



IBM PROJECT

GAS LEAKAGE MONITORING AND ALERTING

SYSTEM FOR INDUSTRIES

Batch: B4-4M6E

Team ID: PNT2022TMID45387

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Team Members:

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1.INTRODUCTION

1.1 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.

1.2 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:

This scheme is meant to fulfill the daily needs of the people. In our country 40 percent people die due to gas explosion at home. That number keeps growing. Even pregnant women and small children are affected. Using a GSM module and a mobile phone, the Gas Leakage Monitor is used to find, intimate leaks. The buzzer and LED are then activated after the gas leak is detected using a bracket sensor. When the designated time has passed, it will automatically turn off.

2.2 References:

[1] Shital Imade, Priyanka Rajmane, Aishwarya Gavali, V. N. Nayakwadi "Review paper on- LPG Gas leakage detection using IOT": IJIRS –International Journal of Innovative Research & Studies, Volume 8, Issue 2, Feb 2018 IJIRS: ISSN NO: 2319-9725. [2] Gas Leakage Detection Based on Arduino And Alarm Sound, Rhonnel S. Paculanan, Israel Carino, International Journal of Innovative Technology and Exploring Engineering (IJITEE) Vol 8, April 2019. [3] Dr. Chetana Tukkoji, Mr. Sanjeev Kumar, "Review paper on- LPG Gas leakage detection using IOT": IJEAST –International Journal of Engineering Applied Science & Technology, Volume 4, Issue 12, April 2020 IJEAST (online): 603-609. [4] Sanjoy Das, Sahana S, Soujanya K Swathi M C, "Gas leakage detection and prevention using IoT", International Journal of Scientific Research % Engineering Trends. Vol 6, Issue 3, May-June 2020, ISSN (online): 2395-566X. [5] Amatul Munnaza, Rupa Tejaswi, Tarun Kumar Reddy, Saranga Moahan "IoT Based Gas Leakage Monitoring Syste", Journal of Xi'an University of Architecture & Technology, Vol 12, ISSN No: 1006-7930, Issue 5, 2020. [6] B. F. Alshammari, M. T. Chughtai, "IoT Gas leakage detector and warning generator". Engineering and Technology and Applied Science Research Volume 10, Issue August 2020 .6142-6146. [7] Gas Leakage Detection and Prevention System, Shreyas

Thorat, Neha Tonape, International Journal of Trendy Research, Vol 4, Issue 7, Dec 2020, ISSN NO: 2582-0958. [8] Rohan KH1, Navanika Reddy, Pranamya Maddy, Sachit Girish, Dr. Badari Nath K "IOT based gas leakage detection and Alerting system": JRP Publications, Vol. 1(1), pp. 002-006, February 2021. [9] D. Surie, O. Laguionie, T. Pederson, "Wireless sensor networking of everyday objects in a smart home environment", Proceedings of the International Conference on Intelligent Sensors", Sensor Networks and Information Processing ISSNIP- 2008, pp. 189 – 194. REFERENCE: [10] J. Tsado, O. Imoru, S.O. Olayemi, "Design and construction of a GSM based gas leak Alert system", IEEE Transaction, IRJEEE Vol. 1(1), pp. 002-006, September, 2014. [11] M. Eisenhauer, P. Rosengren, P. Antolin, "A Development Platform for Integrating Wireless Devices and Sensors into Ambient Intelligence Systems", pp.1- 3. [12] Harshada Navale, Prof. B.V.Pawar, "Arm Based Gas Monitoring System". International Journal of Scientific & Technology Research Volume 3, Issue 6, June 2014. [13] Byeongkwan Kang, Sunghoi Park, Tacklim Lee and Sehyun Park, "IoT based Monitoring System using Tri-level Context Making Model for Smart Home Services", 2015 IEEE International Conference on Consumer Electronics (ICCE), 2015. [14] Abhishek, P. Bharath, "Automation of LPG cylinder booking and leakage monitoring system," International Journal of Combined Research and Development (IJCRD), pp. 693–695, 2016

2.3 Problem statement definition:

This device does not get damaged very quickly, and if it does get damaged, water is the main reason for it. This device is easily damaged by water. Therefore, this device should be installed in a place where water does not go. This installation will not damage the device, if the device does, an example is water.

This tool is considered to be one and very safe for the users. My members are trusted. My members' invention is considered very safe for this country and its people and their families. Absence of this tool makes women in our country nervous by the spread of gas in their kitchen and is considered to be a sign of some accident. It is also proud to think of this project for people's lives only to eliminate this fear.

3. IDEATION & PROPOSED SOLUTION:

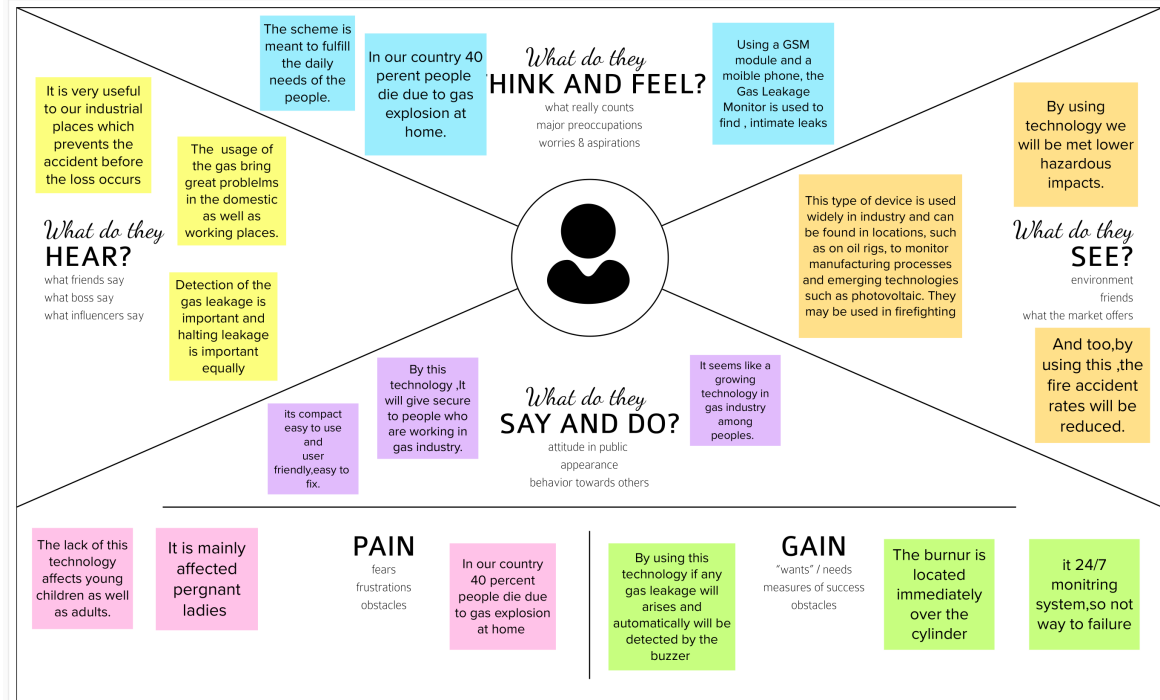
3.1 Empathy Map Canvas:

Empathy Map Canvas

Gain insight and understanding on solving customer problems.

1

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



Share your feedback

3.2 Ideation & Brainstorming:



Brainstorm & idea prioritization

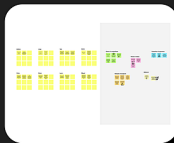
Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

🕒 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](#) →



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

We are trying to prevent the gas leakage explosion in household things as well as industrial fields



Key rules of brainstorming

To run a smooth and productive session



Stay in topic.



Encourage wild ideas.



Defer judgment.



Listen to others.



Go for volume.



If possible, be visual.

2

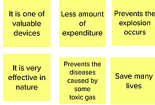
Brainstorm

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

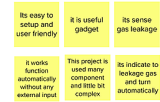
10 minutes

TIP
You can select a sticky note and hit the pencil (switch to sketch) icon to start drawing!

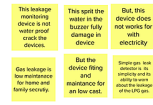
ABDUL AZIZ M



AIYANAR S



KARTHICK PANDIYAN R



JEGAN J

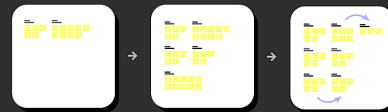
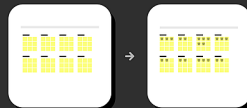
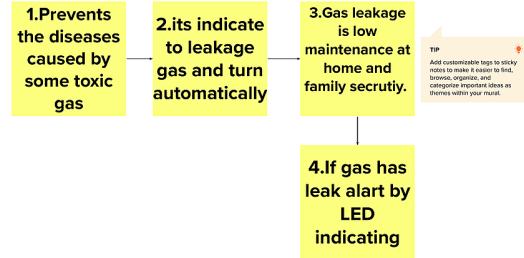


3

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 can break it up into smaller sub-groups.

20 minutes

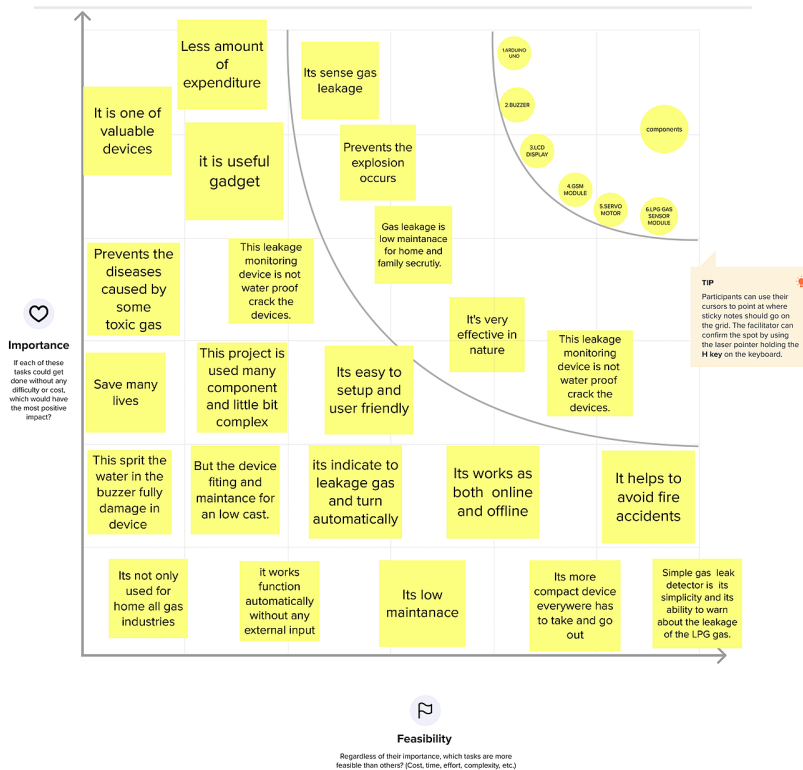


4

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



→

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.

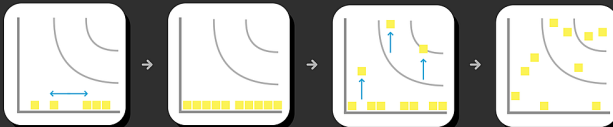
Quick add-ons

- 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](#)



3.3 Proposed Solution:

S.NO	Parameter	Description
1.	Problem Statement (Problem to be solved)	This monitoring is used to prevent fire accidents due to flammable gas leakage in houses from cylinders, industries, hospitals, hotels etc.
2.	Idea / Solution description	This monitoring system uses cloud and IoT-based hardware and sensors. The sensors in the system detect flammable gaseous components in the environment and temperature using an IoT system and send indication via alarms and lights.
3.	Novelty / Uniqueness	The uniqueness of this system is that it uses cloud. Due to this, the alarm can be sent to the person via SMS to his mobile when he is not at home.
4.	Social Impact / Customer Satisfaction	It helps in many ways to society; it prevents fire accidents due to careless handling of gas cylinders. This is a real-time system, so it is faster, and accidents can be prevented very easily.
5.	Business Model (Revenue Model)	This is a cloud-based real-time system that collects data from the environment very quickly, i.e., temperature, humidity, and oxygen composition, using

		sensors and indicate via alarms and lights.
6.	Scalability of the Solution	<input checked="" type="checkbox"/> Accuracy. <input checked="" type="checkbox"/> Low cost. <input checked="" type="checkbox"/> Less maintenance. <input checked="" type="checkbox"/> Reliability.

3.4 Problem Solution Fit:

Project Title: Gas Leakage Monitoring and Alerting System

Project Design Phase-I: Solution Fit Template

Team ID: PNT2022TMID45387

Identify strong TR & EM	<div>Define CS, fit into CC</div> <div>1. CUSTOMER SEGMENT(S) CS</div> <div>Government is our primary customer.</div>	<div>6. CUSTOMER CONSTRAINTS</div> <div>Only one gas can be measured with each instrument.spending power, budget, no cash, network connection, available devices.</div>	<div>5. AVAILABLE SOLUTION AS</div> <div>Apply soapy water to the entire hose assembly, including the tank's valve and regulator, using a spray bottle or sponge. Pressurise the system without turning on any appliances. If you see bubbles or smell rotten eggs, you have a leak.</div> <div>Explore AS, difference</div>
	<div>2. JOBS-TO-BE-DONE / PROBLEMS J&P</div> <div>Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacturing processes and emerging technologies such as photovoltaic.</div>	<div>9. PROBLEM ROOT CAUSE RC</div> <div>Overloading of gas causes the gas leakage. This leads to affect the customers or workers. The leakage of the gas will be detected and help to resolve this problem.</div>	<div>7. BEHAVIOUR BE</div> <div>Our Customer uses All-Purpose Leak Detector is designed to form large bubbles to indicate even the smallest leaks in many types of piping applications</div> <div>Focus on J&P, tip into BE, understand RC</div> <div>Identify strong TR & EM</div>

<p>3. TRIGGERS TR</p> <p>Some of the accidents at industry or home due to gas leakage and is very dangerous to the lives around the surroundings. This triggers the customers to insert this system.</p>	<p>10. YOUR SOLUTION SL</p> <p>If you install the gas leakage detector, it will ensure the humans life. We can work without any fear.</p>	<p>8. CHANNELS of BEHAVIOUR CH</p> <p>8.1 ONLINE We can transmit the information of leakage of gas from the home or industry to the mobile phone of the customer through the message by GSM Module.</p> <p>8.2 OFFLINE After receiving the message, Customer should take immediate action by block the leakage.</p>
<p>4. EMOTIONS: BEFORE / AFTER EM</p> <p>Customer feels insecure and fears before the installation of this device. But, after installation they feel secure and safe</p>		

4. REQUIREMENT ANALYSIS

4.1 Functional Requirement:

FR No.	Functional Requirement (EPIC)	Sub Requirement (Story / Sub-Task)
FR-1	Create cloud account	Registration through Form Registration through G mail Registration through Link
FR-2	User Confirmation	Confirmation via Email Confirmation via OT
FR-3	User Login	User Login Via Mail id And Password
FR-4	Cloud registration	Connect the hardware device
FR-5	Connect to mobile	Connect the cloud with the mobile phone
FR-6	Connect Hardware	Connect hardware to the gas cylinders or in the wall

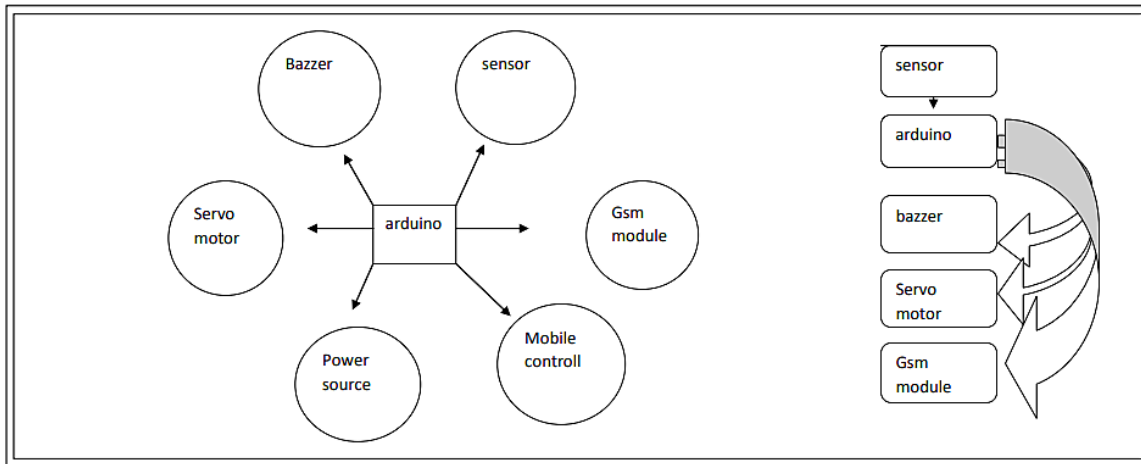
4.2 Non-functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	<ul style="list-style-type: none">● It is user friendly● Easy to handle● Process is simple
NFR-2	Security	<ul style="list-style-type: none">● The device is highly secure.● Privacy is maintained
NFR-3	Reliability	<ul style="list-style-type: none">● The device is more reliable● The device is more trustable in tough conditions
NFR-4	Performance	<ul style="list-style-type: none">● The performance is more accurate.● It is a real time application
NFR-5	Availability	<ul style="list-style-type: none">● It can be available easily.● It requires very few hardware components.
NFR-6	Scalability	<ul style="list-style-type: none">● Less maintenance.● Low cost.● Compact.

5. PROJECT DESIGN:

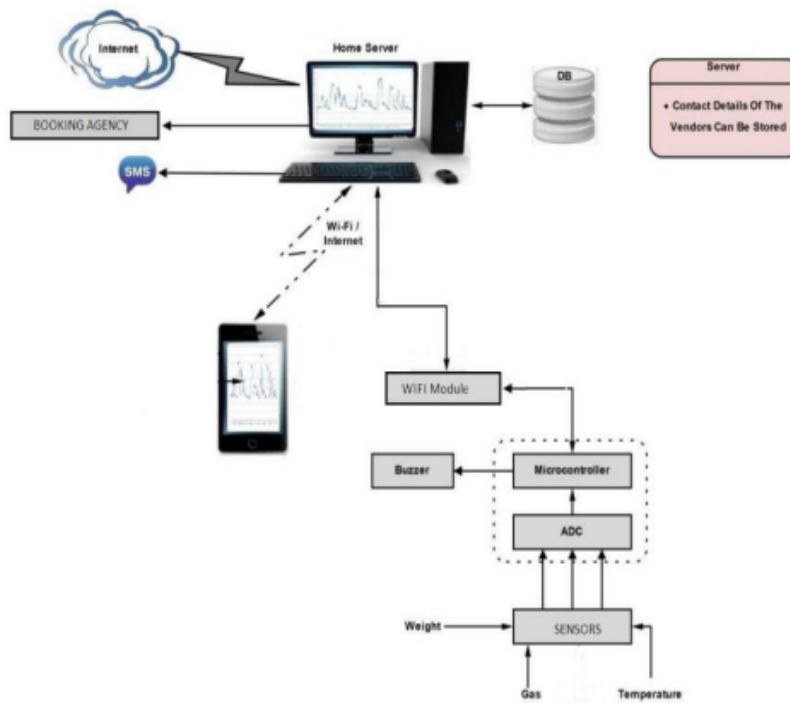
5.1 Data Flow Diagrams:

Data Flow Diagram:



5.2 Solution & Technical Architecture:

Solution Architecture Diagram:



5.3 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	High	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can access by message	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	No need to login mail id	High	Sprint-1
Customer (Web user)	Dashboard					
Customer Care Executive	Registraion	USN-1	User want to use sim card and gsm module	Message reciver for arduino connected sim	High	Sprint-1
		USN-1	Sensor and module	All component is connected to	High	Sprint-1

				arduino		
Administrator	DATA	USN-1	What is Main component in this project	Arduino	High	Sprint-2
power	Dc	USN-1	How much power is required	9v is enff	High	Sprint-1

6. PROJECT PLANNING AND SCHEDULING:

6.1 Sprint Planning & Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Preparation & Data Visualization	USN-1	As a user, I provide Safety to the customers	5	High	Karthick pandiyan R
Sprint-1		USN-2	As an Analyst, I collect the data & Provide meaningful insights through IBM Cloud	3	High	Jegan J
Sprint-2	Dashboard	USN-3	As a user, I want to make sure the safe environment.	3	High	Ayyanar S
Sprint-2		USN-4	As an Analyst, I will upload the data in IBM Cloud to createa interactive dashboard	3	Medium	Abdul Aziz M
Sprint-3	Report	USN-5	As a user, I want to secure the lives and data of each	3	Medium	Karthick pandiyan R

			employee that report a particular event			
Sprint-3		USN-6	As an Analyst, I will use IBM Cloud to generate a report	3	Medium	Jegan J
Sprint-4	Story	USN-7	As a user, I can only understand the Analysis in animated presentation of dataset	5	Medium	Ayyanar S
Sprint-4		USN-8	As an Analyst, I use IBM to create an animated presentation (Story) of the dataset	3	High	Abdul Aziz M

6.2 Sprint Delivery Schedule:

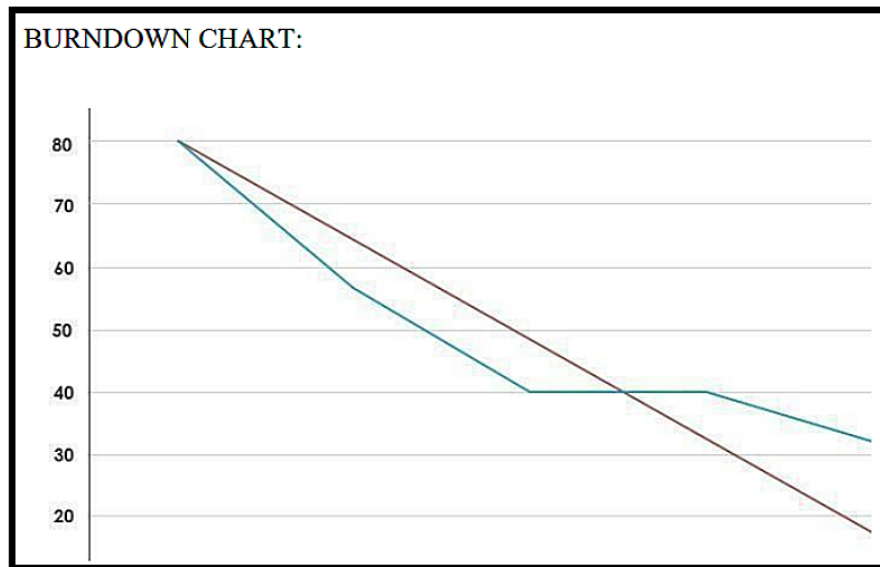
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	5	6 Days	24 Oct 2022	24 Oct 2022	5	29 Oct 2022
Sprint-2	5	6 Days	31 Oct 2022	05 Nov 2022	5	05 Nov 2022
Sprint-3	5	6 Days	07 Nov 2022	12 Nov 2022	5	12 Nov 2022
Sprint-4	5	6 Days	14 Nov 2022	19 Nov 2022	5	15 Nov 2022

Velocity:

We have an 6-day sprint duration, and the velocity of the team is 4 (points per sprint). To

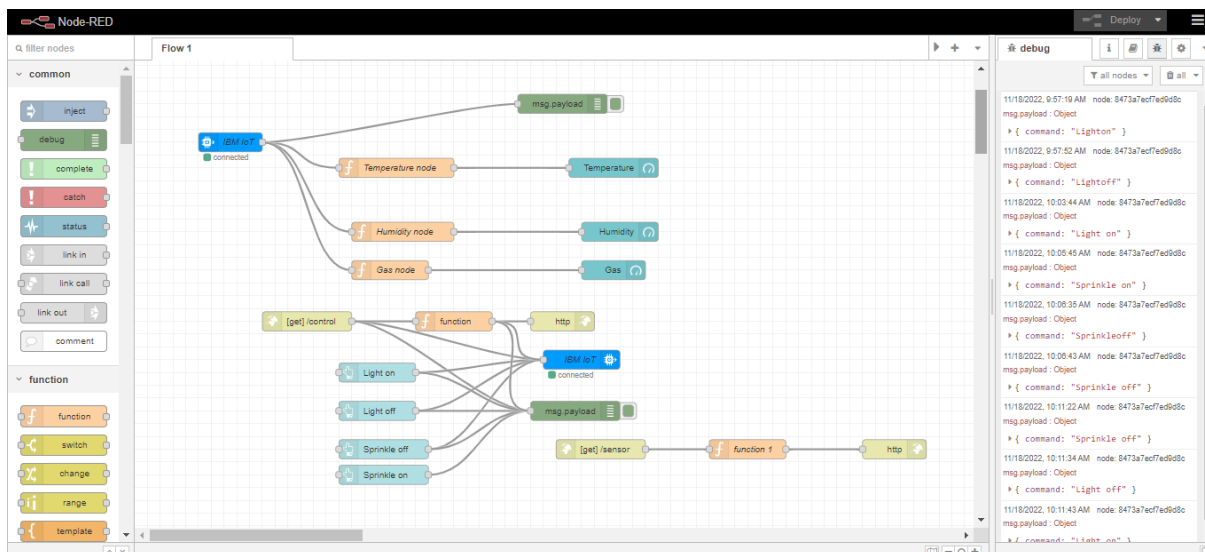
1

$$AV = \frac{\text{SPRINT DURATION}}{\text{VELOCITY}} = \frac{6}{4} = 1.5$$

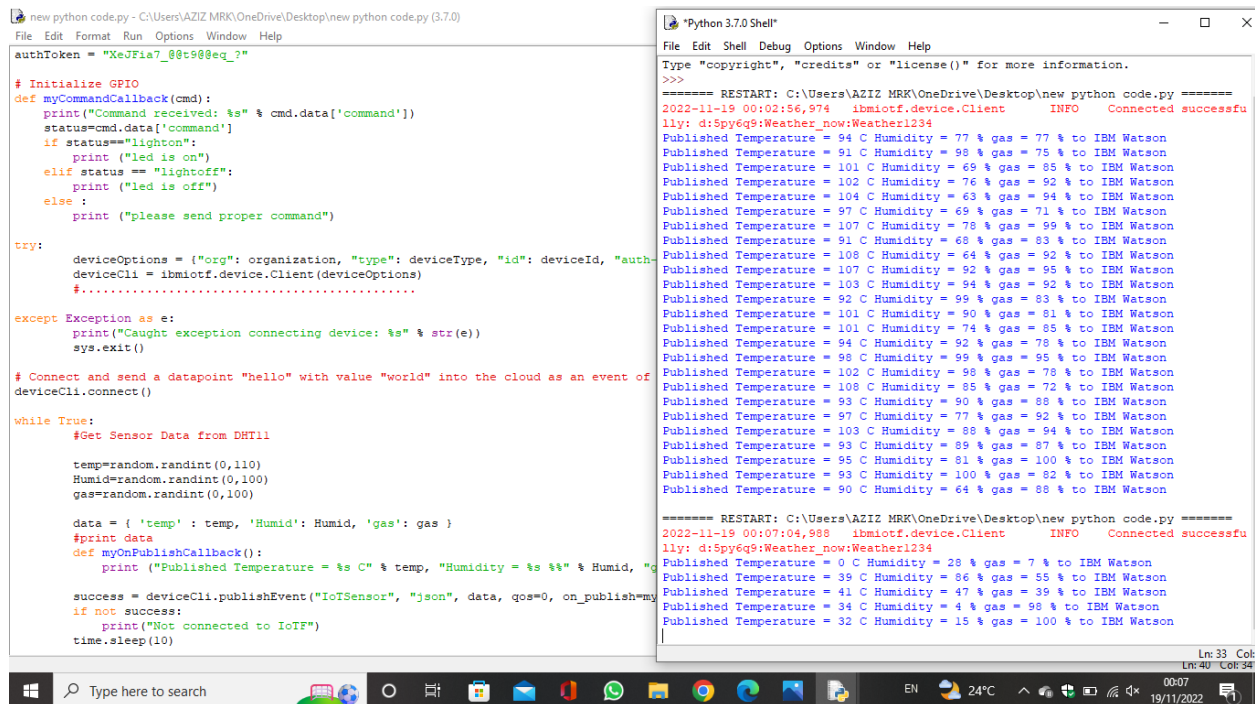


7. CODING AND SOLUTIONING:

7.1 Feature 1(Node Red Output)



7.2 Feature 2: (Python Output)



The image shows a Python script in a text editor and its execution output in a terminal window. The script, named 'new python code.py', is located at 'C:\Users\AZIZ MRK\OneDrive\Desktop\new python code.py (3.7.0)'. It defines a command callback function 'myCommandCallback' that handles 'lighton' and 'lightoff' commands. It also includes a loop that generates random temperature, humidity, and gas data points and publishes them to the cloud using the 'deviceCli.publishEvent' method. The terminal window, titled 'Python 3.7.0 Shell', shows the output of the script, including the command received, the status of the device, and the published data points. The output is formatted as a table with columns for Temperature, Humidity, and Gas, and rows for each published data point. The terminal also shows the restart of the script and the successful connection to the cloud.

```
new python code.py - C:\Users\AZIZ MRK\OneDrive\Desktop\new python code.py (3.7.0)
File Edit Format Run Options Window Help

authToken = "XeJFia7_08t90@eq_?"

# 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":
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
deviceCli.connect()

while True:
    #Get Sensor Data from DHT11

    temp=random.randint(0,110)
    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, "g
success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=my
if not success:
    print("Not connected to IoTF")
    time.sleep(10)
```

```
Python 3.7.0 Shell
File Edit Shell Debug Options Window Help

Type "copyright", "credits" or "license()" for more information.
>>>

===== RESTART: C:\Users\AZIZ MRK\OneDrive\Desktop\new python code.py =====
2022-11-19 00:02:56,974  ibmiotf.device.Client INFO Connected successfu
lly: d:5py6q9:Weather_now:Weather1234
Published Temperature = 94 C Humidity = 77 % gas = 77 % to IBM Watson
Published Temperature = 91 C Humidity = 98 % gas = 75 % to IBM Watson
Published Temperature = 101 C Humidity = 69 % gas = 85 % to IBM Watson
Published Temperature = 102 C Humidity = 76 % gas = 92 % to IBM Watson
Published Temperature = 104 C Humidity = 63 % gas = 94 % to IBM Watson
Published Temperature = 97 C Humidity = 69 % gas = 71 % to IBM Watson
Published Temperature = 107 C Humidity = 78 % gas = 99 % to IBM Watson
Published Temperature = 91 C Humidity = 68 % gas = 83 % to IBM Watson
Published Temperature = 108 C Humidity = 64 % gas = 92 % to IBM Watson
Published Temperature = 107 C Humidity = 92 % gas = 95 % to IBM Watson
Published Temperature = 103 C Humidity = 94 % gas = 92 % to IBM Watson
Published Temperature = 92 C Humidity = 99 % gas = 83 % to IBM Watson
Published Temperature = 101 C Humidity = 90 % gas = 81 % to IBM Watson
Published Temperature = 101 C Humidity = 74 % gas = 85 % to IBM Watson
Published Temperature = 94 C Humidity = 92 % gas = 78 % to IBM Watson
Published Temperature = 98 C Humidity = 99 % gas = 95 % to IBM Watson
Published Temperature = 102 C Humidity = 98 % gas = 78 % to IBM Watson
Published Temperature = 108 C Humidity = 85 % gas = 72 % to IBM Watson
Published Temperature = 93 C Humidity = 90 % gas = 88 % to IBM Watson
Published Temperature = 97 C Humidity = 77 % gas = 92 % to IBM Watson
Published Temperature = 103 C Humidity = 88 % gas = 94 % to IBM Watson
Published Temperature = 93 C Humidity = 89 % gas = 87 % to IBM Watson
Published Temperature = 85 C Humidity = 81 % gas = 100 % to IBM Watson
Published Temperature = 93 C Humidity = 100 % gas = 82 % to IBM Watson
Published Temperature = 90 C Humidity = 64 % gas = 88 % to IBM Watson

===== RESTART: C:\Users\AZIZ MRK\OneDrive\Desktop\new python code.py =====
2022-11-19 00:07:04,988  ibmiotf.device.Client INFO Connected successfu
lly: d:5py6q9:Weather_now:Weather1234
Published Temperature = 0 C Humidity = 28 % gas = 7 % to IBM Watson
Published Temperature = 39 C Humidity = 86 % gas = 55 % to IBM Watson
Published Temperature = 41 C Humidity = 47 % gas = 39 % to IBM Watson
Published Temperature = 34 C Humidity = 4 % gas = 98 % to IBM Watson
Published Temperature = 32 C Humidity = 15 % gas = 100 % to IBM Watson
```

8. TESTING:

8.1 Test cases:

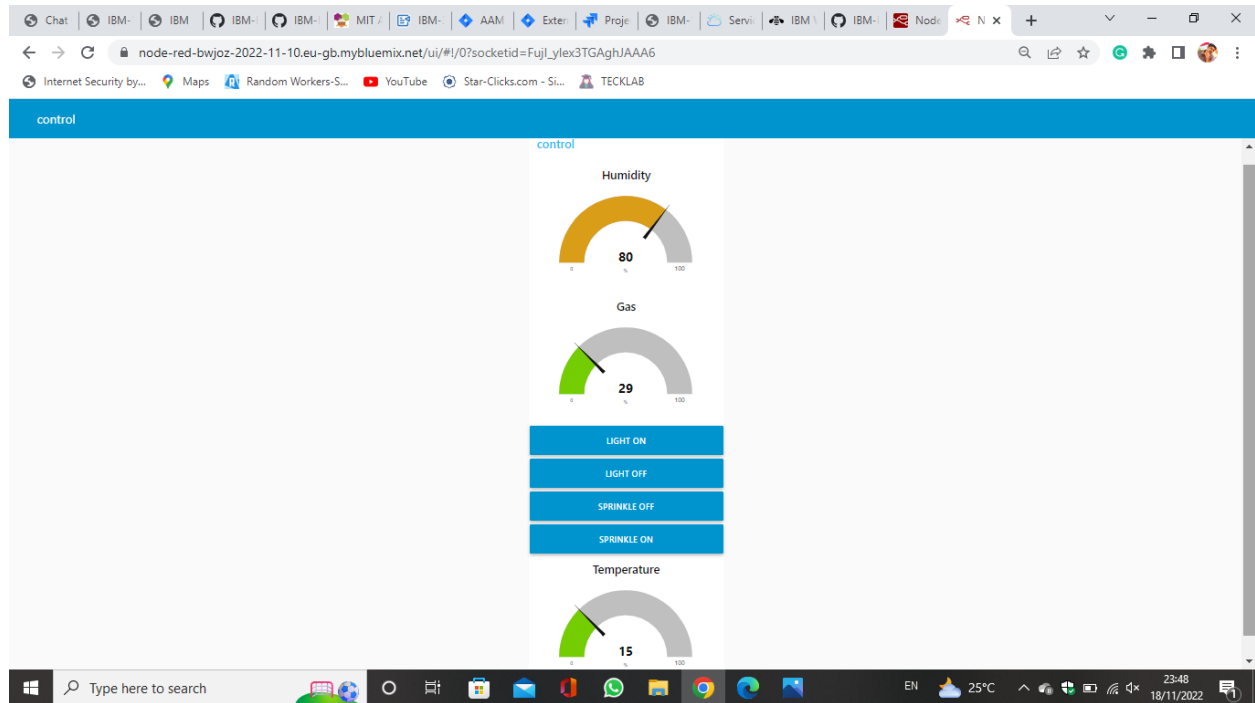
8.2 User Acceptance Testing:

9. RESULTS:

9.1 Performance Testing:

10. WEB APPLICATION DASHBOARD:

I



11.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
- Ensure worker's health
- Real-time updates about leakages
- Cost-effective installation
- Measure oxygen level accuracy
- Get immediate gas leak alerts

Disadvantage:

- Get immediate gas leak alerts
- When heavy dust, steam or fog blocks the laser beam, the system will not be able to take measurements

12. MOBILE APPLICATION:

The screenshot shows a mobile application interface with a dark grey header bar. The header contains the title "Gas Leakage Detection and Alerting" in white text. Below the header, there are three rows of data: "Monitoring Layout Temperature" with a value of 80, "Humidity" with a value of 19, and "Gas" with a value of 68. Each value is displayed in a white box. At the bottom of the screen, there are four colored buttons: "Light on" (green), "Light off" (red), "Sprinkle on" (cyan), and "Sprinkle off" (yellow). The status bar at the top of the screen shows the time as 10:09, a data speed of 1.6KB/s, and various icons for cellular signal, Wi-Fi, and battery level (50%).

13.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.

14. 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.

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15. APPENDIX:

Source Code:

- [Source code](#)

GitHub and Project Demo Link:

- [GitHub link](#)
- [Project Demo Link](#)