# PROJECT REPORT

| Project Title | Gas Leakage Monitoring and Alerting System |
|---|---|
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## 1. INTRODUCTION

### 1.1 PROJECT OVERVIEW

Now a days the home safety detection system plays the important role for the security of people. Since all the people from the home goes to work on daily bases, it makes impossible to check on the appliances available at home specially LPG gas cylinder, wired circuits, Etc. Since last three years there is a tremendous hike in the demands of liquefied petroleum gas (LPG) and natural gas. To meet this access amount of demand for energy and replace oil or coal due to their environmental disadvantage, LPG and natural gas are preferred. These gases are mostly used on large scale in industry, heating, home appliances and motor fuel. So as to track this leakage gas, the system includes MQ6 gas sensor. This sensor senses the amount of leak gas present in the surrounding atmosphere. Through this, explosion or getting affected by the leakage of gas could be avoided.

### 1.2 PURPOSE

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed. This is an affordable, less power using, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for

detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere, but also wastage of gases will hurt our economy. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

## 2. LITERATURE SURVEY

### 2.1 EXISTING PROBLEM

Gas leakage is nothing but the leak of any gaseous molecule from a stove, or a pipeline, or cylinder etc. This can occur either purposefully or even unintendedly. As we are aware that these kinds of leaks are dangerous to our health, and when becomes explosive it could cause great danger to the people, home, workplace, industry and the environment. Few of the major incidents that took place due to gas leakage include the Bhopal Disaster and the Vizag Gas leak. The Bhopal disaster is known to be the worst industrial accident ever. Approximately 45 tons of Methyl Isocyanate was leaked from this insecticide plant. Methyl Isocyanate is an organic compound and a chemical that could come from the carbamate pesticides. This colorless, poisonous and flammable liquid is something that human beings have to be away from. Vizag Gas leak was a resultant of the escape of styrene that were unattended for a long period. This colorless oily liquid can spread in fumes. So, a detector must be made in such a way that could detect any kind of gas, fume, leak, smoke etc. However harmful and dangerous it can be, the detector could be attached with certain parameters that could help to prevent the issue.

### 2.2 REFERENCES

[1] Farnsworth, J.M. Passive Leak Detection Devices and systems for Detecting Gas Leaks.US Patent Pub. No US 2010/0089127 A1, (2010).
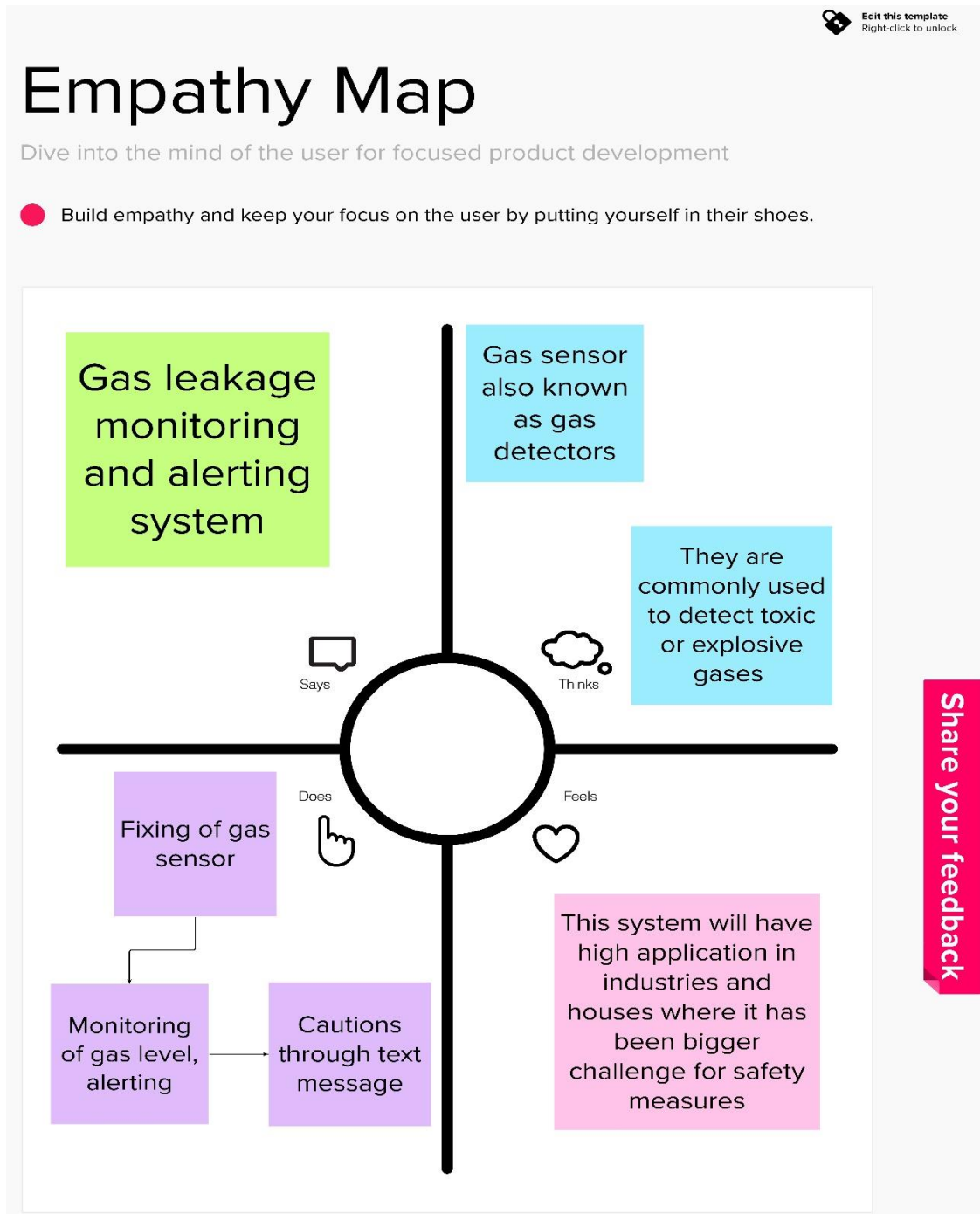
**[2]** Fraiwan, L.; Lweesy, K.; Bani-Salma, A.; Mani, N, "A wireless home safety gas leakage detection system", Proc. of 1st Middle East Conference on Biomedical Engineering, pp. 11-14, 2011.

**[3]** Apeh, S. T., K. B. Erameh, and U. Iruansi. &quot;Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shut off System.&quot; Journal of Emerging Trends in Engineering and Applied Sciences, vol. 5, no. 3, pp. 222-228, 2014.

**[4]** Mahalingam, A., R. T. Naayagi, and N. E. Mastorakis. &quot;Design and implementation of an economic gas leakage detector.&quot; Recent Researches in Applications of Electrical and Computer Engineering, pp. 20-24, 2012.
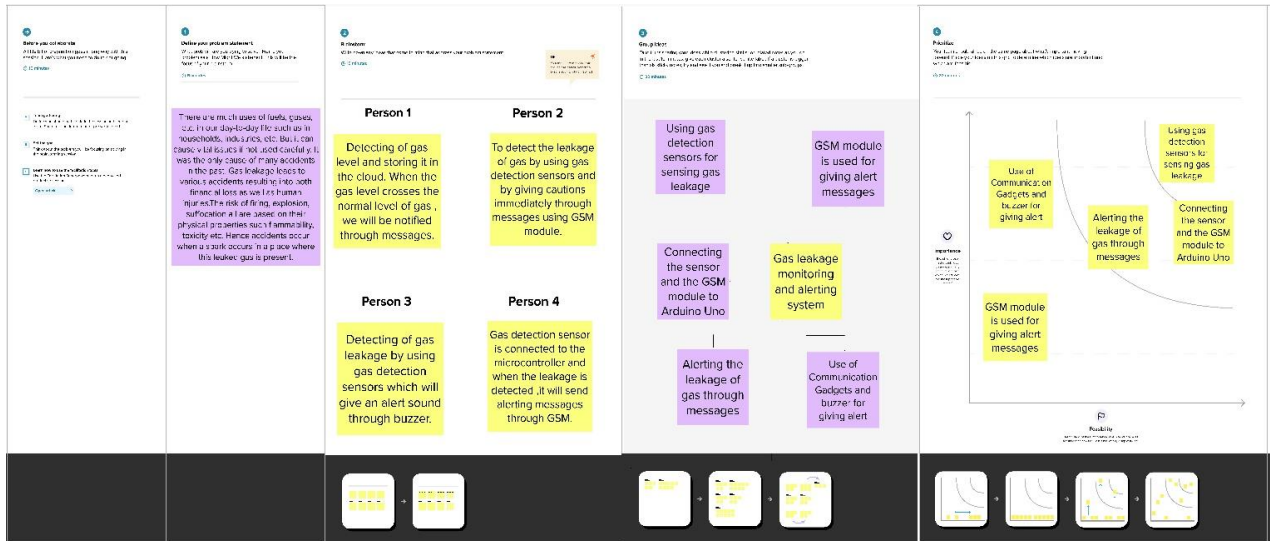
## 2.3 PROBLEM STATEMENT

There are much uses of fuels, gases, etc. in our day-to-day life such as in households, industries,etc. But it can cause vital issues if not used carefully. It was the only cause of many accidents in the past. Gas leakage leads to various accidents resulting into both financial loss as well as human injuries. In human's daily life, environment gives the most significant impact to their health issues. The risk of firing, explosion, suffocation all are based on their physical properties such flammability, toxicity etc. Hence accidents occur when a spark occurs in a place where this leaked gas is present.The focus of this work is to propose a device that can detect gas leakage and alert the owners to avert problems due to gas leakages. The purpose of this project is to detect a gas leak and prevent the accident and blocking of gas leaks in vulnerable areas. Hence a fore coming accident may get avoided.

# 3.IDEATION & PROPOSED SYSTEM

## 3.1 EMPATHY MAP



# Empathy Map

Dive into the mind of the user for focused product development

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

Gas leakage monitoring and alerting system

Gas sensor also known as gas detectors

They are commonly used to detect toxic or explosive gases

Says

Thinks

Does

Feels

Fixing of gas sensor

Monitoring of gas level, alerting

Cautions through text message

This system will have high application in industries and houses where it has been bigger challenge for safety measures

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# 3.2 IDEATION & BRAINSTORM



# 3.3 PROPOSED SOLUTION

| S.No. | Parameter | Description |
|---|---|---|
| 1. | Problem Statement (Problem to be solved) | Gas leaks are considered to be very dangerous since they can build into an explosive concentration, So the proposed solution is used for the development for an efficient system & an application that can monitor and alert the workers. |

| 2. | Idea / Solution description | This system uses GSM technique to send alert message to respective person if no one is there in the house or at the area of gas leakage. So GSM module helps in sending immediate alert message regarding gas leakages. The main advantage of this system over the manual method is that, it does all the process automatically and has a quick response time. |
|----|----|----|
| 3. | Novelty / Uniqueness | Gas Leakage monitoring with low power consumption & small size design, 0-100% vol CH4, CH4 leak detector, High precision, Dual channel. Industry-leading Brand gas sensor with technology innovation and lean manufacturing. |
| 4. | Social Impact / Customer Satisfaction | Low voltage alarm & automatic shutdown, colour LCD display and also quickly detects gas leakage point. Easy installation and provide efficient results. |
| 5. | Business Model (Revenue Model) | The gas leakage model was applied to analyse the pressure, temperature and flow rate of gas leakage over time under both the steady state and dynamic conditions. As the product usage can be understood by everyone, it is easy for their safest organization. |
| 6. | Scalability of the Solution | Establishing fast communication equipment with the nearest fire station and other relief station to have the fastest response in case of an accident. Even when the gas leakage is more, the product sense the accurate values and alerts the workers effectively. |

# 3.4 PROBLEM SOLUTION FIT

**1.CUSTOMER SEGMENTS**

✓ For industry owner-Ensuring the safety of workers is the main thing.

✓ Sometimes it is hard to identify the area where the leakage occurs.

✓ The detection of leakage prevents the loss of lives

**6. CUSTOMER CONTRAINTS**

✓ Proper maintenance should be taken atleast 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**

✓ 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**

✓ Sometimes sensor doesn't work properly which can cause the major problem.

✓ Location of the device installation and the network plan used by the user are the root cause of the network issue.

**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**

✓ Accidents due to gas leakages and loss of physical property and life.

✓ Safe precautions for the workers to work without fear.

**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**

✓ Monitor the status of the sensors

✓ Notification incase of any gas leakage.

**OFFLINE**

✓ Prevent physical damage to sensor.

✓ Provide proper network and power supply to sensors.

✓ Complaint letters.

# 4. REQUIREMENT ANALYSIS
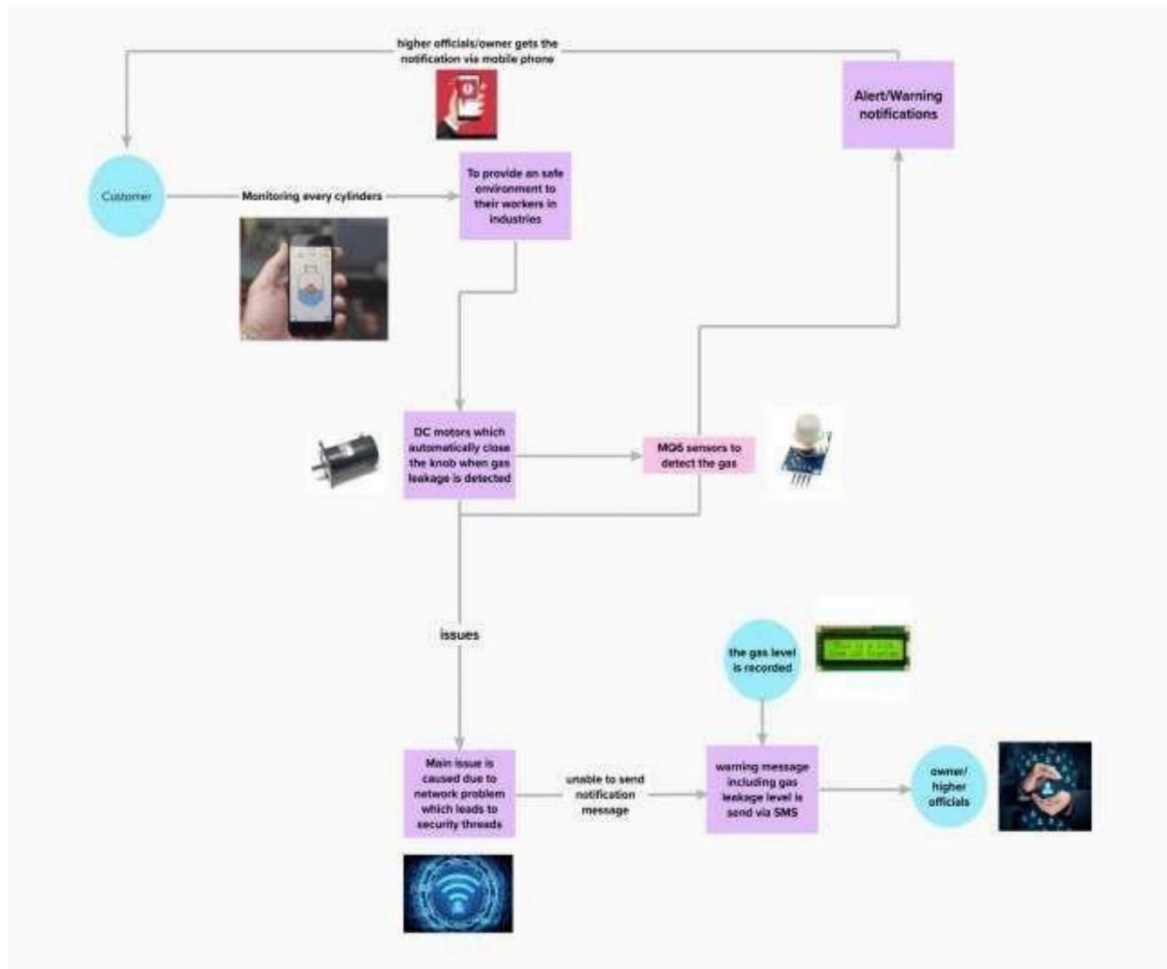
## 4.1 FUNCTIONAL REQUIREMENTS

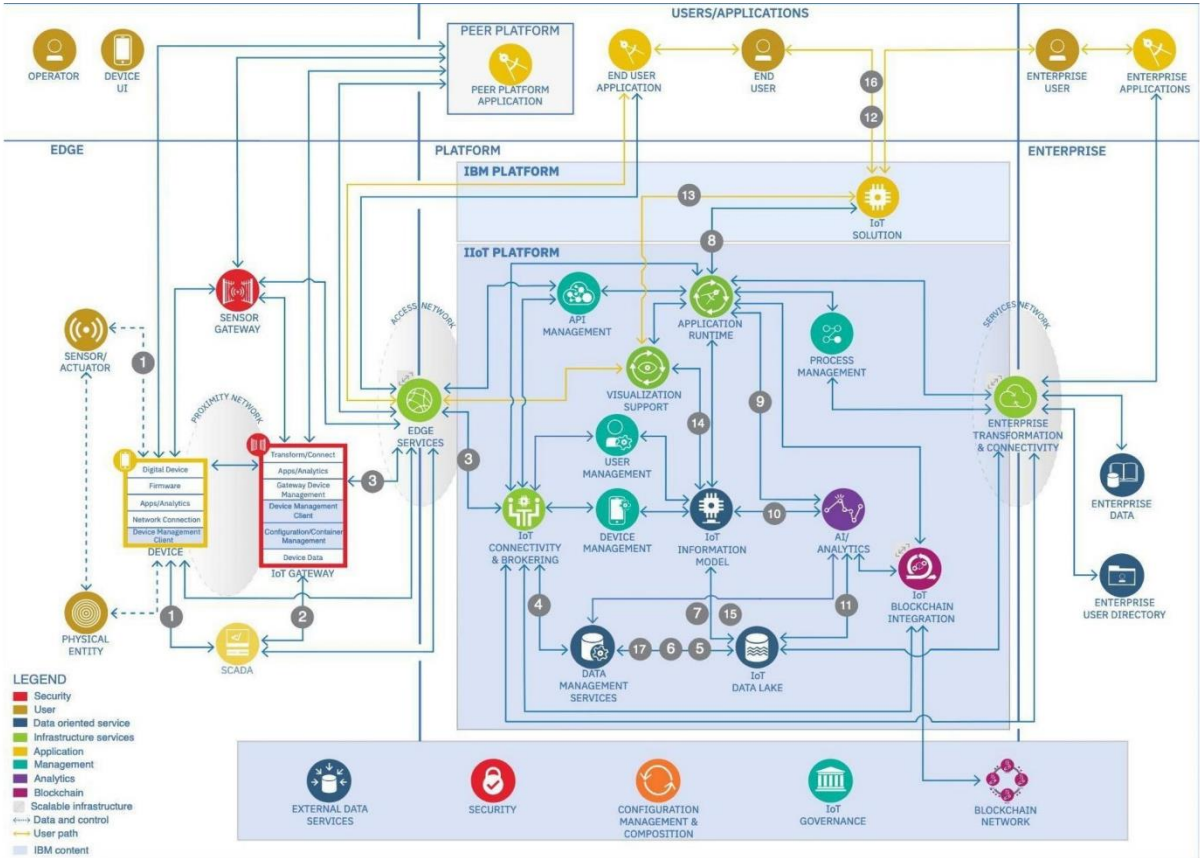| FR No. | Functional Requirement (Epic) | Sub Requirement (Story / Sub-Task) |
|--------|-------------------------------|-------------------------------------|
| FR-1 | User Registration | Registration through Form<br><br>Online Payment for the<br><br>service |
| FR-2 | User Access | Access the details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

## 4.2 NON–FUNCTIONAL REQUIREMENTS

| 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 |

# 5. PROJECT DESIGN

## 5.1 DATA FLOW DIAGRAM

# 5.2 SOLUTION & TECHNICAL ARCHITECTURE



# 5.3 USER STORIES

| User Type | Functional Requirement (Epic) | User story Number | User Story / Task | Acceptance criteria | Priority | Release |
|---|---|---|---|---|---|---|
| Customer (family member / industry owner) | Registration | USN-1 | As a user ,I can register for the device in the owners mobile application by entering my email and password | I can access my account /dashboard | High | Sprint-1 |
| Customer (higher authority) | Confirmation | USN-2 | As a user I will receive confirmation message via email and once I received I can install the device in the owner place. | I can receive confirmation email and click confirm | High | Sprint-1 |
| Customer (fire service 101) | Safety measure register | USN-3 | As a register I can register the application in owner / family members mobile phone | I can register & access the dashboard with Facebook Login | Low | Sprint-2 |
| Customer (mobile user) | Mobile application | USN-4 | As a user I can register by mobile application | I can register for gas leakage detection device in owners' mobile number and the alert message will be sent to that mobile | Medium | Sprint-1 |

| User Type | Functional Requirement (Epic) | User Story Number | User Story / Task | Acceptance criteria | Priority | Release |
|---|---|---|---|---|---|---|
| Customer (credential) | Login | USN-5 | As a user I can log into the device by entering email & password in the owner's mobile application | Mail address and passwords are default | High | Sprint-1 |
| Custome( (web user) | Notification | USN-7 | As a user when there is a critical situation regarding gas explosion the alert notification will be received through GSM module. | Alert message is sent to owners mobile as an SMS | High | Sprint-1 |
| Customer care Executive | Network Connectivity | USN-8 | When there is a gas leakage is detected in the surrounding | Sensor detect the leakage and notifies the owner via message | High | Sprint-1 |
| **User Type** | **Functional Requirement (Epic)** | **User Story Number** | **User Story / Task** | **Acceptance criteria** | **Priority** | **Release** |
| Administration | Accessing | USN-9 | When there is an issue in accessing the device | Admin/Device operator's advice should be undertaken | High | Sprint-1 |

# 6.PROJECT PLANNING & SCHEDULING

## 6.1 SPRINT PLANNING & ESTIMATION

**SPRINT PLAN**

| | |
|---|---|
| Identify the Problem | 1 |
| Prepare a Abstract, Problem Statement | 2 |
| List a required object needed | 3 |
| Create a Code and Run it | 4 |
| Make a Prototype | 5 |
| Test with the created code and check the designed prototype is | 6 |
| Solution for the Problem is Found!! | 7 |

## 6.2 SPRINT DELIVERY SCHEDULE

### SPRINT 1

```
import time

import sys

import ibmiotf.application

import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials organization = "lcft5g"

deviceType   =   "Final"

deviceId      =   "Hello"

authMethod  =   "token"

authToken    =   "8300113450"

# 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 as an event
of type "greeting" 10 times

deviceCli.connect()

while True:

    #Get Sensor Data from DHT11
```

```python
temp=random.randint(0,100)
Humid=random.randint(0,100)
Gas=random.randint(0,100)

data = { 'temp' : temp, 'Humid': Humid, 'Gas':Gas }
#print data

def myOnPublishCallback():

    print ("Published Temperature = %s C" % temp, "Humidity = %s %%"
 % Humid, "Gas Concentration = %s"%Gas "to IBM Watson")

    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()
```

**SPRINT 2**

**TASK**

Sensed data is brought to Node-RED and displayed in dashboard.

**STEPS**

1. IBM IoT node is used to gather sensor data.

    a. Necessary API key is provided to establish connection.

2. Using functions namely Temperature, Humidity and Gas the data is obtained independently and displayed in dashboard.

3. Dashboard Nodes are used to display the sensed data to the user in a portal.

**Source code:**

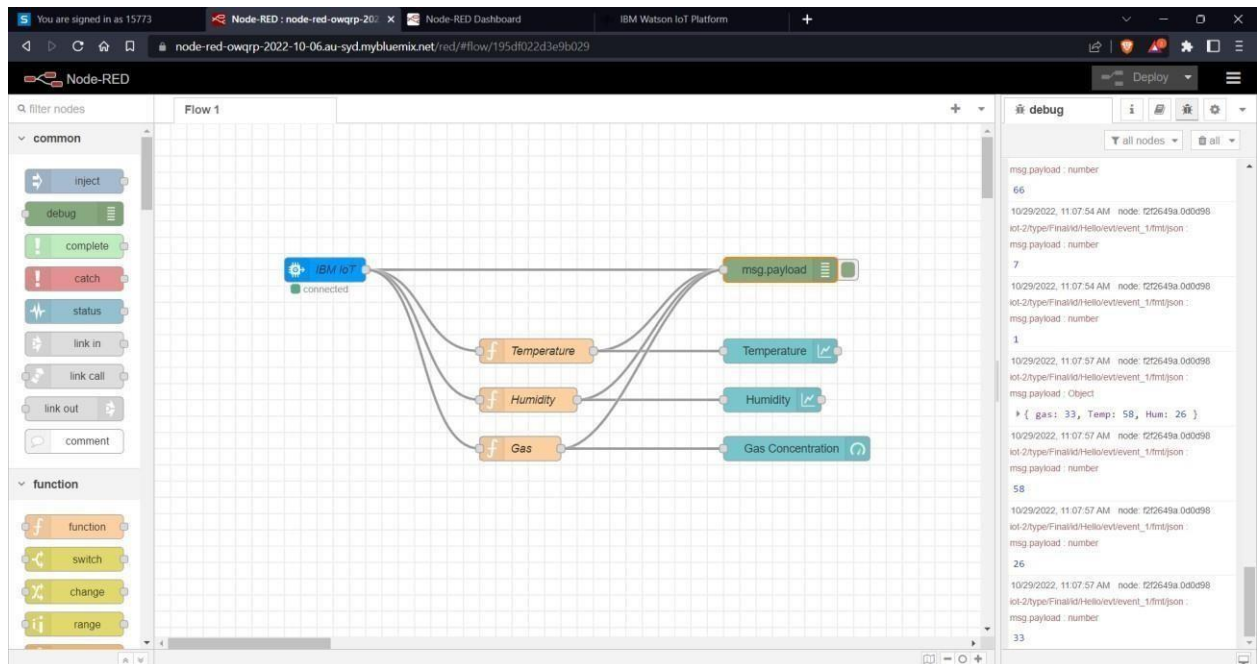Temperature                          : msg.payload = msg.payload.Temp;

                                                  return msg;
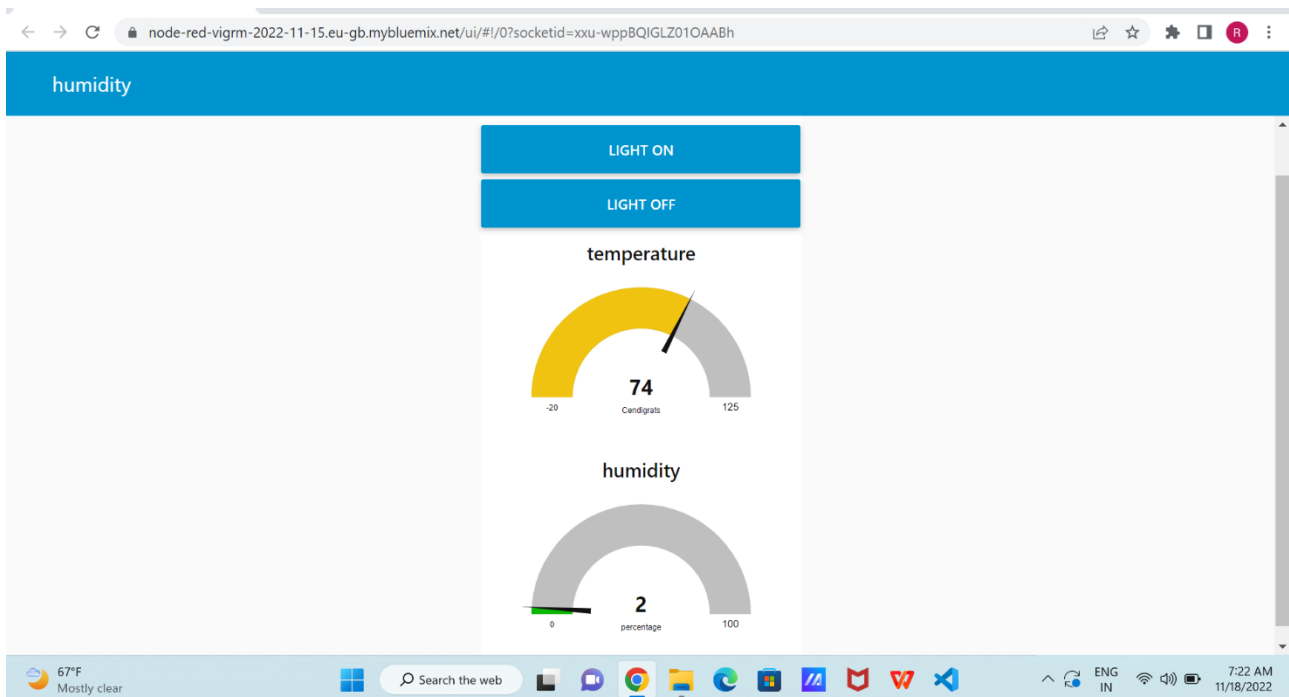
Humidity                              : msg.payload = msg.payload.Hum; return msg;

Concentration of Gas            : msg.payload = msg.payload.gas; return msg;

**Output:**

**1. Data is brought to Node-RED**

## 2. Data is displayed in the dashboard



## SPRINT 3

#include <LiquidCrystal.h> LiquidCrystal lcd(5,6,8,9,10,11);

int redled = 2; int greenled = 3; 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(0,0); lcd.print("SAFE"); delay(1000); lcd.clear();

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

}

}
```

**SPRINT 4**

```
#include <LiquidCrystal.h> LiquidCrystal lcd(5,6,8,9,10,11);

int redled = 2; int greenled = 3; 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(0,0); lcd.print("SAFE"); delay(1000); lcd.clear();
lcd.setCursor(0,1); lcd.print("ALL CLEAR"); delay(1000);
}
}
```

# 7. CODING & SOLUTIONING

## 7.1 FEATURE:

## LOOP (IF-ELSE)

Use if to specify a block of code to be executed, if a specified condition is true. Use else to specify a block of code to be executed, if the same condition is false. Use else if to specify a new condition to test, if the first condition is false. Use switch to specify many alternative blocks of code to be executed.

**CODE:**

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(5,6,8,9,10,11);

int redled = 2;
int greenled = 3;
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(0,0);
  lcd.print("SAFE");
  delay(1000);
  lcd.clear();
  lcd.setCursor(0,1);
  lcd.print("ALL CLEAR");
  delay(1000);
}
```

# 8. RESULTS



**DEMO LINK:**

# 9. ADVANTAGES

- 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

## 10. DISADVANTAGES

- Non-selective in the flammable gas range.

- Under fire, there is a danger of igniting an explosion.

- Most elemental organic vapors are toxic to the sensor.

## 11. CONCLUSION

After this project performance can conclude that the detection of the LPG gas leakage is incredible in the project system. Applicable usefully for industrial and domestic purposes. In dangerous situations, we can save the life by using this system. An alert is indicated by the GSM module. A sensor node senses gas like $CO_2$, oxygen, and 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.

## 12. FUTURE SCOPE

We propose to build the system using an MQ6 gas detection sensor and interface it with an Aurdino Uno microcontroller along with an LCD Display. Our system uses the gas sensor to detect any gas leakages. The gas sensor sends out a signal to the microcontroller as soon as it encounters a gas leakage. The microcontroller processes this signal and a message is displayed on the LCD to alert the user.

# 13. APPENDIX

```
 #include <LiquidCrystal.h>
LiquidCrystal lcd(5,6,8,9,10,11);


int redled = 2;
int greenled = 3;
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(0,0);

  lcd.print("SAFE");

  delay(1000);

  lcd.clear();

  lcd.setCursor(0,1);

  lcd.print("ALL CLEAR");

  delay(1000);

 }
```

**GITHUB LINK:**

https://github.com/IBM-EPBL/IBM-Project-7987-1658905110

**PROJECT DEMO LINK:**

https://drive.google.com/drive/folders/1hcREbirci904H6fTnt6hHwMiOJMXO1ML