INDUSTRY- SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

PROJECT REPORT

Submitted By

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TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
1	**INTRODUCTION** 1.1 Project overview 1.2 Purpose	 **3** **3**
2	**LITERATURE SURVEY** 2.1 Existing problem 2.2 References 2.3 Problem Solution fit	 **3** **5** **5**
3	**IDEATION & PROPOSED SOLUTION** 3.1 Empathy Map Canvas 3.2 Ideation & Brainstorming 3.3 Proposed Solution 3.4 Proposed Solution fit	 **6** **7** **8** **10**
4	**REQUIREMENT ANALYSIS** 4.1 Functional requirement 4.2 Non-Functional requirements	 **11** **12**
5	**PROJECT DESIGN** 5.1 Data Flow Diagrams 5.2 Solution & Technical Architecture 5.3 User Stories	 **13** **14** **15**
6	**PROJECT PLANNING & SCHEDULING** 6.1 Sprint Planning & Estimation 6.2 Sprint Delivery Schedule	 **16** **20**
7	**CODING & SOLUTIONING** 7.1 Feature 1 7.2 Feature 2	 **21** **23**
8	**TESTING** 8.1 Test Cases 8.2 User Acceptance Testing	 **26** **26**

9	**RESULTS** 9.1 Performance Metrics	 **28**
10	**ADVANTAGES & DISADVANTAGES**	**29**
11	**CONCLUSION**	**29**
12	**FUTURE SCOPE**	**30**
13	**APPENDIX** 13.1 Source Code 13.2 GitHub & Project Demo Link	 **30** **33**

1.INTRODUCTION

1.1 PROJECT OVERVIEW

Industry-Specific Intelligent Fire Management System

- The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment.
- Based on the temperature readings and if any Gases are present the exhaust fans are powered ON.
- If any flame is detected the sprinklers will be switched on automatically.
- Emergency alerts are notified to the authorities and Fire station.

1.2 PURPOSE

We develop an Industry-Specific Intelligent Fire Management System based on IOT (Internet of Things) technology and cation strategy & design various sensors connected which detects fire with great accuracy. It alerts by alarms or sprinkling of water and notifies the workers, personnel and fire management department in a shorter period of time so that there are no losses of lives.

1.) Able to detect and manage fire.

2.) To prevent losses of lives and unfavourable circumstances in the industry.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

Problem #1: Inadequate Acceptance Testing of Gas Turbine Enclosure Gaseous Fire Extinguishing Systems

Gaseous fire extinguishing systems, such as carbon dioxide, Inergen, FM-200 and others, need to build up to a minimum agent concentration by volume to extinguish flame. Each gas has a different design concentration (the minimum theoretical concentration plus a factor of safety). This requires a “tight” space, so that the discharged gas concentration can accumulate. Gas turbine generator enclosures are one of the most difficult spaces to keep tight, primarily because they are designed for disassembly so that the equipment may be maintained, repaired or removed. In addition, large volumes of air for cooling usually pass through the enclosure. Also, the enclosure’s “tightness”

deteriorates over time as door and panel seals disintegrate, or as modifications are made to accommodate new equipment.

Problem #2: Failure to Consider Adjacent Sprinkler System Operation

NFPA and insurance carrier standards have strict requirements concerning the acceptability of a fire protection water supply. In the fire protection industry, a water supply must meet the requirements of both an "adequate" and a "reliable" supply. The term "adequate" refers to the water supply's ability to meet the pressure and flow rate requirement of the highest demand fire protection system. This standard is straightforward and generally well within the abilities of a competent mechanical engineer. The challenge occurs when the water supply must supply multiple fire protection systems simultaneously. Such situations arise when a postulated fire is expected to actuate more than one fire protection system. Typical examples include turbine bearing and below-deck systems, multiple cooling tower cells, coal conveyors and coal handling structures and adjacent transformers.

Problem #3: Unreliable Water Supply

A water supply is a system that consists of a body of water and a means to deliver water at pressure. For most electric generating stations, this includes one or more connections to a municipal waterworks or a private system consisting of one or more fire pumps and a suction source. As before, the water supply must be reliable as well as adequate. Reliability refers to water availability during adverse conditions, such as during freeze/drought conditions, mechanical problems and other unforeseen events. This means redundant water supplies are preferred. A lake or major river is typically considered reliable. If a suction tank, such as a raw water tank is considered, it must be arranged to ensure a dedicated volume of fire protection water is available at all times. NFPA 850 requires a two-hour minimum, but the insurance carrier may request a longer duration. This duration is based on the largest, or the simultaneous operation of the largest, fire protection systems plus the required hose streams. According to NFPA 850, a suction tank should be automatically refilled within eight hours from a source capable of replenishing the required two-hour volume.

Problem #4: Substandard Protection for Steam Turbine-Generator

While it is not unusual for older units to lack fire protection systems, some plants less than five years old have been built with no bearing fire protection, no fire protection for the area below the operating deck, or without either. Since the

1950s, studies by independent research and insurance firms show that properly designed and installed fire protection systems protect the turbine-generator from fire-induced damage, significantly reducing the loss potential and eliminating lost income due to forced outages.

Problem #5: Cooling Tower Protection

The emergence of fiber-reinforced plastics (FRP) in cooling tower construction has led some manufacturers to think that FRPs are noncombustible and that their towers do not need automatic sprinkler protection. Since FRP cooling towers have not been around very long, we are not aware of any actual fire experience involving them. Therefore, this discussion is subjective. Although some tower manufacturers routinely state that individual construction and fill materials have been evaluated in accordance with various standards such as ASTM E84, this does not make them non-combustible. It is important to understand that the ASTM E84 test is a comparison test conducted under a controlled environment and measures flame spread and smoke density developed. It is not intended to classify a material's combustibility or heat release rate.

2.2 REFERENCE

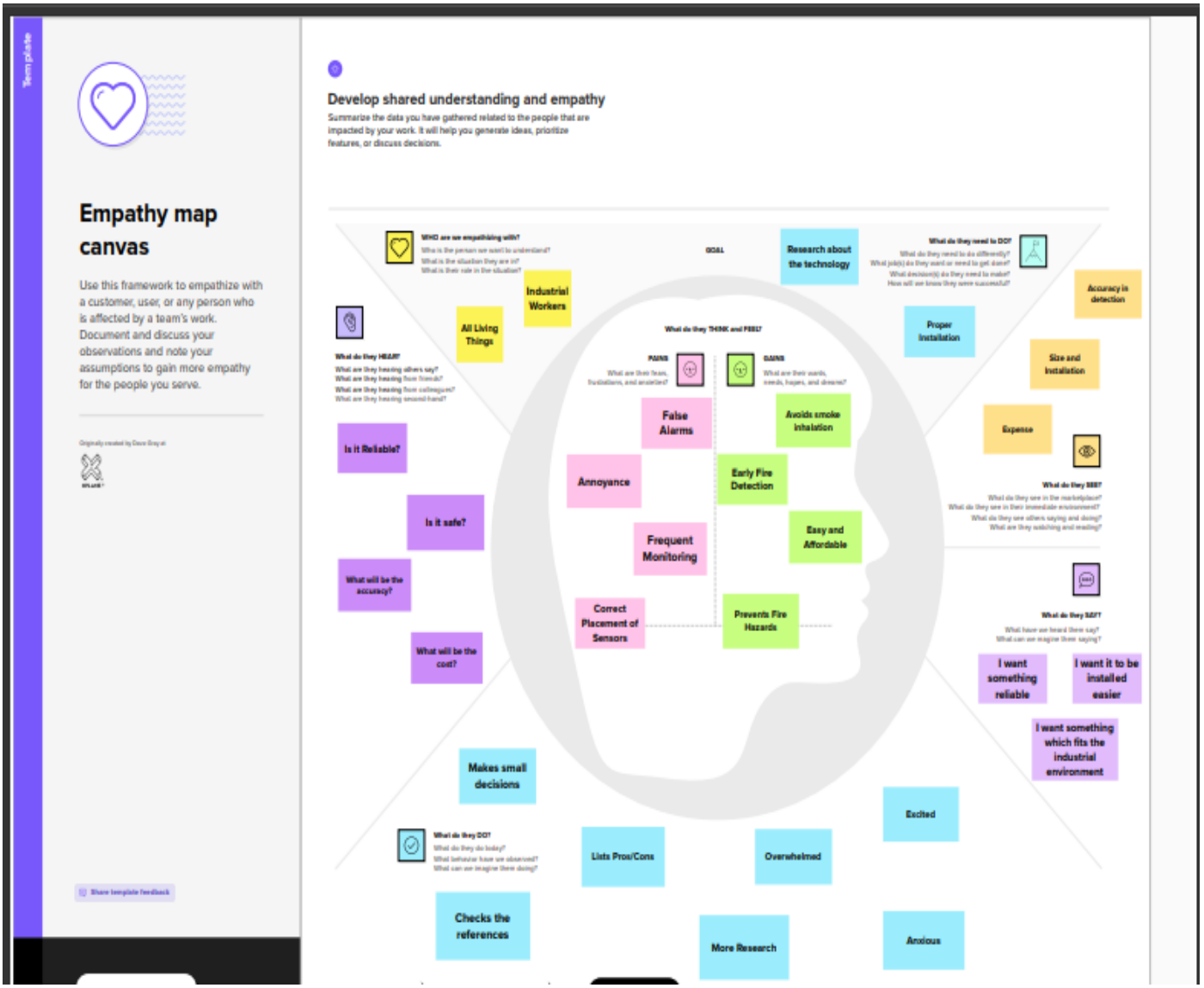
https://www.power-eng.com/coal/five-common-fire-protection-problems/#gref

2.3 PROBLEM STATEMENT DEFINITION

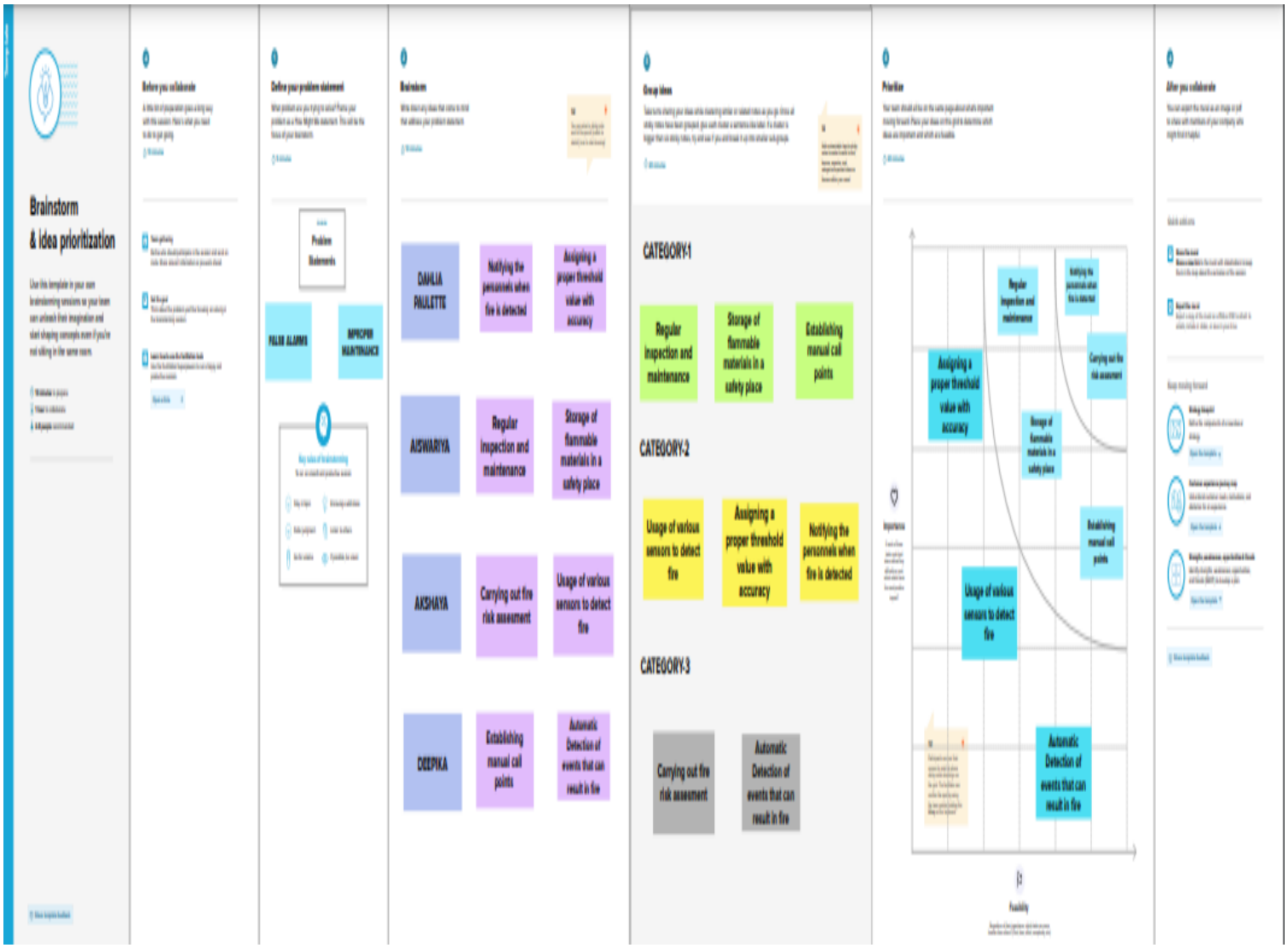
In industries due to improper maintenance of the fire management setup during emergency situations the set up may not function properly. Detecting the smoke and fire using sensors if the certain threshold value in the detector attains fire alarm rings it may lead to false alarm.

3.IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION & BRAINSTORMING



3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Developing an Industry-Specific Intelligent Fire Management System which, ● detects and manages fire with great accuracy. ● alerts the workers,personnels and fire management department in a shorter period of time.
2.	Idea / Solution description	We develop an Industry-Specific Intelligent Fire Management System based on IOT(Internet of Things) technology and various sensors connected which detect fire with great accuracy. It alerts by alarms or sprinkling of water and notifies the workers, personnels and fire management department in a shorter period of time so that there are no losses of lives.
3.	Novelty / Uniqueness	The Industry-Specific Intelligent Fire Management System detects and manages fire with great accuracy and it notifies and alerts the Personnels and Fire management department of the industries within a shorter period of time.

4.	Social Impact / Customer Satisfaction	It will save the lives of workers and employees and minimise the loss of Infrastructure and machineries . It saves the industry from economically unfavourable circumstances.
5.	Business Model (Revenue Model)	There are 2 ways to generate revenue from this project. ● One is by helping the government and getting funds from it. ● Another one is by giving the information to the industries and making them aware of.
6.	Scalability of the Solution	It can detect and manage fire with great accuracy and it notifies and alerts the Personnels and Fire management department of the industries.

3.4 PROBLEM SOLUTION FIT

4.REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

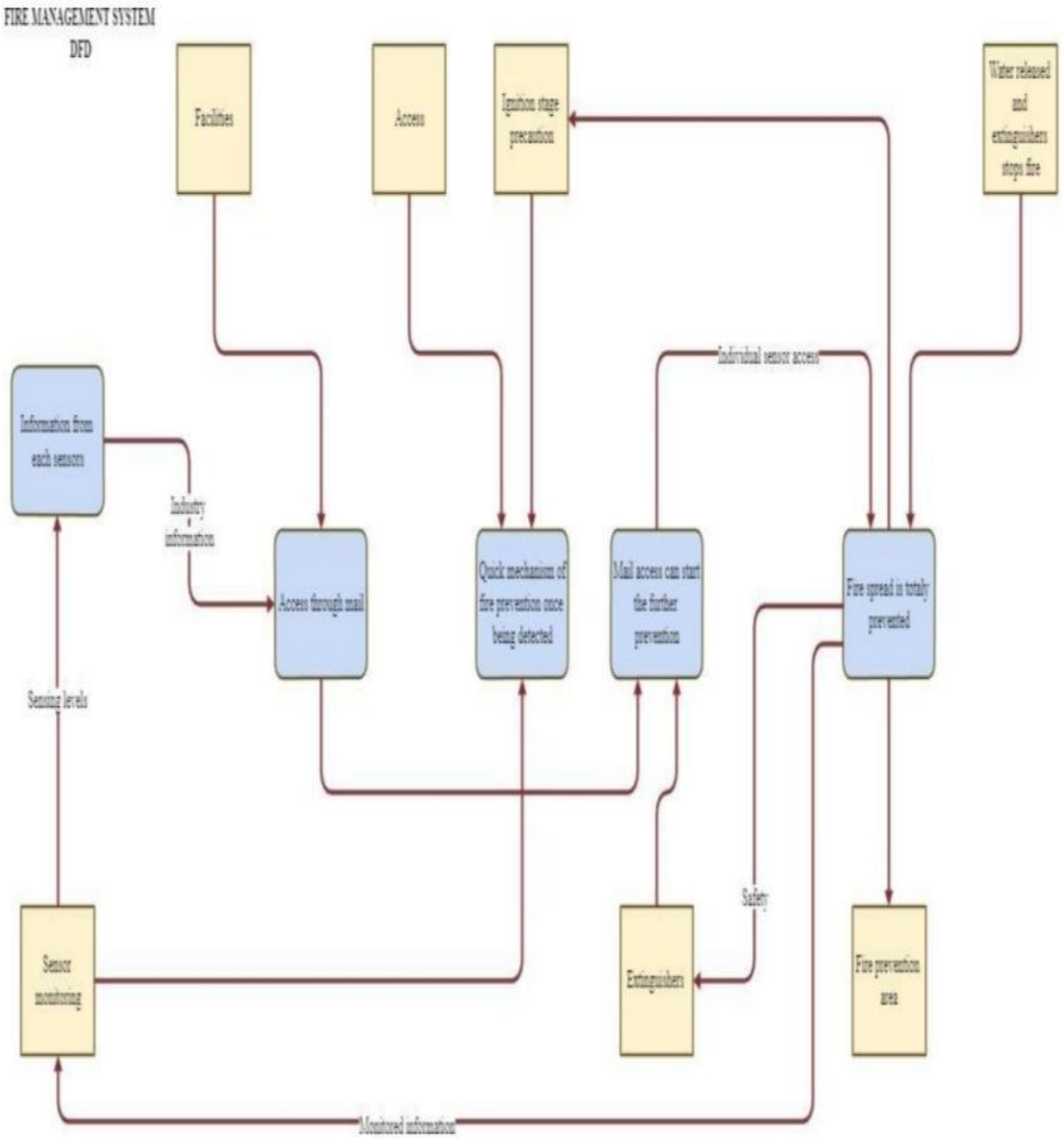
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detection	The fire is detected by a sensor which has a threshold value of temperature.If any gases are present, it is also detected.
FR-2	Accuracy	A great accuracy in detection is maintained by proper and optimized code.
FR-3	Alerting	As soon as the fire is detected, the alarm rings and the water is sprinkled and it is notified to the personnels. .If any gasses are present,the exhaust fans are switched on .

4.2 NON- FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	User friendly and easy to maintain and detect.
NFR-2	**Security**	There are no security issues in this system.
NFR-3	**Reliability**	This system is highly reliable because it can detect change in temperature accurately .
NFR-4	**Performance**	The performance of the system is measured in terms of accuracy and the accuracy of the system is about 95% and it alerts within a shorter period of time.
NFR-5	**Availability**	This system can be easily available and can be installed anywhere.
NFR-6	**Scalability**	This system is highly scalable and it detects accurately.

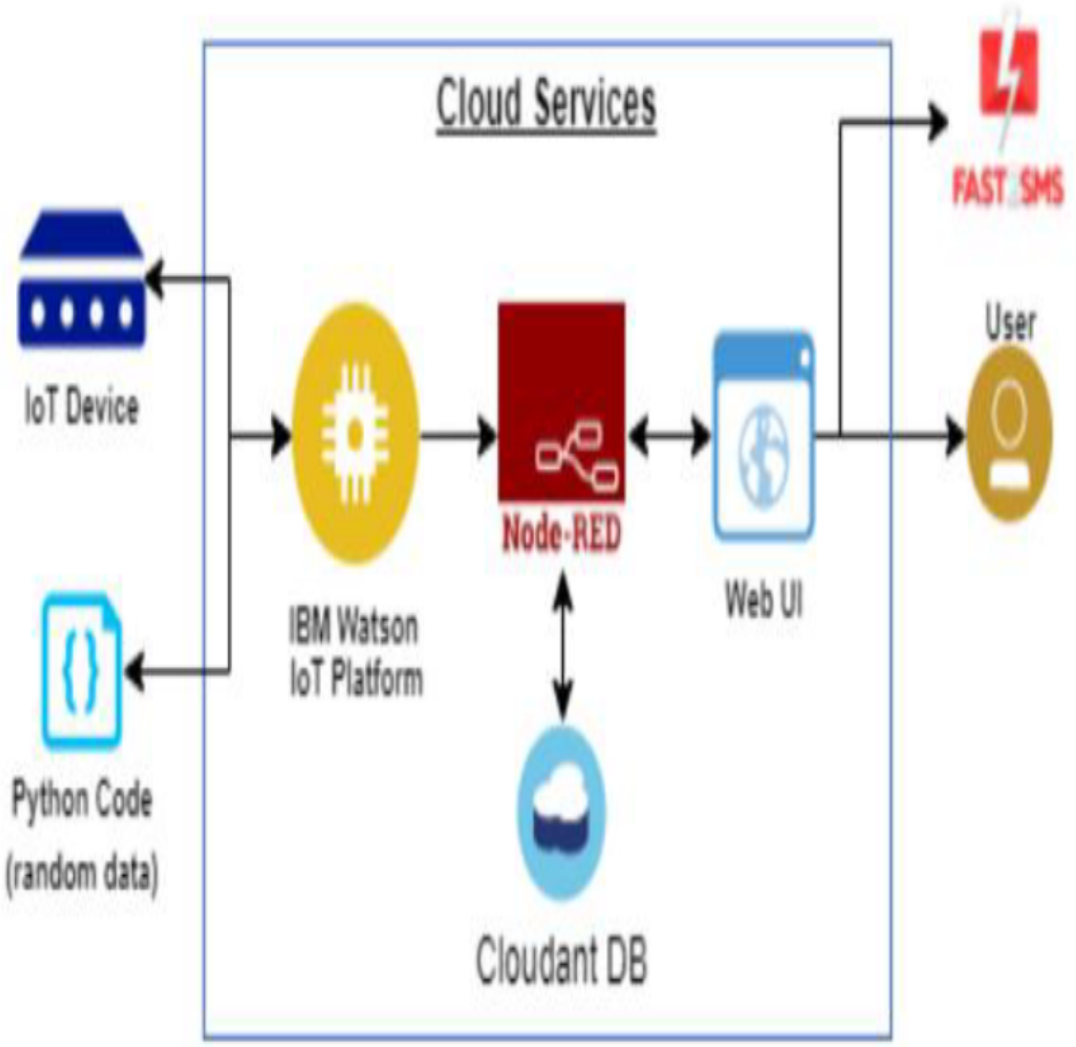
5.PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION AND TECHNICAL ARCHITECTURE

The solution architecture includes the components and the flow we have designed to deliver the solution.



5.3 USER STORIES

User Type	Functional requirement	User story number	User story/ task	Acceptance criteria	Priority	Release
Customer (Mobile user, Web user,care executive, Administrator	Registration	USN-1	As a user,I can register for the application by entering my mail, password, and confirming my password	I can access my account /dashboard	High	Sprint-1
		USN-2	As a user,I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
	Dashboard	USN-3	As a user ,I can register for the application through internet	I can register & access the dashboard with internet login	Low	Sprint-2
		USN-4	As a user ,I can register for the application through Gmail	I can confirm the registration in Gmail	Medium	Sprint-1
	Login	USN-5	As a user,I can log into the app by entering email & password	I can login with my id and password	High	Sprint-1

6.PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High
Sprint-2		USN-3	As a user , I can register for the application through facebook	2	Low
Sprint-1		USN-4	As a user , I can register for the application through Gmail	2	Medium
Sprint-1	Login	USN-5	As a user , I can log into the application by entering email and password	1	High

Sprint-1	Objective	USN-6	As a system, the fire sensor should detect the fire	8	High
Sprint-1	Features	USN-7	As a system, the fire sensor value should be displayed in a LED screen	2	Low
Sprint-1	Features	USN-8	As a system, as soon as the detected fire reaches the threshold level, the red color LED should be turned ON	5	High
Sprint-1	Features	USN-9	As a system, as soon as the detected fire reaches the threshold level, the siren should be turned ON	5	High
Sprint-2	Focus	USN-10	As a system , it should send the location where the fire is detected	8	High
Sprint-2	Focus	USN-11	As a system , it should also send the alerting SMS to the registered phone number	2	Low

Sprint-2	Features	USN-12	As a system ,the fire alarm should detect automatically when the fire accident is held	5	Medium
Sprint-2	Features	USN-13	As a system,it will indicate the fire accident is closed in the LCD screen and SMS to the registered mobile number	5	Medium
Sprint-3	Data transfer	USN-14	As a program , it should retrieve the API key of the IBM cloud to send the details of the system	2	Low
Sprint-3	Data transfer	USN-15	As a cloud system, it should send the data of the sensor values along with latitudes and longitudes to the IBM cloud	5	Medium
Sprint-3	Data transfer	USN-16	As a cloud system ,the IBM cloud should send the data to Node-red	2	Medium
Sprint-3	Data transfer	USN-17	As a system, it should collect the data from the Node-red and give it to the backend of MIT app	3	Medium
Sprint-3	Data transfer	USN-18	As an app , it should display the	8	High

			details of the temperature level and other details to the user through the frontend of MIT app		
Sprint-4	Registration	USN-19	As a user, I must first register my email and mobile no in the website	2	High

Sprint-4	Registration	USN-20	As a user,I must receive confirmation mail and SMS on registration	2	Medium
Sprint-4	Login	USN-21	As a user, i can log in to the web app through email and password	3	High
Sprint-4	Dashboard	USN-22	As a user , I can access the dashboard and make use of available resources	2	Medium
Sprint-4	Focus	USN-23	As a user , I must receive an SMS once the fire is detected	5	High
Sprint-4	Allocation	USN-24	As an admin , I must receive info about the fire accident along with location and	3	High

			share exact location and route to the person		
Sprint-4	Allocation	USN-25	As an action , I must allot particular person to look after the fire accident in a particular location	3	High

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 October 2022	29 October 2022	20	29 October 2022
Sprint-2	20	6 Days	24 October 2022	29 October 2022	20	29 October 2022
Sprint-3	20	6 Days	24 October 2022	29 October 2022	20	29 October 2022
Sprint-4	20	6 Days	24 October 2022	29 October 2022	20	29 October 2022

7.CODING & SOLUTIONING

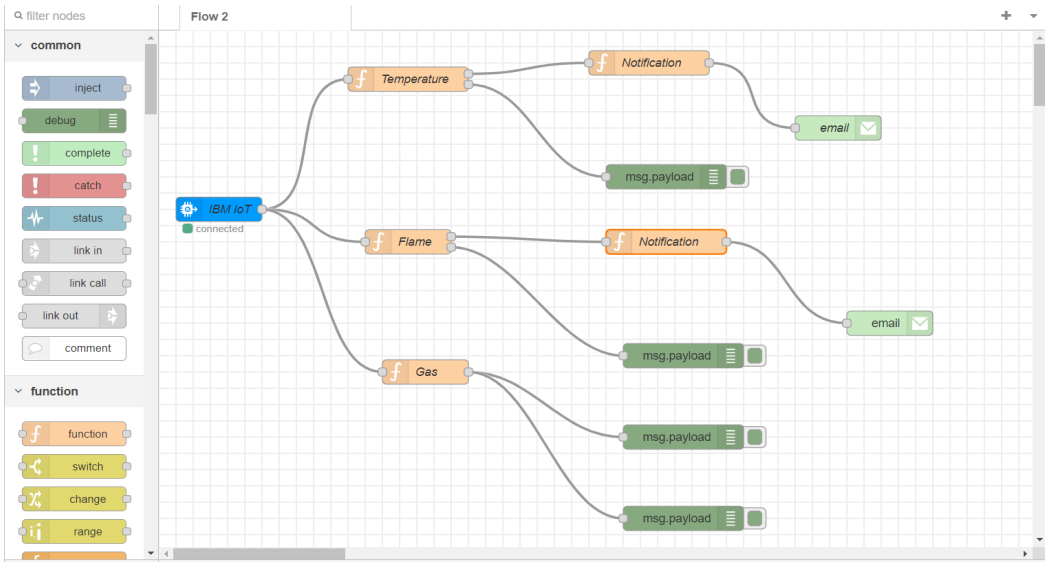
PYTHON CODE (FEATURE-1)

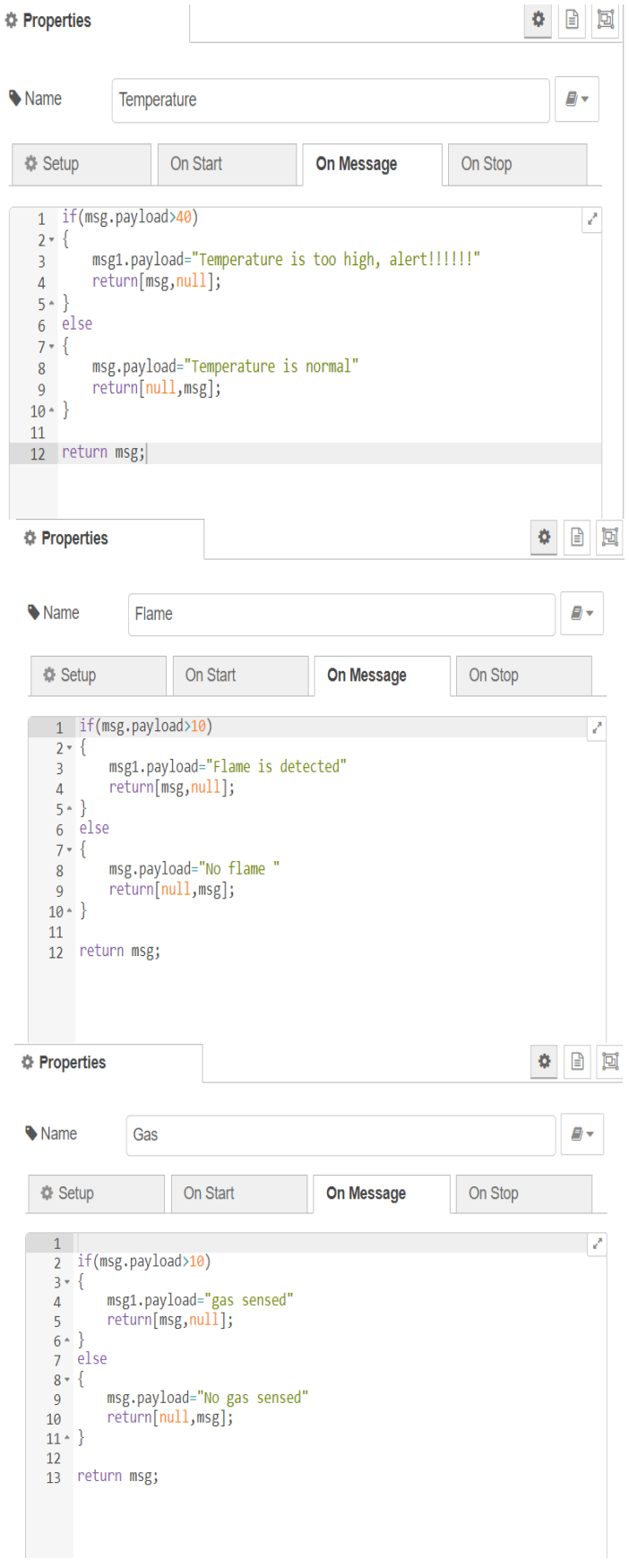
```
import time

import sys

import ibmiotf.application

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials

organization = "zoieul"

deviceType = "IOT123"

deviceId = "12345"

authMethod = "token"

authToken = "123456789"

# 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

          temp=random.randint(90,110)

         Flame=random.randint(90,200)

        Gas=random.randint(90,200)

          data = { 'temp' : temp, 'Flame':Flame,'Gas':Gas}

        #print data
```

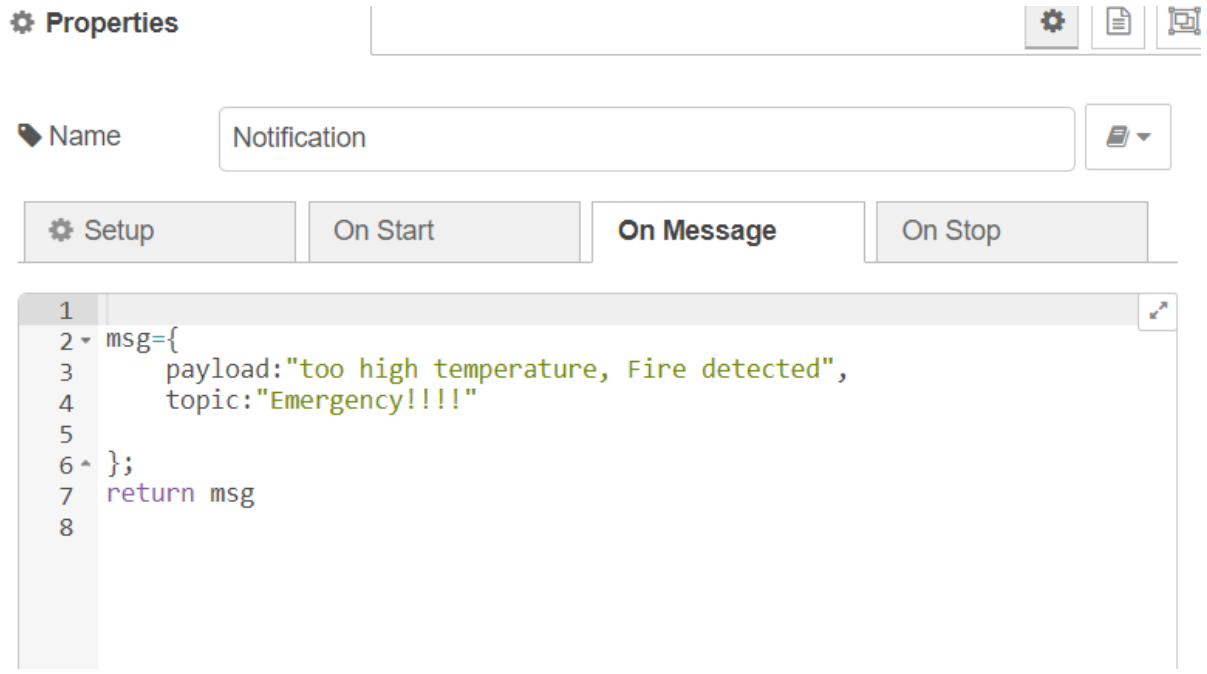
```
        def myOnPublishCallback():

            print ("Published Temperature = %s C" % temp, "Flame = %s %%" %
Flame, "Gas = %s %%" % Gas,"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()
```

NODE-RED FLOW DIAGRAM (FEATURE-2)




Properties
Name
Temperature
Setup
On Start
On Message
On Stop
if(msg.payload>40)
{
msg1.payload="Temperature is too high, alert!!!!!!"
return[msg,null];
}
else
{
msg.payload="Temperature is normal"
return[null,msg];
}
return msg;
Properties
Name
Flame
Setup
On Start
On Message
On Stop
if(msg.payload>10)
{
msg1.payload="Flame is detected"
return[msg,null];
}
else
{
msg.payload="No flame "
return[null,msg];
}
return msg;
Properties
Name
Gas
Setup
On Start
On Message
On Stop
if(msg.payload>10)
{
msg1.payload="gas sensed"
return[msg,null];
}
else
{
msg.payload="No gas sensed"
return[null,msg];
}
return msg;

NOTIFICATION NODE



8.TESTING

8.1 TEST CASES

TEST CASE	FEATURE TYPE	COMPONENT USED	SCENARIO
Notification	Email notification	Node RED	When reached highest criteria, it is notified via Email
Notification condition	Function node	Node RED	Highest value
Code TC	Python	Python IDLE	All the threshold values are fed.
Code Publishing TC	Publishing to IBM Watson	IBM Cloud, IBM Watson	Given to Node RED

8.2 USER ACCEPTANCE TESTING(UAT)

1.Purpose of the Document

The purpose of this document is to briefly explain the test coverage and open issues of the **Industry-Specific Intelligent Fire Management 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	Sub-total
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
Total	24	14	13	26	77

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
Printing	4	0	0	4
Security	2	0	0	2
Exception Reporting	3	0	0	3
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9.RESULTS

9.1PERFORMANCE METRICS

NFT - Detailed Test Plan

S.NO	Project Overview	NFT Test approach	Assumptions/ Dependencies/ Risks	Approvals/ Sign Off
1	Fire Remainder Web - UI	Stress	App Crash/ Developer team/ Site Down	Approved
2	Fire Remainder Web - UI	Load	Server Crash/ Developer team/ Server Down	Approved

End Of Test Report

Project Overview	NFT Test approach	NFR- Met	GO/NO-GO decision	Identified Defects	Approvals / Sign Off
Fire Remainder Web - UI	Stress	Performance	GO	Closed	Approved
Fire Remainder Web - UI	Load	Stability	NO-GO	Closed	Approved

10.ADVANTAGES

To safeguard employees:

Life is more important than anything else on Earth because there is nothing more valuable than life. Fire safety classes teach us about the devices that aid in fire prevention, the various processes that are involved in handling such fire disaster circumstances, and how to safely exit the building during a fire.

This fire safety training helps in reducing the risks. A fire can occur at any moment and in any location. It could be caused by an electric fire, lamps, candles, electric space heaters, or any other flammable item, etc. in an organisation. Lack of personnel training could result in significant property and human life loss. Fire safety training is required in both the domestic and corporate sectors.

To increase productivity and profit:

As mentioned earlier, a safe and healthy environment would result in an increase in the productivity and profit of any organisation. A safe workplace has lower absenteeism, higher turnover, and lower employee injury and illness costs.

To protect property:

Despite the fact that organisations insure things, money is not the only factor. Some objects are too valuable, vital, or customary to be replaced or purchased again. Therefore, taking fire safety precautions is critical in order to protect valuable assets.

DISADVANTAGES

False Alarm

These security systems are prone to false alarms that involve the alarm ringing when anyone from your family enters the restricted area. Or there are instances when the alarm is triggered by itself without any reason

Expensive

Both wireless and hardwired alarm systems are expensive to install. They require an initial investment, which includes equipment cost, installation, and subscription of security monitoring service.

11.CONCLUSION

The Industrial based intelligent emergency response system can reduce the casualties of the disaster in industries to protect the employees, industrial machines and infrastructure by providing appropriate evacuation guidance. The system can also aid disaster fighting with the help of water sprinklers because it allows for a quick assessment of the disaster with decentralized control that can intelligently guide evacuees based on the detection of humans.

12.FUTURE SCOPE

The project can enhanced with many other features that can improve the fire management system in industry.The product currently is a simple basic version.Some other addition features that are planned to be incorporated with this existing product are listed below:

- The system can be enhanced with a smartwatch so that the fire alarm system can be continuously connected with the authorities to supervise and help them during emergencies
- The system can relate to hardware components to improve the performance.

13.APPENDIX

13.1 SOURCE CODE

PYTHON CODE

```
import time

import sys

import ibmiotf.application

import ibmiotf.device

import random
```

```
#Provide your IBM Watson Device Credentials

organization = "zoieul"

deviceType = "IOT123"

deviceId = "12345"

authMethod = "token"

authToken = "123456789"

# 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

       temp=random.randint(90,110)

        Flame=random.randint(90,200)

        Gas=random.randint(90,200)

        data = { 'temp' : temp, 'Flame':Flame,'Gas':Gas}

        #print data

        def myOnPublishCallback():

             print ("Published Temperature = %s C" % temp, "Flame = %s %%" % Flame, "Gas = %s %%" % Gas,"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()
```

13.2 GITHUB AND PROJECT DEMO LINK

CONTENT	LINK
GITHUB	https://github.com/IBM-EPBL/IBM-Project-40411-1660629133
PROJECT DEMONSTRATION VIDEO LINK	https://youtu.be/waFHAQ1VPlo