IBM PROJECT

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

Batch: B8-2A4E

Team ID: PNT2022TMID16227

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Team Members:

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CONTENTS

1. INI’RODUCI’ION

1 Project Overview:

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

1.1 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 by the gases.

2. LITERATURE SURVEY

2.1 Existing Problem:

The number of sensors is unpredictable and the positioning of equipmentis improper and also the affordable of the system is high and the systems are sometimes causing heavy disasters.

2.2 References:

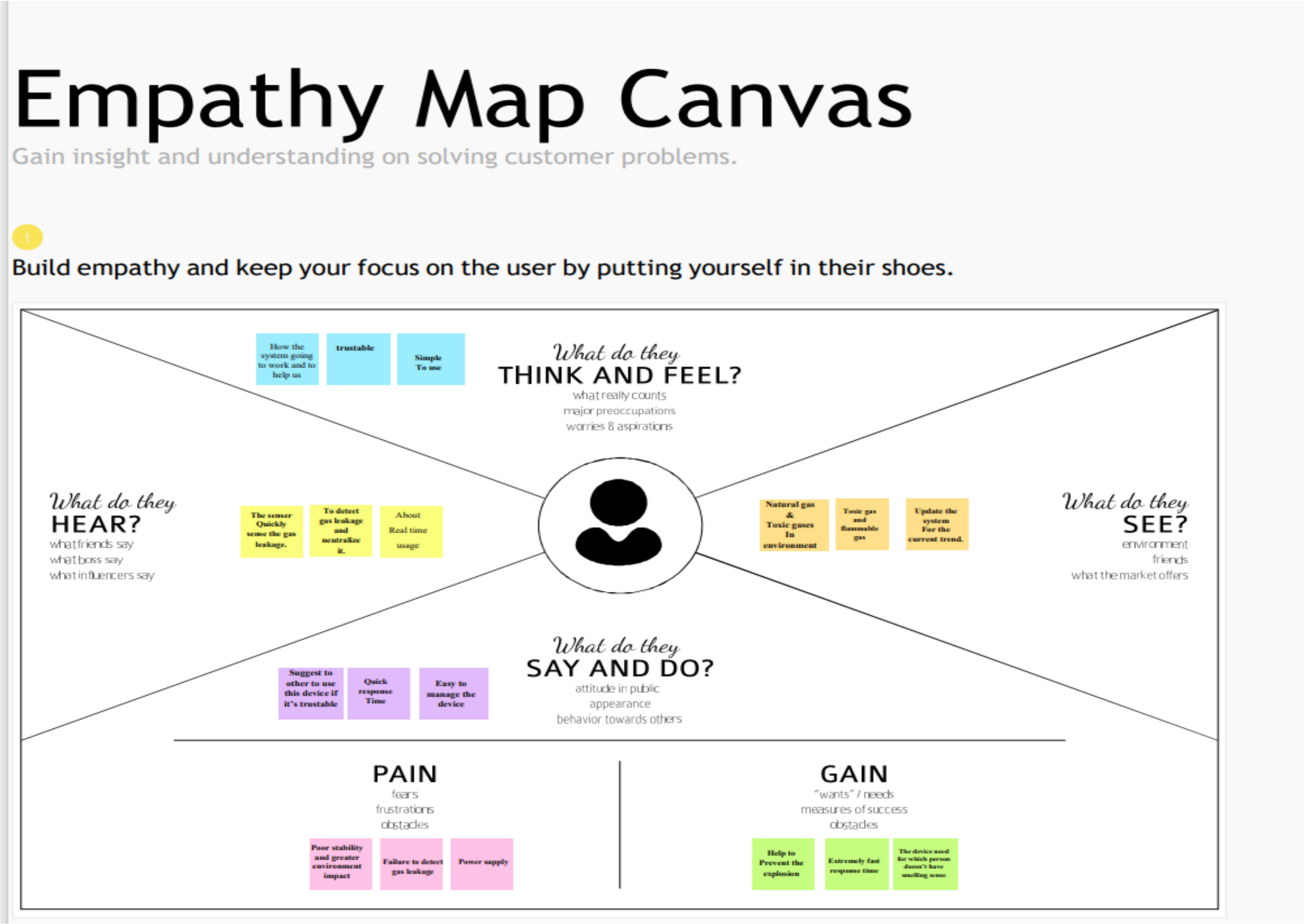
i. Bing Han, Qiang Fu, Hanfang Hou, ‘Methane Leakage Monitoring Technology For Natural Gas Stations and Its Application’, IEEE 5th International Conference on Computer and Communications,2001. Shruthi Unnikrishnan,1 Mohammad Razil, Joshua Benny, Shelvin Varghese and C.V. Hari, ‘LPG Monitoring And Leakage Detection System’, Department of Applied Electronics and Instrumentation Engineering, Rajagiri School of Engineering and Technology, Rajagiri Valley, Kakkanad, Kochi, India. J.Vijayalakshmi, Dr.G.Puthilibhai, S.R.Leoram Siddarth, ‘Implementation Of Ammonia Gas Leakage Detection & Monitoring System Using Internet Of Things’, West Tambaram, Chennai. Makiko Kawada, Tadao Minagawa, Eiichi Nagao, Mitsuhito Kamei, Chieko Nishida and Koji Ueda, ‘Advanced Monitoring System For Gas Density Of GIS’, Mitsubishi Electric Corporation.

2.3 Problem statement definition:

Since the number of sensors is unpredictable, the industrialists feel in secured in handling the gases. Also the cost price of the products and the complications in installing the systems are high. This makes the customers feel disappointed sometimes.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:



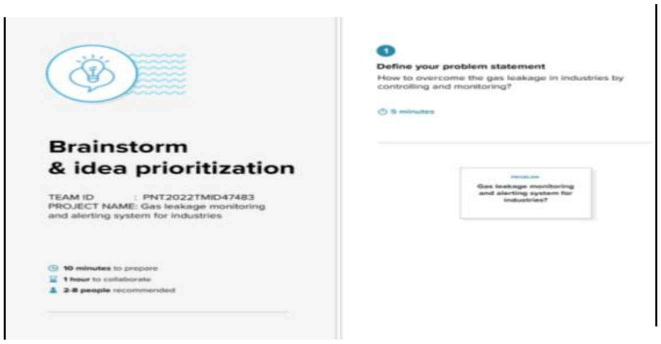
Empathy Map Canvas

Gain insight and understanding on solving customer problems.

Build empathy and keep your focus on the user by putting yourself in their shoes.

How the system going to work and to help us
trustable
Simple To use
What do they THINK AND FEEL?
what really counts
major preoccupations
worries & aspirations
What do they HEAR?
what friends say
what boss say
what influencers say
The senser Quickly sense the gas leakage.
To detect gas leakage and neutralize it.
About Real time usage
Natural gas & Toxic gases In environment
Toxic gas and flammable gas
Update the system For the current trend.
What do they SEE?
environment
friends
what the market offers
What do they SAY AND DO?
attitude in public
appearance
behavior towards others
Suggest to other to use this device if it's trustable
Quick response Time
Easy to manage the device
PAIN
fears
frustrations
obstacles
Poor stability and greater environment impact
Failure to detect gas leakage
Power supply
GAIN
"wants" / needs
measures of success
obstacles
Help to Prevent the explosion
Extremely fast response time
The device need for which person doesn't have smelling sense

3.2 Ideation & Brainstorming



Brainstorm
& idea prioritization

TEAM ID : PNT2022TMID47483
PROJECT NAME: Gas leakage monitoring and alerting system for industries

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

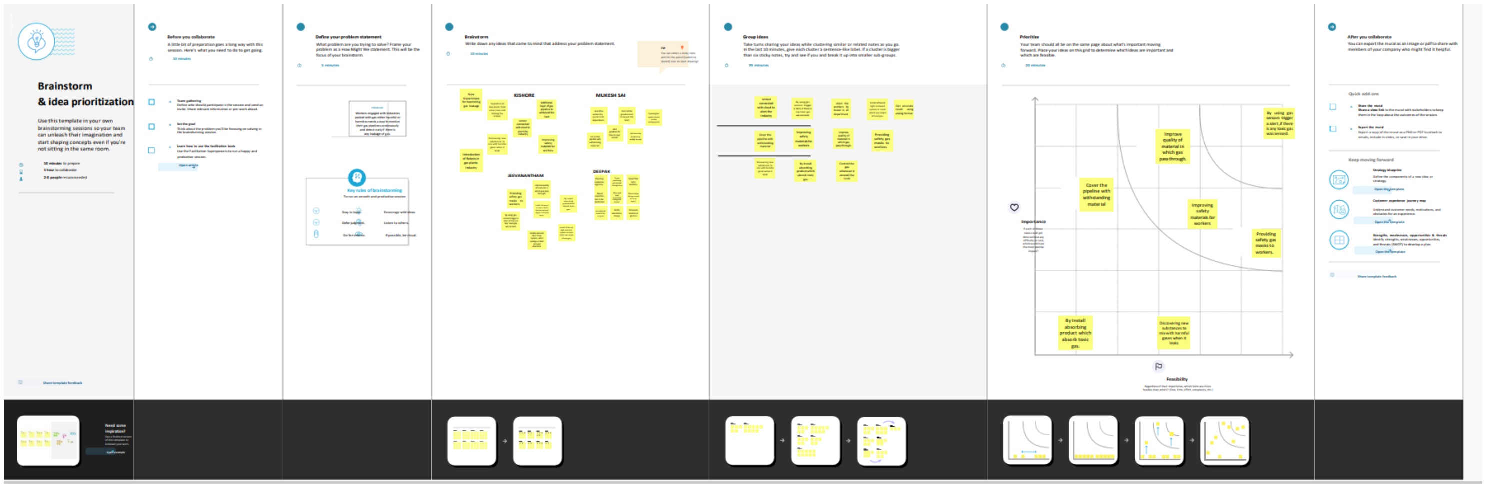
1

Define your problem statement

How to overcome the gas leakage in industries by controlling and monitoring?

5 minutes

Gas leakage monitoring and alerting system for industries?



Brainstorm
& idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

□ A Team gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

□ B Set the goal
Think about the problem you'll be focusing on solving in the brainstorming session.

□ C Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and productive session.

Open article

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

Workers engaged with industries packed with gas either harmful or harmless needs a way to monitor their gas pipelines continuously and detect early if there is any leakage of gas.

Key rules of brainstorming

To run an smooth and productive session

Stay in topic. Encourage wild ideas.
Defer judgment. Listen to others.
Go for volume. If possible, be visual.

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

KISHORE

New Department for monitoring gas leakage

Additional layer of gas pipeline to withstand the leak

sensor connected with cloud to alert the industry

Improving safety materials for workers

Introduction of Robots in gas plants industry

MUKESH SAI

JEEVANANTHAM

Providing safety gas masks to workers

DEEPAK

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, 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

sensor connected with cloud to alert the industry

Improving safety materials for workers

Providing safety gas masks to workers.

By install absorbing product which absorb toxic gas.

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

Importance
Feasibility
By using gas sensors trigger a alert ,if there is any toxic gas was sensed.
Improve quality of material in which gas pass through.
Cover the pipeline with withstanding material
Improving safety materials for workers
Providing safety gas masks to workers.
By install absorbing product which absorb toxic gas.
Discovering new substances to mix with harmful gases when it leaks

After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

□ A Share the mural
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

□ B Export the mural
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.
Open the template

Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.
Open the template

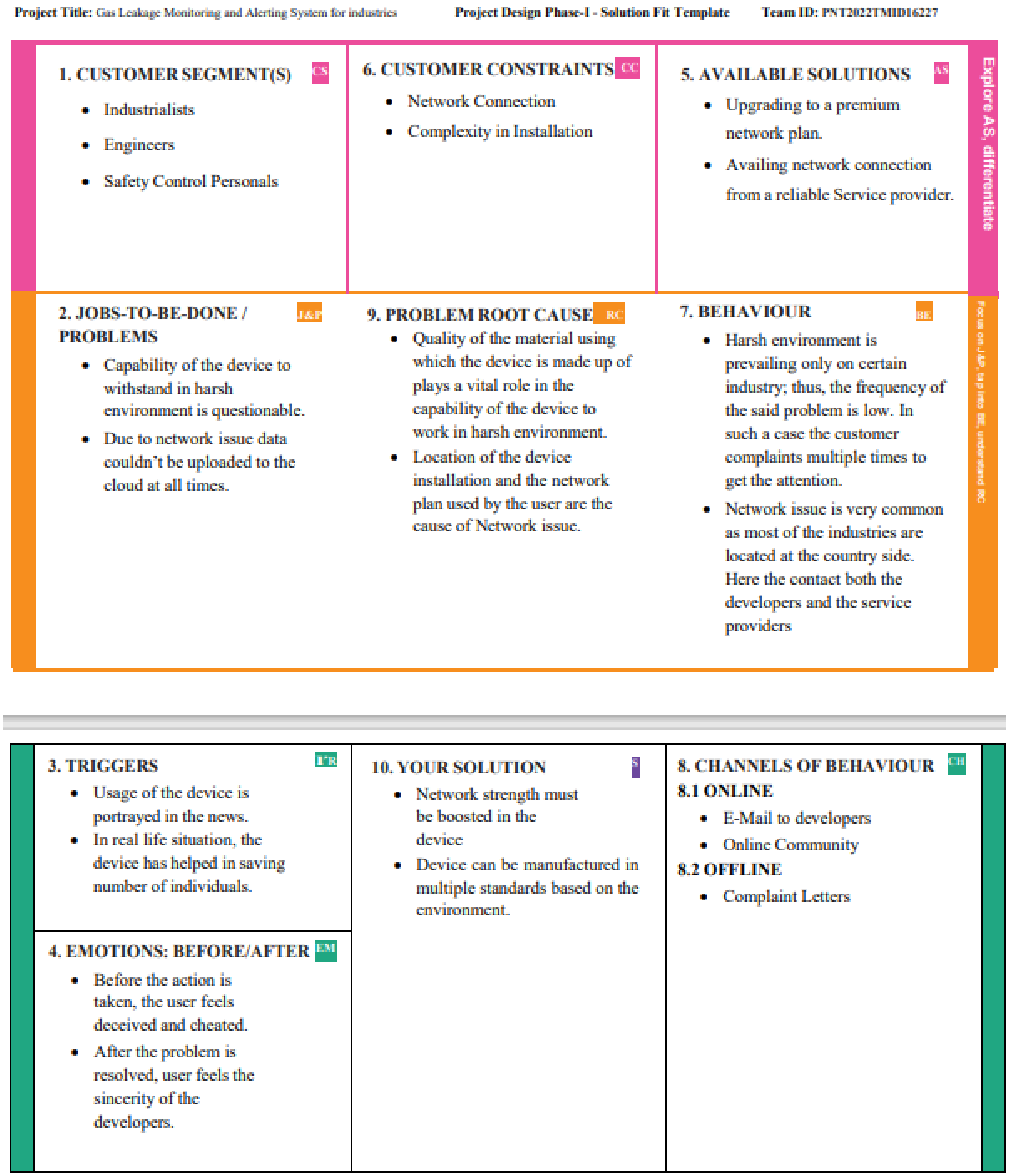
Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template

Share template feedback

Proposed Solution:

S.No.	Parameter	Description
	Problem Statement	Develop an efficient system & an application that can monitor and alert the users(workers)
	Idea / Solution description	This product helps the industries in monitoring the emission of harmful gasesIn several areas, the gas sensors will be integrated to monitor the gas leakage.If in any area gas leakage is detected the admins will be notified along with the locationIn the web application, admins can view the sensor parameters.
	Novelty / Uniqueness	Fastest alerts to the workersUser friendly
	Social Impact / Customer Satisfaction	Cost efficientEasy installation and provide efficient resultsCan work with irrespective of fear
	Business Model (Revenue Model)	The product is advertised all over the platforms. Since it is economical, it even helps small scale industries from disasters.As the product usage can be understood by everyone, it is easy for them to use it properly for their safest organization.
	Scalability of the Solution	Since the product is cost-efficient, it can be placed in many places in the industry. Even when the gas leakage is more, the product senses the accurate values and alerts the workers effectively.

3.3 Problem Solution Fit:



Project Title: Gas Leakage Monitoring and Alerting System for industries **Project Design Phase-I - Solution Fit Template** **Team ID: PNT2022TMID16227**

1. CUSTOMER SEGMENT(S) CS

- Industrialists
- Engineers
- Safety Control Personals

6. CUSTOMER CONSTRAINTS CC

- Network Connection
- Complexity in Installation

5. AVAILABLE SOLUTIONS AS

- Upgrading to a premium network plan.
- Availing network connection from a reliable Service provider.

Explore AS, differentiate

2. JOBS-TO-BE-DONE / PROBLEMS J&P

- Capability of the device to withstand in harsh environment is questionable.
- Due to network issue data couldn't be uploaded to the cloud at all times.

9. PROBLEM ROOT CAUSE RC

- Quality of the material using which the device is made up of plays a vital role in the capability of the device to work in harsh environment.
- Location of the device installation and the network plan used by the user are the cause of Network issue.

7. BEHAVIOUR BE

- Harsh environment is prevailing only on certain industry; thus, the frequency of the said problem is low. In such a case the customer complaints multiple times to get the attention.
- Network issue is very common as most of the industries are located at the country side. Here the contact both the developers and the service providers

Focus on J&P, tap into BE, understand RC

3. TRIGGERS TR

- Usage of the device is portrayed in the news.
- In real life situation, the device has helped in saving number of individuals.

4. EMOTIONS: BEFORE/AFTER EM

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

10. YOUR SOLUTION S

- Network strength must be boosted in the device
- Device can be manufactured in multiple standards based on the environment.

8. CHANNELS OF BEHAVIOUR CH

8.1 ONLINE

- E-Mail to developers
- Online Community

8.2 OFFLINE

- Complaint Letters

4. REQUIREMENT ANALYSIS

4.1 Functional Requirement:

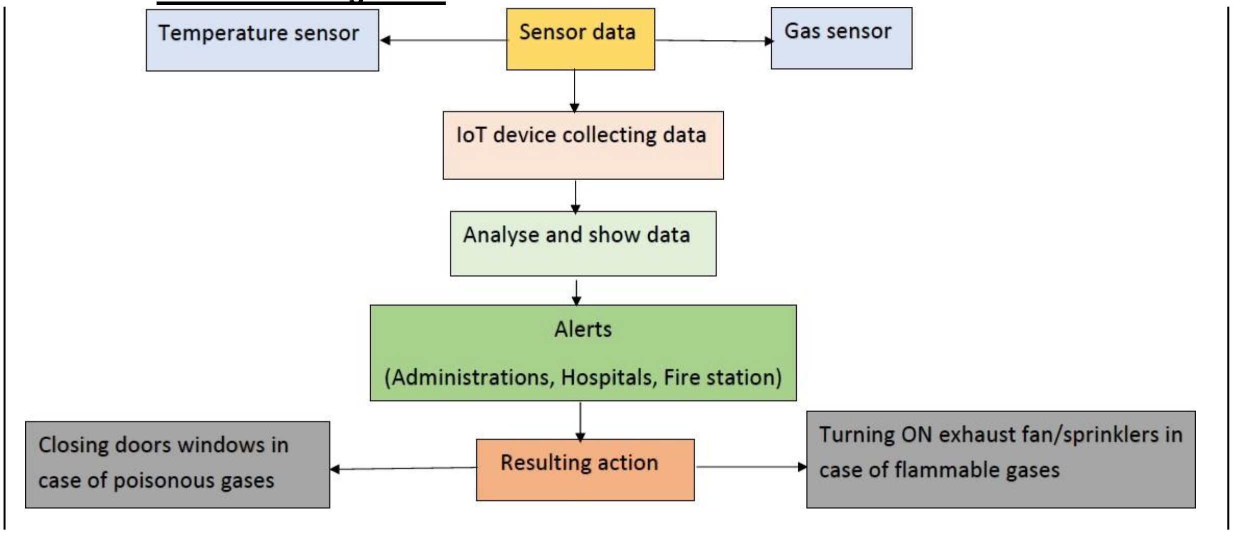
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Online Payment for the service
FR-2	User Access	Access the details using web browser Access the details using mobile application
FR-3	User Alert	Gets alert as an SMS message Gets alert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

4.2 Non-Functional Requirement:

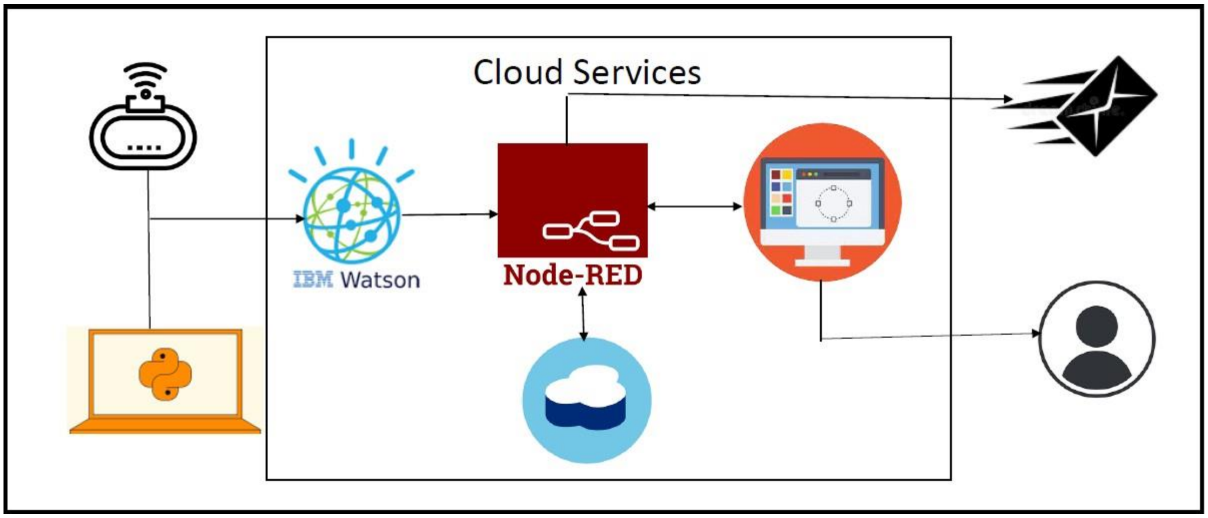
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The device must be usable by the customer anywhere
NFR-2	Security	Data from the sensors are stored securely and away from other data
NFR-3	Reliability	Data can be retrieved anytime and no data is discarded without customer knowledge
NFR-4	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

5. PROJECT DESIGN

5.1 Data Flow Diagrams:


Temperature sensor
Sensor data
Gas sensor
IoT device collecting data
Analyse and show data
Alerts
(Administrations, Hospitals, Fire station)
Closing doors windows in case of poisonous gases
Resulting action
Turning ON exhaust fan/sprinklers in case of flammable gases

5.2 Solution & Technical Architecture:

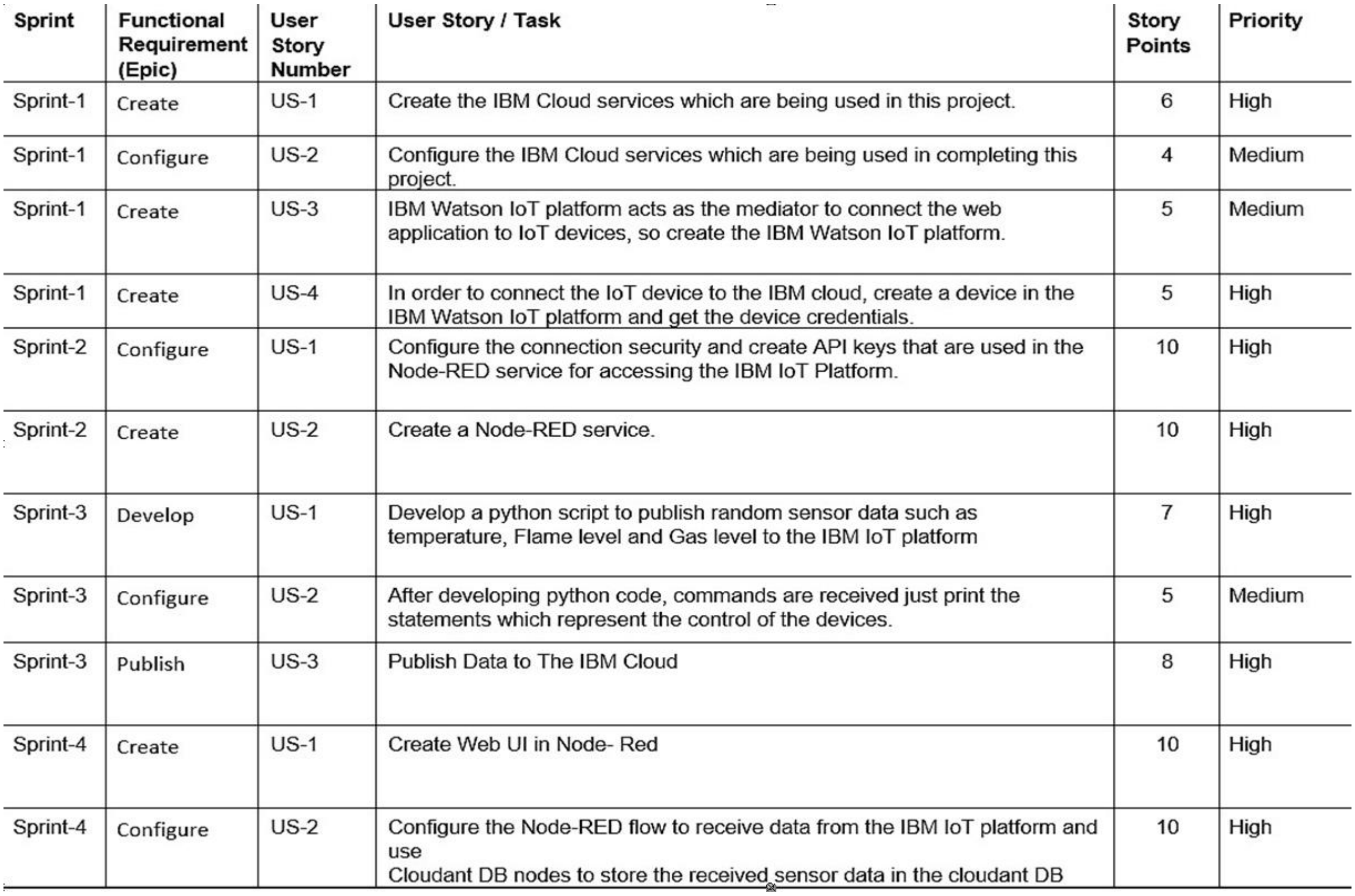


5.3 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptanc ecriteria	Priority	Release
Customer(Mobile user)	Registration	USN-1	User can enter into the webapplication	I can access myaccount / dashboard	High	Sprint-1
		USN-2	Users can register their credentials like email id andpassword	I can receive confirmation emailand click confirm	High	Sprint-1
	Login	USN-3	User can log in to the application by entering email and password	I can login to myaccount	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 datagiven by the device	High	Sprint-2
Customer (Web user)	Usage	USN-1	User can view the webpage 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 alertgiven by the device	I can get the data work according toit	High	Sprint-3
		USN-2	User turns ON the exhaust fan/sprinkler when the leakageoccurs	I can get the data work according toit	High	Sprint-4
CustomerCare Executive	Action	USN-1	User solve the problems whensomeone faces any usage issues	I can solve the issues when someone fails tounderstand the procedure	High	Sprint-4
Administrator	Administration	USN-1	User stores every information	I can store the gained information	High	Sprint-4

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning & Estimation:



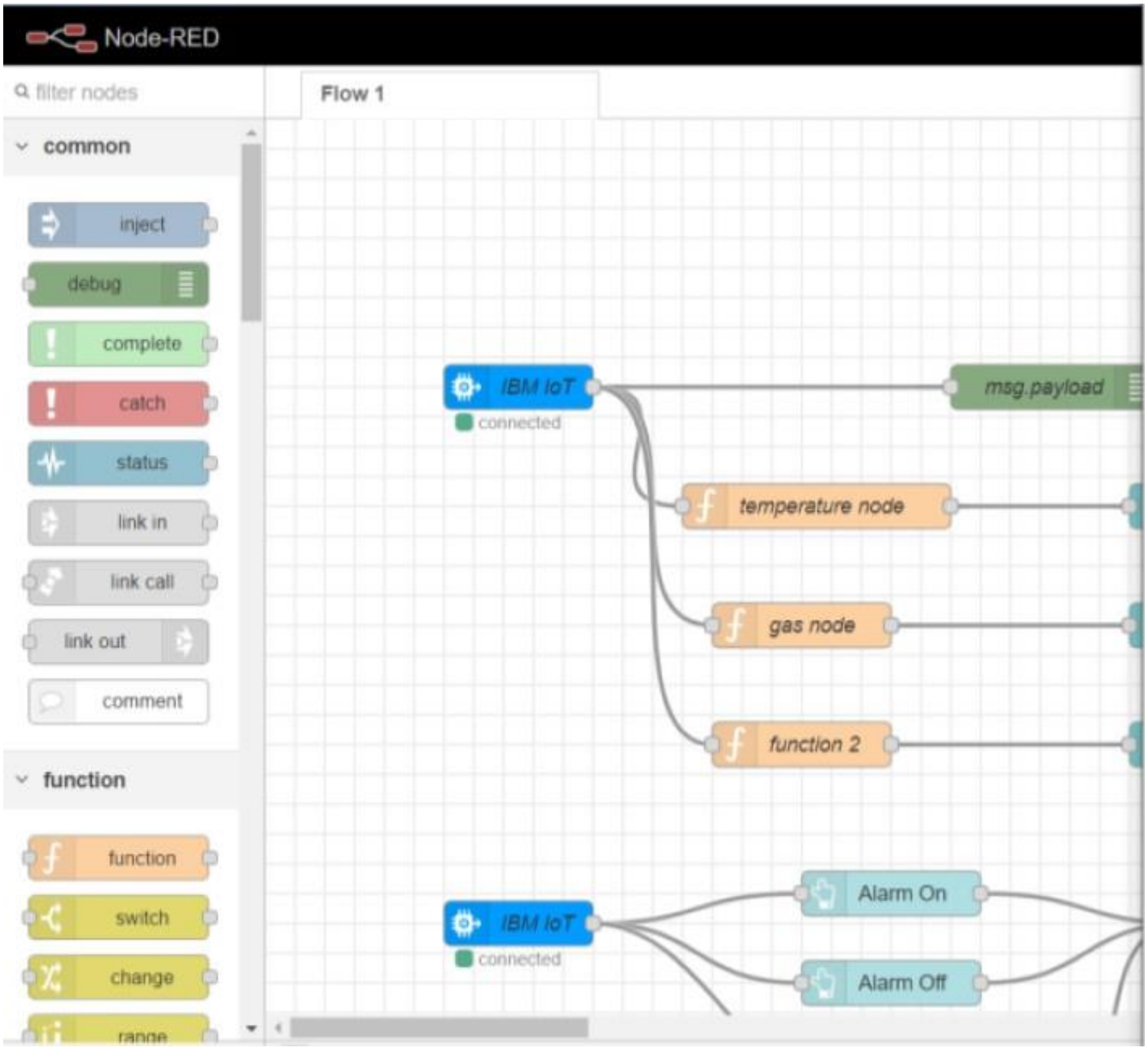
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Create	US-1	Create the IBM Cloud services which are being used in this project.	6	High
Sprint-1	Configure	US-2	Configure the IBM Cloud services which are being used in completing this project.	4	Medium
Sprint-1	Create	US-3	IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices, so create the IBM Watson IoT platform.	5	Medium
Sprint-1	Create	US-4	In order to connect the IoT device to the IBM cloud, create a device in the IBM Watson IoT platform and get the device credentials.	5	High
Sprint-2	Configure	US-1	Configure the connection security and create API keys that are used in the Node-RED service for accessing the IBM IoT Platform.	10	High
Sprint-2	Create	US-2	Create a Node-RED service.	10	High
Sprint-3	Develop	US-1	Develop a python script to publish random sensor data such as temperature, Flame level and Gas level to the IBM IoT platform	7	High
Sprint-3	Configure	US-2	After developing python code, commands are received just print the statements which represent the control of the devices.	5	Medium
Sprint-3	Publish	US-3	Publish Data to The IBM Cloud	8	High
Sprint-4	Create	US-1	Create Web UI in Node- Red	10	High
Sprint-4	Configure	US-2	Configure the Node-RED flow to receive data from the IBM IoT platform and use Cloudant DB nodes to store the received sensor data in the cloudant DB	10	High

6.2.Sprint Delivery Schedule:

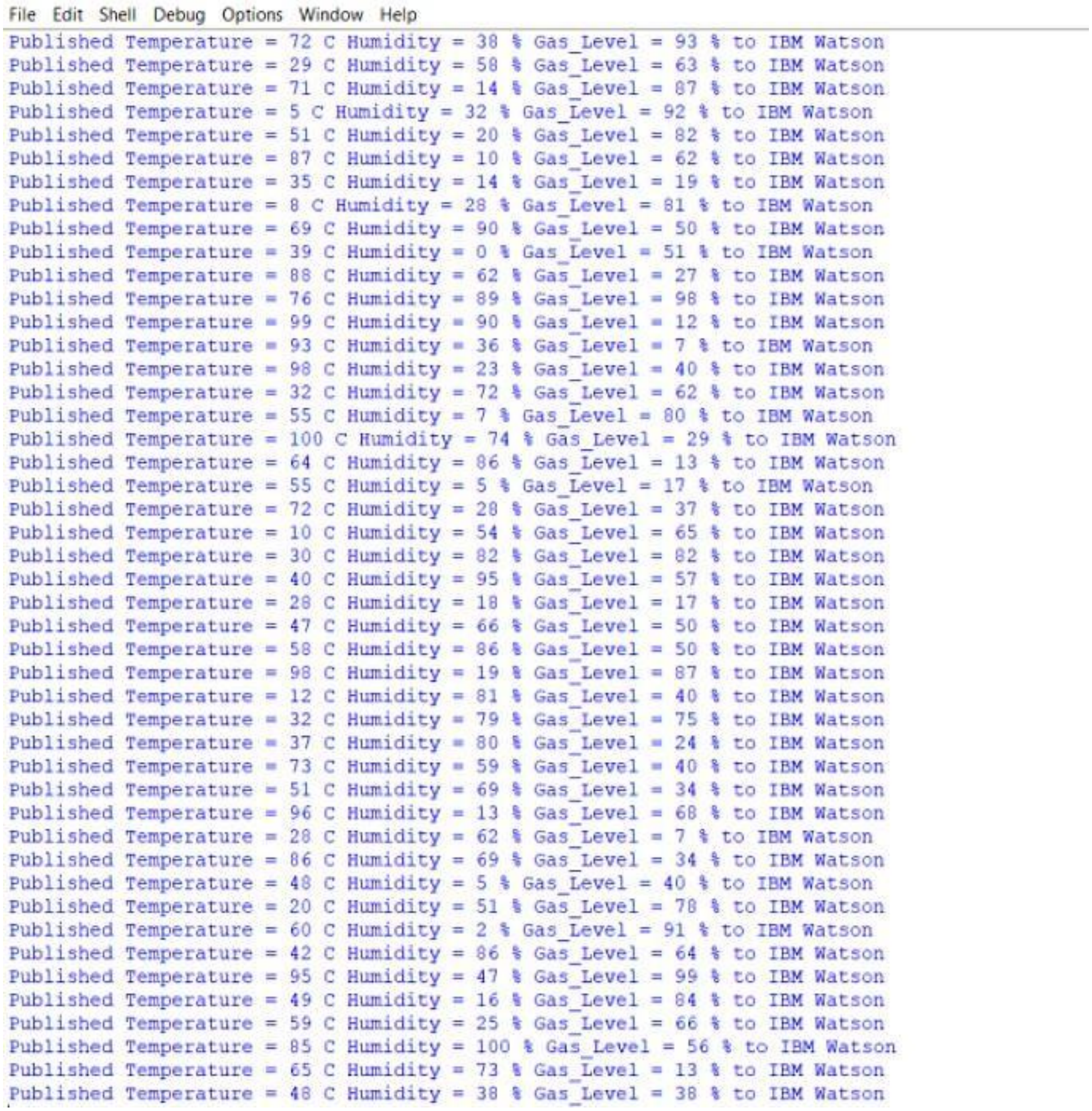
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022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

1. CODING AND SOLUTIONING

1.1 Feature 1(Node Red Output)



1.2 Feature 2: (Python Output)



```
Published Temperature = 72 C Humidity = 38 % Gas_Level = 93 % to IBM Watson
Published Temperature = 29 C Humidity = 58 % Gas_Level = 63 % to IBM Watson
Published Temperature = 71 C Humidity = 14 % Gas_Level = 87 % to IBM Watson
Published Temperature = 5 C Humidity = 32 % Gas_Level = 92 % to IBM Watson
Published Temperature = 51 C Humidity = 20 % Gas_Level = 82 % to IBM Watson
Published Temperature = 87 C Humidity = 10 % Gas_Level = 62 % to IBM Watson
Published Temperature = 35 C Humidity = 14 % Gas_Level = 19 % to IBM Watson
Published Temperature = 8 C Humidity = 28 % Gas_Level = 81 % to IBM Watson
Published Temperature = 69 C Humidity = 90 % Gas_Level = 50 % to IBM Watson
Published Temperature = 39 C Humidity = 0 % Gas_Level = 51 % to IBM Watson
Published Temperature = 88 C Humidity = 62 % Gas_Level = 27 % to IBM Watson
Published Temperature = 76 C Humidity = 89 % Gas_Level = 98 % to IBM Watson
Published Temperature = 99 C Humidity = 90 % Gas_Level = 12 % to IBM Watson
Published Temperature = 93 C Humidity = 36 % Gas_Level = 7 % to IBM Watson
Published Temperature = 98 C Humidity = 23 % Gas_Level = 40 % to IBM Watson
Published Temperature = 32 C Humidity = 72 % Gas_Level = 62 % to IBM Watson
Published Temperature = 55 C Humidity = 7 % Gas_Level = 80 % to IBM Watson
Published Temperature = 100 C Humidity = 74 % Gas_Level = 29 % to IBM Watson
Published Temperature = 64 C Humidity = 86 % Gas_Level = 13 % to IBM Watson
Published Temperature = 55 C Humidity = 5 % Gas_Level = 17 % to IBM Watson
Published Temperature = 72 C Humidity = 28 % Gas_Level = 37 % to IBM Watson
Published Temperature = 10 C Humidity = 54 % Gas_Level = 65 % to IBM Watson
Published Temperature = 30 C Humidity = 82 % Gas_Level = 82 % to IBM Watson
Published Temperature = 40 C Humidity = 95 % Gas_Level = 57 % to IBM Watson
Published Temperature = 28 C Humidity = 18 % Gas_Level = 17 % to IBM Watson
Published Temperature = 47 C Humidity = 66 % Gas_Level = 50 % to IBM Watson
Published Temperature = 58 C Humidity = 86 % Gas_Level = 50 % to IBM Watson
Published Temperature = 98 C Humidity = 19 % Gas_Level = 87 % to IBM Watson
Published Temperature = 12 C Humidity = 81 % Gas_Level = 40 % to IBM Watson
Published Temperature = 32 C Humidity = 79 % Gas_Level = 75 % to IBM Watson
Published Temperature = 37 C Humidity = 80 % Gas_Level = 24 % to IBM Watson
Published Temperature = 73 C Humidity = 59 % Gas_Level = 40 % to IBM Watson
Published Temperature = 51 C Humidity = 69 % Gas_Level = 34 % to IBM Watson
Published Temperature = 96 C Humidity = 13 % Gas_Level = 68 % to IBM Watson
Published Temperature = 28 C Humidity = 62 % Gas_Level = 7 % to IBM Watson
Published Temperature = 86 C Humidity = 69 % Gas_Level = 34 % to IBM Watson
Published Temperature = 48 C Humidity = 5 % Gas_Level = 40 % to IBM Watson
Published Temperature = 20 C Humidity = 51 % Gas_Level = 78 % to IBM Watson
Published Temperature = 60 C Humidity = 2 % Gas_Level = 91 % to IBM Watson
Published Temperature = 42 C Humidity = 86 % Gas_Level = 64 % to IBM Watson
Published Temperature = 95 C Humidity = 47 % Gas_Level = 99 % to IBM Watson
Published Temperature = 49 C Humidity = 16 % Gas_Level = 84 % to IBM Watson
Published Temperature = 59 C Humidity = 25 % Gas_Level = 66 % to IBM Watson
Published Temperature = 85 C Humidity = 100 % Gas_Level = 56 % to IBM Watson
Published Temperature = 65 C Humidity = 73 % Gas_Level = 13 % to IBM Watson
Published Temperature = 48 C Humidity = 38 % Gas_Level = 38 % to IBM Watson
```

8.TESTING

8.1 Test Cases:

8.2 User Acceptance Testing

8.2.1.Purpose of Document

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

8.2.2. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	4	2	3	14
Duplicate	1	0	3	0	4
External	2	3	2	1	8
Fixed	5	2	4	9	20
Not Reproduced	0	0	0	0	0
Skipped	1	1	1	1	4
Won't Fix	0	0	0	0	0

Totals 14 10 12 14 50

8.2.3.Test Case Analysis

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

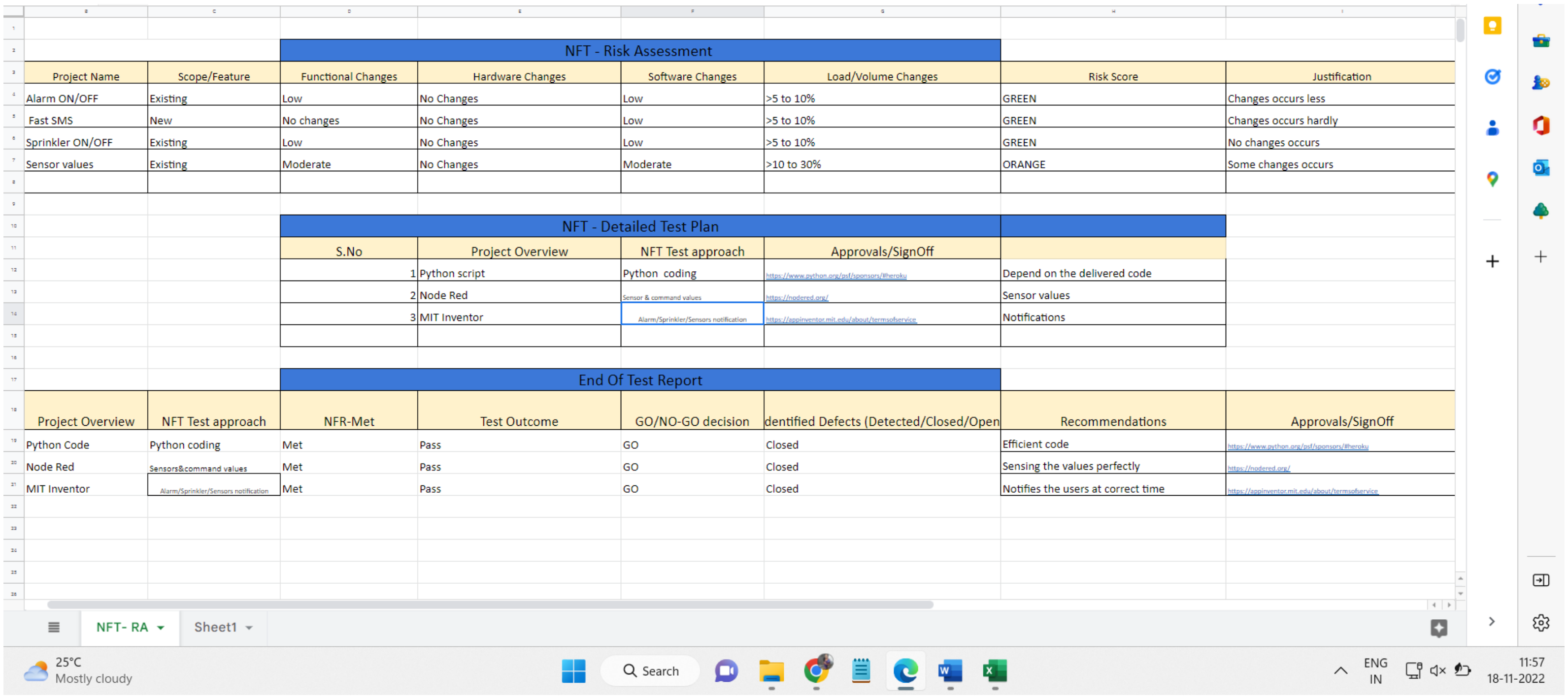
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	10	0	0	10
Client Application	75	0	0	75
Security	8	0	0	8
Outsource Shipping	2	0	0	2
Exception Reporting	10	0	0	10
Final Report Output	5	0	0	5

Version Control 10 0 0 10

- -

9.RESULTS

PERFORMANCE MATRIX:



NFT - Risk Assessment

Project Name	Scope/Feature	Functional Changes	Hardware Changes	Software Changes	Load/Volume Changes	Risk Score	Justification
Alarm ON/OFF	Existing	Low	No Changes	Low	>5 to 10%	GREEN	Changes occurs less
Fast SMS	New	No changes	No Changes	Low	>5 to 10%	GREEN	Changes occurs hardly
Sprinkler ON/OFF	Existing	Low	No Changes	Low	>5 to 10%	GREEN	No changes occurs
Sensor values	Existing	Moderate	No Changes	Moderate	>10 to 30%	ORANGE	Some changes occurs

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Approvals/SignOff	
1	Python script	Python coding	https://www.python.org/psf/sponsors/#heroku	Depend on the delivered code
2	Node Red	Sensor & command values	https://nodered.org/	Sensor values
3	MIT Inventor	Alarm/Sprinkler/Sensors notification	https://appinventor.mit.edu/about/termsofservice	Notifications

End Of Test Report

Project Overview	NFT Test approach	NFR-Met	Test Outcome	GO/NO-GO decision	dentified Defects (Detected/Closed/Open	Recommendations	Approvals/SignOff
Python Code	Python coding	Met	Pass	GO	Closed	Efficient code	https://www.python.org/psf/sponsors/#heroku
Node Red	Sensors&command values	Met	Pass	GO	Closed	Sensing the values perfectly	https://nodered.org/
MIT Inventor	Alarm/Sprinkler/Sensors notification	Met	Pass	GO	Closed	Notifies the users at correct time	https://appinventor.mit.edu/about/termsofservice

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 leakalert

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 leakageis 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 SmartHome 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 cylindersused 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 medicalequipment requires gas cylinders.

13.APPENDIX

Source Code:

```
#include <LiquidCrystal.h>

LiquidCrystal lcd(6, 7, 8, 9, 10, 11);
float gasPin = A0;
float gasLevel;
int ledPin = 2;
int buttonPin = 3;
int buzzPin = 4;
int buttonState;
int fan = 5;

void setup(){
  pinMode(ledPin, OUTPUT);
  pinMode(buttonPin, INPUT);
  pinMode(gasPin,INPUT);
  pinMode(fan,OUTPUT);
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.setCursor(0,0);
  lcd.print(" Welcome");
  lcd.setCursor(0,2);
  lcd.print("GAS LEAKAGE SYSTEM");
  delay(500);
  lcd.clear();
}

void loop(){
  // Read the value from gas sensor and button
  gasLevel = analogRead(gasPin);
  buttonState = digitalRead(buttonPin);

  // call the function for gas detection and button work
  gasDetected(gasLevel);
  buzzer(gasLevel);
  exhaustFanOn(buttonState);
}

// Gas Leakage Detection & Automatic Alarm and Fan ON
void gasDetected(float gasLevel){
  if(gasLevel >= 300){
   digitalWrite(buzzPin,HIGH);
```

```
    digitalWrite(ledPin,HIGH);
    digitalWrite(fan,HIGH);
    lcd.setCursor(0,0);
   lcd.print("GAS:");
    lcd.print(gasLevel);
   lcd.setCursor(0,2);
   lcd.print("FAN ON");
   delay(1000);
   lcd.clear();
  }else{
   digitalWrite(ledPin,LOW);
    digitalWrite(buzzPin,LOW);
    digitalWrite(fan,LOW);
    lcd.setCursor(0,0);
   lcd.print("GAS:");
    lcd.print(gasLevel);
   lcd.setCursor(0,2);
   lcd.print("FAN OFF");
   delay(1000);
   lcd.clear();
  }
}
//BUZZER
void buzzer(float gasLevel){
if(gasLevel>=300)
  {
  for(int i=0; i<=30; i=i+10)
  {
  tone(4,i);
  delay(400);
  noTone(4);
  delay(400);
  }
  }
}
// Manually Exhaust FAN ON
void exhaustFanOn(int buttonState){
  if(buttonState == HIGH){
    digitalWrite(fan,HIGH);
    lcd.setCursor(0,0);
   lcd.print("Button State:");
    lcd.print(buttonState);
    lcd.setCursor(0,2);
    lcd.print("FAN ON");
    delay(10000);
    lcd.clear();
  }
```

```
}
```