IBM PROJECT

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

Batch: B9-3A5E

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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 any 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 bythe gases.

2. LITERATURE SURVEY

2.1 Existing Problem:

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

2.2 References:

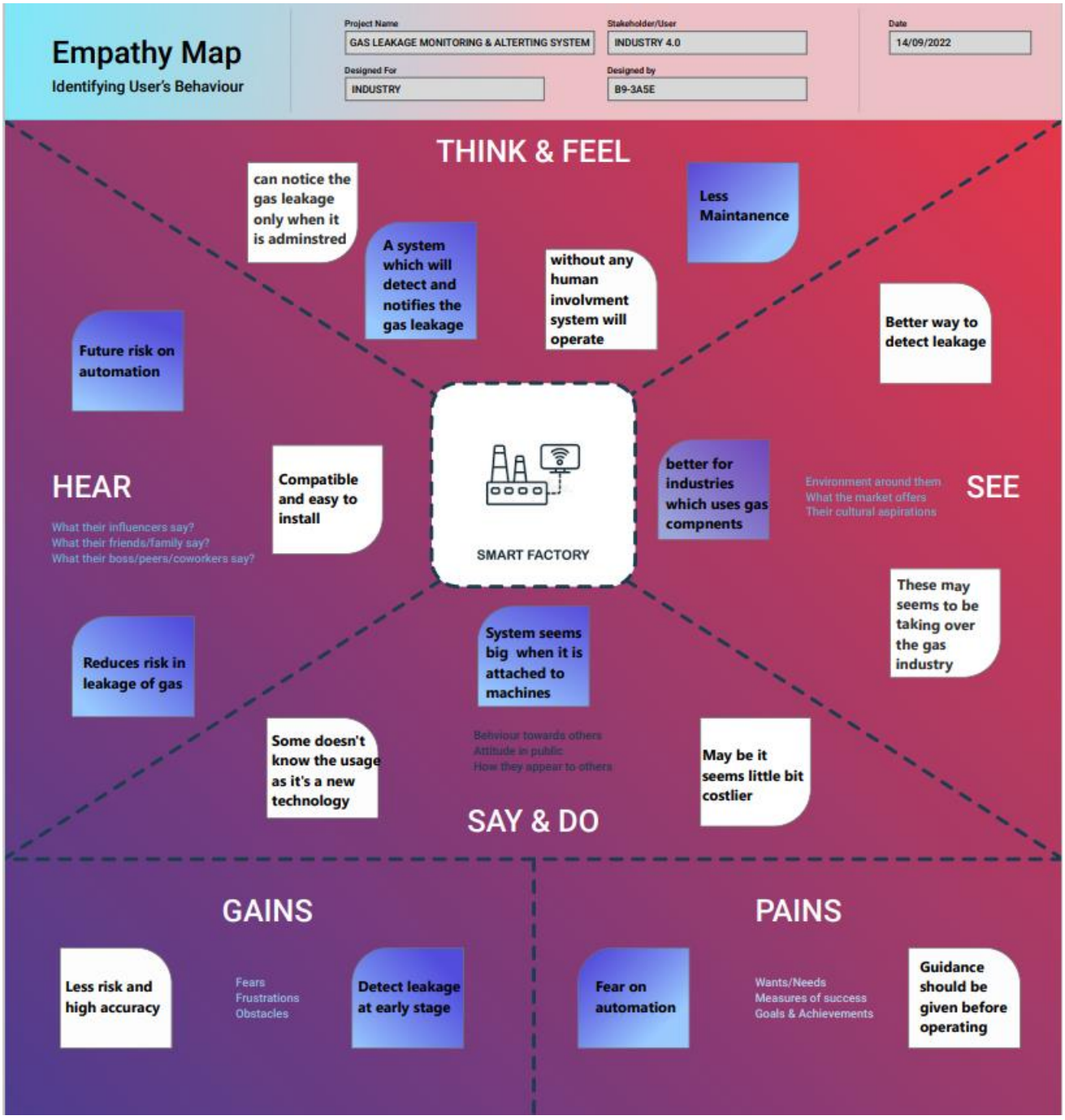
i. ***NAME:*** **IoT based Gas leakage detection system with database logging, prediction and smart alerting system.**
AUTHOR: **Chaitali Bagwe, Vidya Ghadi, Vinayshri Naik, Neha Kunte** ***CONTENT:*** **The system provides constant monitoring and detection of gas leakage along with storage of data in database for predictions and analysis. The IOT components used helps in making the system much more cost effective in comparison with traditional Gas detector systems.**
NAME: **Internet of things (IoT) based gas leakage monitoring and alerting system with Mq-6 sensor.** ***AUTHOR:*** **Rohan Chandra Pandey , Manish Verma , Lumesh Kumar Sahu , Saurabh Deshmukh** ***CONTENT*****: An overall conclusion IOT based toxic gas detector is it has become more efficient, more applicable to today's applications and smarter.**
NAME: **Internet of Things (IOT) Based Gas Leakage Monitoring and Alerting System with MQ-2 Sensor** ***AUTHOR:*** **Rohan Chandra Pandey , Manish Verma , Lumesh Kumar Sahu** ***CONTENT:*** **This paper choice of using a real time gas leakage monitoring and Sensing the output levels of gas has been clearly observed by the help of this system**

2.3 Problem statement definition:

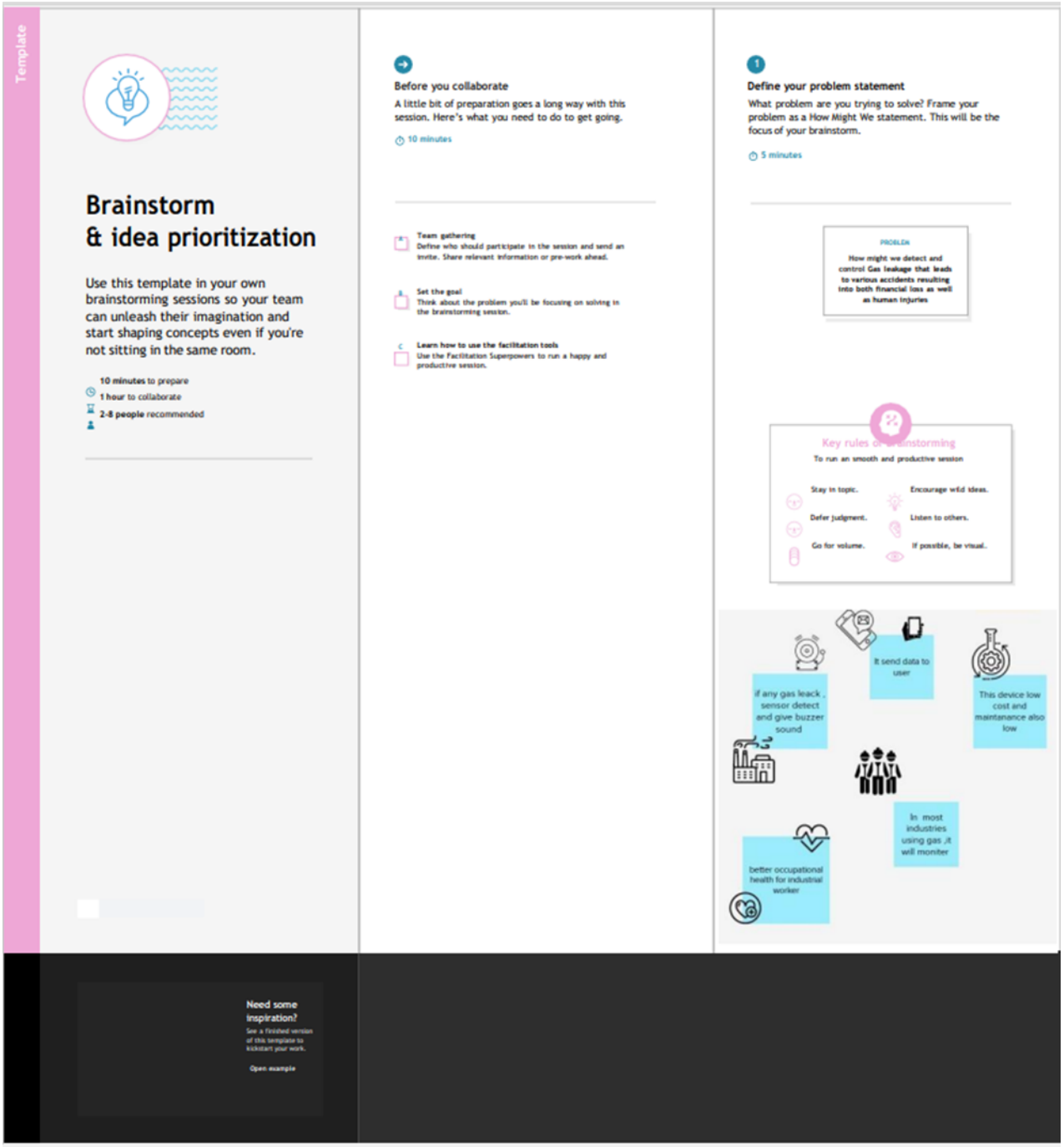
Since the number of sensors is unpredictable, the industrialists feel in secured in handling the gases. Also the cost price of the products and the complications in installing the systems are high. This makes the customers feel disappointed sometimes.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:



3.2 Ideation & Brainstorming:



2

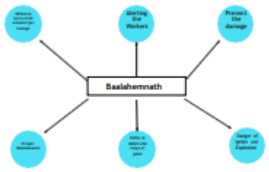
Brainstorm

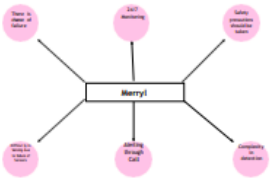
Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!





General Points

3

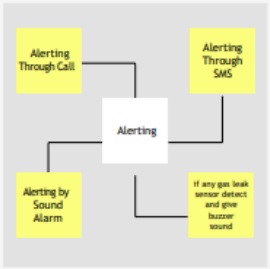
Group ideas

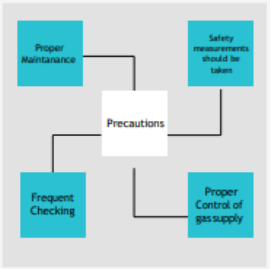
Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

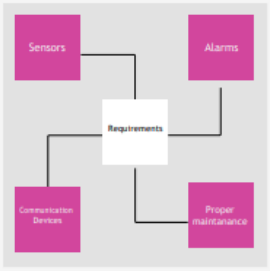
20 minutes

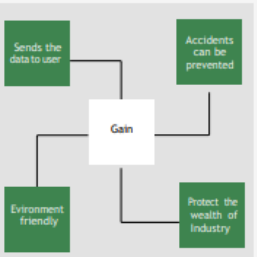
TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.







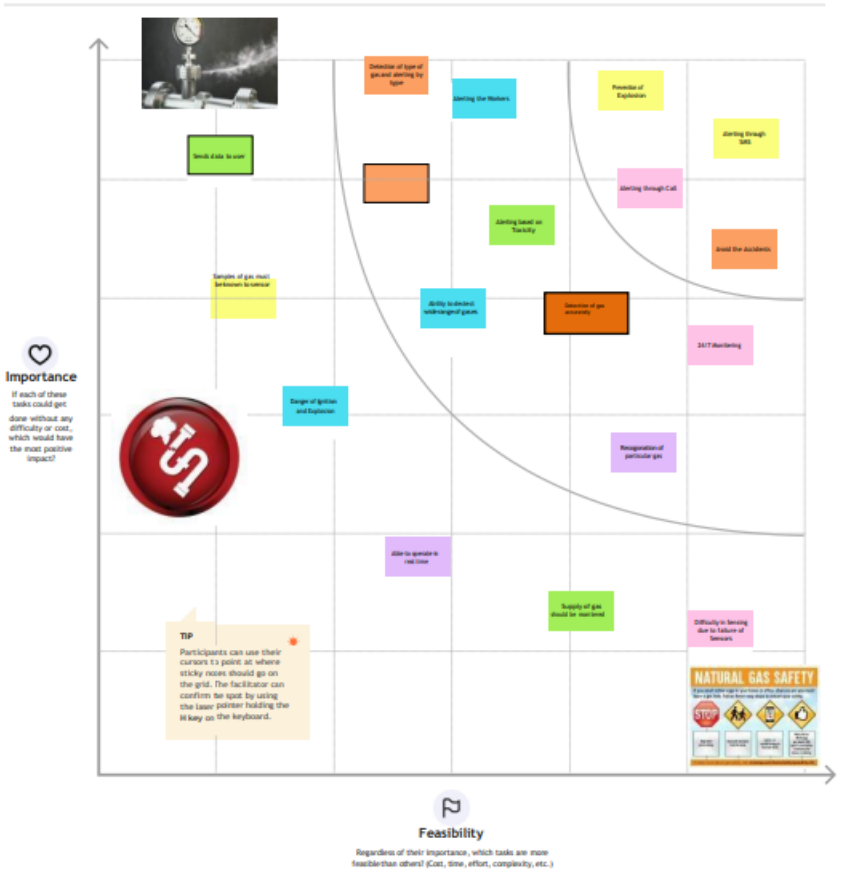


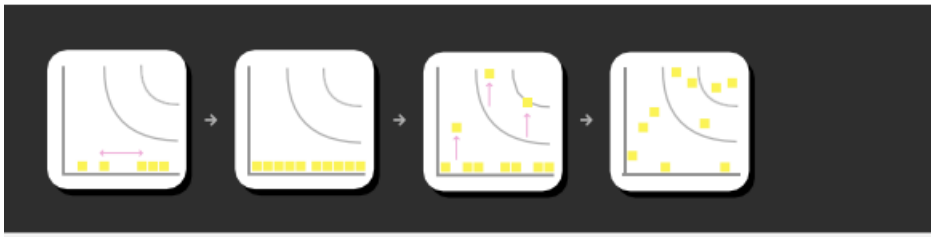
4

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
	Problem Statement	**Develop an efficient system & an application that can monitor and alert the users(workers)**
	Idea / Solution description	**This product helps the industries in monitoring the emission of harmful gases.In several areas, the gas sensors will be integrated to monitor the gas leakage.If in any area gas leakage is detected the admins will be notified along with the location. In the web application, admins can view the sensor parameters.**
	Novelty / Uniqueness	**Fastest alerts to the workers. User friendly**
	Social Impact / Customer Satisfaction	**Cost efficient. Easy installation and provide efficient results. Can work with irrespective of fear**
	Business Model (Revenue Model)	**The product is advertised all over the platforms. Since it is economical, it even helps small scale industries from disasters. As the product usage can be understood by everyone, it is easy for themto use it properly for their safest organization.**
	Scalability of the Solution	**Since the product is cost-efficient, it can be placedin many places in the industry. Even when the gas leakage is more, the product senses the accurate values and alerts the workers effectively.**

3.4 Problem Solution Fit:

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

It targets industry owners and workers. The main aim is to ensure the safety of workers from gas leakages that may occur in an industry.

6. CUSTOMER CC

To make sure that gas does not leak from anywhere, proper and regular maintenance must be done on the equipment. This might be expensive.

5. AVAILABLE SOLUTIONS AS

Sensors can be used to detect gas leakage and a buzzer can indicate the same. If there is a gas leakage, GSM module helps us to get appropriate notifications. This might be easier to implement but can be more expensive.

Explore AS, differentiate

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

2. JOBS-TO-BE-DONE / PROBLEMS

Due to certain network or connectivity issues, the reliability of data transfer in the real time system might be affected. The system might not withstand extremely harsh environmental conditions.

9. PROBLEM ROOT CAUSE RC

Gas leakage might be caused due to usage of unreliable metal to metal seals or poor tubing during the construction of gas lines.

7. BEHAVIOUR BE

Regular inspections can be done to find out areas in which there are gas leakages. Some detection systems can be hardwired to detect leaks. In the case of wireless systems, if there are network issues, the service provider or the helpline can be contacted.

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

3. TRIGGERS TR

Reports in the news about the accidents due to gas leakage and concern for the safety of workers might encourage customers to take action.

4. EMOTIONS: BEFORE / AFTER EM

When a problem arises suddenly, the user might feel confused and scared and when the problem is resolved, the user might feel relief and a sense of success.

10. YOUR SOLUTION SL

To develop a cost effective IOT based system that can be easily accessed and manipulated by the customers so that gas leakages are detected at the earliest possible time.

8.CHANNELS of BEHAVIOUR CH

8.1 ONLINE

The status of the sensor is continuously monitored and notification is received if there is any gas leakage.

8.2 OFFLINE

Ensure that proper network and power is supplied to the system for it to work efficiently and prevent any physical damage that might occur to the sensor.

4. REQUIREMENT ANALYSIS

4.1 Functional Requirement:

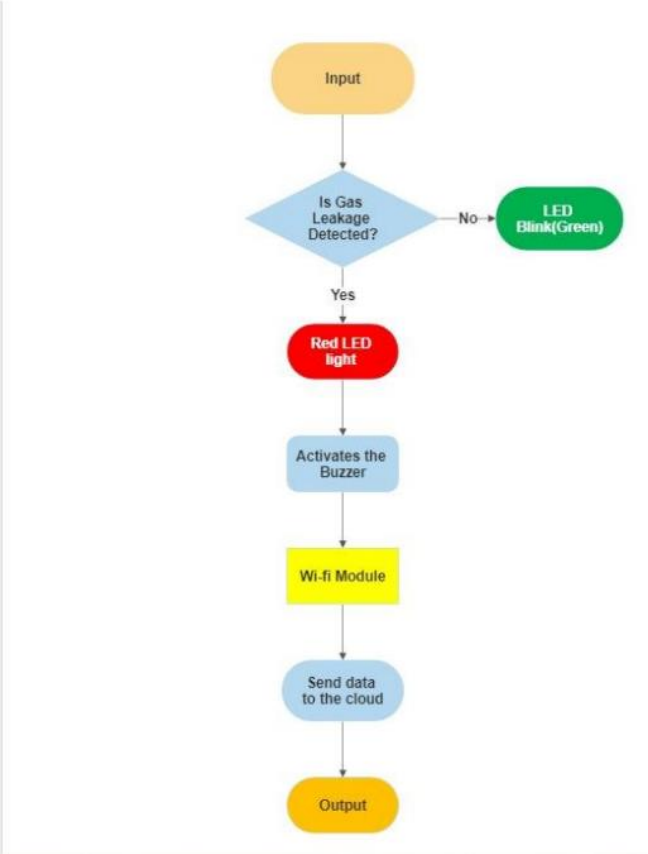
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Visibility	The level of gas can be monitored by users if there is any leakage, alerts can be sent through messages.
FR-2	User Reception	The data like the level of gas can be sent through messages
FR-3	User Understanding	The user can monitor the level of gas with the help of the data. If there is an increase in gas level, then the alert will be given. They also get notified by the alert.
FR-4	User Convenience	Through messages we can easily get data of gas level and in case of gas leakage, it can directly send notifications to nearby police stations and hospitals.
FR-5	User Performance	When the user gets notified, he could turn on the exhaust fan/sprinkler.

4.2 Non-Functional Requirement:

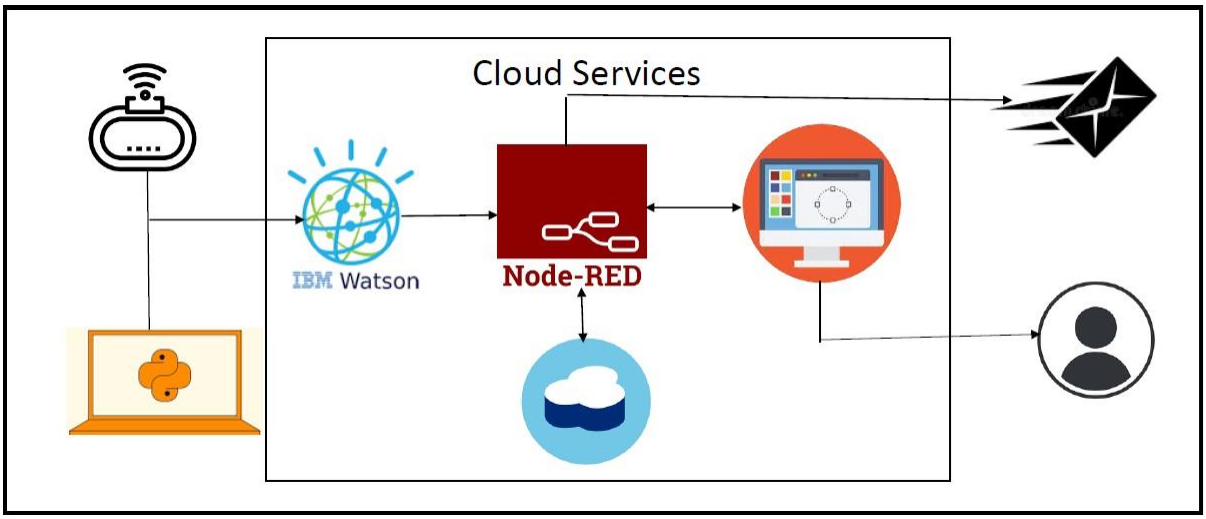
Business Requirements	User Requirements	Product Requirements
The said system can be deployed in homes, hotels, factory units, LPG cylinder storage areas, and so on. The main advantage of this IoT and Arduino-based application is that it can determine the leakage and send the data over to a site. It can be monitored, and preventive measures can be taken to avoid any disaster.	The gas leakage detection system can be optimized for detecting toxic gasses along with upgrading them with smoke and fire detectors to identify the presence of smoke and fire. Ensuring worker safety is important but making using of the right technology is even more vital.	Detecting gasses is necessary regardless of your business role or individual purpose. Certain technologies at play make such IoT devices what they are, and if you want to indulge in IoT application development, you must know what they are and what purpose they can fulfil.

5. PROJECT DESIGN

5.1 Data Flow Diagrams:



5.2 Solution & Technical Architecture:



5.3 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptanc ecriteria	Priority	Release
Custome r(Mobile user)	Registration	USN-1	User can enter into the webapplication	I can access myaccount / dashboard	High	Sprint-1
		USN-2	Users can register their credentials like email id andpassword	I can receive confirmation emailand click confirm	High	Sprint-1
	Login	USN-3	User can log in to the application by entering email and password	I can login to myaccount	High	Sprint-1
	Dashboard	USN-4	User can view the temperature	I can view the data given by the device	High	Sprint-2
		USN-5	User can view the level of gas	I can view the datagiven by the device	High	Sprint-2
Customer (Web user)	Usage	USN-1	User can view the webpage and get the information	I can view the data given by the device	High	Sprint-3
Customer	Working	USN-1	User act according to the alertgiven by the device	I can get the data work according toit	High	Sprint-3
		USN-2	User turns ON the exhaust fan/sprinkler when the leakageoccurs	I can get the data work according toit	High	Sprint-4
CustomerCare Executiv e	Action	USN-1	User solve the problems whensomeone faces any usage issues	I can solve the issues when someone fails tounderstand the procedure	High	Sprint-4
Administr a tor	Administratio n	USN-1	User stores every information	I can store the gained information	High	Sprint-4

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning & Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Objective	USN-1	As a system, the gas sensor should detect the gas	8	High	Baalahemnath S
Sprint-1	Features	USN-2	As a system, the gas sensor values should be displayed on an LCD screen	2	Low	Merryl Mekana P
Sprint-1	Features	USN-3	As a system, as soon as the detected gas reaches the threshold level, the red colored LED should be turned ON.	5	High	Dhekshaa E
Sprint-1	Features	USN-4	As a system, as soon as the detected gas reaches the threshold level, the buzzer should be turned ON.	5	High	Shanmuham S
Sprint-2	Focus	USN-5	As a system, it should the send the location at which the gas is detected	8	High	Dhekshaa E
Sprint-2	Focus	USN-6	As a system, it should also send the alerting SMS to the registered phone number	2	Low	Shanmuham S

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Features	USN-7	As a system, the gas leakage pipe should beclosed automatically once it attains the threshold value	5	Medium	Baalahemnath S
Sprint-2	Features	USN-8	As a system, it should indicate that the gas leakage pipe is closed in the LCD screen and send SMS to the registered mobile number.	5	Medium	Merryl Mekana P
Sprint-3	Data Transfer	USN-9	As a program, it should retrieve the API key of the IBM cloud to send the details of the system.	2	Low	Baalahemnath S
Sprint-3	Data Transfer	USN-10	As a system, it should send the data of sensor values along with latitudes and longitudes to theIBM cloud	5	Medium	Merryl Mekana P
Sprint-3	Data Transfer	USN-11	As a cloud system, the IBM cloud should sendthe data to NodeRed	2	Medium	Dhekshaa E
Sprint-3	Data Transfer	USN-12	As a system, it should collect the data from NodeRed and give it to the backend of the MIT app.	3	Medium	Shanmuham S
Sprint-3	Data Transfer	USN-13	As an application, it should display the details ofthe gas level and other details to the user through the frontend of the MIT app.	8	High	Merryl Mekana P
Sprint-4	Registration	USN-14	As a user, I must first register my email andmobile number in the website	2	High	Merryl Mekana P

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-4	Registration	USN-15	As a user, I must receive confirmation mail and SMS on registration	2	Medium	Baalahemnath S
Sprint-4	Login	USN-16	As a user, I can login into the web application through email and password.	3	High	Dhekshaa E
Sprint-4	Dashboard	USN-17	As a user, I can access the dashboard andmake use of available resources.	2	Medium	Merryl Mekana P
Sprint-4	Focus	USN-18	As a user, I must receive an SMS once the leakage is detected.	5	High	Shanmuham S
Sprint-4	Allocation	USN-19	As an admin, I must receive information about theleakage along with location and it should share exact location and route to the person.	3	High	Dhekshaa E
Sprint-4	Allocation	USN-20	As an admin, I must allot a particular person to look after the leakage in a particular location.	3	High	Shanmuham S

6.2 Sprint Delivery Schedule:

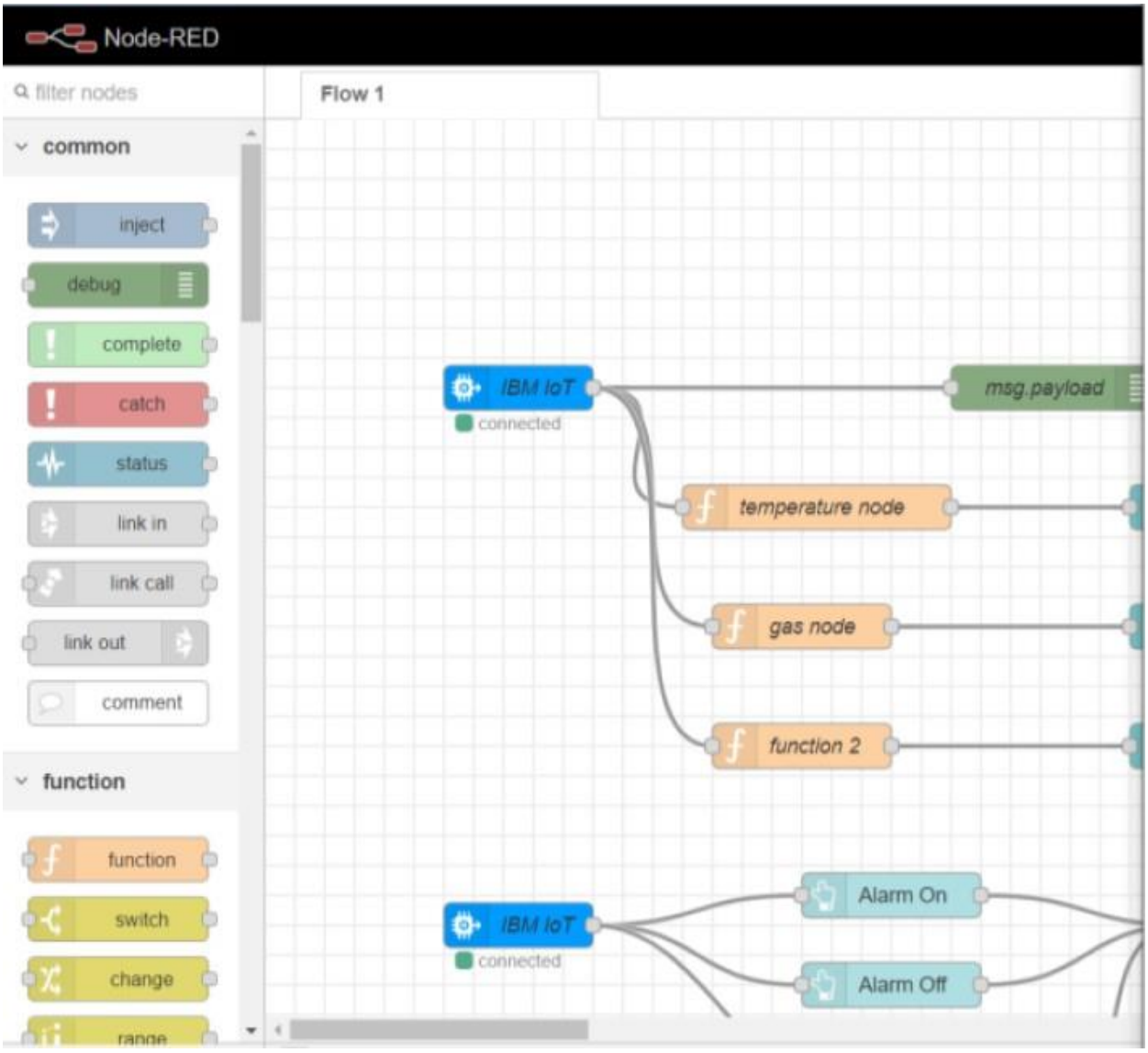
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022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

6.3 Reports From JIR

Report of Zoho project management software

7. CODING AND SOLUTIONING

7.1 Feature 1(Node Red Output)



7.2 Feature 2: (Python Output)

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

8. TESTING

8.1 Test Case Report

8.2 User Acceptance Test:

9. RESULTS

9.1 Performance Testing Report :

10. ADVANTAGES AND DISADVANTAGES

Advantages:

- **Detect the concentration of the gases**
- **The sensor-enabled solution helps prevent the high risk of gas explosionsand 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 alert**

Disadvantages:

- **Only one gas can be measured with each instrument.**
- **When heavy dust, steam or fog blocks the laser beam, the system will notbe 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 inadequateawareness of the people. Hence, gas leakage detection is essential to prevent accidents and to save human lives. This paper presented LPG leakage detection and alert system. This system triggers buzzer and notification to alert people when gas leakageis detected. This system is basic yet reliable.

12. FUTURE SCOPE

Major cities of India are pushing Smart Home application, gas monitoring system is a part of SmartHome application. Enhancing Industrial Safety using IoT. This system can be implemented in Industries, Hotels and wherever the gas cylinders are used. This systemcan be used in industries involving applications such as Furnace, Boilers, Gas welding, Gas cutting, Steel Plants, Metallurgical industries, Food processing Industries, Glass Industries, Plastic industries, Pharmaceuticals, Aerosol manufacturing. As hospitals require to provide maximum possible safety to patients, this system can be used to keep track of all the cylindersused in it. Some of the cylinders used are Oxygen cylinder, Carbon dioxide cylinder, Nitrous oxide cylinder. As many students are naive the risk of causing accidents is high. Hence, our system can also be used in schools, colleges. Many colleges have well established labs including chemistry lab and pharmaceutical labs where gas burners are used. Several medicalequipment requires gas cylinders.

13. APPENDIX

Source Code:

- **Final Deliveries**

GitHub and Proteus Design Link:

- **Github Link**
- **Proteus Design Link**

Node-Red design Link:

- **Node-Red Flow diagram**
- **Node-Red Socket Link**