Gas Leakage Monitoring and Alerting system for Industries

A PROJECT REPORT

Submitted by

TEAM ID	**PNT2022TMID15063**
MANUSA K R	**19BEC131**
GOPIKA S	**19BEC124**
SOBIYA SELSIYA M	**19BEC129**
PRIYADHARSHINI S	**19BEC126**

in partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING IN

ELECTRONICS AND COMMUNICATION ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE-641049

ANNA UNIVERSITY: CHENNAI 600025

NOVEMBER 2022

Abstract

Leakage of any kind of gas has been a concern in recent years, whether it is ina residential setting, a business, a cafe, or a canteen. In this paper, development of an IoT based gas wastage monitoring, leakage detecting and alerting system is proposed. This paper elaborates design such an intelligent system that will help savegas and smartly prevent accidents. The system needs to be integrated with the cooker. The technology includes ultrasonic sensors that determine if the cooker is being utilized for cooking purposes or not. If it is discovered that the cooker is not inuse, the system uses an automatic switching off mechanism to cut off the gas supply.The moment gas leakage will probably be recognized, users will be informed via SMS through GSM, and so that user can solve the issue as soon as possible. The system will monitor flame and fire through flame sensor. When gas is detected, the buzzer begins to sound. Aside from that, the system also has a cloud storage capability. The usage of gas for each user each day may be tracked with the aid of this cloud storage solution. At the end of the day, this procedure will assist in detecting per user naturalgas usage. The system has been tested and it is able to monitor gas wastage, leakageand send a SMS to the user. The resulting performance indicated its effectivenesstoward saving a significant portion of the wasted gas in domestic.

CHAPTER -1

INTRODUCTION

1.1 INTRODUCTION TO IOT:

At present, safety is still attracting the attention of world. And in the all kinds of disaster, the gas leakage occurrence is high rate and damages more. With the rapid development of science and technology, late-model gas monitor and alarm systems are merged new semiconductor technique and artificial intelligent theory Although traditional gas detect and alarm system may be satisfied either gas leakage in a certain extent, there are some defects, such as uncertainty sensitivity of gas detector, deficiency ability in self-diagnosis and self-elimination which gas detection system is adopted in structure. There is some scarcity in transport and communication fire signal in real system is not satisfied with gas detection in modern time. Intelligent gas detects and alarm control system is of gas signal detected, transmitted, processed and controlled system. Gas is very dangerous situation and it's very much necessary to monitor and give warning before anything unwanted happens. In many developing countries, Industries do not come fitted with fire alarm system This results in gas being attended and leading to lot of loss of property, human and so also in developing countries like India we do not have strict laws pertaining to installation of Gas Detection system So there is an urgent need towards developing an automated Gas leakage monitoring and warning system.

1.2 SCOPE:

- The future scope is regarding to minimize the problem of Gas leakage Accidents and for reducing overall cost of other commercial Gas sensor products.

- Also, in order find the amount of temperature and humidity is sensed by the sensor and control action to take automatically to turn off the gas generated.

1.3. Project Overview:

The main aim of smart gas management system includes a Gas sensor, humidity sensor and temperature sensors to detect any changes in the environment. Based on the temperature readings and if any Gases are present the warning will be sent and the exact location in which the gas leakage gas been occurred.

1.4. Purpose:

The primary purpose of a Gas management system is to design, manage, plan and co-ordinate appropriate Gas safety procedures to reduce the risks of Gas and to ensure the safety of building occupants. A complete gas management system ensures legal compliance and protection of lives and assets.

CHAPTER-2
LITERATURE SURVEY

A number of reviews on the subject of gas leakage detection techniques were done in the past either as part of research papers/technical reports on a certain leak detection method and other gas related subjects.

A.Mahalingam, r. T. Naayagi, n. E. Mastorakis; they introduce design and implementation of an economic gas leakage detector. They gave the formulation of many problems in previous gas leakage detectors. They told that several standards have been formulated for the design of a gas leakage detection system such as IEEE, BS 5730, and IEC.For this work, the recommended UK safety standards have been adopted. The proposed alarm system is mainly meant to detect LPG leakage, which is most commonly used in residential and commercial premises. The system detects not only the presence of gas (gas leak),but also the amount of leakage in the air, and accordingly raises an appropriate audio visual alarm. The objective of the system is to detect LPG gases such as propane and butane. The allowed UK level for butane is 600 ppm above which it is considered to be of high level and poses a danger.The proposed system ensures a continuous monitoring of the gas levels. If the gas level increases above the normal threshold level of 400 ppm butane (LPG), the system starts to issue early warning alarms at 100ms interval, which implies low level gas leakage. If the leakage level increases to 575 ppm of butane (LPG), the system activates high severity audio alarms at 50 ms intervals warning the occupants to run to safety.

Prof. M.Amsaveni, A.Anurupa, R.S.Anu Preetha, C.Malarvizhi, M.Gunasekaran; they told in their research paper on “GSM based LPG leakage detection and controlling system” the leakage of LPG gas is detected by the MQ-6 gas sensor. Its analog output is given to the microcontroller. It consists of predefined instruction set. Based on this, the exhaust fan is switched on. So, the concentration of gas inside the room gets decreased. Then, the stepper motor is rotated thus closing the knob of the cylinder. Because of this process, the leakage of gas is stopped. The relay is switched to off the power supply of the house. The buzzer produces an alarm to indicate the gas leakage. Then, the user is alerted by SMS through the GSM module. They proposed their methodology that the system takes an automatic control action after the detection of 0.001% of LPG leakage. This automatic control action provides a mechanical handle for closing the valve. We are increasing the security for human by means of a relay which will shut down the electric power to the house. Also by using GSM, we are

sending an alert message to the users and a buzzer is provided for alerting the neighbors about the leakage.

B. B. Did paye, Prof. S. K. Nanda; in this paper they told about their research on leakage detection and review of"Automated unified system for LPG using microcontroller and GSM module". Their paper proposed an advance and innovative approach for LPG leakage detection, prevention and automatic booking for refill. In advance, the system provides the automatic controlling of LPG regulator also if leakage is detected the system will automatically turn off the main switch of power supply. Hence it helps to avoid the explosion and blast.

Srinivasan, Leela, Jeya bharathi, Kirthik,Rajasree; in this research paper they told about gas leakage detection and control. In this paper, the gas leakage resulting into fatal inferno has become a serious problem in household and other areas where household gas is handled and used. It alerts the subscriber through the alarm and the status display besides turning off the gas supply valve as a primary safety measure.

Manohar Raju and N. Sushma Rani, 2008, they introduce an android based automatic gas detection and indication robot. They proposed prototype depicts a mini mobile robot which is capable to detect gas leakage in hazardous places. Whenever there is an occurrence of gas leakage in a particular place the robot immediately read and sends the data to android mobile through wireless communication like Bluetooth. We develop an android application for android based smartphones which can receive data from robot directly through Bluetooth. The application warns with an indication whenever there is an occurrence of gas leakage and we can also control the robot movements via Bluetooth by using text commands as well as voice commands. The previous mobile robots are based on heterogeneous technologies like GSM, GPS, internet based etc., but the main disadvantage of those prototypes were the absence of communication in particular areas. So, with the rapid developments and tremendous changes in technology we have lots of techniques to eradicate previous problems. Wireless communication protocols play a vital role in present trends. Bluetooth, WI-Fi, Zigbee etc., we use one of the best feature of smartphone, i.e., the Bluetooth technology to control and monitor parameters driven by a robot.

Ch. Manohar Raju and N. Sushma Rani, 2008, they introduce an android based automatic gas detection and indication robot. They proposed prototype depicts a mini mobile robot which is

capable to detect gas leakage in hazardous places. Whenever there is an occurrence of gas leakage in a particular place the robot immediately read and sends the data to android mobile through wireless communication like Bluetooth. We develop an android application for android based smartphones which can receive data from robot directly through Bluetooth. The application warns with an indication whenever there is an occurrence of gas leakage and we can also control the robot movements via Bluetooth by using text commands as well as voice commands. The previous mobile robots are based on heterogeneous technologies like GSM, GPS, internet based etc., but the main disadvantage of those prototypes were the absence of communication in particular areas. So, with the rapid developments and tremendous changes in technology we have lots of techniques to eradicate previous problems. Wireless communication protocols play a vital role in present trends. Bluetooth, WI-Fi, Zigbee etc., we use one of the best feature of smartphone, i.e., the Bluetooth technology to control and monitor parameters driven by a robot.

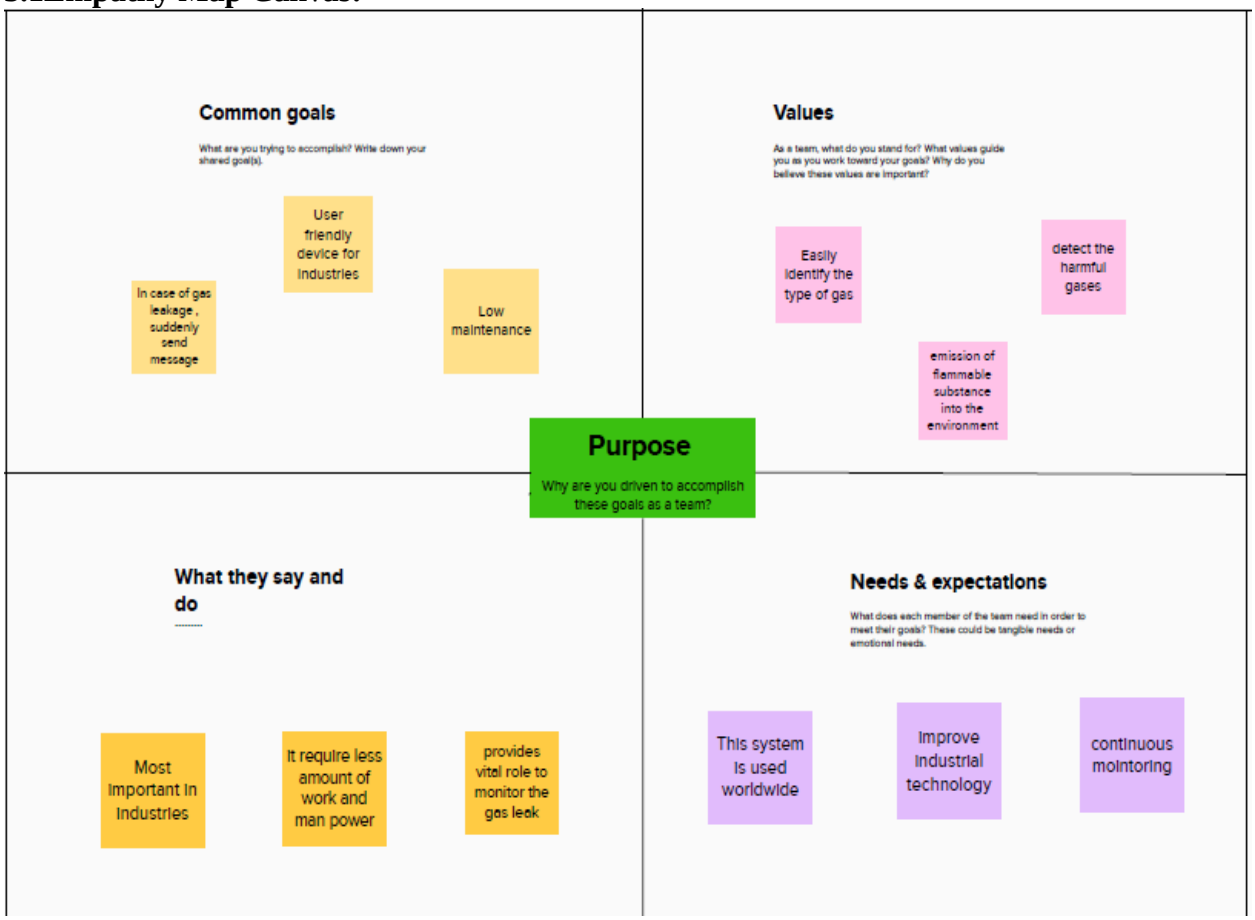
Hina Ruqsar , Chandana R , Nandini R , Dr. T P Surekha, have proposed a system that along with monitoring and detection of gas leakage, real time data is made available through real time feed over internet They have used Xively IOT platform to provide real time sensor data over the internet.

CHAPTER – 3

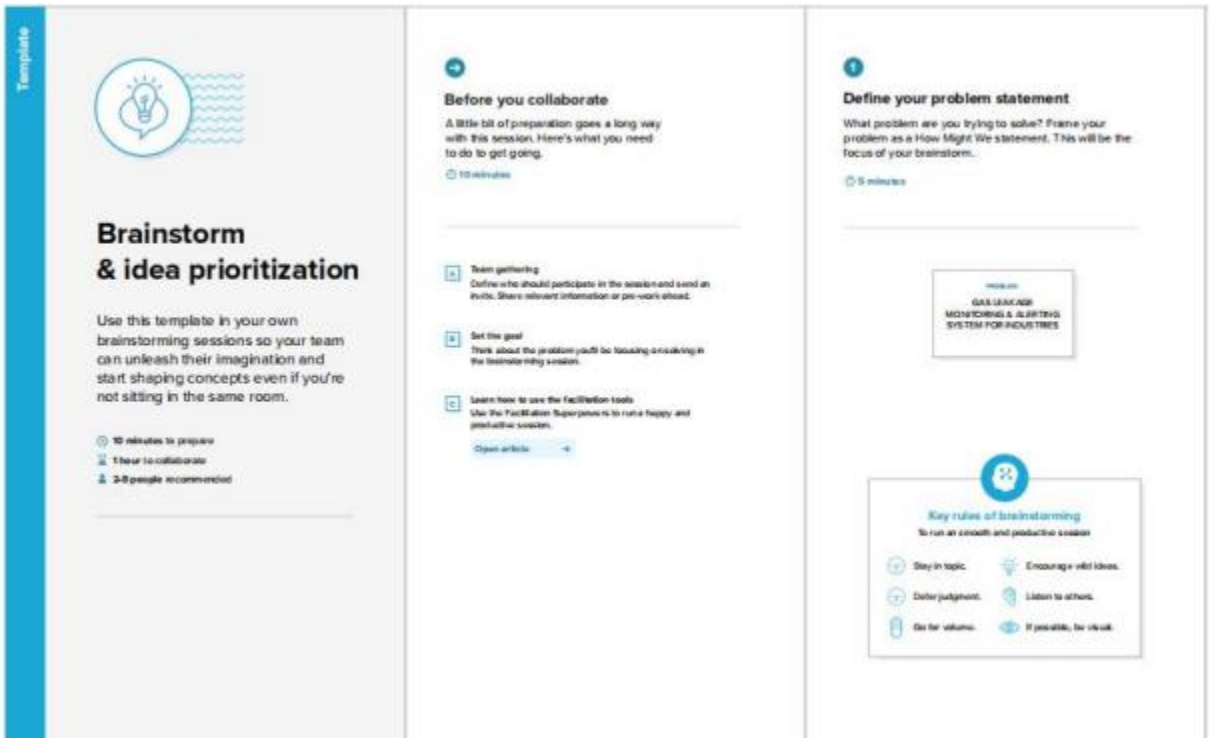
IDEATION & PROPOSED SOLUTION

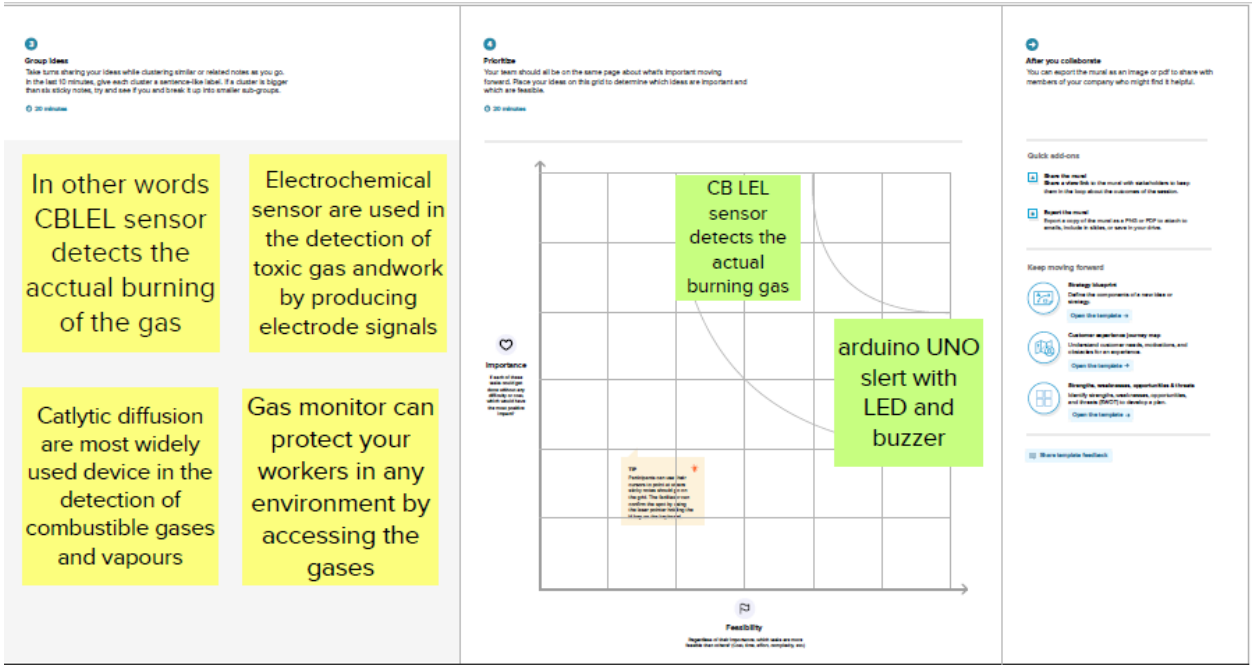
Ideation is the creative process of generating new ideas, which can be accomplished through a variety of ideation techniques, such as brainstorming and prototyping. If done right, ideation is what helps founders and executives determine the right problem to solve and how to solve it. proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved. So, begin your proposed solution by briefly describing this desired result.

3.1Empathy Map Canvas:



3.2 Ideation and Brainstorming





CHAPTER – 4

REQUIREMENT ANALYSIS

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Leakage	Installation of Gas sensors at specified intervals.
FR-2	Notification	When rule condition is met, notification triggered using MQTT.
FR-3	Geo coordinates of nodes	1. Predefined set of GPS locations of nodes is obtained. 2. When notification is triggered, Geo coordinates of the node is also sent along
FR-4	IoT Platform	IBM Watson IoT Platform
FR-5	Cloud Services	IBM Cloud Database
FR-6	Programming tool	NODE-RED Services

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Easy user interface with alerting notifications and location of the defect gas cylinder.
NFR-2	**Security**	1. Secure Cloud database is used. 2. Notify only the registered and verified users. 3. Multiple deployments across the potential sources can help industries to avoid any industrial accident and protect workplace safely.
NFR-3	**Reliability**	1. Gas exposure will measured with ± 25% of the true concentration of the target analyse with 95% certainty. 2.Robust device that can withstand harsh industrial conditions and provide real-time gas leakage detection.

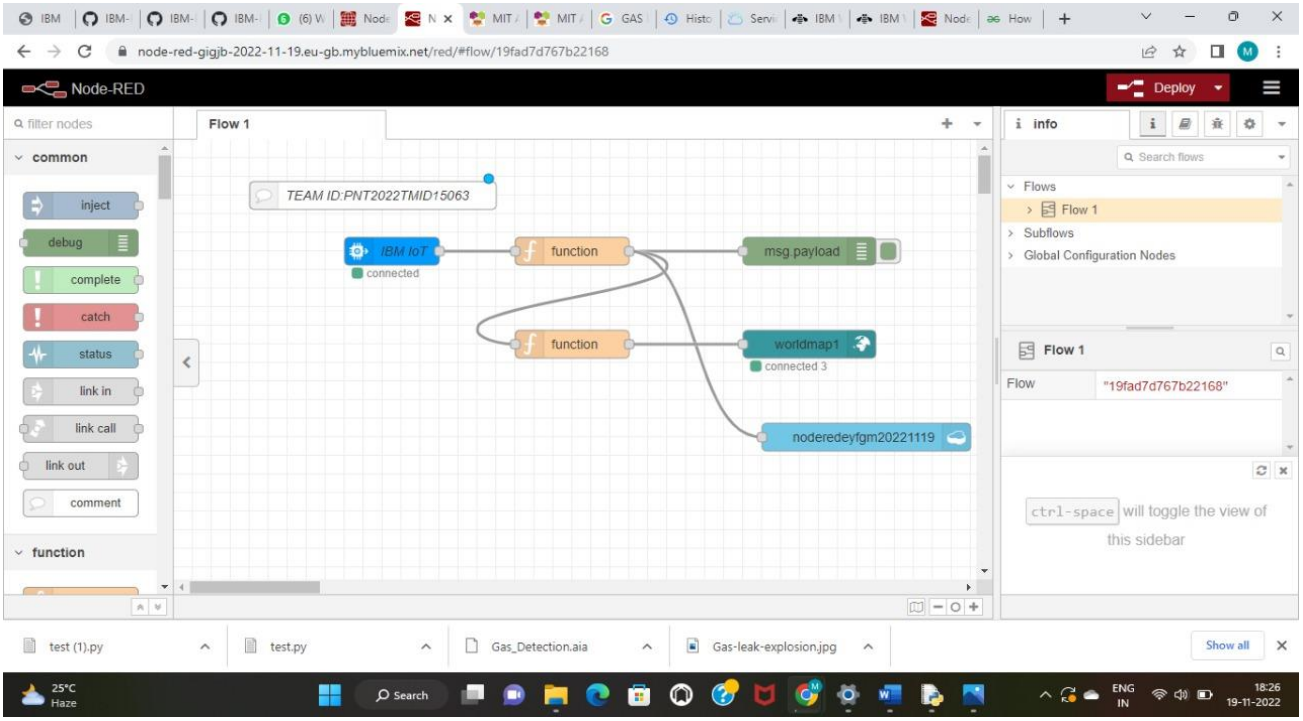
NFR-4	**Performance**	1. Accurate data monitoring system enables periodic analysis of the air quality.
		2. Provides data on a real-time basis which enables safety managers to take timely corrective actions
NFR-5	**Availability**	1. Through Suppliers. 2. With online shopping platforms.
NFR-6	**Scalability**	1. Can be extended further from industrial application to domestic gas applications. 2. Deployment in petrol banks and vehicle fuel plants for gas leakage detection application.

CHAPTER – 5

PROJECT DESIGN

Processes are something that are often overlooked in our industry, but are absolutely essential for a number of reasons. They help you create a repeatable template for a winning formula. They help your team understand how to move through a project in the correct way.

5.1 Data Flow Diagram:



5.2 Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application Web UI and Mobile App	NodeRed
2.	Application Logic-1	Logic for a process in the IoT Device to sense	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson Assistant
4.	Cloud Database	Database Service on Cloud	IBM Cloudant DB
5.	External API-1	Purpose of External API used in the application	IBM Weather API
6.	Infrastructure (Server / Cloud)	Application Deployment on Cloud Server Configuration	Cloud Foundry.

5.3 Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Python
2.	Security Implementations	List all the security / access controls implemented,use of firewalls etc.	Use API Gateway and Internet Gateway as firewall Protection
3.	Scalable Architecture	Every Cloud Services are hosted separately andmake is scalable separately	Public and Private Gateway
4.	Availability	Application is hosted on two regions for availability	London and Frankfurt Region Data Centres are used
5.	Performance	Used Content Delivery Network and API gatewayto scale millions of users and IoT Devices as well	IBM CDN and IBM API Gateway are used

5.4 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
Customer(higher authority)	confirmation	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
Customer (fire service 101)	Safety measure register	USN-3	As a user, I can register for the application through Facebook	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 for the application through Gmail	I can register & access the dashboard with Gmail Login	Medium	Sprint-1
Customer (credential)	Login	USN-5	As a user, I can log into the application by entering email & password	I can access my account / dashboard	High	Sprint-1
	Dashboard	USN-6	Uploading data	I can be able to upload my dataset	High	Sprint 2
Customer (Web user)	Notification	USN-7	As a user when there is a critical situation regarding a gas explosion the alert notification will be received through GSM module	The alert message is sent to the owner's mobile as an SMS.	High	Sprint 2
Customer Care Executive	Network Connectivity	USN-8	When there is a gas leakage is detected in the surrounding	The sensor detects the leakage and notifies the owner via message	High	Sprint 3
Administrator	Accessing	USN-9	When there is an issue in accessing the device	Admin/Device operator's advice should be undertaken	High	Sprint 3
		USN-10	Asking Help / feedback	I can be able to ask help if I can face any issues or problems while using the webpage	Medium	Sprint 4
		USN-11	Managing the database	I can assure that my data is in secure state	High	Sprint 4
		USN-12	Managing the over all process	I can assure that my data and process is going good	High	Sprint 4

CHAPTER – 6

PROJECT PLANNING & SCHEDULING

The definition of a sprint is a dedicated period of time in which a set amount of work will be completed on a project. It's part of the agile methodology, and an Agile project will be broken down into a number of sprints, each sprint taking the project closer to completion.

6.1 Project Planning Phase:

Gas Leakage alarm systems are only effective if they can generate reliable and fast fire alerts with exact location of leakage of gas. There is a direct correlation between the amount of damage caused by gas leakage and interventions time in various gas leakage alarm systems. As the time of intervention decreases, the damage also decreases. Hence the most important factor in a Gas leakage alarm system is the reaction or response time of gas leakage alarm system, that is, the time between gas detection and knowing the exact the location.

6.2 Product Backlog, Sprint Schedule, and Estimation (USN 1-6):

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	Manusa K R Gopika S Sobiya Selsiya M Priyadharshini S
Sprint 1	Features	USN-2	As a system, the gas sensor values and the exact location of the detected gas should be sent.	2	Low	Manusa K R Gopika S Sobiya Selsiya M Priyadharshini S
Sprint 1	Features	USN-3	As a system, as soon as the detected gas reaches the threshold level, the red color LED should be turned ON.	5	High	Manusa K R Gopika S Sobiya Selsiya M Priyadharshini S
Sprint 1	Features	USN-4	As a system, as soon as the detected gas reaches the threshold level, the siren (alarm) should be turned ON.	5	High	Manusa K R Gopika S Sobiya Selsiya M Priyadharshini S
Sprint 2	Features	USN-5	As a system, the gas alarm should detect automatically when the gas leakage is held.	5	Medium	Manusa K R Gopika S Sobiya Selsiya M Priyadharshini S
Sprint 2	Features	USN-6	As a system, it will indicate the gas leakage and the exact location.	5	Medium	Manusa K R Gopika S Sobiya Selsiya M

6.3 Product Backlog, Sprint Schedule, and Estimation (USN 7-14):

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
						Aartisha S Naveen Karthick R
Sprint 2	Data transfer	USN-7	As a cloud system, it should send the data of the sensor values to the IBM cloud.	5	Low	Anitha K Kanimozhi J Aartisha S Naveen Karthick R
Sprint 2	Data transfer	USN -8	As a cloud system, the data's will be received in the IBM Watson IOT Platform.	5	Medium	Anitha K Kanimozhi J Aartisha S Naveen Karthick R
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	5	Medium	Anitha K Kanimozhi J Aartisha S Naveen Karthick R
Sprint 3	Data transfer	USN-10	As a cloud system, the IBM cloud should send the data to Node-red and the Node Red should Process the data from IBM cloud.	4	High	Anitha K Kanimozhi J Aartisha S Naveen Karthick R
Sprint 3	Data Transfer	USN-11	As a cloud system, the IBM Node Red should send the data to the dashboard	3	Medium	Anitha K Kanimozhi J Aartisha S Naveen Karthick R
Sprint 3	Dashboard	USN-12	As a user, I can access the dashboard and make use of available resources	4	Medium	Anitha K Kanimozhi J Aartisha S Naveen Karthick R
Sprint 3	Focus	USN-13	As a system, the dashboard must display location of the gas leakage.	4	High	Anitha K Kanimozhi J Aartisha S Naveen Karthick R
Sprint 4	Data transfer	USN-14	As a cloud system, the Node Red must send data to MIT app through API key	3	Medium	Anitha K Kanimozhi J Aartisha S Naveen Karthick R

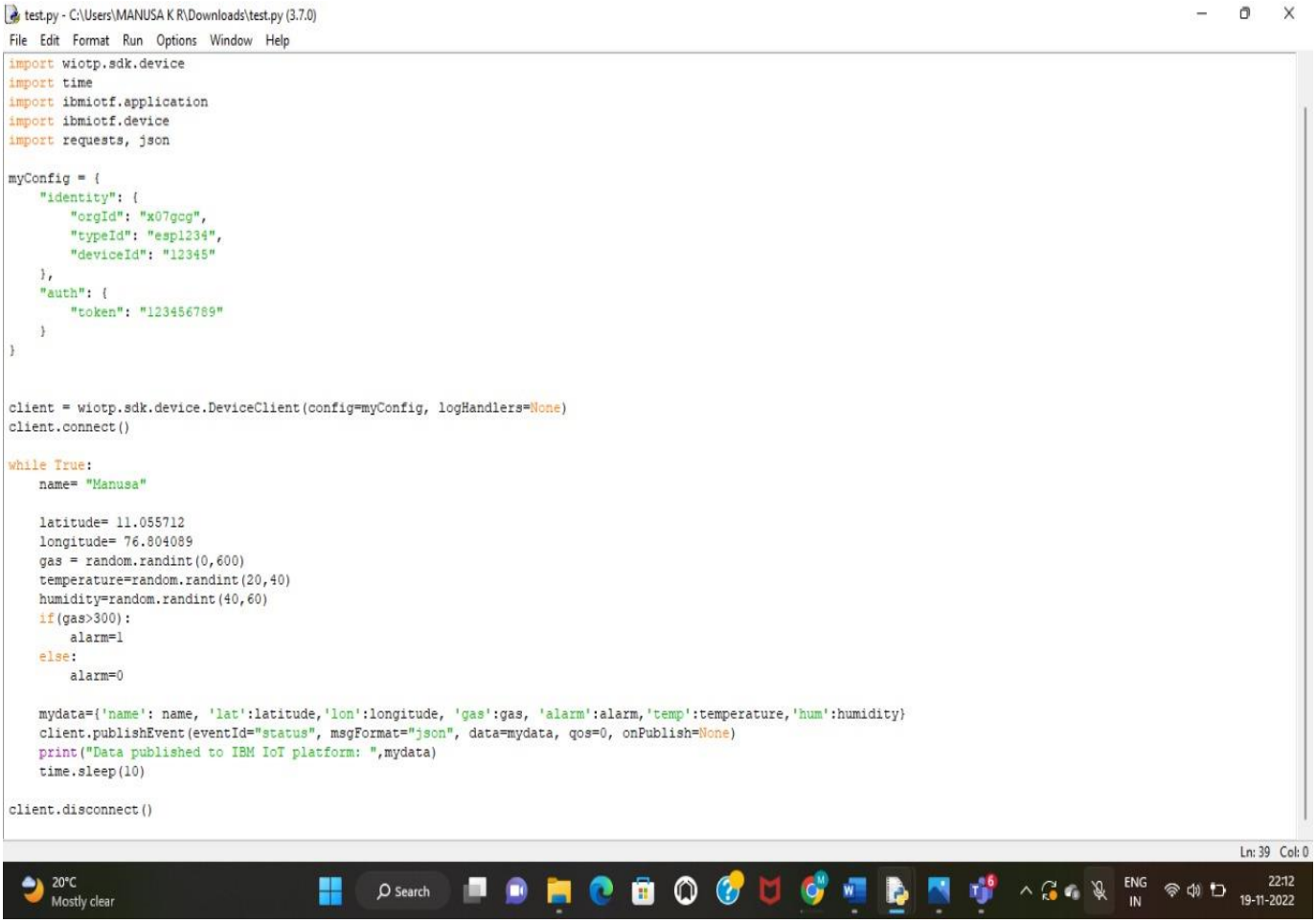
6.4 Sprint Delivery Schedule:

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

CHAPTER – 7

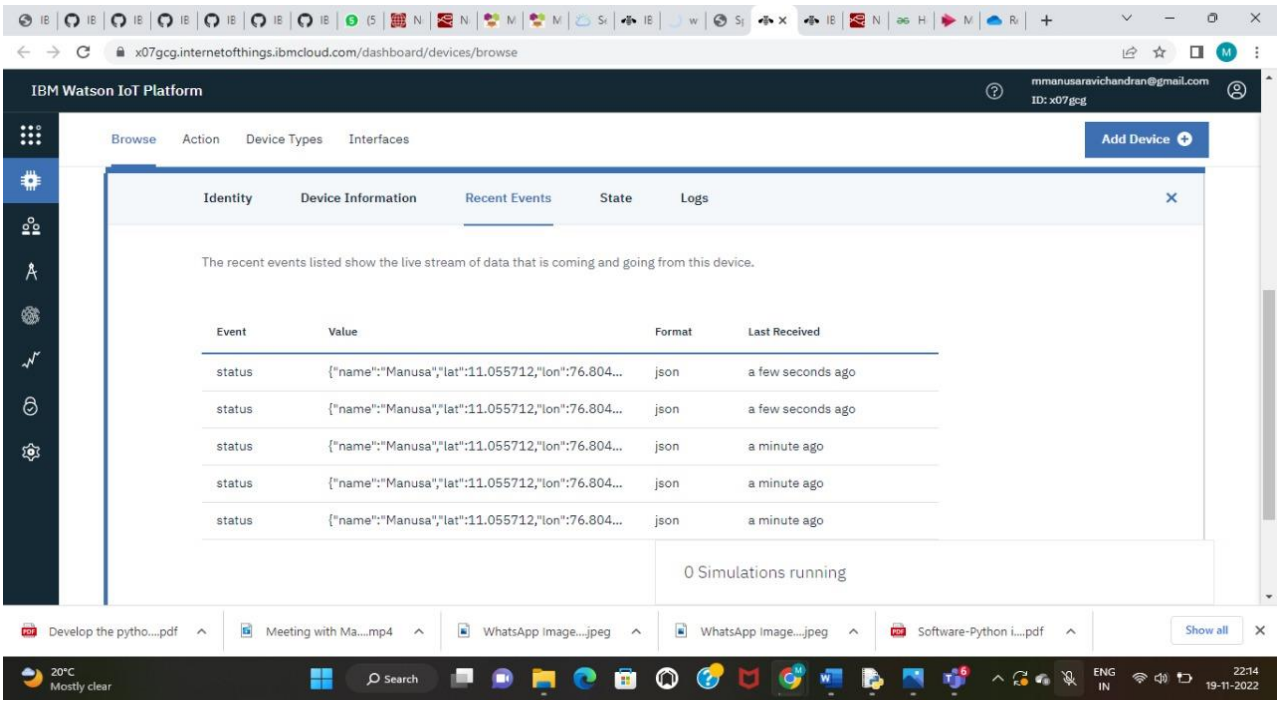
CODING & SOLUTIONING

7.1 Feature 1 (coding and result):

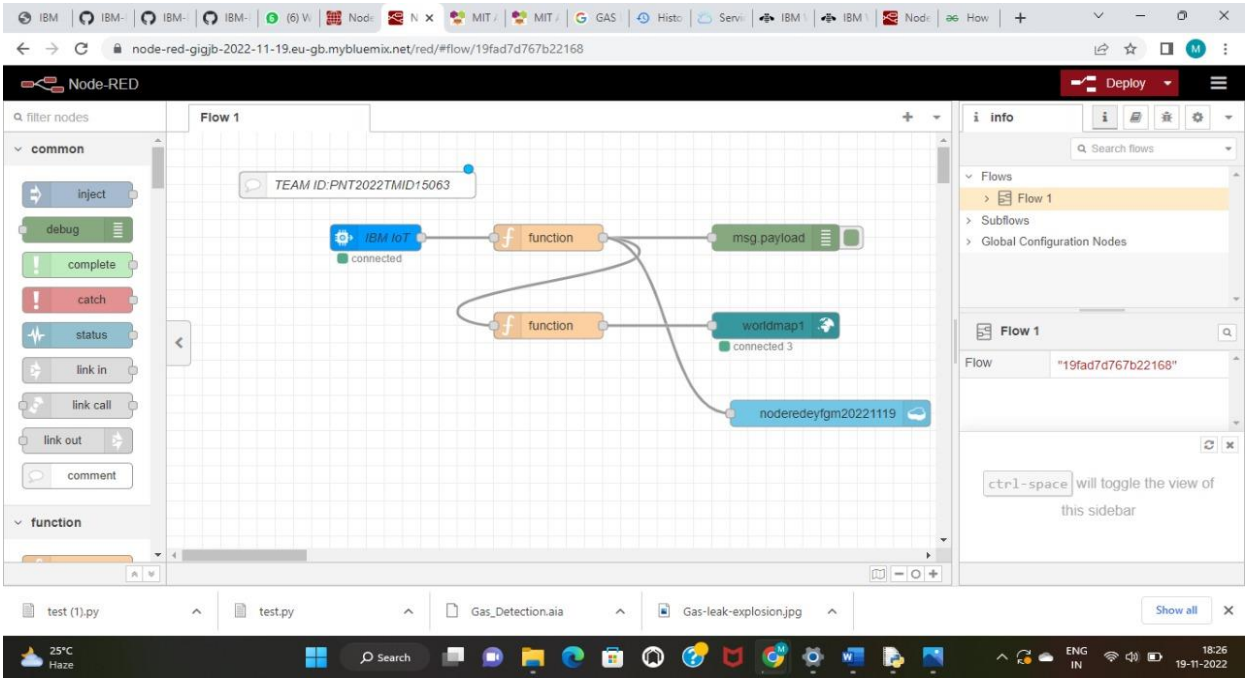


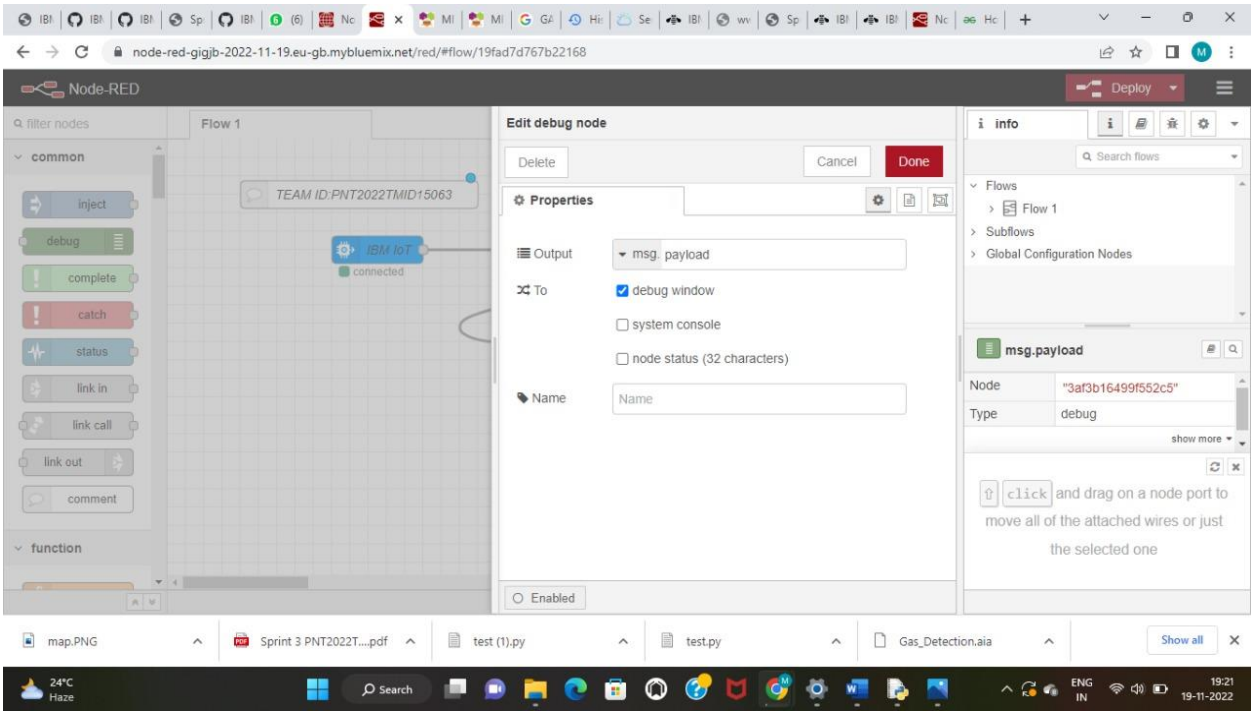
7.2 Feature 2

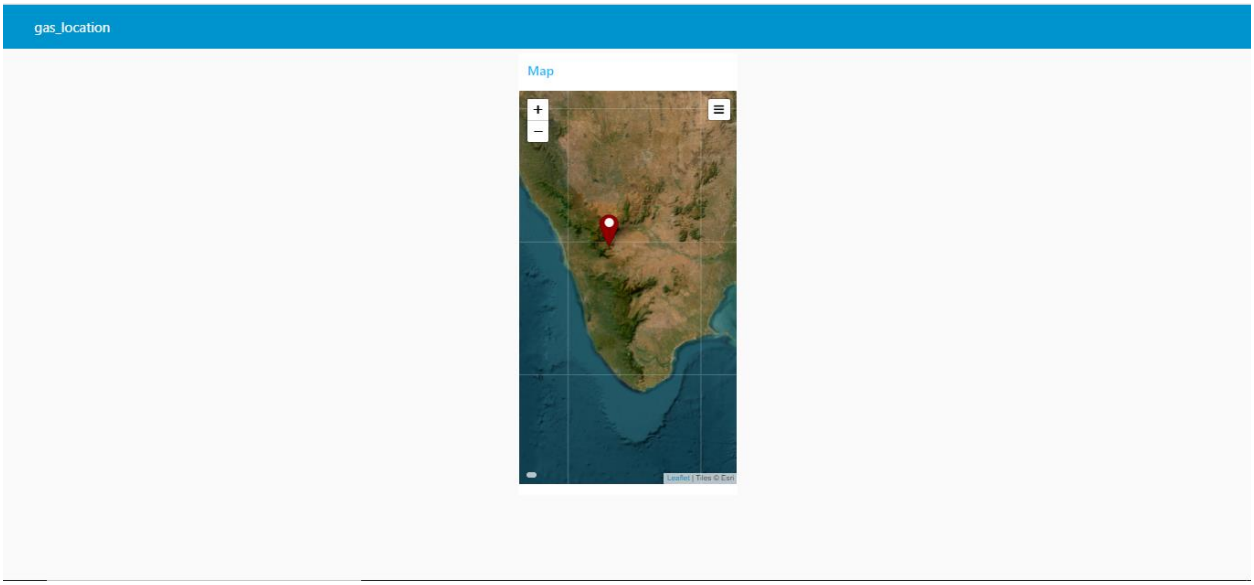
Watson IOT Platform



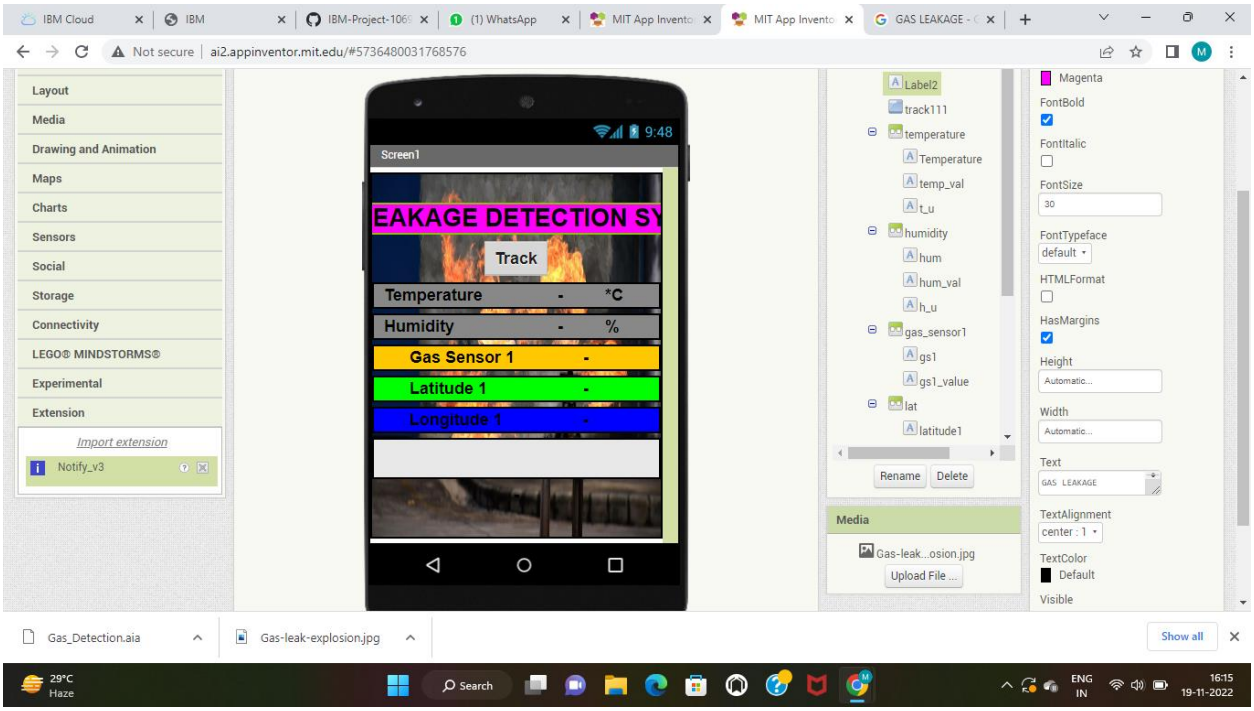
7.3 Feature 3 (Node-Red)




node-red-gigjb-2022-11-19.eu-gb.mybluemix.net/red/#flow/19fad7d767b22168
Node-RED
Deploy
Flow 1
common
inject
debug
complete
catch
status
link in
link call
link out
comment
function
TEAM ID:PNT2022TMID15063
IBM IoT
connected
Edit debug node
Delete
Cancel
Done
Properties
Output
msg. payload
To
debug window
system console
node status (32 characters)
Name
Name
Enabled
info
Search flows
Flows
Flow 1
Subflows
Global Configuration Nodes
msg.payload
Node
"3af3b16499f552c5"
Type
debug
show more
click and drag on a node port to move all of the attached wires or just the selected one
map.PNG
Sprint 3 PNT2022T....pdf
test (1).py
test.py
Gas_Detection.aia
Show all
24°C
Haze
Search
ENG
IN
19:21
19-11-2022


gas_location
Map
Leaflet | Tiles © Esri

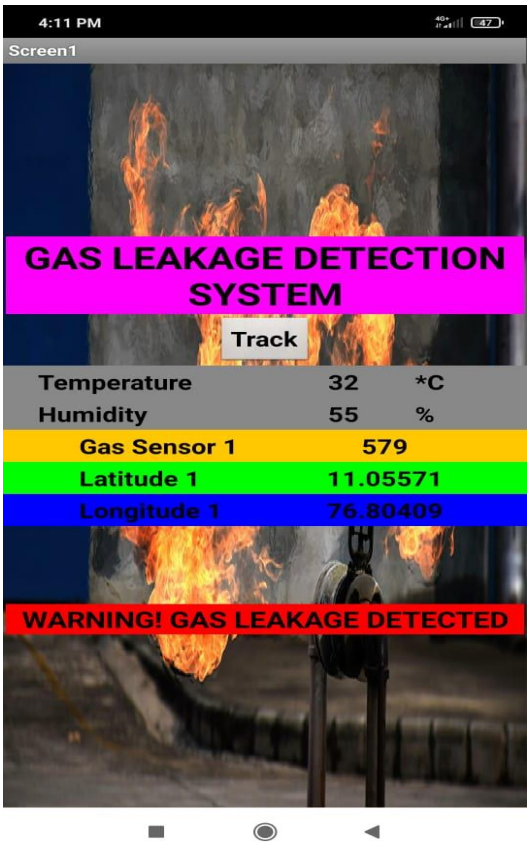
7.3 Feature 4 (MIT APP Inventor)

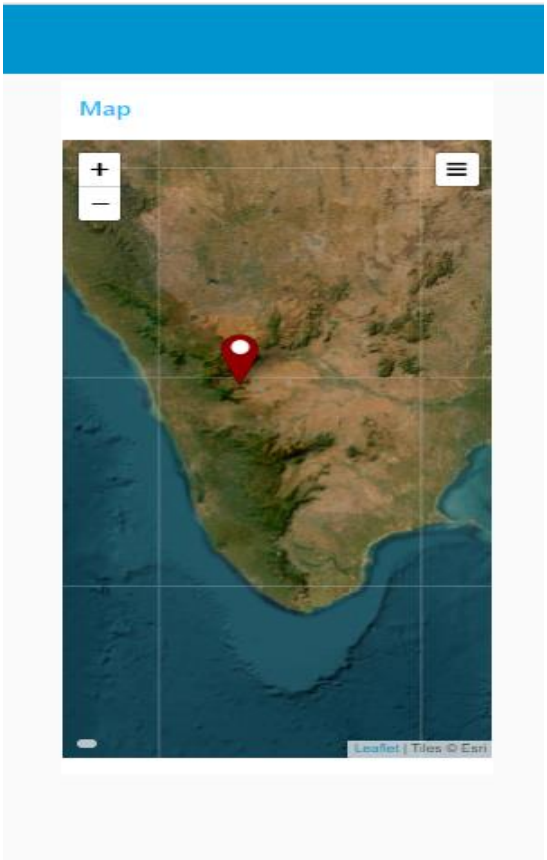


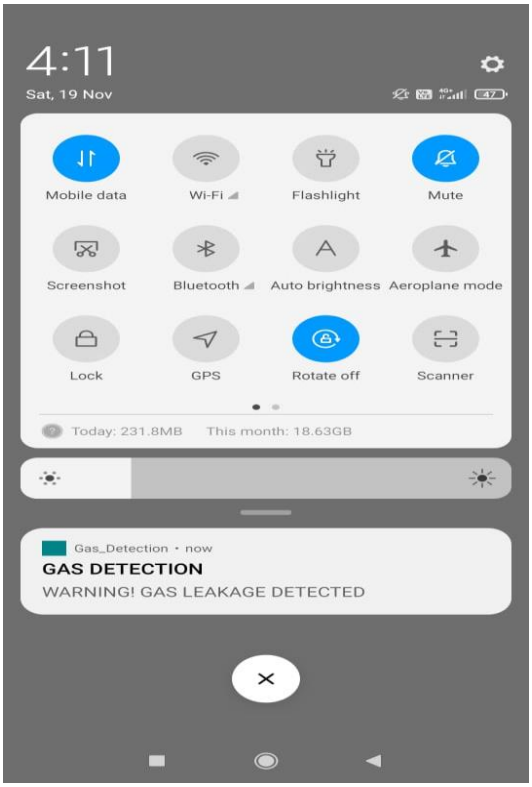
CHAPTER – 8

RESULTS

Measuring gas leakage is not easy and there are no simple answers to achieve this. The key to effective selection and measurement of gas leakage performance indicators is the quality of the performance standards and specifications that have been established. Performance indicators for reviewing overall performance can then be developed based on active and reactive measures that include: assessment of the degree of compliance with gas leakage detection system requirements identification of areas where the gas leakage detection system is absent or inadequate assessment of the achievement of specific objectives and plans within organizational policies and codes of practice gas and near miss data accompanied by analysis of immediate and underlying causes, trends and common features. In other words, the performance indicators should be answering questions in relation to where the organization stands in terms of aims and objectives and risk control, along with the effectiveness, reliability, efficiency and proportionality of the management system. Indicators should also be able to indicate whether performance is getting better or worse and how well the organizational culture is supporting implementation.


4:11 PM
Screen1
GAS LEAKAGE DETECTION SYSTEM
Track
Temperature 32 *C
Humidity 55 %
Gas Sensor 1 579
Latitude 1 11.05571
Longitude 1 76.80409
WARNING! GAS LEAKAGE DETECTED


Map
Leaflet | Tiles © Esri


4:11
Sat, 19 Nov
Mobile data
Wi-Fi
Flashlight
Mute
Screenshot
Bluetooth
Auto brightness
Aeroplane mode
Lock
GPS
Rotate off
Scanner
Today: 231.8MB
This month: 18.63GB
Gas_Detection • now
GAS DETECTION
WARNING! GAS LEAKAGE DETECTED

CHAPTER – 9

CONCLUSION

Gas leakage detection and alarm systems are only effective if they can generate reliable and fast gas leakage alerts with exact location of fire. There is a direct correlation between the amount of damage caused by gas leakage and interventions time in various gas leakage detection and alarm systems. As the time of intervention decreases, the damage also decreases. Hence the most important factor in a gas leakage detection and alarm system is the reaction or response time of gas leakage detection and alarm system, that is, the time between fire detection and knowing the exact location**.**