IoT Based Gas Leakage Monitoring and Alerting System for Industries

NALAIYA THIRAN PROJECT BASED LEARNING

on

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

Project Report Submitted by

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IN

ELECTRONICS AND COMMUNICATION ENGINEERING

ABSTRACT

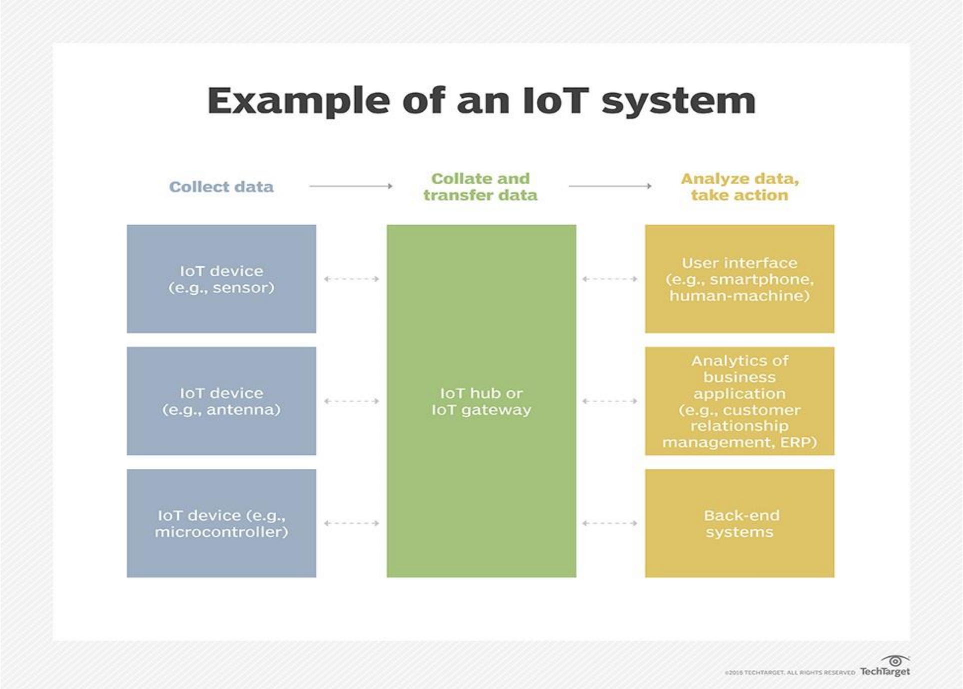
As we know in present era everything is based on digital technology. Gas leakage is a major problem in the industrial sector, residential premises, etc. Nowadays, home security has become a major issue because of increasing gas leakage. One of the preventive methods to stop accidents associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this project is to propose and discuss a design of a gas leakage detection system that can automatically detect, it aims in opening the windows and paves way for the gas to pass in open air when installed in residential area. This project helps the industries in monitoring the emission of harmful gases. In several areas, the gas sensors will be integrated to monitor the gas leakage. In the web application, admins can view the sensor parameters such as toxicity of the gas, temperature and humidity. If there is any gas leakage occurs inside the industry or at any residential area the surrounding people will be notified through a siren. Siren will alert the nearby locality people if the gas leak goes beyond a level. Our solution will be very helpful for the workers and the society which is associated or located nearby the industries. Our solution will prevent great disasters like Bhopal Gas Tragedy so that so many lives can be saved. Through this project the workers mental pressure will be reduced so that they can concentrate on other works or by relaxing them.

CONTENT

1. INTRODUCTION

Internet of Things (IoT) is a network of physical objects or people called “things” that are embedded with software, electronics, network, and sensors that allows these objects to collect and exchange data. The goal of IoT is to extend to internet connectivity from standard devices like computer, mobile, tablet to relatively dumb devices like a toaster. IoT makes virtually everything “smart,” by improving aspects of our life with the power of data collection, AI algorithm, and networks. The thing in IoT can also be a person with a diabetes monitor implant, an animal with tracking devices, etc.

How IoT works?


Example of an IoT system
Collect data
Collate and transfer data
Analyze data, take action
IoT device (e.g., sensor)
IoT device (e.g., antenna)
IoT device (e.g., microcontroller)
IoT hub or IoT gateway
User interface (e.g., smartphone, human-machine)
Analytics of business application (e.g., customer relationship management, ERP)
Back-end systems
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An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. **IoT devices** share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

1.1 PROJECT OVERVIEW

The presence of hazardous gas leakage in a domestic, work place, industries, also, stored gases container gas which exhibits ideal characteristic is use. For that sake, an alarm unit is used to vibrate an alarm which is buzzer. Buzzer gives an audible sign of the presence of gas volume. The sensors are widely used to detect essence of propane, iso-butane, LPG and even smoke. The sensor has an advantage to combine a sensitivity response time. If the gas sensor senses gas leak from work place, industries or home, sensor output goes to active low (logic-0) condition. The ESP32 module turns on the buzzer and controls the functionality of servo based upon the gas leak and temperature. The user can open the MIT application and can view the current status and values of gas leak, temperature and humidity.

PROJECT FLOW

- ✓ The GPS coordinates of the child will be sent to the IBM IoT platform.
- ✓ Location can be viewed in the Web Application.
- ✓ A parent can create a geofence in the web application.
- ✓ The web application will check if the child is inside or outside the geofence.
- ✓ Notifies the parents if the child goes out of the geofence.

To accomplish this, we have to complete all the activities and tasks listed below:

- ✓ Create and configure IBM Cloud Services
  - ii. Create IBM Watson IoT Platform
  - iii. Create a device & configure the IBM IoT Platform
  - iv. Create Node-RED service
  - v. Create a database in Cloudant DB to store location data
- ✓ Develop a web Application using Node-RED Service.
  - vii. Develop the web application using Node-RED.
  - viii. Integrate the geofence & google map.
- ✓ Develop a python script to publish the location details to the IBM IoT platform.

1.2 PURPOSE

Child tracker helps the parents in continuously monitoring the child's location. They can simply leave their children in school or parks and create a geofence around the particular location. By continuously checking the child's location notifications will be generated if the child crosses the geofence. Notifications will be sent according to the child's location to their parents or caretakers. The entire location data will be stored in database.

2. LITERATURE SURVEY

2.1 & 2.2 Existing problem and Referance

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.

LPG leakages are a mutual hindrance in household and manufacturing nowadays. It is very life threatening if you will not distinguish and modified right away. The idea behind our project is to give a solution by power cut the gas provision as soon as a gas leakage is perceived apart from activating the sounding alarm. In addition to this, the authorized person will receive a message informing him about the leakage.

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.

This paper fundamentally manages the advancement of a straightforward gas spill locator at the underlying stage and after that changing this basic gadget into a most progressive gas identifier framework later on. Gas sensors have been specifically utilized which has high affectability for propane (C3H8) and butane (C4H10). Gas leakage system consists of GSM (Worldwide System for versatile communication) module, which sends SMS as soon as gas leakage is detected. Keywords: Arduino, MQ-6 Gas Sensor, LCD, LPG, Stepper.

Dr. Chetana Tukkoji, Mr. Sanjeev Kumar, “Review paper on- LPG Gas leakage detection using IOT”: IJEAST - International Journal of Engineering Applied Science & Technology, Vol 4, Issue 12, April 2020 IJEAST (online): 603-609.

This paper provides a brand new approach to discover LPG discharge supported microcontroller based Arduino. To alert on Liquefied rock oil Gas (LPG) leakage and preventing any unwanted incident, we need to apply some cautions to discover the discharge. It can be developed associate degree Arduino based LPG gas detector alarm, if gas leakage happens. The LPG detector MQ 6 is associate degree correct LPG sensing device that acquires the signal intensity. Associate degree economical Arduino based signal process mechanism is followed that effectively quantizes the noninheritable electrical signal. The intensity of the LPG leakage is classed into 3 categories, such as LOW, MEDIUM and HIGH based on square measure. This paper conjointly shows the ratio and temperature over the alphanumeric display. The importance and connection of the paper is very beneficiary for man as a result of it's a vital caution for our domestic life.

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, pp no. 6142-6146.

This paper presents an industrial monitoring system design using the Internet of Things (IoT). The gas sensor (MQ-5) captured information is posted into a data cloud. The sensor detects the leakage of gas under most atmospheric conditions. All the components are controlled by an Arduino (UNO-1) that acts as a central processor unit in the setup t. As soon as a gas leakage is detected by the sensor, the alarm is raised in the form of a buzzer. This alarm is supported by an LCD to display the location of leakage.

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.

The objective of this project is to present the design of a automatic alarming system, which can detect and prevent liquefied petroleum gas leakage in various premises. This system alerts the user by sending him a phone call and alerting the neighbors by buzzer alarm after the gas leaks above setpoint1.The servo motor is used to close the gas pipe valves. This device ensures safety and prevents suffocation and explosion due to gas leakage. This project is implemented using Arduino uno and simulated using Arduino ide and proteus software.

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 no. 002-006, February 2021.

Gas leakages are causing massive explosions in places throughout the world. The conventionally available gas leakage detectors only have the provision to alarm the user who is physically present at the spot. Hence, to overcome this limitation, this project implements a model which sends an email to the user in case there is a leakage. This model detects the leakage of Liquid Petroleum Gas & Benzene. The prototype of this model generates an email to the concerned person using IFTTT web service. An LED is also used as a visual alarm at the site of leakage.

Merits:

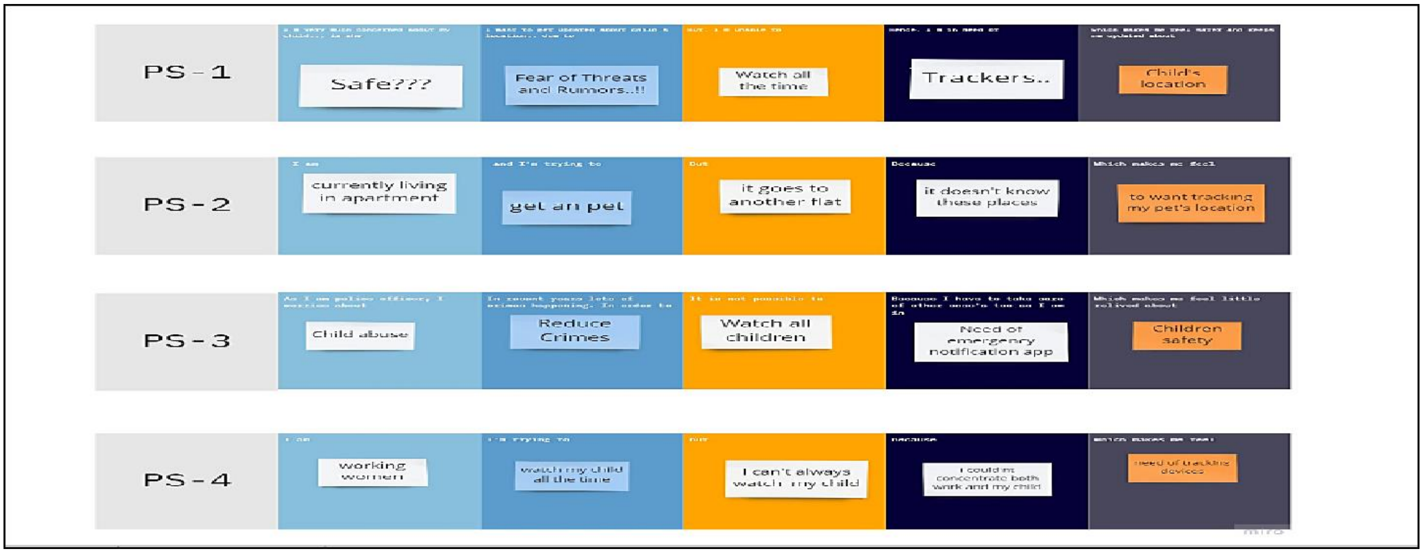
IOT based gas leakage monitoring and alerting system helps

in knowing the level of gas and buzzer indicates the leakage.

Demerit: Any circuitry fault may lead to failure in the

system.

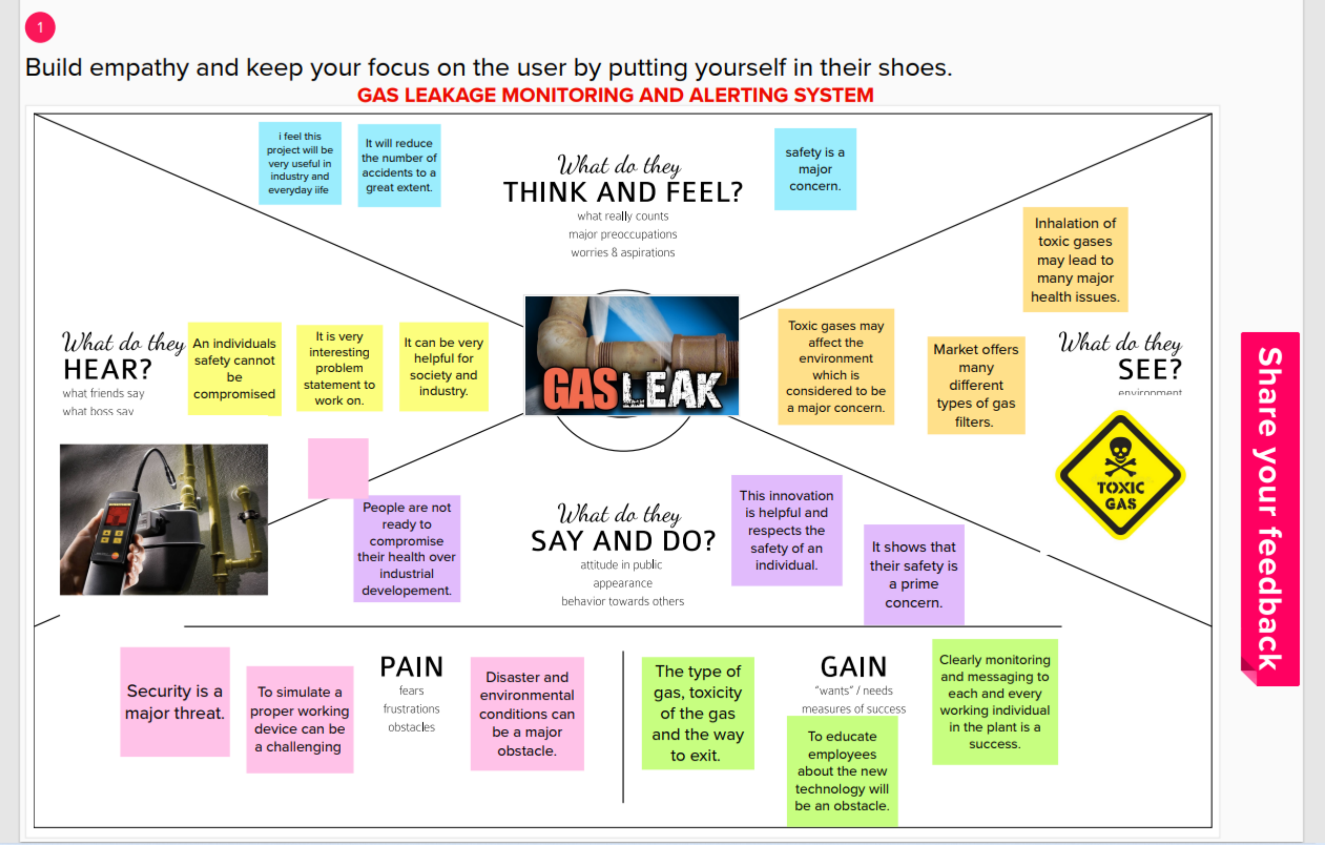
2.3 Problem Statement Definition



PS - 1	I m very much concerned about my child... is she Safe???	I want to get updated about child's location.. due to Fear of Threats and Rumors..!!	But, I m unable to Watch all the time	Hence, I m in need of Trackers..	Which makes me feel safer and [illegible] me updated about Child's location
PS - 2	I am currently living in apartment	and I'm trying to get an pet	But it goes to another flat	Because it doesn't know these places	Which makes me feel to want tracking my pet's location
PS - 3	As I am police officer, I worried about Child abuse	In recent years lots of crimes happening. In order to Reduce Crimes	It is not possible to Watch all children	Because I have to take care of other one's too as I am in Need of emergency notification app	Which makes me feel little relived about Children safety
PS - 4	I am working women	I'm trying to watch my child all the time	But I can't always watch my child	Because I couldn't concentrate both work and my child	Which makes me feel need of tracking devices

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



1

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

GAS LEAKAGE MONITORING AND ALERTING SYSTEM

What do they THINK AND FEEL?

what really counts
major preoccupations
worries & aspirations

i feel this project will be very useful in industry and everyday life

It will reduce the number of accidents to a great extent.

safety is a major concern.

Inhalation of toxic gases may lead to many major health issues.

What do they HEAR?

what friends say
what boss say

An individuals safety cannot be compromised

It is very interesting problem statement to work on.

It can be very helpful for society and industry.

What do they SEE?

environment

Toxic gases may affect the environment which is considered to be a major concern.

Market offers many different types of gas filters.

What do they SAY AND DO?

attitude in public
appearance
behavior towards others

People are not ready to compromise their health over industrial developement.

This innovation is helpful and respects the safety of an individual.

It shows that their safety is a prime concern.

PAIN

fears
frustrations
obstacles

Security is a major threat.

To simulate a proper working device can be a challenging

Disaster and environmental conditions can be a major obstacle.

GAIN

"wants" / needs
measures of success

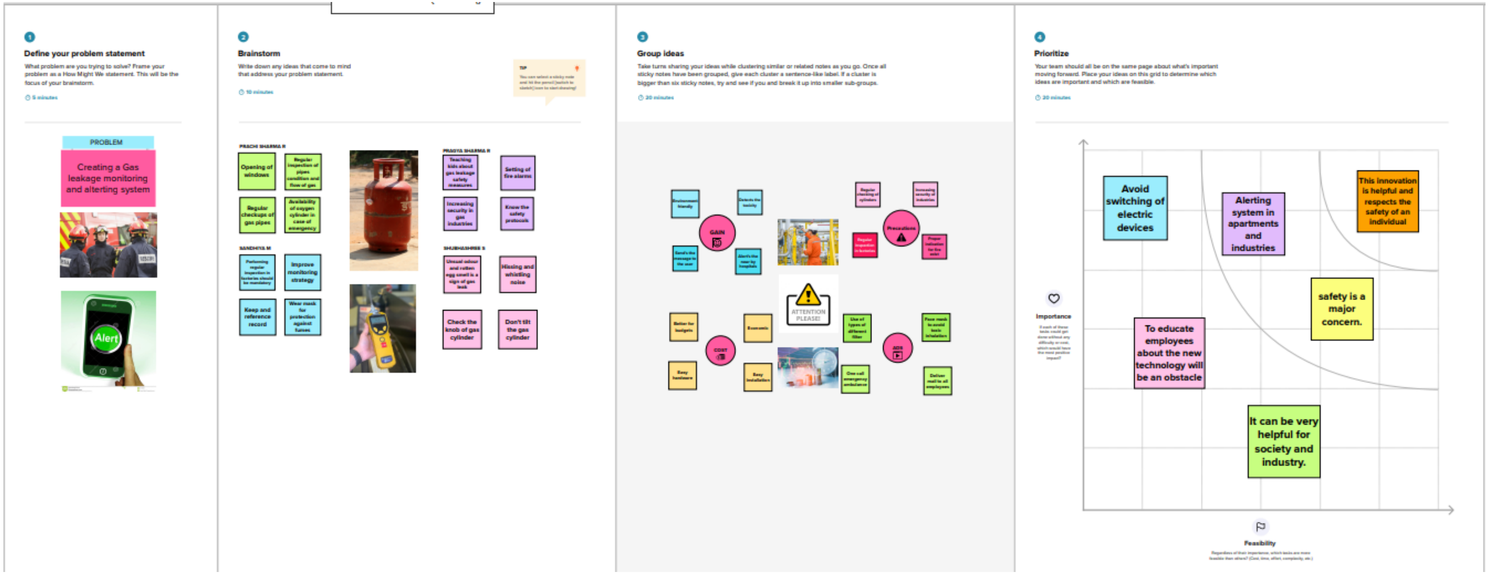
The type of gas, toxicity of the gas and the way to exit.

To educate employees about the new technology will be an obstacle.

Clearly monitoring and messaging to each and every working individual in the plant is a success.

Share your feedback

3.2 Ideation & Brainstorming



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

Creating a Gas leakage monitoring and alterting system

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!

PRACHI SHARMA R

Opening of windows

Regular inspection of pipes condition and flow of gas

Regular checkups of gas pipes

Availability of oxygen cylinder in case of emergency

SANDHIYA M

Performing regular inspection in factories should be mandatory

Improve monitoring strategy

Keep and reference record

Wear mask for protection against fumes

PRAGYA SHARMA R

Teaching kids about gas leakage safety measures

Setting of fire alarms

Increasing security in gas industries

Know the safety protocols

SHUBHASHREE S

Unusal odour and rotten egg smell is a sign of gas leak

Hissing and whistling noise

Check the knob of gas cylinder

Don't tilt the gas cylinder

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, 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

GAIN

Environment friendly

Detects the toxicity

Send's the message to the user

Alert's the user by hospitals

Precautions

Regular checking of cylinders

Increasing security of industries

Regular inspection in factories

Proper indication for fire exist

COST

Better for budgets

Economic

Easy hardware

Easy installation

ADS

Use of types of different filter

Face mask to avoid toxic inhalation

One call emergency ambulance

Deliver mail to all employees

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

Importance

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

Avoid switching of electric devices

Alerting system in apartments and industries

This innovation is helpful and respects the safety of an individual

safety is a major concern.

To educate employees about the new technology will be an obstacle

It can be very helpful for society and industry.

3.3 Proposed Solution

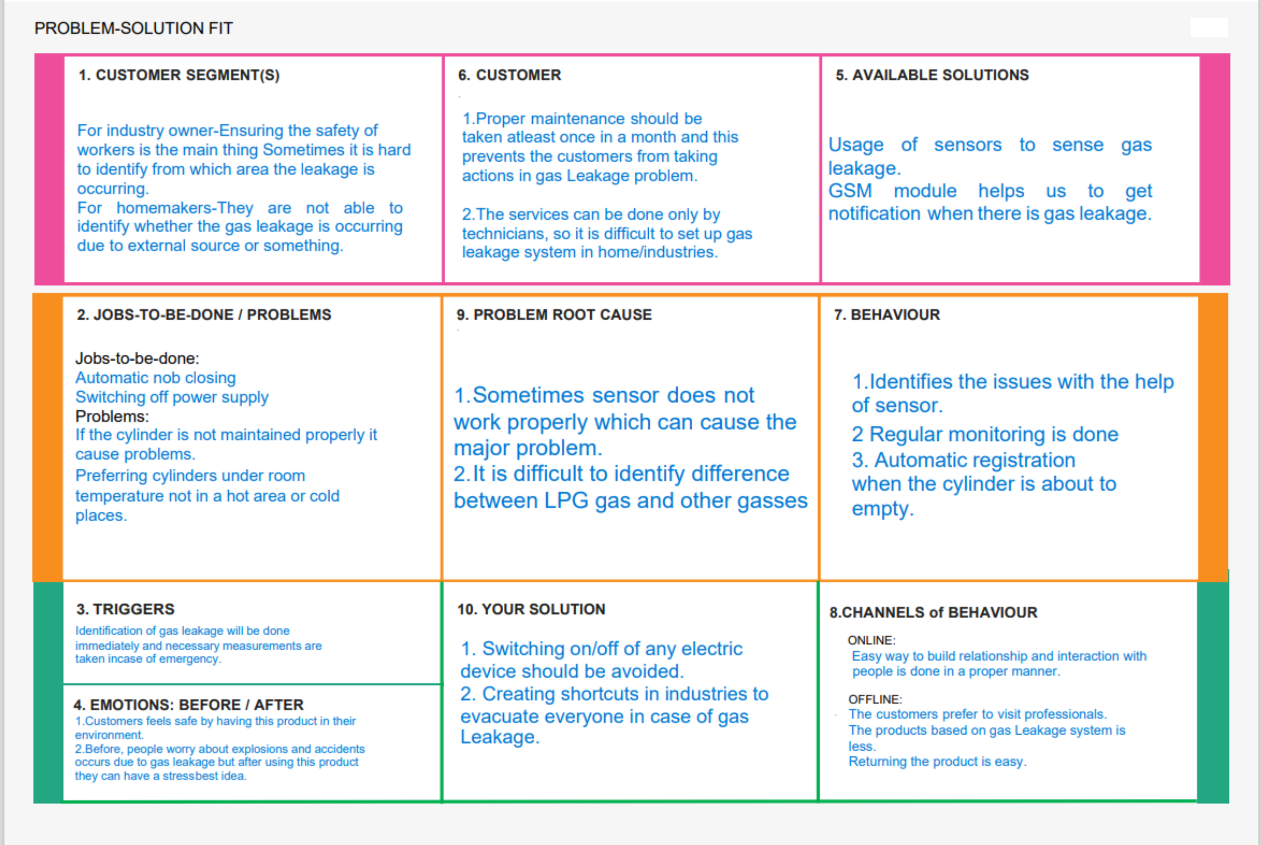
S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Gas leakage is a major problem in the industrial sector, residential premises, etc. Nowadays, home security has become a major issue because of increasing gas leakage. One of the preventive methods to stop accidents associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this project is to propose and discuss a design of a gas leakage detection system that can automatically detect, it aims in alerting the nearby hospitals and has ability to send message to the emergency service like ambulance.
2.	Idea / Solution description	• If there is any gas leakage occurs inside the industry or at any residential area the surrounding people will be notified through a siren. • The gas leakage will be indicated by the LED lights. • To detect the different harmful gases like methane, hydrogen sulphide, LPG, carbon monoxide etc., by using the required sensors. • 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. • In each and every unit of the industry gas sensors will be attached in specified area so as to detect the gas leakage which can be

		detected through LED's which is monitored in the security and altering room.
3.	Novelty / Uniqueness	• Our solution not only notify the industry person but also notify the near by hospitals and ambulances through IBM cloud. • Low latency • Location of leakage can be noted through LED's • The position of the LED displays is placed on the conspicuous part • It has the ability to detect various type of gases, not just of single type. Hence the system makes more efficient.
4.	Social Impact / Customer Satisfaction	Our solution will be very helpful for the workers and the society which is associated or located nearby the industries. Our solution will prevent great disasters like Bhopal Gas Tragedy so that so many lives can be saved. Through this project the workers mental pressure will be reduced so that they can concentrate on other works or by relaxing them.
5.	Business Model (Revenue Model)	• The main target of our solution is Industries and domestic areas so we have planned to visit industries and educate people through social media platforms and explain them about the usage and benefits of our products. • A efficient business

		model can be achieved by providing services to various industries and houses and also upgrading the model time to time through which a great profit can be achieved. • The pickup line for the product can” Live’s matter the most”
6.	Scalability of the Solution	Safety being the major concern, it will reduce the risk of major mishap in every area of gas usage. It will send timely message to user and ambulance service, hence reduce the risk of explosion. People are not ready to compromise their health over industrial development and hence this innovation is helpful and respects the safety of an individual.

3.4 Problem Solution

Purpose: To create IOT based gas leakage monitoring and alerting system for industries



PROBLEM-SOLUTION FIT

1. CUSTOMER SEGMENT(S)

For industry owner-Ensuring the safety of workers is the main thing Sometimes it is hard to identify from which area the leakage is occurring.
For homemakers-They are not able to identify whether the gas leakage is occurring due to external source or something.

6. CUSTOMER

1.Proper maintenance should be taken atleast once in a month and this prevents the customers from taking actions in gas Leakage problem.

2.The services can be done only by technicians, so it is difficult to set up gas leakage system in home/industries.

5. AVAILABLE SOLUTIONS

Usage of sensors to sense gas leakage.
GSM module helps us to get notification when there is gas leakage.

2. JOBS-TO-BE-DONE / PROBLEMS

Jobs-to-be-done:
Automatic nob closing
Switching off power supply
Problems:
If the cylinder is not maintained properly it cause problems.
Preferring cylinders under room temperature not in a hot area or cold places.

9. PROBLEM ROOT CAUSE

1.Sometimes sensor does not work properly which can cause the major problem.
2.It is difficult to identify difference between LPG gas and other gasses

7. BEHAVIOUR

1.Identifies the issues with the help of sensor.
2 Regular monitoring is done
3. Automatic registration when the cylinder is about to empty.

3. TRIGGERS

Identification of gas leakage will be done immediately and necessary measurements are taken incase of emergency.

4. EMOTIONS: BEFORE / AFTER

1.Customers feels safe by having this product in their environment.
2.Before, people worry about explosions and accidents occurs due to gas leakage but after using this product they can have a stressbest idea.

10. YOUR SOLUTION

1. Switching on/off of any electric device should be avoided.
2. Creating shortcuts in industries to evacuate everyone in case of gas Leakage.

8.CHANNELS of BEHAVIOUR

ONLINE:
Easy way to build relationship and interaction with people is done in a proper manner.

OFFLINE:
The customers prefer to visit professionals.
The products based on gas Leakage system is less.
Returning the product is easy.

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	The system shall support registration through forms. The system shall provide a quick and secure registration process. The system shall support online payment for the service.
FR-2	User Access	The system shall allow access to the details using a web browser. The system shall allow access to the details using mobile applications too.

4.2 Non-Functional requirements

NFR NO	Non-functional Requirements	Description
NFR-1	Usability	The device must be usable by the customer anywhere. The device must be usable by the customer anytime.
NFR-2	Security	Data from the sensors are stored securely and away from other data. Only authorized people can access the data stored.
NFR-3	Reliability	Data can be retrieved anytime. No data is discarded without the customer's knowledge.
NFR-4	Performance	• The system should not have any type of delay in its performance as it is used for emergency situations. • No performance delay in case of large number of data or parameters.

NFR-5	Availability	The device does not fail even under harsh conditions. Even after going under an alert situation, the device continues to send the parameters.
NFR-6	Scalability	Device must be capable of measuring conditions even in larger industry .

5. PROJECT DESIGN

5.1 Data Flow Diagrams

✓

FLOWS:

1. Connecting IoT devices to the Watson IoT platform and exchanging the sensor data.

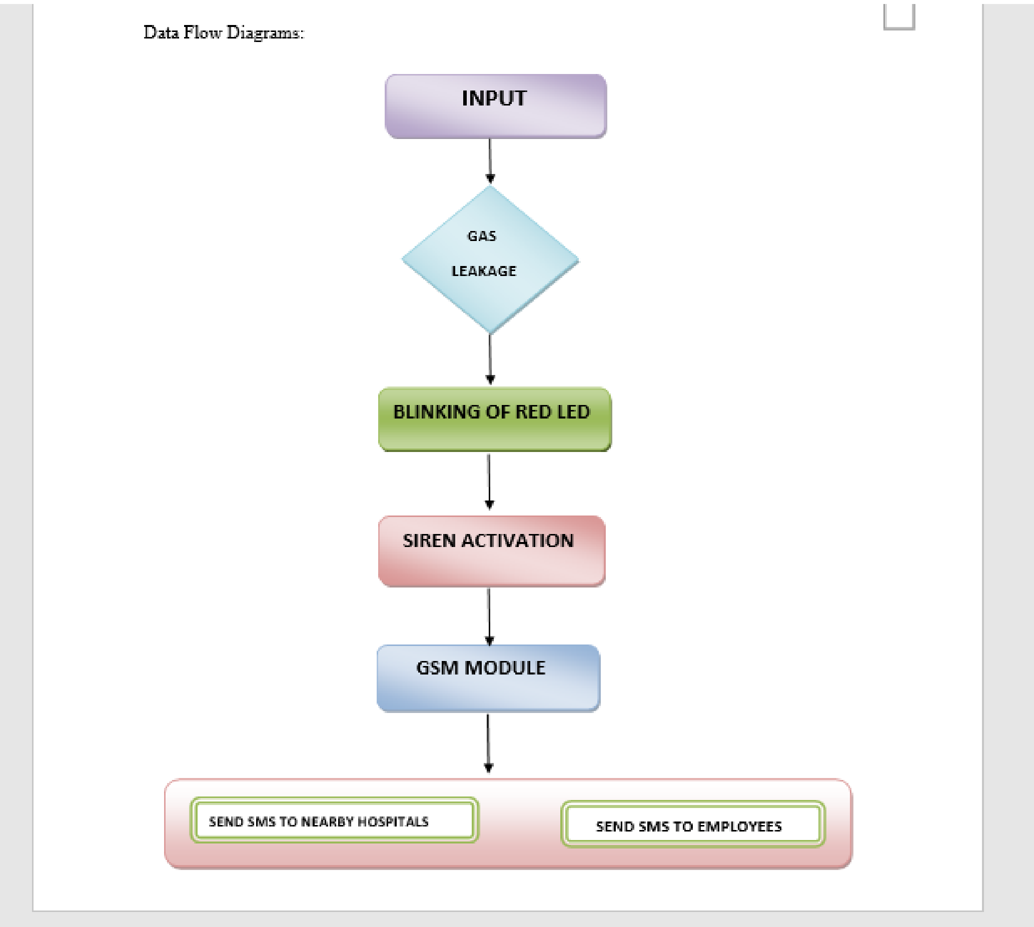
2. The sensor parameters are recorded and sent to the IBM IoT platform

3. IBM platform records these parameters and sends message to user saying gas leak is detected.

4. Develop a web Application using Node-RED Service.

5. The web application will check if the parameters is within safe levels.

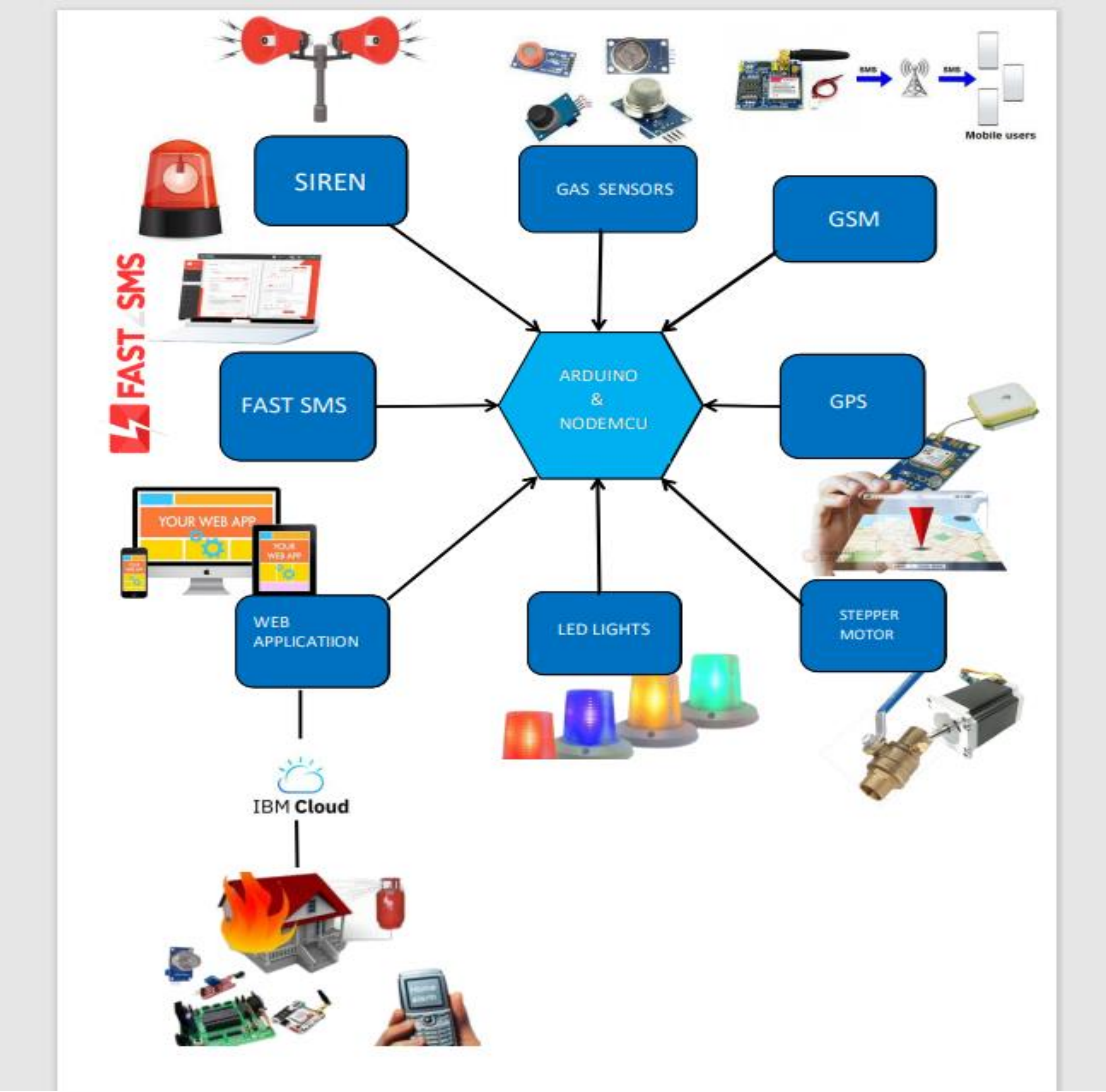
6. Notifies and alerts the user and ambulance about gas leak.



Data Flow Diagrams:

5.2 Solution & Technical Architecture

SOLUTION ARCHITECTURE:



Solution Architecture

Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud/Big Data Analytics)
3. Indicate external interfaces (third party API’s etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models
6. Android application

TECHNICAL ARCHITECTURE:

Technical Architecture:

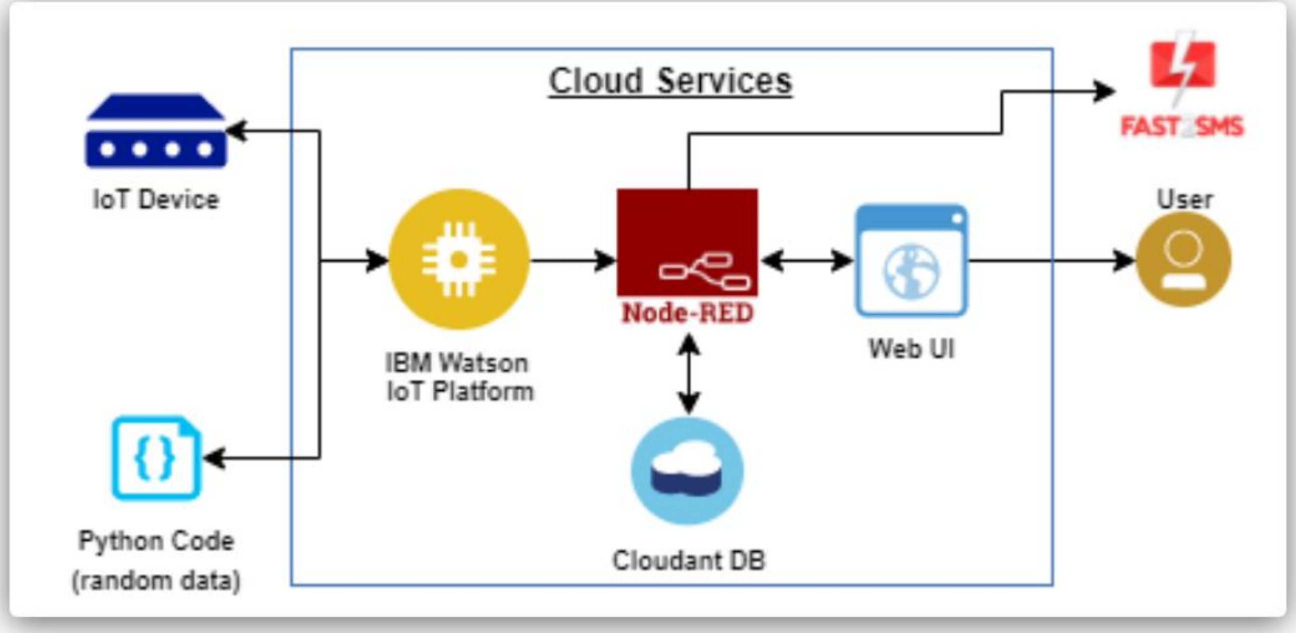


Table-1 :

Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g., Web UI, Mobile App etc.	node JS
2.	ESP with WIFI module	This detects the flow and depletion of gas by using the MQ-2, GP2D129 sensor	Python
3.	ARM7 Processor	The system detects the load cell sensor for measuring the gas present in the cylinder.	IBM Watson IoT Platform
4.	Application -3	It assists the IoT Platform	IBM Watson Assistant
5.	Database	Data Configuration & Types	MySQL, etc
6.	Cloud Database	Database Service on Cloud	Machine learning, DBaas, etc,.
7.	File Storage	File storage requirements	IBM Block Data Storage
8.	External API-1	Connect the device to the IoT platform	IBM Device API
9.	External API-2	Connect the node-RED services	Location API
10.	Machine Learning Model	It uses past behaviour to identify patterns and builds models that help predict future behaviour and events	Using program condition loop
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Wireless local Server Cloud Server Configuration : IBM Cloud Server	Cloud Foundry

Table-2:

Application Characteristics:

S.No	Characteristics	Description	Technology

1.	Open-Source Frameworks	Sensors, software applications & Cloud application	Open connectivity foundation
2.	Security Implementations	The technology segments focused on safeguarding connected devices and networks in the IoT	Encryptions, monitor traffic congestion, using admin, device authentication
3.	Scalable Architecture	If the communication stack from the end devices to the cloud is made asynchronous, so that load times are cut down	Agile methodology, IBM architecture
4.	Availability	Detection of combustible, flammable and poisonous gases and for loss of oxygen, and to detected a gas leak or other pollutants. It makes the area where the leak occurs a warning sound and instructs operators to leave the area	client server, server service, GPS System
5.	Performance	The sensors are widely used to detect essence of propane, iso-butane, LPG and even smoke.	Bandwidth, Latency(Delay), Throughput, Jitter, Bandwidth- Delay Product.

5.3 User Stories

User Type	Functional Requirement	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-4
		USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive confirmation email & get confirmed	High	Sprint-4

		USN-3	As a user, I can register for the application through browser	I can register & access the dashboard with Google Sign in	Low	Sprint-4
		USN-4	As a user, I can register for the application through Gmail	---	Medium	Sprint-4
	Login	USN-5	As a user, I can log into the application by entering email & password	---	High	Sprint-4
	Dashboard	USN-6	As a user,I can see the desired information on the screen of the phone	I can access my screen	High	Sprint-2
Customer (Web user)	Users	USN-1	As a user, I can integrate all users in this account	I can configure the account, active and inactive	Medium	Sprint-2
	Web applicator	USN-2	As a web applicator, I can form backend server	I can progress the code in the server	Medium	Sprint 3
Customer Care Executive	Security	USN-1	As a customer care, I can secure the data in cloud database	I can secure the data location	High	Sprint-3
Administrator		USN-1	As a user,I can manage the application	I can configure the settings their account.	Medium	Sprint-3
Devices	Simulation	USN-1	As a user, I can connect the required parameter in device.	I can deliver the product	High	Sprint-1
		USN-2	As a user, I can activate the device	I can applicable to the child devices	Medium	Sprint-1
Message Sender	API requests	USN-1	As a message sender, API requests whenever some function is invoked from a device.	I can send or receive the from an application.	High	Sprint-2

	Fast SMS	USN-2	As a sender, I can send bulk messages using the SMS	I can receive the messages in device	Low	Sprint-3
Programmer	Software	USN-1	As a programmer, I can create the user-friendly program for ease access by parents	To configure the devices	High	Sprint-2
		USN-2	As a software, I compute coding in	To simultaneously run the device	High	Sprint-2
			devices			
Authenticator	User	USN-1	As a user, I can use identification technique in IoT device	I can eminent the security	High	Sprint-3
	Open Authorization	USN-2	As a user, I use an open standard communication protocol	It provides tokens to the end users	Medium	Sprint-3
	Identifier	USN-3	User successfully register into the system	It stores the user's unique identification	Medium	Sprint-2
Admin	Admin Authorities	USN-1	In this other end-user are restricted	to add devices into the system	Low	Sprint-4
	User	USN-1	As a user, I can create organizations	The user to login to IoT Platform	High	Sprint-2
		USN-2	As a user, I allow admin to create & edit user accounts	For assigning access rights to user or device group	Medium	Sprint-2
		USN-2	As a software, I compute coding in devices	To simultaneously run the device	High	Sprint-2

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Product backlog, Sprint Schedule, Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members

Sprint- 1	Simulation	USN-1	As a user, I can install online simulator	1	medium	Shubhashree S
Sprint- 1		USN-2	As a user, I can connect the required parameters in device	1	high	Sandhiya M
Sprint- 1		USN-3	As a user, I can activate the device	2	medium	Pragya Sharma R
Sprint- 1		USN-4	As a user, I will write the code in this stimulation	3	high	Prachi Sharma R
Sprint- 1		USN-5	As a user, I can run the program to check whether the error is present or not.	5	high	Prachi Sharma R
Sprint- 2	Cloud	USN-1	As a user, I create a cloud server	2	medium	Sandhiya M
Sprint- 2		USN-2	As a user, I can enter the device specification in the created cloud	2	medium	Shubhashree S
Sprint- 2		USN-3	As a user, I can integrate device into this cloud.	3	high	Pragya Sharma R
Sprint- 2		USN-4	As a user, I can connect device through Wi-Fi to the cloud.	5	high	Prachi Sharma R
Sprint- 3	Programming Tool	USN-1	As a programmer, I can provide a browser-based editor.	2	low	Pragya Sharma R

Sprint- 3		USN-2	As an editor, I can easy to wire together flows using the wide range of nodes in the palette.	3	medium	Sandhiya M
Sprint- 3		USN-3	I can be deployed to its runtime in a single click.	5	high	Shubhashree S
Sprint- 3	Platform	USN-1	As a programmer, I can use Node.js platform.	3	medium	Prachi Sharma R
Sprint- 3		USN-2	As a user, I can integrate the geofence nodes in the	3	high	Shubhashree S
			palette.			
Sprint- 3		USN-3	As a programmer, I can communicate through HTTP to the tool.	2	medium	Sandhiya M
Sprint- 4	API	USN-1	As a user, I can generate API tokens through cloud.	3	medium	Prachi Sharma R
Sprint- 4		USN-2	As a user, I use API keys to integrate the programming tool.	3	medium	Pragya Sharma R
Sprint- 4		USN-3	As a user, I can register SMS services.	2	high	Shubhashree S
Sprint- 4	SMS	USN-1	As a user, I can send messages through API to the client number.	2	high	Sandhiya M
Sprint- 4		USN-2	As a user, I can receive messages through inform of SMS.	2	high	Prachi Sharma R

6.2 Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart

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	12	6 Days	24 Oct 2022	29 Oct 2022	12	29 Oct 2022
Sprint-2	12	6 Days	31 Oct 2022	05 Nov 2022	12	31 Oct 2022
Sprint-3	18	6 Days	07 Nov 2022	12 Nov 2022	18	12 Nov 2022
Sprint-4	12	6 Days	14 Nov 2022	19 Nov 2022	12	19 Nov 2022

Velocity:

AV for sprint-1 = 12/6 = 2 points

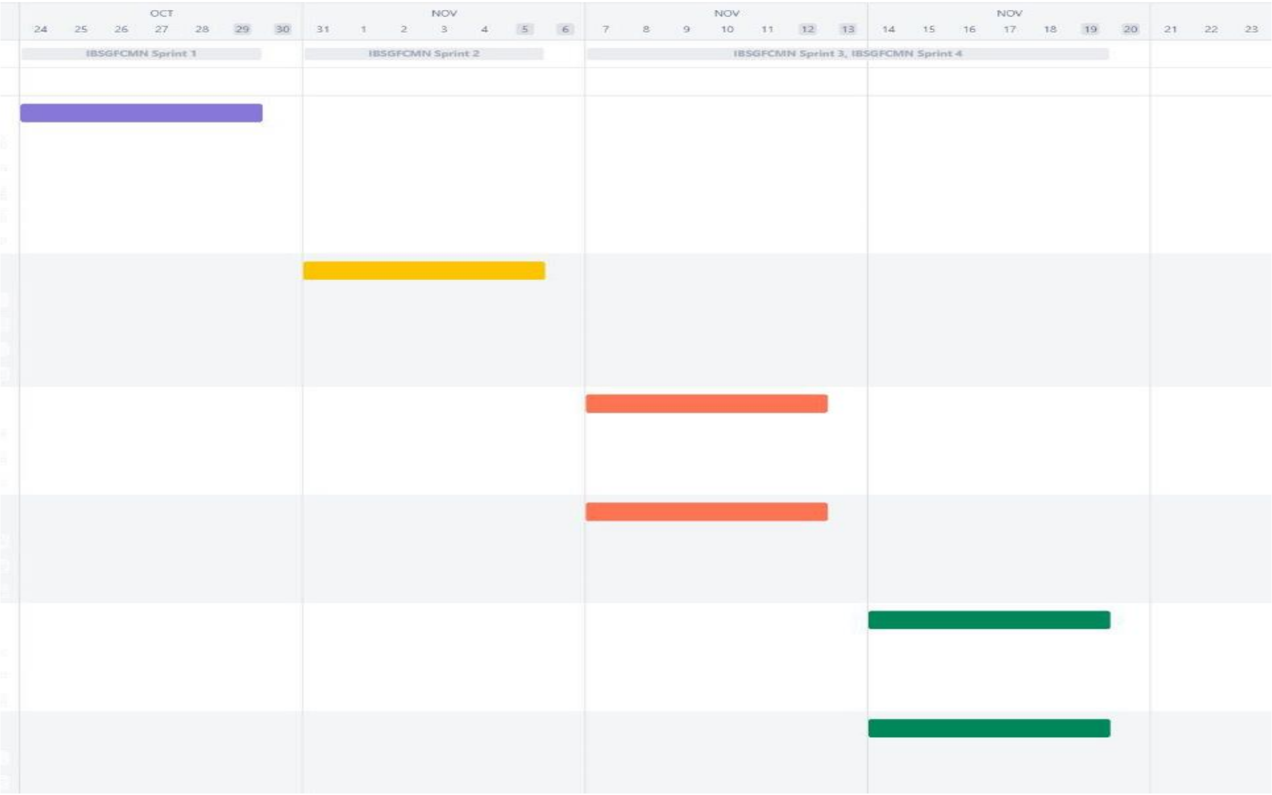
AV for sprint-2 = 12/6 = 2 points

AV for sprint-3 = 18/6 = 3 points

AV for sprint-4 = 12/6 = 2 points

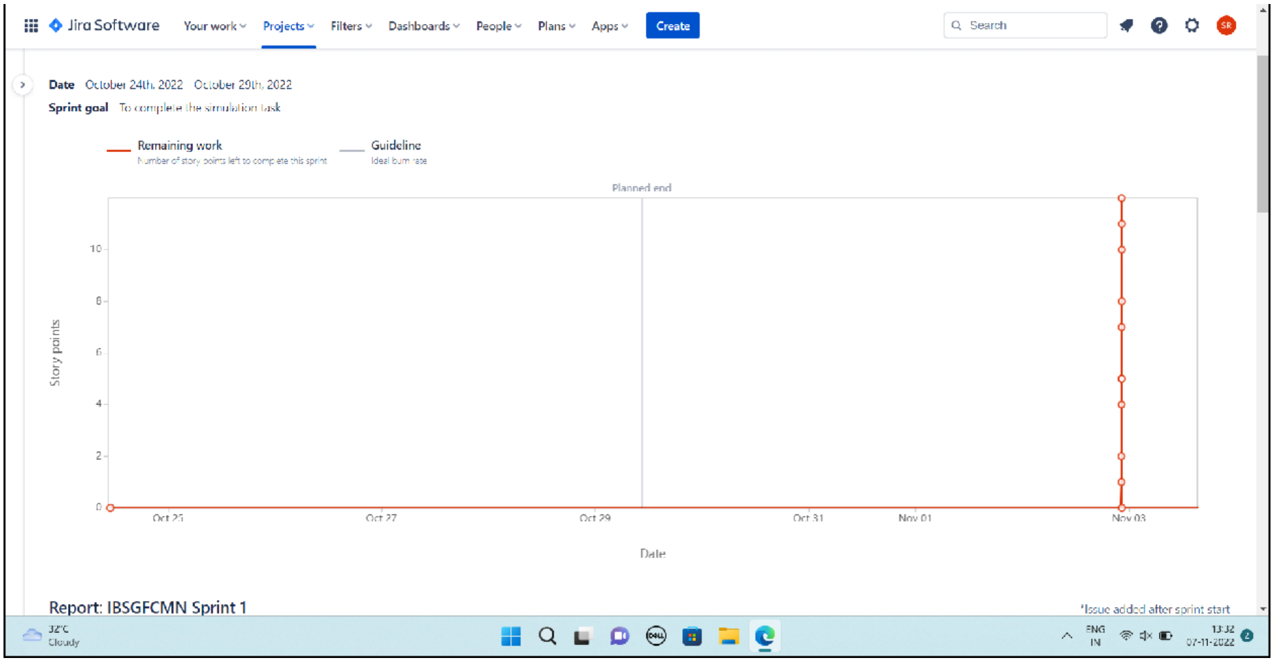
6.3 Reports from JIRA

JIRA RoadMap:



Burndown Chart:

Sprint-1



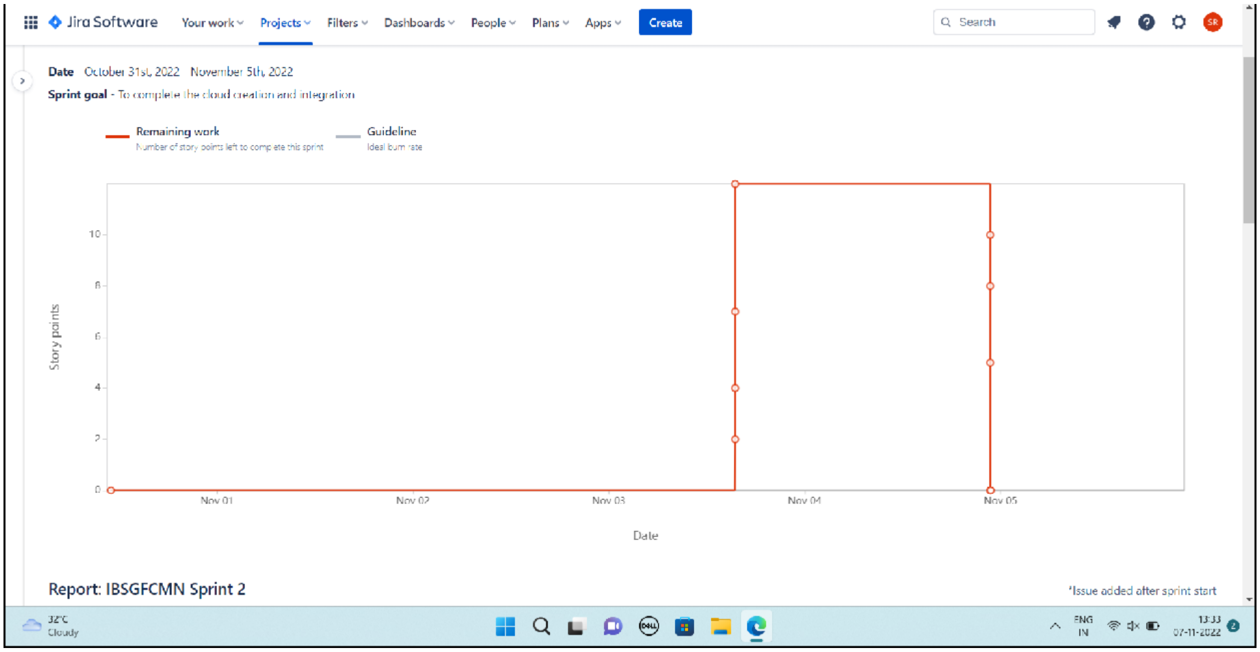
Date October 24th, 2022 October 29th, 2022

Sprint goal To complete the simulation task

Report: IBSGFCMN Sprint 1

*Issue added after sprint start

Sprint-2



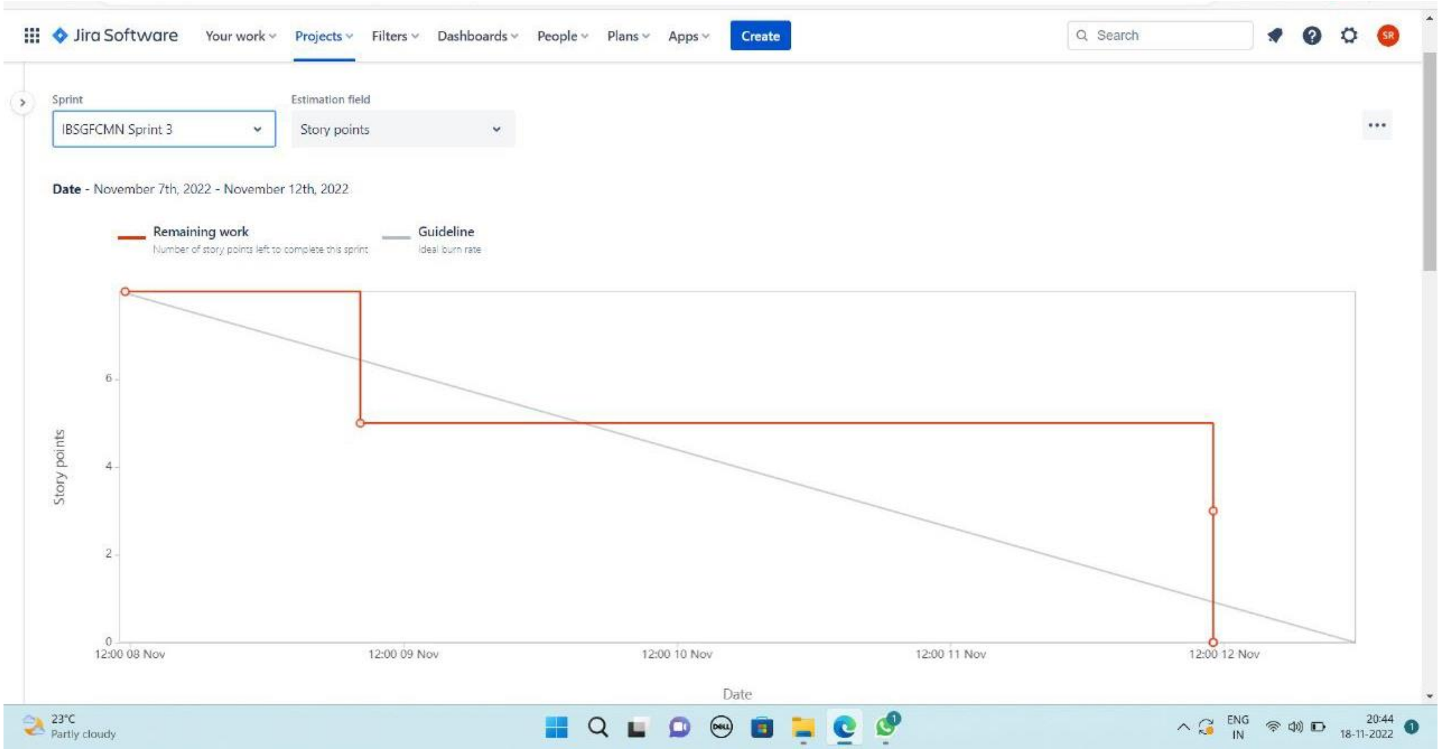
Date October 31st, 2022 November 5th, 2022

Sprint goal - To complete the cloud creation and integration

Report: IBSGFCMN Sprint 2

*Issue added after sprint start

Sprint-3

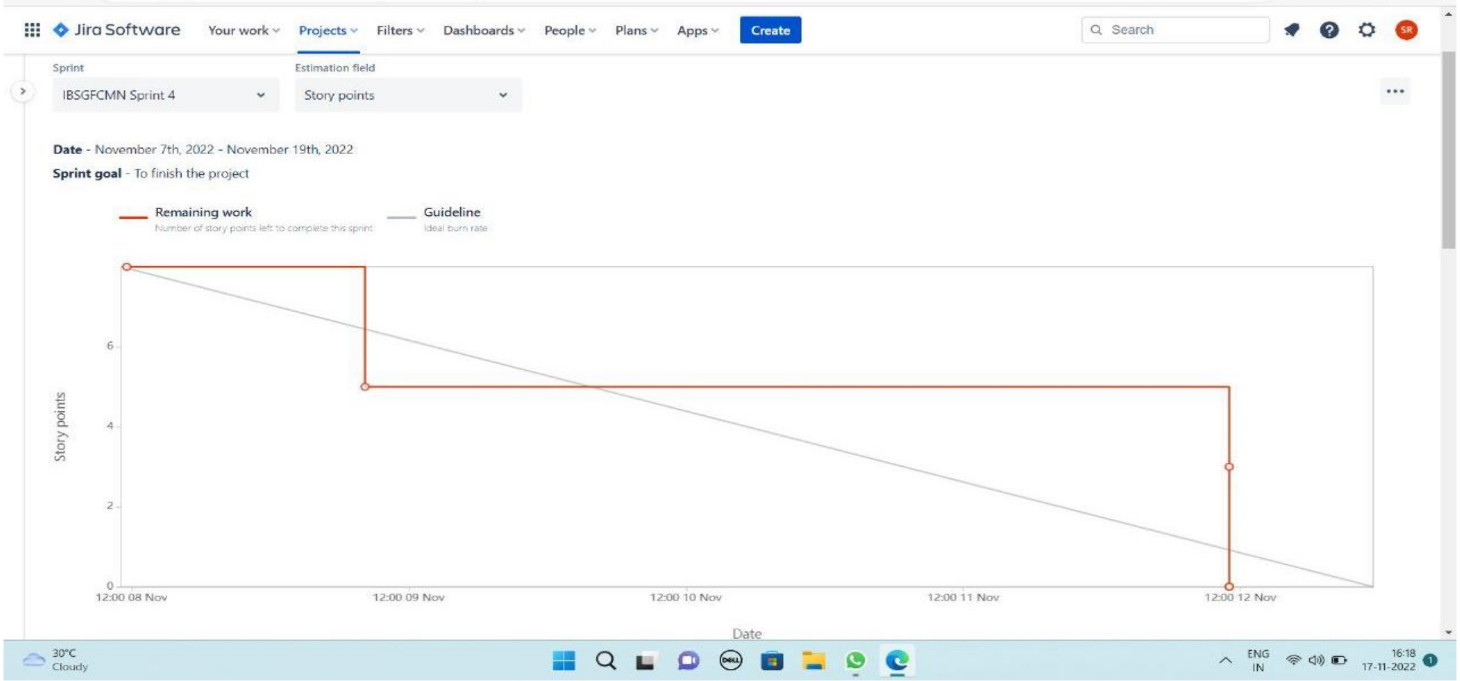


Sprint: IBSGFCMN Sprint 3

Estimation field: Story points

Date - November 7th, 2022 - November 12th, 2022

Sprint-4



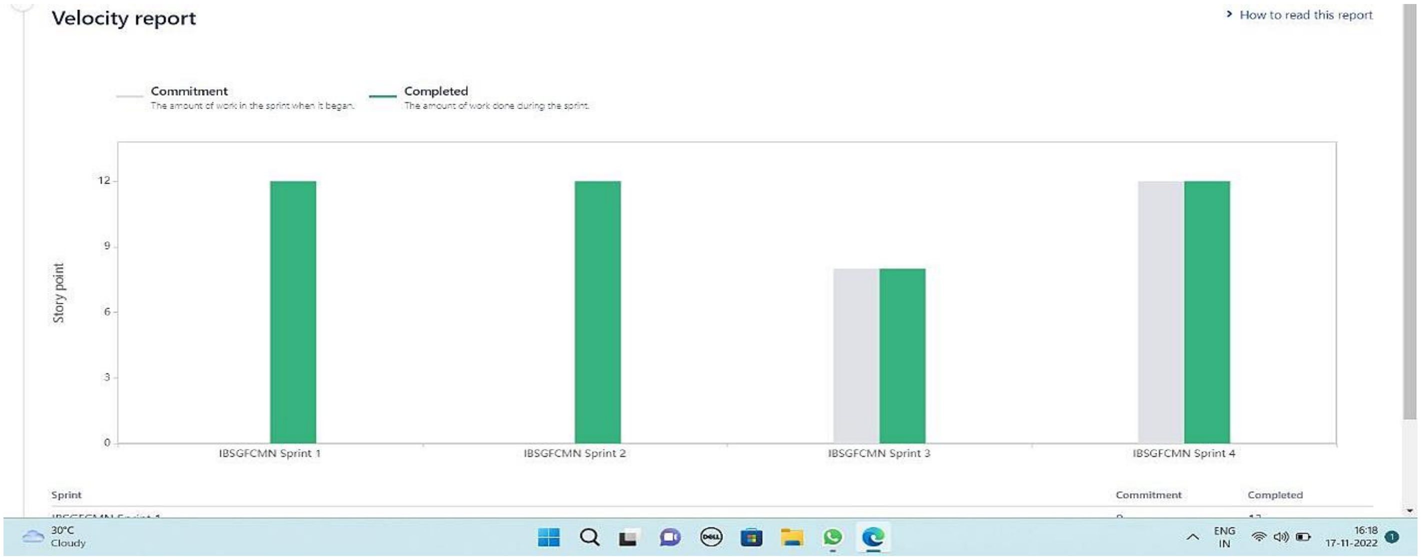
Sprint: IBSGFCMN Sprint 4

Estimation field: Story points

Date - November 7th, 2022 - November 19th, 2022

Sprint goal - To finish the project

Velocity Report

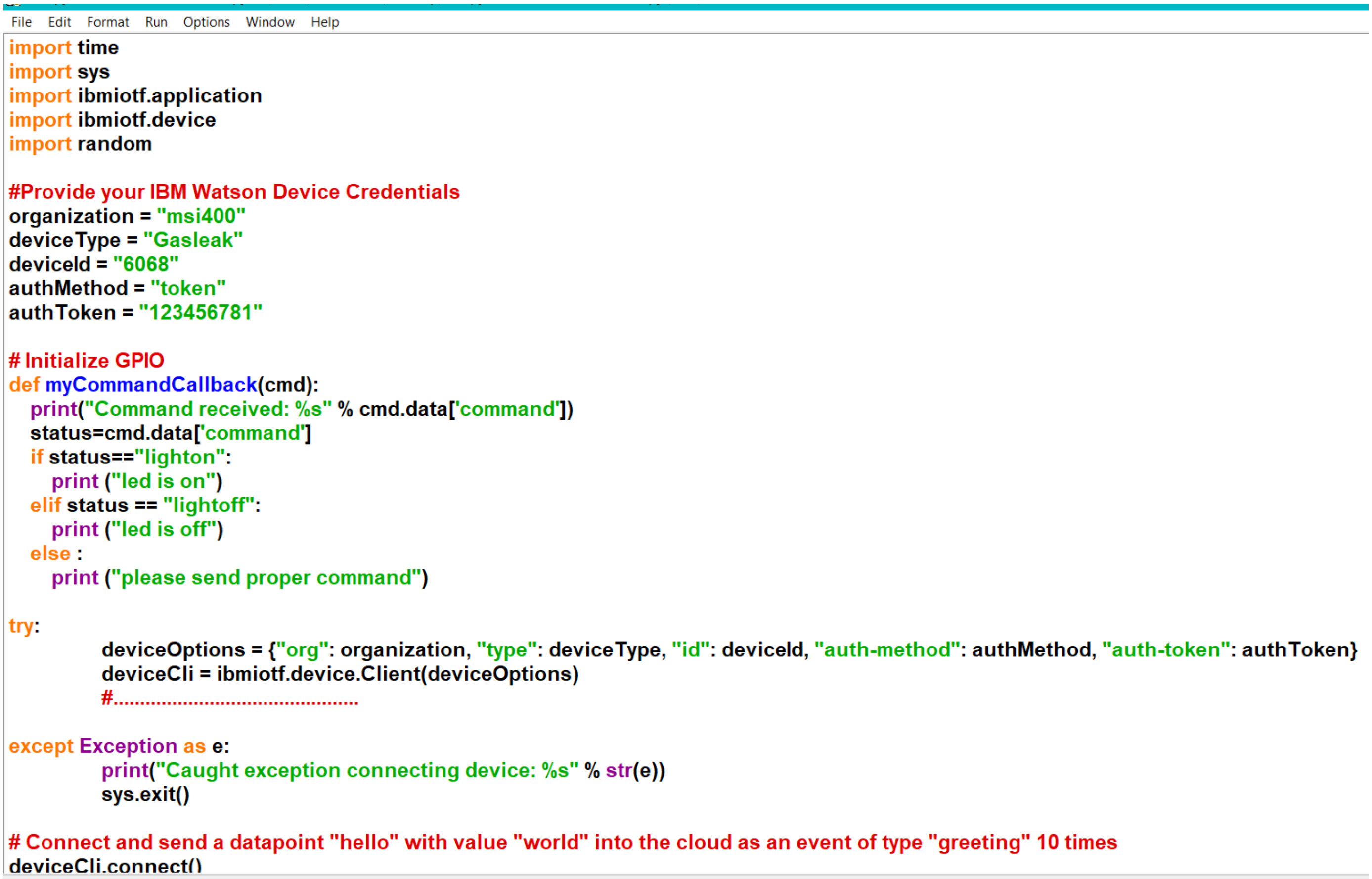


Sprint	Commitment	Completed

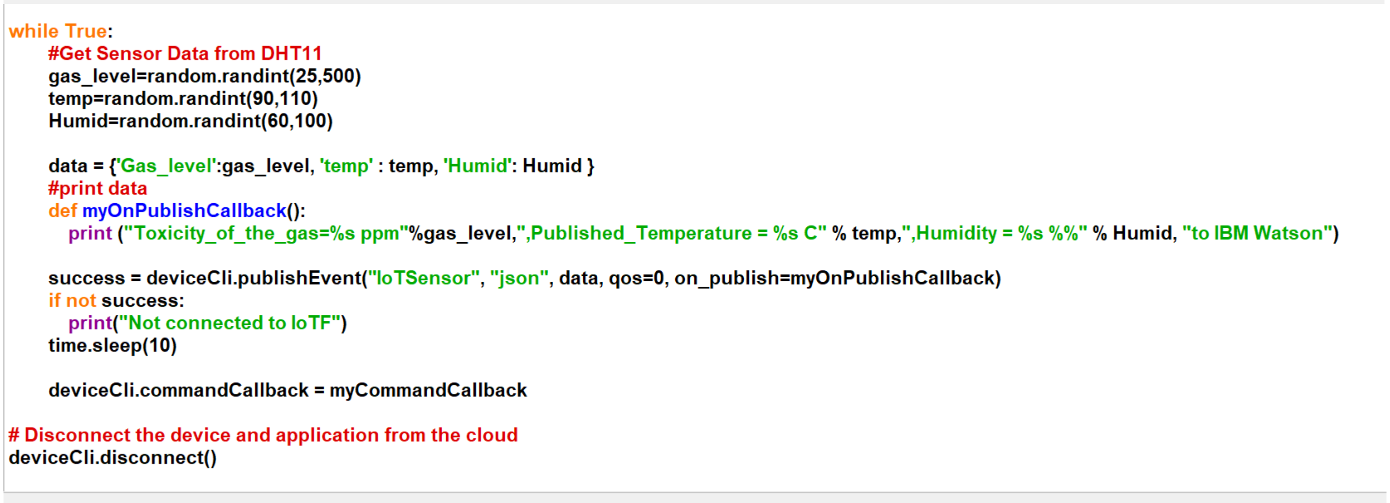
7. CODING & SOLUTIONING

7.1 Feature 1 - PYTHON CODE

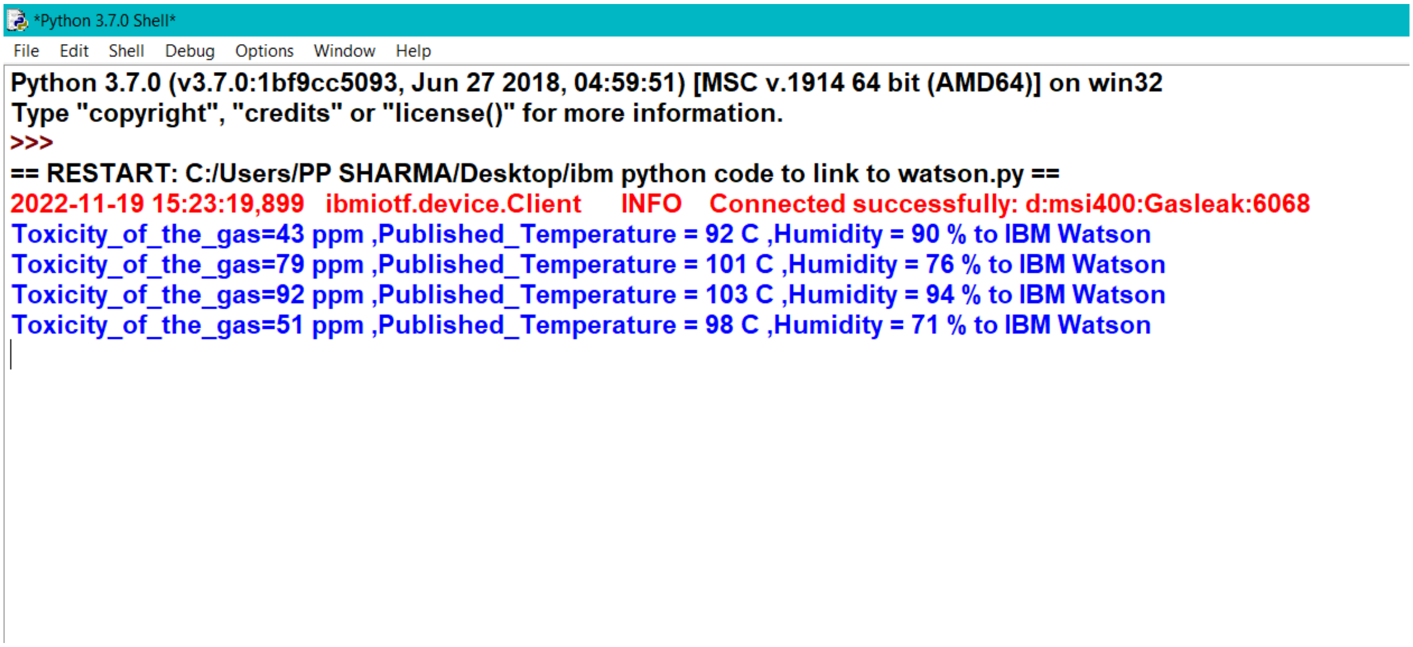
Instead of hardware, we are using python code. In this code we send randomly generated parameters to the IBM Watson IoT platform.



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

#Provide your IBM Watson Device Credentials
organization = "msi400"
deviceType = "Gasleak"
deviceId = "6068"
authMethod = "token"
authToken = "123456781"

# 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
        gas_level=random.randint(25,500)
        temp=random.randint(90,110)
        Humid=random.randint(60,100)

        data = {'Gas_level':gas_level, 'temp' : temp, 'Humid': Humid }
        #print data
        def myOnPublishCallback():
            print ("Toxicity_of_the_gas=%s ppm"%gas_level,",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()
```



```
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
== RESTART: C:/Users/PP SHARMA/Desktop/ibm python code to link to watson.py ==
2022-11-19 15:23:19,899   ibmiotf.device.Client     INFO    Connected successfully: d:msi400:Gasleak:6068
Toxicity_of_the_gas=43 ppm ,Published_Temperature = 92 C ,Humidity = 90 % to IBM Watson
Toxicity_of_the_gas=79 ppm ,Published_Temperature = 101 C ,Humidity = 76 % to IBM Watson
Toxicity_of_the_gas=92 ppm ,Published_Temperature = 103 C ,Humidity = 94 % to IBM Watson
Toxicity_of_the_gas=51 ppm ,Published_Temperature = 98 C ,Humidity = 71 % to IBM Watson
```

7.2 Feature 2 - Wokwi Platform Simulation:

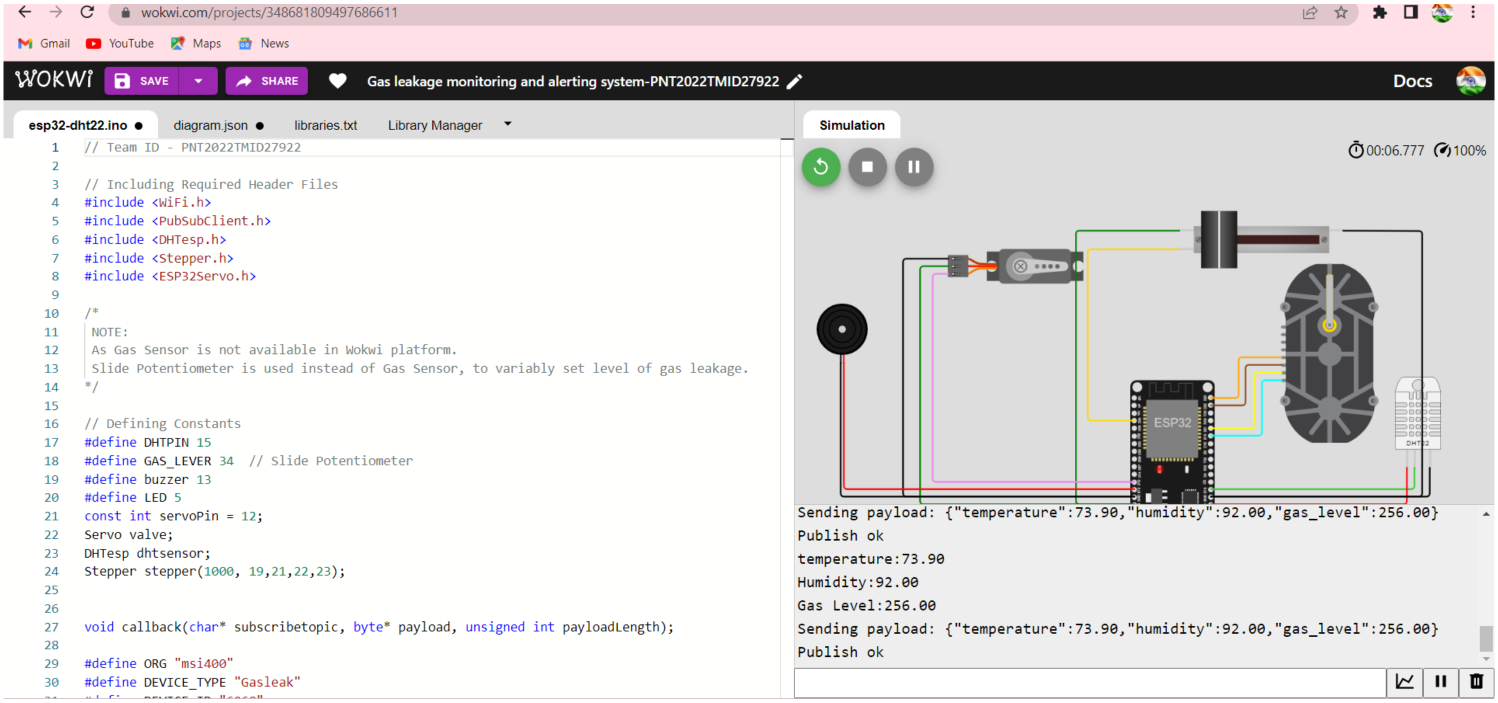
- As Gas sensor is not available in Wokwi platform, slide potentiometer is used.
- Slide potentiometer is used to set the level of gas leakage.
- DHT Sensor is used to set the increase/decrease in level of Humidity and Temperature.
- The data is sent to IBM IoT Watson platform and rendered to dashboard using Node-Red.

If Gas Leakage is detected,

The system automatically turns ON the exhaust fans.

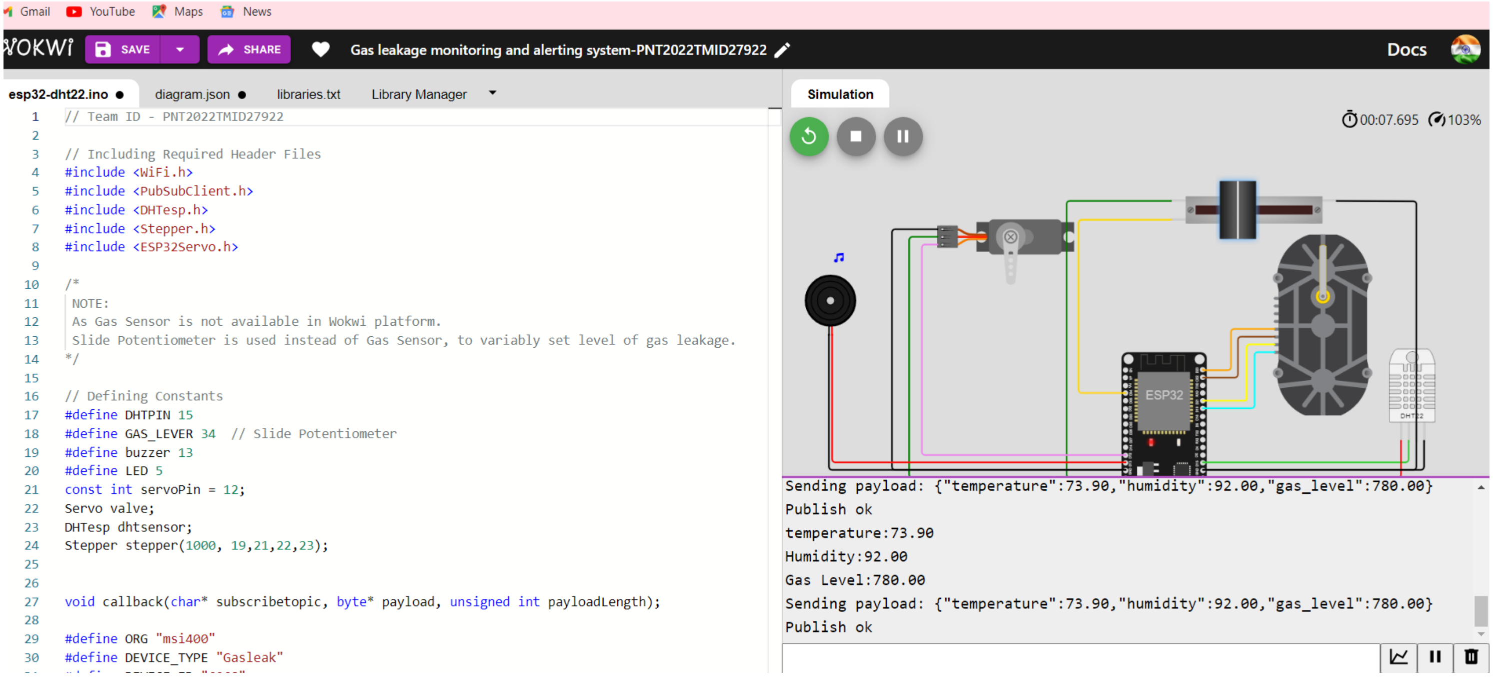
An alarm is set off to alert the workers of the industry.

The system automatically closes the gas value.



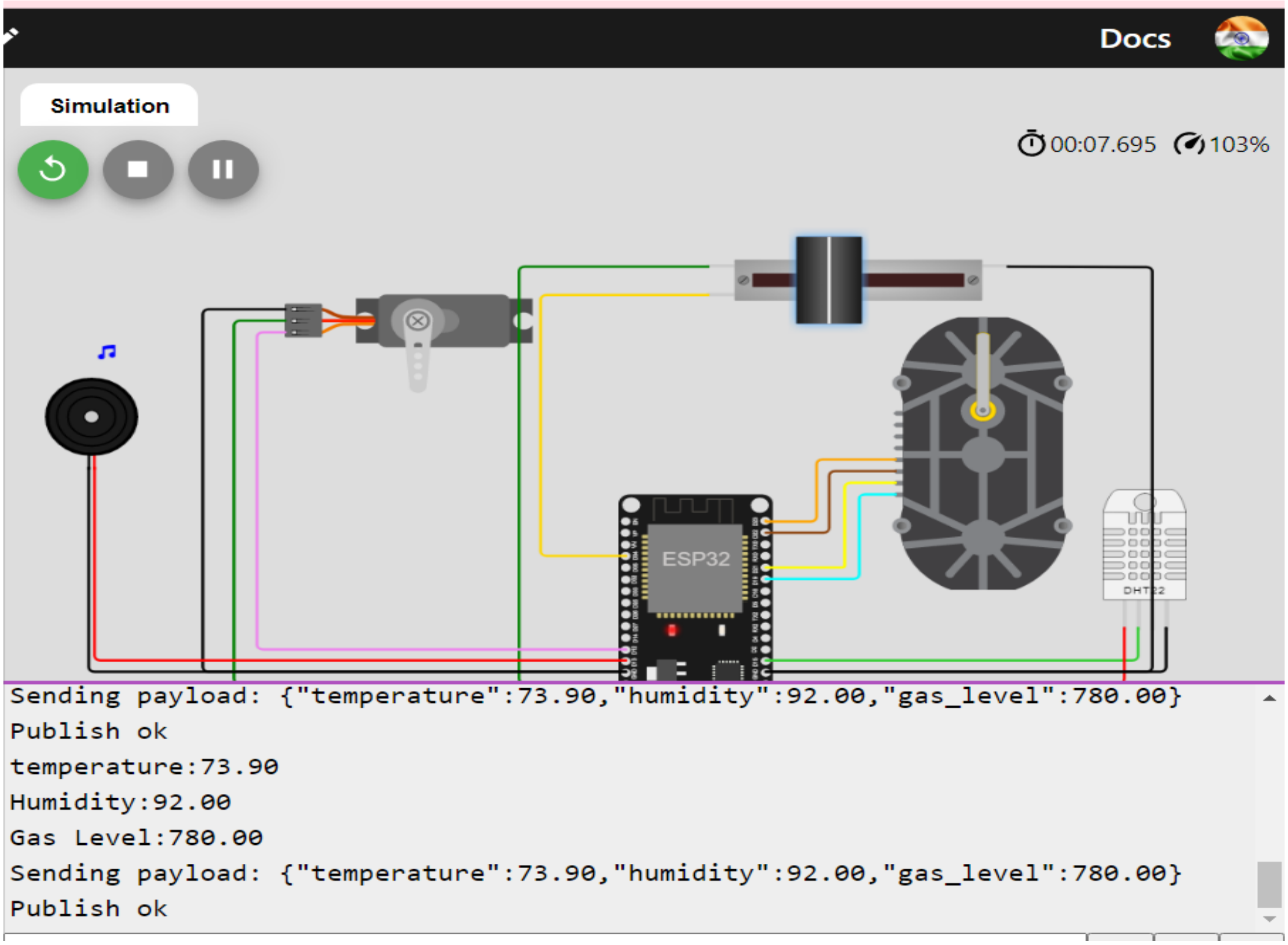
```
// Team ID - PNT2022TMID27922

// Including Required Header Files
#include <WiFi.h>
#include <PubSubClient.h>
#include <DHTesp.h>
#include <Stepper.h>
#include <ESP32Servo.h>

/*
 NOTE:
 As Gas Sensor is not available in Wokwi platform.
 Slide Potentiometer is used instead of Gas Sensor, to variably set level of gas leakage.
*/

// Defining Constants
#define DHTPIN 15
#define GAS_LEVER 34  // Slide Potentiometer
#define buzzer 13
#define LED 5
const int servoPin = 12;
Servo valve;
DHTesp dhtsensor;
Stepper stepper(1000, 19,21,22,23);


void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

#define ORG "msi400"
#define DEVICE_TYPE "Gasleak"
```

```
Sending payload: {"temperature":73.90,"humidity":92.00,"gas_level":256.00}
Publish ok
temperature:73.90
Humidity:92.00
Gas Level:256.00
Sending payload: {"temperature":73.90,"humidity":92.00,"gas_level":256.00}
Publish ok
```



```
// Team ID - PNT2022TMID27922

// Including Required Header Files
#include <WiFi.h>
#include <PubSubClient.h>
#include <DHTesp.h>
#include <Stepper.h>
#include <ESP32Servo.h>

/*
 NOTE:
 As Gas Sensor is not available in Wokwi platform.
 Slide Potentiometer is used instead of Gas Sensor, to variably set level of gas leakage.
*/

// Defining Constants
#define DHTPIN 15
#define GAS_LEVER 34  // Slide Potentiometer
#define buzzer 13
#define LED 5
const int servoPin = 12;
Servo valve;
DHTesp dhtsensor;
Stepper stepper(1000, 19,21,22,23);


void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

#define ORG "msi400"
#define DEVICE_TYPE "Gasleak"
```

```
Sending payload: {"temperature":73.90,"humidity":92.00,"gas_level":780.00}
Publish ok
temperature:73.90
Humidity:92.00
Gas Level:780.00
Sending payload: {"temperature":73.90,"humidity":92.00,"gas_level":780.00}
Publish ok
```

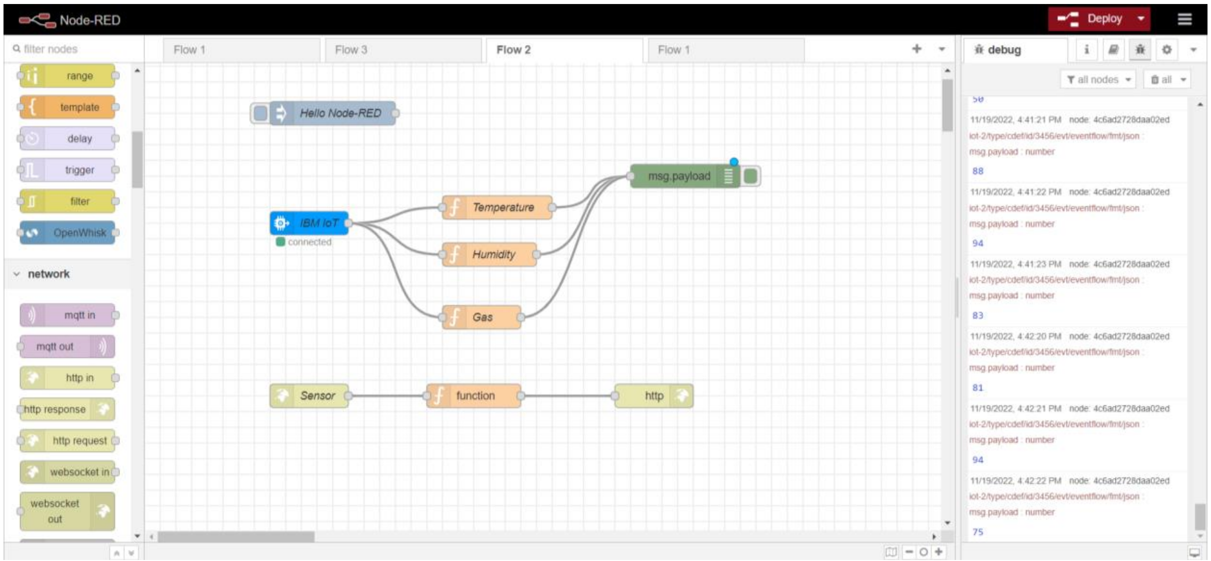


```
Sending payload: {"temperature":73.90,"humidity":92.00,"gas_level":780.00}
Publish ok
temperature:73.90
Humidity:92.00
Gas Level:780.00
Sending payload: {"temperature":73.90,"humidity":92.00,"gas_level":780.00}
Publish ok
```

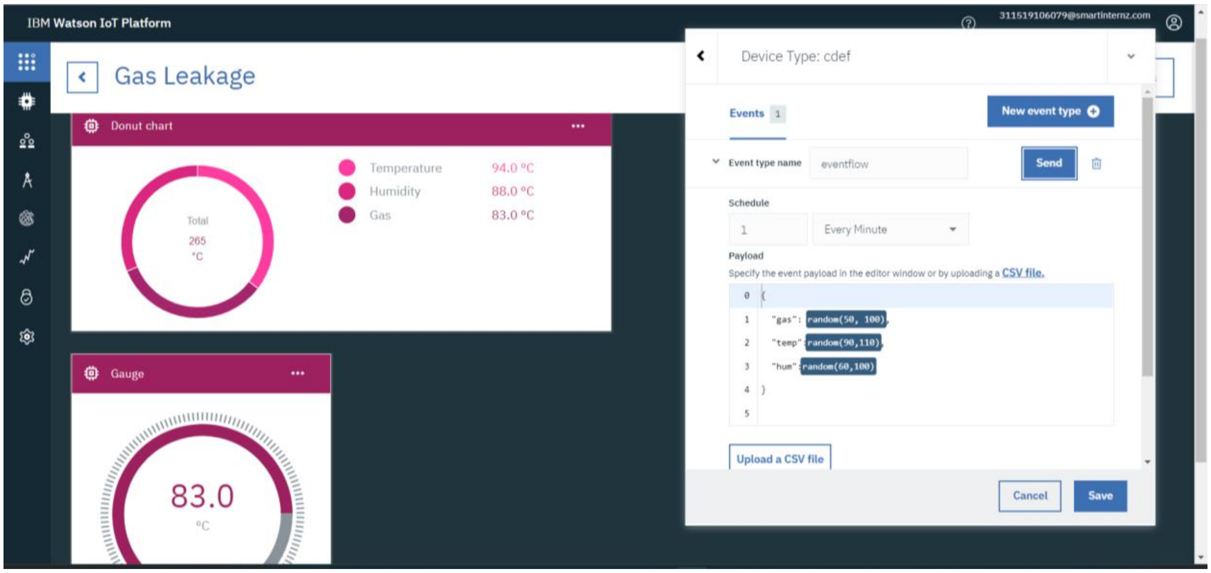
7.3 Feature 3 - Node-Red Service:

Once we get parameters details in the IBM Watson Platform, we are extracting that data into the Node-Red Service.

We going to pass these data to find parameters like Gas leak, Temperature and Humidity.



```
11/19/2022, 4:41:21 PM  node: 4c6ad2728daa02ed
iot-2/type/cdef/id/3456/evt/eventflow/fmt/json :
msg.payload : number
88
11/19/2022, 4:41:22 PM  node: 4c6ad2728daa02ed
iot-2/type/cdef/id/3456/evt/eventflow/fmt/json :
msg.payload : number
94
11/19/2022, 4:41:23 PM  node: 4c6ad2728daa02ed
iot-2/type/cdef/id/3456/evt/eventflow/fmt/json :
msg.payload : number
83
11/19/2022, 4:42:20 PM  node: 4c6ad2728daa02ed
iot-2/type/cdef/id/3456/evt/eventflow/fmt/json :
msg.payload : number
81
11/19/2022, 4:42:21 PM  node: 4c6ad2728daa02ed
iot-2/type/cdef/id/3456/evt/eventflow/fmt/json :
msg.payload : number
94
11/19/2022, 4:42:22 PM  node: 4c6ad2728daa02ed
iot-2/type/cdef/id/3456/evt/eventflow/fmt/json :
msg.payload : number
75
```



● Temperature	94.0 °C
● Humidity	88.0 °C
● Gas	83.0 °C

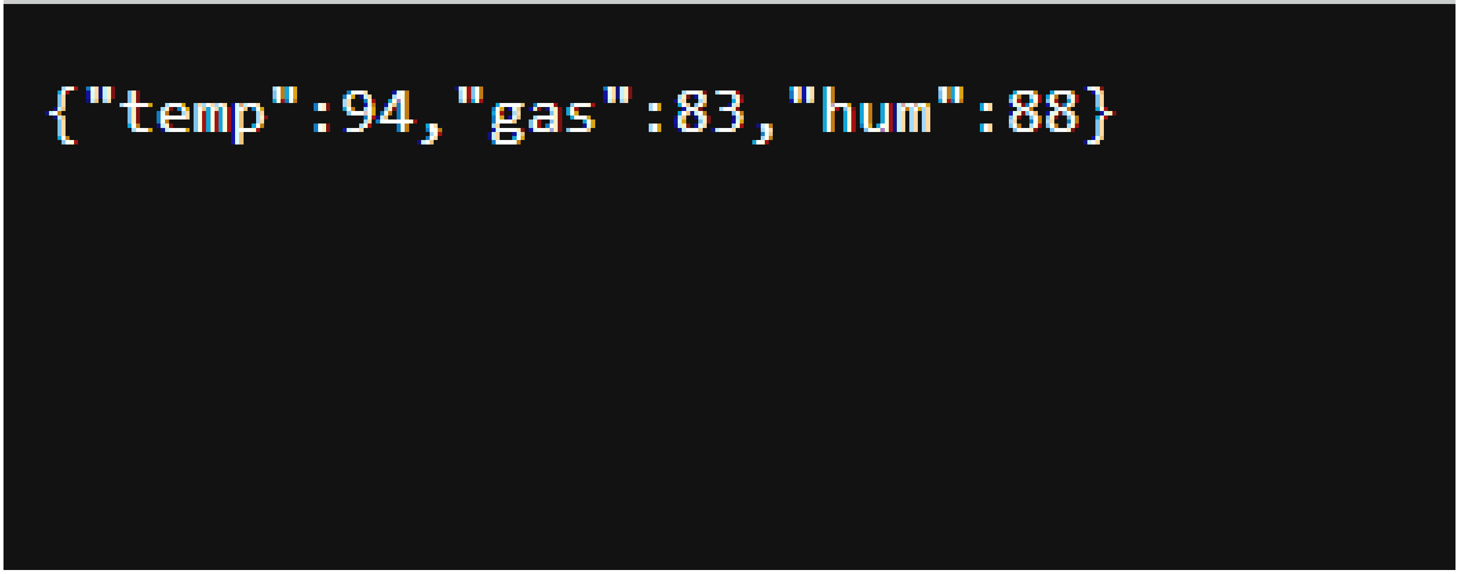
Event type name: eventflow

Schedule: 1 Every Minute

Payload

Specify the event payload in the editor window or by uploading a CSV file.

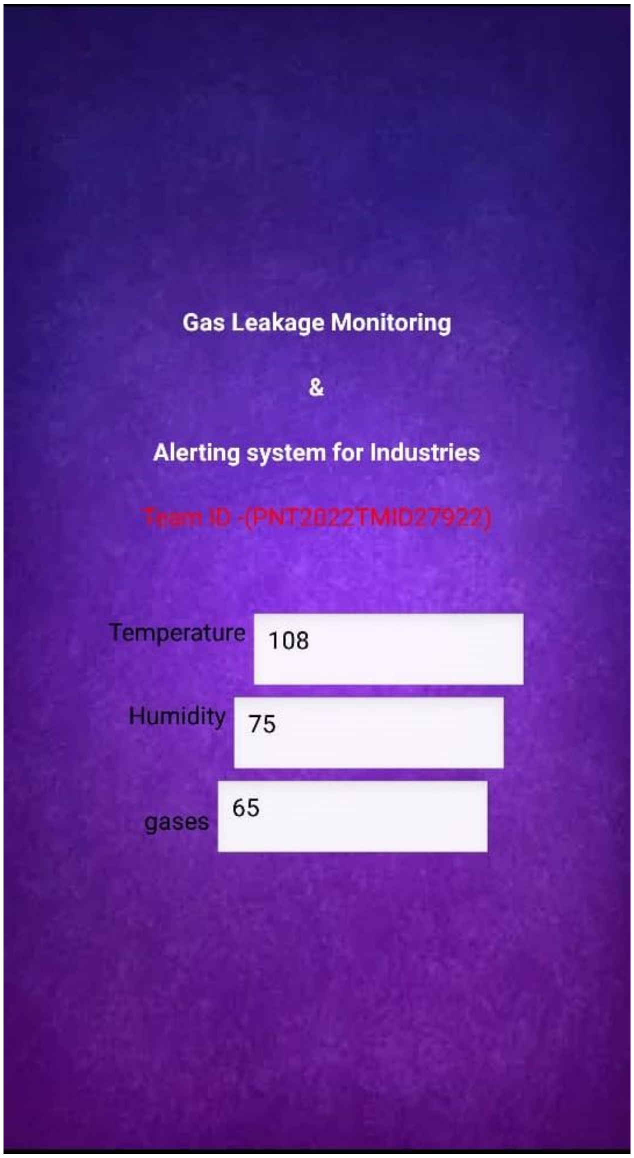
```
{
  "gas": random(50, 100),
  "temp":random(90,110),
  "hum":random(60,100)
}
```



```
{"temp":94,"gas":83,"hum":88}
```

7.4 Feature 4 - Mobile App

In addition we are using mobile app to view the parameter details along with toxicity.



Gas Leakage Monitoring

&

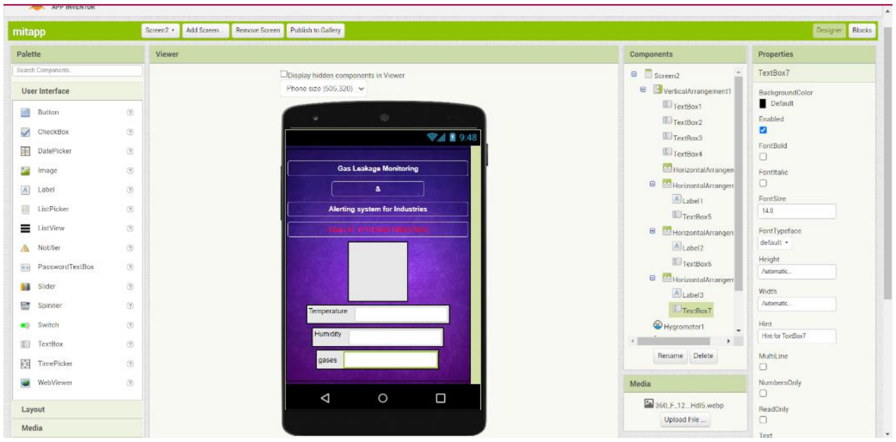
Alerting system for Industries

Team ID -(PNT2022TMID27922)

Temperature 108

Humidity 75

gases 65



☐ Display hidden components in Viewer

Phone size (505,320)

Gas Leakage Monitoring

&

Alerting system for Industries

Temperature

Humidity

gases

Components:
- Screen2
  - VerticalArrangement1
    - TextBox1
    - TextBox2
    - TextBox3
    - TextBox4
    - HorizontalArrangem
    - HorizontalArrangem
      - Label1
      - TextBox5
    - HorizontalArrangem
      - Label2
      - TextBox6
    - HorizontalArrangem
      - Label3
      - TextBox7
  - Hygrometer1

Media: 360_F_12...Hdl5.webp

Properties: TextBox7

BackgroundColor: Default

Enabled: ☑

FontBold: ☐

FontItalic: ☐

FontSize: 14.0

FontTypeface: default

Height: Automatic...

Width: Automatic...

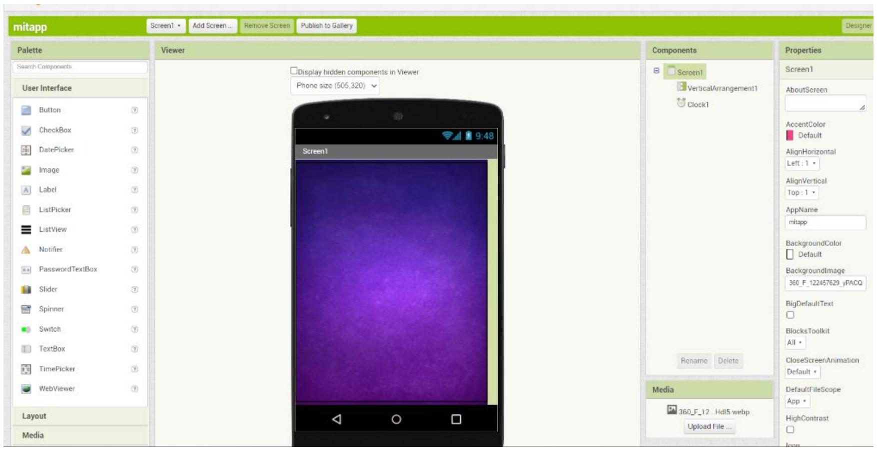
Hint: Hint for TextBox7

MultiLine: ☐

NumbersOnly: ☐

ReadOnly: ☐

Text



☐ Display hidden components in Viewer

Phone size (505,320)

Components:
- Screen1
  - VerticalArrangement1
  - Clock1

Media: 360_F_12...Hdl5.webp

Properties: Screen1

AboutScreen

AccentColor: Default

AlignHorizontal: Left : 1

AlignVertical: Top : 1

AppName: mitapp

BackgroundColor: Default

BackgroundImage: 360_F_122457629_yPACQ

BigDefaultText: ☐

BlocksToolkit: All

CloseScreenAnimation: Default

DefaultFileScope: App

HighContrast: ☐

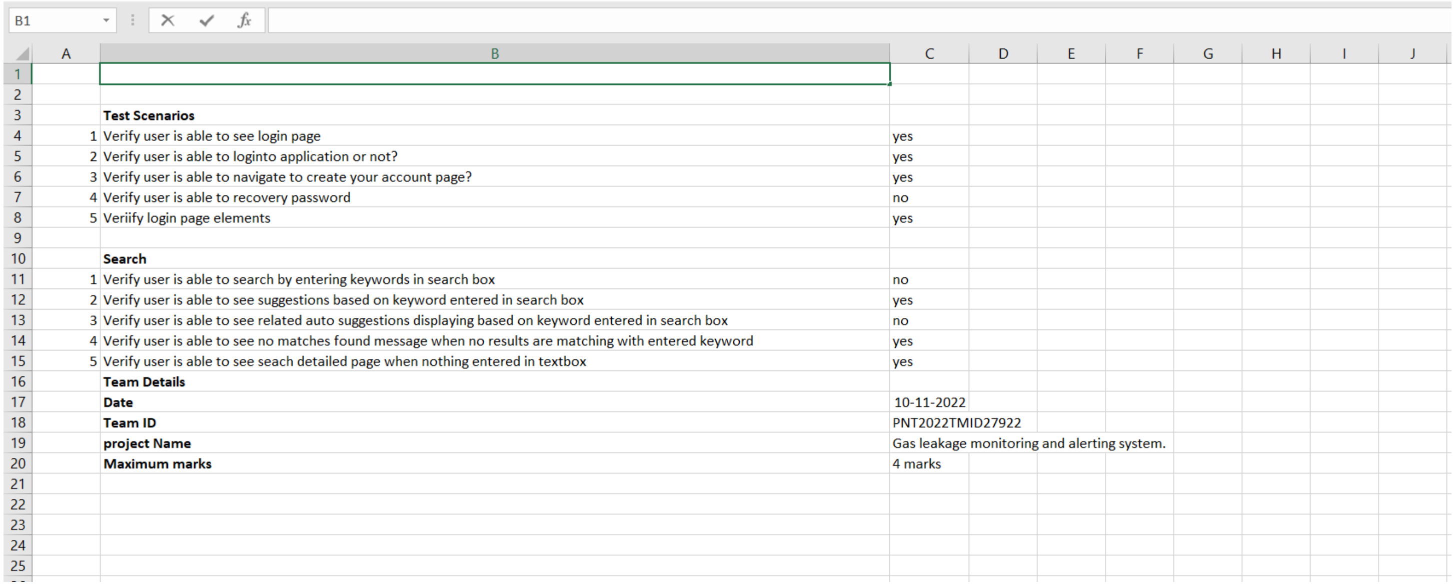
Icon

8. TESTING

Test Scenarios

1. Verify python code is run without error.
2. Verify the login the Cloud Services.
3. Verify create a device in the IBM Watson IoT platform and get the device credentials.
4. Verify the events is shown in the card.
5. Verify the events is stored in the database.
6. Verify to create a node -red services.
7. To create Mit app inventor.
8. To send SMS to the user and ambulance.
9. Verify user is able to log into app with Valid credentials.
10. Verify it, show the sensor parameters.

8.1 Test cases



A	B	C
	Test Scenarios	
1	Verify user is able to see login page	yes
2	Verify user is able to loginto application or not?	yes
3	Verify user is able to navigate to create your account page?	yes
4	Verify user is able to recovery password	no
5	Veriify login page elements	yes
	Search	
1	Verify user is able to search by entering keywords in search box	no
2	Verify user is able to see suggestions based on keyword entered in search box	yes
3	Verify user is able to see related auto suggestions displaying based on keyword entered in search box	no
4	Verify user is able to see no matches found message when no results are matching with entered keyword	yes
5	Verify user is able to see seach detailed page when nothing entered in textbox	yes
	Team Details	
	Date	10-11-2022
	Team ID	PNT2022TMID27922
	project Name	Gas leakage monitoring and alerting system.
	Maximum marks	4 marks

8.2 User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [IoT Based Gas leakage monitoring and alerting system] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved.

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	3	2	0	10
Duplicate	0	0	0	1	1
External	2	0	0	1	3
Fixed	6	2	0	0	8
Not Reproduced	0	1	1	0	2
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	13	6	3	2	24

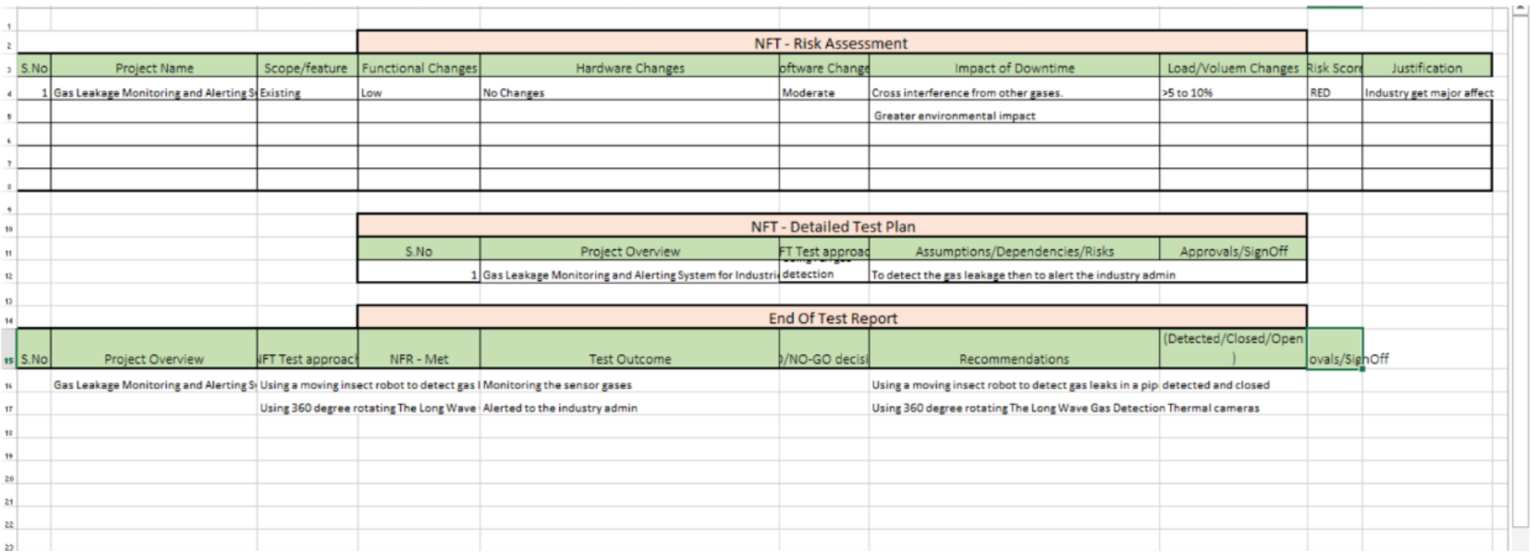
3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested.

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	1	0	0	1
Client Application	2	0	0	2
Security	1	0	0	1
Outsource Shipping	1	0	0	1
Exception Reporting	1	0	0	1
Final Report Output	2	0	0	2
Version Control	2	0	0	2

9. RESULTS

9.1 Performance Metrics



NFT - Risk Assessment

S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	oftware Change	Impact of Downtime	Load/Voluem Changes	Risk Score	Justification
1	Gas Leakage Monitoring and Alerting S	Existing	Low	No Changes	Moderate	Cross interference from other gases.	>5 to 10%	RED	Industry get major affect
						Greater environmental impact			

NFT - Detailed Test Plan

S.No	Project Overview	FT Test approac	Assumptions/Dependencies/Risks	Approvals/SignOff
1	Gas Leakage Monitoring and Alerting System for Industri	detection	To detect the gas leakage then to alert the industry admin	

End Of Test Report

S.No	Project Overview	IFT Test approac	NFR - Met	Test Outcome	)/NO-GO decisi	Recommendations	(Detected/Closed/Open)	ovals/SignOff
	Gas Leakage Monitoring and Alerting S	Using a moving insect robot to detect gas l		Monitoring the sensor gases		Using a moving insect robot to detect gas leaks in a pip	detected and closed	
		Using 360 degree rotating The Long Wave		Alerted to the industry admin		Using 360 degree rotating The Long Wave Gas Detection Thermal cameras		

10. ADVANTAGES & DISADVANTAGES

Advantages:

1. To detect combustible, flammable, and toxic gases and oxygen depletion.
2. Supervise the gas concentration levels.
3. Ensures workers health.
4. Real-time updates about leakages.
5. Get immediate gas leak alerts.
6. Helps prevent the high risk of gas explosion.

Disadvantages:

1.The instrument needs to be connected to the power supply to work.

2. Not easy to move.

3.The use of environment (temperature and humidity) requires a higher.

4.Poor stability.

5.Greater environment impact.

CONCLUSION:

- Designing a fire and gas detection system is a significant challenge- the range of scenarios, detector positions, technologies and minimal industry guidance leave the whole process ill-defined, leading to poor potential detection performance in practice.
- First and foremost, our design should be informed by risk assessment, from which we can define the specific detection requirements, choose appropriate technology, and select the best layout strategy. Performing these activities initially will yield the greatest risk reduction benefits and only once these are completed are we able to decide whether mapping is needed. Crucially, this pragmatic approach will be reflected

in the forthcoming energy institute guidance on fire and gas detection design.

FUTURE SCOPE

- It could be including an automatic shut-off device which will turn off the gas supply whenever it will detect any gas leakage. This system can be implemented in industries, hotels and wherever the LPG cylinders are used.
- The gas leakage detection is not only highly accurate but cheap and portable and can be used for industries and domestic safety.
- This project’s future scope is to use a HOG feature for SVM classifier which is used to identify pipeline gas leaks and keep tabs on them.
- In addition, the system utilizes an image processing technique to identify pipeline fractures.
- According to the suggested design, the robot captures the image down the pipe, looking for any sign of gas leakage by the Eddy current method.
- When gas and smoke is detected then system will send short message service (SMS) to the user then user will take respective system.
- We mean to use new platform to feed actual time sensor data on the internet. The sensor displays, distinguishes and advances a alarm whenever there is a gas outflow or fire penniless out conditions is there.

11. APPENDIX:

Wokwi code:

Link:

https://wokwi.com/projects/348681809497686611

Node-Red flow:

Link:

https://node-red-ntmuo-2022-10-10.eu-de.mybluemix.net/red/#flow/5cd0318a9f47bd22

Source Code:

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

#Provide your IBM Watson Device Credentials
organization = "msi400"
deviceType = "Gasleak"
deviceId = "6068"
authMethod = "token"
authToken = "123456781"

# 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
        gas_level=random.randint(25,500)
        temp=random.randint(90,110)
        Humid=random.randint(60,100)

        data = {'Gas_level':gas_level, 'temp' : temp, 'Humid': Humid }
        #print data
        def myOnPublishCallback():
            print ("Toxicity_of_the_gas=%s ppm"%gas_level,",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()
```

Link:

https://drive.google.com/file/d/1P-snpeiWyi443e9m4XAFEzPkMEM8_jxt/view?usp=sharing

GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-18471-1659685793

GITHUB AND PROJECT DEMO LINK:

https://github.com/IBM-EPBL/IBM-Project-18471-1659685793/tree/main/Final%20Deliverables

GITHUB PROJECT REPORT LINK:

https://github.com/IBM-EPBL/IBM-Project-18471-1659685793/tree/main/Final%20Deliverables/Project%20Report