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CHAPTER - 1

INTRODUCTION

1.1 PROJECT OVERVIEW

Gases of all kind are dangerous while they leak and it puts human’s life into risks. It is very life threatening if you will not distinguish and modified right away. The idea behind our project is to give a solution by power cut the gas provision as soon as a gas leakage is perceived apart from activating the sounding alarm. In addition to this, Gas leakage system is based on the process of monitoring and alerting when the gases leaked in the industries, it will harm the surrounding society and it may lead to disaster, so. This project is about monitor the leakages and sends an alert message through SMS or mail when the gases are leaked. The temperature, oxygen, humidity can be separately programmed like setting the limit for each of the content, if the numbers raised from the given limit. the alert system automatically cut the power and sends the SMS or mail to the industry peoples. The entire system is managed by Web UI applications which give connectivity between industries peoples. This system is connected to IoT, to regularly monitor gas leakages in the industries. the authorized person will receive a message informing him about the leakage with the increase of natural gas productions in the last 10 years. Industries like storing gas or surrounded by gas companies are high at risk, so in our project our main goal is to make a gas monitoring and alerting system for industries.

1.2 PURPOSE

The purpose of this project is to keep industries people safe from leakage of harmful gases, because a human can’t monitor each and every time the leakage of the gases in their industries. One of the preventive methods to stop accidents associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this paper is to purpose and discuss of a gas leakage detection system that can automatically detect, alert control gas leakage, so. The surrounding people and the industries people will feel safe.

Industries, especially producing chemical gases or surrounded by gas producing companies are feeling so much unsecured and unsafe without knowing when the gases will be leaked and they can’t be monitor the leakage every time.

When purposed solution is set to work, the problem can be reduced. This software can alert the industry people next minute after the gas is leaked and hence the people will be saved.

This solution can ultimately help the industries people and the industry surrounded society.

CHAPTER - 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM

The system can perform an automatic alarm, which calls the police hotline number automatically. It can also be avoice alarm and shows alarm occurred address. This intelligent security system can be used control the electrical power remotely through telephone. Application a remote monitoring system based on SMS. The system uses PIC18F1320 microcontroller which detects the gas leakage and activates the alarm when certain exposure limit is exceeded.

Author and year	Technique/ Methodology	Limitations/ Drawback	Advantages	Applications
Rohan Chandra Pandey,2017	Intelligent Residential Security Alarm	Costly	Automatic Police hotline number	Industries
Chaitali Bagwe,2018	The system uses PIC18F1320 microcontroller which detects the gas leakage	Works for only one type of commercial sensor	Audio-Video Alarm	Industries
Saurabh Deshmukh, 2018	Security Alarm and Remote-Control System Based on Single Chip Computer	Costly	Automatic alarm and which shows alarm occurred address	Industries

2.2 REFERENCES

1. Rohan Chandra Pandey, Manish Verma, Lumesh Kumar Sahu (2017)' Internet of Things (IOT) Based Gas Leakage Monitoring and Alerting System with MQ-2 Sensor
2. Chaitali Bagwe, Vidya Ghadi, Vinayshri Naik, Neha Kunte (2018)' IOT Based Gas Leakage Detection System with Database Logging, Prediction and Smart Alerting
3. Rohan Chandra Pandey, Manish Verma, Lumesh Kumar Sahu, Saurabh Deshmukh (2018)' Internet of Things (IoT) Based Gas Leakage Monitoring and Alerting System with Mq-6 Sensor
4. Shital Imade, Priyanka Rajmanes, Aishwarya Gavali, Prof. V. N. Nayakwadi (2018)' Gas Leakage Detection and Smart Alerting System.

2.3 PROBLEM STATEMENT DEFINITION

Creating a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love.

Our main aim is to make a Smart medicine box for those users who regularly take medicines and the prescription of their medicine is very long as it is hard to remember for patients and their caregivers.

Figure 2.1. Problem Statement

CHAPTER - 3

IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

Figure 3.1. Empathy Map

3.2 IDEATION & BRAINSTORMING

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem-solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich number of creative solutions.

STEP-1 TEAM GATHERING, COLLABORATION AND SELECTING THE PROBLEM STATEMENT

This step includes the formation of a team, collaborating with the team by collecting the problems of the domain we have taken and consolidating the collected information into a single problem statement.

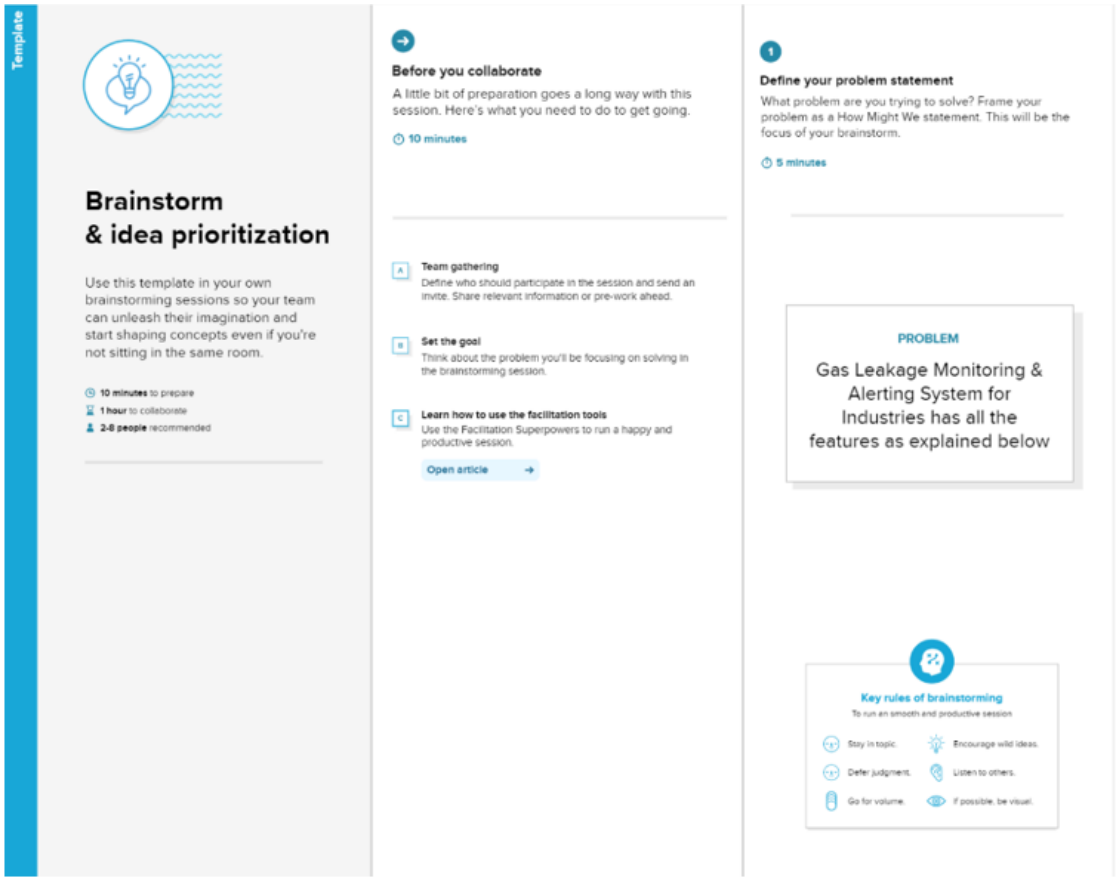

Figure 3.2. Ideation and Brainstorming

STEP 2 BRAINSTORM, IDEA LISTING AND GROUPING

This step of ideation includes the listing of individual ideas by teammates to help with the problem statement framed. All the individual ideas have been valued and made individual clusters.

Then discussed as a team and finally made an ideation Cluster A and concluded with the most voted ideas from all the clusters together and Cluster B with the least needed ideas.

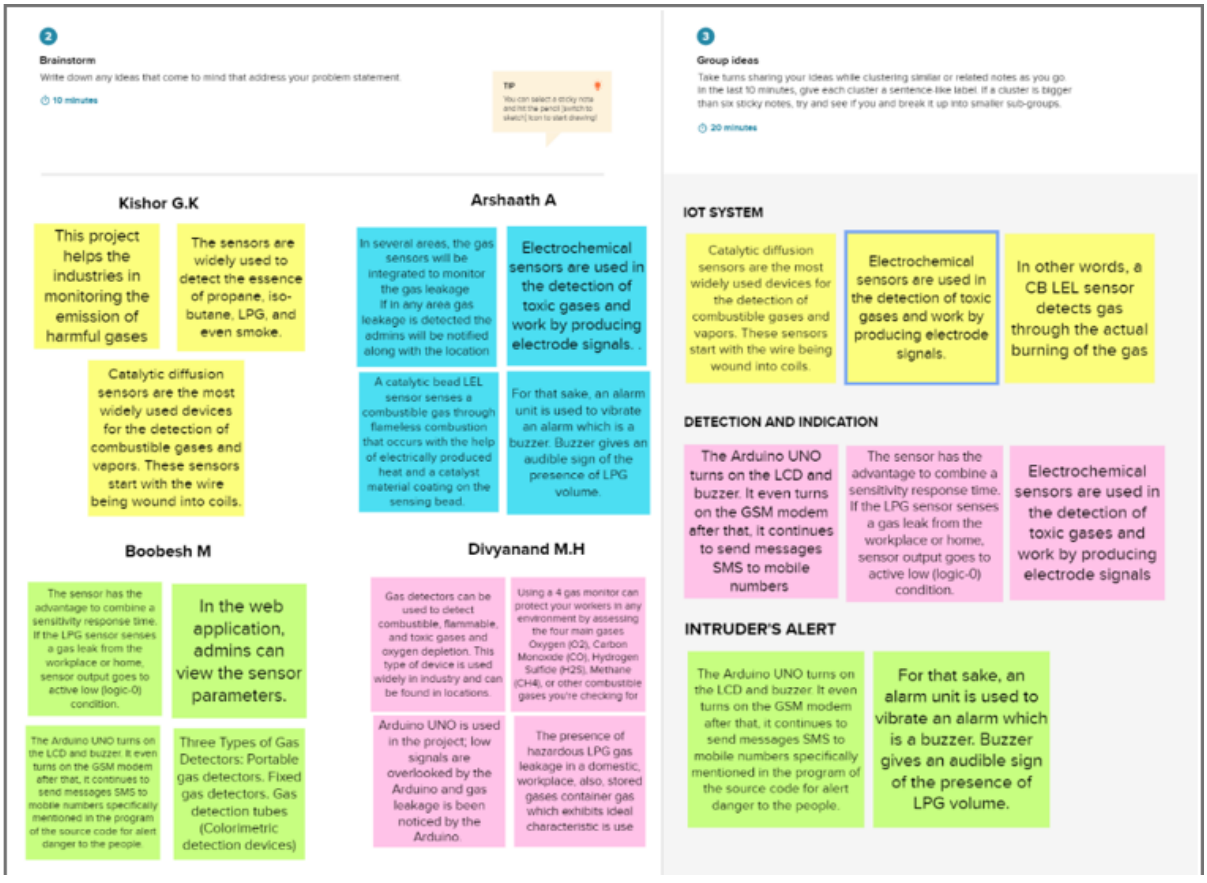

Figure 3.3. Brainstorm, Idea Listing and Grouping

STEP 3 IDEA PRIORITIZATION

This step includes the process of listing necessary components to come up with the working solution and making a hierarchy chart by prioritizing the components based on importance, say from the higher being backend and lower being the user interfacing components.

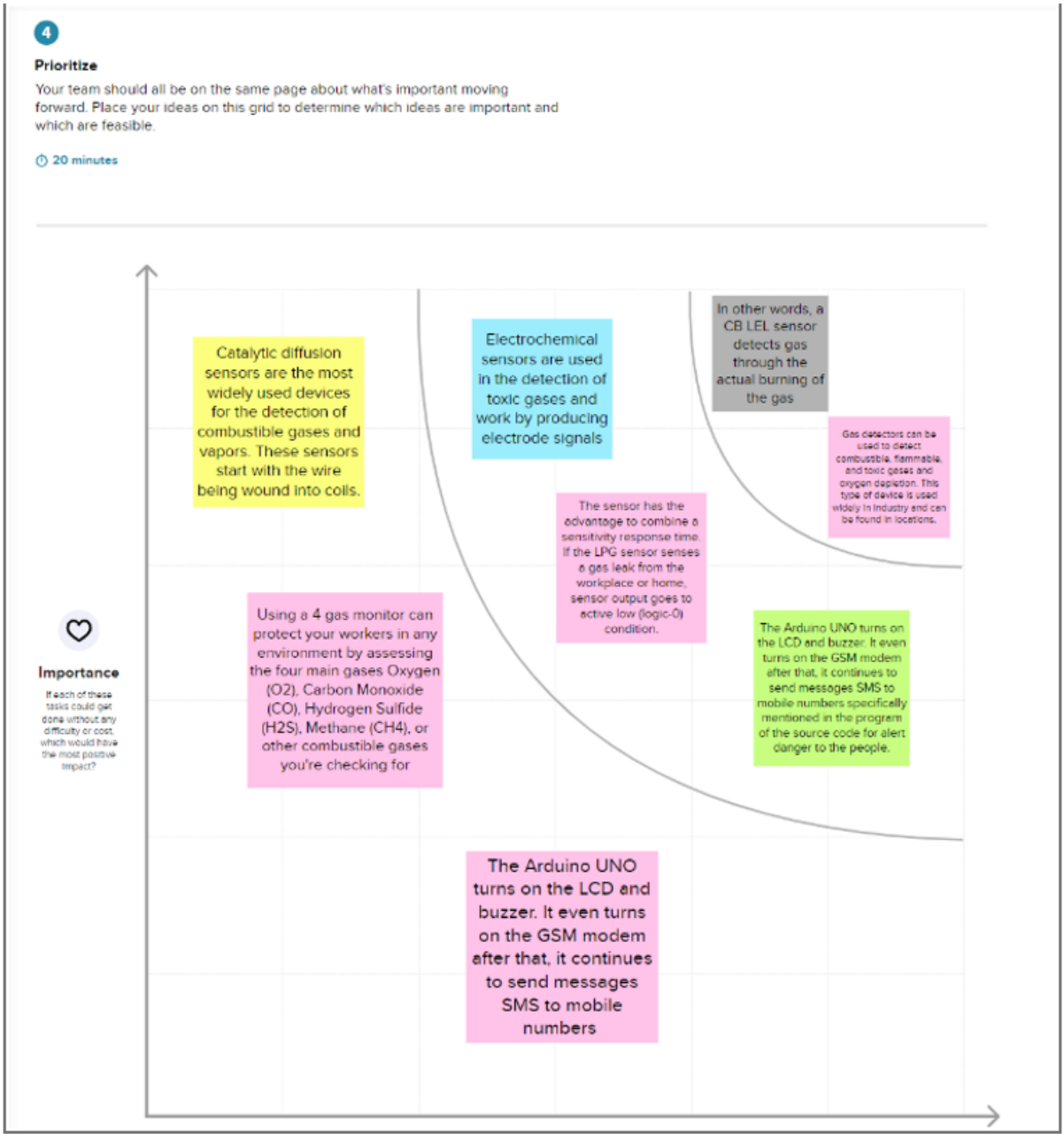

Figure 3.4. Idea Prioritization

3.3 PROPOSED SOLUTION

Problem statement (problem to be solved)

Workers are the pillar of the company, while working in gases areas it is very difficult to avoid leakage of gases, hence we need to ensure the safety of the workers

Idea / Solution description

This problem can be overcome by using IoT. By implementing IoT, we are able to monitor the surroundings of the workers as well as their body condition.

Novelty / Uniqueness

The uniqueness of our application is, by using our application we will get live updates of gas leakage by the way of SMS, in and around the workers environment using IoT.

Social Impact / Customer Satisfaction

It is best suited for the industries which relocated in gas leakage environments like sudden leakage of gas. The admin can able to track the data of the workers environment. When there is any deviation occur, admin alert the workers for evacuation.

Business Model (Revenue Model)

We can introduce product-based approach to earn a good revenue. The greater number of features attract the end users to use our application.

Scalability of the Solution

Our application can be used by the company which located in under the gas leakage area. We use IBM Watson cloud server to collect the live data the current data. we will ensure the safety of the workers.

3.4 PROBLEM-SOLUTION FIT

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why

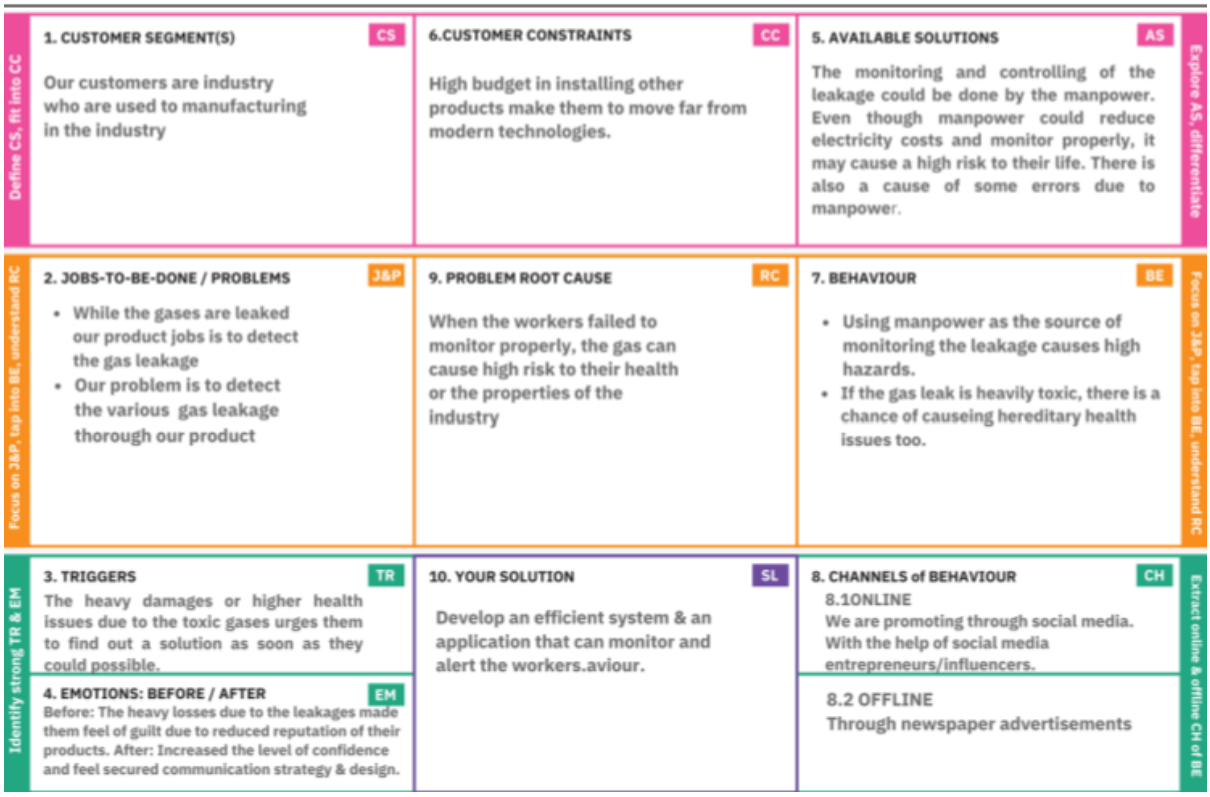

Figure 3.4. Solution Fit

CHAPTER - 4
REQUIREMENT ANALYSIS

4.1 Functional Requirements

- User Requirement - Set up the device in necessary place
- User Registration - Manual Registration
- User Confirmation - Confirmation of receiving the calls & message
- User Alert - Gets alert as an SMS message
  Gets alert alarm in working area

4.2 Non-Functional Requirements

Usability

The Device must be usable by customer anywhere.

Smart

Data from the sensor are stored securely and away from other data.

Reliability

Data can be retrieved anytime and no data is discarded without customer knowledge.

Performance

No performance delay in case of large number of data or parameters.

Availability

It works for 24/7 without rest it can be monitor with durability.

Scalability

Device must be capable of measuring conditions even in large industry.

CHAPTER - 5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

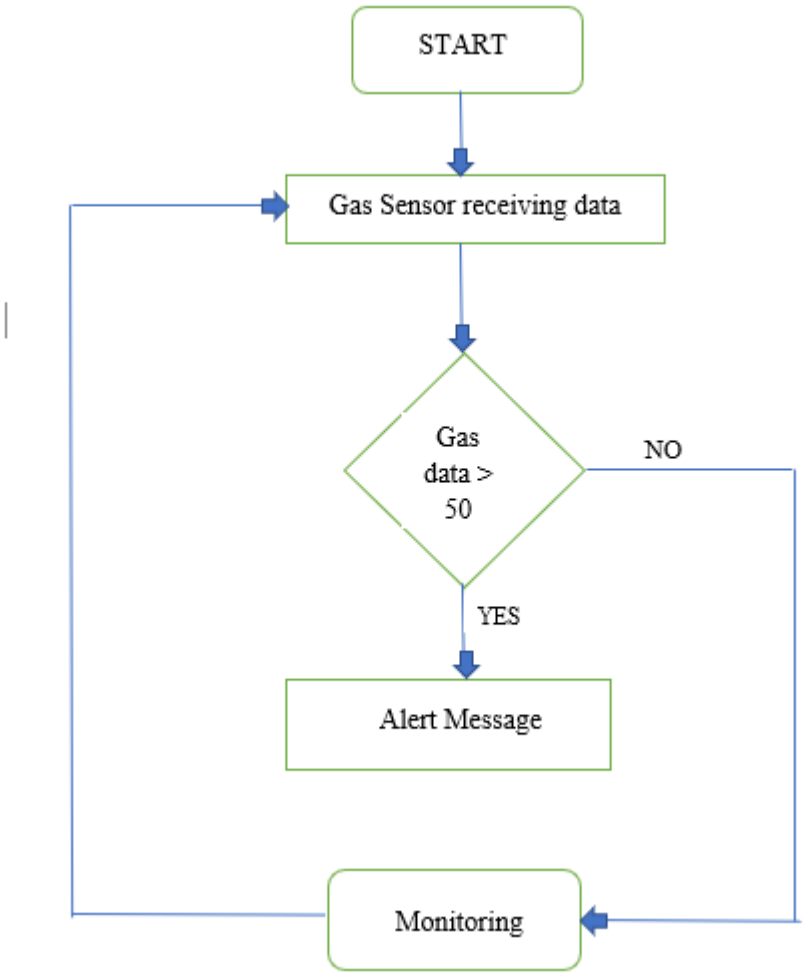

Figure 5.1. Data flow Diagram

5.2 SOLUTION AND TECHNICAL ARCHITECTURE

The solution architecture includes the components and the flow we have designed to deliver the solution.

Here, the application is planned to be designed, where the software monitors the gas leakages in industry sends the alerting message through SMS or Mail

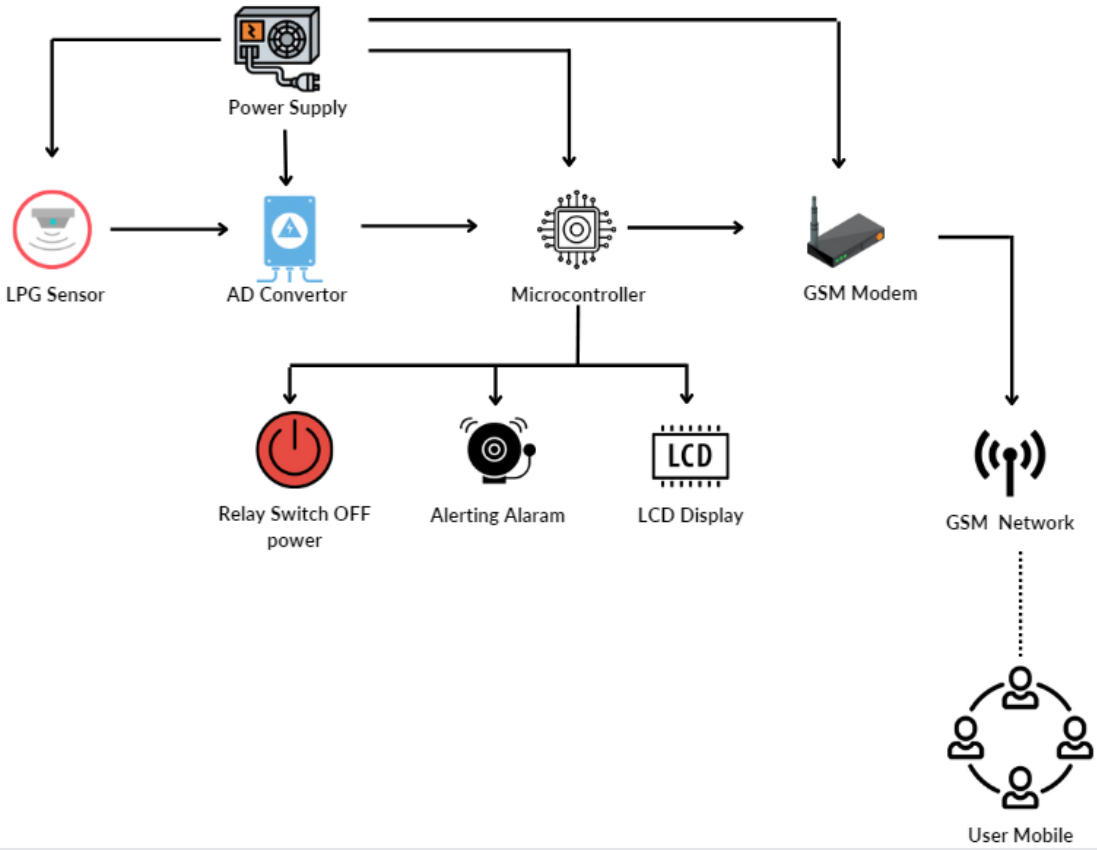

Figure 5.2. Technology Architecture

5.3 USER STORIES

Table 5.1. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Industries owner)	Installation	USN-1	As a user, I want to know to measure gas level in necessary area	I want to make necessary program to detect the gas using Gas sensor	High	Sprint-1
Customer (Industries owner)	User Interface	USN-2	As user I want to know the Hazardous gas level in real time	I want to make UI with all Information	Medium	Sprint-2
Customer (Industries owner)	Dashboard	USN-3	As a user, I want to know to alert the employee to manage it	I want to make sure the gas level which Overcome the limit. If done the alert message will shown	Low	Sprint-3
Customer (Industri	Checking	USN-4	As user I want to	I want to make a	Medium	Sprint-4

es owner)			notify with message or mail	message or mail alert when the gas overcome the limit		

CHAPTER - 6

PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

SPRINT 1

In Sprint one we had developed the python code for the industries, to measure the Hazardous Gas Level, Oxygen, Temperature & Humidity from the environment and publish in Watson IoT platform. When it starts and gets data from the gas sensor. In Watson IoT platform device created and registered in it. Then device is switched on and the sensor data is fetched.

Organization ID: printid

Device Type: print1

Authentication Token: z?7tcRfcekcO08R6f2

```
================ RESTART: C:\Users\user\Downloads\Sprint-2.py ================
2022-11-18 21:51:39,963   wiotp.sdk.device.client.DeviceClient  INFO    Connected successfully: d:b31tni:print1:printid
Published data Successfully: %s {'Alert': 'Alert the gas is leaked', 'othergas': 66}
Published data Successfully: %s {'Alert': 'Alert the gas is leaked', 'othergas': 74}
Published data Successfully: %s {'Alert': 'Alert the gas is leaked', 'othergas': 78}
Published data Successfully: %s {'oxygen': 69, 'othergas': 46, 'temperture': 12, 'humidity': 1}
Published data Successfully: %s {'Alert': 'Alert the gas is leaked', 'othergas': 57}
Published data Successfully: %s {'Alert': 'Alert the gas is leaked', 'othergas': 56}
Published data Successfully: %s {'Alert': 'Alert the gas is leaked', 'othergas': 83}
```

SPRINT 2

In this sprint, an organization is created and registered. Then an API key is generated for the registered device. In node-red, the IBM Watson IoT Platform is connected using the API key, Device Type and Device ID. Then a msg.payload node is connected to receive the sensor data. Then the function node (Toxic gas, Oxygen, Temperature, Humidity) in Node-RED is connected with the IBM Watson platform and then the sent data is connected to the gauge in dashboard of Web application UI.

Figure 6.1.3 Web Application using Node-Red

SPRINT 3

In this sprint we work backend in node-red for the separation of data and display it and written a program for function comparison if the toxic gas across the limit it gives the alert pop-up message else it will continue the data collection process. For pop-up message we want to write a condition for compare the receiving the data if the toxic gas across the limit it will be true it goes for notification node for pop-up the message

Once the Hazardous gas level cross the set limit automatically Web application deploy the pop up like **“Alert! The toxic gas is leaked”** in that pop-up the button contains alert message. After pressing the button alert it convey the message to workers by speaker or alarm on it will alert the all workers to manage the situation in industries.

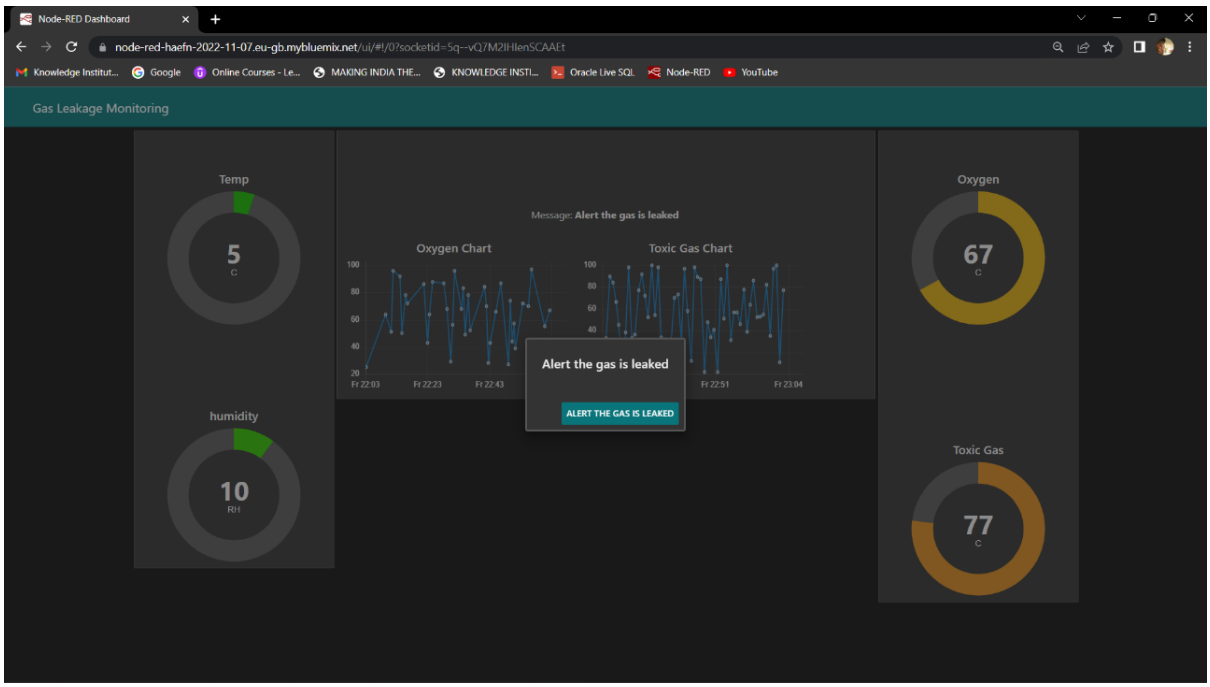

Figure 6.1.4 Web Application Dashboard with Alert pop-up

SPRINT 4

In this sprint we worked in backend for node-red for sending message to Owner (or)Manger. In this we worked on the condition which is true it will pass to next flow which is email node, in this node we work for the conveying the message.

In this node we want to enable the two-step verification for the security purpose, after enabling the two-step verification it shows for App password in that we want to create the security code for secure account using node-red name it will generate the App password. Then copy and paste in the email node in password place. Then place the email for sending purpose.

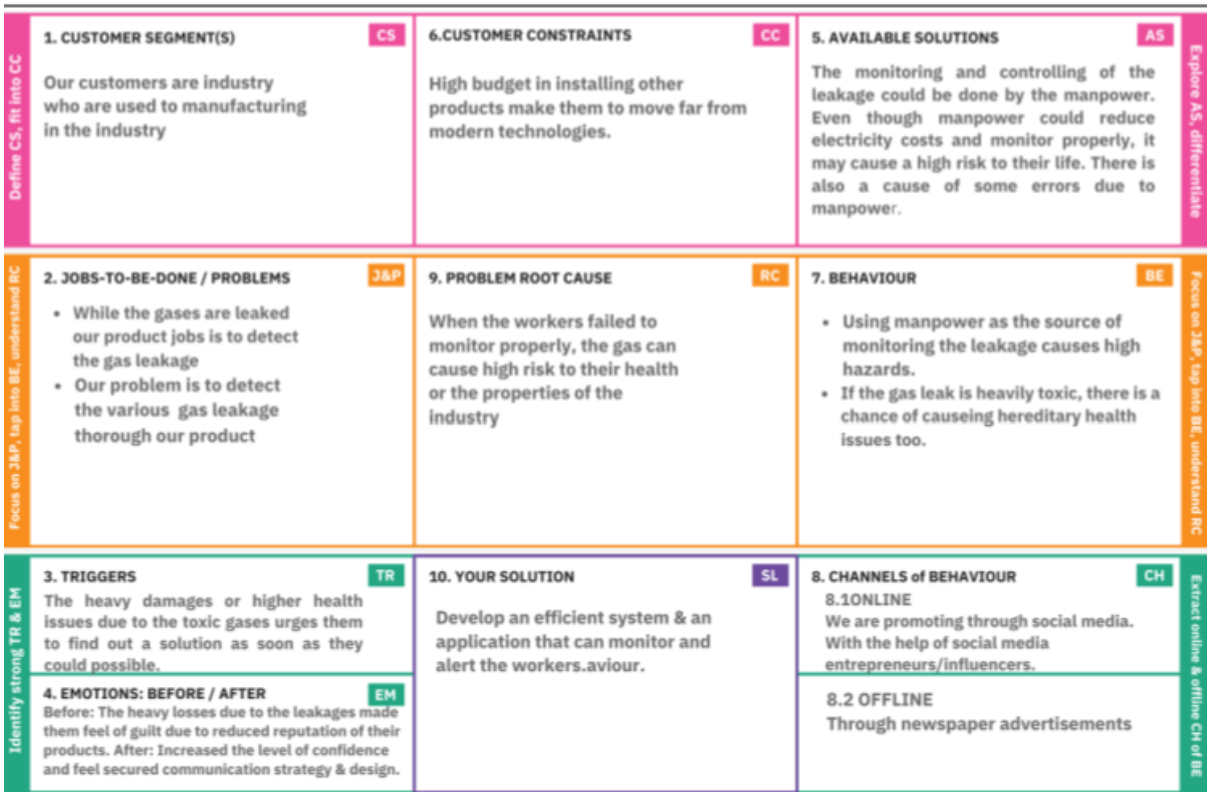

Figure 6.1.5 Web Application Dashboard with Alert message

6.2 SPRINT DELIVERY SCHEDULE

Table 6.1. Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	Sprint Start Date	Sprint End Date	Story Points	Team Members
Sprint- 1	Installation	24 Oct 2022	30 Oct 2022	3	Kishore G K
Sprint- 2	User interface	31 Oct 2022	05 Nov 2022	2	Divyanand M H
Sprint- 3	Dashboard	07 Nov 2022	12 Nov 2022	1	Bhoobesh M
Sprint- 4	Checking	14 Nov 2022	19 Nov 2022	2	Arshaath A

6.3 REPORTS FROM JIRA

Burndown chart

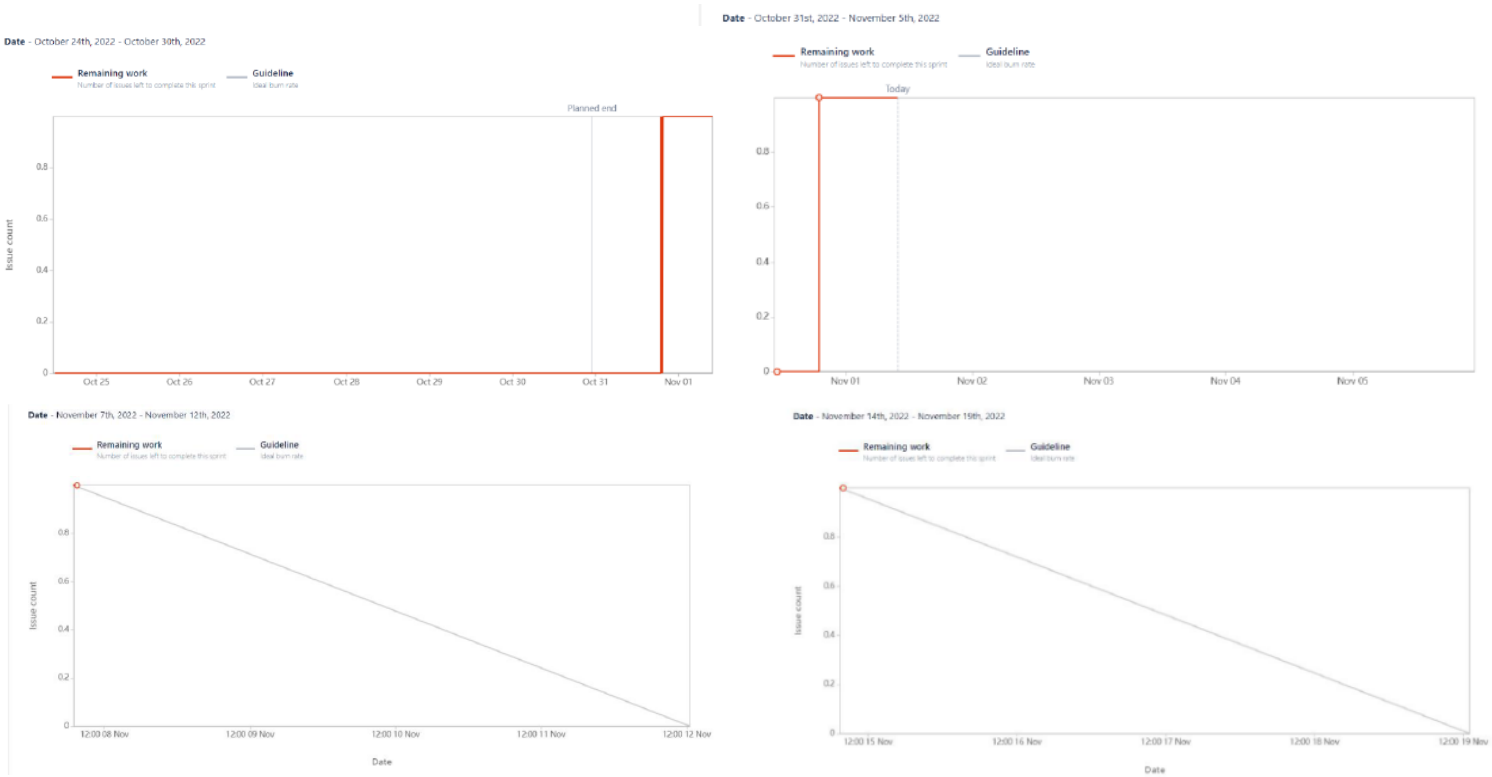

Figure 6.3.1 Burndown Chart

Road map

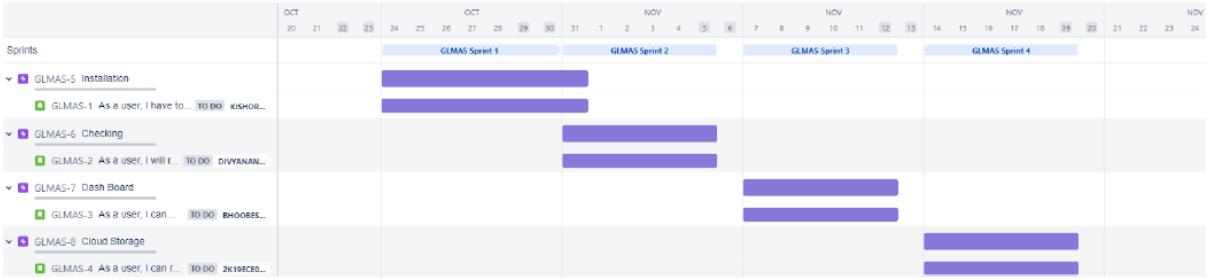

Figure 6.3.2 Road Map

CHAPTER - 7

CODING AND SOLUTIONS

7.1 FEATURE 1

Node-RED Supports browser-based flow editing making it user friendly, accessible and visual. It is built on Node.js, which is a none-blocking, lightweight I/O model, making it lightweight and efficient. Flows created in Node-RED are stored using JSON, and can imported and exported and shared with ease.

Features of React

Ability to run in cloud environments

Simple user interface creation

7.2 FEATURE 2

In web application, Industries owner able to monitor the parameters in the particular area such as oxygen level, hazardous gas level, Temperature & Humidity at any place they can watch the data and can be alert the employee to manage the situation with proper manner full control not only with owner at also have monitor in industry with small place.

CHAPTER - 8

TESTING

8.1 TEST CASES

A test case might be created as an automated script to verify the functionality per the original acceptance criteria. After doing manual exploratory testing, QA testers might suggest other functionality be added to the application as well as updated test cases be incorporated in the automated test suite.

Table 8.1. Test Case

Test case ID	Feature Type	Component	Test Scenario
Watson IOT platform_TC_OO1	Random data to cloud	Python 3.7.0	Sensor data generated and sent to Watson IOT platform
Frontend_TC_OO2	Dashboard UI	Node. RED	The data should be sent from cloud to NODE and data needed to be displayed
Backend_TC_OO3	API for Alerting the gas leakage	Node. RED	When the gas leakage crosses the limit, it will sent an alert message from python code to cloud and from cloud to node-red also node-red to dashboard

Step To Execute	Test Data	Expected Result	Status	Executed By
1.write the python code for connection 2. enter the credentials 3.Run the code to connect with Watson platform	https://b31tni.internetofthings.ibmcloud.com/dashboard/devices/browse	Watson IoT platform receives the data generated	Pass	Kishor G.K Divyanand M H
1.cloud configuration 2.Node-red Configuration 3. API Route	https://node-red-haefn-2022-11-07.eu-gb.mybluemix.net/red/#flow/c0203df60272f3de	Data is received in Node-red and displayed in web UI	Pass	Kishor G. K. Arshaath A
1.Open the Node-Red dashboard	https://node-red-haefn-2022-11-07.eu-gb.mybluemix.net/ui/#!/0?socketid=qw56aMbtEEVH0QVXAAFw	User Input command has to be sent to the notification	Pass	Kishor G. K. Bhoobesh M

Table.8.2. Test Report

8.2 USER ACCEPTANCE TESTING

The Temperature, Humidity and Hazardous Gas level values are generated continuously and a certain limit is assigned to the program, whenever the cases exceed a limit the monitoring individual will receive a alert mail

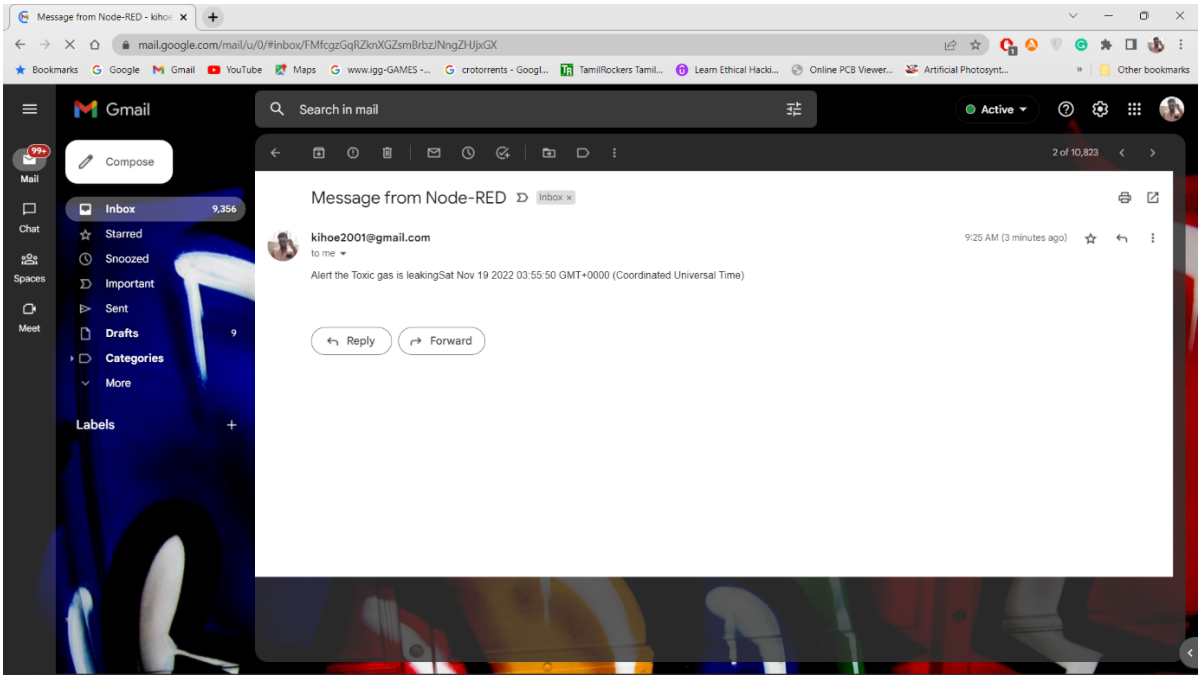

Figure.8.2.1 Notification

Defect Analysis:

Table.8.2.3 Defect Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	3	4	1	16
Duplicate	0	0	1	2	3
External	3	3	0	1	7
Fixed	7	1	4	14	26
Not Reproduced	0	0	1	0	1
Skipped	0	0	0	1	1
Won't Fix	0	0	0	1	1
Totals	19	7	10	20	55

Test Case Analysis:

Table. 8.2.2 Test Case Analysis

Section	**Total Cases**	**Not Tested**	**Fail**	**Pass**
Sensor data generation	4	0	0	4
Watson platform connection	4	0	0	4
Node-RED	5	0	0	5
API for control	6	0	0	6
Alert Status	6	0	0	6

CHAPTER - 9
RESULTS

9.1 Performance Metrics

NFT - Detailed Test Plan

Table 9.1. NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/Signoff
1.	Gas Leakage Web-UI	Stress	App Crash/ Developer team/ Site Down	Approved
2.	Gas Leakage Web-UI	Load	Server Crash/ Developer team/ Server Down	Approved

End Of Test Report

Table 9.2. End Of Test Report

Project Overview	NFT Test approach	NFR - Met	GO/NO-GO decision	Identified Defects	Approvals/ Sign Off
Gas Leakage Web-UI	Stress	Performance	GO	Closed	Approved
Gas Leakage Web-UI	Load	Scalability	NO-GO	Closed	Approved

CHAPTER - 10
ADVANTAGES AND DISADVANTAGES

ADVANTAGES

• The software can help people set free from the fear of gas leakage.
• Get real-time alerts about the gaseous presence in the atmosphere.
• The software is very user-friendly.
• Ensure worker’s health.
• Real time update about leakages
• Cost-effective installation.
• Measure oxygen level accuracy.
• Get immediate gas leakage alerts

DISADVANTAGES

• It is difficult to know failure modes unless very advanced methods of monitoring are used.
• The software currently can only alert people with SMS, it cannot make phone calls to help.

CHAPTER - 11

CONCLUSION

After this project performance, can conclude that detection of the gas leakage is incredible in the project system. Applicable usefully in the industrial and domestic purpose. In danger situations we are able to save the life by using this system. An alert is indicated by SMS or Mail. A sensor node senses gas like CO2, oxygen, propane. The estimated range of transmission and consumption of power is obtained. The simple procedures and Arduino UNO Micro controller area used to build the sensor

Gas leakage leads to severe accidents resulting in material losses and human injuries. Gas leakage occurs mainly due to poor maintenance of equipment's 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 LED and buzzer to alert people when LPG leakage is detected. This system is very simple yet reliable.

In this paper we use IOT technology for enhancing the existing safety standards. While making this prototype has been to bring a revolution in the field of safety against the leakage of harmful and toxic gases in environment and hence nullify any major or minor hazard being caused due to them. We have used the IOT technology to make a Gas Leakage Detector for society which having Smart Alerting techniques involving sending message like SMS or Mail to the concerned authority and an ability performing data analytics on sensor. This system will be able to detect the gas in environment using the gas sensors. This will prevent form the major harmful problem.

CHAPTER - 12
FUTURE SCOPE

The project can be enhanced with many other features that can serve the workers in the industry. The product currently is a simple basic version which can only send SMS alerts and mail alert on time. Some other additional features that are planned to be incorporated with this existing product are listed below

• The dashboard can be made more versatile for the industry employee to be feel and to monitor how it monitoring the gas leakage every day.

• The system can be enhanced with a smartwatch so that the employees in the industry can have an alert vibrate message, even they be unaware of the gas leakage they will get noticed.

• The system can further relate to the Houses so that the hardware system automatically senses the gas leakage and alerts the family in the houses.

CHAPTER - 13
APPENDIX

13.1SOURCE CODE

CLIENT

```
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
       "orgId": "b31tni",
       "typeId": "print1",
       "deviceId":"printid"
},
"auth":
     "token": "z?7tcRfcekcO08R6f2"
  }
def myCommandCallback(cmd);
   print("Message received from IBM IoT Platform: %s" %
cmd.data['command'])
    m=cmd.data['command']
client = wiotp.sdk.device.DeviceClient(config=myConfig,
     logHandlers=None)
client.connect()
```

```
while True:
    o2=random.randint(25,100)
    def my_function():
        othergas=random.randint(2,100)
time.sleep(20)
        return othergas
        othergas=my_function()
temp=random.randint(0,100)
       humidity=random.randint(0,100)
limit=50
if(othergas >= limit):
      myData = { 'Alert': "Alert the gas is leaked",'othergas':othergas}
else:
myData={'oxygen':o2, 'othergas':othergas,
       'temperture':temp,'humidity':humidity}35
client.publishEvent(eventId="Gas Sensor", msgFormat="json",
data=myData,
qos=0, onPublish=None)
       print("Published data Successfully: %s", myData)
client.commandCallback = myCommandCallback
time.sleep(15)
     client.disconnect()
```

13.2 SCREENSHOT:

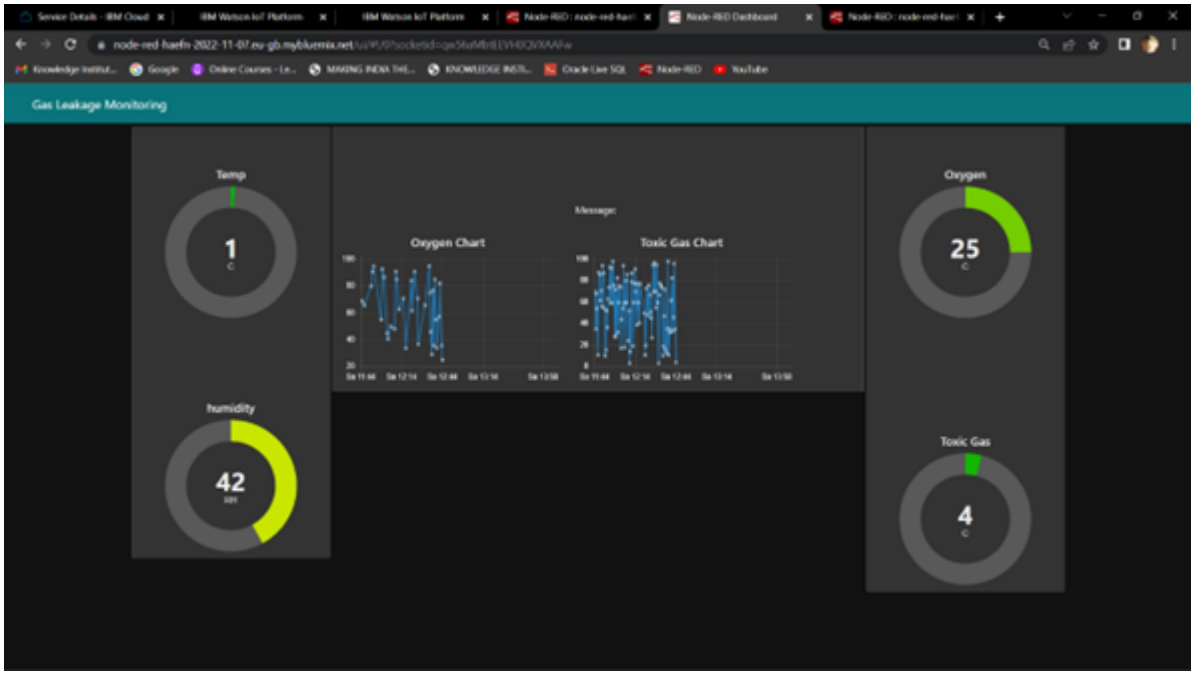

Figure.13.2.1. Dashboard UI

13.3 GITHUB & PROJECT DEMO LINK:

Content	Link
Github	https://github.com/IBM-EPBL/IBM-Project-39764-1660499342
Project Demonstration video	https://youtu.be/nPyUt1xHmTo

CHAPTER - 14

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• Rohan Chandra Pandey, Manish Verma, Lumesh Kumar Sahu, SaurabhDeshmukh (2018)' Internet of Things (IoT) Based Gas Leakage Monitoring and Alerting System with Mq-6 Sensor

• Shital Imade, Priyanka Rajmanes, Aishwarya Gavali, Prof. V. N. Nayakwadi (2018)' Gas Leakage Detection and Smart Alerting System.