INDUSTRY SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

A PROJECT REPORT

Submitted by

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ABSTRACT

The primary purpose of fire alarm system is to provide an early warning of fire so that people can be evacuated & immediate action can be taken to stop or eliminate of the fire effect as soon as possible. Alarm can be triggered by using detectors or by manual call point (Remotely). To alert/evacuate the occupants siren are used. With the Intelligent Building of the rapid development of technology applications, commercial fire alarm market demand growth, the key is to use the bus system intelligent distributed computer system fire alarm system, although installation in the system much easier than in the past , but still cannot meet the modern needs, the installation costs of equipment costs about 33% ~ 70. The suggested technique in Fire alarm system used the addressable detectors units besides using the wireless connection between the detector in zones as a slave units and the main control unit as the master unit. The system shall include a python code, alarm initiating sensor, notification appliances, and the accessory equipment necessary for a complete functioning fire alarm system. In the IOT based fire alarm, individual units are powered by IBM Watson, IBM Cloud and Node Red for the communication

TABLE OF CONTENT

LIST OF FIGURES:

LIST OF TABLES:

CHAPTER -1

INTRODUCTION

1.1 INTRODUCTION TO IOT

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

1.2 SCOPE

- The future scope is regarding to minimize the problem of Fire Accidents and also for reducing overall cost of other commercial Fire sensor products
- Also, in order find The amount of temperature and humidity is sensed by the sensor and control action to take automatically to turn off the fire generated.

1.3.Project Overview:

The main aim of 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

Fig. 1.1 Project Overview

1.4.Purpose:

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

CHAPTER -2

LITERATURE SURVEY :

2.1 INTRODUCTION:

Internet of Things (IoT) is a concept and a paradigm that considers pervasive presence in the environment of a variety of things that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things to create new applications/services and reach common goal. A world where the real, digital and the virtual are converging to create smart environments that make energy, transport, cities and many other areas more intelligent. The goal of the Internet of Things is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service.

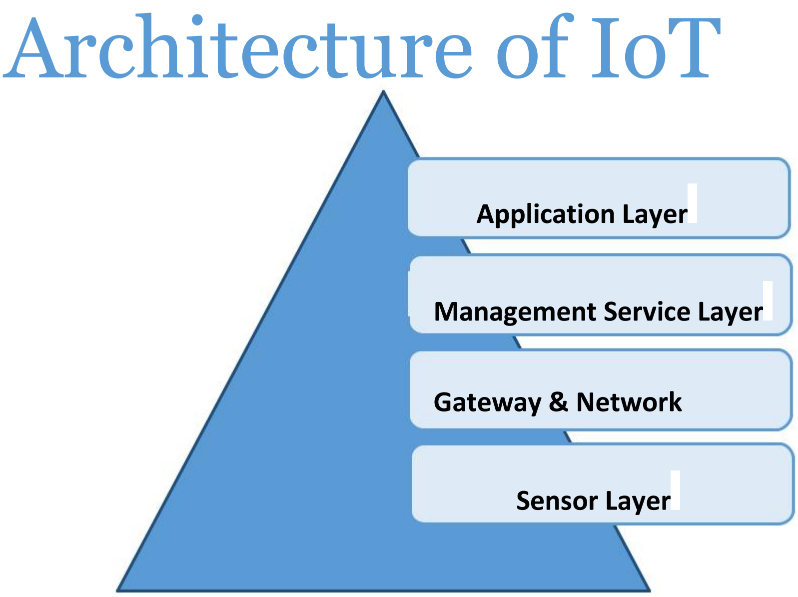

Fig. 2.1 Architecture of IOT

2.2 Sensor Layer:

The lowest layer is made up of smart objects integrated with sensors. The main function of this layer is to obtain the various types of static/ dynamic information of the real world through various types of sensors and to share with Internet access. The miniaturization of hardware has enabled powerful sensors to be produced in much smaller forms which are integrated into objects in the physical world. There are various types of sensors for different purposes. The sensors have the capacity to take measurements such as temperature, air quality, distance, movement and electricity. In some cases, they may also have a degree of memory, enabling them to record acertain number of measurements. A sensor can measure the physical property and convert it into signal that can be understood by an instrument.

2.3 Gateways and Networks:

A large volume of data will be produced by these sensors and this requires a robust and high performance wired or wireless network infrastructure as a transport medium. The network helps to distinguish each object that is interconnected in the physical world. Current networks, often tied with very different protocols, have been used to support machine-to-machine (M2M) networks and their applications. With demand needed to serve a wider range of IOT services and applications such as high speed transactional services, context-aware applications, etc. multiple networks with various technologies and access protocols are needed to work with each other in a heterogeneous configuration. These networks can be in the form of a private, public or hybrid models and are built to support the communication requirements for latency, bandwidth or security.

2.4 Management Service Layer:

It renders the processing of information possible through analytics, security controls, process modeling and management of devices. One of the important features of the management service layer is the business and process rule engines. IOT brings connection and interaction of objects and systems together providing information in the form of events or contextual data such as temperature of goods, amount of fuel, current location and traffic data. Some of these events require filtering or routing to post-processing systems such as capturing of periodic sensory data, while others require response to the immediate situations such as reacting to emergencies on patient's health conditions. Data management is the ability to manage data information flow. With data management in the management service layer, information can be accessed, integrated and controlled.

2.5 Application Layer:

It is at the top of the stack is responsible for delivery of various applications to different users in IoT. It consists of protocols that focus on process-to-process communication across an IP network and provides a firm communication interface and end-user services.

2.6 Fire detection devices:

As a rule, fire detection devices are divided into two basic types: manually actuated and automatically actuated devices Figure shows its types.

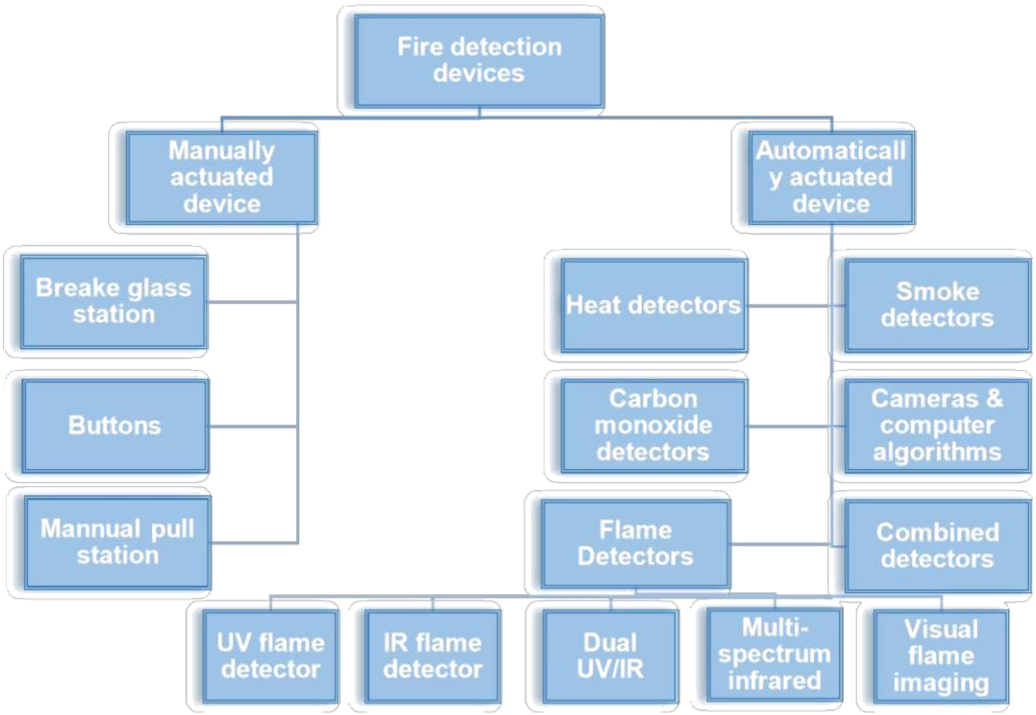

Fig. 2.2 Fire detection devices

process-to-process communication across an IP network and provides a firm communication interface and end-user services Manually actuated devices are located near the exits and in many cases look like the red button on the wall. Somebody should push the button in a risk of a fire. But it will be late when somebody will push the button after he will see the flame[4].

Modern automatically actuated fire alarms are used to detect fire at the earliest possible stage. They were produced for working 24 hours per day without any human intervention. Fire detection sensors are divided into smoke sensors, flame sensors, heat sensors, carbon monoxide sensors and also cameras operated by computer algorithms. As a rule fire detection sensors trigger at a critical value. There are point fire detectors, linear and sampling fire detectors. Point fire detectors take sample in that place where they are installed. The linear one consists of elements which look like cameras. They are installed in front of each other on the opposite walls of the room and based on laser technologies. This type of detectors can operate in large spaces up to the 100 meters long. Sampling fire detectors are the kind of smoke detectors which can be located in the ventilation system or another place and it takes the samples of the air at specified predetermined intervals.

PAPER TITLE	AUTHOR	OBJECTIVE/OUTCOME
A Survey of Fire Safety Measures for Industry Safety Using IOT	N. Savitha; S. Malathi 2019	In the system the fire safety practices is going to implement for the fire crackers industry. In that the root cause for the fire is to be analyzed and prevent from the fire before it is triggered. Through this hazardous fire accidents can be avoided and many lives can be saved.
Design of Distributed Factory Fire Alarm Systems	Li Liu ;Yanke C I ; Haosong chen 2020	The Distributed plant fire alarm system can quickly detect the fire and issues an alarm to reduce the damage caused by the fire. The fire alarm system is a control system that integrates signal detection,transmission , processing and control .It mainly complete the basic function of Fire ,smoke and temperature module monitering fire.
A Microcontrollerbased Fire Protection System for the Safety of Industries in Bangladesh	Md. Saiam Dept. of Electrical and Electronic Engineering, Khulna University of Engineering & Technology, Khulna, Bangladesh 2021	The affected area is also triggered by the fire extinguishing equipment. At the same time, it also notifies the manager and the nearby fire station via SMS. This paper presents a simulation and practical arrangement of the system to demonstrate how it can be implemented as a fire prevention equipment.
Safety Robot for Flammable Gas and Fire Detection using Multisensor Technology	Sandeep Prabhakaran; Mathan N	In case of fire accidents, the robot alerts the workstation and sends a mail to the firefighting department with the location read from the GPS module. As the robot works as an autonomous system, it does not need to be controlled remotely. Hence this robot is based on the line following mechanism, it is quite easy to install and can cover a large area efficiently.
Computer Vision Based Industrial and Forest Fire Detection Using Support Vector Machine (SVM)	Md. Abdur Rahman; Sayed Tanimun Hasan; Mohammed Abdul Kader 2022	The real-life situations and from the internet. This SVM pipeline model shows the maximum accuracy is 93.33%. The system can fulfill the precision and detect faster realtime fire detection. It’s forest and industrial application will aid in the early detection of fires, as well as emergency management, and so immensely contribute to loss prevention.

2.7 Existing Problem:

It was found that the value of absorption coefficient along the flame axis depended on the fuel flow velocity, and a sharp decrease emerged at 5 mm/s. Based on [81], Bouhafid [82,83] employed laboratory-scale oil pool fire, further investigated the absorption coefficient profile in the flames. The flame radiation fraction is an important parameter quantifying its radiation loss and impact on the surroundings.

2.8 References:

1. https//:www.researchgate.net
2. https//:www.wikipedia.org
3. https//:www.rapidonline.com
4. https//:www.schematics.com
5. https//:www.batteryuniversity.com

2.9 Problem statement definition :

A problem statement is a concise description of the problem or issues a project seeks to address. The problem statement identifies the current state, the desired future state and any gaps between the two. A problem statement is an important communication tool that can help ensure everyone working on a project knows what the problem they need to address is and why the project is important

CHAPTER – 3

IDEATION & PROPOSED SOLUTION

Ideation is the creative process of generating new ideas, which can be accomplished through a variety of ideation techniques, such as brainstorming and prototyping. If done right, ideation is what helps founders and executives determine the right problem to solve and how to solve it.

proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved. So, begin your proposed solution by briefly describing this desired result.

3.1 Empathy Map Canvas:

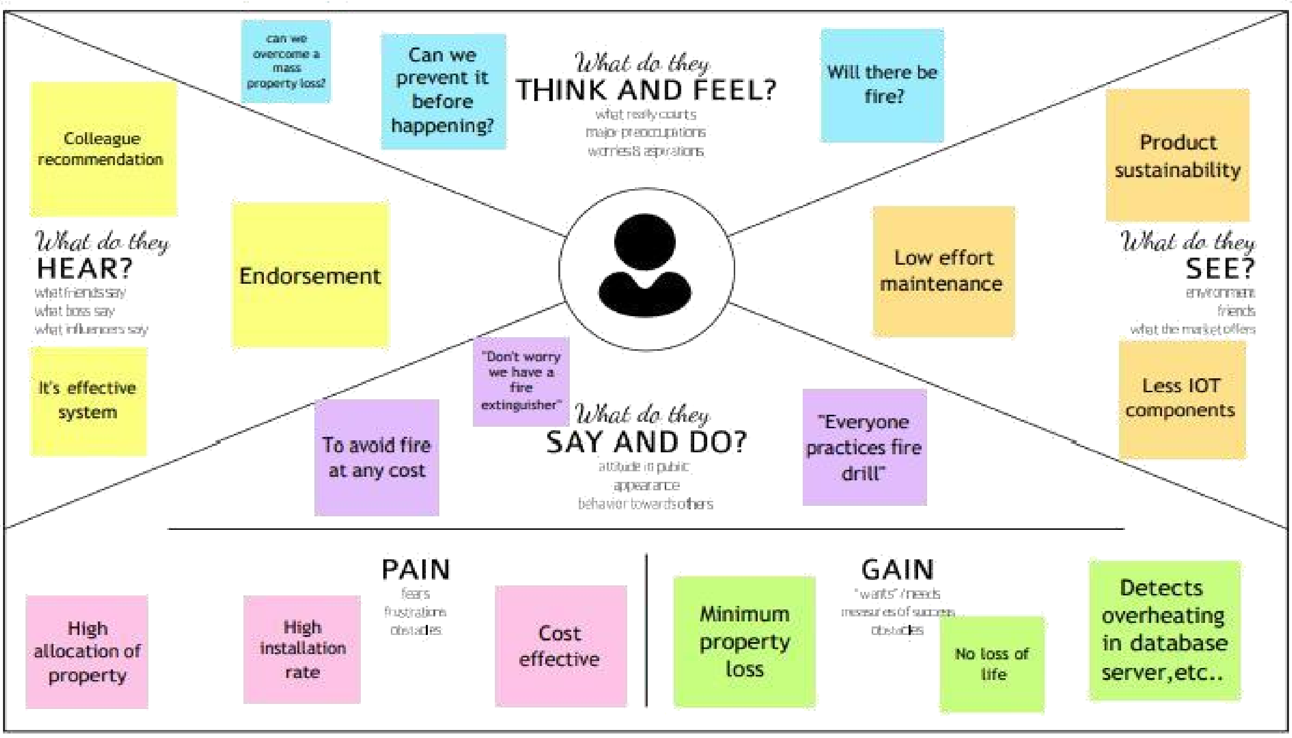

Fig. 3.1 Empathy Map Canvas

3.2 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Industry Specific Fire Management System
2.	Idea / Solution description	This Project helps the industries in monitoring the leakage of fire in several locations , the sensors like flame/temperature sensors will be integrated to monitor the fire leakage.
3.	Novelty / Uniqueness	Fire Explotion /fire leakage location send to the management.
4.	Social Impact / Customer Satisfaction	The industrial admin /management can prevent before the accident through the fire leakage monitoring System.
5.	Business Model (Revenue Model)	*Efficiency of cost *High security
6.	Scalability of the Solution	High Scalability

Table 3.1 Proposed Solution

3.3 Ideation & Brainstorming:

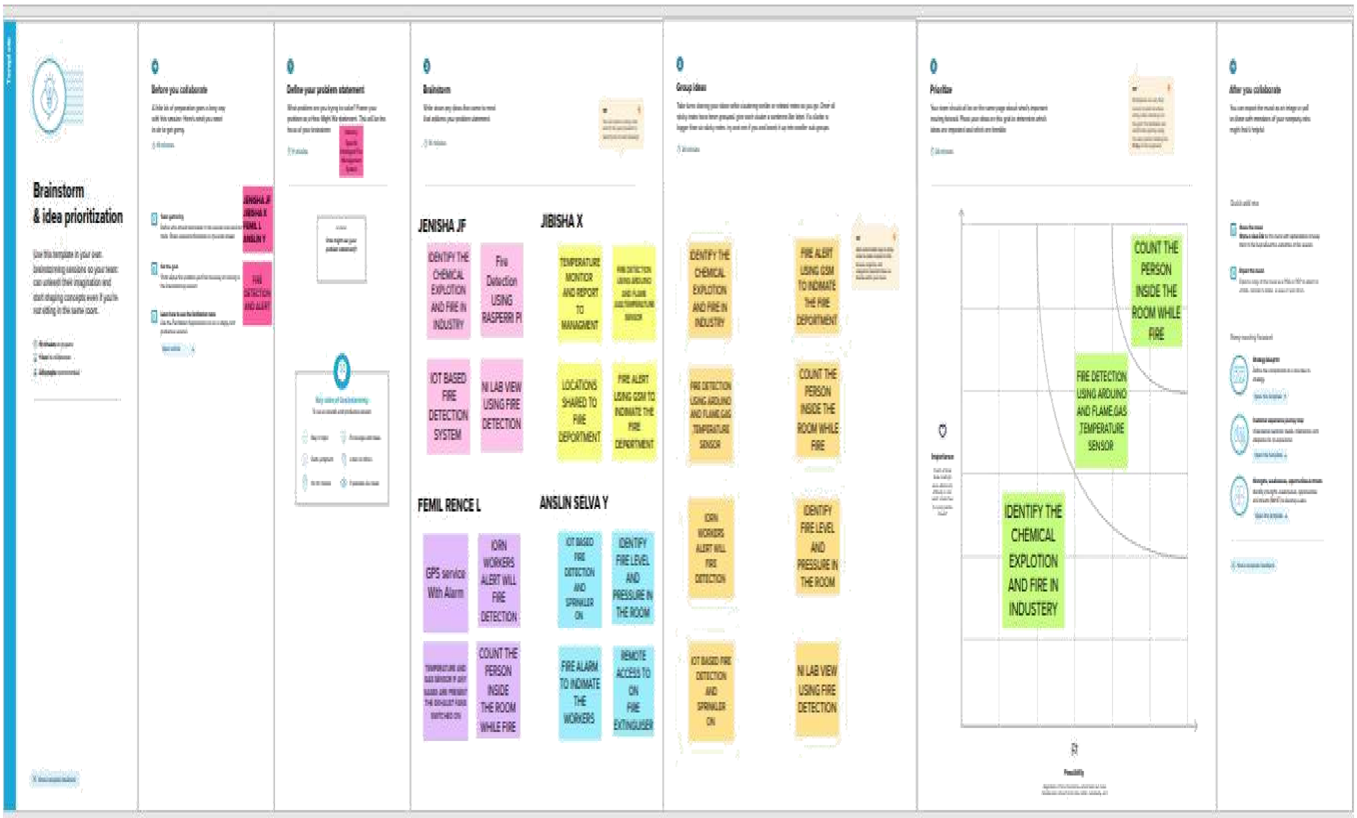

Fig. 3.2 Ideation & Brainstorming

3.4 Problem Solution fit:

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Economic Value of Customer	6. CUSTOMER CONSTRAINTS CC The Priority, Frequency and Minimum Space Between, visit.	5. AVAILABLE SOLUTIONS AS ➢ Fire Alarms Systems ➢ Fire Suppression Systems ➢ Fire Extinguishers.	Explore AS, differentiate
Focus on J&P, tap into BE, understand RC	2. JOBS-TO-BE-DONE / PROBLEMS J&P ➢ Harmful Fire Detection ➢ Burns ➢ Destruction of Industries ➢ Decode station	9. PROBLEM ROOT CAUSE RC ➢ Heat ➢ Fuel ➢ Oxygen	7. BEHAVIOUR BE ➢ Fire Stations ➢ Intimate management ➢ Emergency vehicles ➢ Road Network Components	Focus on J&P, tap into BE, understand RC
Identify strong TR & EM	3. TRIGGERS TR ➢ Efficient ➢ Candles ➢ Lightning. 4. EMOTIONS: BEFORE / AFTER EM BEFORE: Detection of Fires. AFTER: To secure the Objects or Things .	10. YOUR SOLUTION SL ➢ Proper Disposal ➢ Regular Maintenance ➢ Clean Environment	8. CHANNELS of BEHAVIOUR CH 8.1 ONLINE Intimate the management of Fire Station and Emergency number 8.2 OFFLINE Remove the Fire Burn Things	Identify strong TR & EM

Table 3.2 Problem Solution Fit

CHAPTER – 4
REQUIREMENT ANALYSIS

4.1 Functional requirement:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through website or application Registration through Social medias Registration through LinkedIN
FR-2	User Confirmation	Verification via Email or OTP
FR-3	User Login	Login through website or App using the respective username and password
FR-4	User Access	Access the app requirements
FR-5	User Upload	User should be able to upload the data
FR-6	User Solution	Data report should be generated and delivered to user for every 24 hours
FR-7	User Data Sync	API interface to increase to invoice system

Table 4.1 Functional requirements

4.2 Non-Functional requirement:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability requirements includes language barriers and localization tasks. Usability can be assessed by Efficiency of use.
NFR-2	**Security**	Access permissions for the particular system information may only be changed by the system's data administrator.
NFR-3	**Reliability**	The database update process must roll back all related updates when any update fails.
NFR-4	**Performance**	The front-page load time must be no more than 2 seconds for users that access the website using an VoLTE mobile connection.
NFR-5	**Availability**	New module deployment must not impact front page, product pages, and check out pages availability and mustn't take longer than one hour.
NFR-6	**Scalability**	We can increase scalability by adding memory, servers, or disk space. On the other hand, we can compress data, use optimizing algorithms.

Table 4.2 Non-Functional requirements

CHAPTER – 5
PROJECT DESIGN

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

5.1 Data Flow Diagram:

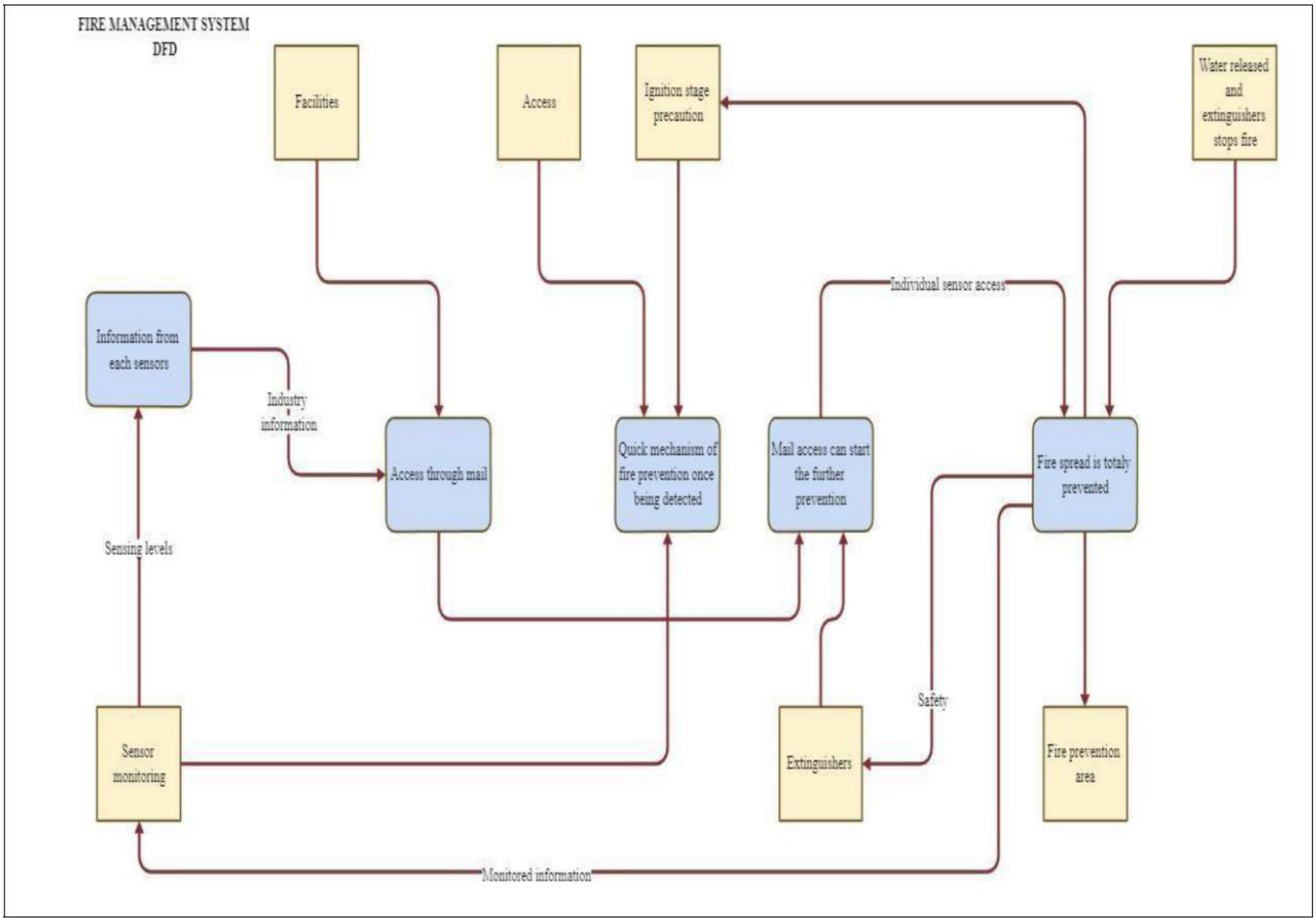

Fig. 5.1 Data Flow Diagram

5.2 Solution & Technical Architecture:

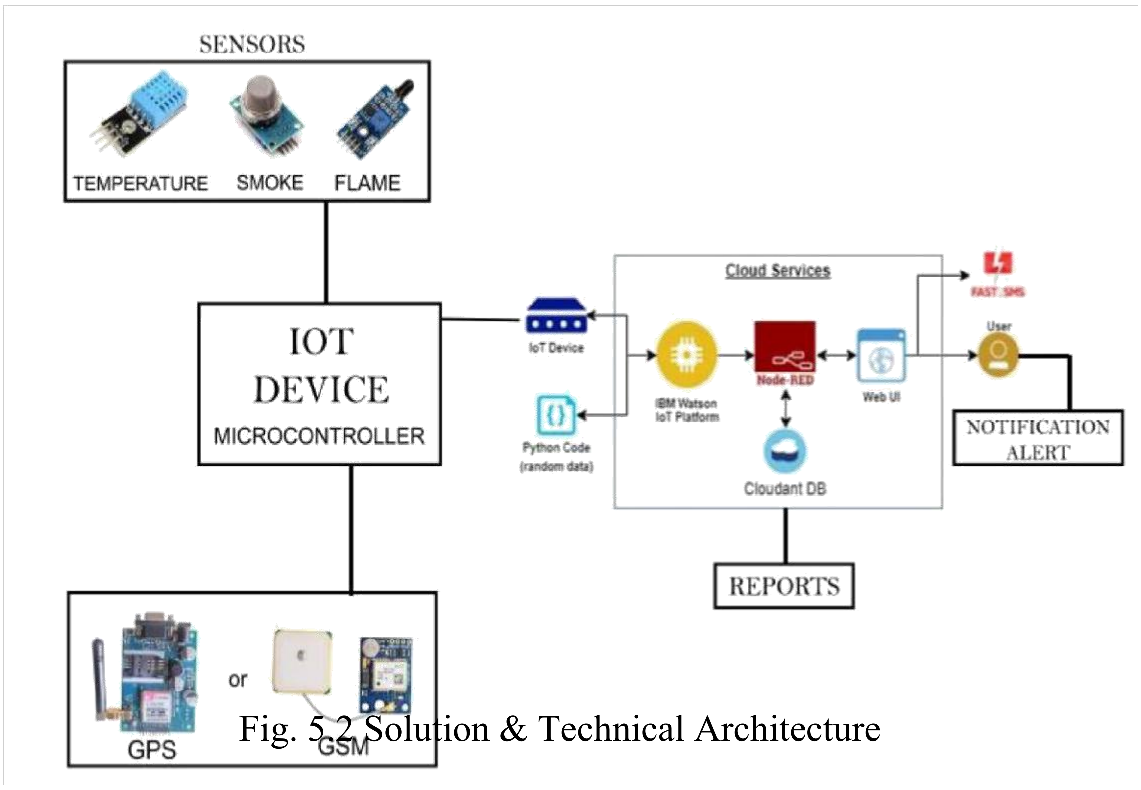

Fig. 5.2 Solution & Technical Architecture

Fig. 5.2 Solution & Technical Architecture

5.3 Components & Technologies:

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

Table 5.1 Components & Technology

5.4 Application Characteristics:

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

Table 5.2 Application Characteristics

5.5 User Stories:

User Type	Functional Requirement (Epic)	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 logic	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 application by entering email & password	I can login with my id and password	High	Sprint-1

CHAPTER – 6
PROJECT PLANNING & SCHEDULING

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

6.1 Project Planning Phase

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

The earliest recorded examples of fire protection can be traced back to the Roman Empire and the catastrophic fires that started in Rome. As a result, Emperor Neron has adopted regulations that required fireproof material for walls and buildings restoration to be used. The second recorded case of adopting fire protection regulations occurred in the year 1666, after the Great fire of London, which destroyed more than 80% of the city. The fire of London spurred interest in the development of the first equipment for fire suppression in the form of hand pumps and fire hydrant installation for water supply.

6.2 Product Backlog, Sprint Schedule, and Estimation (USN 1-5)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
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	Shanthosh D
Sprint-2	Registration	USN-2	As a user, I will receive confirmation email once I have registered for the application	3	Medium	Mohamed Shajith S
Sprint-3	Registration	USN-3	As a user, I can register for the application through Facebook	1	Low	Rajarishi A
Sprint-2	Registration	USN-4	As a user, I can register for the application through Gmail	1	High	Shanthosh D
Sprint-4	Login	USN-5	As a user, I can log into the application by entering email & password	5	High	Shanthosh D

Table 6.1 Product Backlog, Sprint Schedule, and Estimation (USN 1-5)

6.3 Product Backlog, Sprint Schedule, and Estimation (USN 6-11)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Dashboard	USN-6	As a user, I can get the notification alert.	1	Medium	Saranesh R
Sprint-3	Testing & Deployment Phase-I	USN-7	Testing the system performance. For an emergency case, it is deployed.	8	High	Shanthosh D
Sprint-3	Testing & Deployment Phase-I	USN-8	Checking whether the system correctly detects the fire and gas. Also, it will give the alert to the user.	2	High	Shanthosh D
Sprint-1	Deployment Phase-II & Model Improvement	USN-9	Deployment of IOT based industrial specific fire management system, I can see and use the system 24*7.	1	Low	RajaRIshi A
Sprint-2	Verification	USN-10	Administrator can completely verify the submitted application.	5	High	Saranesh R
Sprint-3	Approval	USN-11	After completion, new banking credentials areprovided to the customers.	2	High	Mohamed Shajith S

Table 6.2 Product Backlog, Sprint Schedule, and Estimation (USN 6-11)

6.4 Sprint Delivery Schedule:

Project Tracker, Velocity & Burndown Chart:

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

Table 6.3 Project Tracker, Velocity & Burndown Chart

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) per iteration unit (story points per day)

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

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

6.5 Reports from JIRA:

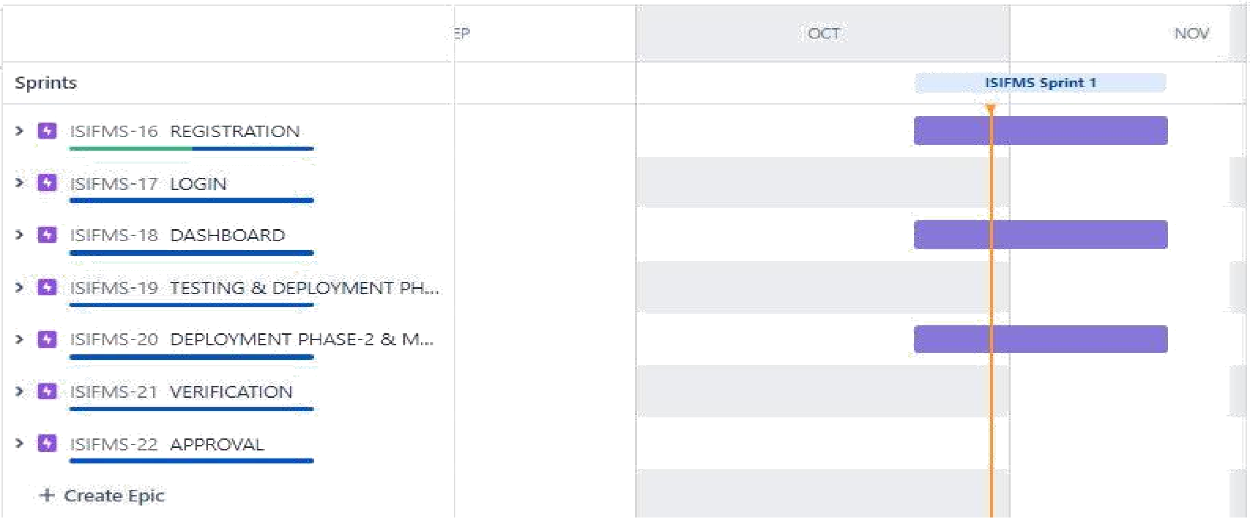

Fig. 6.1 Reports from JIRA

CHAPTER – 7

CODING & SOLUTIONING

7.1 Feature 1 (coding and result):

```
#include <time.h>
#include <WiFi.h>
#include <PubSubClient.h>

#define ORG "ksgtfi"
#define DEVICE_TYPE "123"
#define DEVICE_ID "123_1"
#define TOKEN "12345678"

char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/data/fmt/json"; char authMethod[]
= "use-token-auth";
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;

WiFiClient wifiClient;
PubSubClient client(server, 1883, wifiClient);

float temperature  = 0;
int gas = 0;
int flame = 0;

String flame_status = "";
String Gas_status = "";
String exhaust_fan_status = "";
String sprinkler_status = "";


void setup() {
  Serial.begin(99900);
   wifiConnect();
   mqttConnect();
}

void loop() {

  srand(time(0));

    //initial variables and random generated data

    temperature = random(-20,125);
    gas = random(0,1000);
```

```
flame = map(flamereading,200,1024,0,2);

//set a flame status
int flamereading = random(200,1024);

switch (flame) {
case 0:
   flame_status = "No Fire";
   break;
case 1:
   flame_status = "Fire is Detected";
   break;
}

//send the sprinkler status

if(flame==1){
   sprinkler_status = "Working";
}
else{
   sprinkler_status = "Not Working";

}

//toggle the fan according to gas reading

if(gas > 100){
   Gas_status = "Gas Leakage is Detected";
   exhaust_fan_status = "Working";

}
else{
   Gas_status = "No Gas Leakage is Detected";
   exhaust_fan_status = "Not Working";
}

//json format for IBM Watson

String payload = "{";
payload+="\"gas\":";
payload+=gas;
payload+=",";
payload+="\"temperature\":";
payload+=(int)temperature;
payload+=",";
payload+="\"flame\":";
payload+=flamereading;
payload+=",";
payload+="\"fire_status\":\""+flame_status+"\",";
payload+="\"sprinkler_status\":\""+sprinkler_status+"\",";
```

```
    payload+="\"Gas_status\":\""+Gas_status+"\",";
    payload+="\"exhaust_fan_status\":\""+exhaust_fan_status+"\"}";

    if(client.publish(publishTopic, (char*) payload.c_str()))
    {
        Serial.println("Publish OK");
    }
    else{
        Serial.println("Publish failed");
    }
    delay(1000);


    if (!client.loop())
    {
      mqttConnect();
    }
}


void wifiConnect()
{
  Serial.print("Connecting to ");
  Serial.print("Wifi");
  WiFi.begin("Wokwi-GUEST", "", 6);
  while (WiFi.status() != WL_CONNECTED)
  {
    delay(500);
    Serial.print(".");
  }
  Serial.print("WiFi connected, IP address: ");
  Serial.println(WiFi.localIP());

}


void mqttConnect()
{
  if (!client.connected())
  {
    Serial.print("Reconnecting MQTT client to ");
    Serial.println(server);
    while (!client.connect(clientId, authMethod, token))
    {
      Serial.print(".");
      delay(500);
    }

    Serial.println();
  }
```

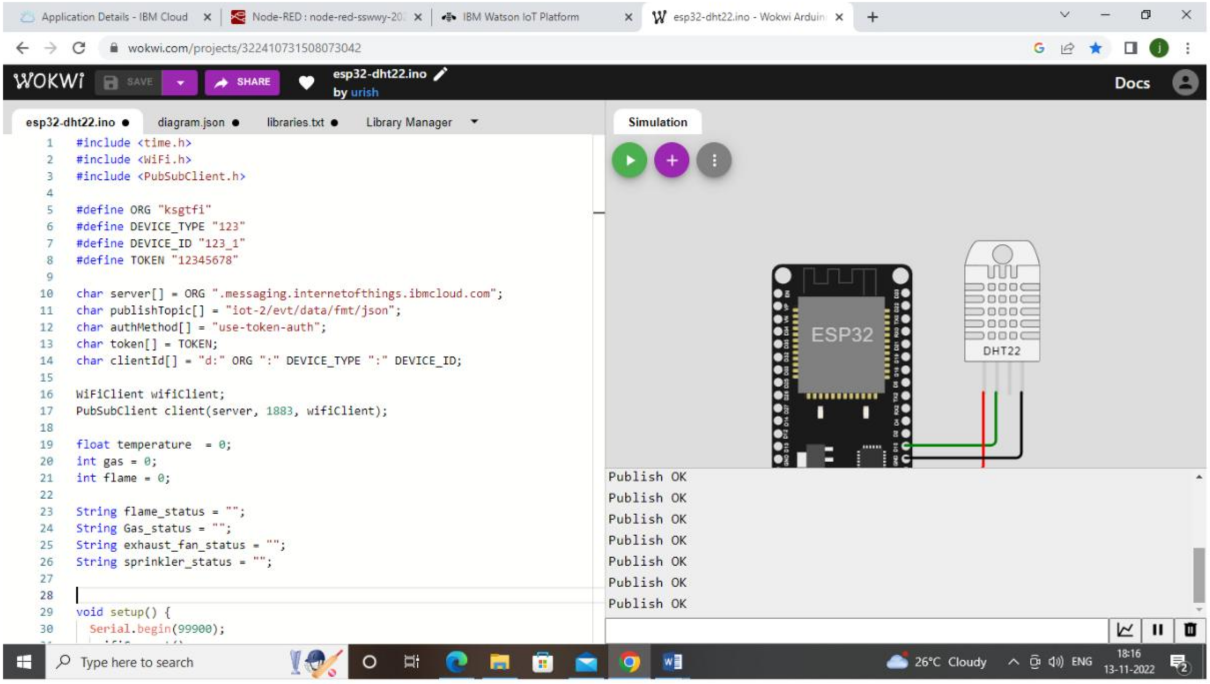

Fig. 7.1 Coding Interface

7.2 Feature 2

Watson IOT Platform

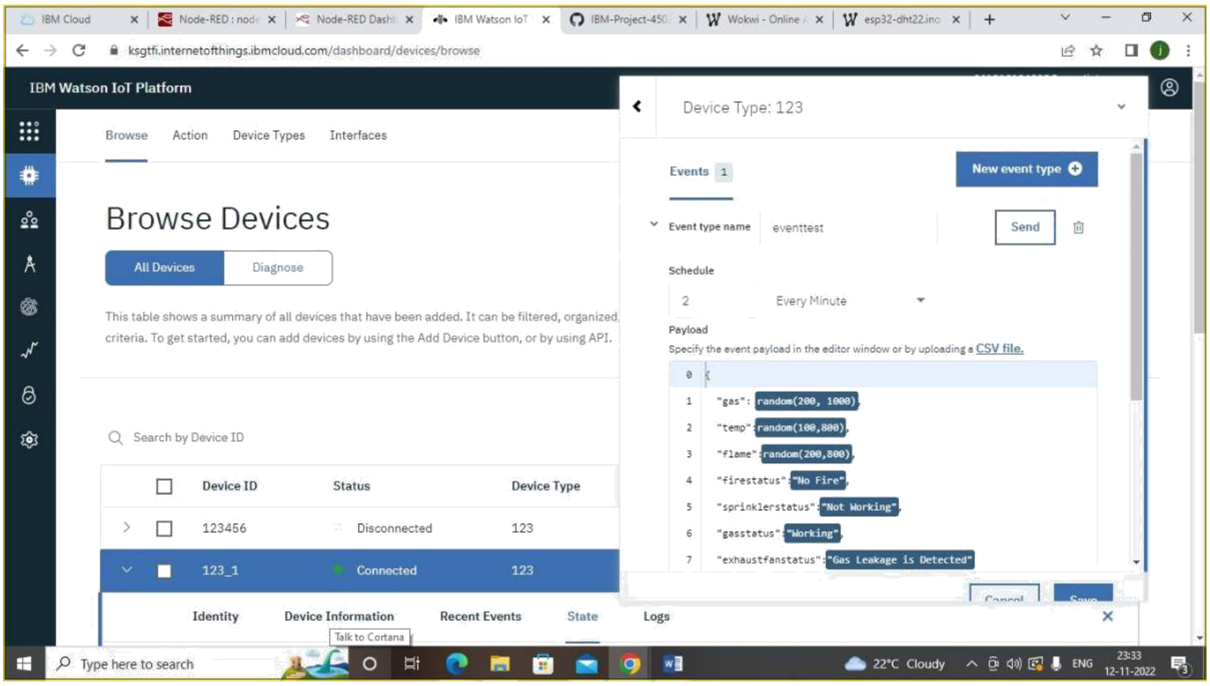

Fig. 7.2 Watson IOT Platform

Watson(output)

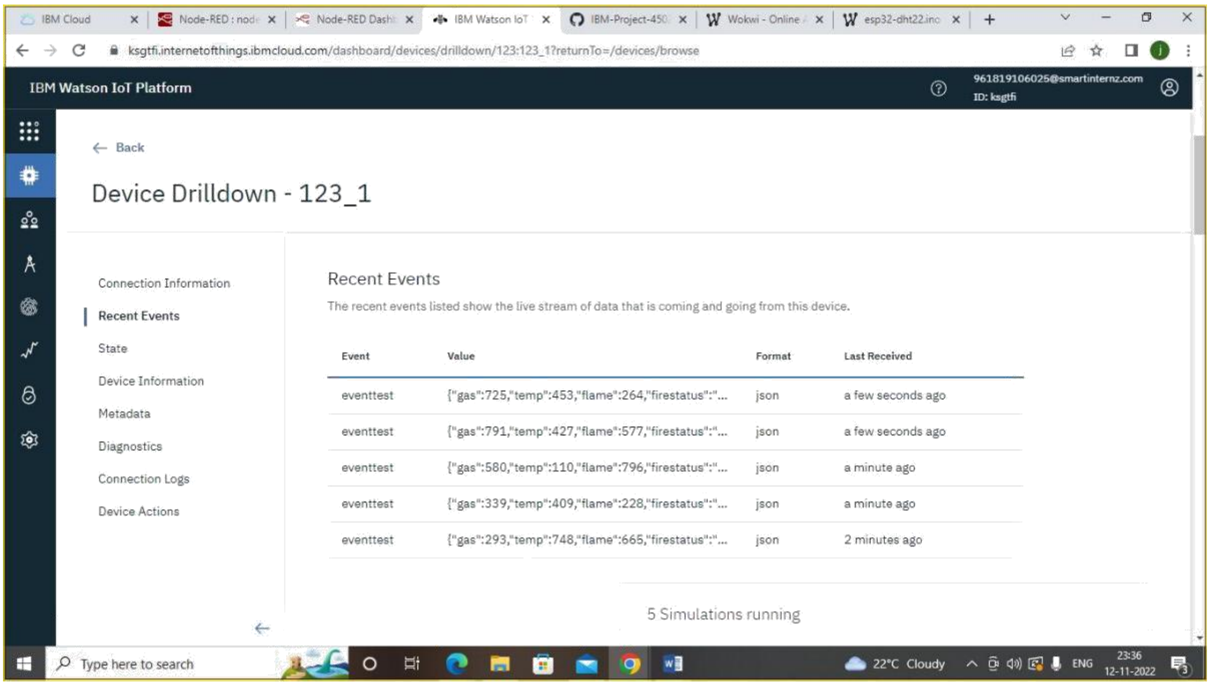

Fig. 7.3 Watson Output - 1

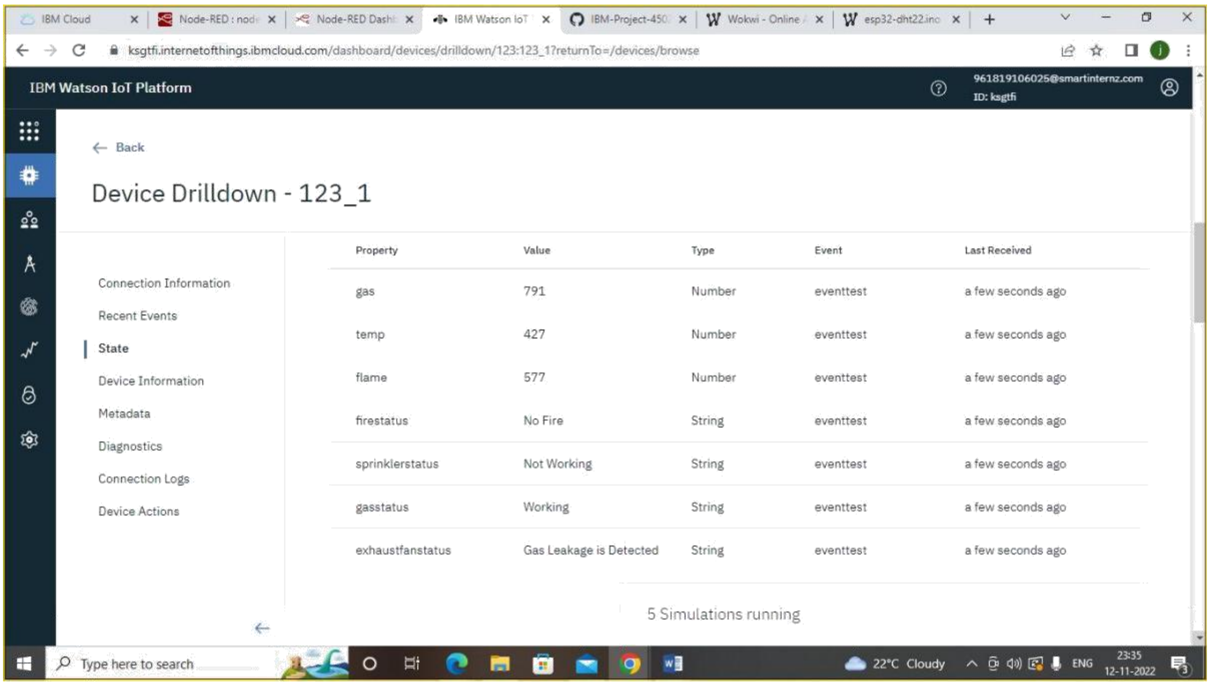

Fig. 7.4 Watson Output - 2

7.3 Feature 3(Node-Red):

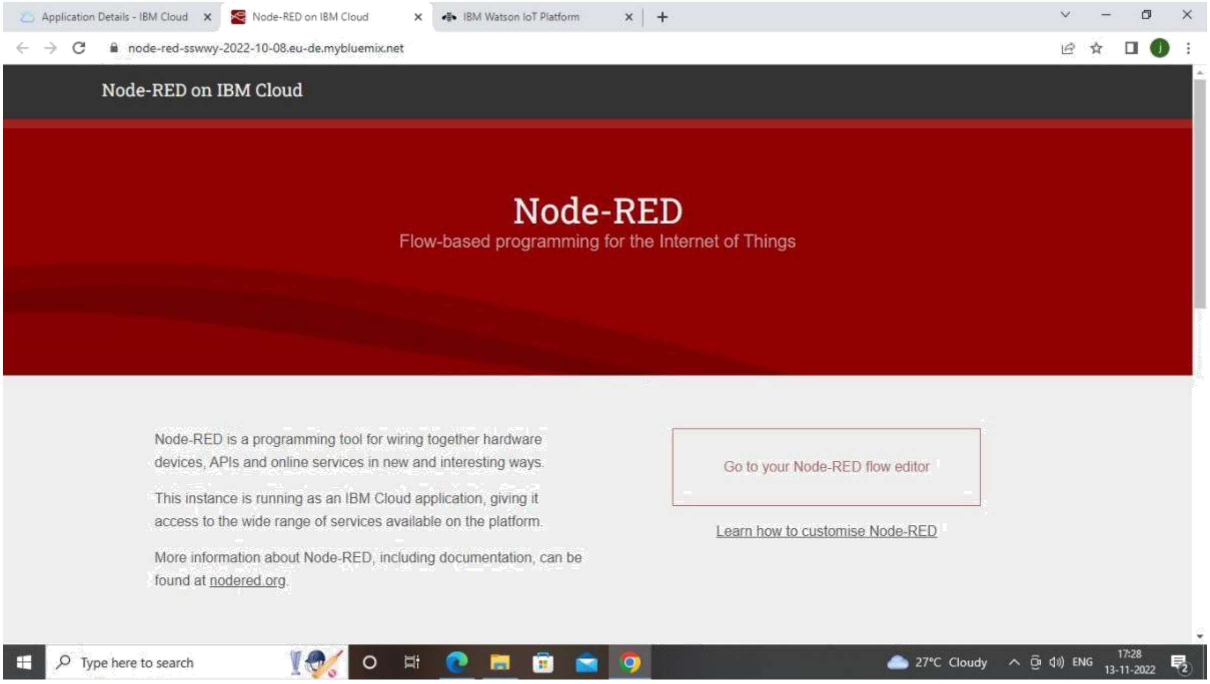

Fig. 7.5 Node Red

Web Application Using Node-Red:

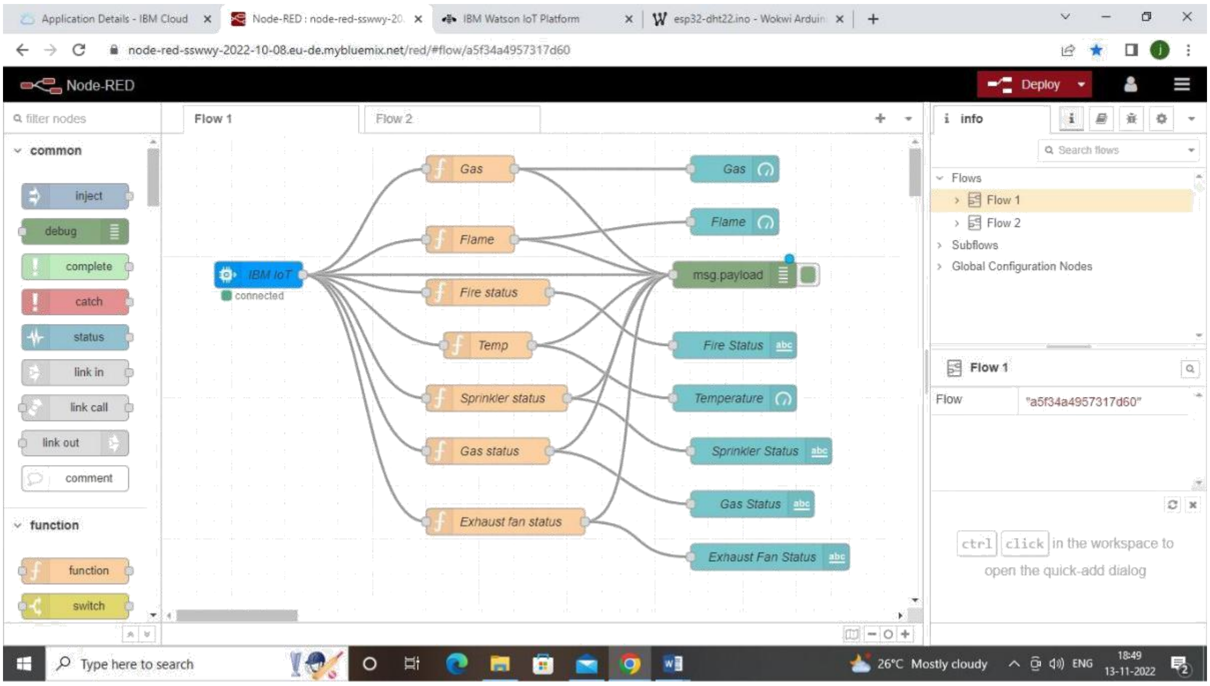

Fig. 7.6 Node Red Web Application

Node-Red(output):

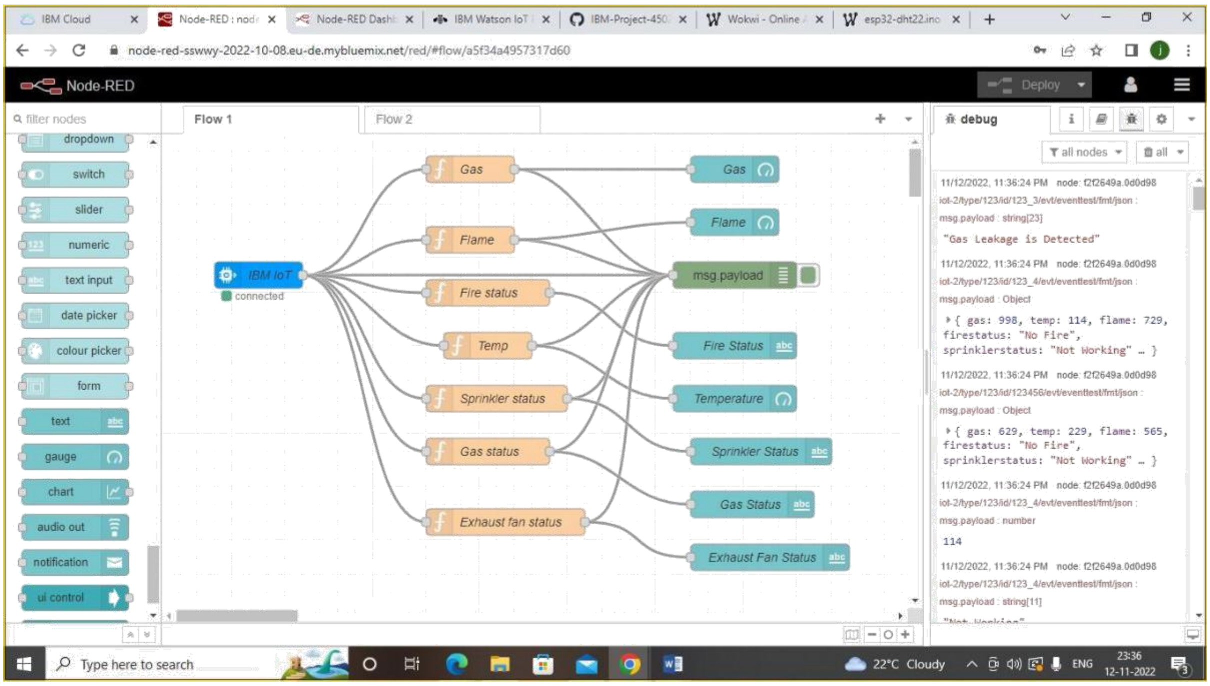

Fig. 7.7 Node Red Output - 1

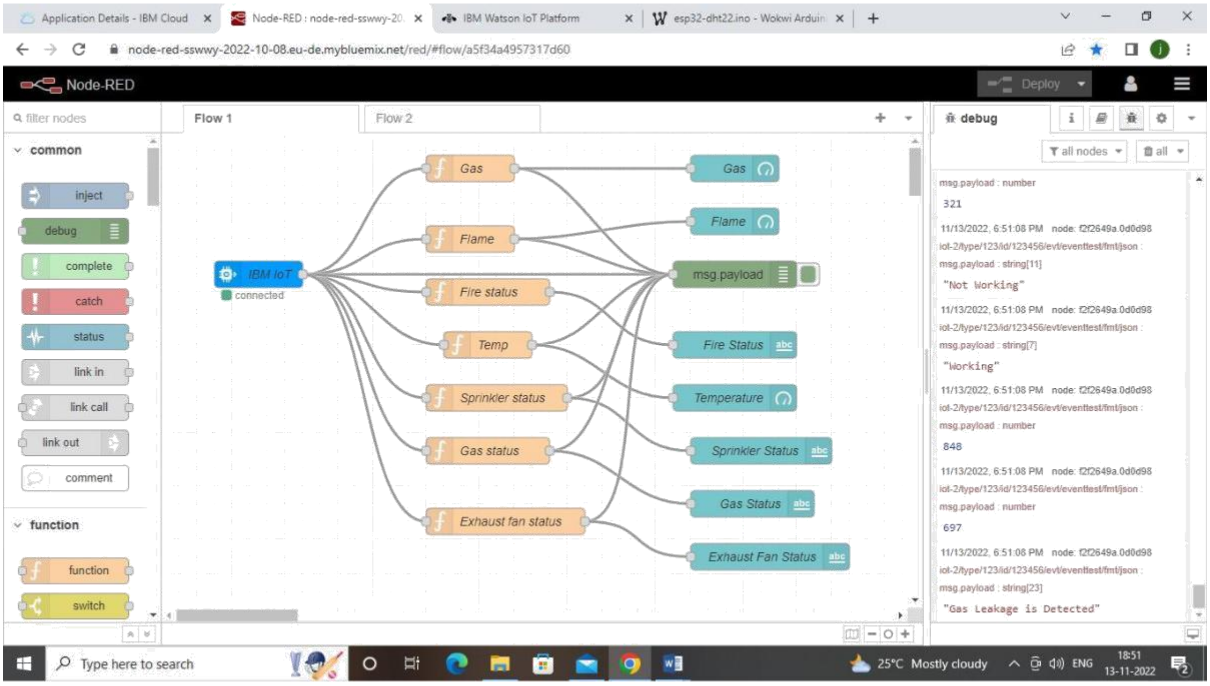

Fig. 7.8 Node Red Output - 2

Node-Red Dashboard Status:

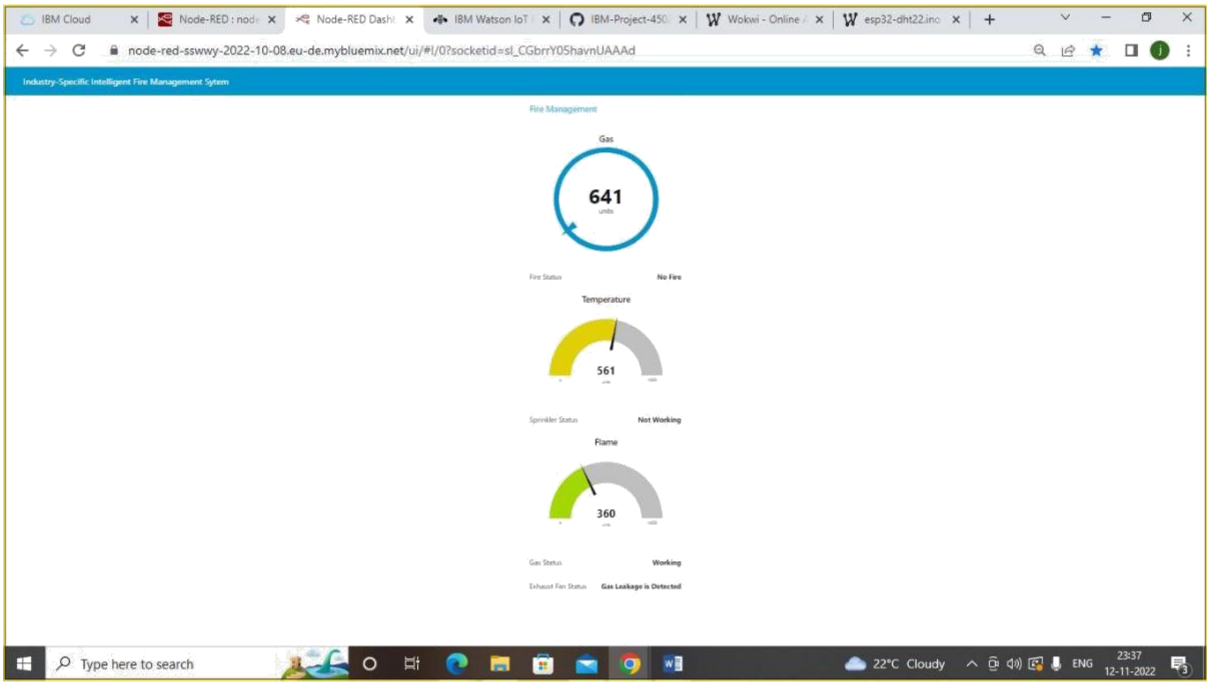

Fig. 7.9 Node Red Dashboard

CHAPTER – 8
TESTING

Testing Introduction:

Test cases help guide the tester through a sequence of steps to validate whether a software application is free of bugs, and working as required by the end-user. Learning how to write test cases for software requires basic writing skills, an attention to detail, and a good understanding of the application under test (AUT).

8.1 Testcase:

SI.NO	INPUT	OUTPUT	RESULT
01.	Gas:218 Temperature:59.30 Flame:369	Exhaust fan on:TRUE Sprinklers:ON	Passed
02.	Gas:437 Temperature:59.30 Flame:693	Exhaust fan on:TRUE Sprinklers:OFF	Passed
03.	Gas:941 Temperature:59.30 Flame:155	Exhaust fan on:TRUE Sprinklers:ON	Passed
04.	Gas:2 Temperature:27.90 Flame:479	Exhaust fan on:FALSE Sprinklers:OFF	Passed
05.	Gas:503 Temperature:59.30 Flame:531	Exhaust fan on:TRUE Sprinklers:OFF	Passed
06.	Gas:933 Temperature:59.30 Flame:207	Exhaust fan on:TRUE Sprinklers:ON	Passed
07.	Gas:722 Temperature:59.30 Flame:855	Exhaust fan on:TRUE Sprinklers:OFF	Passed
08.	Gas:229 Temperature:29.2 Flame:309	Exhaust fan on:TRUE Sprinklers:OFF	Passed
09.	Gas:690 Temperature:75.10 Flame:440	Exhaust fan on:TRUE Sprinklers:ON	Passed
10.	Gas:0 Temperature:59.30 Flame:45	Exhaust fan on:FALSE Sprinklers:OFF	Passed
11.	Gas:1 Temperature:27.80 Flame:53	Exhaust fan on:FALSE Sprinklers:OFF	Passed
12.	Gas:843 Temperature:50 Flame:167	Exhaust fan on:TRUE Sprinklers:OFF	Passed
13.	Gas:347 Temperature:64 Flame:815	Exhaust fan on:TRUE Sprinklers:ON	Passed
14.	Gas:414 Temperature:64.40 Flame:491	Exhaust fan on:TRUE Sprinklers:OFF	Passed

Table 8.1 Testcase

8.2 User Acceptence Testing:

Testing fire protection systems following their installation is of utmost importance. This month Scott Futrell, president of Futrell Fire Consult & Design Inc., joins this column to take a closer look at acceptance testing and the numerous requirements that are part of the process. He shows examples of what can happen if the proper testing is not completed and some common modes of failure. There is a focus on dry pipe sprinkler systems, but many of the items draw attention to the detail of acceptance testing needed in fire protection systems in general.

Acceptance testing of fire and life safety systems, if not done properly and thoroughly, can have disastrous implications. Fire protection engineers, and the engineers in other disciplines who specify fire and life safety systems, should be at the forefront and actively involved in the acceptance testing of these systems.

CHAPTER – 9
RESULTS

9.1 Performance Metrics:

Fire safety differs from many areas measured because success results in the absence of an outcome (fires, injuries, property damage, business disruption, etc) rather than a presence. As such, measuring fire safety is not easy and there are no simple answers to achieve this.

The key to effective selection and measurement of fire safety performance indicators is the quality of the performance standards and specifications that have been established. Performance indicators for reviewing overall performance can then be developed based on active and reactive measures that include: assessment of the degree of compliance with fire safety system requirements identification of areas where the fire safety system is absent or inadequate assessment of the achievement of specific objectives and plans within organizational policies and codes of practice

fire and near miss data accompanied by analysis of immediate and underlying causes, trends and common features.

In other words, the performance indicators should be answering questions in relation to where the organization stands in terms of aims and objectives and risk control, along with the effectiveness, reliability, efficiency and proportionality of the management system. Indicators should also be able to indicate whether performance is getting better or worse and how well the organizational culture is supporting implementation.

CHAPTER -10

Advantages & Disadvantages:

10.1 Advantages:

- Cost effective for larger applications.
- The location of a fire condition is detected and recorded at each individual device, identifying exactly where the fire is occurring. This will improve response time for emergency responders.
- Lower ongoing service cost, because when a device goes into trouble (i.e. needs cleaning, repair or replacement), the panel will tell you the exact location of the device needing service.
- Online capabilities: New intelligent panels have the capability to provide detailed online notification of alarm/trouble/supervisory events.

10.2 Disadvantages:

- Cost, not as competitively priced for smaller applications.
- Typically with an intelligent panel, your peripheral devices (i.e. smoke detectors, etc…) tend to be more expensive than conventional devices.
- This panel is computer like and at times there maybe issues caused by the firmware (panel software). However, this is not common and the advantages of intelligent panel far outweigh any of these firmware issues.

CHAPTER – 11
CONCLUSION

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

CHAPTER – 12
FUTURE SCOPE

Fire alarm systems, however, are designed and installed in the majority of applications for life safety. The only detector that is used for this application is the smoke detector. Smoke detectors and smoke alarms are and remain as the single best method for the early detection of a fire and have saved countless lives. These devices however have one principle problem, they are a source for unwanted alarms.

CHAPTER – 13

APPENDIX

13.1 Source Code:

```
#include <time.h>
#include <WiFi.h>
#include <PubSubClient.h>

#define ORG "ksgtfi"
#define DEVICE_TYPE "123"
#define DEVICE_ID "123_1"
#define TOKEN "12345678"

char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/data/fmt/json"; char authMethod[]
= "use-token-auth";
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;

WiFiClient wifiClient;
PubSubClient client(server, 1883, wifiClient);

float temperature  = 0;
int gas = 0;
int flame = 0;

String flame_status = "";
String Gas_status = "";
String exhaust_fan_status = "";
String sprinkler_status = "";


void setup() {
  Serial.begin(99900);
   wifiConnect();
   mqttConnect();
}

void loop() {

  srand(time(0));

    //initial variables and random generated data

    temperature = random(-20,125);
    gas = random(0,1000);
```

```
int flamereading = random(200,1024);
flame = map(flamereading,200,1024,0,2);

//set a flame status

switch (flame) {
case 0:
    flame_status = "No Fire";
    break;
case 1:
    flame_status = "Fire is Detected";
    break;
}

//send the sprinkler status

if(flame==1){
    sprinkler_status = "Working";
}
else{
    sprinkler_status = "Not Working";

}

//toggle the fan according to gas reading

if(gas > 100){
    Gas_status = "Gas Leakage is Detected";
    exhaust_fan_status = "Working";

}
else{
    Gas_status = "No Gas Leakage is Detected";
    exhaust_fan_status = "Not Working";
}

//json format for IBM Watson

String payload = "{";
payload+="\"gas\":";
payload+=gas;
payload+=",";
payload+="\"temperature\":";
payload+=(int)temperature;
payload+=",";
payload+="\"flame\":";
payload+=flamereading;
payload+=",";
payload+="\"fire_status\":\""+flame_status+"\",";
payload+="\"sprinkler_status\":\""+sprinkler_status+"\",";
```

```
    payload+="\"Gas_status\":\""+Gas_status+"\",";
    payload+="\"exhaust_fan_status\":\""+exhaust_fan_status+"\"}";

    if(client.publish(publishTopic, (char*) payload.c_str()))
    {
        Serial.println("Publish OK");
    }
    else{
        Serial.println("Publish failed");
    }
    delay(1000);


    if (!client.loop())
    {
      mqttConnect();
    }
}


void wifiConnect()
{
  Serial.print("Connecting to ");
  Serial.print("Wifi");
  WiFi.begin("Wokwi-GUEST", "", 6);
  while (WiFi.status() != WL_CONNECTED)
  {
    delay(500);
    Serial.print(".");
  }
  Serial.print("WiFi connected, IP address: ");
  Serial.println(WiFi.localIP());

}


void mqttConnect()
{
  if (!client.connected())
  {
    Serial.print("Reconnecting MQTT client to ");
    Serial.println(server);
    while (!client.connect(clientId, authMethod, token))
    {
      Serial.print(".");
      delay(500);
    }

    Serial.println();
  }
```

GIT HUB LINK:

https://github.com/IBM-EPBL/IBM-Project-13140-1659511757

PROJECT DEMO LINK

https://drive.google.com/file/d/1GOpy6WvKXF311mpEfCA8gxzVYx5IZT7S/view?usp=drivesdk