REPORTS

Team ID	**PNT2022TMID47356**
PROJECT NAME	**Industry Specific Intelligent Fire Management System**

Introduction:

The growth of population in the world are coupled in every year. The population growth increases the day-to-day basic needs of the people. Due to the increased needs, the accidents and damages are also get increased. 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 transport and communication, fire signal in real system is not satisfied with fire detection in modern time.

PURPOSE:

Fire is a very dangerous situation and it is very much necessary to monitor and give warning before anything untoward happens. In many developing countries, houses do not come fitted with fire alarm system as seen in developed countries like Singapore, USA etc. This results in fire being unattended and leading to lot of losses like property, human. This is the IOT (internet of things) based on intelligent fire management system which not only gives the real time

information about the situation on the monitor but also takes the corrective action as per the need.

LITERATURE SURVEY:

The author [1] says that 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, such as a smoke from a cigarette which might cause the fire alarm to go off. 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, our system uses a combination of three sensors to increase the efficiency. The result from the sensor is then analysed by a specified rule-set using an IOTbased fuzzy logic algorithm; defined in the purposed research, our system detects the presence of fire.

The author [2] says that the maglev rail transit has entered a rapid development stage. In order to prevent potential safety hazards in the operation of maglev train, the related monitoring technology needs to be studied urgently. In this article, in view of the wide application of the Internet of Things (IoT) in intelligent transportation, a new method for realizing suspension control for medium-low-speed maglev trains using the IoT and an adaptive fuzzy controller is proposed. First, a mathematical model of the suspension system of mediumlow-speed maglev trains is established. Then, the basic composition of the IoT and the circuit design of the key components of maglev trains are introduced. On this basis, an improved Apriori algorithm is used to extract the stored historical database and establish a trusted database. Then, according to the data of the trusted database, the suspension airgap control law is extracted, and the adaptive fuzzy rules of the maglev train suspension system are determined. An improved adaptive suspension controller is designed. Finally, the

effectiveness of the method is verified by experiments utilizing a full-scale maglev train

The author [3] says that in the current scenario, the concept of Smart Cities is one of the emerging and challenging research areas. The cities are surrounded by forests, agricultural land, or open areas, where fire incidence can occur threatening human life and causing many resources to become extinct. This article aims to design an early fire detection system to get rid of fire events using the concept of senor network and UAV's technology. The architecture proposal is based on sensors for monitoring environmental parameters and to process the information through sensors and IoT application. The proposed fire detection system is the combination of wireless sensor technologies, UAVs, and cloud computing. Some image processing techniques are also integrated into the proposed fire detection system to identify the fire event with better accuracy and used as an integrated solution. To improve the true detection rate, rules are also designed. The simulation results of the proposed fire detection system are compared with several existing methods. It is observed that the proposed system has a higher fire detection rate to improve the true detection of forest fire from 95 to 98 percent.

REFERENCES :

1. Rehman, A., Qureshi, M. A., Ali, T., Irfan, M., Abdullah, S., Yasin, S., ... & Wegrzyn, M. (2021). Smart Fire Detection and Deterrent System for Human Savior by Using Internet of Things (IoT). Energies, 14(17), 5500..

2. Yixi Chen, Yang Zhang, Bin Cai, "Suspension Strategy of Maglev Vertical Axis Wind Turbine Based on Sliding Mode Adaptive Neural Network Predictive Control", IEEE Access, vol.10, pp.91712-91721, 2022.

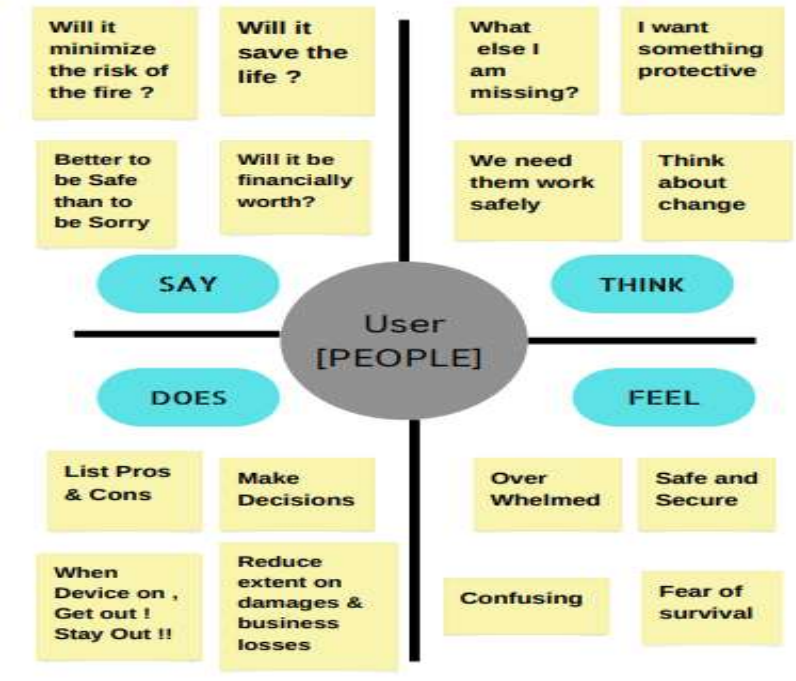
3. Sharma, A., Singh, P. K., & Kumar, Y. (2020). An integrated fire detection system using IOT and image processing technique for smart cities. Sustainable Cities and Society, 61, 10233

PROBLEM STATEMENT:

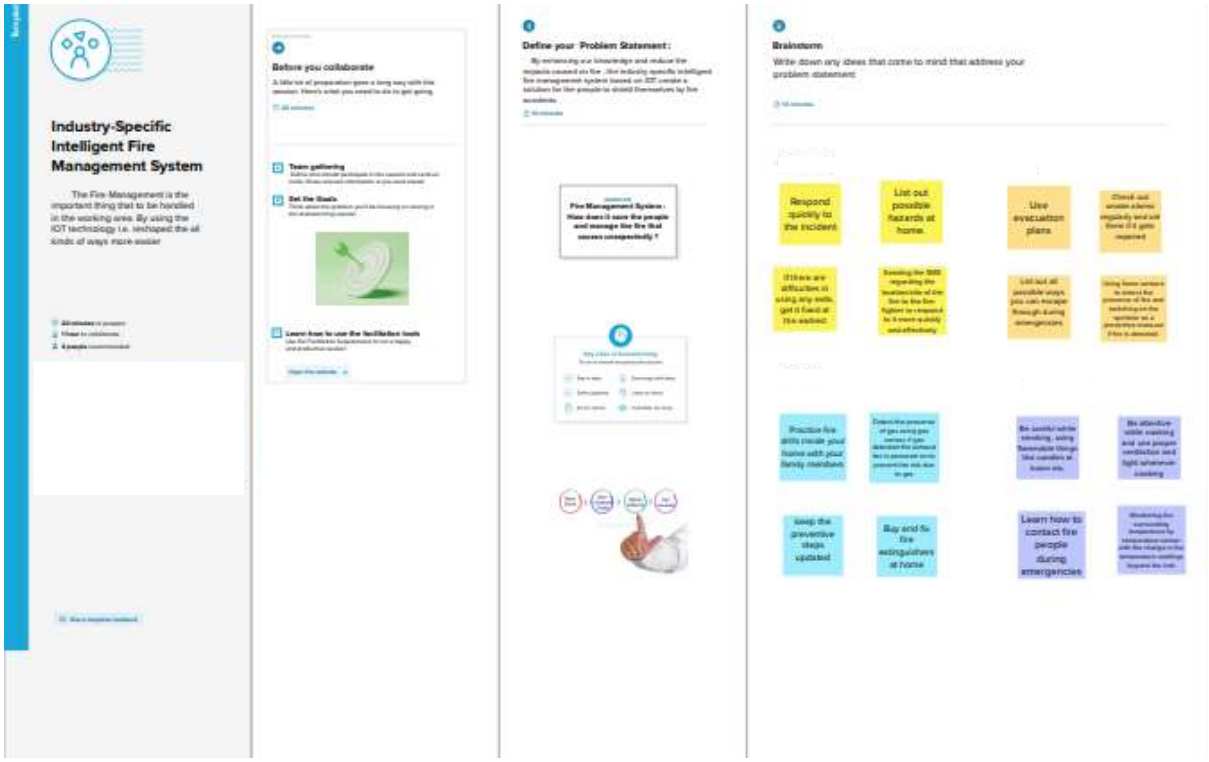
Recently, it has sometimes been impossible for firefighting personnel to access the site of a fire, even as the fire causes tremendous property damage and loss of human life, due to high temperatures or the presence of explosive materials. By enhancing our knowledge and reduce the impacts caused on fire, the industry specific intelligent fire management system based on IOT create a solution for the people to shield themselves by fire accidents.

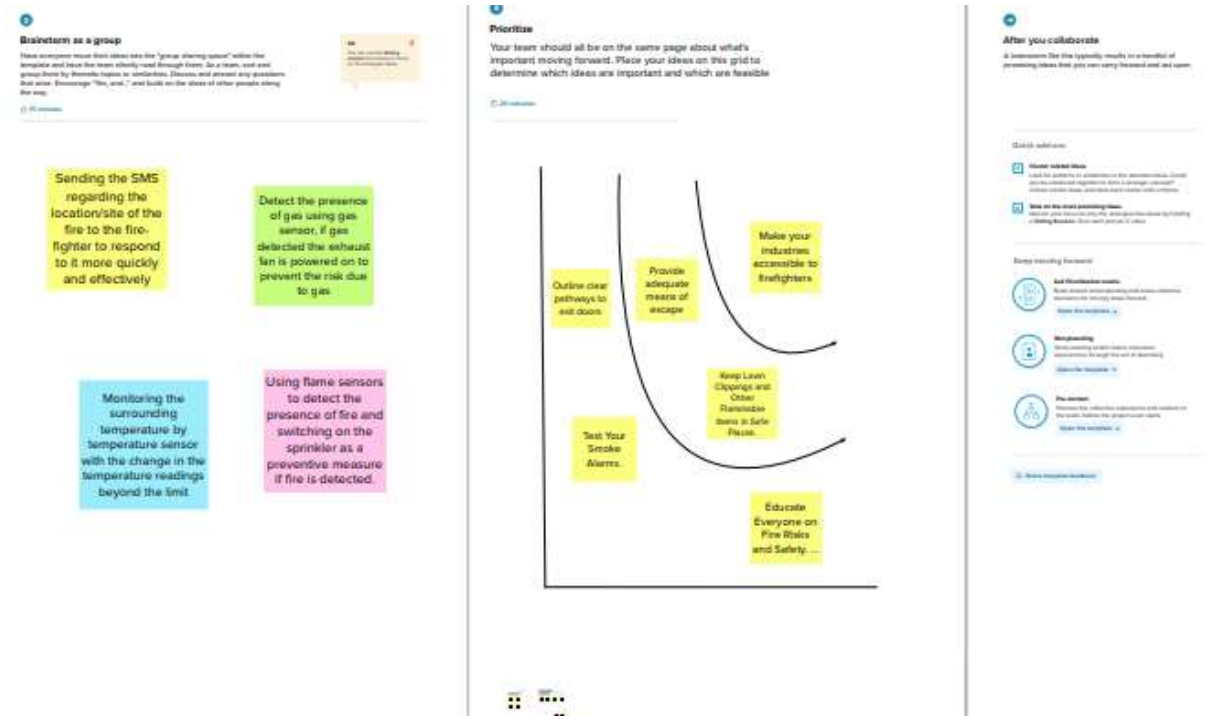
IDEATION AND PROPOSED SOLUTION:

1. EMPATHY MAP & CANVAS



2.IDEATION AND BRAINSTROMING:





3. PROPOSED SOLUTION & SOLUTION FIT

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Recently, it has sometimes been impossible for the fire-fighters to access the site of fire, that causes tremendous property damage due to high temperature or the explosive materials.
2.	Idea / Solution description	The industry-specific intelligent fire management system provide a great level of fire safety by pinpointing the exact location of fire that allows the fire-fighter to respond more quickly and effectively to prevent from accidents.
3.	Novelty / Uniqueness	Thus it is an IOT based intelligent fire management system, it starts the preventive measures by itself before the fire-fighting personnel reach the site by receiving the SMS alert from the device.
4.	Social Impact / Customer Satisfaction	The proposed solution effectively uses the sensors and sense the true occurrence of the fire. If fire is detected, the sprinklers will be switched on. If any gas is detected, the exhaust fan will be switched on so as to prevent from fire accidents which causes tremendous loss of prosperity and life.
5.	Business Model (Revenue Model)	The Industry-Specific intelligent fire management system is designed in such a way that it should be profitable as compared to the conventional method and it is reliable compared to conventional method.
6.	Scalability of the Solution	The Industry-Specific Intelligent Fire management system provide a great deal of flexibility in comparison to conventional system. Because it requires less wire and its control panel can accommodate far more devices.

1.Customer segments:- On the basis of applications, the fire management equipment is segmented as: ○ Academia and institutional ○ Government ○ Healthcare ○ Manufacturing ○ Oil and gas ○ Transportation ○ Power Stations ○ Reatils	**6.Customer constrains:-** The primary constraint on the fire detection system is to detect a developing fire prior to belt ignition, or as quickly as possible thereafter before the onset of rapid flame spread can begin.	**5.Available solutions** Available Solutions is a full service design, installation, renovation, repair, inspection and consulting of fire and life safety systems. We strive to provide our clients with the best systems and services to meet there needs, budgets, and timeline.
2.Jobs to be done :- Contemporary fire alarm systems use automatic functions to detect the occurrence of an event that may result in a fire. They receive a signal from a fire sensor (smoke, heat or carbon monoxide detector) and automatically transmit it to the fire alarm panel.	**9.Problem route cause:-** There are many causes of fire and explosion due to electrical hazards. Exposed wiring, overloaded outlets, overloaded circuits, static discharge etc are common fire hazards. The source of the fire can be anywhere- it may just cause a spark and the dust may become the ignition source.	**7.Behavior:-** A system that combines qualities for fire, temperature and smoke detection, sending alert Text Message about the fire to the user along with onsite alarm(buzzer), updating temperature, humidity and smoke on cloud every 15 seconds, and it also moves manually with the help of Android Application.
3.Triggers :- The most important thing is that fire system play is in protecting the lives of those who are inside the building. What it does is, it slows down the spread of a fire and allows people to safely evacuate the building, and reduce the number of toxic fumes released by a fire to a survivable level. These make the customer to install fire management system. 4.Emotions:- There could be no work going on and thus cash flow is decreased and in the long term, a fire could lead to severe job losses. For the staff that do return, they will be demoralised and even have feelings of being unsafe or upset.	**10.Solution**:- IPT based fire management system is used as an ADC convertor, which converts the analog signals received at the sensor end to digital and then transmits them to the micro-controller, Arduino.	8.Channels of behavior:- Fire alarm systems use automatic functions to detect the occurrence of an event that may result in a fire. They receive a signal from a fire sensor (smoke, heat or carbon monoxide detector) and automatically transmit it to the fire alarm panel.

REQUIREMENT ANALYSIS:

1. FUNCTIONAL REQUIREMENTS:

FR No.	Functional Requirement (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	Rapid Detection	The system must be able to detect a fire rapidly(within seconds/ minutes) .
FR-4	Automation, Autonomy	The system must be able to activate and function completely autonomously, without any external network or power and without human intervention.
FR-5	Web Server	The system must have a built-in web server, that allows providing personnel with a real time alerts.
FR-6	Multiple flames	The system must be able to handle multiple fires simultaneously.

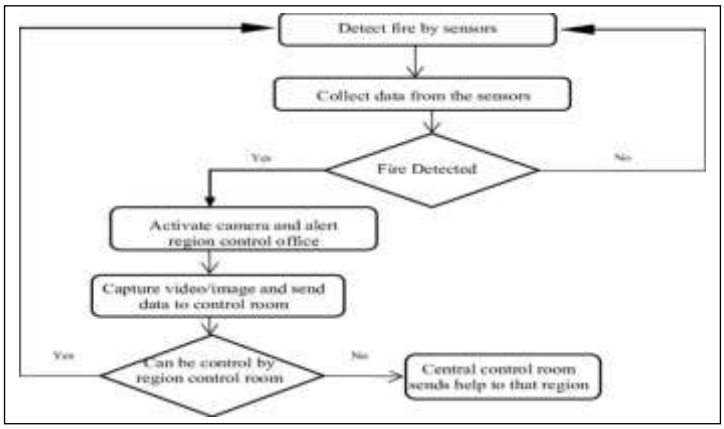
2. NON FUNCTIONAL REQUIREMENTS:

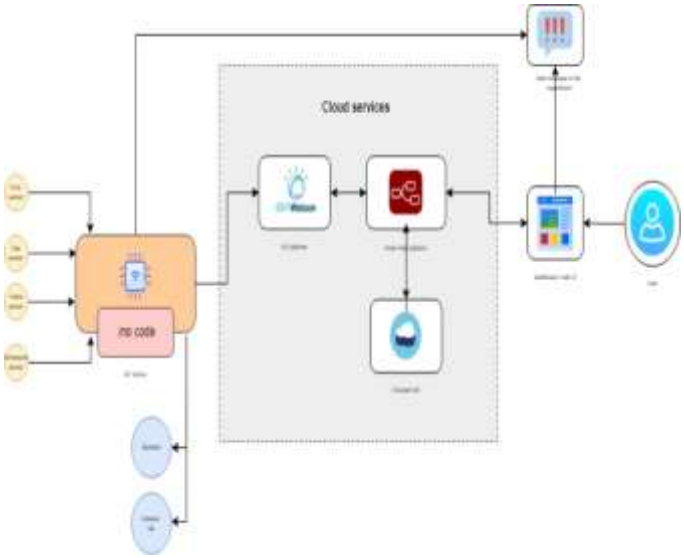
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	With IOT, safety alerts can be sent to hundreds of people fast and effectively. Several leading fire safety companies have already launched IOT-enabled fire detectors.
NFR-2	**Security**	It provide a greater level of fire safety because they allow fire-fighters to respond more quickly and effectively by pinpointing the exact location of a fire in a building, and takes necessary preventive measures.
NFR-3	**Reliability**	It is a reliable fire alarm system that quickly detect a fire and provide clear messages within the facility with least disruption to theoperations of buildings.

NFR-4	**Performance**	The system is able to communicate in real time with the other devices and can be programmed to take a limited judgemental call for a pre-decided actions. In the event of an alarm, the detectors can sound a local alarm as well as send notifications on the mobile phones.
NFR-5	**Availability**	Technology is also available today to add connectivity to existing detectors. With a monitor, users don't have to change all the detectors. The monitor listens for the specific frequency of these detectors and sends an alert. One single monitor can cover multiple detectors covering large areas.
NFR-6	**Scalability**	It provide a great deal of flexibility and can accommodate far more devices.

PROJECT DESIGN:

DATA FLOW DIAGRAMS & TECHNICAL ARCHITECTURE:





USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	User Registration	USN-1	Registration through Form Registration through Gmail Registration through LinkedIN.	I can access my account	Medium	Sprint-1
	User Confirmation	USN-2	Confirmation via Email Confirmation via OTP	I can receive confirmationemail & click confirm	High	Sprint-1
	Rapid Detection	USN-3	The system must be able to detect a fireRapidly (within seconds/ minutes)	Fire alarm systems are only effective if they can generate reliable and fastfire.	High	Sprint-1
	Automation, Autonomy	USN-4	The system must be able to activate and function completely autonomously, withoutany external network or power and withouthuman intervention.	The system is able to communicate in real time with the other devices and can be programmed to take a limited judgementalcall for a pre-decided actions.	High	Sprint-1
Customer (Webuser)	Web Server	USN-5	The system must have a built-in web server,that allows providing personnel with a real time alerts.	systems must only be handled by authorized users and used for its intended purpose	High	Sprint-1
	Dashboard and Login	USN-6	As a user, I can log into the application byentering email & password	I can register & access the dashboard with anyLogin	Low	Sprint-2
Customer Care Executive	Multiple flames	USN-7	The system must be able to handle multiplefires simultaneously.	It should handle sensingof fire and to produce alarm	High	Sprint-1

PROJECT PLANNING & SCHEDULING:

1. SPRINT PLANNING AND ESTIMATION:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As a customer , I might ensure login credential Through Gmail ease manner for the purpose ofsending alert message to the owner.	2	High	Gunavathi S
Sprint-1	Registration	USN-2	As a user , I have to registered my details and tools details in a simple and easy manner in case of fire incident, this registered system sends Notification to the industrialist.	2	High	Jegapriya P
Sprint-2	Dashboard	USN-3	As a user, In case of Fire in the industry I need the sprinkler to spray water on the existing fire automatically.	2	Low	Gopika A
Sprint-1	Dashboard	USN-4	As a user , I need to safeguard my properties as well as and it will be better to send alert message to the fire department.	2	Medium	Dharshini S G
Sprint-1	Dashboard	USN-5	As a user , Its good to have a IOT based system to extinguish the fire without human presence.	2	High	Gunavathi S Jegapriya P

SPRINT DELIVERY & SCHEDULING:

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	29Oct2022	20	11 Nov 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	13 Nov2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	15 Nov2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov2022

CODING AND SOLUTIONING:

```
#include <WiFi.h>
#include <PubSubClient.h>
#define temp_pin 15
void callback(char* subscribetopic,byte* payload, unsigned int payloadLength);
#define ORG "ev99eb"
#define DEVICE_TYPE "esp32"
#define DEVICE_ID "32"
#define TOKEN "12345678"
String command;

char server[]= ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[]="iot-2/evt/Data/fmt/json";
char subscribeTopic[]="iot-2/cmd/test/fmt/String";
char authMethod[]="use-token-auth";
char token[]=TOKEN;
char clientID[]="d:"ORG":"DEVICE_TYPE":"DEVICE_ID;

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




 // should match the Beta Coefficient of the thermistor

void setup() {
  Serial.begin(9600);
  analogReadResolution(10);
  pinMode(32,INPUT);
  pinMode(14,OUTPUT);
```

```

  wificonnect();
  mqttconnect();

}
void loop() {
  const float BETA = 3950; // should match the Beta Coefficient of the thermistor
int analogValue = analogRead(A4);
float temp = 1 / (log(1 / (1023. / analogValue - 1)) / BETA + 1.0 / 298.15) - 273.15;
  //float temp = 1 / (log(1 / (1023. / analogValue - 1)) / BETA + 1.0 / 298.15) - 273.15;
  Serial.print("Temperature: ");
  Serial.print(temp);
  Serial.println(" °C");
  if(temp>=35){
    PublishData2(temp);
    digitalWrite(14, HIGH);
  }else{
    digitalWrite(14, LOW);
    PublishData1(temp);
}
 delay(1000);
  if(!client.loop()){
    mqttconnect();
  }

  //delay(2000);
}
void PublishData1(float tem){
  mqttconnect();
  String payload= "{\"temp\":";
```

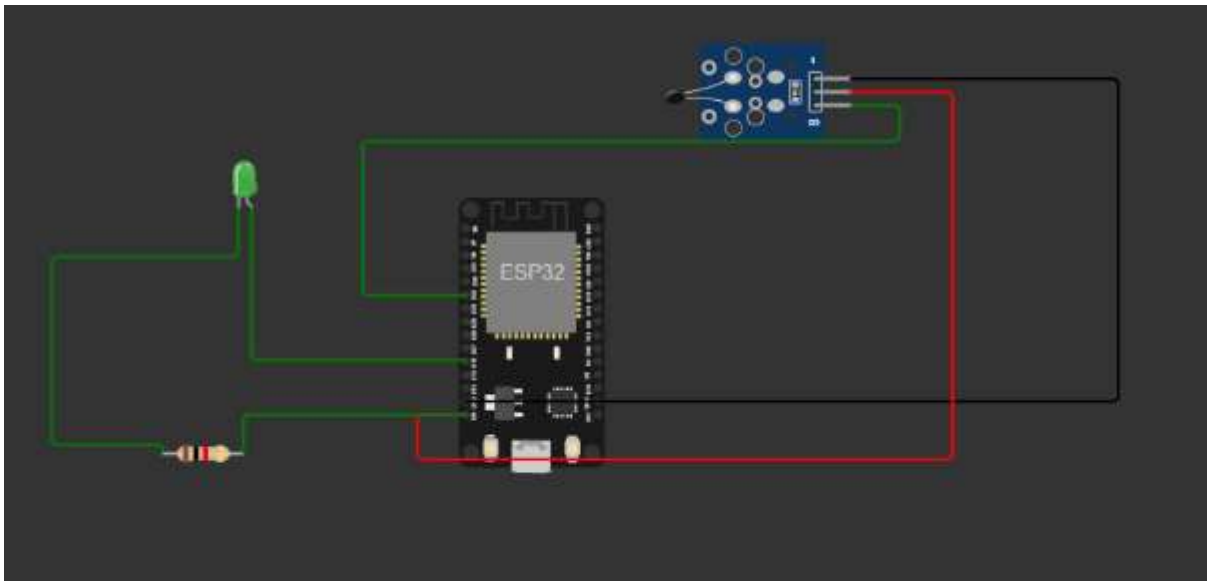
```
    payload += tem;
    payload+="}";

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

    if(client.publish(publishTopic,(char*)payload.c_str())){
      Serial.println("publish ok");
    } else{
      Serial.println("publish failed");
    }
  }
  void PublishData2(float tem){
    mqttconnect();
    String payload= "{\"ALERT\":";
    payload += tem;
    payload+="}";

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

    if(client.publish(publishTopic,(char*)payload.c_str())){
      Serial.println("publish ok");
    } else{
      Serial.println("publish failed");
    }
  }
  void mqttconnect(){
    if(!client.connected()){
      Serial.print("Reconnecting to");
      Serial.println(server);
      while(!!!client.connect(clientID, authMethod, token)){
        Serial.print(".");
        delay(500);
      }
      initManagedDevice();
      Serial.println();
    }
  }

  void wificonnect(){
    Serial.println();
    Serial.print("Connecting to");

    WiFi.begin("Wokwi-GUEST","",6);
    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{
```

```
120     }else{
121       Serial.println("subscribe to cmd failed");
122     }
123   }
124
125   void callback(char* subscribeTopic, byte* payload, unsigned int payloadLength){
126     Serial.print("callback invoked for topic:");
127     Serial.println(subscribeTopic);
128     for(int i=0; i<payloadLength; i++){
129       command += (char)payload[i];
130     }
131     Serial.println("data:"+ command);
132     if(command=="lighton"){
133       Serial.println(command);
134       digitalWrite(14,HIGH);
135     }else{
136       Serial.println(command);
137       digitalWrite(14,LOW);
138     }
139     command="";
140   }
```

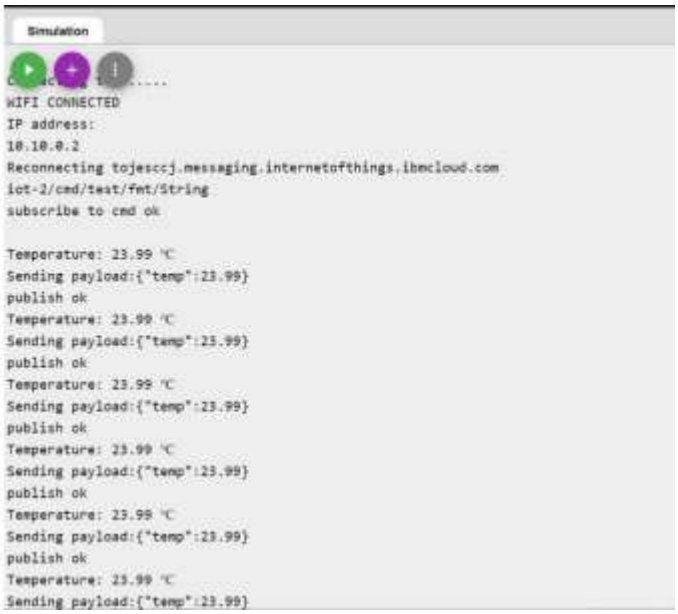
```
}
```

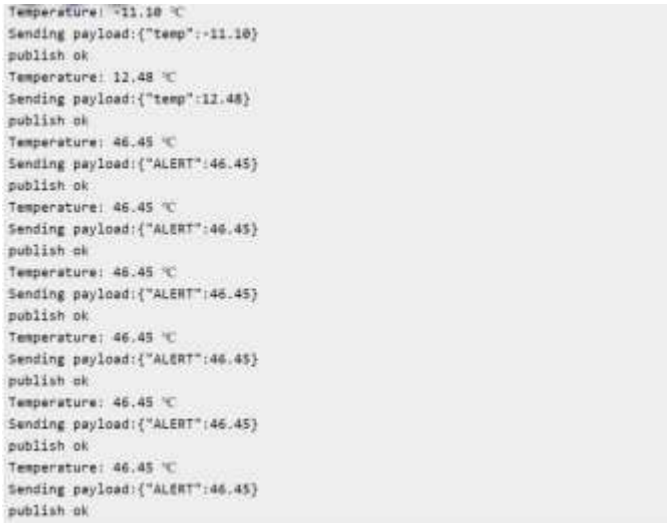
Used Components:

- ESP32
- LED
- Temperature sensor
- Resistor



TESTING:





RESULTS:

The Industry-Specific Intelligent Fire management system provide a great deal of flexibility in comparison to conventional system. Because it requires less wire and its control panel can accommodate far more devices. The temperature sensor identifies the changes in the surrounding room temperature. If there is any changes occurred it gives warning alert.

ADVANTAGES:

- The Industry-Specific intelligent fire management system is designed in such a way that it is profitable as compared to the conventional method and it is reliable.
- Uses the sensors and sense the true occurrence of the fire.
- Provide a great level of fire safety.

DISADVANTAGES:

- Maintenance be little bit difficult. If the network fails, the signal is not received to the fire personnel’s and it may cause risk.

CONCLUSION:

The system is able to communicate in real time with the other devices and can be programmed to take a limited judgemental call for a pre-decided actions. In the event of an alarm, the detectors can sound a local alarm as well as send notifications on the mobile phones.

FUTURE SCOPE:

Fire safety technology has made tremendous advancements over the last few decades, saving many lives in the process. Although fire safety has come a long way, there are still improvements being implemented in commercial and domestic properties, even today. In future the system can be designed in such a way that it satisfies the requirements.

SOURCE CODE:

The source code and its respective requirements are attached in the below .zip file(Source code.zip)

PROJECT LINK: https://wokwi.com/projects/348216497189945940