GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

TEAM ID: **PNT2022TMID49056**

TEAM MEMBERS:

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1 INTRODUCTION:

1.1PROJECT OVERVIEW:

Safety is of the biggest importance in today's environment, and certain precautions must be take both at work and at home to assure it. Whether the topic is electricity or oil and gas, working or living in a hazardous environment requires certain safety measures. "Liquified Petroleum Gas" (LPG), a kind of natural gas, is compressed under high pressure and kept in a metal cylinder. Leaving LPG exposed next to any fire source can cause catastrophic harm because it is highly flammable. LPG is more widely available than any other natural gas and is largely used for cooking. Sadly, due to its widespread use, gas leaks and even explosions are frequent occurrences. Consequently, a system for gas detection and monitoring

1.2PURPOSE:

These days, a home safety detection system is crucial to people's security. 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 industrial uses for these gases include heating, home appliances, and motor fuel. The system has a MQ6 gas detector to keep an eye on this gas leak. This sensor detects the amount of leaking gas present in the surrounding atmosphere. In this way, the consequences of an explosion or gas leak can be avoided.

2 LITERATURE SURVEY :

2.1EXISTING PROBLEM:

The goal of the Internet of Things is to simplify our lives by automating all of the little tasks around us. The advantages of IoT can be extended to improving the current safety standards in addition to helping to automate jobs. IoT has not been immune to the fundamental worry of any project, safety. Gas leaks can be fatal and harmful, whether they occur in open or closed spaces. Despite their high level of precision, conventional gas leak detection systems overlook a few important aspects of warning others of a leak. As a result, we have created a Gas Leakage Detector for society using IoT technology, which incorporates Smart Alerting procedures that involve sending a text message to the relevant authorityandthe capacity to analyse sensor readings using data. Our main goal is to provide a gas leak detection system for a society in which every apartment has gas leak detecting equipment. This will identify dangerous gases in the environment and deliver notifications and alarms to society's members.

2.2 REFERENCES:

In their research article on "GSM-based LPG leakage detection and regulating system," Prof. M. Amsaveni, A. Anurupa, R.S. Anu Preetha, C. Malarvizhi, and M. Gunasekaran explained that the MQ-6 gas sensor is used to detect LPG leaks. It provides the microcontroller with its analogue output. It is made up of a predetermined set of instructions. The exhaust fan is turned on in light of this. As a result, the room's gas concentration decreases. After that, the stepper motor is turned, shutting the cylinder's knob. Gas leakage is prevented as a result of this procedure. The house's electricity supply is turned off by switching the relay. To signal the gas leak, the buzzer emits an alarm. The user is then informed through SMS via the GSM module. They suggested their methodology, which calls for the system to automatically initiate control measures upon detecting a 0.001% LPG leak. A mechanical handle is provided by this automatic control action to close the valve. By using a relay to turn off the electricity to the house, we are enhancing human security. A bell is given to notify the neighbours about the leakage, and we are also sending alert messages to consumers via GSM..

The leakage detection and real-time gas monitoring system were suggested in the April 2014 publication "Automatic LPG detection and hazard controlling" by P. Meenakshi Vidya, S. Abinaya, G. Geetha Rajeswari, and N. Guna. The exhaust fan in this system is used to both detect and regulate gas leaks. Additionally, the amount of LPG in the cylinder is regularly checked.

In this study work, Srinivasan, Leela, Jeyabharathi, Kirthik, and Rajasree discussed the detection and control of gas leaks. This essay discusses how lethal inferno caused by gas leaks has become a significant issue in homes and other locations that handle and utilise household gas. In addition to closing the gas supply valve as a primary safety measure, it warns the subscriber via the alarm and the status display.

In 2014, Hitendra Rawat, Ashish Kushwah, Khyati Asthana, and Akanksha Shivhare created a framework that addressed security concerns around hoodlums, spills, and fire incidents. When that occurs, their framework sends an SMS to the designated crisis number.

In this publication, B. B. Did paye and Prof. S. K. Nanda discussed their work on leakage detection as well as a review of the "Automated unified system for LPG employing microcontroller and GSM module." In their article, they suggested a cutting-edge method for detecting LPG leaks, stopping them, and automatically scheduling a refill. In advance, the system offers automatic control of the LPG regulator, and if a leak is found, it will also immediately turn off the power supply's main switch. As a result, it aids in preventing explosions and blasts.

Pal-Stefan Murvaya and IoanSileaa (2008) described numerous methods for detecting gas leaks in their survey on gas leak localization approaches. They introduce some new or ancient methods for gas detection. The approaches that are suggested in this paper are nontechnical and hardware-based, and they comprise active, optical, and auditory methods. According to their survey, there are numerous leak-detecting methods available for gas pipelines.

2.3 Problem Statement Definition:

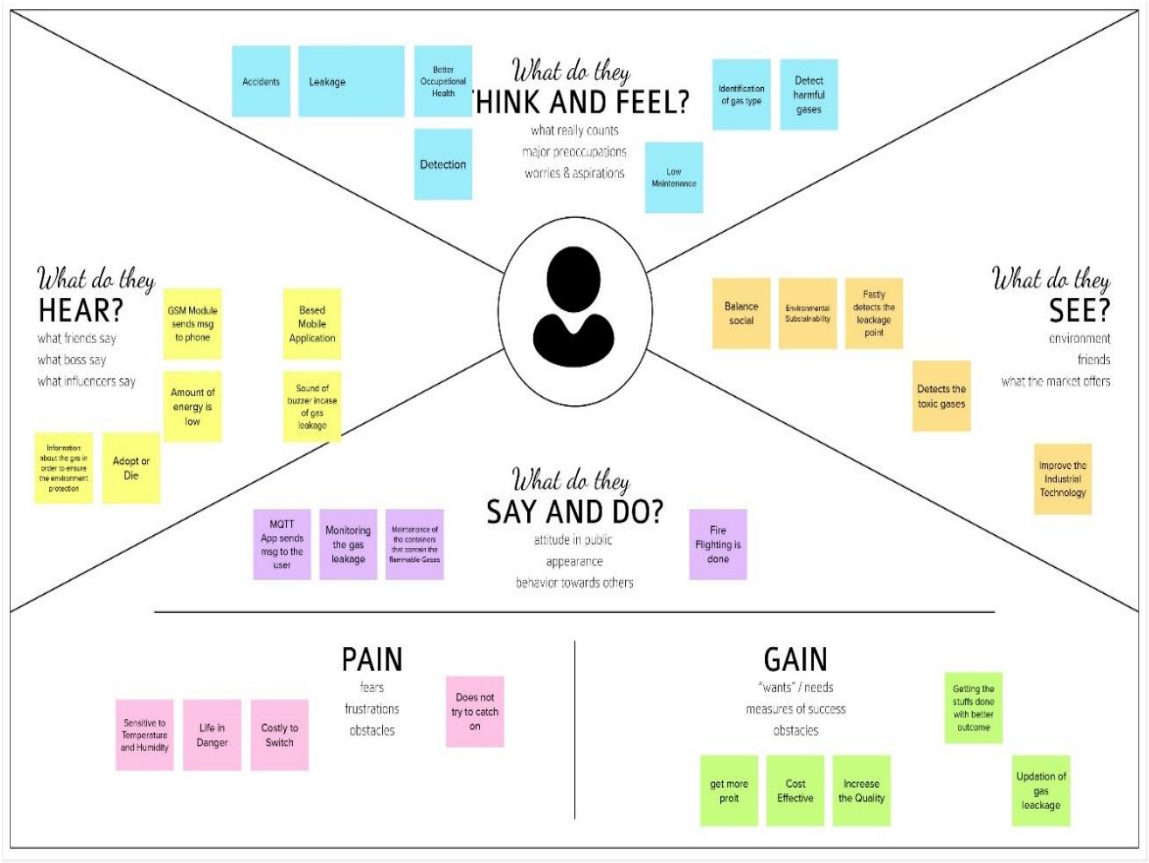
Gas detector can sound an alarm to operators in the area where the leak is occurring. Giving them the opportunity to leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

SOLUTIONS:

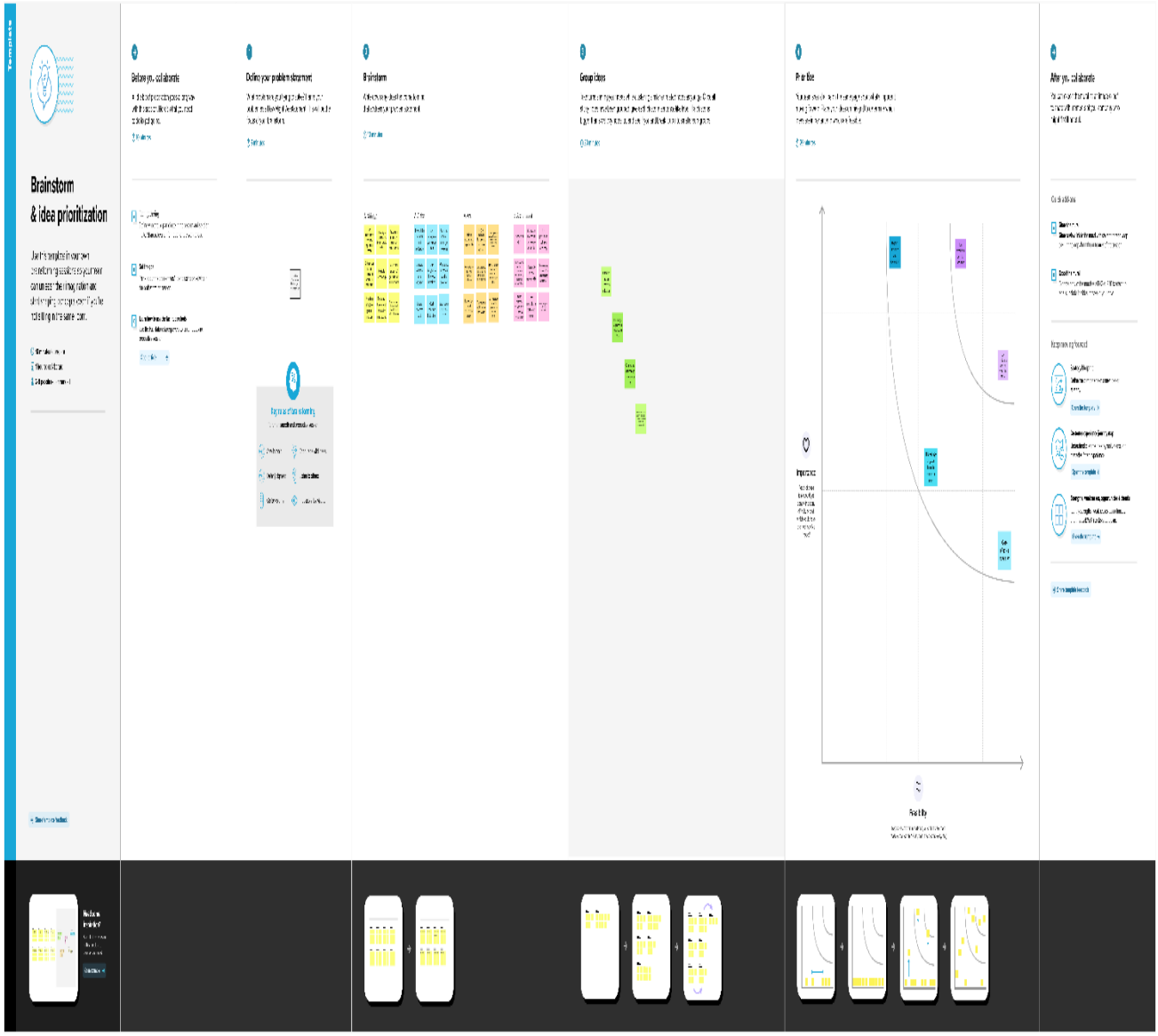
- We can use sensors that are used to detect essence of propane, isobutane ,LPG and even smoke. These sensors has an advantage to combine &sensitivity response time.
- The system will detect the presence of excess amounts of harmful gases in environment then this system will notify the use.
- We can provide the information such as when a gas leakage is noticed. sensors in the project are used to notice the gas leakage and immediately turns ON the buzzer for the danger indication. Buzzer is a clear indication of gas leakage.
- We can also send messages SMS to mobile number specifically mentioned in the program of the source code for alerting danger to the people.

3 IDEATION & PROPOSED SOLUTION:

3.1Empathy Map Canvas:



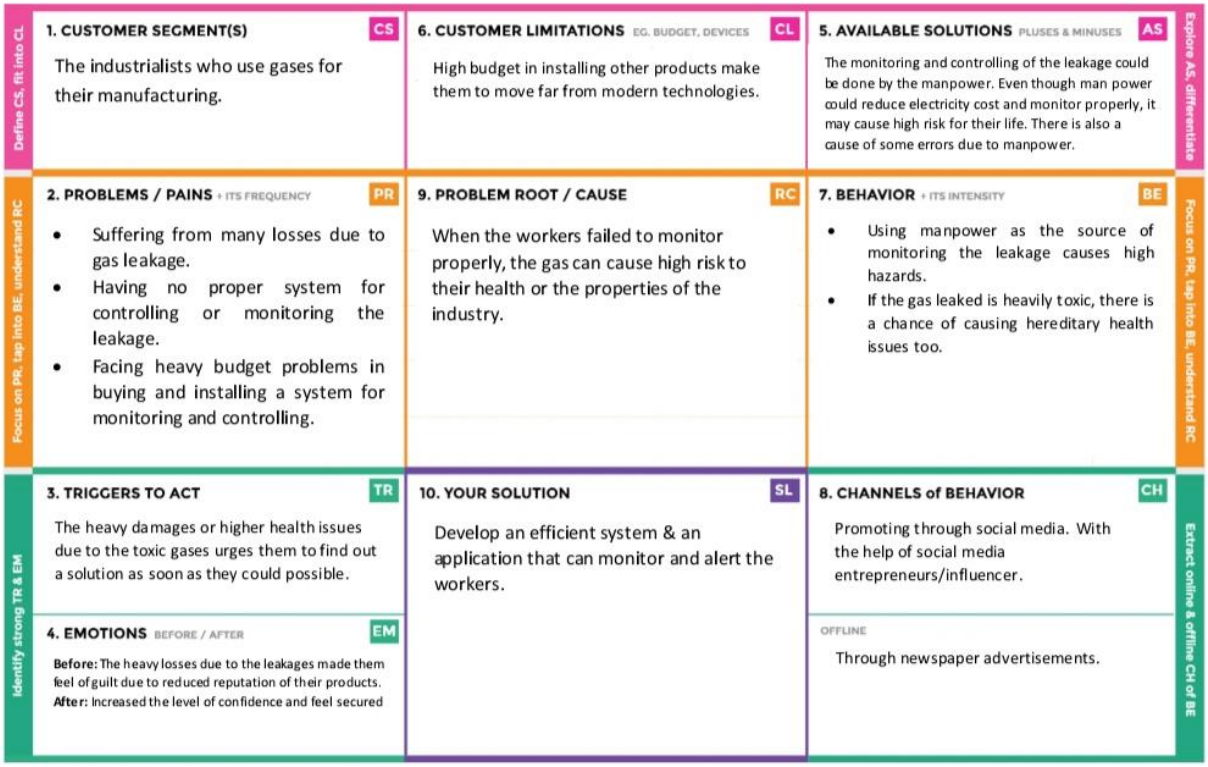
3.2 IDEATION & BRAINSTORMING:



3.3 PROPOSED SOLUTION:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	➢ Develop an efficient system& an application that can monitor and alert the users(workers)
2.	Idea / Solution description	➢ This product helps the industries in monitoring the emission of harmful gases ➢ In several areas,the gas sensors will be integrated to monitor the gas leakage ➢ If 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.
3.	Novelty / Uniqueness	➢ Fastest alerts to the workers ➢ User friendly
4.	Social Impact / Customer Satisfaction	➢ Cost efficient ➢ Easy installation and provide efficient results ➢ Can work with irrespective of fear
5.	Business Model (Revenue Model)	➢ The product is advertised all over the platforms.since it is economical ,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
6.	Scalability of the Solution	➢ Since the product is cost efficient ,it can be placed in many places in the industries . ➢ Even when the gas leakage is more ,the product sense the accurate values and alerts the workers effectively.

3.4 PROBLEM SOLUTION FIT:



4 REQUIREMENT ANALYSIS:

4.1 FUNCTIONAL REQUIREMENT:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story/Sub-Task)
FR-1	User Registration	Registration
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Hardware Requirement	Optical oil Ultra-Sonic Flow Meter
FR-4	Software Requirement	Flow change Pressure point Statistic

FR-5	User Welfare	Calibration No Poisoning of the Sensor Reliable in All Environmental Conditions Easy to Use

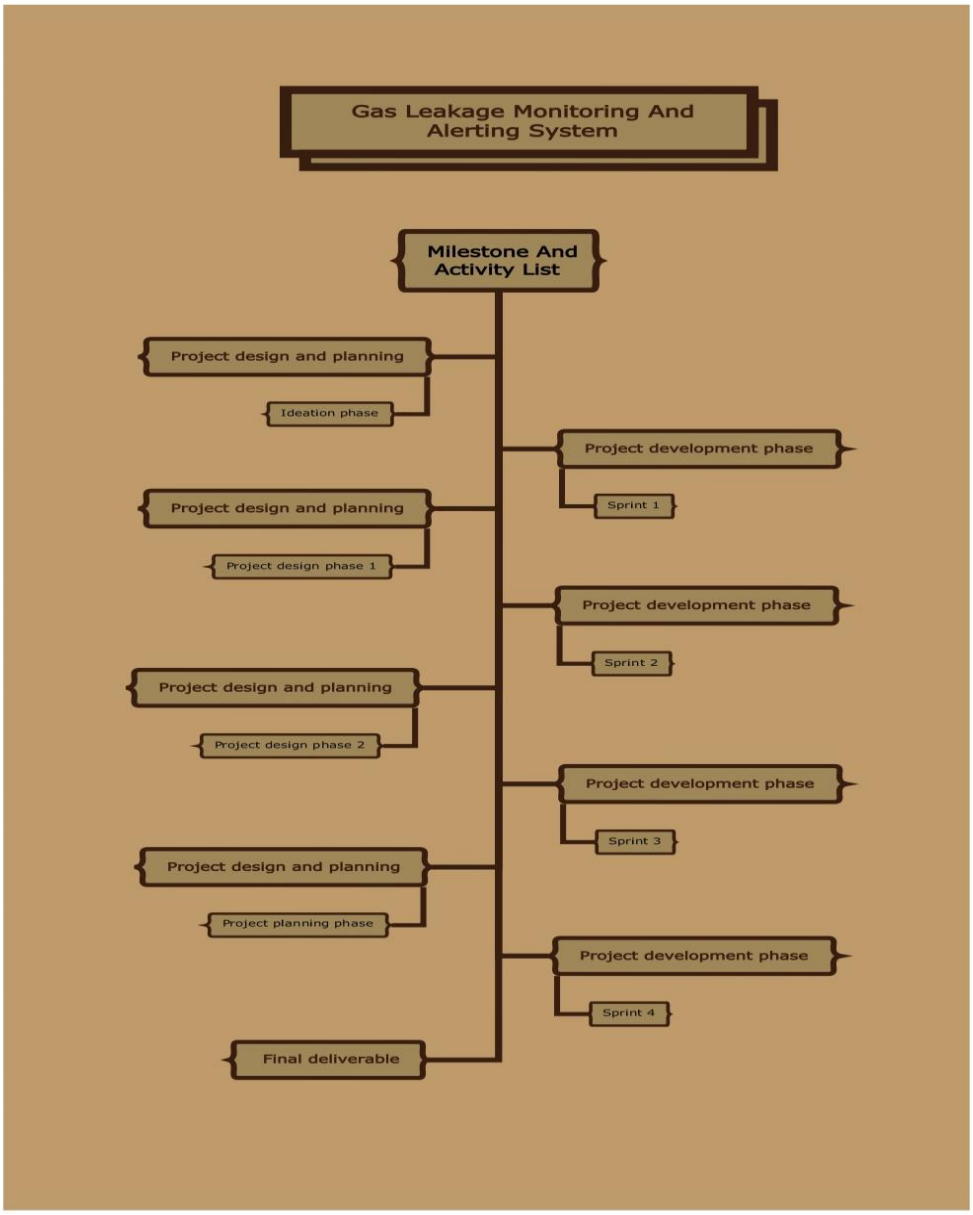
4.3NON-FUNCTIONAL REQUIREMENTS:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties with in and outside the premises
NFR-2	**Security**	The device is intended for use in household safety where appliances and heaters that use natural gas and liquid petroleum gas (LPG)maybe a source of risk.
NFR-3	**Reliability**	Gas Leakage Detection System(GLDS) can detect leakage at homes ,commercial premises or factories GLDS detects the leakage soon after it happened and sends users an immediate Alarm on the incident.
NFR-4	**Performance**	The Gas Leakage Detector is a wall mounted device fitted close to the floor level with an alarm setting at20% of lower explosive limit. Whenever there is a leak, the in-built sensor detects and alerts the user in less than 5minutes, much before it can cause any accidents
NFR-5	**Availability**	The circuit for an LPG leakage detector is readily available in the market, but it is extremely expensive Presented here is a low-cost circuit for a Gas Leakage Detection that you can build easily.
NFR-6	**Scalability**	The system proves the need for gas detection alarm systems to 100% reliable. A backup power supply can be

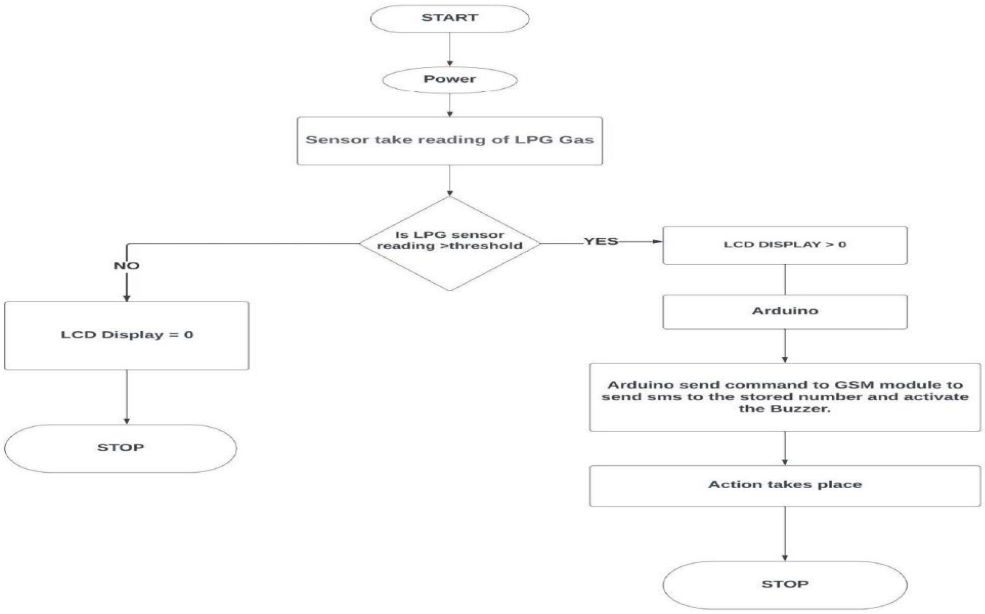
		included in the system design to argument for power failure condition. Also, calibration of the gas sensor can be done in other for a specific gas to be sensed instead of the LPG numerous gases It sense

5 PROJECT DESIGN:

5.1DATA FLOW DIAGRAMS:



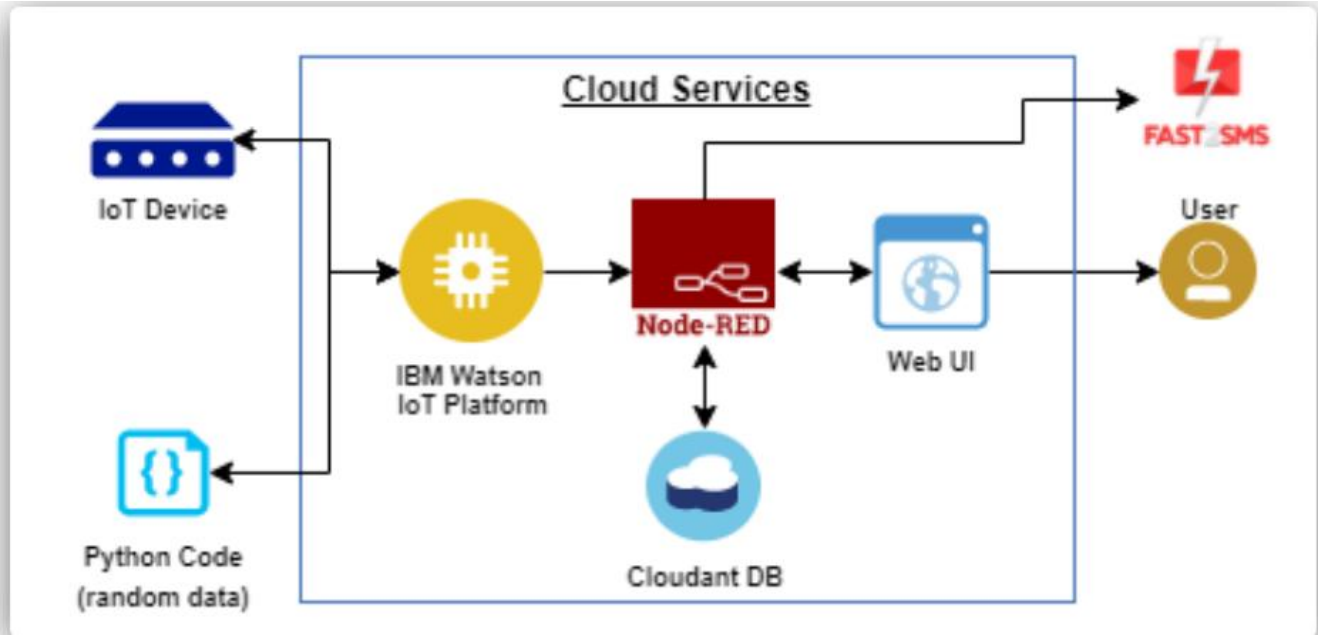
Data Flow Diagram for Gas Leakage Monitoring and Alerting System for Industries:



Steps in data flow diagram:

1. Power is supplied to the Arduino
2. Sensor which is connected to the Arduino takes the reading of the LPG gas from the gas cylinder
3. If the reading of the sensor is greater than the threshold value, the LCD DISPLAY is assigned to the value greater than zero.
4. If the LCD DISPLAY is greater than zero, Arduino send the command to GSM module to send SMS to the stored number and activate the Buzzer
5. So that action will takes place and stop.
6. If the reading of the sensor is less than threshold value, LCD DISPLAY is equal to zero and then stop.

5.2SOLUTION & TECHNICAL ARCHITECTURE :



5.3 USER STORIES:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Industry owner)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	Register to the application by email and password with password confirmation.	High	Sprint-1
Customer (Industry Owner)	Confirmation	USN-2	I will receive confirmation email once Ihave registered for the application	Receive confirmation email & click confirm	High	Sprint-1
Customer (Industry Owner)	Authorize	USN-3	As a user, I will enable the supervisor to monitor the gas leakage system status.	Provide access to supervisor.	High	Sprint-1
Customer (Supervisor)	Login	USN-4	As a user, I can log into the application by entering email & password.	Get access to dashboard.	High	Sprint-1
Customer (Supervisor)	Monitor	USN-5	As a user, I can monitor the status of the gas leakage system.	Status of gas leakage system.	High	Sprint-1
Customer (Line Workers)	Notification	USN-6	As a user, I can get (alarm system) alert about gas leakage.	Get alert about gas leak.	Medium	Sprint-2
Customer (Supervisor)	Notification	USN-7	As a user, I can get SMS notification & alarming alert about gas leakage.	Get alert about gas leakage.	Medium	Sprint-2
Customer (Industry Owner)	Sign-Up	USN-9	As a user, I can sign-up using Facebook login.	I can sign-up with the application using Facebook.	Low	Sprint-3
Customer (Supervisor)	Sign-Up	USN-10	As a user, I can sign-up using Google login.	I can sign-up with the application Google using.	Low	Sprint-3
Administrator	Service Request	USN-11	As a user, I can request for service in case of any issue with gas leakage monitoring system	Get service from provider	Low	Sprint-3
Administrator	Increase dservice	USN-12	As a user, I can request for scaling up the gas leakage monitoring system.	Get service from the provider.	Low	Sprint-4
Customer (Industry Supervisor)	Leakage detection	USN-13	Look for gas leakage in any other container	Access the monitor Display	High	Sprint-1

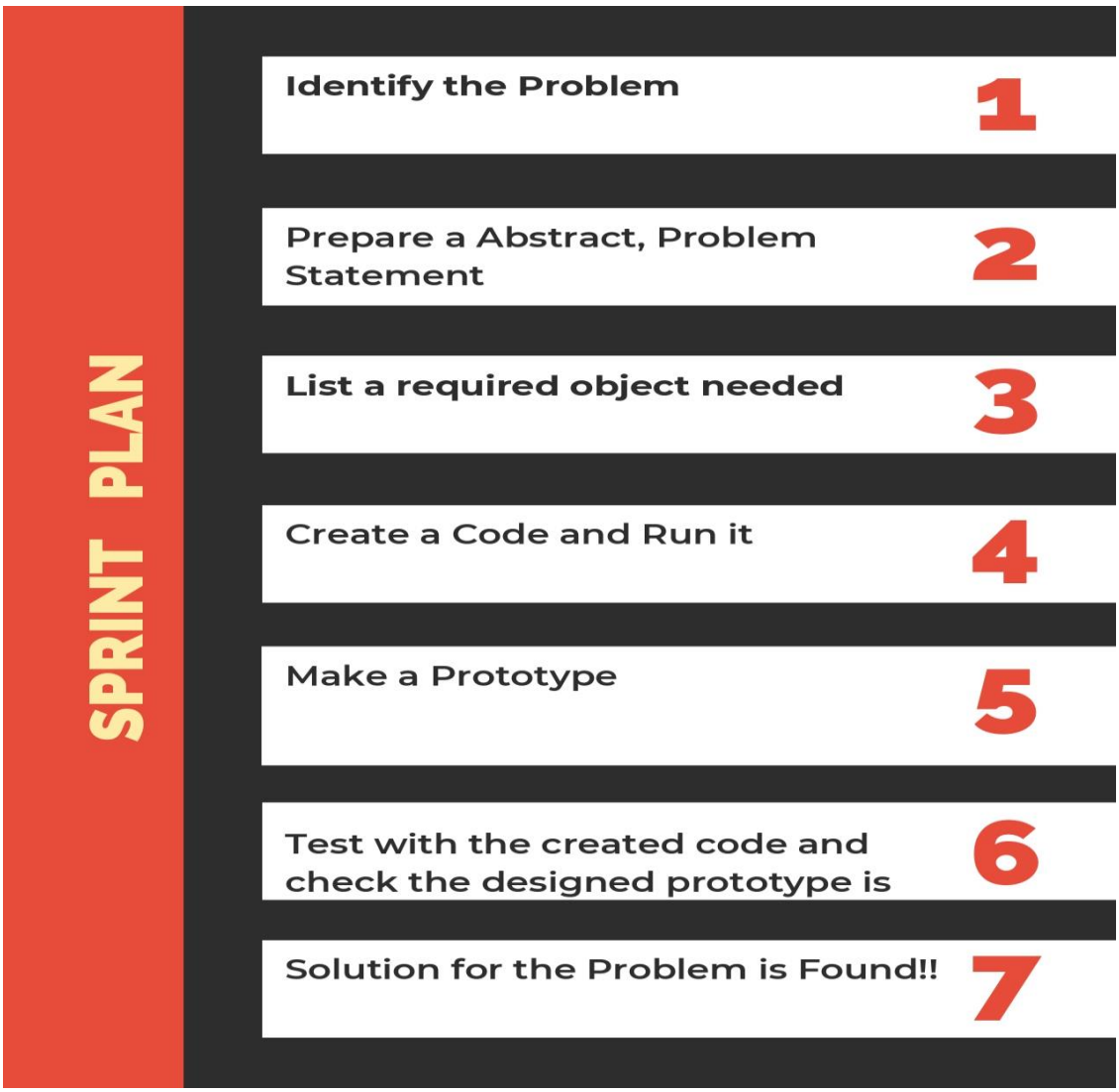
6 PROJECT PLANNING & SCHEDULING :

6.1 SPRINT PLANNING &ESTIMATION:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members

Sprint-1	Create	US-1	Create the IBM Cloud services which are being used in this project.	6	High	Abinaya R Ajitha A
Sprint-1	Configure	US-2	Configure the IBM Cloud services which are being used in completing this project	4	Medium	Abinaya R Anu A
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	Abinaya R Archanadevi S
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	Abinaya R Ajitha A
Sprint-2	Configure	US-1	the connection security and create API keys Configure that are used in the Node-RED service for accessing the IBM IoT Platform.	10	High	Ajitha A Anu A
Sprint-2	Create	US-2	Create a Node-RED service.	10	High	Ajitha A Archanadevi S
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	Anu A Abinaya R
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	Anu A Ajitha A
Sprint-3	Publish	US-3	Publish Data to The IBM Cloud	8	High	Archanadevi S Abinaya R
Sprint-4	Create	US-1	Create Web UI in Node- Red	10	High	Archanadevi S Ajitha A
Sprint-4	Configure	US-2	Configure the Node-RED flow to receive data from the IBM IoT platform and also use cloudant DB nodes to store the received sensor data in the cloudant DB	10	High	Abinaya R Anu A Ajitha A Archanadevi S

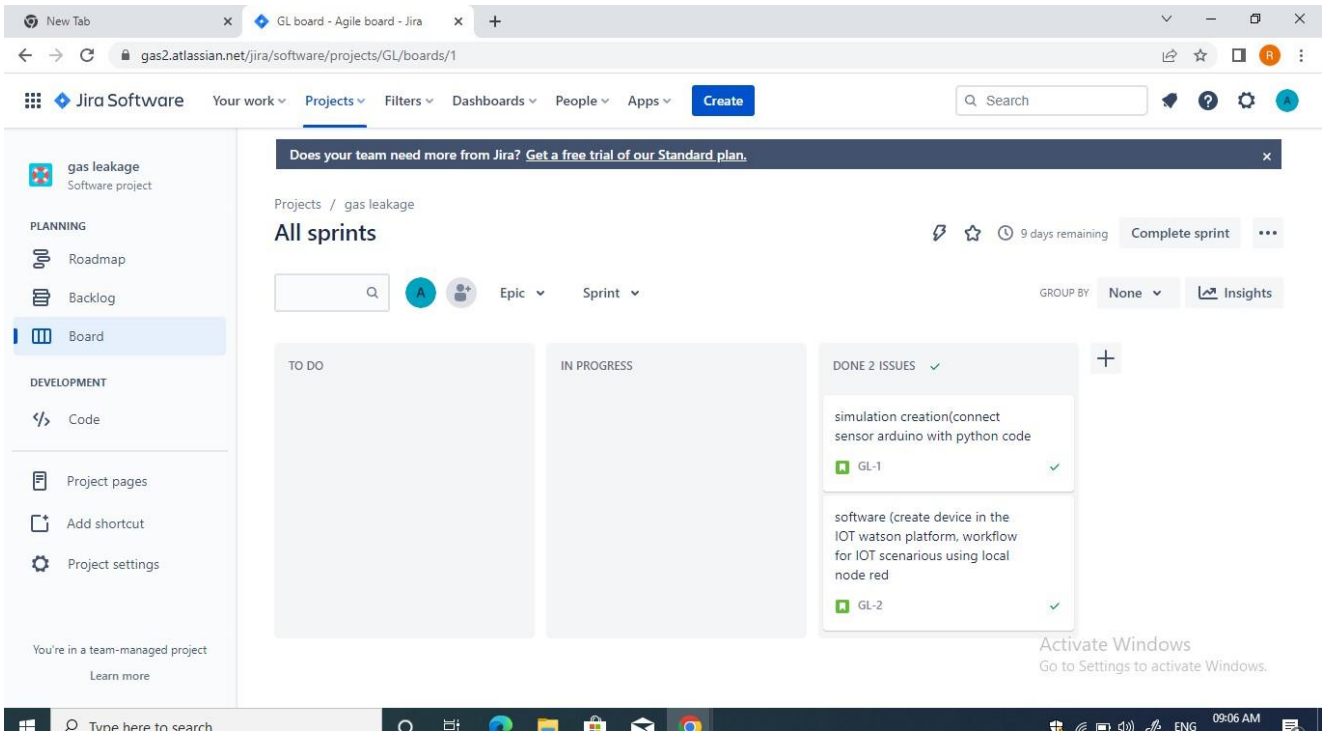
6.2 SPRINT DELIVERY SCHEDULE:

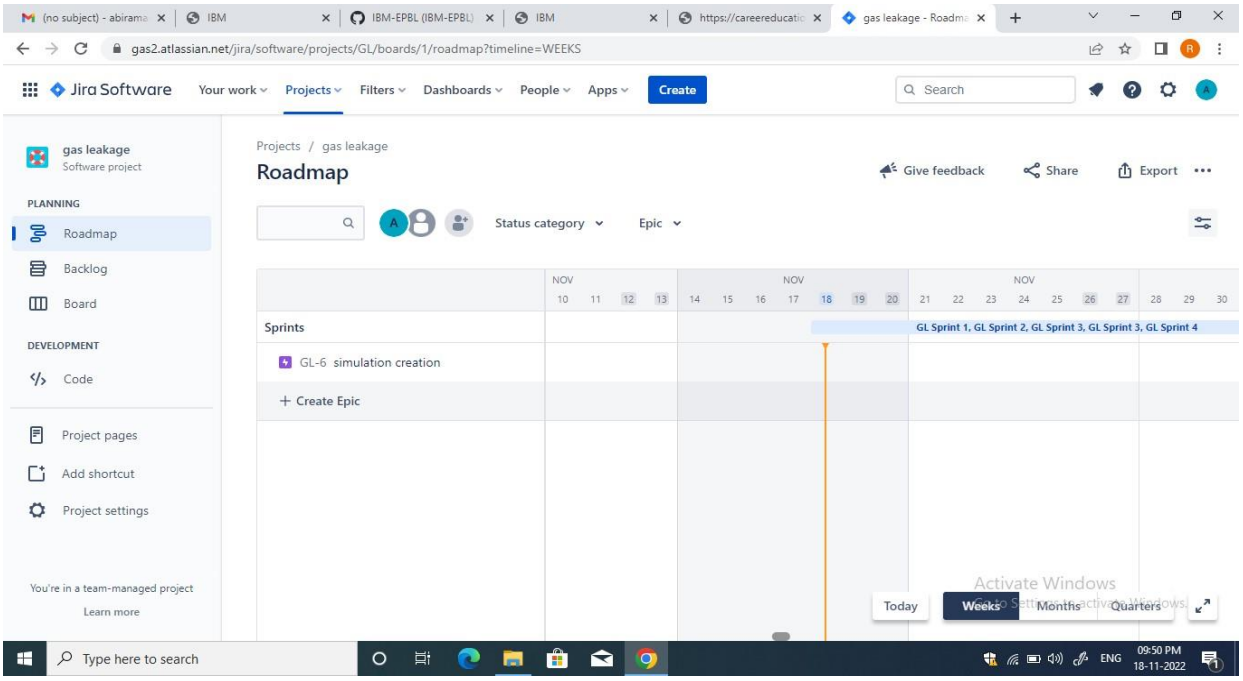


- Sprint 1
- Sprint 2
- Sprint 3
- Sprint 4

We are Developing the code in this Schedule.

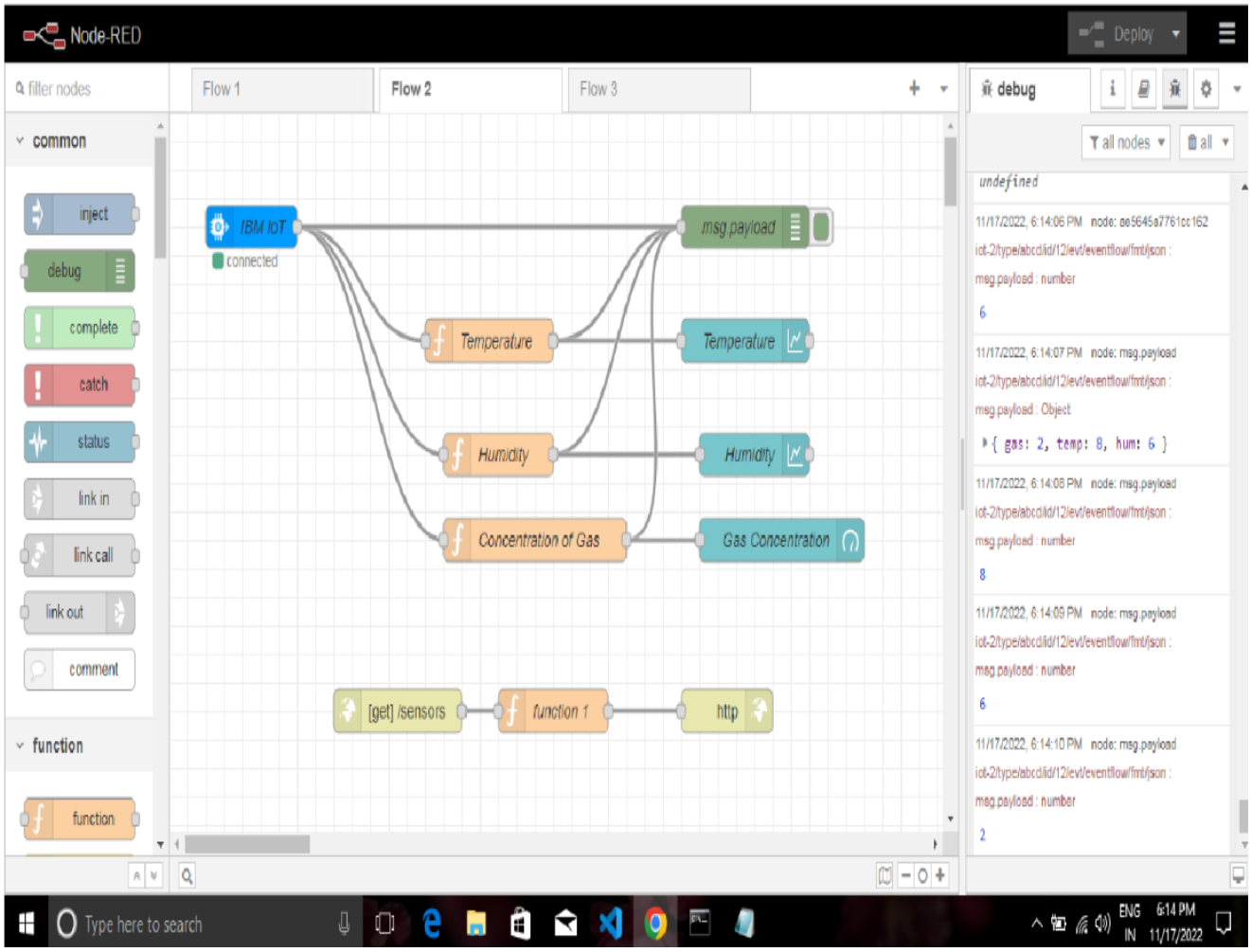
6.3 REPORTS FROM JIRA:





7. CODING AND SOLUTIONING :

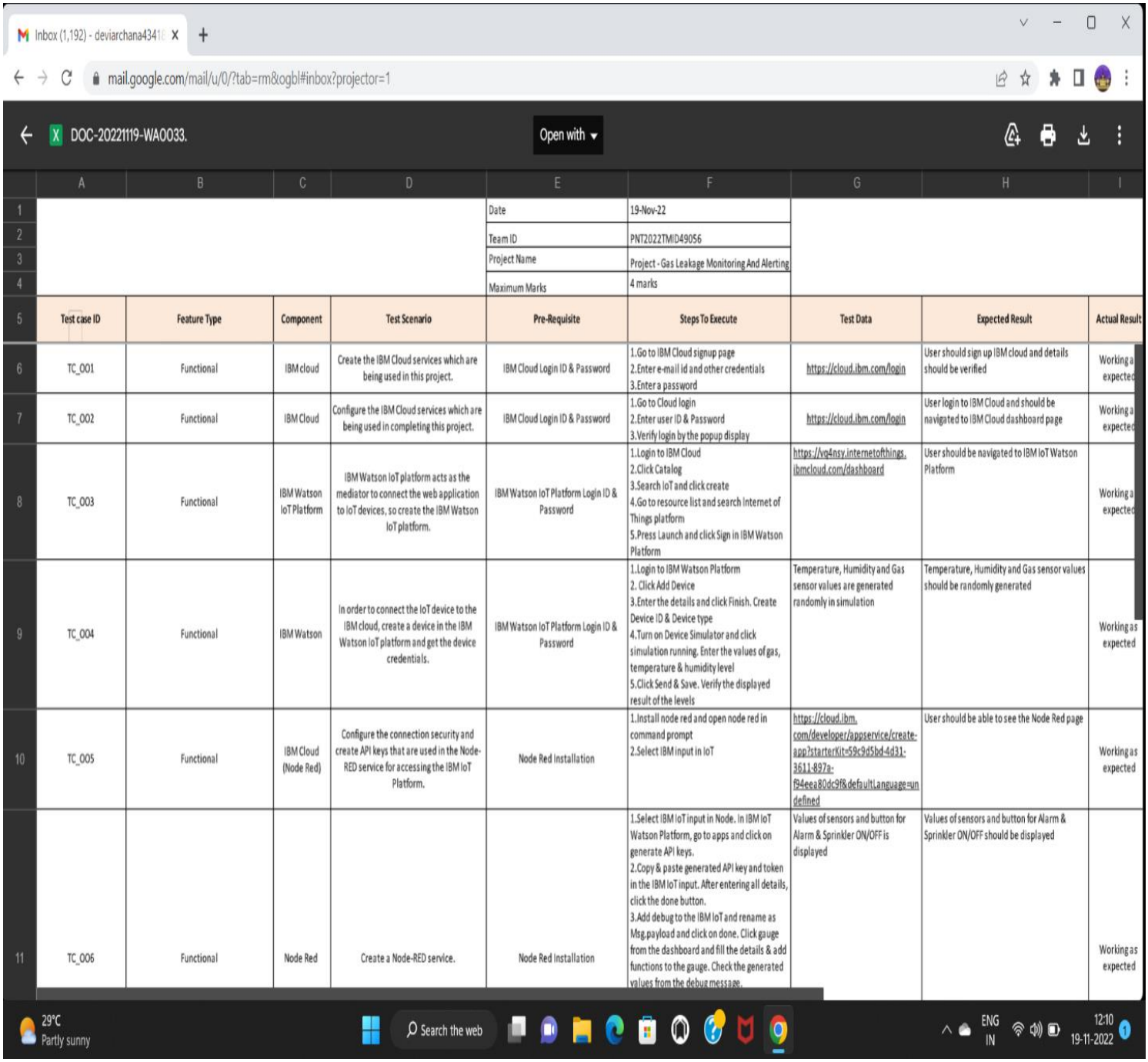
7.1 FEATURE 1(NODE RED OUTPUT) :



7.2 FEATURE2 (PYTHON OUTPUT):

8 TESTING:

8.1 TEST CASES:



				Date	19-Nov-22			
				Team ID	PNT2022TMID49056			
				Project Name	Project - Gas Leakage Monitoring And Alerting			
				Maximum Marks	4 marks			
Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result
TC_001	Functional	IBM cloud	Create the IBM Cloud services which are being used in this project.	IBM Cloud Login ID & Password	1.Go to IBM Cloud signup page 2.Enter e-mail id and other credentials 3.Enter a password	https://cloud.ibm.com/login	User should sign up IBM cloud and details should be verified	Working as expected
TC_002	Functional	IBM Cloud	Configure the IBM Cloud services which are being used in completing this project.	IBM Cloud Login ID & Password	1.Go to Cloud login 2.Enter user ID & Password 3.Verify login by the popup display	https://cloud.ibm.com/login	User login to IBM Cloud and should be navigated to IBM Cloud dashboard page	Working as expected
TC_003	Functional	IBM Watson IoT Platform	IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices, so create the IBM Watson IoT platform.	IBM Watson IoT Platform Login ID & Password	1.Login to IBM Cloud 2.Click Catalog 3.Search IoT and click create 4.Go to resource list and search Internet of Things platform 5.Press Launch and click Sign in IBM Watson Platform	https://vq4nsy.internetofthings.ibmcloud.com/dashboard	User should be navigated to IBM IoT Watson Platform	Working as expected
TC_004	Functional	IBM Watson	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.	IBM Watson IoT Platform Login ID & Password	1.Login to IBM Watson Platform 2. Click Add Device 3.Enter the details and click Finish. Create Device ID & Device type 4.Turn on Device Simulator and click simulation running. Enter the values of gas, temperature & humidity level 5.Click Send & Save. Verify the displayed result of the levels	Temperature, Humidity and Gas sensor values are generated randomly in simulation	Temperature, Humidity and Gas sensor values should be randomly generated	Working as expected
TC_005	Functional	IBM Cloud (Node Red)	Configure the connection security and create API keys that are used in the Node-RED service for accessing the IBM IoT Platform.	Node Red Installation	1.Install node red and open node red in command prompt 2.Select IBM input in IoT	https://cloud.ibm.com/developer/appservice/create-app?starterKit=59c9d5bd-4d31-3611-897a-f94eea80dc9f&defaultLanguage=undefined	User should be able to see the Node Red page	Working as expected
TC_006	Functional	Node Red	Create a Node-RED service.	Node Red Installation	1.Select IBM IoT input in Node. In IBM IoT Watson Platform, go to apps and click on generate API keys. 2.Copy & paste generated API key and token in the IBM IoT input. After entering all details, click the done button. 3.Add debug to the IBM IoT and rename as Msg.payload and click on done. Click gauge from the dashboard and fill the details & add functions to the gauge. Check the generated values from the debug message.	Values of sensors and button for Alarm & Sprinkler ON/OFF is displayed	Values of sensors and button for Alarm & Sprinkler ON/OFF should be displayed	Working as expected

8.2 USER ACCEPTANCE TESTING:

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).

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

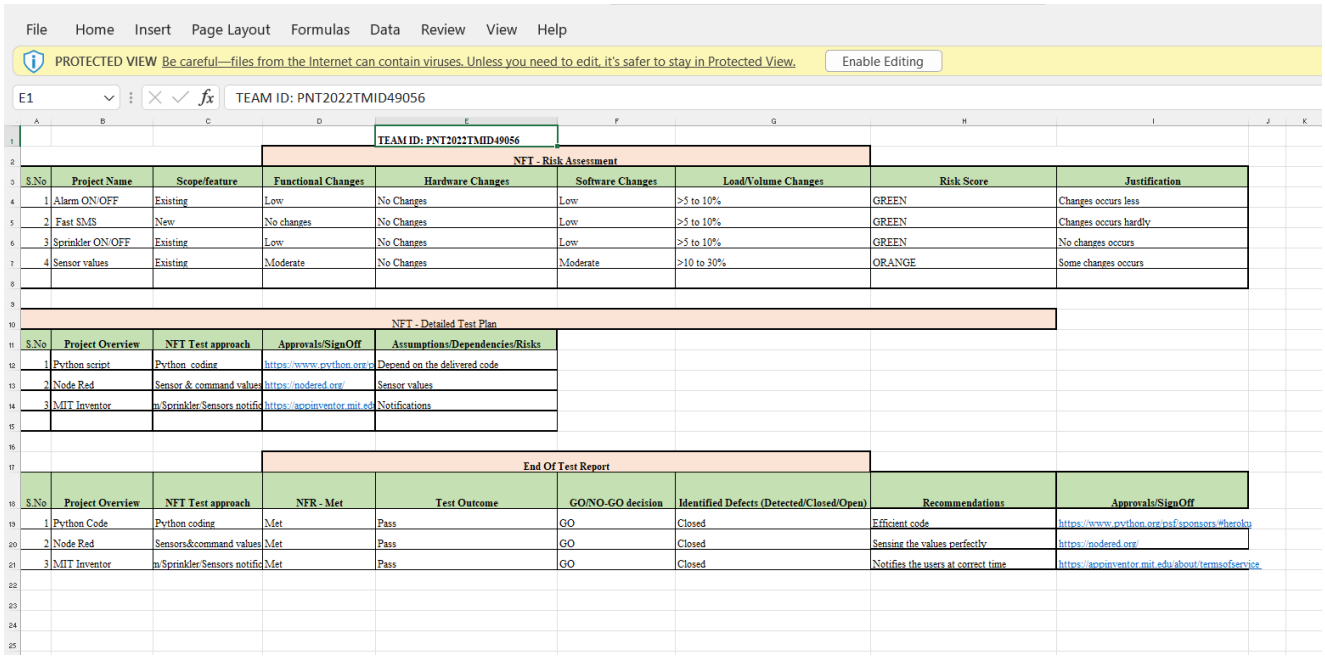
3. Test Case Analysis

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:

9.1 PERFORMANCE METRICS:



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PROTECTED VIEW Be careful—files from the Internet can contain viruses. Unless you need to edit, it's safer to stay in Protected View. Enable Editing

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NFT - Risk Assessment

S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Load/Volume Changes	Risk Score	Justification
1	Alarm ON/OFF	Existing	Low	No Changes	Low	>5 to 10%	GREEN	Changes occurs less
2	Fast SMS	New	No changes	No Changes	Low	>5 to 10%	GREEN	Changes occurs hardly
3	Sprinkler ON/OFF	Existing	Low	No Changes	Low	>5 to 10%	GREEN	No changes occurs
4	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	Assumptions/Dependencies/Risks
1	Python script	Python coding	https://www.python.org/p	Depend on the delivered code
2	Node Red	Sensor & command values	https://nodered.org/	Sensor values
3	MIT Inventor	n/Sprinkler/Sensors notific	https://appinventor.mit.ed	Notifications

End Of Test Report

S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Identified Defects (Detected/Closed/Open)	Recommendations	Approvals/SignOff
1	Python Code	Python coding	Met	Pass	GO	Closed	Efficient code	https://www.python.org/psf/sponsors/#heroku
2	Node Red	Sensors&command values	Met	Pass	GO	Closed	Sensing the values perfectly	https://nodered.org/
3	MIT Inventor	n/Sprinkler/Sensors notific	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 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 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 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:

```
#include <LiquidCrystal.h>

LiquidCrystal lcd(5,6,8,9,10,11);

int redled = 3;

int greenled = 2;

 int buzzer = 4;

 int sensor = A0;

 int sensorThresh = 400;

 void setup()
```

```
{
pinMode (redled,OUTPUT);
pinMode(greenled,OUTPUT);
 pinMode(buzzer,OUTPUT);
 pinMode(sensor,INPUT);
Serial.begin(9600);
lcd.begin(16,2);
 }
void loop()
{
int analogValue = analogRead(sensor);
Serial.print(analogValue);
if(analogValue>sensorThresh)
 {
digitalWrite(redled,HIGH);
digitalWrite(greenled,LOW);
tone(buzzer,1000,10000);
lcd.clear();
 lcd.setCursor(0,1);
 lcd.print("ALERT");
 delay(1000);
 lcd.clear();
 lcd.setCursor(0,1);
lcd.print("EVACUATE");
delay(1000);
 }
 else
{
digitalWrite(greenled,HIGH);
digitalWrite(redled,LOW);
noTone(buzzer);
```

```
 lcd.clear();
lcd.setCursor(0,1);
lcd.print("ALL CLEAR");
delay(1000);
 }
 }
```

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-41455-1660642271

PROJECT DEMO LINK: https://photos.app.goo.gl/6MPPL8vMA3KNNNvQ9

TINKERCAD LINK: https://www.tinkercad.com/things/hOVSDWOeZBN-frantic-wluff-rottis/editel?sharecode=FBfeK1jRWjNbXfICX27kGqnIqvG7y6aVLuBsp3ge9og