Team ID : PNT2022TMID04560

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

1. INTRODUCTION

1.1 Project Overview

The Internet of Things (IoT) describes the physical object network like things which are embedded with software, sensors and many other technologies to connect and exchange data with some other devices through internet. IoT has become the most important technology in today's world. Access to low cost, low-power sensor, Connectivity, Cloud computing platforms, Machine learning and analytics, Conversational artificial intelligence are some of the technologies which made the IoT possible. IoT also helps in automating tasks and its benefits can be extended for enhancing the safety standards. Gas leakage whether in an open environment or a contained one, can be extremely harmful or even fatal. The Traditional gas leakage detection systems are highly accurate, but they ignore some important details when it comes to warning the public. As a result, we have utilized IoT to develop a Gas Leakage Detector for the public that is equipped with Smart Alerting approaches, such as the capacity to perform data analyses on detected gas leaks and send text messages to the appropriate authorities. Our primary objective is to advocate for a system in which all dwellings are equipped with gas leak detectors. This will be able to identify dangerous gases in the atmosphere and deliver alarms and notifications to the public. In order to have a control over such conditions we have proposed a system that uses sensors which is capable of detecting the gases such as LPG, CO, CO_2 and CH_4. This system not only detect the gas leakage but also alerts the people through alarms which are audible. System consists of LPG sensor, buzzer, microprocessor. LPG sensor senses whether there is a leakage or not. If there is a leakage it gives signal to micro controller which in turn, makes the buzzer ON and gives notification in mobile through IoT.

1.2 Purpose

The aim of this project is to detect the gas leakage and prevent it from the explosion. It also aims to present a design which can automatically detect, alert the leakage of the gas in the industry.

2. LITERATURE SURVEY

2.1 Existing problem

Nowadays, there is leakage of gases are common problem in both homes and industries. These accidents are happened due to carelessness and improper maintenance of the gas system in the industries. The natural gas leakage will be dangerous because it increases the risk of explosion or fire. Mostly all the gas companies work hard to provide sufficient warning when the gases are leaked. But gases like methane and some other natural gases does not have any odor. So the gas companies add rotten-egg smell for the warning which can be easily

detected by the industries. However, people who have a diminished sense of smell may not be able to rely upon this safety mechanism. The potential for an explosion increases if the leak happens when nobody is around to prevent it.

2.2 References

1. Linxi Dong et al [2019] have proposed a wireless gas monitoring system which detects the gas leakage not only in fixed concentration levels but also detects the gas which has low explosive limit using Auto Co-relation Function(ACF). It has been implemented successfully and has a detection rate of more than 95%. The average detection time delay has been reduced by less than 30 seconds.

2. Fabien Chraim et al [2016] has proposed a gas leakage and localization method to identify the areas where leakage is happening. The detection and localization algorithms proposed here are applied to the collected concentration data, and the methodology is evaluated. A detection rate of 91 % is achieved, with seven false alarms recorded over 3 days, and an average detection delay of 108 s.

3. Ravi Kishore Kodali et al [2018] has proposed a project proposes a leakage detector which sends the warning to the concerned people through SMS. This detector senses the presence of harmful gases particularly, LPG, Methane and Benzene. LPG and Methane gases catch fire easily resulting in blasts. Different color LEDS are used to specify the gas leaked for example, RED LED indicates the presence of LPG.

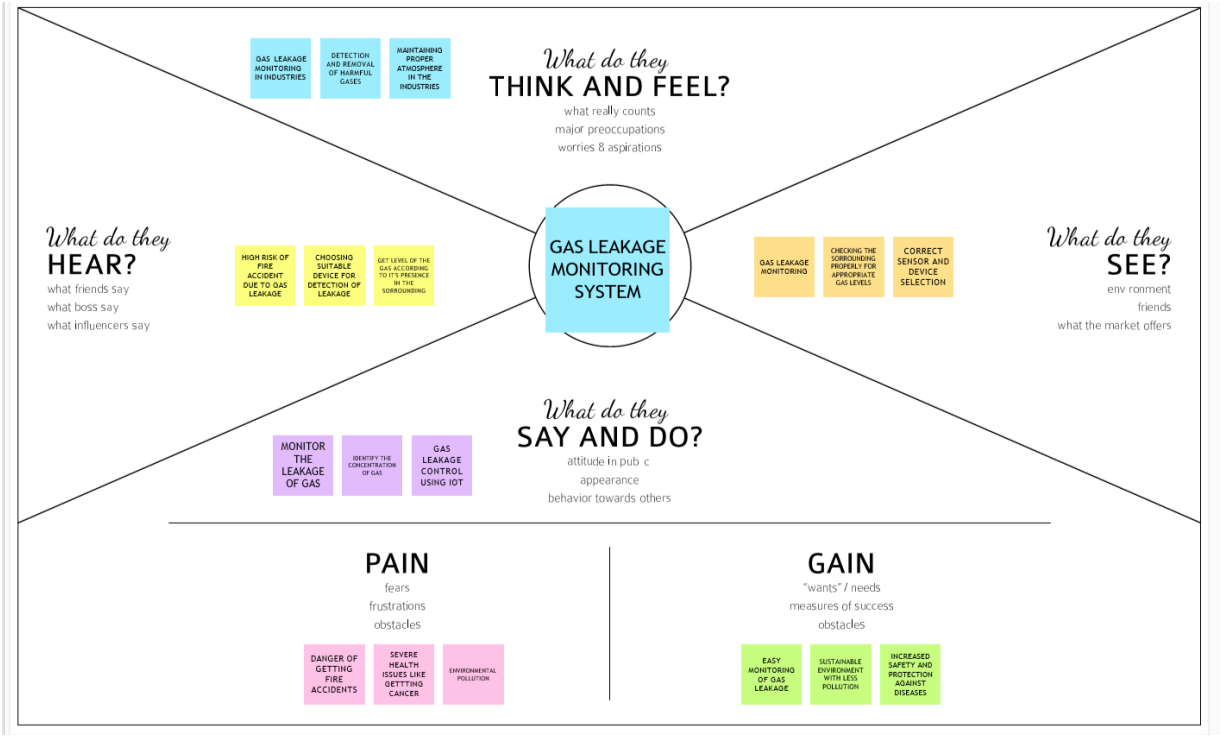
4. V Suma et al [2019] has proposed a paper to present a new system automatically books a cylinder when the gas is about to empty is by sending a notification to the gas agency using Wi-Fi using Internet of Things approach. In addition to that sensor is used to detect gas leakage at home.This, work this helps the society to specifically indicate gas leakage and also helps both customers and the agency to get the gas booking made automatically using the IOT technique.

5. Junchi Bin has proposed an article which contains a generalized framework, i.e., tensor-based leakage detection (TBLD), is proposed to detect LNG leakage in the rural area from surveillance thermal cameras. First, the proposed TBLD takes advantage of tensor factorization to fuse thermal image and corresponding gradient maps for improving sensitivity. The experimental results demonstrate the effectiveness of the proposed TBLD, which also shows the great potential of (Tensor Based Leakage Detection) TBLD in future industrial applications.

2.3 Problem Statement Definition

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

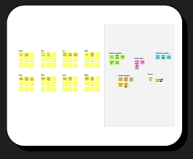
Template

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

Share template feedback



Need some inspiration?
See a finished version of this template to kickstart your work.

Open example →

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 →

1 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

PROBLEM

How might we [your problem statement]?

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.

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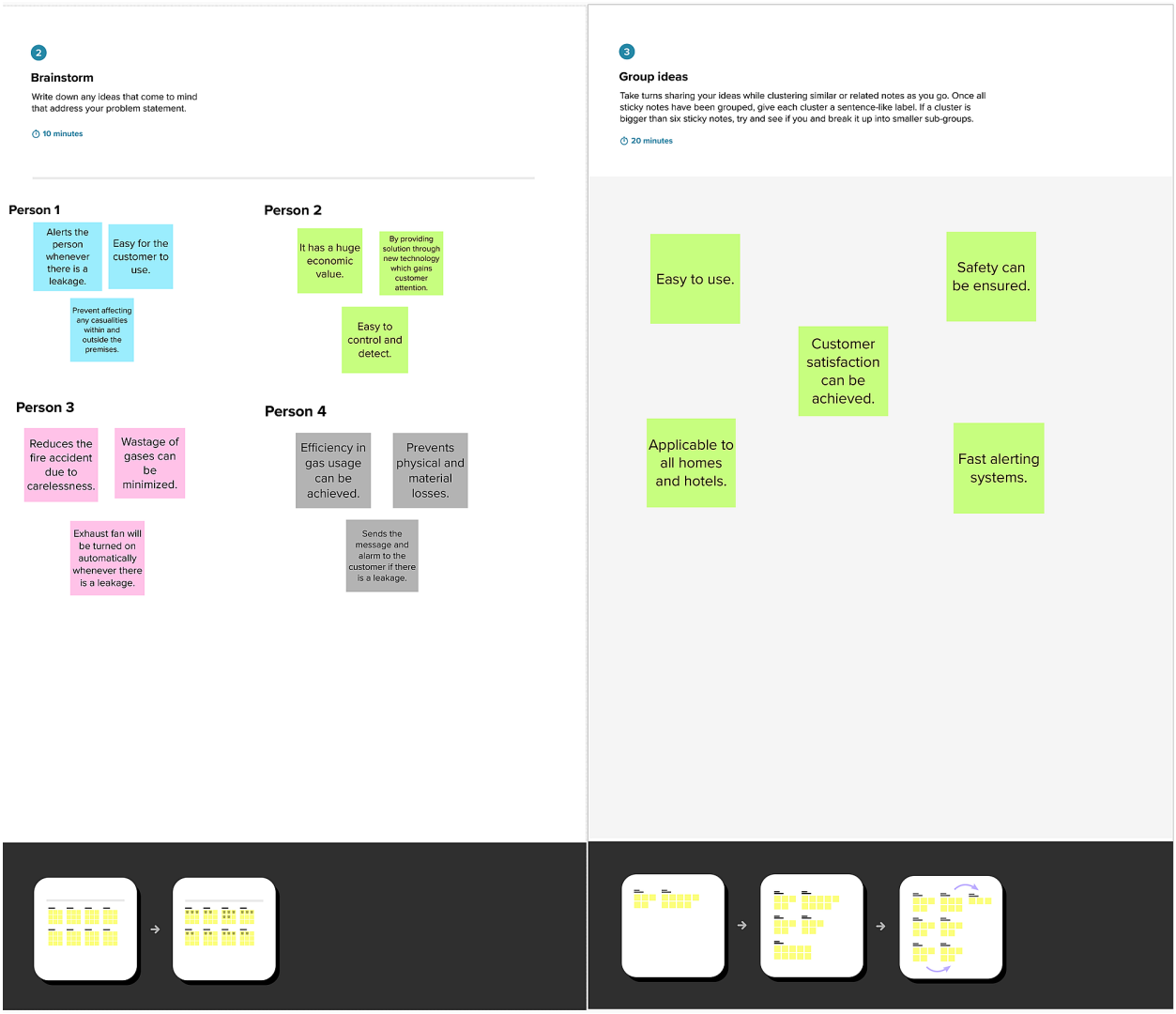

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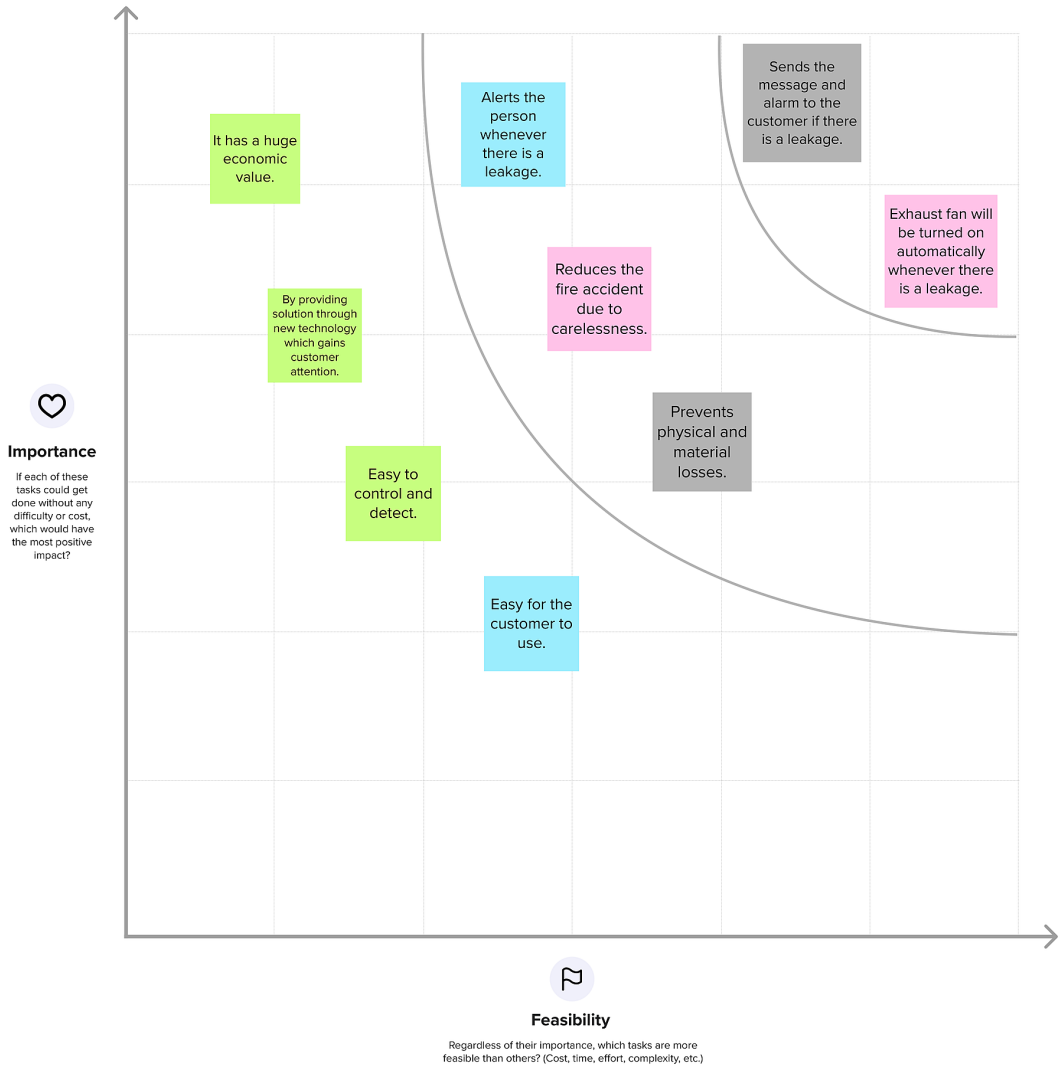
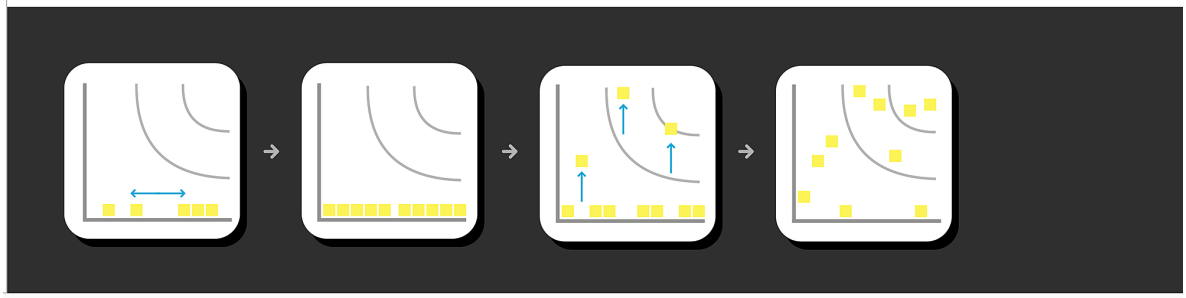
4

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

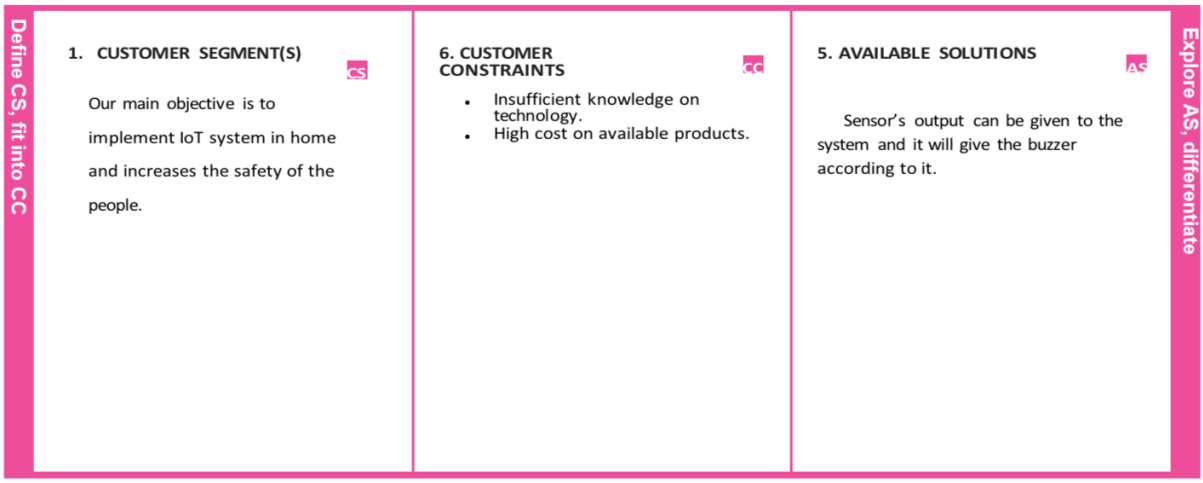




3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Accidents due to gas leakage has a huge effect in our country. It should be avoided.
2.	Idea / Solution description	It can be avoided by using Hardware integrated with sensors and connected with IoT.
3.	Novelty / Uniqueness	It will inform customer about the gas leakage and gives alarm in low cost.
4.	Social Impact / Customer Satisfaction	It will improve the customer satisfaction because of enhanced safety and new technology.
5.	Business Model (Revenue Model)	Available methods are of high cost. So, this method will have high market potential.
6.	Scalability of the Solution	It can be used by all type of customers in their home.

3.4 Problem Solution fit



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

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

- Implement gas leakage monitoring sensor in kitchen.
- Connect the sensor's output to the customer 's mobile or digital display.

9. PROBLEM ROOT CAUSE RC

- There are several news regarding fire accidents in kitchen due to lack of concentration and improper maintenance

7. BEHAVIOUR BE

- Heavy losses may incur due to carelessness

Identify strong TR & EM

3. TRIGGERS TR

If relatives visit the customer's house and when they happen to see the IoT system, they will get excited and triggered to use such a system in their home.

4. EMOTIONS: BEFORE / AFTER EM

At first there is no surety about the safety in the house.
After installing the IoT system the level of safety has been increased.

10. YOUR SOLUTION SL

- It alerts the customer through a buzzer and also turns on the exhaust fan.
- It also gives notification regarding gas leakage regarding gas leakage.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE

- Get notifications regarding gas leakage.

8.2 OFFLINE

- Take appropriate measures to stop leakage.

Identify strong TR & EM

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Business Requirements	This system can be implemented in industries. It has a great advantage because data can be fetched through mobile application and precautionary measures can be taken at ease.
FR-2	User Confirmation	Can be able to see details via developed application.
FR-3	Future Requirements	It is designed for specific gas. If required monitoring of other gases can also be implemented.
FR-4	Product Requirements	Detection of gas is necessary regardless of business perspective. Certain such IoT devices can fulfil the requirement.

4.2 Non-Functional requirements

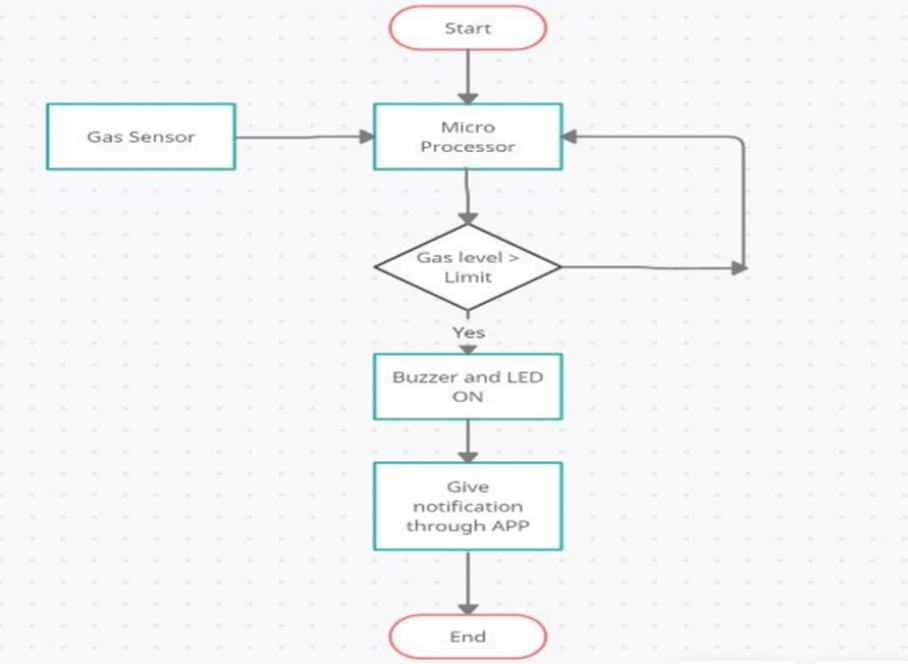
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The system can be used easily by users having minimum knowledge about the app.
NFR-2	**Security**	Only users entering correct username and password can be able to visit the previous details.
NFR-3	**Reliability**	It will be checked and certified before installation for proper working.
NFR-4	**Performance**	The performance metrics of the device will be verified before usage.
NFR-5	**Availability**	The device can be readily available because it is made up of tools which are of low cost.
NFR-6	**Scalability**	The system should be compatible and also be open for future up gradation.

5. PROJECT DESIGN

Data Flow Diagram

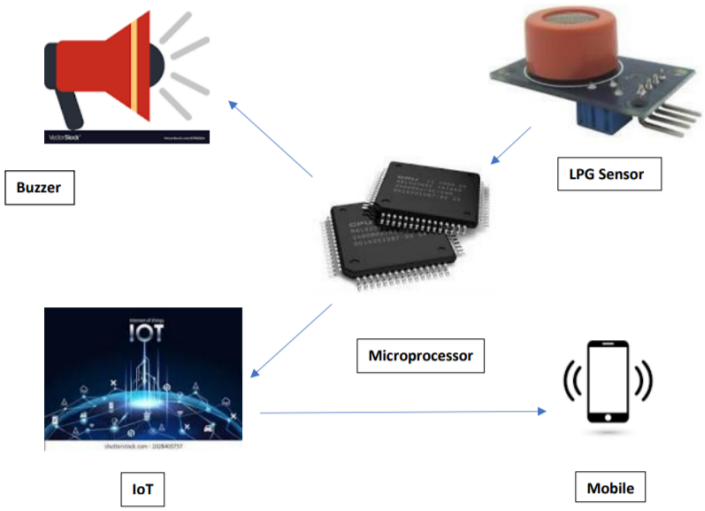
A data flow diagram (DFD) is a graphical or visual depiction that details how data is moved through an organization's activities.

5.1 Data Flow Diagrams



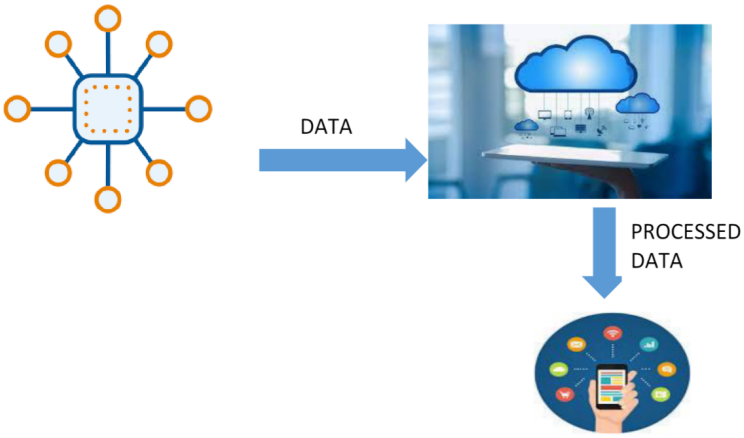
5.2 Solution & Technical Architecture

Solution Architecture



Team ID : PNT2022TMID04560

Technical Architecture



5.3 User Stories

User Type	Functional Requirement (epic)	User Story Number	User story/ Task	Acceptance criteria	Priority	Release
Customer	IoT device creation	USN-1	As a user, I can send able to create device	I can access my account/ dashboard	High	Sprint-1
	Sending data to the device	USN-2	As a user, I can send data to device	I can login to the application	High	Sprint-1
Customer Care Executive	Problem Solving	USN-3	As a user, I can able to check the details from the monitoring system	Easy to maintain and solve problems	Medium	Sprint-2
Administrator	Administration	USN-4	As a user, I can administrate all the process	Maintenance	High	Sprint-3
Application	Service	USN-5	As a user, I can able to check the details via app.	Maintenance	High	Sprint-4

6. PROJECT PLANNING & SCHEDULING

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the gas leakage monitoring system and gathering information by referring the papers, research publications and so on.	19 October 2022
Prepare Empathy Map	Preparing Empathy Map Canvas to know the harms and advantages. Also preparing the list of problem statements.	18 October 2022
Ideation	Doing the Brainstorming as a team and we have listed our problem statement. After we prioritize the top ideas based on the feasibility and importance.	19 October 2022

6.1 Sprint Delivery Schedule

Velocity

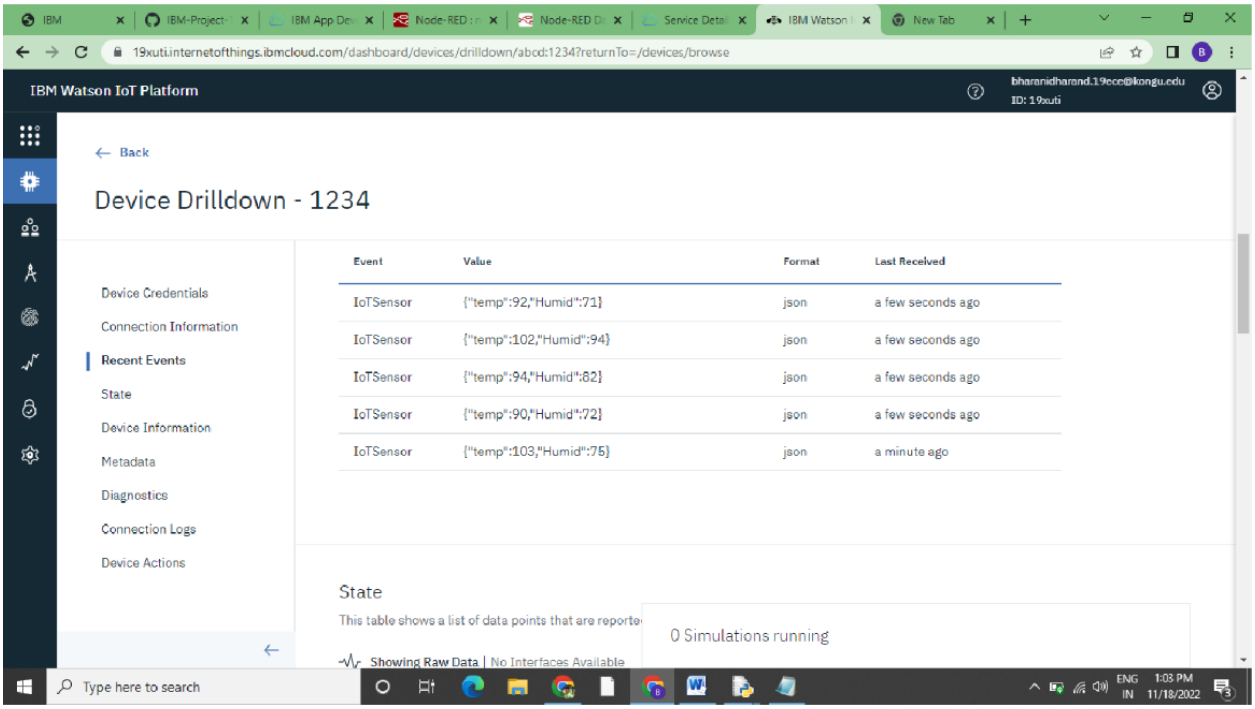
Let us imagine we have spent 10 days for the sprint planning. The velocity of the team is 20 which is the points per sprint. So we can calculate the team's average velocity (AV) from this per iteration unit which is story points per day.

AV = Sprint duration / Velocity = (20/10) = 2

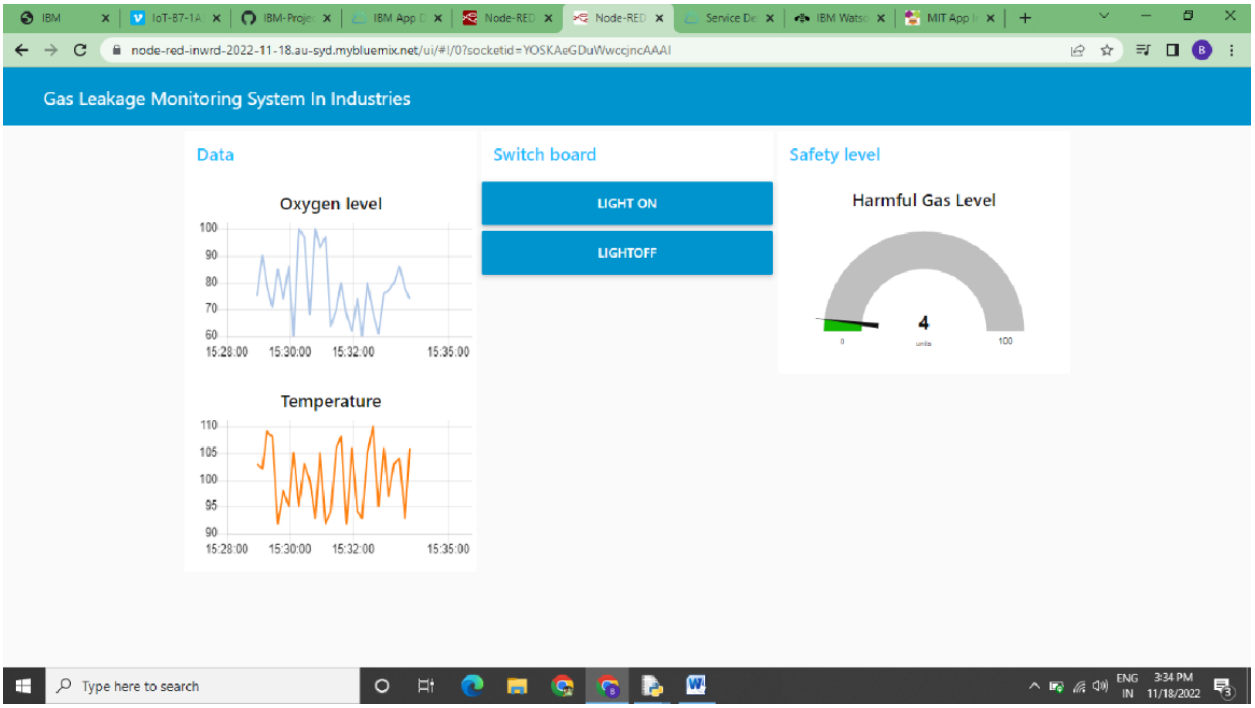
7. CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Features

Device Creation

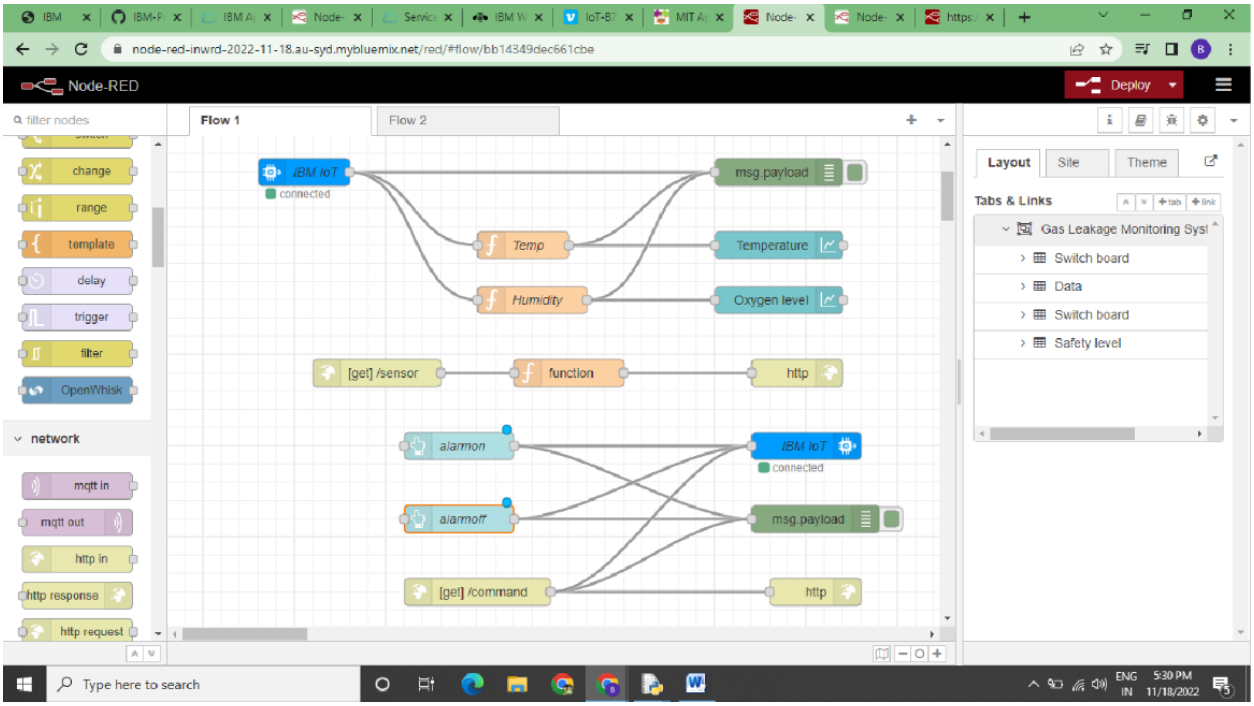


Deployed Web page in Node Red

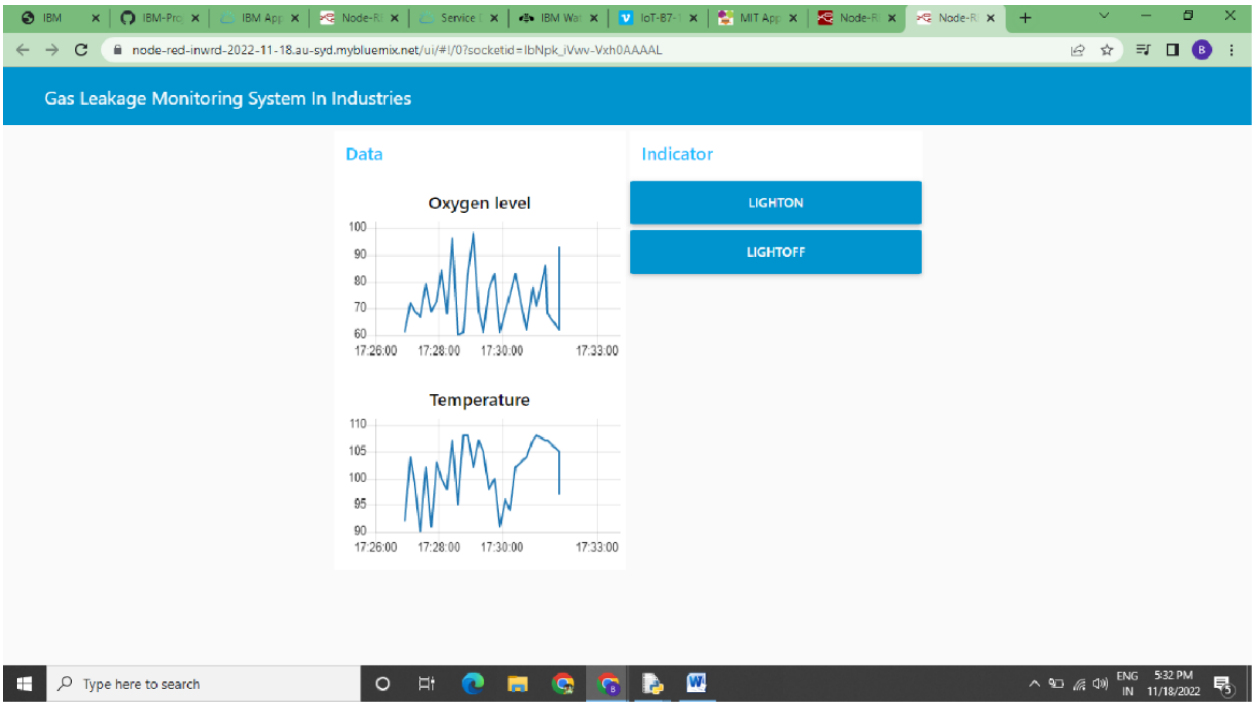


Team ID : PNT2022TMID04560

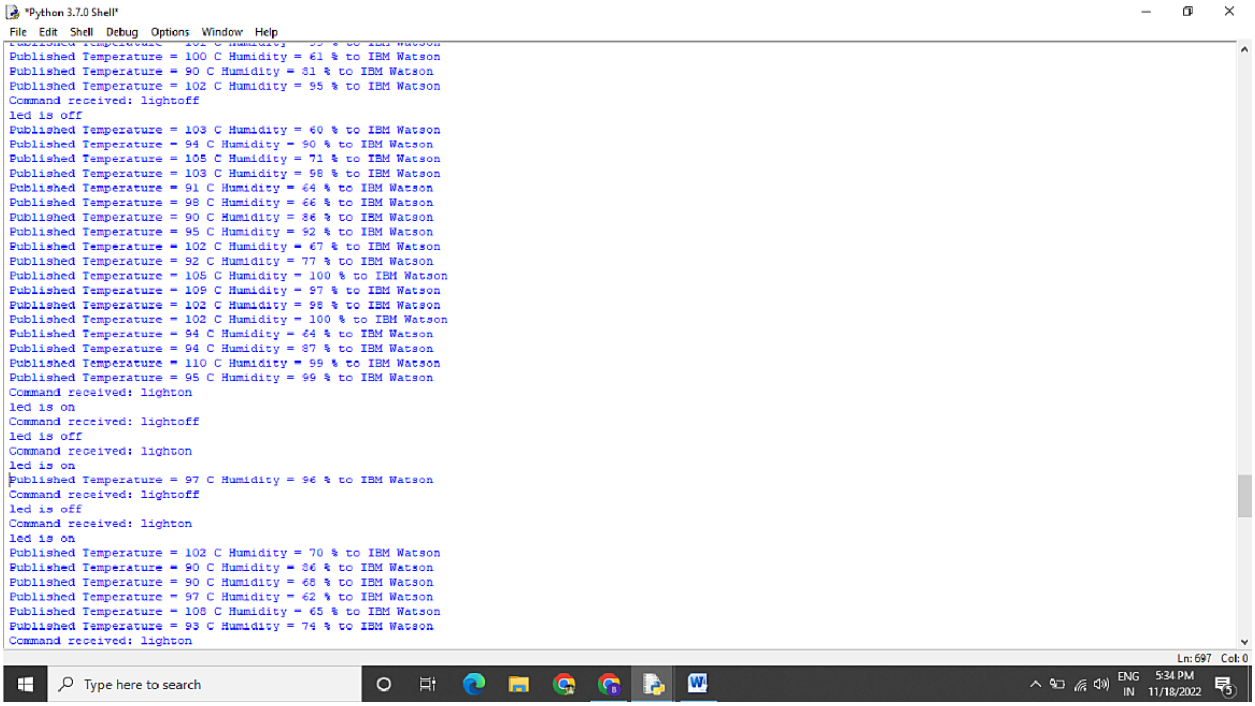
Creating nodes in Node Red



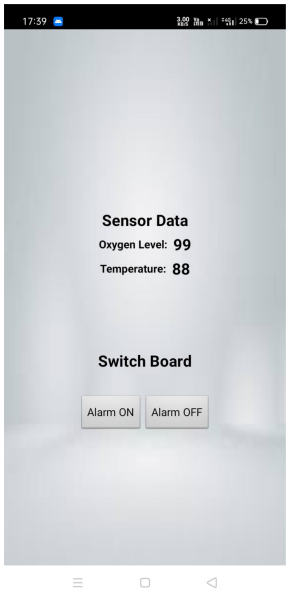
Receiving data from python code



Output of python code connected to IBM Watson



Resultant App page in mobile



8. ADVANTAGES & DISADVANTAGES

Advantages

- People can be alerted before entering containment zone.
- Further spread of gas can be reduced considerably.
- Safety can be ensured.

Disadvantages

- Accuracy of application depends on the number of data given to the application.
- Application's accuracy is directly proportional to the number of data given to the application.

9. CONCLUSION

This application is intended to provide information about containment zones in a particular region by alerting people, through continuous monitoring of gas leakage. Key benefits of the application are monitoring gas leakage activity and alerting them to their safety movements.

10. FUTURE SCOPE

Although we tried to cover almost all of the aspects during our developmental phase, however we were forced to leave some aspects because of lack of time and there are always some shortcomings and room for improvement our application can be enhanced further:-

1) Emergency signal in case of network failure and internet connection loss.
2) Can give signal to nearby station if there is a leakage detection.

11. APPENDIX

Source Code

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "19xuti"
deviceType = "NodeMcu"
deviceId = "1"
```

```
authMethod= "token"
authToken = "ZSIF*5Xaign97&839E"

#Initialize GPIO
def myCommandCallback (cmd):
   print ("Command received: %s" % cmd.data['command'])
   status=cmd.data['command']
   if status=="lighton":
      print ("led is on")
   elif status == "lightoff":
      print ("led is off")
   else:
      print ("please send proper command")

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

   temp=random.randint (90,110)
   Humid=random.randint (60, 100)

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

   def myOnPublishCallback():
      print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "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()
```

GitHub Link:
https://github.com/IBM-EPBL/IBM-Project-22379-1659850745

Drive Video Link:
https://drive.google.com/file/d/16wEEZIqPyvqqEvpRjuTaAtKHv1eX-4Y7/view?usp=drivesdk