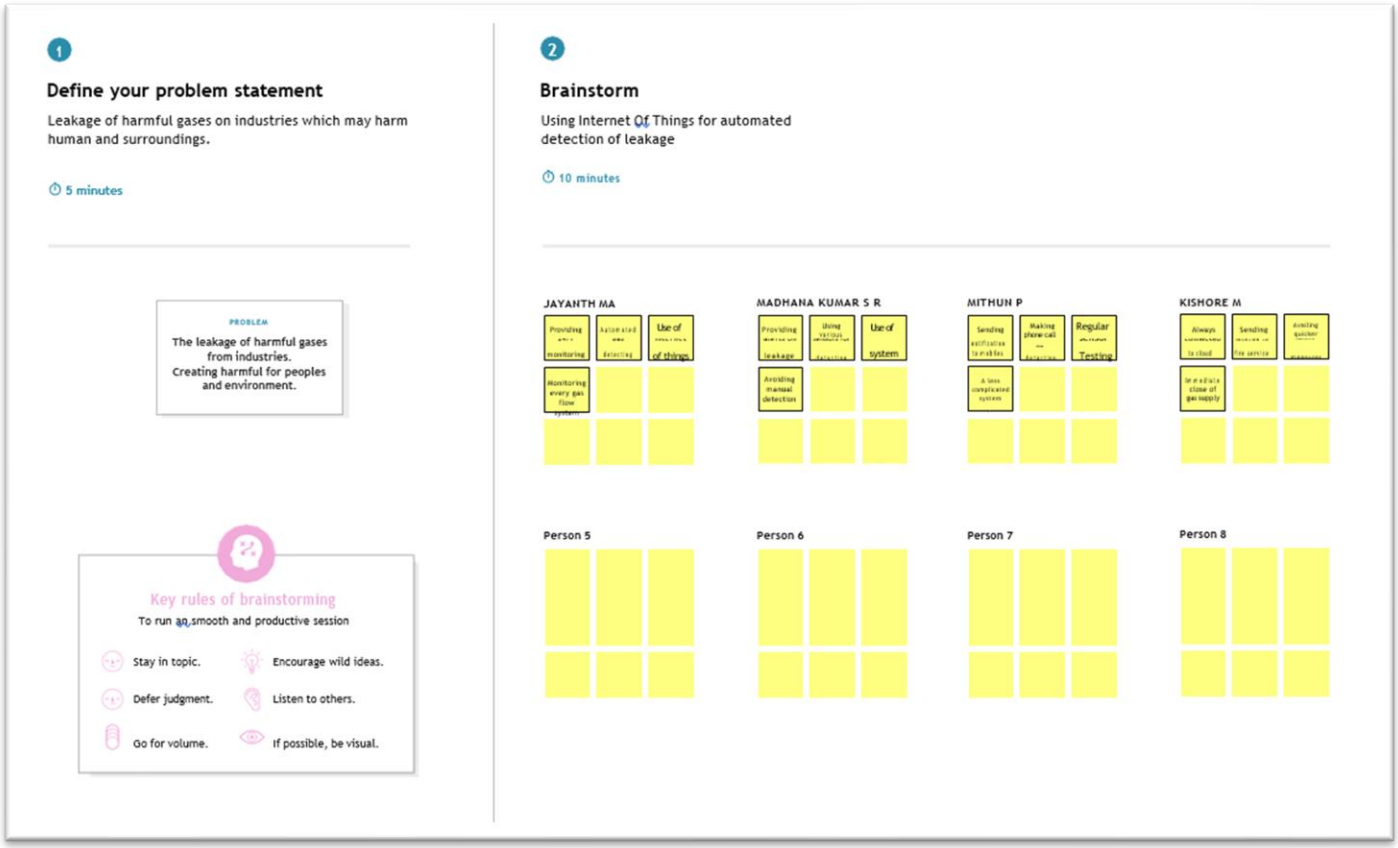
IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION AND BRAINSTORMING

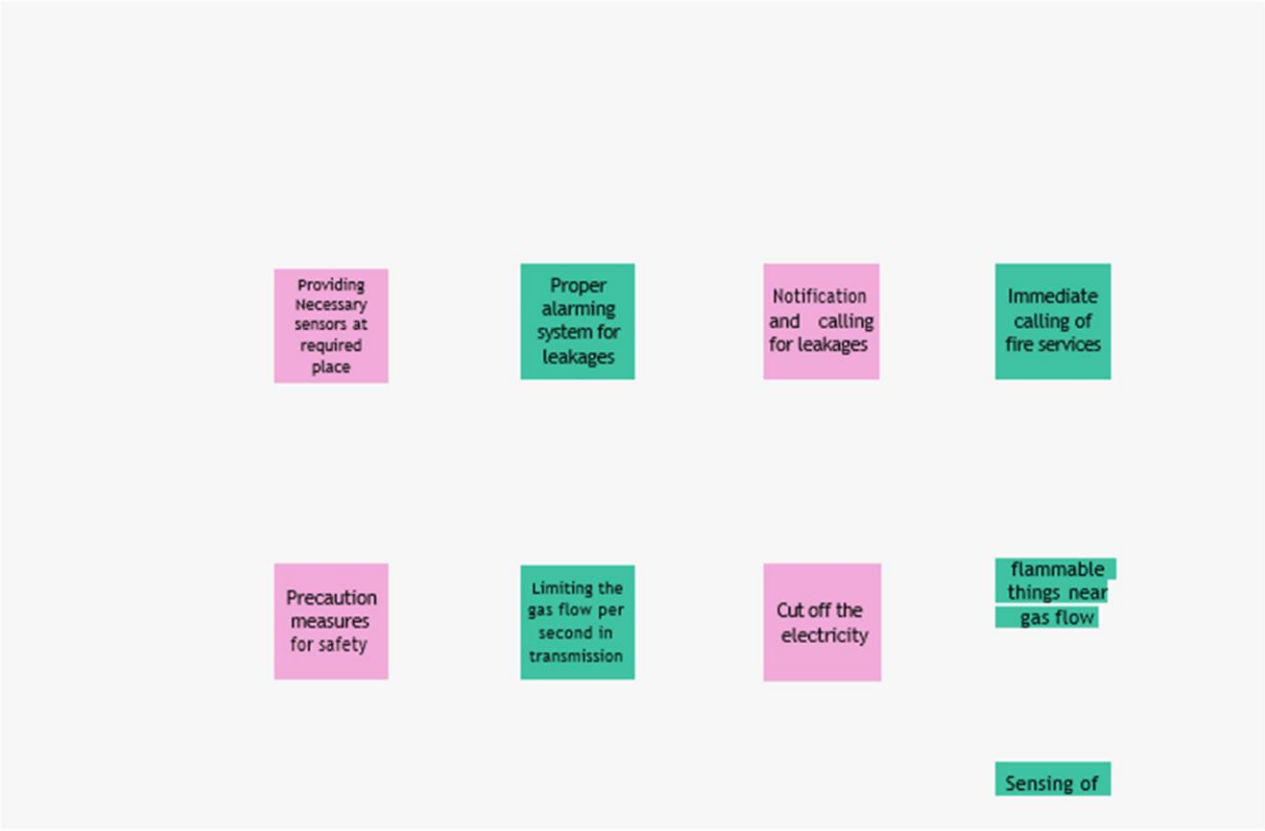
Step-1: Brainstorm, Idea Listing and Grouping



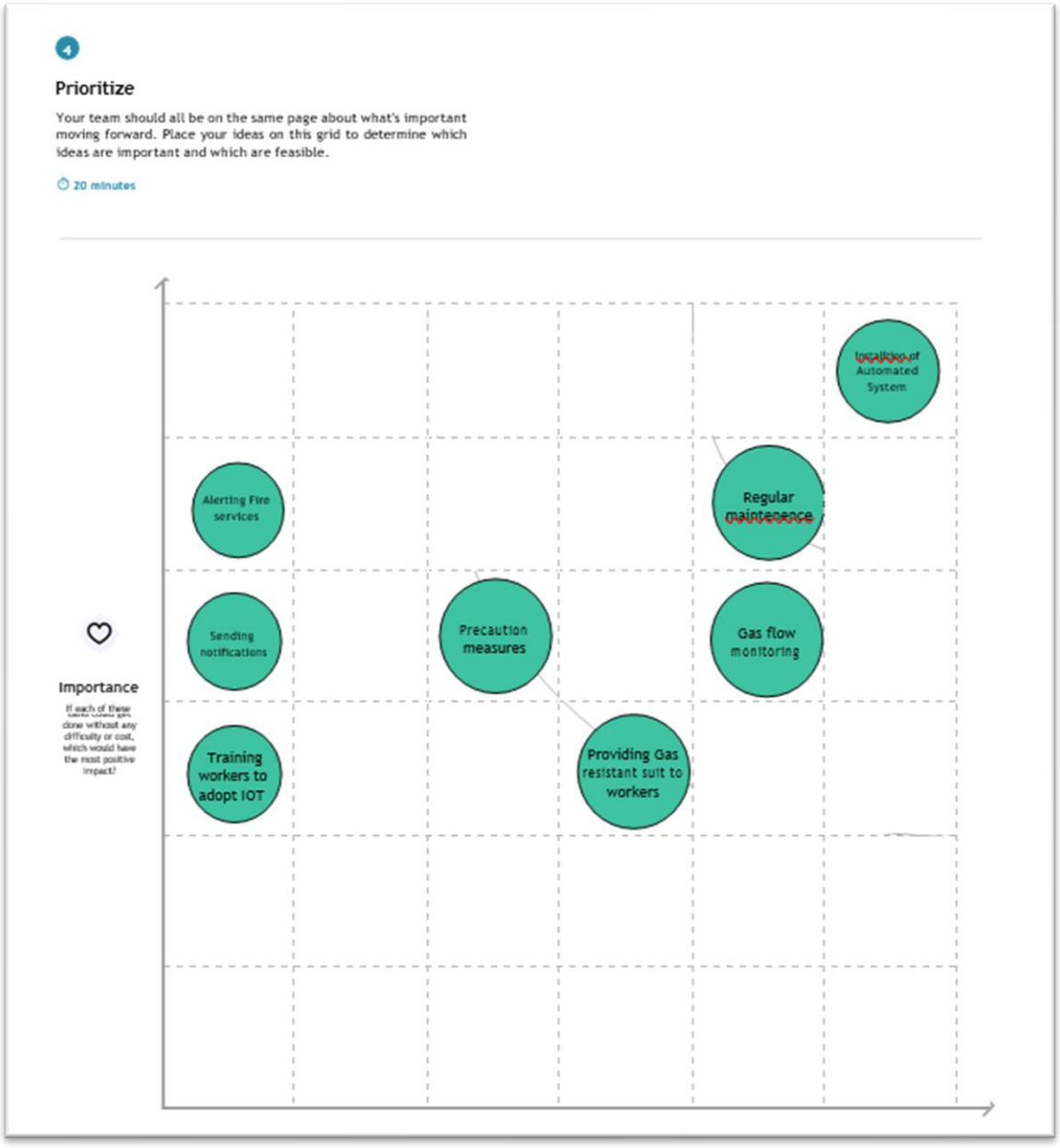
Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes



Step-2: Idea Prioritization



3.3 PROPOSED SOLUTION

System for detecting and notifying gas leaks for safety. In many facilities where gas is being manufactured, as well as in several industries, monitoring of gas leakage plays a significant role. This monitoring will prevent numerous accidents caused by gas leaks.

S. No	PARAMETER	DESCRIPTION
1.	Problem Statement	➢ Emission of harmful gases due to leakages in industries. ➢ It is hard for a human to detect gas leakage at early stage. ➢ Due to which it may harm surrounding peoples and nearby areas.
2.	Idea/Solution description	➢ The proposed system that uses the sensor which is capable of detecting hazardous gases like LPG and propane etc., ➢ It immediately sends alerts via message or call. ➢ It also sends the location of industry to Disaster Management Team.
3.	Novelty/Uniqueness	➢ Ability to predict the hazardous gases like LPG and propane ➢ User friendly ➢ Live alert to the workers
4.	Social Impact / Customer Satisfaction	➢ Low cost ➢ Compact size ➢ Easy to use without fear
5.	Business Model (Revenue Model)	➢ As this product is user friendly, it is advertised in all social media platforms. ➢ It is cost effective so it will be engaged in installation in industries.
6.	Scalability of the Solution	➢ Includes many hazardous gas detections inindustries. ➢ The system can be extended in future based on industry requirements and features.

3.4 PROBLEM SOLUTION FIT

3.5

1. CUSTOMER SEGMENTS

- Large industries where heavy equipment is used in which gas leakage is possible these industries admins are our major customer.
- Sometimes it is hard to identify the area where the leakage occurs.

6. CUSTOMER CONTRAINTS

- Proper maintenance should be taken at least once in a month and this prevents the customers from taking actions in gas leakage problem.

5. AVAILABLE SOLUTIONS

- Usage of sensors to sense gas Leakage.
- Buzzer to indicate the leakage.
- GSM module helps us to get notification when there is a gas leakage.

2. JOBS-TO-BE-DONE / PROBLEMS

- Most of GAS explosions are caused by undetected gas leakage in the pre detection condition.
- So that the gas leakage monitoring and alerting systemis needed
- The purpose of the system intodetects the gas leakage neutralize it and prevent explosion.

9. PROBLEM ROOT CAUSE

- Some of the faults in the machines, leakage by the machines, people carelessness in workplace and life security.

7. BEHAVIOUR

- Network issue is very common as most of the industries are located at the country side. Here contact both the developers and the service providers.
- To determine the gas characteristics and solve the issue, they will locate the leak and identify the warning.

3. TRIGGERS

- The trigger varies from the incorrect installation to the use of defective gas cylinders. Employee and organization safety triggers this installation.

4.EMOTIONS: Before/After

- Before the action is taken the user feels deceived and cheated.
- After the problem is resolved user feels the sincerity of the developer.

10. YOUR SOLUTION

- Low cost IOT based device that can be easily accessed and fixed by people.
- Network strength must be boosted in the device.
- Device can be manufactured in multiple standards based on the environment.

8. CHANNELS OF BEHAVIOUR

ONLINE

- Sending messages via GSM

OFFLINE

- Prevent physical damage to sensor.
- Provide proper network and power supply to sensors.
- Complaint letters.
- Alarm generates high noise which provides warning.

CHAPTER-4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

Functional Requirements:

Following are the functional requirements of the proposed solution.

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

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-Functional Requirements:

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

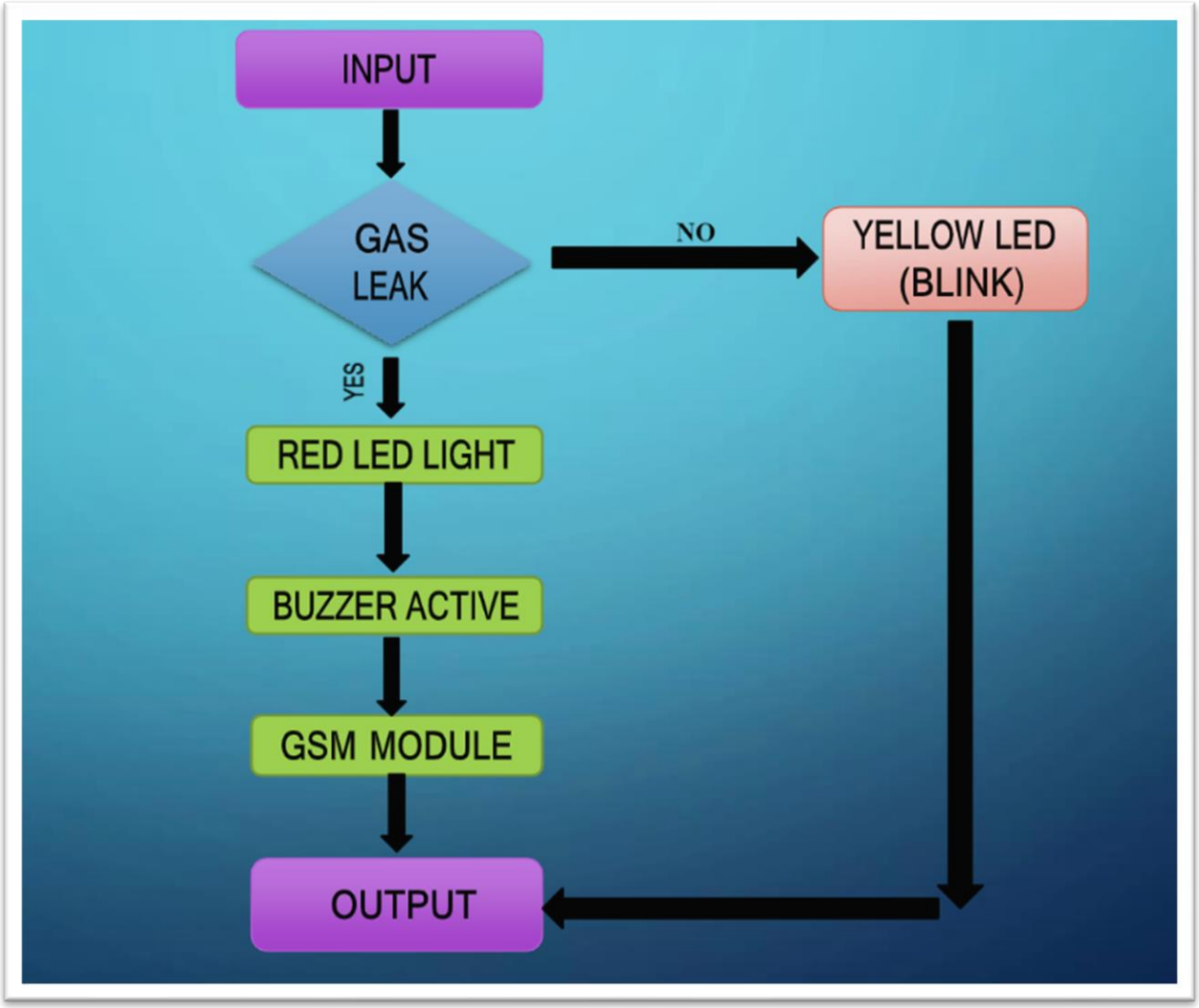
NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	The device must be usable by the customer anywhere
NFR-2	Security	Data from the sensors are stored securely and away from other data
NFR-3	Reliability	Data can be retrieved anytime and no data is discarded without customer knowledge
NFR-4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

CHAPTER-5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

The monitoring and detection of gas leaks is shown in the data flow diagram. Here, information from an IOT device is gathered regarding the temperature and gas sensors, and the information is then analyzed. A warning is issued and the necessary actions are taken if the alert action calls for it.



5.2 SOLUTION AND TECHNOLOGY ARCHITECTURE

The monitoring and detection of gas leaks is shown in this technical diagram. In this case, data is gathered from temperature and gas sensors and connected to IBM Watson (cloud). The outcome of the data from the cloud flows through Node Red, which is connected to the cloud.

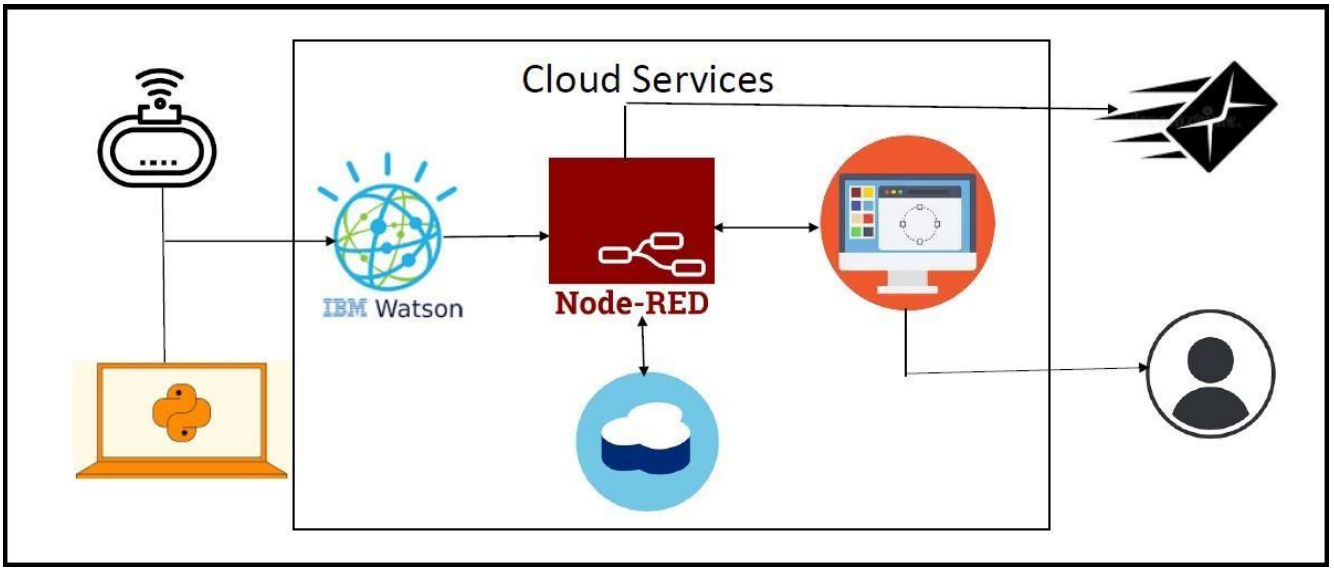


TABLE-1: COMPONENTS & TECHNOLOGIES

S. No	Component	Description	Technology
1.	User Interface	Web UI	HTML, CSS, JavaScript
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM Cloudant.
7.	File Storage	File storage requirements	IBM Block Storage
8.	External API-1	Purpose of External API used in the application	IBM Weather API

9.	External API-2	Purpose of External API used in the application	Aadhar API
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / CloudLocal Server Configuration: Cloud Server Configuration:	Cloud Foundry

TABLE-2: APPLICATION CHARACTERISTICS

S. No	**Characteristics**	**Description**	**Technology**
1.	Open-Source Frameworks	The open-source frameworks used	Mozilla Firefox
2.	Security Implementations	The usage of firewalls, security and access controls, etc.	IBM cloud Encryptions
3.	Scalable Architecture	The scalability of architecture (3 – tier, Micro-services)	IBM cloud architecture
4.	Availability	Application accessibility (e.g., use of load balancers, distributed servers etc.)	Web applications are even accessible to industrial employees
5.	Performance	Take into account the application's performance when designing it (requests per second, cache usage, CDN usage, etc.).	The online application may be used by employees at any time because of its excellent efficiency.

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story/Task	Acceptance Criteria	Priority	Release
Customer (Mobile User)	Registration	USN-1	User Can enter into the web application	I can access my account /Dashboard	High	Sprint-1
		USN-2	User can register their credentials like email id and password	I can receive confirmation email & click confirm	High	Sprint-1
	Login	USN-3	User can log into the application by entering email &Password	I can login to my account	High	Sprint-1
	Dashboard	USN-4	User can view the temperature	I can view the data given by the device	High	Sprint-2
		USN-5	User can view the level of gas	I can view the data given by the device	High	Sprint-2
Customer (Web User)	Usage	USN-1	User can view the web page and get the information	I can view the data given by the device	High	Sprint-3
Customer	Working	USN-1	User act according to the alert given by the device	I can get the data work according to it	High	Sprint-3
		USN-2	User turns ON the exhaust fan/sprinkler when the leakage occurs	I can get the data work according to it	High	Sprint-4
Customer Care Executive	Action	USN-1	user solve the problems when someone faxes any usage issues	I can solve the issues when someone fails to understand the procedure	High	Sprint-4
Administrator	Administration	USN-1	User Stores every information	I can store the gained information	High	Sprint-4

CHAPTER-6

6.1 SPRINT PLANNING AND ESTIMATION

Project Tracker:

Sprint	Total Story Points	Duration	Sprint StartDate	Sprint End Date (Planned)	Story Points Completed (as on Planned EndDate)	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	05 Nov2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Velocity: Sprint – I to 4

Sprint duration = 6 days Velocity of the team = 20 points

$$\text{average velocity (AV)} = \frac{\text{Velocity}}{\text{Sprint duration}}$$

$$AV = 20/6 = 3.34$$

Average Velocity = 3.34

Sprint	Functional Requirement (EPIC)	User Story Number	User Story/Task	Story Points	Priority	Team Members
Sprint-1	IDE	USN-1	Installing all the software's which is required like python IDE	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-1	Checking the simulation with condition	USN-1	Simulating the circuits and experimenting	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-2	Software	USN-2	-IBM Watson iot -Node Red Integration	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-2	Software	USN-2	Test the device and workflow	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M

Sprint-3	Application Development	USN-3	using MIT App Inventor Create an app	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-3	Testing	USN-3	Testing the Application	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-4	Web UI	USN-4	User interface with the software	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M

6.2 PRINT DELIVERY SCHEDULE

Sprint	Functional Requirement (Epic)	User Story/Task	Story Points	Priority	Team Members
Sprint -1	Resource initialization	create and initialize accounts in various public APIs like Open/Weather Map API	1	Low	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-1	Local Server /Software to cloud	Write a python program that outputs results given the inputs like weather and location	1	Medium	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-2	Push the server/software to cloud	Push the code from sprint 1 to cloud as it can be accessed from anywhere	2	Medium	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud and provide inputs to the same	2	High	Jayanth M A Madhanakumar S R Mithun P Kishore M
Sprint-4	UI/UX Optimization &Debugging	Optimize all the short coming and provide user experience	2	Low	Jayanth M A Madhanakumar S R Mithun P Kishore M

CHAPTER-7

CODING AND SOLUTIONING

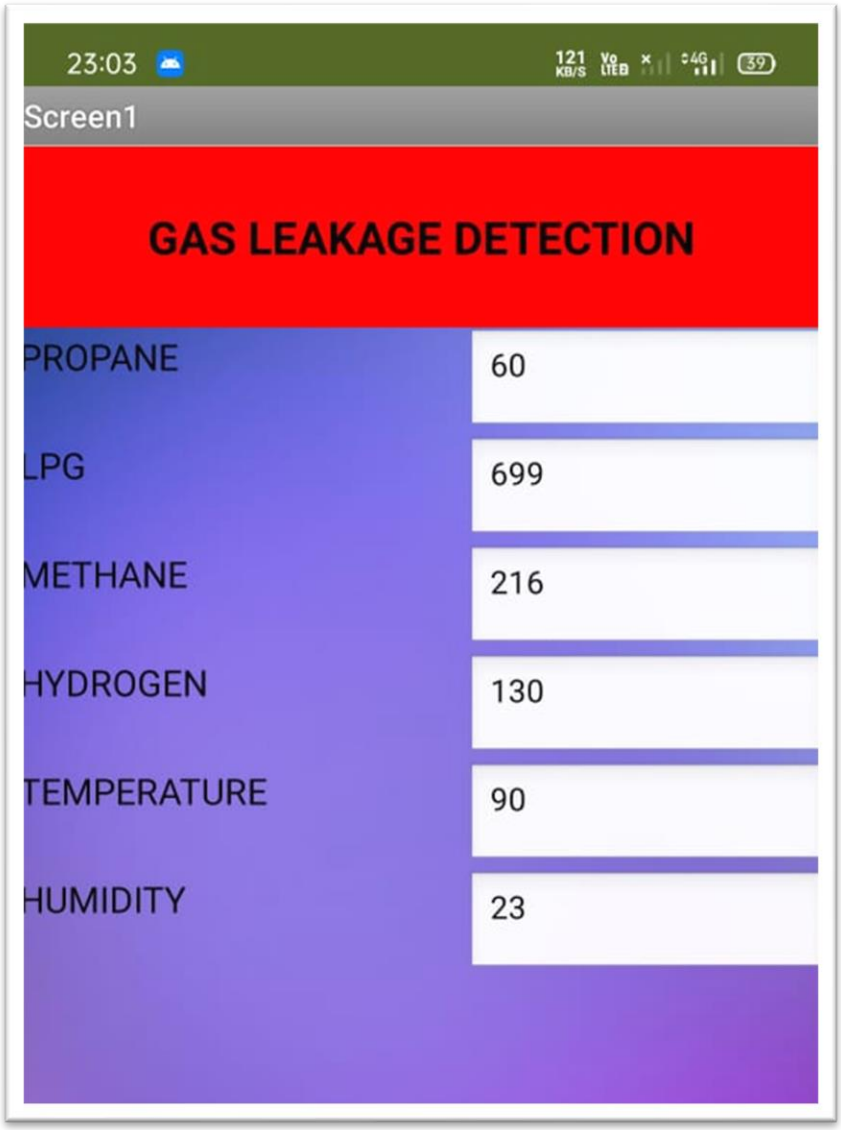
7.1 FEATURE CODE

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
#Provide your IBM Watson Device Credentials
organization = "kz2her"
deviceType = "NODE"
deviceId = "4222"
authMethod = "token"
authToken = " j5RIM+NYy8Uv6+!s4q"
# Initialize GPIO
try:
deviceOptions = {"org": organization, "type": deviceType, "id":
deviceId, "auth-method": authMethod, "auth-token": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
#.....
except Exception as e:
print("Caught exception connecting device: %s" % str(e))
sys.exit()
# Connect and send a datapoint "hello" with value "world" into the cloud asan event of
type "greeting" 10 times
deviceCli.connect()
while True:
#Get Sensor Data from DHT11
```

```
Propane = random.randint(0, 500);

Carbon_Monoxide = random.randint(0, 500);

LPG= random.randint(0, 1000);

Methane = random.randint(0, 500);

Hydrogen= random.randint(0, 500);

Temperature=random.randint(0,100 );

Humidity=random.randint(0,100 );

data = { "temp" : Temperature, "Humid": Humidity,"Propane": Propane,

"Carbon_Monoxide": Carbon_Monoxide,

"LPG": LPG,

"Methane": Methane,

"Hydrogen":Hydrogen  }

#print data

def myOnPublishCallback():

print ("Published Temperature = %s C" % Temperature, "Humidity = %s%%" %
Humidity,"Propane = %s ppm" % Propane, "LPG = %s ppm" % LPG,"Methane = %s
ppm" % Methane,"Hydrogen = %s ppm" % Hydrogen,"Carbon monoxide = %s ppm" %
Carbon_Monoxide , "to IBM Watson")

if (Propane or Carbon_Monoxide or LPG or Methane or Hydrogen)>150:

print("GAS LEAKAGE FOUND")

else:

print("NO LEAKAGE")

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

if not success:

print("Not connected to IoTF")

time.sleep(10)

deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud

deviceCli.disconnect()
```

7.2 FEATURE:

We have developed the application in MIT app inventer which can monitor the temperature, humidity and type of gas leakage.

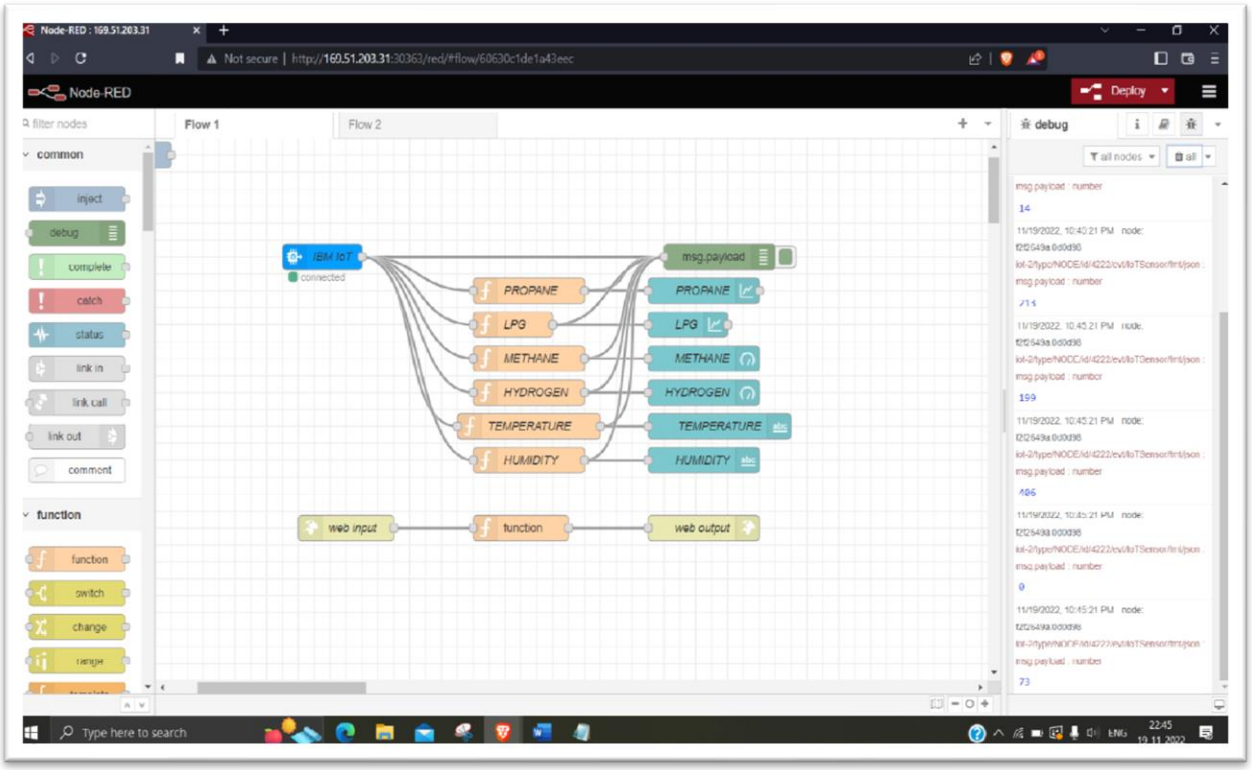


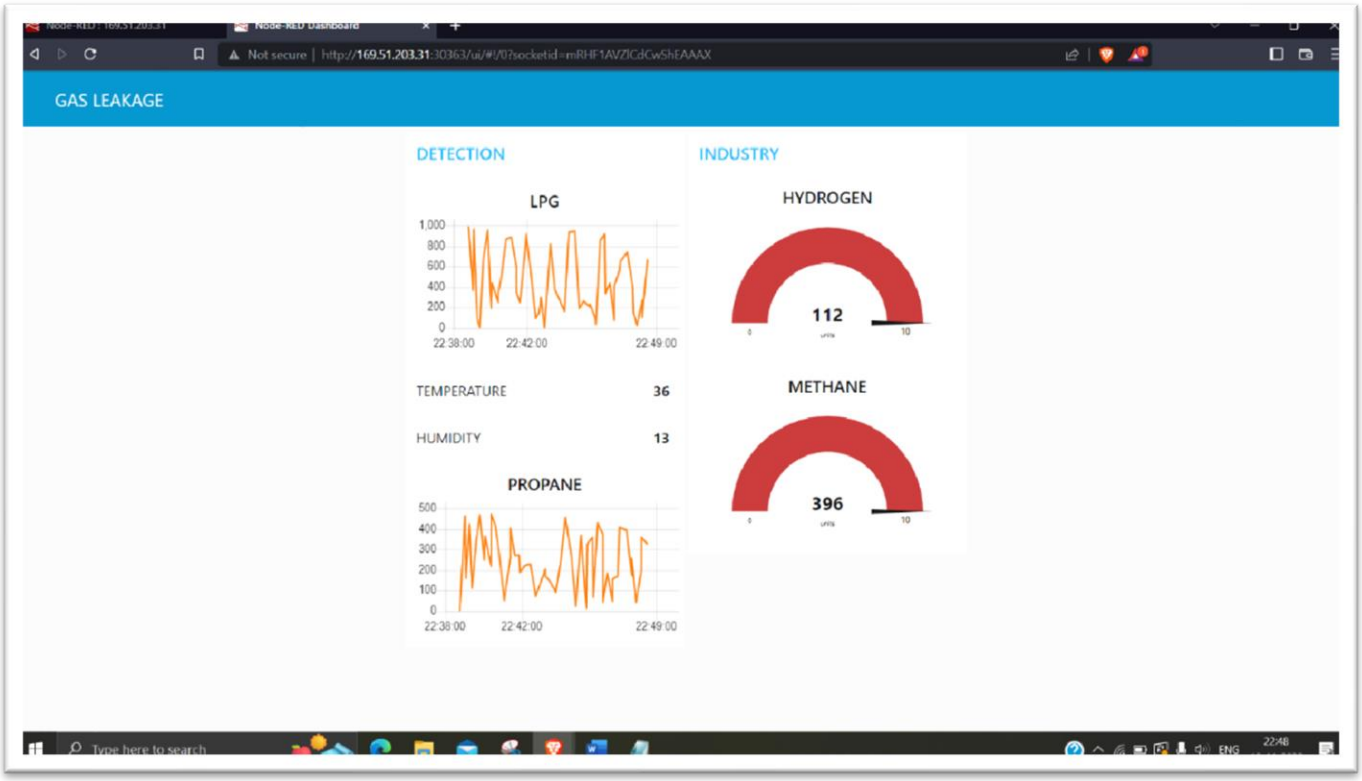
CHAPTER-8

RESULT

8.1 PERFORMANCE METRICS

Below image represents the result of node red dash board

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GAS LEAKAGE
DETECTION
LPG
1,000
800
600
400
200
0
22:38:00
22:42:00
22:49:00
TEMPERATURE
36
HUMIDITY
13
PROPANE
500
400
300
200
100
0
22:38:00
22:42:00
22:49:00
INDUSTRY
HYDROGEN
112
0
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METHANE
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CHAPTER – 9

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- ✓ For locating gas leaks in industrial environments, this project is helpful.
- ✓ More effective equipment and components.
- ✓ Dependable and low-power utilisation.
- ✓ Another purpose for it is to locate LPG gas leaks inside the house.

DISADVANTAGES

- ✓ Gas cylinders are stored in a variety of locations; therefore, it is impossible to pinpoint the specific position of the leak.
- ✓ Its sensitivity is influenced by both temperature and relative humidity.
- ✓ Without the Internet, setup cannot work and perform.
- ✓ It's difficult to install the setup.

CHAPTER 10

CONCLUSION

Gas leakage causes serious mishaps that cause property damage and injuries to people. Gas leaks are caused by inadequate maintenance of the machinery and a lack of public knowledge. Therefore, it is crucial to identify gas leaks in order to stop accidents and save lives. This study described a method for detecting and alerting LPG leaks. When a gas leak is detected, this system sends out a warning and activates a buzzer to warn people. This technique is simple but dependable.

CHAPTER-11

FURTURE SCOPE

A. Extended System Features

The surrounding air's temperature and humidity have an impact on how gases behave. A gas may not be flammable at low temperatures at a certain concentration, but it may be explosive at high temperatures. The inclusion of a temperature and humidity sensor will be quite beneficial for this reason.

B. Applying Big Data Analytics to the sensor readings

On the sensor readings, analytics might be run. The results of the sensors' readings could be used to forecast potential accident scenarios. Algorithms could be developed that could anticipate such circumstances rather than immediately alarming when the concentrations have reached high levels. The system's accuracy would be improved by combining the results from the temperature and humidity sensors with the readings from the gas sensor. The number of false alarms raised will drop to extremely low percentages.

C. Dedicated System Application

For the system, a specific mobile application might be created. The app would have the following features:

1. Being able to quickly and easily learn the house's degrees of attentiveness.

2. Because it is a safety equipment, it must be meticulously calibrated and maintained. The app can ensure that notifications are sent as reminders to periodically get the system reviewed.

CHAPTER – 12

APPENDIX

12.1 GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-22371-1659850515