GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

Team ID	PNT2022TMID21389
Team members	**Team Leader**: Nanthini K - 917719D056 **Team members:** Aghalya P - 917719D006 Anandha Ganesh M - 917719D009 Lokesh V S - 917719D045
Branch	Electronics and Communication Engineering
Institution	Thiagarajar College of Engineering

CHAPTER 1

INTRODUCTION

` Today's world places a high priority on safety, making it imperative that specific safety measures be taken in both work and residential settings. Working or living in hazardous environment necessitates particular safety practises, whether the conditions involve electricity or oil and gas. Natural gas that has been liquified under high pressure and is housed in a metal cylinder is known as "liquefied petroleum gas" (LPG). LPG is extremely flammable and can result in a major catastrophe if exposed to any fire source without protection. LPG is the most accessible natural gas and is largely used for cooking. Unfortunately, because of its widespread use, gas leaks and even explosions have become prevalent. Consequently, a method for detecting and monitoring gas leaks must be developed.

1.1 PROJECT OVERVIEW

To provide the greatest customer service possible, many commercial enterprises like hotels and fast-food restaurants use combustible gases, such as carbon dioxide, LPG, ammonia, and so forth. There is no denying the use of such gases. They have, however, also increased the risk to human life and the harm it poses. Businesses that deal with gas must take specific procedures to ensure work is completed in the safest manner possible, with safety being their first priority. An MQ6 sensor is used for gas leak detection enabled by the Internet of Things. It recognises when the pressured gas system isn't working properly to stop gas from building up and causing an explosion.

The MQ6 gas sensors first identify gas leaks. Secondly, the IOT sensors are used to transmit the signals to the ARM. After then, a microcontroller is used to send an activation ping to the outside linked devices. Lastly, the GSM module is further activated by a number of devices, including an exhaust fan, buzzer, and sprinkler.

1.2 PURPOSE

The 400 different types of scent receptors in the human nose allow us to detect over 1 trillion different odours. However, most of us are unable to distinguish between the various gases that are present in the environment. Gas detection sensors are helpful in this regard. The development of an IOT-powered system and the detection of different dangerous gas concentrations in industrial facilities are where they are most frequently used. By protecting them from unforeseen hazards like gas leaks and explosions, it aids refineries and manufacturers. The following are the top advantages of IOT-based apps for gas leak detection.

a. Fire hazard prevention

b. Harmful gas detection

c. Oxygen level indication

d. Gas leak alerts

CHAPTER 2

LITERATURE SURVEY

We did a research over the possible sources that we could access. We have studied the previous state of arts and have known their drawbacks well. And we attempted amending those in our proposal.

2.1 EXISTING PROBLEM

The primary problem associated with the existing state of arts is that they concentrate more on detecting and monitoring the leaks and seldom do they care about what to be done post detection. The ultimate aim of the proposals was to detect the leaks and not to control the leaks. Secondly, there were minimal arts that contributed for industrial applications rather domestic applications. Moreover, the proposals that are applicable for industries also, were not very specific to the industries alone.

2.2 REFERENCES

- "*Smart Gas Leakage Detection with Monitoring and Automatic Safety System*", by S.M. Zinnuraain, Mahmudul Hasan, Md. AkramulHakque, and Mir Mohammad NazmulArefin, published in International Conference on Wireless Communications Signal Processing and Networking (WiSPNET), 2019.

- "*Gas Leakage Detection System using IoT with integrated notifications using Pushbullet-A Review*", by M Athish Subramanian, Naveen Selvam, Rajkumar S, R Mahalakshmi, and J Ramprabhakar, published in Fourth International Conference on Inventive Systems and Control (ICISC), 2020.

- "*FPGA-GSM based Gas Leakage Detection System*", by Arpitha .T,Divya Kiran, V. S.N. Sitaram Gupta and Punithavathi Duraiswamy, published in IEEE Annual India Conference (INDICON), 2016.

- "*Gas Leakage Detection Based on IOT*", by Suma V, Ramya R Shekar, and Akshay Kumar A, published in 3rd International conference on Electronics, Communication and Aerospace Technology (ICECA), 2019.

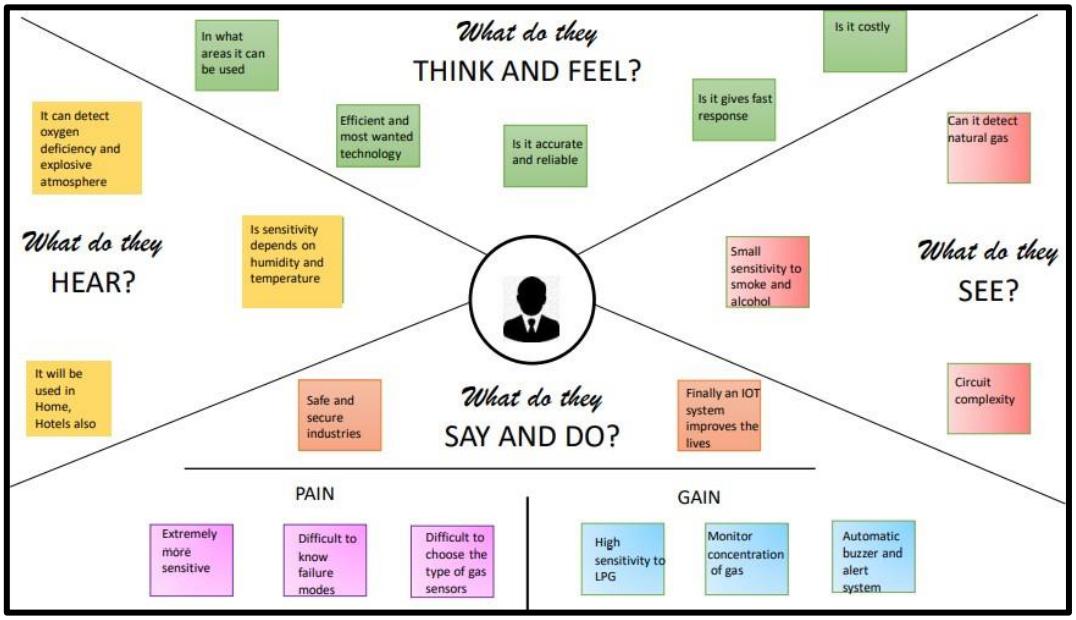
2.3 PROBLEM STATEMENT DEFINITION

The problem is to develop a system that efficiently monitors and detects harmful gas leaks and also has an in- built mechanism to nullify the gas leakage if detected so.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION AND BRAINSTORMING

The leakage of gas leads to major fire accidents which lead to heavy damage inside the industry as well as the loss of human beings. It is feasible to detect the gas leakage before any disaster happened. So, industries need a very efficient gas leakage detection system.

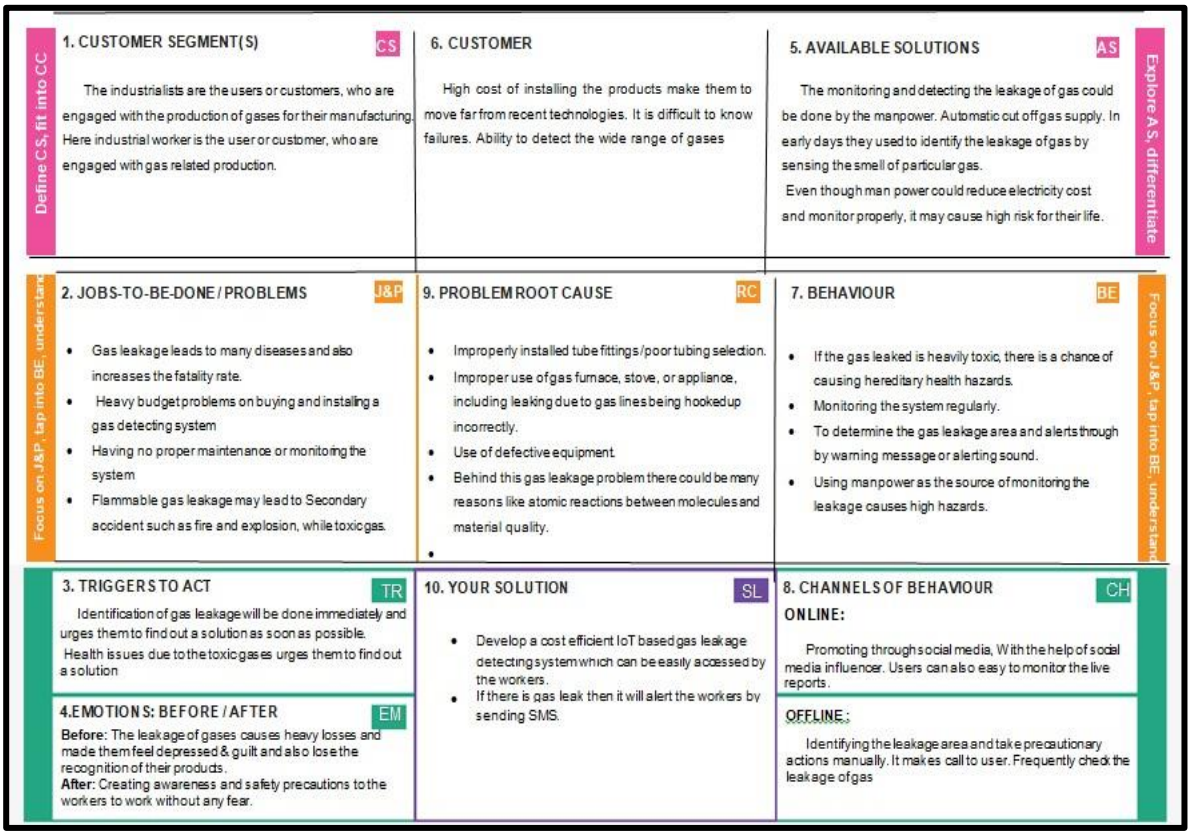
The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises. The gas sensors help detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts.

A catalytic gas sensor contains a platinum coil and is heated when it comes into contact with gaseous reactants. This raises the temperature within the coil. The catalytic gas sensor will sound the alarm and alert people if that temperature change is not within what is considered as safe.

3.3 PROPOSED SOLUTION

The proposed solution essentially uses node red to monitor the gas leaks and send alert messages to the concerned people. The process of operating the model is easy and the results are accurate to greater scale. The sensor plays indeed a major role in the system. The whole of the system is relied on the efficiency of the sensor that is used. Once the sensor sense the leakage, the system generates an alert message and send it to the concerned contact, the details of which is pre-stored in our IBM cloud.

3.4 PROBLEM SOLUTION FIT



CHAPTER 4

REQUIREMENT ANALYSIS

4.1FUNCTIONAL REQUIREMENT

FRNo.	FunctionalRequirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	GPS Access	GPS access to know the location
FR-4	Business Requirements	The device is intended for the use of industries or factories and also for cylinder storage areas. It detects the leakage of gas and sends the data over to a site and preventive measures can be taken to avoid the loss of properties.
FR-5	User Requirements	The Gas leakage detecting system with upgrading technologies which identifies the leakage of gas and also ensures theworkers safety.

4.2 NON – FUNCTIONAL REQUIREMENT

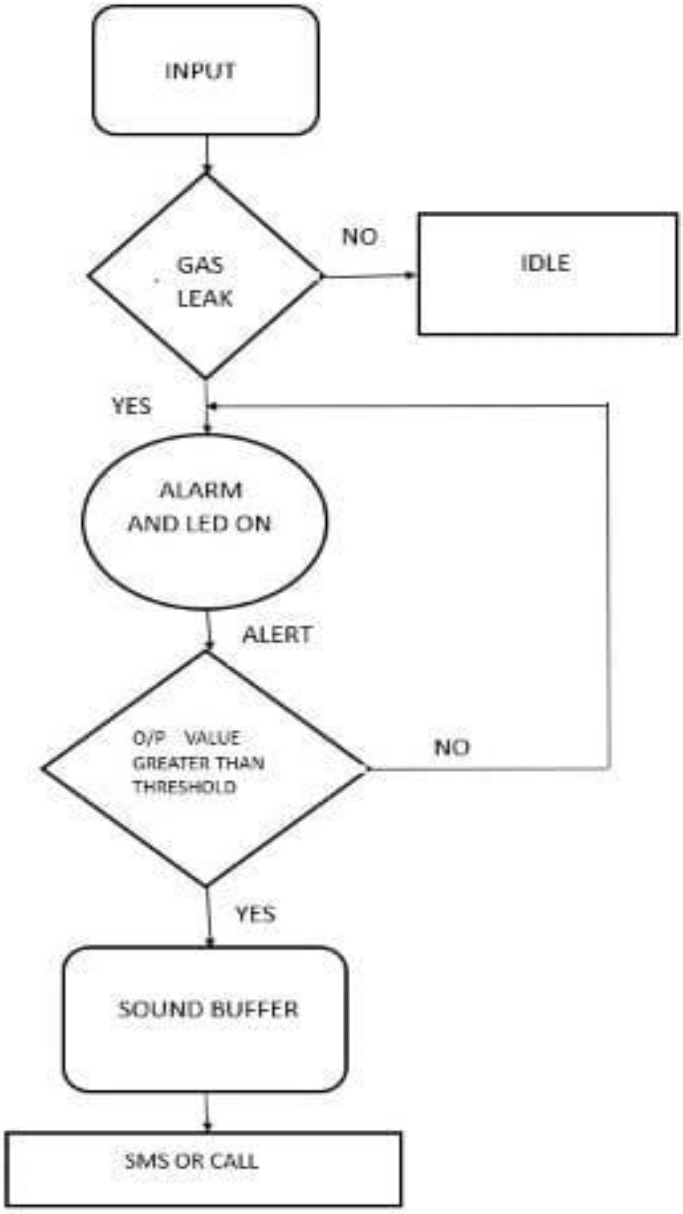
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The sensors used to detect the gas leakage which helps to prevent the high risk of gas explosion and also can prevent the causalities within and outside the covering area of the industries.
NFR-2	**Security**	The device is intended for the use of industries or factories, where there is a use of explosive gas is a source of risk. This device will help and secures from the causes.
NFR-3	**Reliability**	Gas leakage detecting system detects the gas leakage at industries or factories which detects the small amount of gas leakage as soon and sends the alerting SMS to users.
NFR-4	**Performance**	The Gas leakage detecting system is a device with an alarm setting. Whenever there is a gas leak, which is greater than the threshold level, the in-build sensor detects and alerts the user within a minute much before it can cause any accidents.

NFR-5	**Availability**	The gas leakage detecting system is readily available in the market which is extremely expensive, but here we are providing a low-cost circuit for gas leakage detecting system and also it is user friendly
NFR-6	**Scalability**	The system is very simple and easy to maintain with cost efficient. A backup power supply will be included in the design to prevent from the powerfailure conditions. It has the capability to works fora period of time without any damage in the system components.

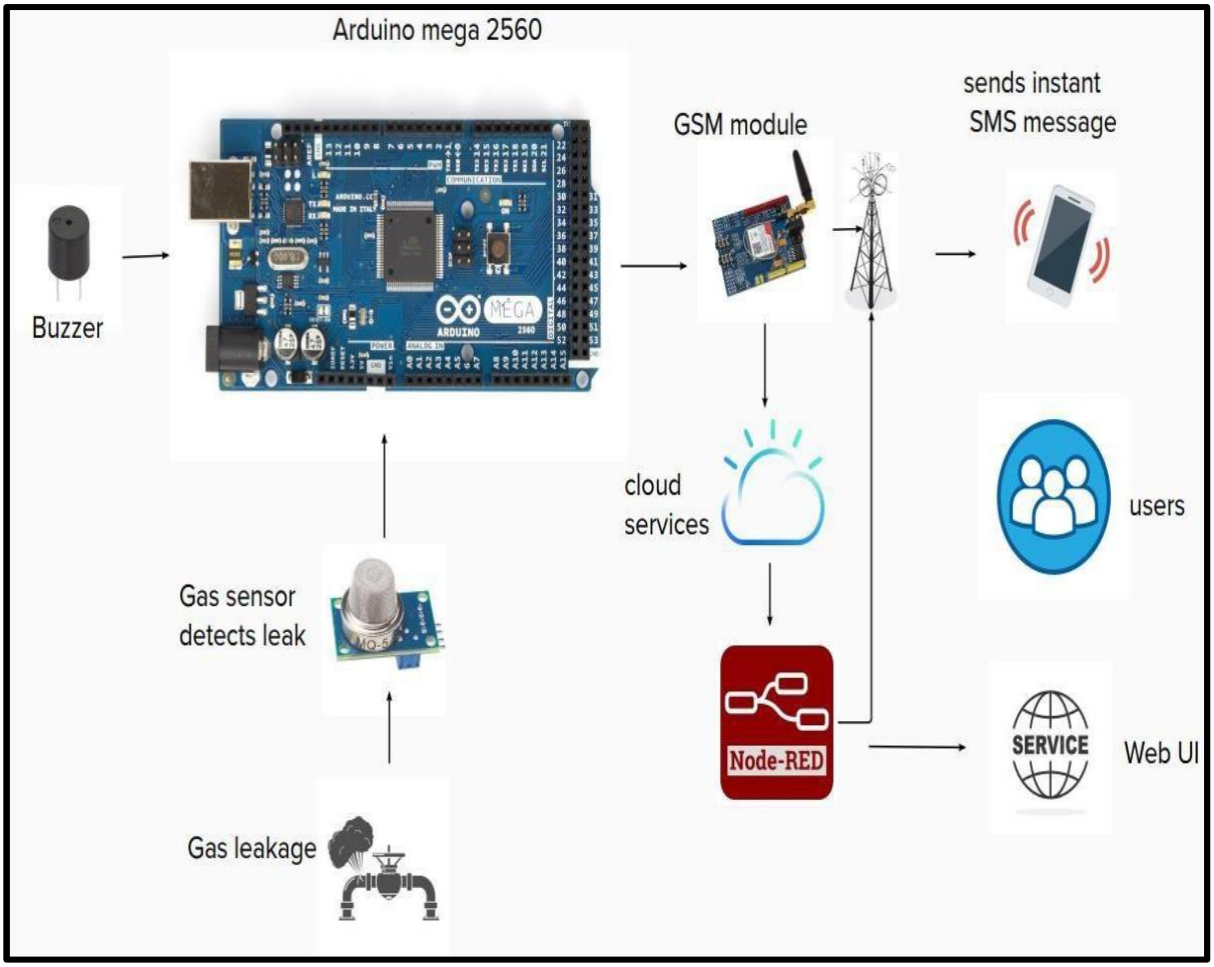
CHAPTER 5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAM



5.2 SOLUTION AND TECHNICAL ARCHITECHTURE



5.3 USER STORIES

User Type	Functioal Requment (Epic)	User Story Nuber	User Story /Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can create an accountin the application provided.	I can access myaccount/ dashboard	High	Sprint- 1
		USN-2	As a user, I registered using my Gmail	I can receive confirmat ion email	High	Sprint- 1
		USN-3	As a user, I can successfull y install the app.	I can register & access the dashboard.	Low	Sprint- 2
	Login	USN-4	As a user, I canlogin using my Gmail and password easily.	The login process was easy and simple to accessthe dashboard .	High	Sprint- 1
Customer (Web user)	Registration	WUSN-1	As a web user I can login to web dashboard just like a website.	I can register & access the dashboard.	High	Sprint- 2

	Dashboard	WUSN-2	As a user I can view the alert/warning SMS in the web application.	I can login to the website using my login credentials	High	Sprint- 2

Customer Care Executive		CCE-1	A customer care executive will always be available for the interaction with the customer to clarify the queries.	An executive will clarify the doubts and note down the complaints of the application if any.	High	Sprint- 2
Administrator		ADMIN-1	I as an Admin can access and view the data or information provided by the application &can also check, analyse the threshold value ofthe gas.	The details of the gas leakage level of the gas are provided to the users through SMSwhen an alerting sound is received.	High	Sprint- 1

CHAPTER 6

PROJECT PLANNING AND SCHEDULING

6.1SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resources Initialization	Createand initialize accounts in IBM cloud and NODE- RED Services.	1	LOW	Nanthini K Aghalya P Anandha Ganesh M Lokesh VS
Sprint-1	Local Server/Software Run	Create a Required device in IBM cloudand the python code	1	MEDIUM	Nanthini K Aghalya P Anandha Ganesh M Lokesh VS
Sprint-2	Push the server/software to cloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	2	MEDIUM	Nanthini K Aghalya P Anandha Ganesh M Lokesh VS
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the sameusing Nodered	2	HIGH	Nanthini K Aghalya P Anandha Ganesh M Lokesh VS

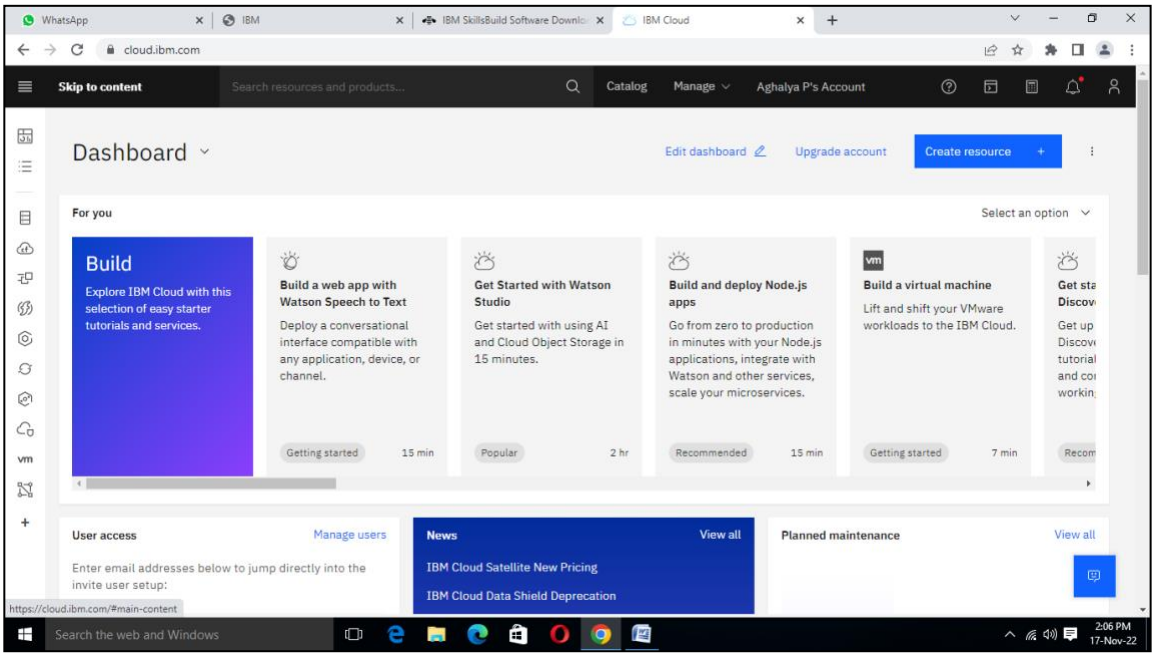
Sprint -4	UI/UX Optimization & Debugging	Optimize all the shortcomings and provide better user experience.	2	LOW	Nanthini K Aghalya P Anandha Ganesh M Lokesh VS

6.2 SPRINT DELIVERY SCHEDULE

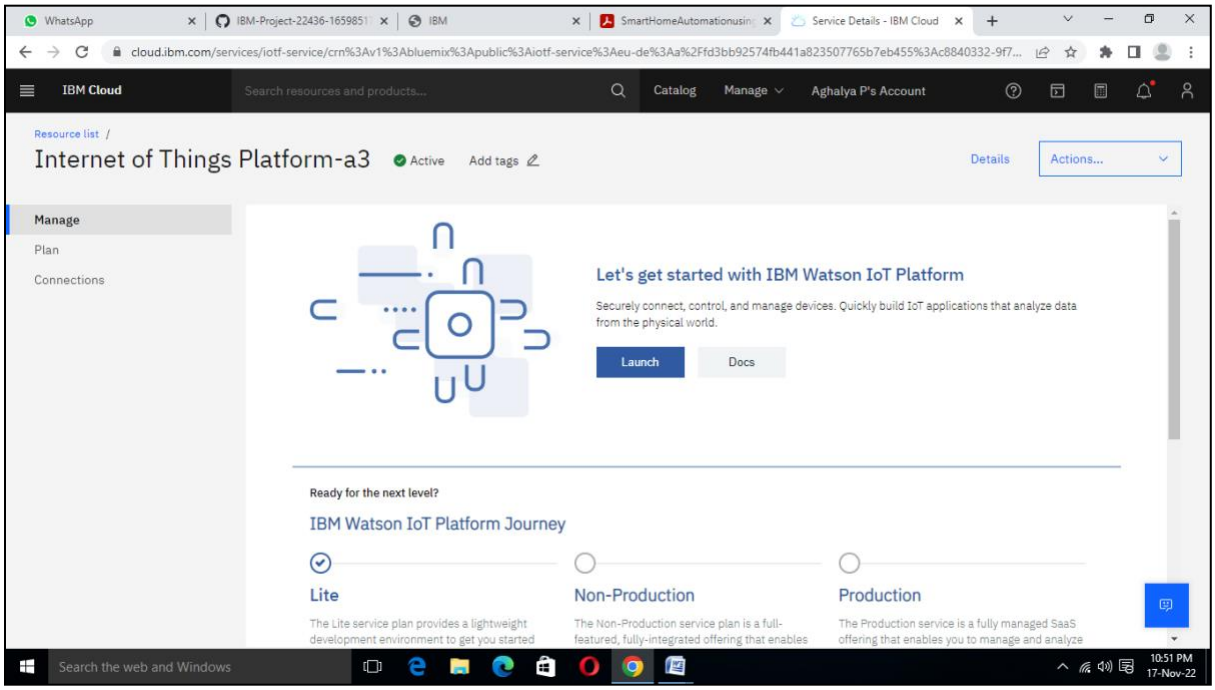
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date(Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022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

IBM WATSON - DEVICE

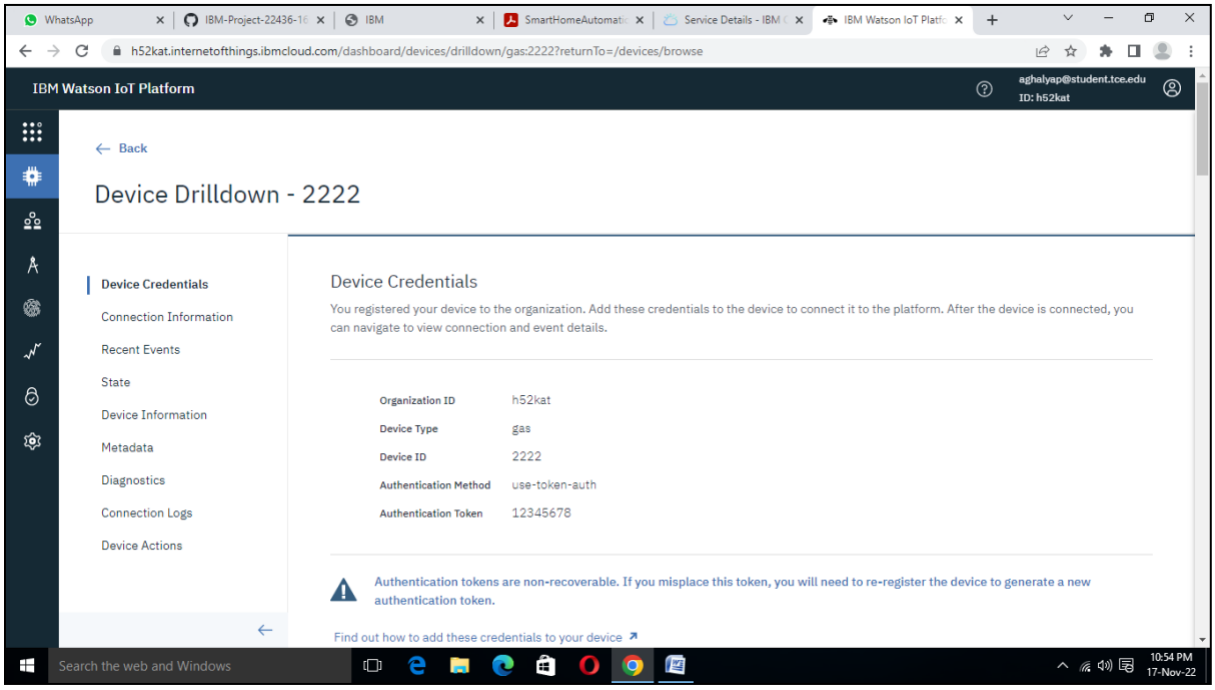
Ibm login dashboard



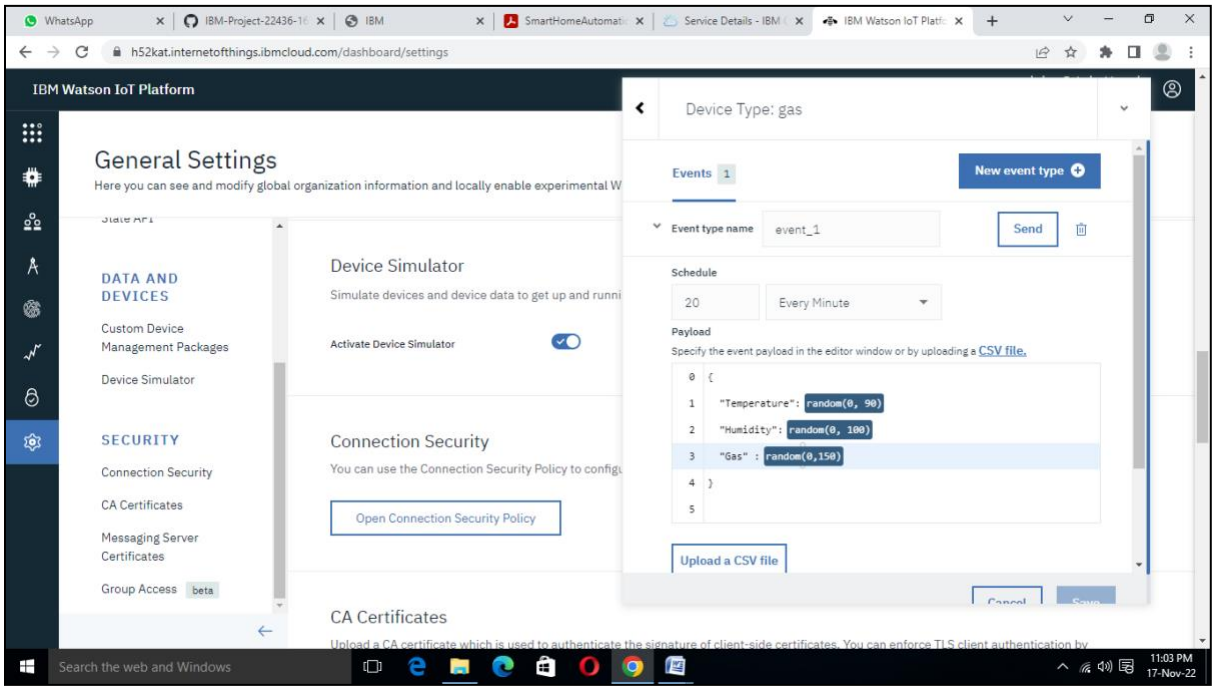
Launching the device



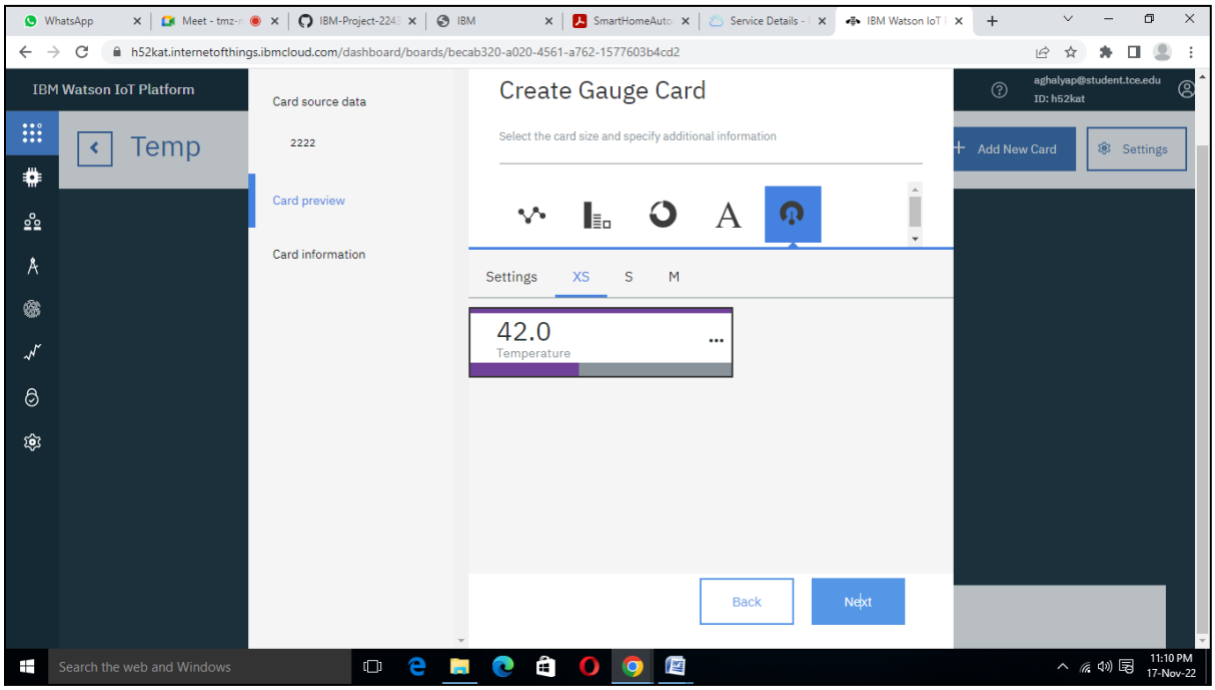
Device credentials



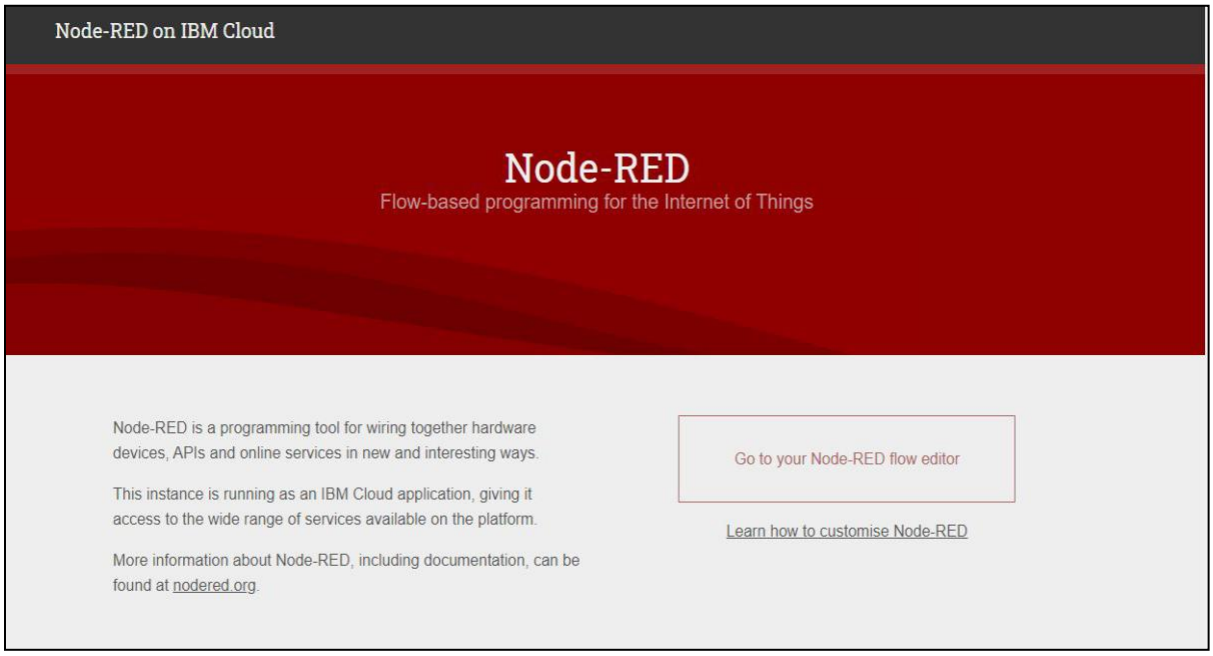
Sensor testing simulation



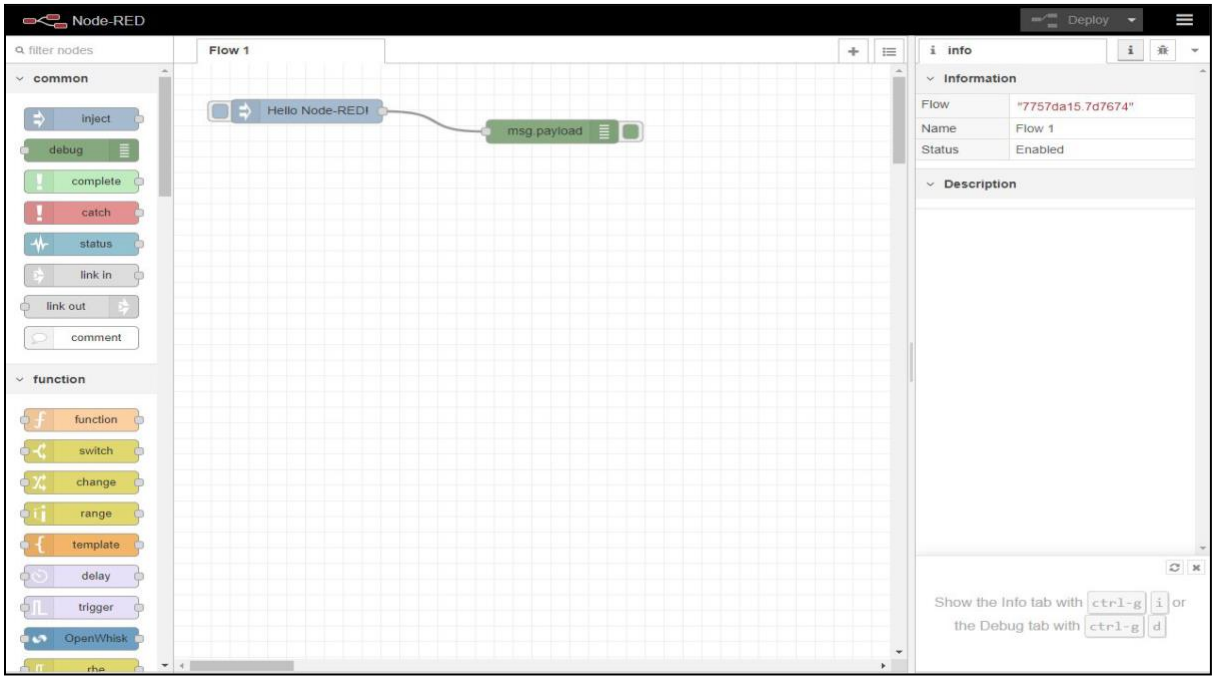
Simulation result

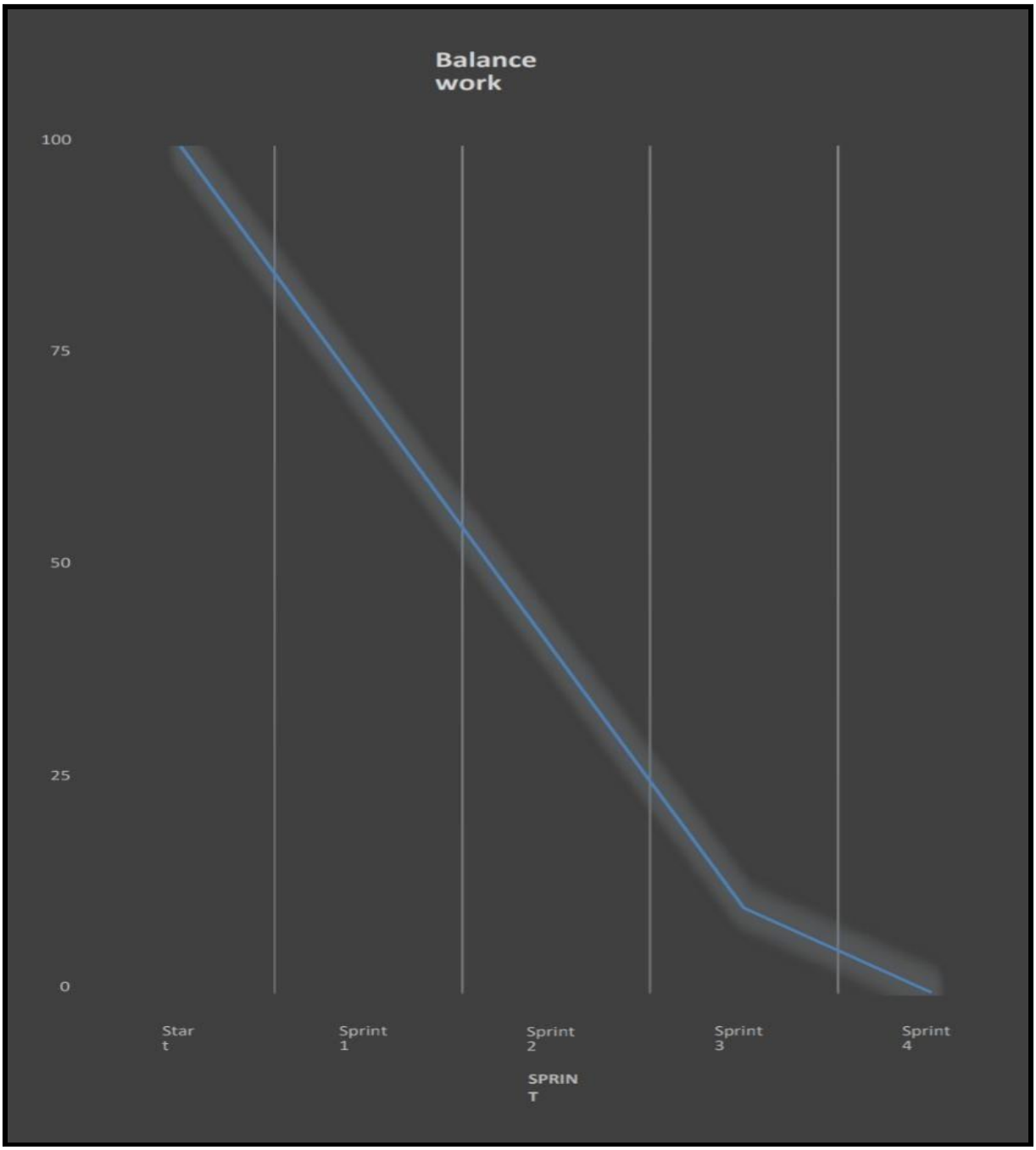


Node red app



Simulation


Node-RED
Deploy
filter nodes
Flow 1
common
inject
debug
complete
catch
status
link in
link out
comment
function
function
switch
change
range
template
delay
trigger
OpenWhisk
Hello Node-RED!
msg payload
info
Information
Flow
"7757da15.7d7674"
Name
Flow 1
Status
Enabled
Description
Show the Info tab with ctrl-g i or
the Debug tab with ctrl-g d


Balance work
100
75
50
25
0
Start
Sprint 1
Sprint 2
Sprint 3
Sprint 4
SPRINT

CHAPTER 7

CODING AND SOLUTIONING

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

#Provide your IBM Watson Device Credentials
organization = "h52kat"
deviceType = "gas"
deviceId = "2222"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO
def myCommandCallback(cmd):
print("Command received: %s" % cmd.data['command'])
status=cmd.data['command']
if status == "alarmon":
print ("Alarm is on please all Evacuate Fans On")
elif status == "alarmoff":
print ("Alarm is off and Fans Off")
elif status == "sprinkleron":
print ("Sprinkler is On Evacuate Faster")
elif status == "sprinkleroff":
print("Sprinkler is Off")
else:
print("Please send proper command")
#print(cmd)

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 random function
temp=random.randint(0,120)
Humid=random.randint(0,100)
gas=random.randint(0,1500)
data={'temp':temp,'Humid':Humid,'gas':gas}
#print data
def myOnPublishCallback():
print (" Published Temperature = %s C" % temp, "Humidity = %s %%" %
Humid, "Gas_Level = %s ppm" %gas, "to IBM Watson")
success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
if not success:
print("\n Not connected to IoTF")
if temp>60 :
print("\n Fire Detected due to gas Leak ! Alarm ON! Sprinkler ON! Call The
Fire Police \n")
elif gas>350:
print("\n Gas is Leaking \n")

time.sleep(10)
deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

7.1 FEATURE 1 – SENSING ELEMENTS

As stated earlier the sensing elements or the sensors are the most essential part of the whole system. Without the proper functioning of these sensing elements, the system as a whole has nothing to do with the environment. The proposed system uses temperature sensor, humidity sensor and gas sensor.

The temperature sensor senses the temperature level of the environment in which the system is set. This has some pre- set threshold values, above or below which it reports negative.

Humidity sensor is responsible for monitoring the humidity level of the surrounding. Again this works on the principle of threshold value maintenance.

The gas sensor, being the heart of the system, senses the presence of gas in the air around. And if it senses the presence of any gas, it reports negative. And the system will take over further.

7.2 FEATURE 2 – ALERTING SYSTEM

Another solid part of the prototype is its alerting system. While the sensing elements is responsible for sensing the hazardous situation, alerting system is responsible for alerting the user with the light and buzzer. Also the system notifies the user with a message if he/she is away.

CHAPTER 8

TESTING

8.1TEST CASES

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	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

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

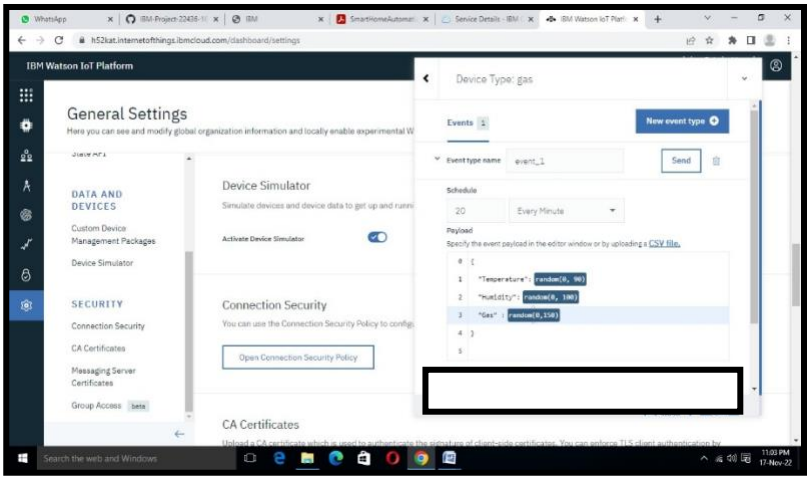
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	58	0	0	58
Security	5	0	0	5
Outsource Shipping	4	0	0	5
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	4	0	0	4

8.2 USER ACCEPTANCE TESTING

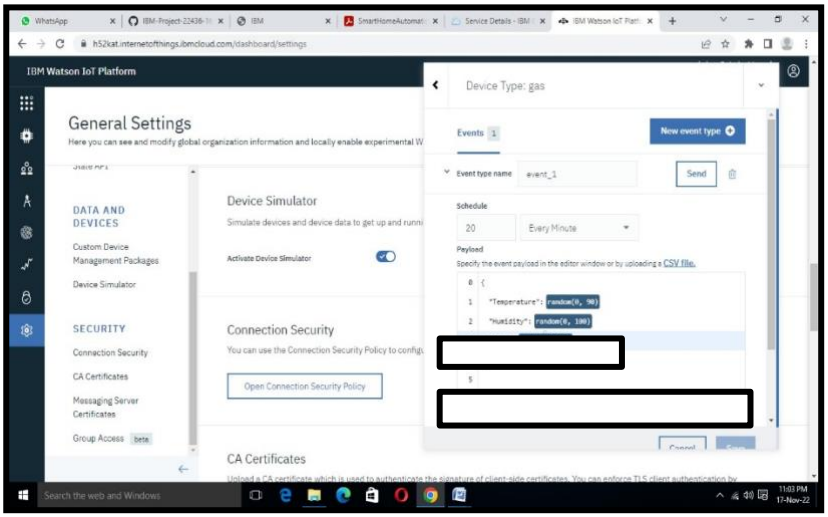
This gas leakage monitoring system incorporates three sensors temperature, humidity and gas level detecting sensor. when the gas leakage increases, the atmospheric temperature increases thus the humidity decreases which in turn buzz an alarm.

Design

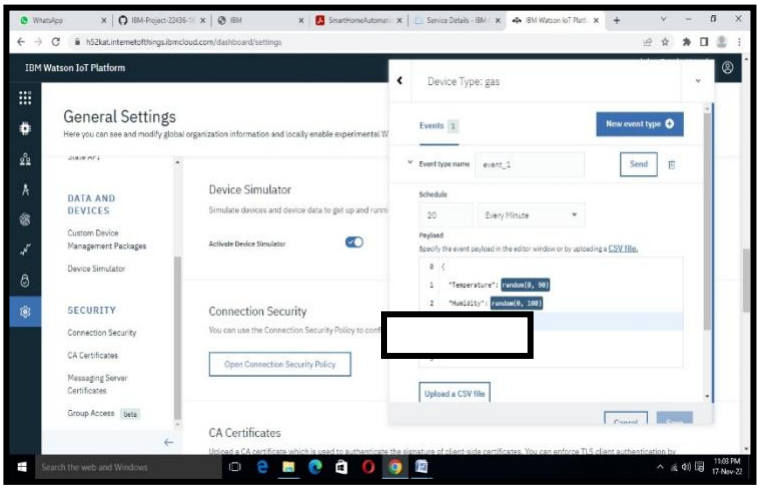
Temperature sensor testing

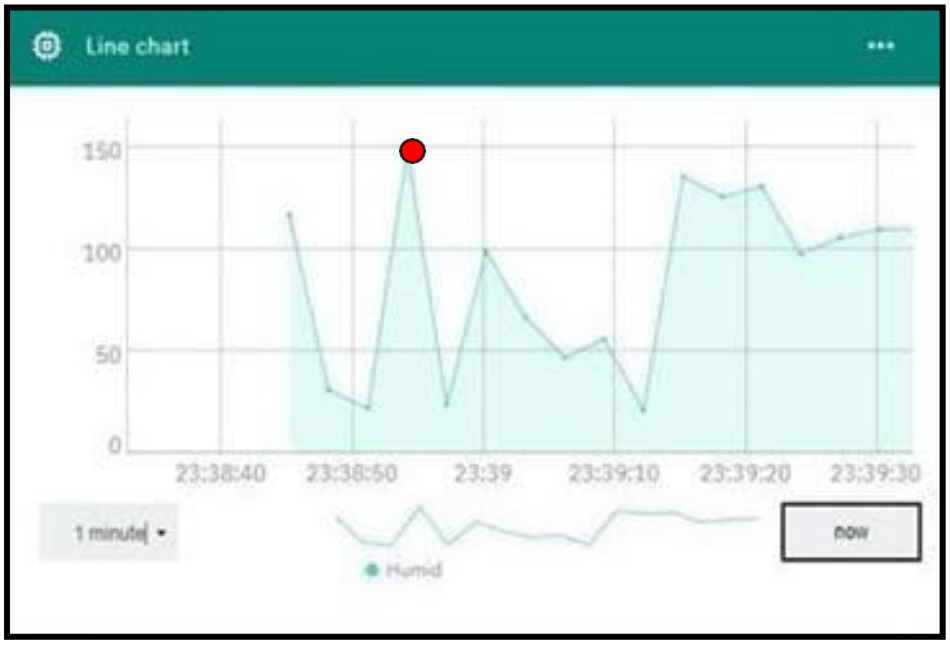


Humidity sensor testing



Gas sensor testing





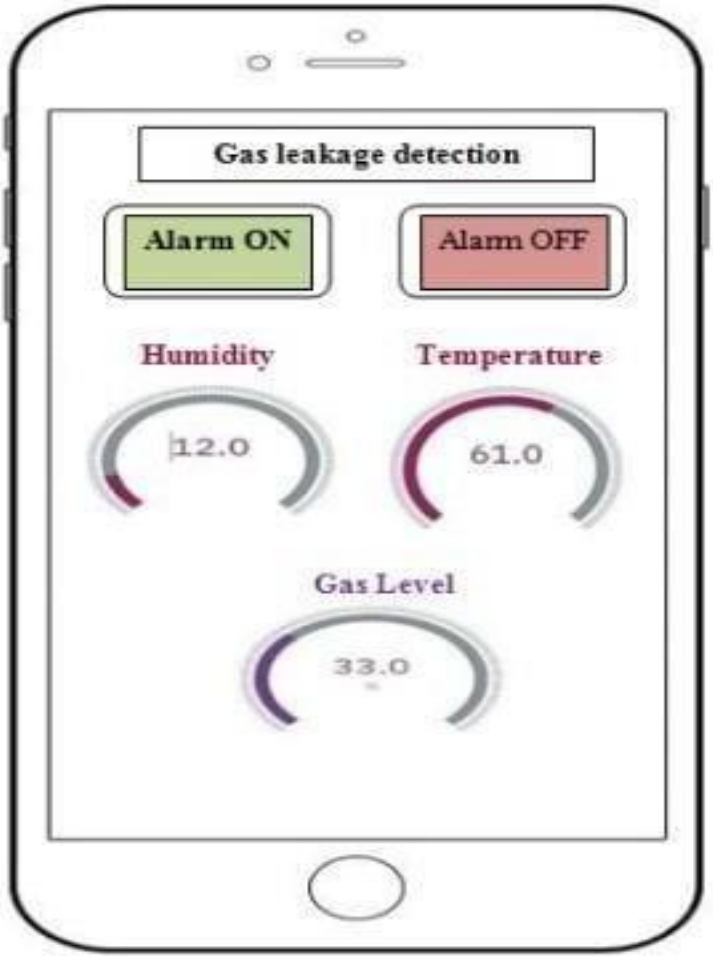
The alarm is on when the gas level is in peak.

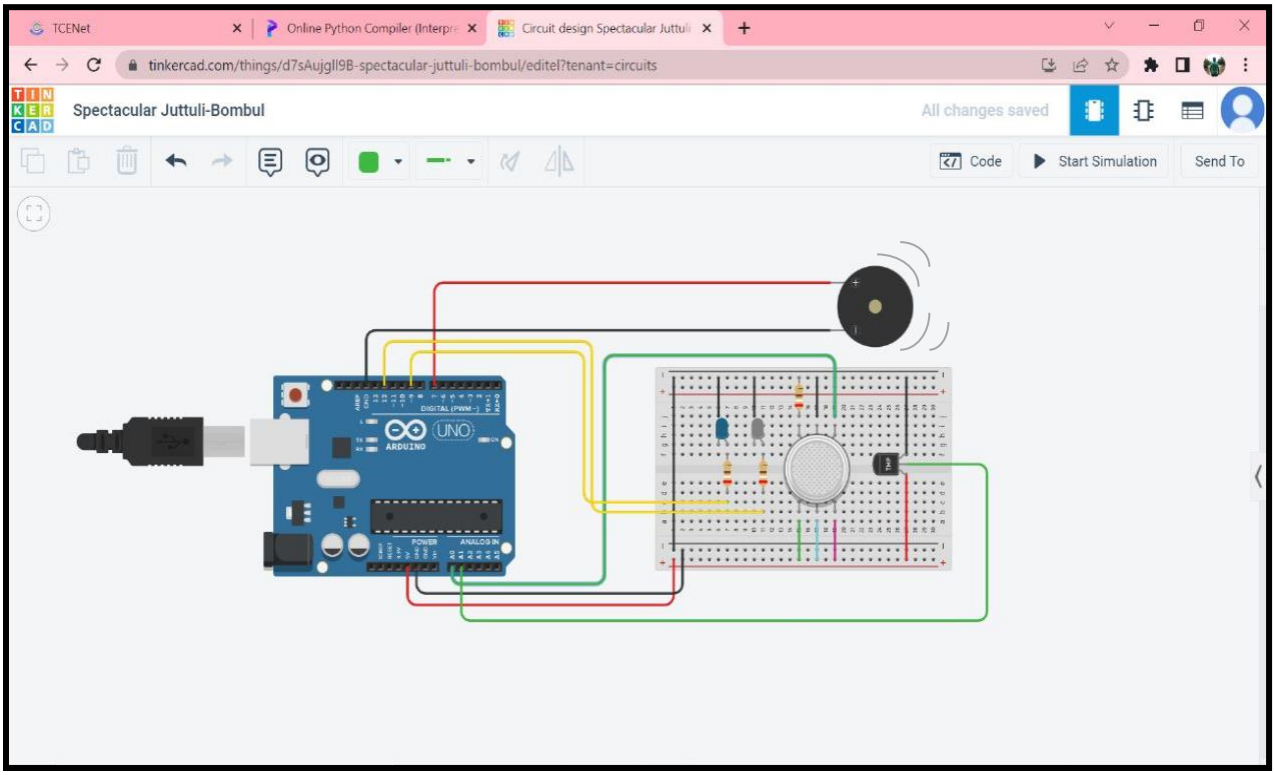
CHAPTER 9

RESULTS

9.1 PERFORMANCE METRICS

```
int V_TempSens = 0;
int V_GasSen = 0;
void setup(){
pinMode(A0, INPUT);
pinMode(7, OUTPUT);
pinMode(4, OUTPUT);
pinMode(A1, INPUT);
pinMode(2, OUTPUT);
}
void loop()
{
V_GasSen = analogRead(A0);
if (V_GasSen >=250) {
tone(7, 523, 1000); // play tone 60 (C5 = 523 Hz)
digitalWrite(9, HIGH);
}
V_TempSens = -40+ 0.488155*(analogRead(A1)- 20);
if (V_TempSens >= 70) {
tone(7, 523, 1000); // play tone se (C5 523 Hz)
digitalWrite(12, HIGH);
}
delay(10);
}
```


Gas leakage detection
Alarm ON
Alarm OFF
Humidity
Temperature
12.0
61.0
Gas Level
33.0


TCENet
Online Python Compiler (Interpre
Circuit design Spectacular Juttuli
tinkercad.com/things/d7sAujgll9B-spectacular-juttuli-bombul/editel?tenant=circuits
Spectacular Juttuli-Bombul
All changes saved
Code
Start Simulation
Send To
UNO
ARDUINO

CHAPTER 10

ADVANTAGES AND DISADVANTAGES

The advantages of the system are pretty much straight forward. The world now has a mechanism to detect the gas leak with great ease of accuracy. And in addition the system manages to send messages to the users which make the system more mobile.

The major drawback of the system is that it highly relies on sensors and other electronic elements which are always prone to damage. So this in turn increases the sensitivity of the system as a whole. Secondly, the range of the sensor used plays a vital role in the efficiency and accuracy of the results. So that must be taken care of.

CHAPTER 11

CONCLUSION

The suggested method is both affordable and real-time. It continuously monitors gas leaks and shows the gas level on mobile devices. The customer will be informed of the LPG leak and, if anyone is nearby his or her home at the time, they will be alerted appropriately. Users will receive a warning message on their phones from an IOT-based system, making them more aware of the gas level and LPG leak.

CHAPTER 12

FUTURE SCOPE

The Smart Home application, which includes a gas monitoring system, is being promoted in major Indian cities. IOT had enhanced industrial safety. IOT transforms a drone into a gas detector. Incorporating an Automatic Shut-off mechanism that will cut off the gas supply whenever it detects a gas leak could be another important future development. This system can be used in businesses, lodging facilities, and wherever else that LPG cylinders are used. This system can be employed in sectors that use applications like furnaces, boilers, gas welding, gas cutting, steel plants, metalworking, food processing, glass, plastic, pharmaceutical, and aerosol manufacturing. This system can be used to maintain track of all the cylinders used in hospitals, which are required to provide patients with the utmost level of safety. The cylinders utilised include those for oxygen, carbon dioxide, and nitrous oxide. The likelihood of accidents occurring is high because so many pupils are naive. So, schools and colleges can also use our system. There are several colleges with well-established laboratories, such as chemistry labs and pharmaceutical labs that employ gas burners. Numerous medical devices need gas cylinders.

Github link

https://github.com/IBM-EPBL/IBM-Project-10231-1659114876

Demo link

https://drive.google.com/drive/folders/1pSRtBQ4s4gmW0r3aqJv6Ojuli751yku