PROJECT REPORT

PROJECT TITLE : **INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM.**

TEAM ID : PNT2022TMID14319.

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1. INTRODUCTION

1.1 Project overview

Fire alarm systems are essential for the adequate detection and warning of a fire situation within commercial and residential premises. The detection, visual and audible requirements of a fire management system are dependent on the layout and use of the building. It is due to the diversity of these application that fire alarm panels and related accessories have been developed to meet these varying needs.

1.2 Purpose

A fire alarm system warns people when smoke, fire, carbon monoxide or other fire-related or general notification emergencies are detected. A properly designed, installed, operated, and maintained fire alarm system can reduce the losses associated with an unwanted fire in any building. These losses include property and, more importantly, human life. The primary motivation for fire alarm system requirements in building and fire codes is to provide early notification to building occupants so they can exit the building, and to notify the fire service so it can respond to the fire. In settings such as hospitals the fire alarm system provides notification to staff so they can respond to the fire emergency. This module will explain the basic features of fire alarm systems and the inspection of these systems.

2. LITERATURE SURVEY

2.1 Existing problem

Fire monitoring systems have usually been based on a single sensor such as smoke or flame. These single sensor systems have been unable to distinguish between true and false presence of fire. Consuming energy all day long and being dependent on one sensor that might end with false alert is not efficient and environmentally friendly. We need a system that is efficient not only in sensing fire accurately, but we also need a solution which is smart. In order to improve upon the results of existing single sensor systems, the smart fire management system includes a Gas sensor, Flame sensor and a temperature sensor. This system also requires a proper network with individual smart devices connected to various panels.

2.2 References

[1] N N Mahzan, N I M Enzai, N M Zin and K S S K M Noh,"Design of an Arduino-based home fire alarm system with gSM module", 1st International conference on green and Sustainable computing (ICoGeS), 2017.

[2] ZHANG Ying-Cong, YU Jing, "Study on the Fire IOT Development Strategy", Shenyang Fire Research Institute --Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling, US: ANSI/FMRC, pp. FM32602004.

[3] Public Security, Shenyang 110034, China Shenyang Institute of Engineering, Shenyang 110136, China, 2019. Liu Yunhong Qi Meini,"The Design of Building Fire Monitoring System Based on ZigBee-WiFi Networks", Eighth International

Conference on Measuring Technology and Mechatronics Automation, IEEE, 2016, pp-733-735

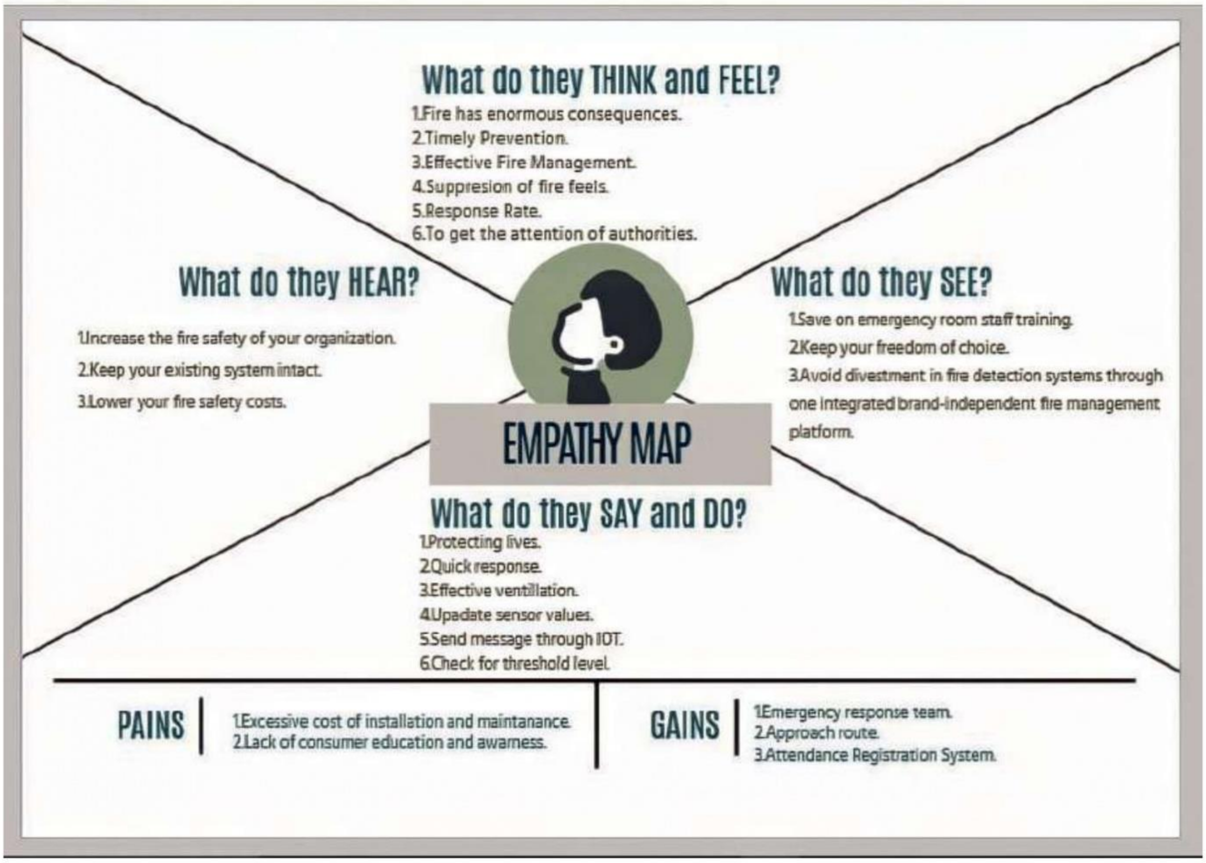
[4] R.A. Sowah, A.R. Ofoli, S.N. Krakani, S.Y. Fiawoo, hardware Design and Web-Based Communication Modules of a Real-Time multisensor Fire Detection and Notification System Using Fuzzy Logic, IEEE Transactions on Industry Applications, 53 (2016) 559-566.

2.3 Problem Statement Definition

Industry Specific Intelligent fire management system are designed to prevent fire accidents due to Gas leakage and flame in industry.

3. IDEATIOIN AND PROPOSED SOLUTION

3.1 Empathy Map Canvas



EMPATHY MAP

What do they THINK and FEEL?

1.Fire has enormous consequences.
2.Timely Prevention.
3.Effective Fire Management.
4.Suppresion of fire feels.
5.Response Rate.
6.To get the attention of authorities.

What do they HEAR?

1.Increase the fire safety of your organization.
2.Keep your existing system intact.
3.Lower your fire safety costs.

What do they SEE?

1.Save on emergency room staff training.
2.Keep your freedom of choice.
3.Avoid divestment in fire detection systems through one integrated brand-independent fire management platform.

What do they SAY and DO?

1.Protecting lives.
2.Quick response.
3.Effective ventillation.
4.Upadate sensor values.
5.Send message through IOT.
6.Check for threshold level.

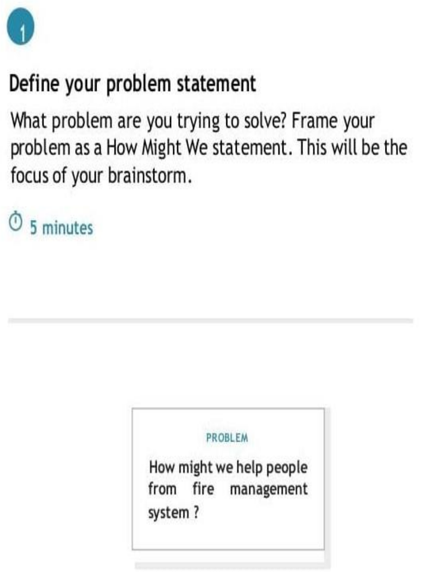
PAINS

1.Excessive cost of installation and maintanance.
2.Lack of consumer education and awarness.

GAINS

1.Emergency response team.
2.Approach route.
3.Attendance Registration System.

3.2 Ideation and Brainstroming



1

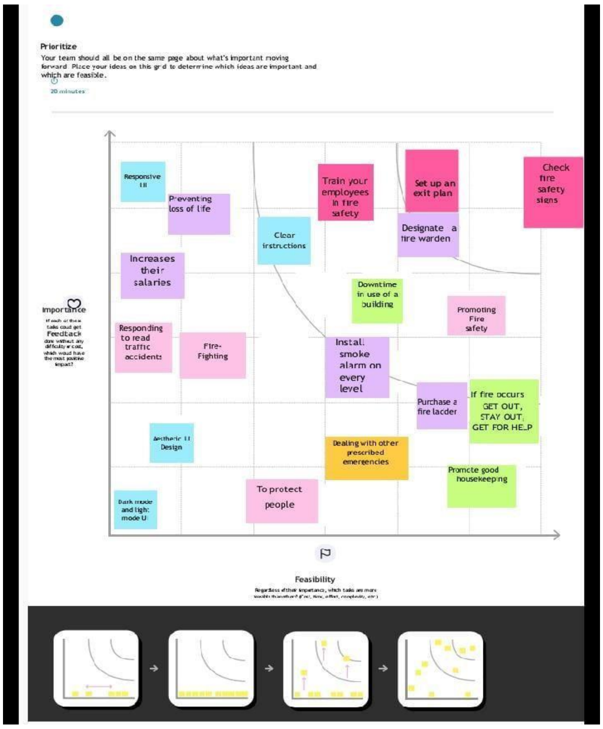
Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM

How might we help people from fire management system ?



Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

Importance

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

Feasibility

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

Responsive UI

Preventing loss of life

Train your employees in fire safety

Set up an exit plan

Check fire safety signs

Designate a fire warden

Clear instructions

Increases their salaries

Downtime in use of a building

Promoting Fire safety

Responding to read traffic accidents

Fire-Fighting

Install smoke alarm on every level

Purchase a fire ladder

If fire occurs GET OUT, STAY OUT, GET FOR HELP

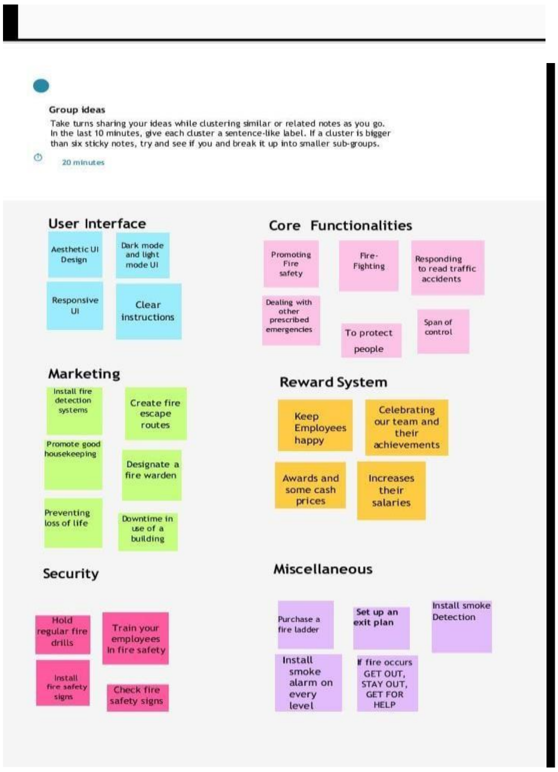
Aesthetic UI Design

Dealing with other prescribed emergencies

Promote good housekeeping

To protect people

Dark mode and light mode UI



Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

User Interface

Aesthetic UI Design

Dark mode and light mode UI

Responsive UI

Clear instructions

Core Functionalities

Promoting Fire safety

Fire-Fighting

Responding to read traffic accidents

Dealing with other prescribed emergencies

To protect people

Span of control

Marketing

Install fire detection systems

Create fire escape routes

Promote good housekeeping

Designate a fire warden

Preventing loss of life

Downtime in use of a building

Reward System

Keep Employees happy

Celebrating our team and their achievements

Awards and some cash prices

Increases their salaries

Security

Hold regular fire drills

Train your employees In fire safety

Install fire safety signs

Check fire safety signs

Miscellaneous

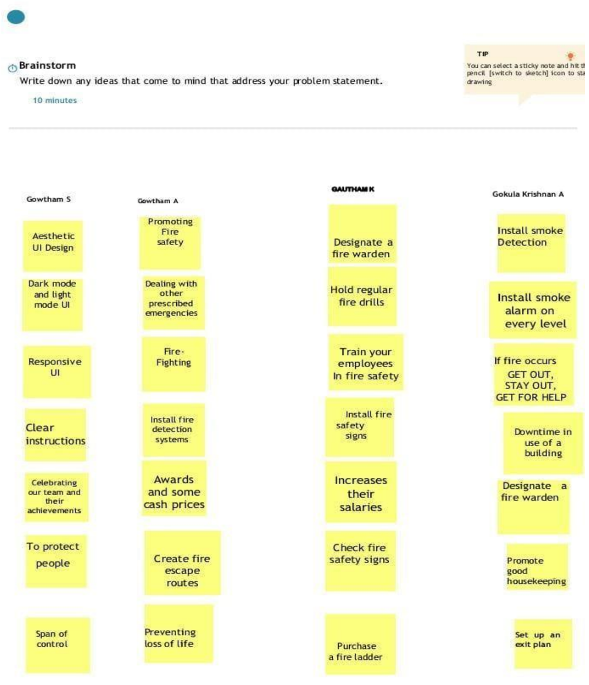
Purchase a fire ladder

Set up an exit plan

Install smoke Detection

Install smoke alarm on every level

If fire occurs GET OUT, STAY OUT, GET FOR HELP



Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit th pencil [switch to sketch] icon to sta drawing

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Aesthetic UI Design

Dark mode and light mode UI

Responsive UI

Clear instructions

Celebrating our team and their achievements

To protect people

Span of control

Gowtham A

Promoting Fire safety

Dealing with other prescribed emergencies

Fire-Fighting

Install fire detection systems

Awards and some cash prices

Create fire escape routes

Preventing loss of life

GAUTHAM K

Designate a fire warden

Hold regular fire drills

Train your employees In fire safety

Install fire safety signs

Increases their salaries

Check fire safety signs

Purchase a fire ladder

Gokula Krishnan A

Install smoke Detection

Install smoke alarm on every level

If fire occurs GET OUT, STAY OUT, GET FOR HELP

Downtime in use of a building

Designate a fire warden

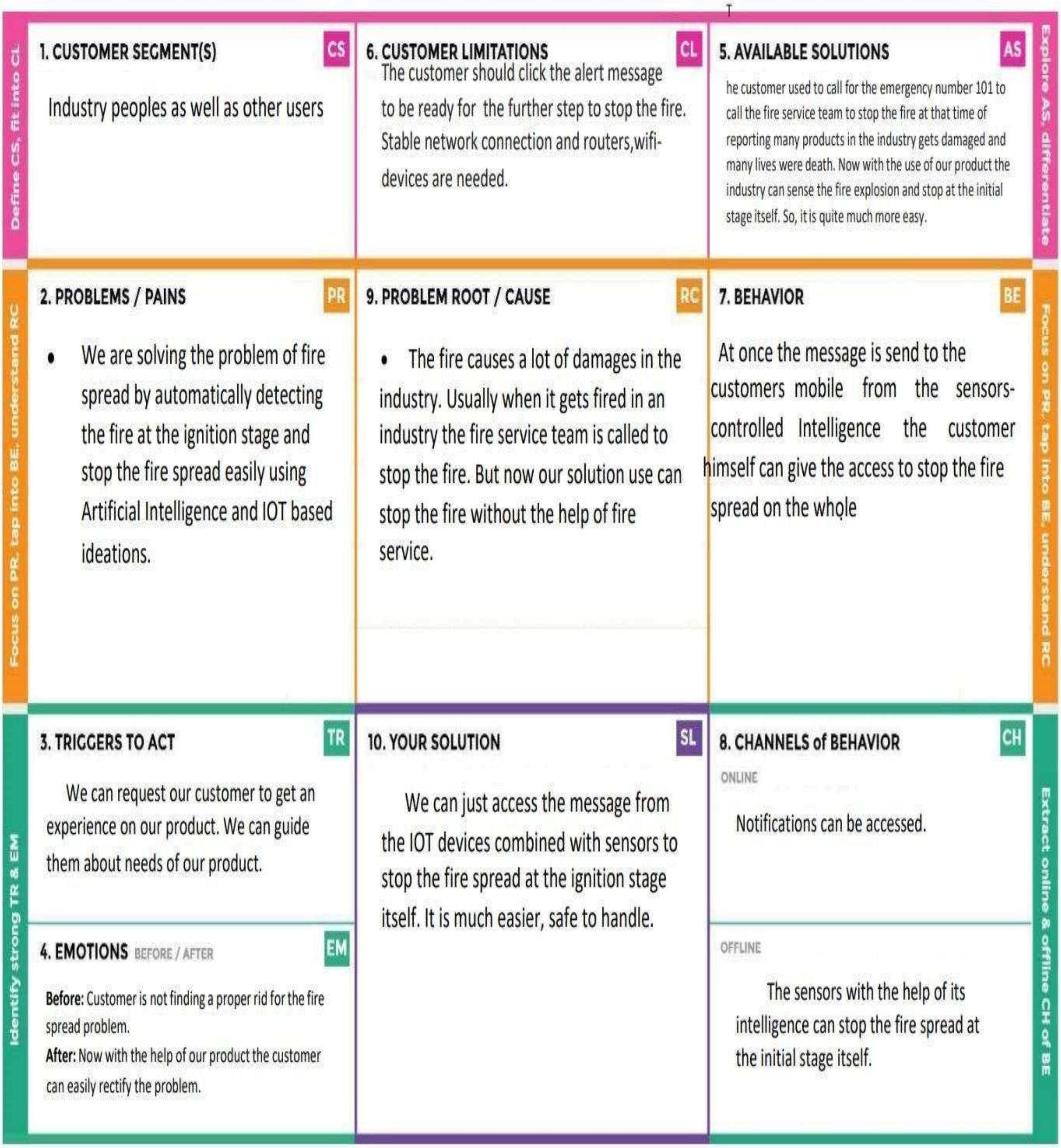
Promote good housekeeping

Set up an exit plan

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	1) We are ready to solve the unintended fire explosion in the industry level. 2) The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment.
2.	Idea / Solution description	1) The exhaust fans are activated if the temperature readings exceed the threshold. 2) Sprinklers will be activated in the event of a flame detection. 3) An alarm will be activated to notify employees. 4) In the event that the flame cannot be contained, a message will be sent to the fire station along with the location.
3.	Novelty / Uniqueness	By using Latest Technology Artificial Intelligence to answer and solve the fire explosion without Human presence.
4.	Social Impact / Customer Satisfaction	It serves of value to users, Fire detection systems increase response times, as they are able to alert the correct people in order to extinguish the fire.
5.	Business Model (Revenue Model)	1) Fire detection systems can be connected to sprinklers that will automatically respond when a fire is detected. 2) We can learn more about how changes in one aspect of management can affect other aspects.
6.	Scalability of the Solution	1) The System is completely modular make it expandable and business efficiency in customized fire detection, with affordable price. 2) This can be used in any kind of industry.

3.4 Problem Solution Fit


Define CS, fit into CL
Explore AS, differentiate
Focus on PR, tap into BE, understand RC
Focus on PR, tap into BE, understand RC
Identify strong TR & EM
Extract online & offline CH of BE
CS
CL
AS
PR
RC
BE
TR
SL
CH
EM

1. CUSTOMER SEGMENT(S)

Industry peoples as well as other users

6. CUSTOMER LIMITATIONS

The customer should click the alert message to be ready for the further step to stop the fire. Stable network connection and routers,wifi-devices are needed.

5. AVAILABLE SOLUTIONS

he customer used to call for the emergency number 101 to call the fire service team to stop the fire at that time of reporting many products in the industry gets damaged and many lives were death. Now with the use of our product the industry can sense the fire explosion and stop at the initial stage itself. So, it is quite much more easy.

2. PROBLEMS / PAINS

- We are solving the problem of fire spread by automatically detecting the fire at the ignition stage and stop the fire spread easily using Artificial Intelligence and IOT based ideations.

9. PROBLEM ROOT / CAUSE

- The fire causes a lot of damages in the industry. Usually when it gets fired in an industry the fire service team is called to stop the fire. But now our solution use can stop the fire without the help of fire service.

7. BEHAVIOR

At once the message is send to the customers mobile from the sensors-controlled Intelligence the customer himself can give the access to stop the fire spread on the whole

3. TRIGGERS TO ACT

We can request our customer to get an experience on our product. We can guide them about needs of our product.

4. EMOTIONS BEFORE / AFTER

Before: Customer is not finding a proper rid for the fire spread problem.

After: Now with the help of our product the customer can easily rectify the problem.

10. YOUR SOLUTION

We can just access the message from the IOT devices combined with sensors to stop the fire spread at the ignition stage itself. It is much easier, safe to handle.

8. CHANNELS of BEHAVIOR

ONLINE

Notifications can be accessed.

OFFLINE

The sensors with the help of its intelligence can stop the fire spread at the initial stage itself.

4.REQUIREMENT ANALYSIS

4.1Functional requirement

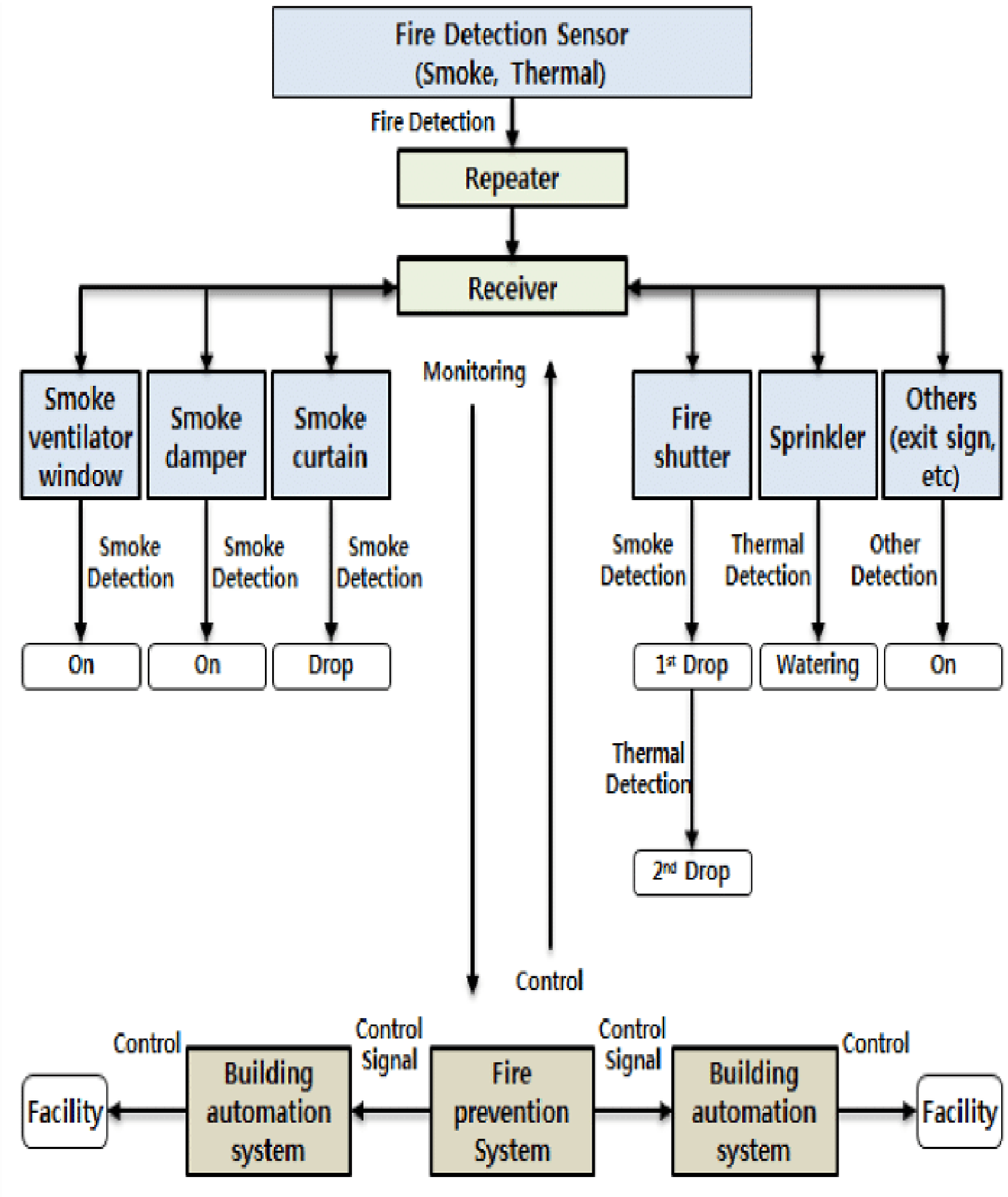
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through website or application Registration through Social medias Registration through LinkedIN
FR-2	User Confirmation	Verification via Email or OTP
FR-3	User Login	Login through website or App 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

4.2 Non-Functional requirement

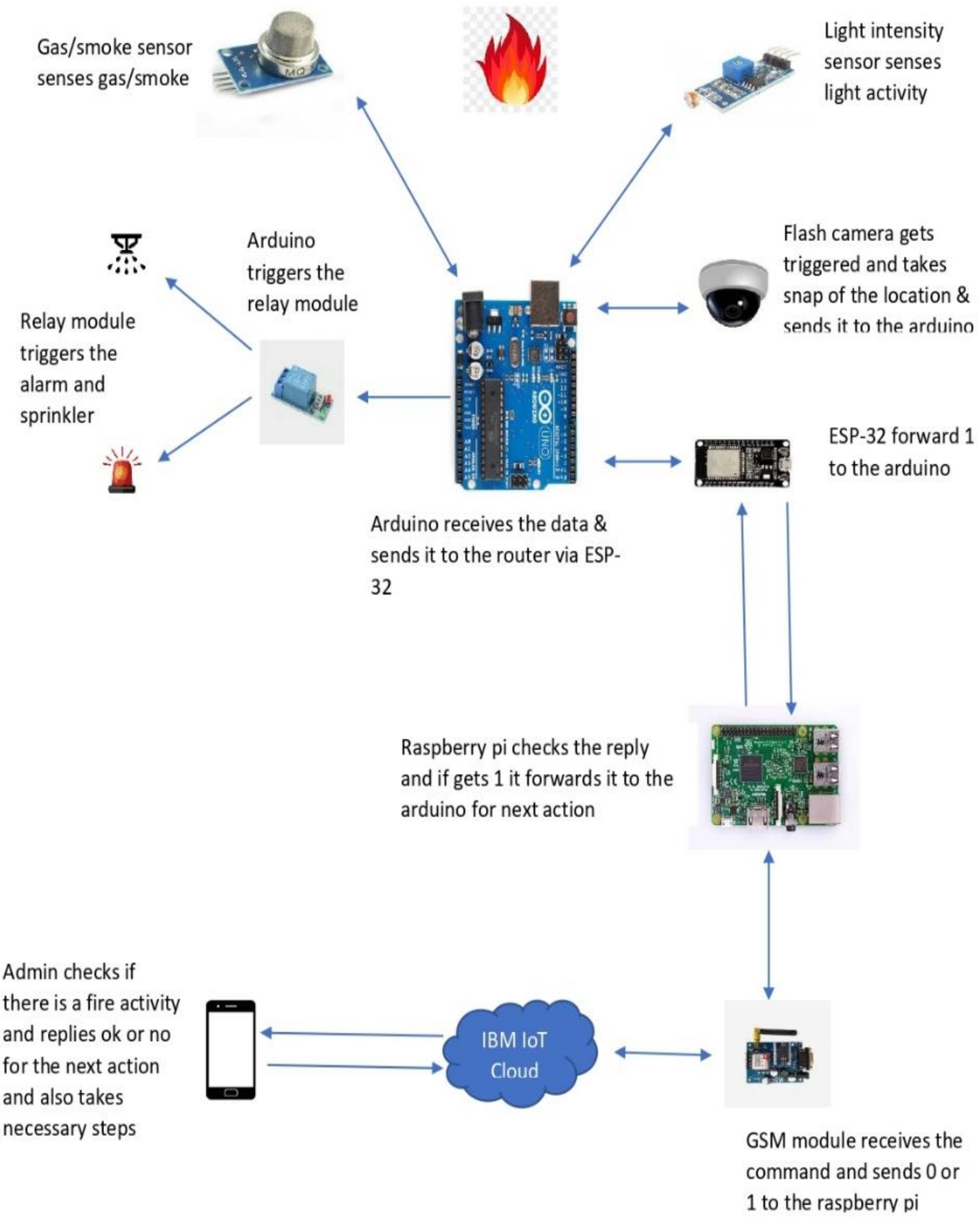
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability requirements includes language barriers and localization tasks. Usability can be assessed by Efficiency of use.
NFR-2	**Security**	Access permissions for the particular system information may only be changed by the system' s 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 4 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.

5.PROJECT DESIGN

5.1 Data Flow Diagram



5.2Solution Architecture


Gas/smoke sensor senses gas/smoke
Light intensity sensor senses light activity
Arduino triggers the relay module
Relay module triggers the alarm and sprinkler
Flash camera gets triggered and takes snap of the location & sends it to the arduino
ESP-32 forward 1 to the arduino
Arduino receives the data & sends it to the router via ESP-32
Raspberry pi checks the reply and if gets 1 it forwards it to the arduino for next action
Admin checks if there is a fire activity and replies ok or no for the next action and also takes necessary steps
IBM IoT Cloud
GSM module receives the command and sends 0 or 1 to the raspberry pi

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 application by entering email & password	I can login with my id and password	High	Sprint-1

6.PROJECT PLANNING &SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resources Initialization	We have to create and initialize accounts in various public APIs like OpenWeatherMap API.	1	LOW	Manojkumar.G Mathu shree.P Manjit.S Ragul.M
Sprint-1	Local Server/Software Run	Write a Python program that outputs results given the inputs like weather and location through the software	1	MEDIUM	Manojkumar.G Mathu shree.P Manjit.S Ragul.M
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	Manojkumar.G Mathu shree.P Manjit.S Ragul.M
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the same.	2	HIGH	Manojkumar.G Mathu shree.P Manjit.S Ragul.M
Sprint-4	UI/UX Optimization & Debugging	Optimize all the shortcomings and provide better user experience.	2	LOW	Manojkumar.G Mathu shree.P Manjit.S Ragul.M

7.CODING & SOLUTIONING

7.1 Feature 1

- IoT device
- IBM Watson Platform
- Node red
- Cloudant DB
- Web UI
- MIT App Inventor
- Python code

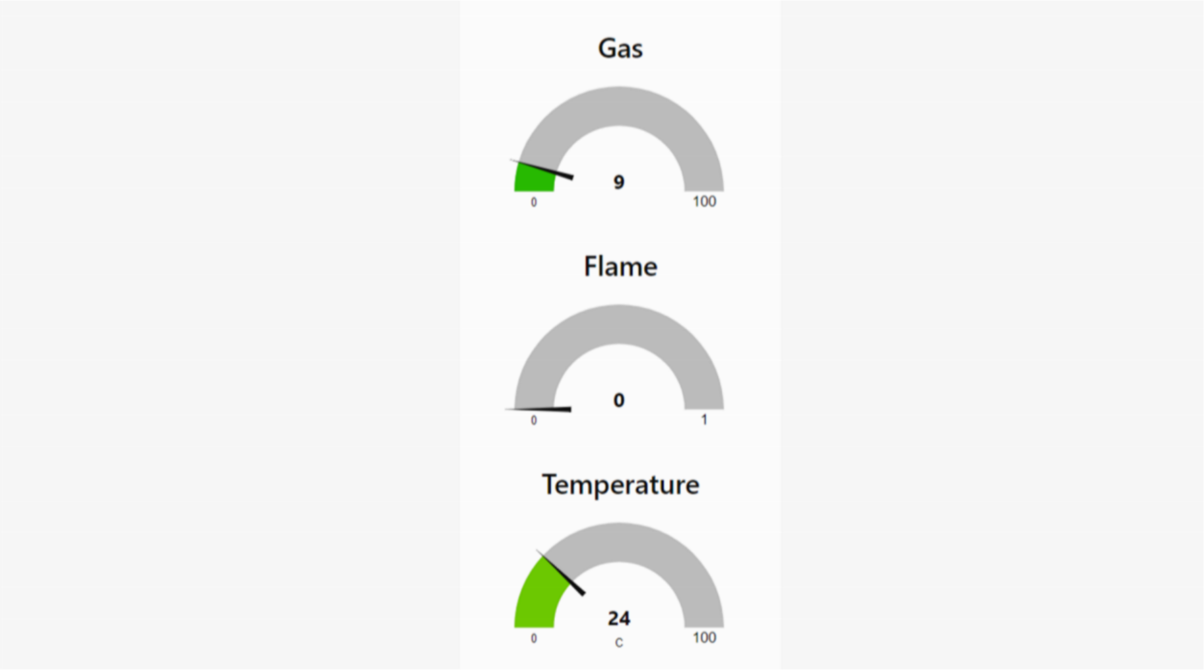
7.2 Feature 2

- Login
- Wokwi

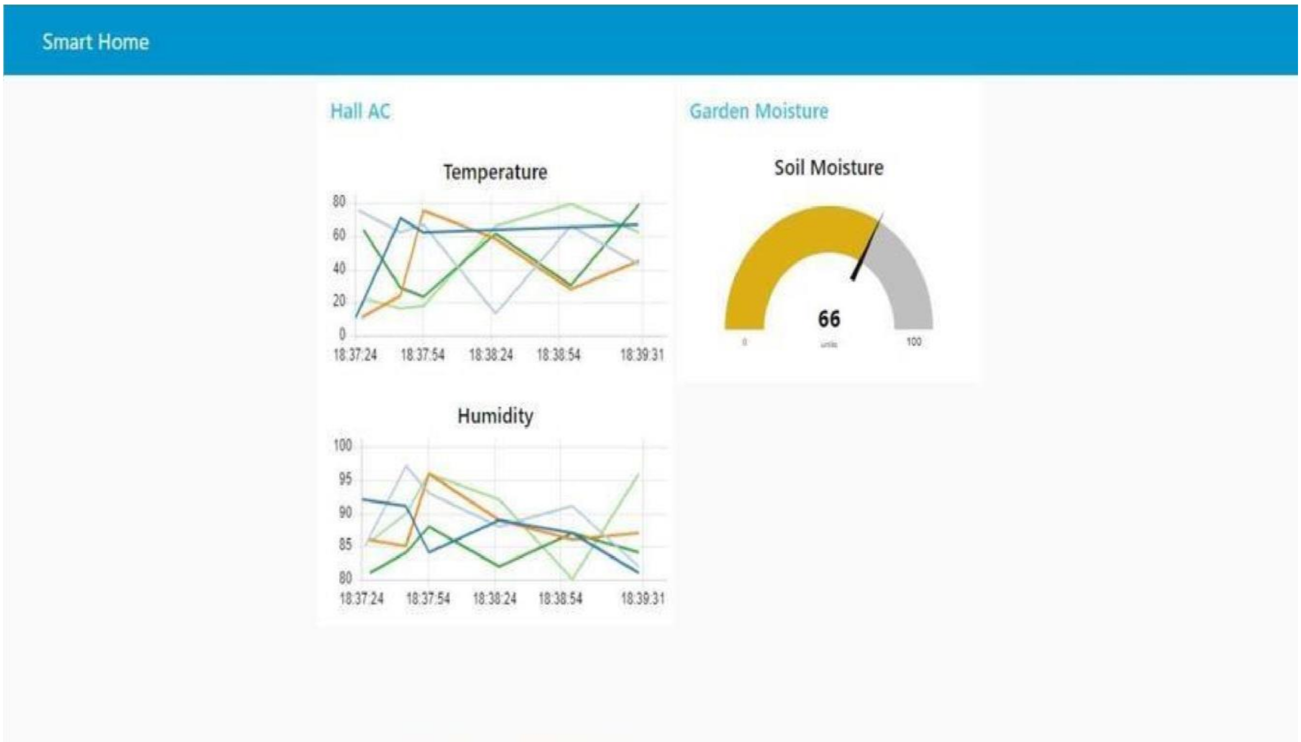
8.TESTING AND RESULTS

8.1 Test Cases

Test case 1:



Test case 2:



9.ADVANTAGES

- This will reduced installation cost.
- It will monitor 24/7.
- Improved security in homes, industries and Offices.
- It pin points location of the fire.
- It will also reduce the use of chemicals and water due to the identification of exact fire region

10.DISADVANTAGES

- Heat detectors are not considered as life saving devices because they are sensitive only to heat.
- High battery or current consumption will need for these detectors.
- Control pannel may need to be replaced if it becomes damaged.
- Some times the over temperature leads to misunderstand as fire.

11.CONCLUSION

This gas leakage system can be applied for household safety and many other applications in the industry . Gas leakages and fire outbreaks in industries as well as houses have lead to wide destruction and losses in the past. Gas leakages and fire outbreaks both spread widely and lead to even greater loss of life and property if proper action is not taken on time. So here we proposed a system that detects gas as well as fire outbreaks and alert us accordingly so that proper action may be taken to control it.

12.FUTURE SCOPE

Smoke detectors and alarms are migrating from just the detection of smoke, to combination detectors and multicriteria detector. The future will be with multicriteria detection in which the detector will be more of a sensor,with the detection more for the products of combustion,such as carbon monoxide, carbon dioxide,sulfur dioxide ,nitrogen dioxide in addition to heat and particulate matter. Within the next decade, video image detection (VID) will become more mainstream in which, through analytics, the image of either smoke or flame will be able to be isolated and detected from within a room or space. The VID system would also be able to detect if an individual is within the space and through the integration with the notification appliances, provide a path of exit.

13.APPENDIX

13.1 Source Code

```
#include <WiFi.h>//library for wifi

#include <PubSubClient.h>//library for MQtt

#include "DHT.h"// Library for dht11

#define DHTPIN 15     // what pin we're connected to

#define DHTTYPE DHT22   // define type of sensor DHT 11

#define LED 2


DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr
of dht connected
```

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


//-------credentials of IBM Accounts------


#define ORG "i3869j"//IBM ORGANITION ID
#define DEVICE_TYPE "abcd"//Device type mentioned in ibm watson IOT
Platform
#define DEVICE_ID "1234"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"     //Token
String data3; float h, t;



//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server
Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event
perform and format in which data to be send char subscribetopic[] = "iot-
2/cmd/command/fmt/String";// cmd  REPRESENT command type AND
COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method char
token[] = TOKEN; char clientId[] = "d:" ORG ":" DEVICE_TYPE ":"
DEVICE_ID;//client id



//-----------------------------------------
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined
client id by passing parameter like server id,portand wificredential
```

```
void setup()// configureing the ESP32
{
  Serial.begin(115200);
dht.begin();
  pinMode(LED,OUTPUT);
  delay(10);
Serial.println();
wificonnect();
mqttconnect();
}

void loop()// Recursive Function
{

  h = dht.readHumidity();   t
= dht.readTemperature();
  Serial.print("temp:");
  Serial.println(t);
  Serial.print("Humid:");
  Serial.println(h);

  PublishData(t, h);
delay(1000);   if
(!client.loop()) {
  }
    mqttconnect();

}




/....................................retrieving to Cloud............................../

void PublishData(float temp, float humid) {
mqttconnect();//function call for connecting to ibm
  /*      creating the String in in form JSon to update the data to ibm
cloud
  */
  String payload = "{\"temp\":";
payload += temp;   payload +=
"," "\"Humid\":";   payload +=
humid;   payload += "}";


  Serial.print("Sending payload: ");
  Serial.println(payload);


  if (client.publish(publishTopic, (char*) payload.c_str())) {
    Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it
will print publish ok in Serial monitor or else it will print publish failed   } else
{
  }
    Serial.println("Publish failed");



}



void mqttconnect() {   if
(!client.connected()) {
    Serial.print("Reconnecting client to ");
Serial.println(server);
    while (!!!client.connect(clientId, authMethod, token)) {
Serial.print(".");       delay(500);
    }
     initManagedDevice();
     Serial.println();
  } }
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish
the connection   while (WiFi.status() != WL_CONNECTED) {     delay(500);
    Serial.print(".");

  Serial.println("");
  }
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void initManagedDevice() {   if
(client.subscribe(subscribetopic)) {
Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd FAILED");
  }
}

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

  Serial.print("callback invoked for topic: ");
Serial.println(subscribetopic);   for (int i =
0; i < payloadLength; i++) {
//Serial.print((char)payload[i]);     data3 +=
(char)payload[i];
  }
  Serial.println("data: "+ data3);
  }
  if(data3=="lighton")
  {
Serial.println(data3); digitalWrite(LED,HIGH);
  }   else
  {
Serial.println(data3); digitalWrite(LED,LOW);
  } data3="";
}
```

13.2 GitHub

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-9978-1659087598