GAS LEAKAGE MONITORING & ALERTING SYSTEM FOR INDUSTRIES

Category: INTERNET OF THINGS

A PROJECT REPORT

Submitted by

NITHYA V - 411819104702
ALAMELUMANGAI B - 411819104712
KAVIYARASU K - 411819104711
PRAVEEN V - 411819104718
SAM PRAVEEN RAJ P - 411819104722

FROM

RRASE COLLEGE OF ENGINEERING,PADAPPAI-601301
ANNA UNIVERSITY:CHENNAI 600025

In fulfillment of project in IBM-NALAYATHIRAN 2022

Team Id: PNT2022TMID36794

PROJECT GUIDES

Industry Mentor: Kumar Juluri

Faculty Mentor: A. Vijayan

INDEX

GAS LEAKAGE MONITORING AND ALERTING SYSTEM

1.INTRODUCTION:

Nowadays, home safety detection systems play a significant part in people's security. Since everyone in the household works every day, it is impossible to check on the household appliances, particularly the LPG gas cylinder, wired circuits, etc. Liquefied petroleum gas (LPG) and natural gas demand has significantly increased during the past three years. LPG and natural gas are recommended to meet this high level of energy demand and to substitute oil or coal due to those fuels' negative environmental effects. Large-scale applications for these gases include industry, heating, home appliances, and motor fuel. The system has a MQ6 gas sensor to monitor this leakage gas. This sensor detects how much leak gas is there in the environment around it. Explosions or being harmed by gas leaks could be avoided in this way.

2.LITERATURE SURVEY:

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.

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.

Hitendra Rawat, Ashish Kushwah, Khyati Asthana, Akanksha Shivhare,in the year 2014 planned a framework, They gave security issues against hoodlums, spillage and fire mishaps. In those cases their framework sends SMS to the crisis number gave to it.

P.Meenakshi Vidya, S.Abinaya, G.Geetha Rajeswari, N.Guna,"Automatic LPG detection and hazard controlling " published in April 2014 proposed the leakage detection and real time gas monitoring system. In this system, the gas leakage is detected and controlled by means of exhaust fan. The level of LPG in cylinder is also continuously monitored. Ch. Manohar Raju and N. Sushma Rani, 2008, they introduce an android based automatic gas detection and indication robot.

3.PROPOSED SOLUTION:

IDEATION PROPOSED SOLUTION:

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	o Gas Leakage Monitoring and Alerting System.
2.	Idea / Solution description	o Using a variety of sensor, the environmental parameters such as concentration of the gas can be monitored in real time o If the concentration of gas reaches hazardous level an alert message can be sent to the user.
3.	Novelty / Uniqueness	o Device being developed can monitor a wide range of gases that are highly used in industries. o Apart from notifying the user, Safety personnel are also notified in case of emergencies. o User friendly in nature.
4.	Social Impact / Customer Satisfaction	o As the device is small, it is easy to install them in various locations based on necessity.
5.	Business Model (Revenue Model)	o Device can be obtained by paying for the subscription. o It can be yearly or monthly. o Based on the term of subscription 5 – 8% discount shall be made available.
6.	Scalability of the Solution	o In future more variety of gas can also be monitored, by adding the necessary sensor and monitoring the data obtained from it.

PROPOSED METHOD:

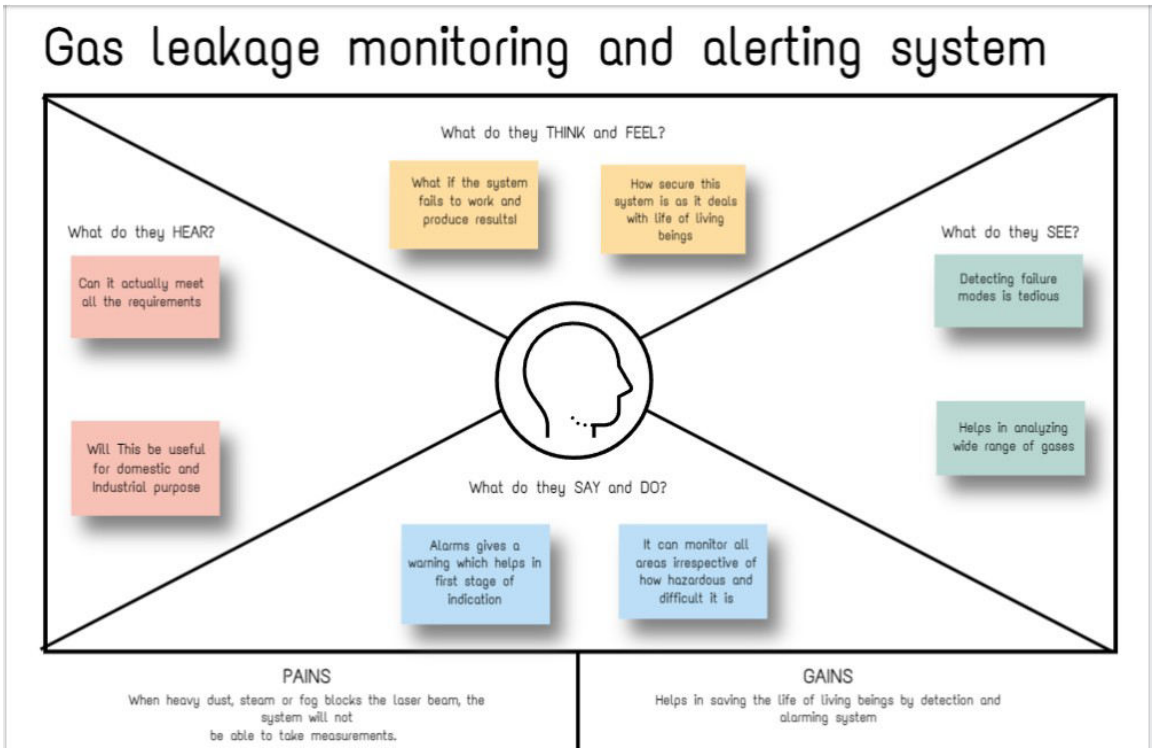
The core component of the system, the Arduino UNO (Atmega-328), carries out the following functions. The output signal of the sensor, which serves as input to Arduino, performs signal conditioning. Results of the detection were shown on LCD. warns individuals of risk at work, in factories, and at home. There is buzzer activity and a beep (siren) sound. Additionally, using a GSM modem, send an alarm SMS to the plant manager whose phone number is saved on the SIM card. The SMS you receive is based on whether there is a gas leak in the sensor's field of detection.

EMPATHY MAP CANVAS:

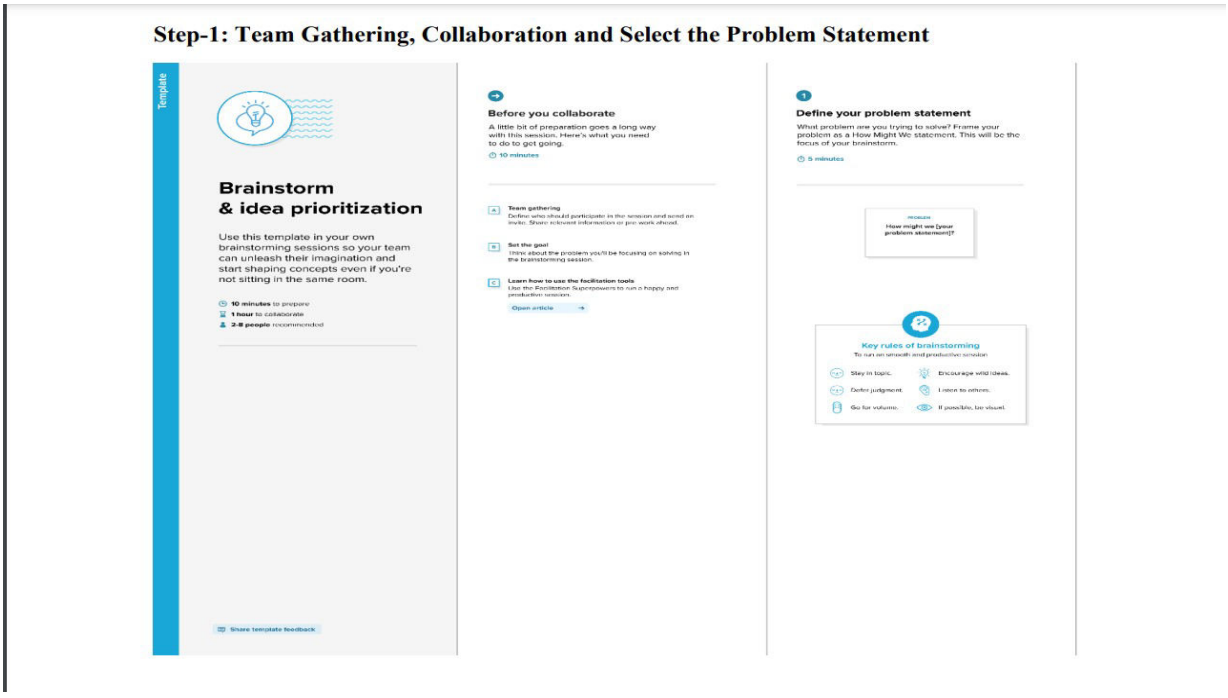
An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

- It is a useful tool to helps teams better understand their users.Creating an effective solution requires understanding the true problem and the person who is experiencing it.

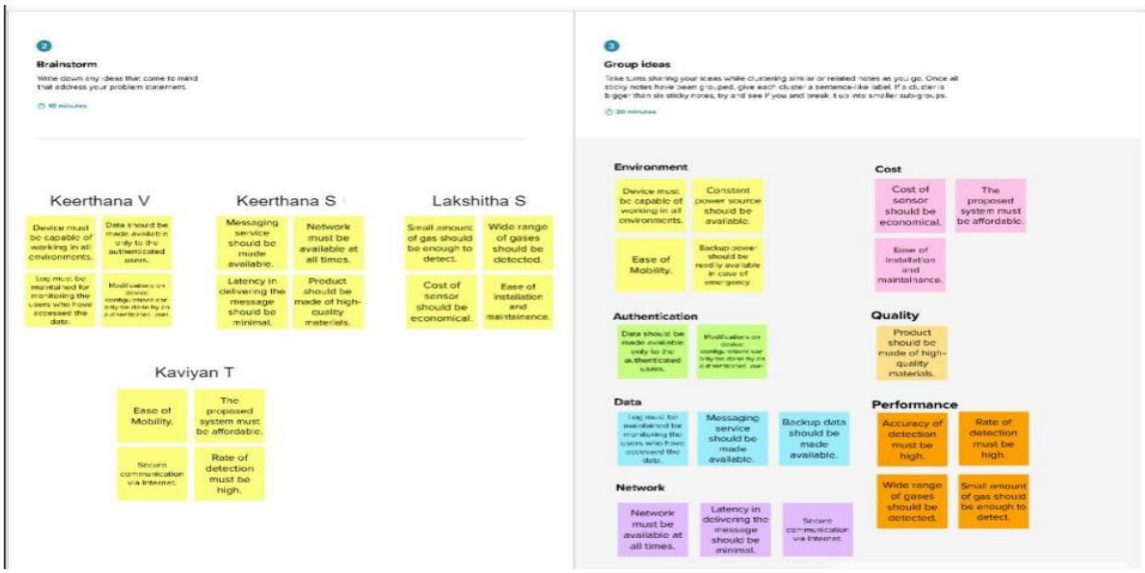
- The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



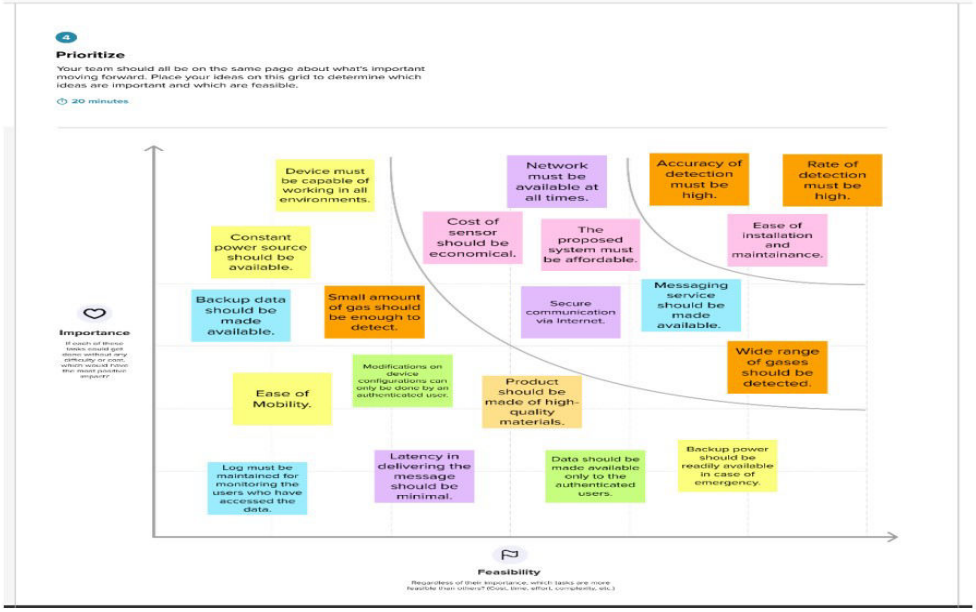
IDEATION AND BRAINSTORMING:



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization



PROPOSED SOLUTION FIT:

Project Title: Gas Leakage Monitoring and Alerting System | **Project Design Phase-I - Solution Fit Template** | **Team ID:** PNT2022TMID14295

1. CUSTOMER SEGMENT(S) CS

- Industrialists
- Engineers
- Safety Control Personals

6. CUSTOMER CONSTRAINTS CC

- Network Connection
- Complexity in Installation

5. AVAILABLE SOLUTIONS AS

- Upgrading to a premium network plan.
- Availing network connection from a reliable Service provider.

Explore AS, differentiate

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

- Capability of the device to withstand in harsh environment is questionable.
- Due to network issue data couldn't be uploaded to the cloud at all times.

9. PROBLEM ROOT CAUSE RC

- Quality of the material using which the device is made up of plays a vital role in the capability of the device to work in harsh environment.
- Location of the device installation and the network plan used by the user are the cause of Network issue.

7. BEHAVIOUR BE

- Harsh environment is prevailing only on certain industry; thus, the frequency of the said problem is low. In such a case the customer complaints multiple times to get the attention.
- Network issue is very common as most of the industries are located at the country side. Here the contact both the developers and the service providers

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

3. TRIGGERS TR

- Usage of the device is portrayed in the news.
- In real life situation, the device has helped in saving number of individuals.

4. EMOTIONS: BEFORE/AFTER EM

- Before the action is taken, the user feels deceived and cheated.
- After the problem is resolved, user feels the sincerity of the developers.

10. YOUR SOLUTION S

- Network strength must be boosted in the device
- Device can be manufactured in multiple standards based on the environment.

8. CHANNELS OF BEHAVIOUR CH

8.1 ONLINE

- E-Mail to developers
- Online Community

8.2 OFFLINE

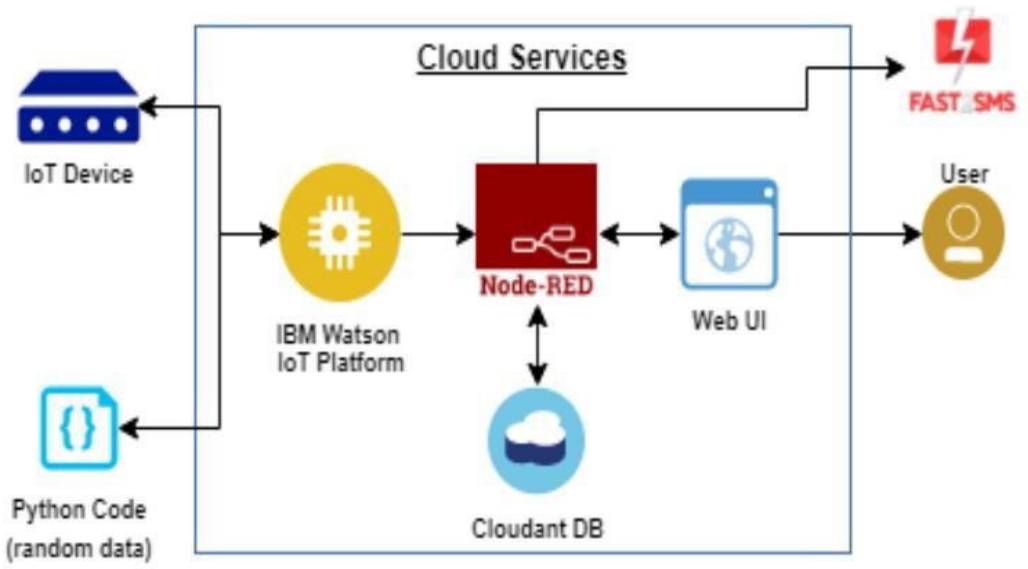
- Complaint Letters

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To detect the gas in the industry and prevent from making hazardous damages.
2.	Idea / Solution description	To detect the gas in the industry and prevent from making hazardous damages.
3.	Novelty / Uniqueness	Sensor automatically restores the gas and saves the data in IoT cloud.
4.	Social Impact / Customer Satisfaction	Customer feel great about this invention because, huge damage is prevented.
5.	Business Model (Revenue Model)	The cost is very low for manufacturing this product.
6.	Scalability of the Solution	It is more reliable and flexible.

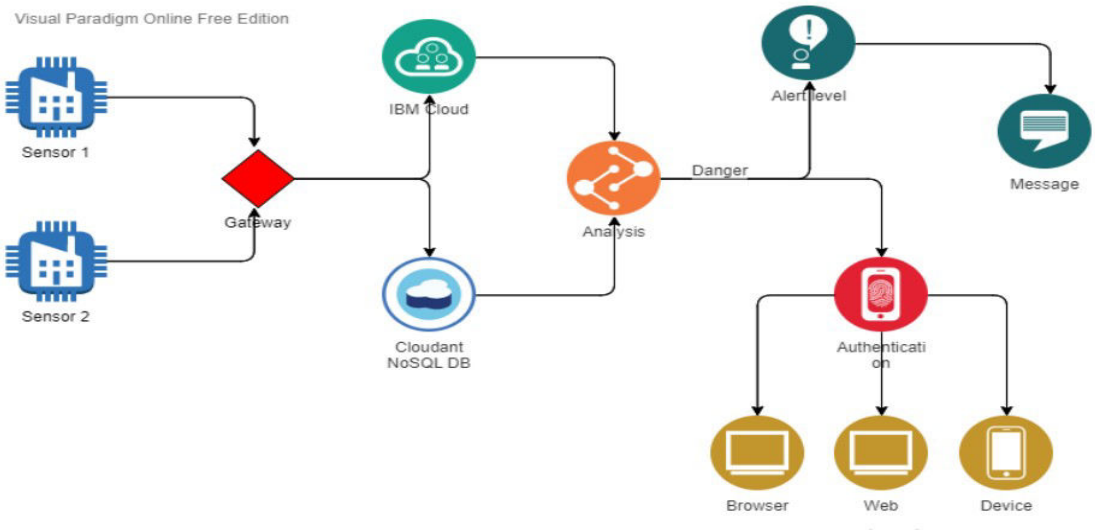
4.REQUIREMENT ANALYSIS:

SOLUTION ARCHITECTURE:

The system can be taken as a small attempt in connecting the existing primary gas detection methods to a mobile platform integrated with IoT platforms. The gases are sensed in an area of 1m radius of the rover and the sensor output data are continuously transferred to the local server. The accuracy of MQ sensors are not upto the mark thus stray gases are also detected which creates an amount of error in the outputs of the sensors, especially in case of methane. Further the availability and storage of toxic gases like hydrogen sulphide also creates problems for testing the assembled hardware. As the system operates outside the pipeline, the complication of system maintenance and material selection of the system in case of corrosive gases is reduced. Thus the system at this stage can only be used as a primary indicator of leakage inside a plant.



Solution Architecture Diagram:

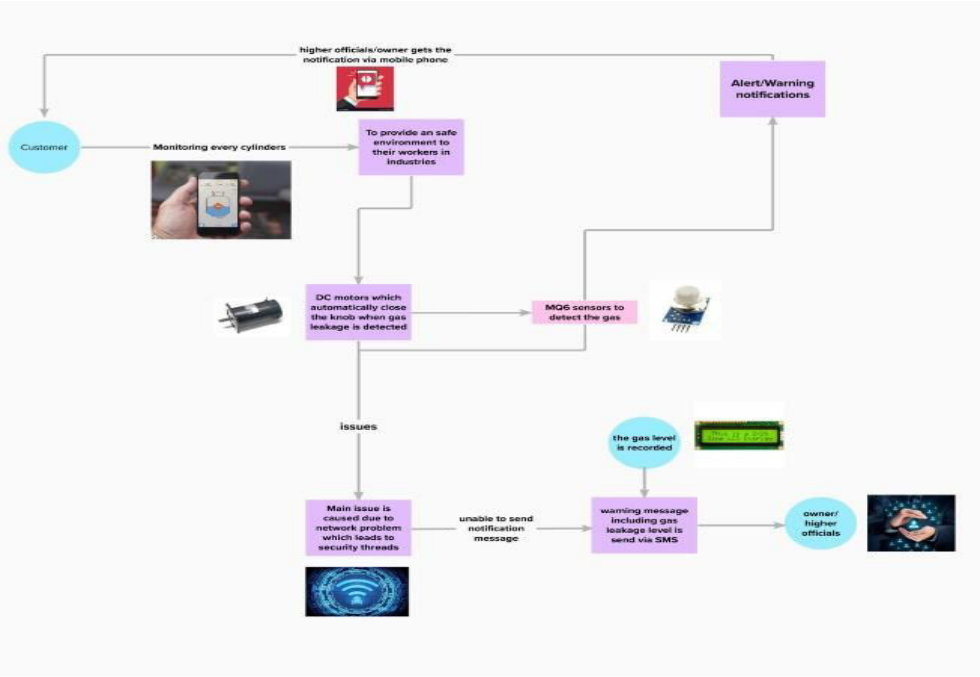


FUNCTIONAL REQUIREMENT:

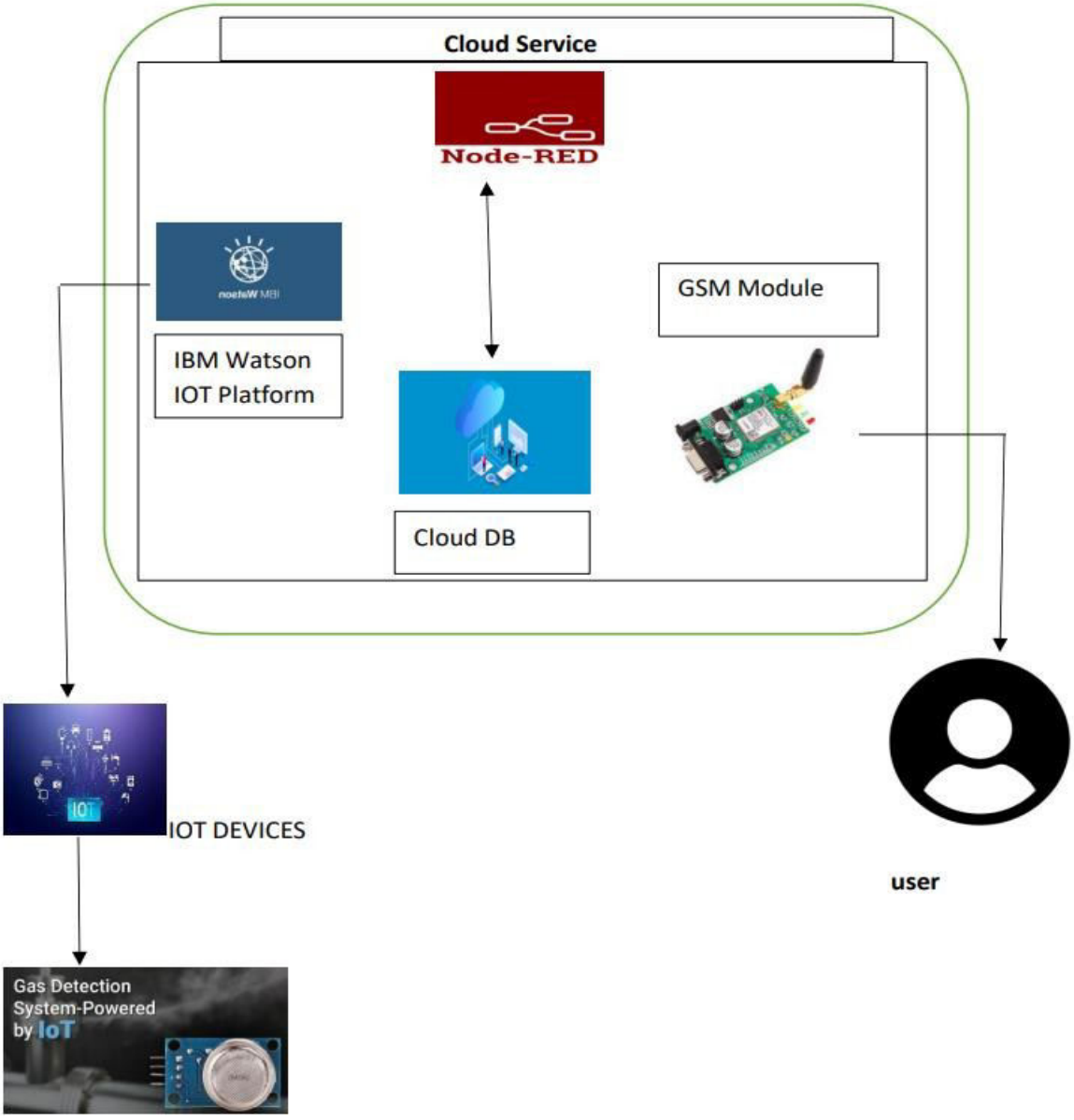
Business Requirements	User Requirements	Product Requirements
The mentioned system is usable in residences, hotels, industrial settings, LPG cylinder storage places, etc. The ability to detect leakage and transmit the information to a location is the primary benefit of this IoT and Arduino-based application. It is observable, and precautions can be taken to avert any catastrophe.	The gas leakage detection system can be upgraded with smoke and fire detectors to detect the presence of smoke and fire in addition as being optimised for detecting dangerous gases. Although ensuring worker safety is critical, adopting the appropriate technology is even more crucial.	Regardless of your professional position or personal goals, gas detection is essential. Such IoT devices are what they are due to certain technologies in use, therefore understanding these technologies and the functions they can serve is necessary if you want to engage in IoT application development.

5.PROJECT DESIGN:

DATA FLOW DIAGRAM:



SOLUTION AND TECHNICAL ARCHITECTURE:



6 PROJECT PLANNING PHASE

PROJECT PLANNING TEMPLANT (PRODUCT BACKLOG, SPRINT PLANNING, STORIES,STORY POINTS)

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

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	NITHYA V
Sprint-1	Features	USN-2	As a system, the gas sensor values should be displayed in a LCD screen	2	Low	SAMPRAVEENR
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	PRAVEEN
Sprint-1	Features	USN-4	As a system, as soon as the detected gas reaches the threshold level, the siren should be turned ON.	5	High	KAVIYARASU

Sprint-2	Focus	USN-5	As a system, it should they send the locationwhere the gas is detected	8	High	NITHYA V
Sprint-2	Focus	USN-6	As a system, it should also send the alerting SMS to the registered phone number	2	Low	

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 be closed automatically once there it attains the threshold value	5	Medium	PRAVEEN
Sprint-2	Features	USN-8	As a system, it will indicate that the gas leakage pipe is closed in the LCD screen and send SMS to the registered mobile number.	5	Medium	MANGAI.B
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	SAMPRAVEE
Sprint-3	Data Transfer	USN-10	As a system, it should send the data of sensor values along with latitudes and longitudes to the IBM cloud	5	Medium	NITHYA V
Sprint-3	Data Transfer	USN-11	As a cloud system, the IBM cloud should send the data to Node Red	2	Medium	KAVIYARASU
Sprint-3	Data Transfer	USN-12	As a system, it should collect the data from the Node Red and give it to the backend of the mint app.	3	Medium	PRAVEEN

Sprint-3	Data Transfer	USN-13	As an application, it should display the details of the gas level and other details to the user through the frontend of the mint app.	8	High	Jeevitha D
Sprint-4	Registration	USN-14	As a user, I must first register my email and mobile number in the website	2	High	Amosdaniel E

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	Anitha P
Sprint-4	Login	USN-16	As a user, I can login into the web application through email and password.	3	High	Arunkumar M
Sprint-4	Dashboard	USN-17	As a user, I can access the dashboard and make use of available resources.	2	Medium	Shalini Sj
Sprint-4	Focus	USN-18	As a user, I must receive an SMS once the leakage is detected.	5	High	Velu R
Sprint-4	Allocation	USN-19	As an admin, I must receive information about the leakage along with location and share exact location and route to the person.	3	High	Jeevitha D
Sprint-4	Allocation	USN-20	As an admin, I must allot particular person to look after the leakage in a particular location.	3	High	Amosdaniel E

Project Tracker, Velocity & Burn down Chart: (4 Marks)

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		29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022		05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		19 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

per iteration unit (story points per day)

7- CODE FOR IBM Watson IoT Platform:

```
import time import sys

import

ibmiotf.application

import ibmiotf.devicex

import random

#Provide your IBM Watson Device Credentials

organization = "jjrtf7" deviceType = "ESP32"

deviceId = "1234" authMethod = "token"

authToken = "12345678" # Initialize GPIO def

myCommandCallback(cmd):

print("Command received: %s" %

cmd.data['command']) status=cmd.data['command'] if

status=="switchon": print ("Switch is on") else :

print ("Switch is off") #print(cmd)

try:

deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth method": authMethod,

"auth-token": authToken} deviceCli =

import time import sys

import

ibmiotf.application

import ibmiotf.devicex

import random
event of type "greeting" 10 times deviceCli.connect() while True:

#Get Sensor Data from DHT11
```

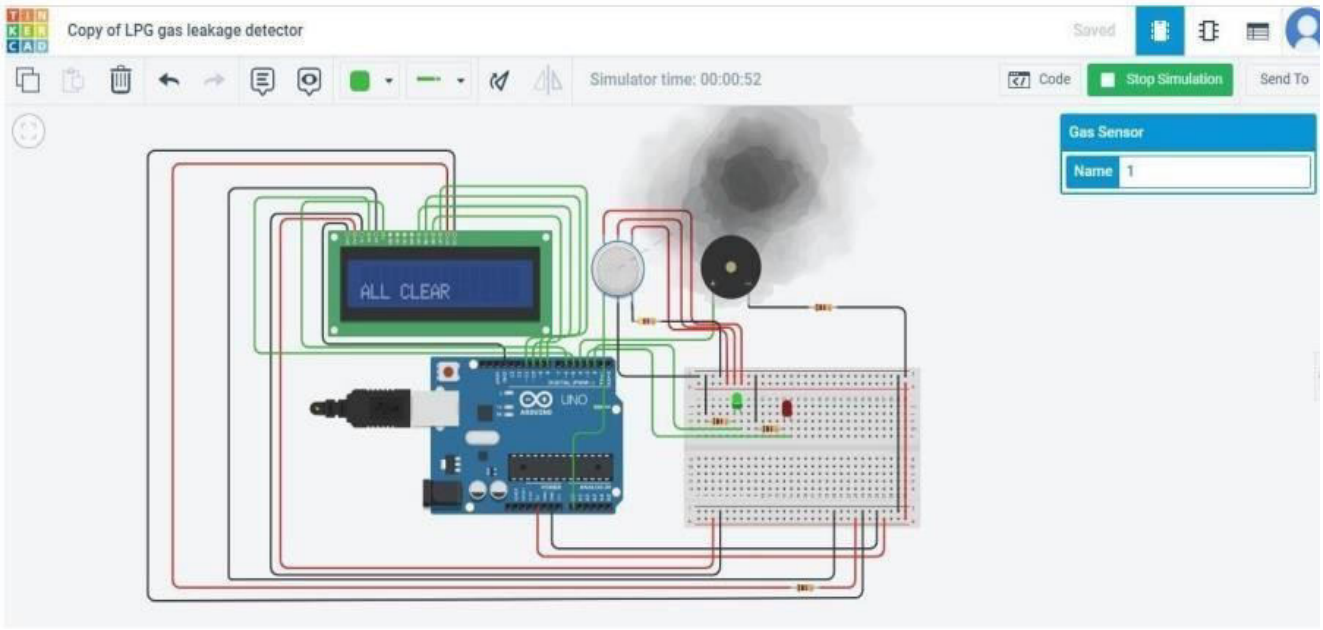
```
temp=random.randint(0,100)
Humid=random.randint(0,100)
gasconcentration=random.randint(0,100) data = { 'temp' :
temp, 'Humid': Humid, "gasconcentration":
gasconcentration} #print
data def
myOnPublishCallback():
print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid,
"gasconcentration = %s %%" % gasconcentration, "to IBM Watson") success =
deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
if notsuccess: print("Not connected to IoTF")
time.sleep(1) deviceCli.commandCallback =
myCommandCallback # Disconnect the device and
application from the cloud deviceCli.disconnect()
```

SOLUTION STATEMENT:

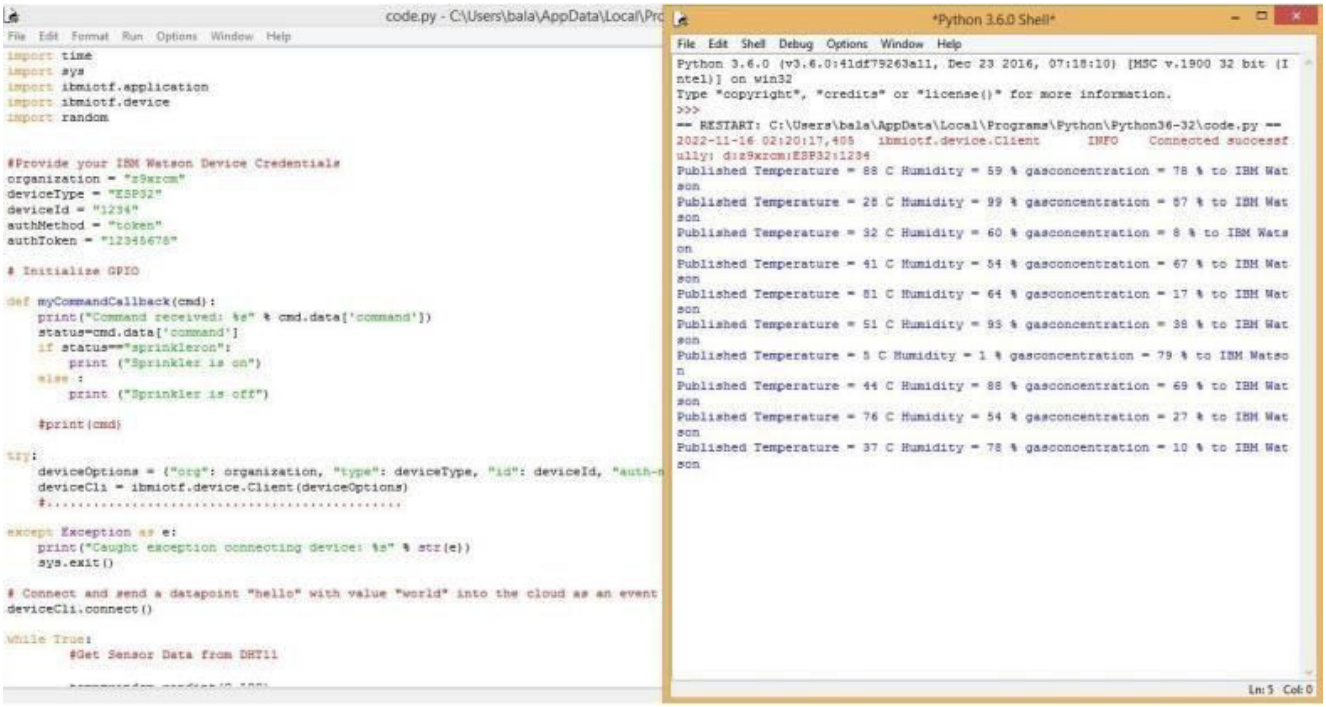
The system might be viewed as a modest attempt to link up the principal gas detection techniques now in use with a mobile platform coupled with IoT platforms. One metre around the rover, the gases are detected, and the sensor output data is continually sent to the nearby server. Stray gases are also detected because of the sensors' subpar precision, which introduces some inaccuracy into their results, particularly in the case of methane. Additionally, the storage and availability of hazardous gases like hydrogen sulphide makes it difficult to test the integrated gear. The complexity of system maintenance and material selection for the system in the event of corrosive gases is reduced because the system operates outside the pipeline. The system can only be used as a primary indicator of leakage inside a plant at this point.

8 &9 -TESTING & RESULTS:

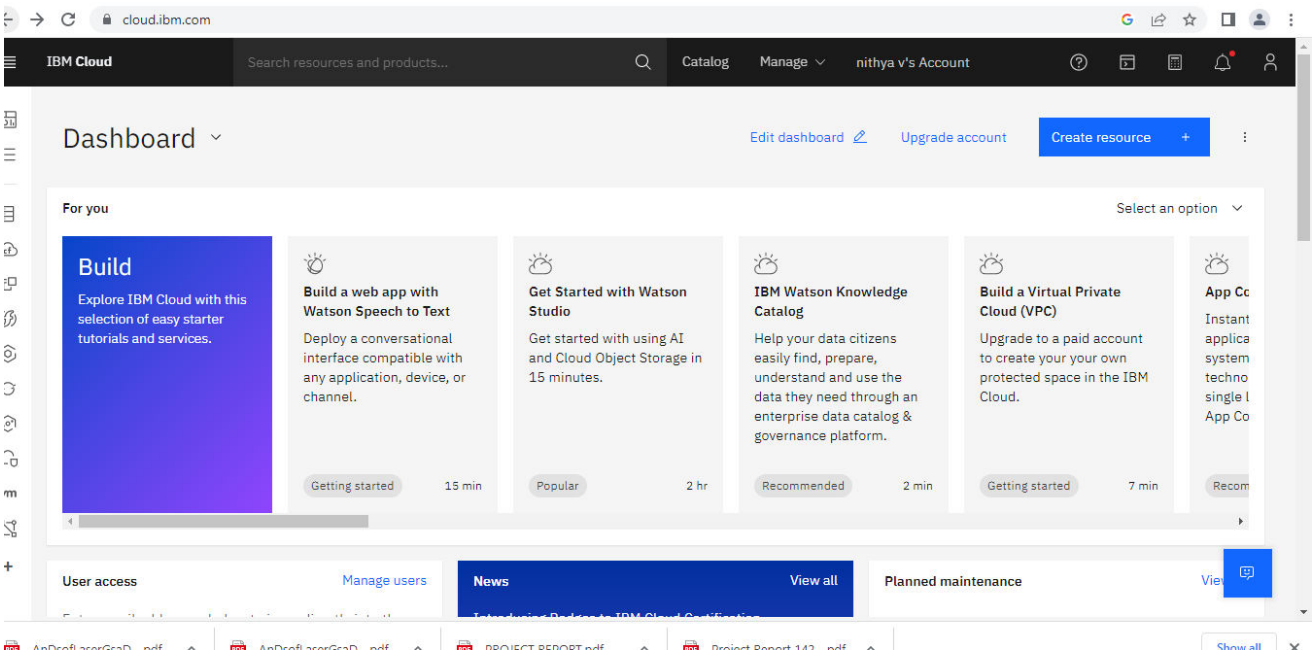
TINKERCAD:

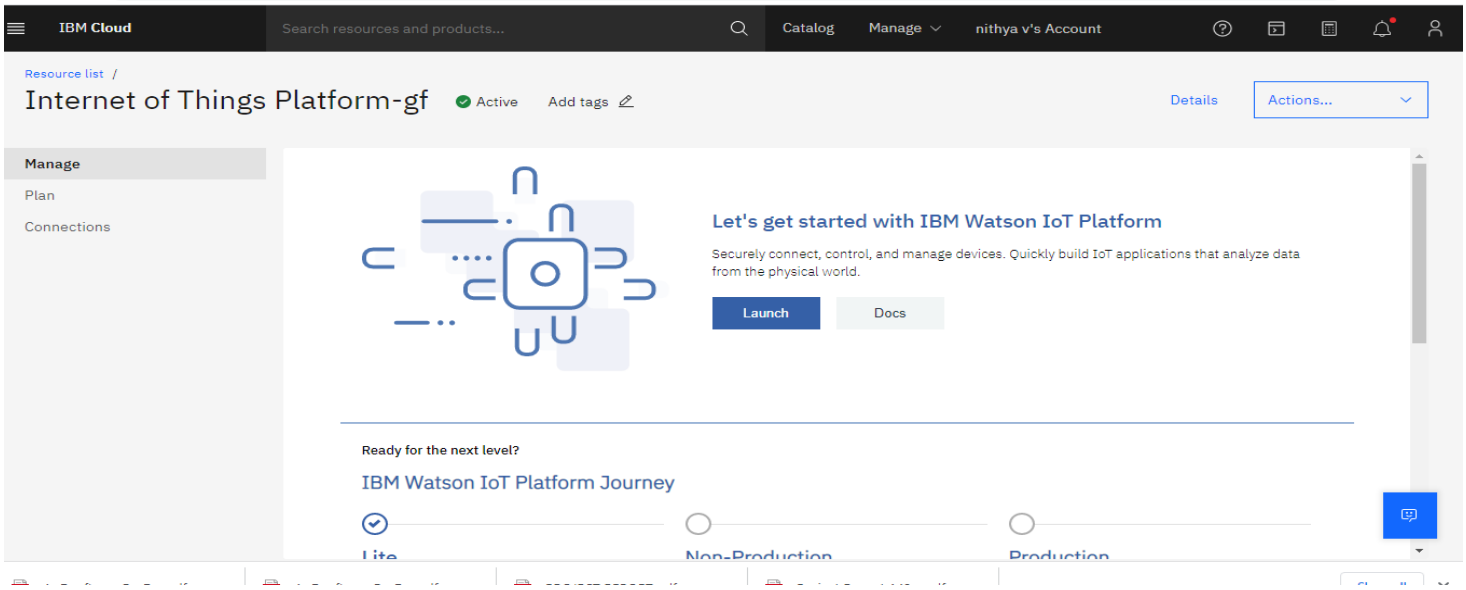


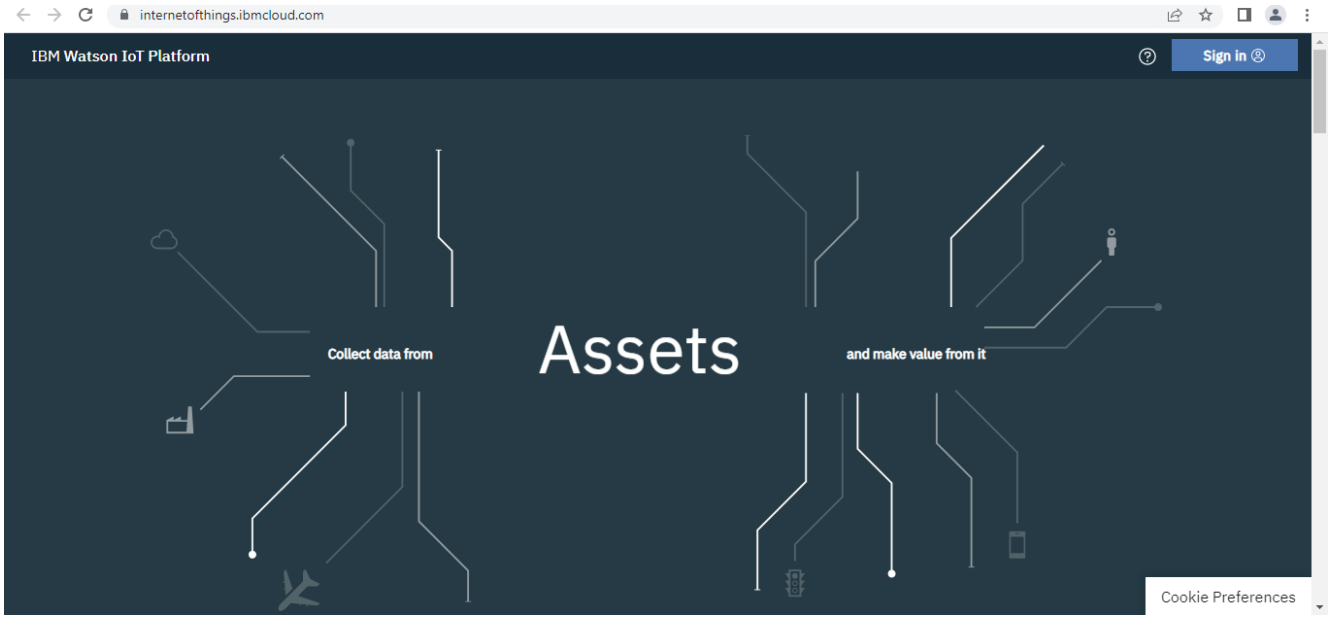
PYTHON CODE EXECUTION:

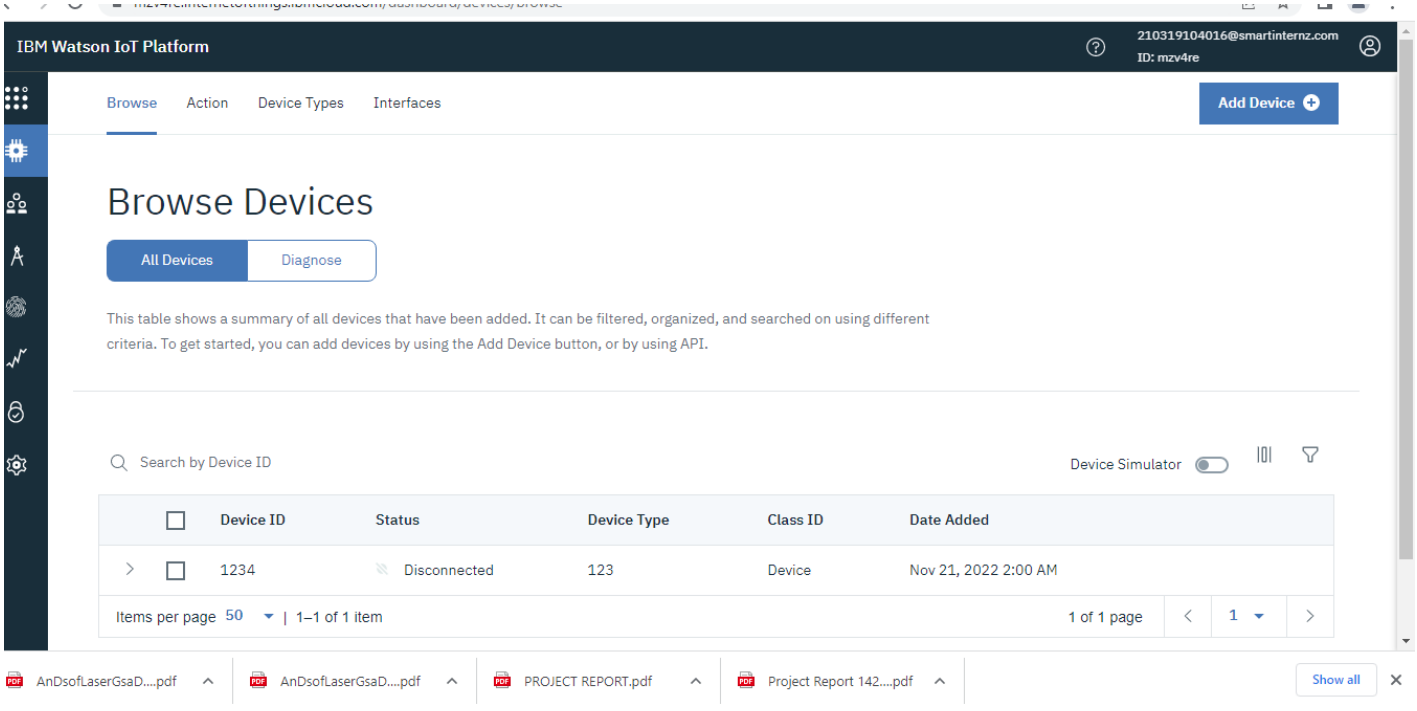


RECENT EVENTS IN IBM WATSON IOT PLATFORM:

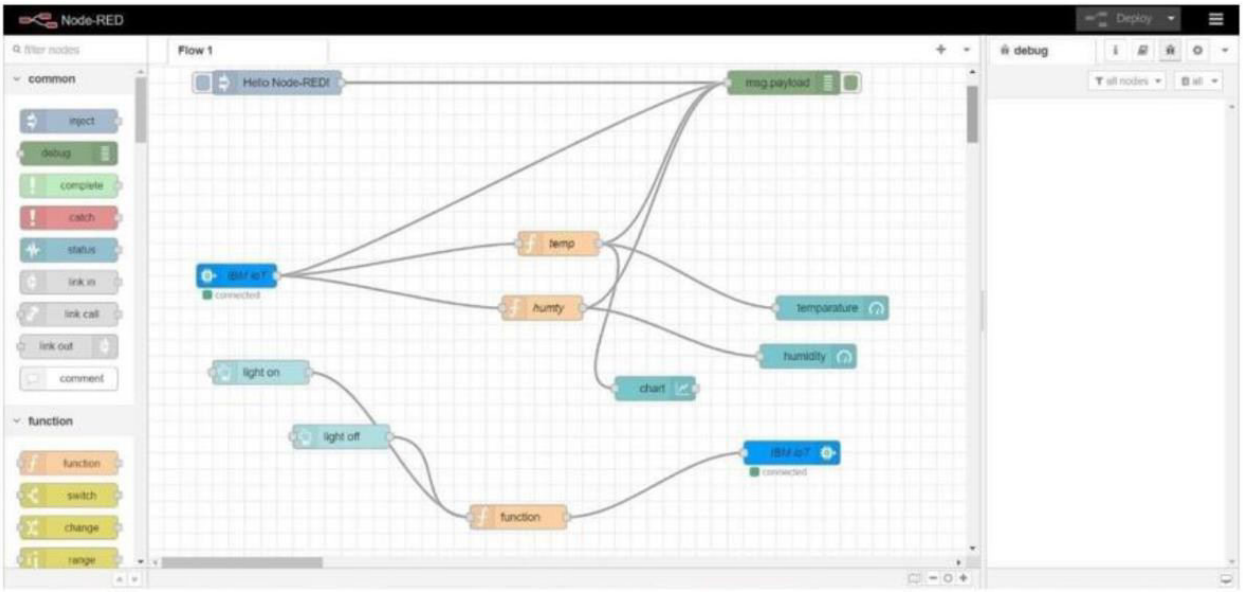




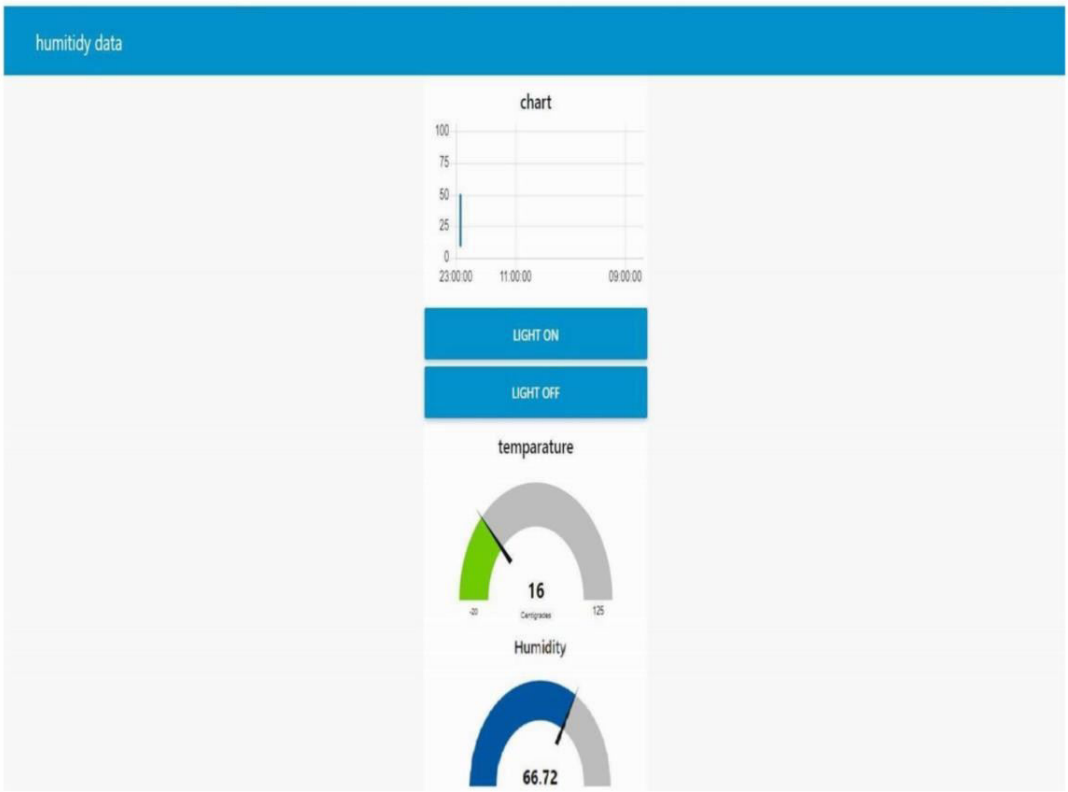

internetofthings.ibmcloud.com
IBM Watson IoT Platform
Sign in
Collect data from
Assets
and make value from it
Cookie Preferences


IBM Watson IoT Platform
210319104016@smartinternz.com
ID: mzv4re
Browse
Action
Device Types
Interfaces
Add Device
Browse Devices
All Devices
Diagnose
This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.
Search by Device ID
Device Simulator
Device ID
Status
Device Type
Class ID
Date Added
1234
Disconnected
123
Device
Nov 21, 2022 2:00 AM
Items per page 50
1–1 of 1 item
1 of 1 page
1
AnDsofLaserGsaD....pdf
AnDsofLaserGsaD....pdf
PROJECT REPORT.pdf
Project Report 142....pdf
Show all

NODE RED FLOW:



DASHBOARD CREATED USING NODE:



10. The Advantages and Disadvantages gas leakage monitoring & alerting

Advantages:

- Because of the very narrow 0.3 nm line width of the laser emission, there is no interference from other gases.
- Response times are in the order 1 second. This allow for fine resolution/control when making process measurements.
- The intense laser light concentrated at the absorption wavelength enables path lengths up to 1 km to be measured.
- An average measurement is taken over the total path so that a narrow plume of gas has less chance of escaping detection.
- The range of measurement can be up to 4 orders of magnitude, enabling concentrations of 0.1 ppm to 1000 ppm to be measured.
- Because of the internal reference cell, the system is self calibrating.
- There is no ‘poisoning’ or degradation of the instrument with long term exposure to a gas.
- Can easily be conformed to be ‘Intrinsically Safe’.
- Low maintenance and low operating costs.
- Reliable technology.

Disadvantages:

- Only one gas can be measured with each instrument.
- When heavy dust, steam or fog blocks the laser beam, the system will not be able to take measurements. This is also the case when a person or vehicle blocks the path.

11 CONCLUSION:

We can conclude from the project's performance that the system's detection of LPG gas leakage is remarkable. Useful for both residential and commercial purposes. We can use this technique to save lives in dangerous situations. The GSM module indicates an alert. Propane, CO2, and other gases are detected by a sensor node. Power usage and transmission range estimates are made. The sensor was constructed using straightforward techniques and an Arduino UNO Micro controller.

12 APPENDIX:

SOURCE CODE:

```
#include <LiquidCrystal.h>
LiquidCrystal
lcd(5,6,8,9,10,11);
 int redled = 2;
 int greenled = 3;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 400;
void setup()
{
pinMode(redled, OUTPUT);
pinMode(greenled,OUTPUT);
pinMode(buzzer,OUTPUT);
```

```
pinMode(sensor,INPUT);
Serial.begin(9600);
lcd.begin(16,2); }
 void loop() {
  int analogValue = analogRead(sensor);
Serial.print(analogValue);
if(analogValue>sensorThresh)
  {
   digitalWrite(redled,HIGH);
digitalWrite(greenled,LOW);
tone(buzzer,1000,10000);
    lcd.clear();
lcd.setCursor(0,1);
lcd.print("ALERT");
delay(1000);     lcd.clear();
lcd.setCursor(0,1);
lcd.print("EVACUATE");
delay(1000);
  }
else
  {

digitalWrite(greenled,HIGH);
digitalWrite(redled,LOW);
noTone(buzzer);
```

```
        lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("SAFE");
      delay(1000);

    lcd.clear();

 lcd.setCursor(0,1);
lcd.print("ALL CLEAR");
delay(1000);

       }
}
```

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-55269-1667971560