PROJECT REPORT

PROJECT TITLE: INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM.

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INTRODUCTION

1.1 Project overview

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.

Fire safety is among the various areas that can realize the extraordinary benefits of the Internet of Things (IoT) as it has led to much of the world becoming smarter and more connected. 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.

- IIoT Enabled Connected Detectors: There is a variety of connected smoke and gas detectors for domestic and industrial applications. These connected detectors are able to communicate in real time with the other devices and can be programmed to take a limited judgemental call for a pre-decided action. The detectors can be accessed from anywhere using mobile apps and internet connectivity. In the event of an alarm, the detectors can sound a local alarm as well as send notifications on the mobile phones.

- IoT Retrofitting: 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 to its app. One single monitor can cover multiple detectors covering large areas.

1.2 Purpose

- Suitable for Smaller Applications
- Not Suitable for Large and Complex Buildings
- No special or complex peripherals are needed as compared to its intelligent counterpart
- Simple Panel requiring no special skill sets is needed to operate.
- The location of fire needs to be estimated
- More judgement time for identification
- It is not a self-diagnostic system needing more frequent routine maintenance to ensure its functionality
- Integration with BMS is not possible.

2.LITERATURE SURVEY

2.1 Existing problem

- Current system uses hard wired interconnection which is having disadvantage of cost expensive, long time consuming and disruptive. A hard-wired system is also very difficult to maintain and too expensive to reconfigure when circumstances change, If the methods used at the design of the wireless system and the components employ revolve around a compromise between effectiveness, compactness, low power requirements and cost
- Fires, thefts or intrusions are undesirable events that could leadto a great loss of social wealth and human life. To avoid these losses, various alarm systems have been developed by the industry such as smoke detectors, temperature sensors, intelligent surveillance cameras, and this with the development of technologies at affordable prices
- Fire alarm system are essential in alerting people before fire engulfs their homes. However, Fire alarm systems today require a lot of wiring and

labour to be installed. This discourages users from installing them in their homes.

- There are some existing methods for Gas and fire accident avoiding. It sends the only SMS to the user and fire officer. If they are near to the place, then they can stop the accident. Otherwise, they can't do anything even if they know about the incident. So, here only monitoring is possible and no automatic control.
- The second existed method raise the only alarm whenever Gas is detected at any place. Due to this alarm, people create faired situation start to run haphazardly. As a result worker in the factory gets injured severely. Sometimes people do not realize the intensity of the fire, and they can't escape from the fire affected building quickly. Drawbacks in the existing system are The intimation is possible. Automation is not possible. Can't detect the intensity of the fire.
- House combustion is one of the main concerns for builders, designers, and property residents. Singular sensors were used for a long time in the event of detection of a fire, but these sensors cannot measure the amount of fire to alert the emergency response units.
- Large public buildings are densely populated, with various structures and complex functions. In case of sudden disasters (fire, earthquake, gas leakage, etc.), the evacuation is inefficient due to the lack of effective evacuation guidance and panic psychological instructions. Firefighting facilities, such as fire hydrants, fire extinguishers, safety evacuation signs, fire sprinklers, fire pumps, smoke, temperature, and fire doors in buildings are not dynamically monitored and controlled.

2.2 References

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14. Automatic Gas Fire Detection System Using IoT
15. A smart fire detection system using IoT technology with automatic water sprinkler
16. Mobile Fire Evacuation System for Large Public Buildings Based on Artificial Intelligence and IoT

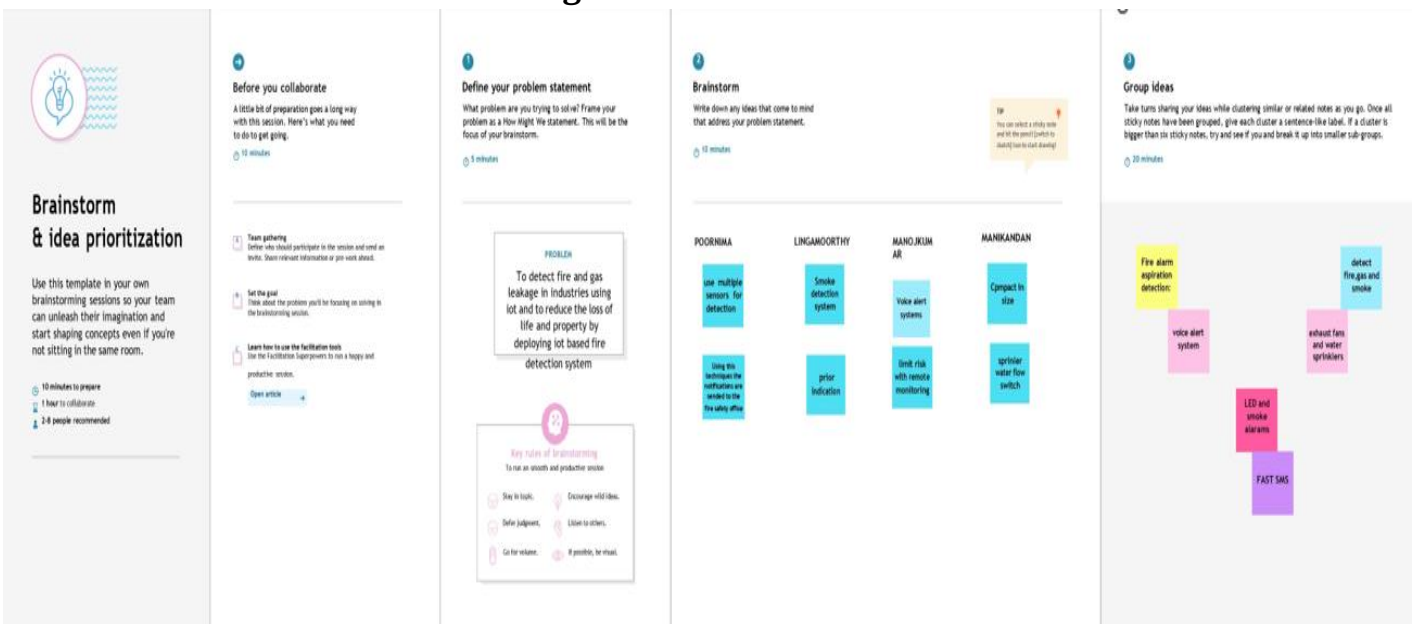
2.3 Problem Statement Definition

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

3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

3.2 Ideation &Brainstorming



3.3 Proposed Solution

- This paper review about the current research, technologies and applications of IoT in fire related industries. This paper done a survey of identifying research trends and challenges in fire industries and summarizes systematically. The fire IoT aims to connect different things over the networks related with fire. Service Oriented Architecture is applied to support fire IoT. In that layers interact each other for monitoring fire and products. This paper functionally realizes some of the layer required for fire monitoring and industry.
- Sensing layer is functionally realized with WSN node with sensors, RFID tagged device and Video node for fire and product monitoring. All things such as sensor network, mobile network are connected together in the network layer. Service layer and interface layer are used to realize Mobile node data, WSN node data displayand graph display for the fire related parameters.
- The solution proposed in our project, security and surveillance with Raspberry Pi consists of different systems: facial recognition, vehicle license plate recognition, fire detection with access control.

- The proposed system is an ad-hoe network that consists of several nodes distributed over the house. Each of these nodes consist of a microcontroller (ESP8266 nodeMCU) connected to smoke,
- temperature, humidity, flame, methane and Carbon Monoxide sensors that continuously sense the surrounding environment to detect the presence of fire. The nodes communicate with a centralised node implemented with a raspberry Pi microcontroller integrated with a 4G module. Once fire is detected by the node, it sends a signal to a centralized node that is triggered to send SMS to the fire department and the user.
- Here we are developing a system called gas fire detection system that smartly avoids fire as well as gas accidents by detecting fire and gas leakages and taking corrective action to avoid any accidents from happening. The system consists of gas fire sensors for detection purpose. If the system detects a gas leakage, the system first shuts off the gas supply and starts an exhaust fan. The system also has a fire sensor to detect fires.
- A smart fire detection system that would not only detect the fire using integrated sensors but also alert property owners, emergency services, and local police stations to protect lives and valuable assets simultaneously. The signals from those detectors go through the system algorithm to check the fire's potentiality and then broadcast the predicted result to various parties using
- GSM modem associated with the system. The main feature of the proposed system is to minimize false alarms, which, in turn, makes this system more reliable.
- The mobile terminal intelligent fire evacuation prototype system for large public buildings is implemented based on the construction of indoor maps and road network models, indoor positioning technology and dynamic evacuation model by ant colony algorithms, using ArcGIS Android SDK 10.1 to provide users with GIS spatial graphics expression interface, to design prototype system on Android platform. The system interface is designed with Material Design style.
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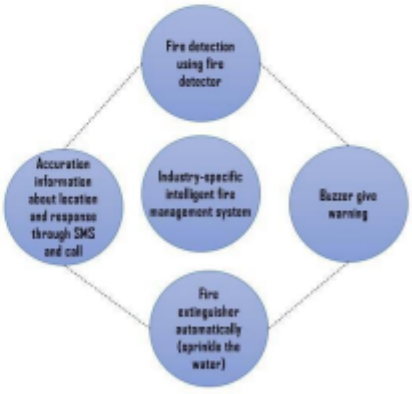
3.4 Problem Solution Fit

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To improve the safety management system in industries. Improving the safety management system against the fire incidents in industries.
2.	Idea / Solution description	To implement the fire safety management in industry based on IOT using Arduino uno board with fire detection and fire extinguisher system. And using some sensors (Humidity sensor, Flame sensor, smoke sensor) with GPS tracking system.
3.	Novelty / Uniqueness	An Integrated system of temperature monitoring, gas monitoring, fire detection automatically fire extinguisher with accuration of information about locations and response through SMS notification and call.
4.	Social Impact / Customer Satisfaction	▪ It early prevents the accident cost by fire in industries. ▪ Nearby locations so maximum extend more accurate reliability . ▪ Compatability design integrated system.
5.	Business Model (Revenue Model)	
6.	Scalability of the Solution	▪ This project can be used more efficiently with accurate information requiring. ▪ Easy operatability and maintenance. ▪ Required low time for maintain ▪ Cost is reasonable value.

4.REQUIREMENT ANALYSIS

4.1Functional requirement

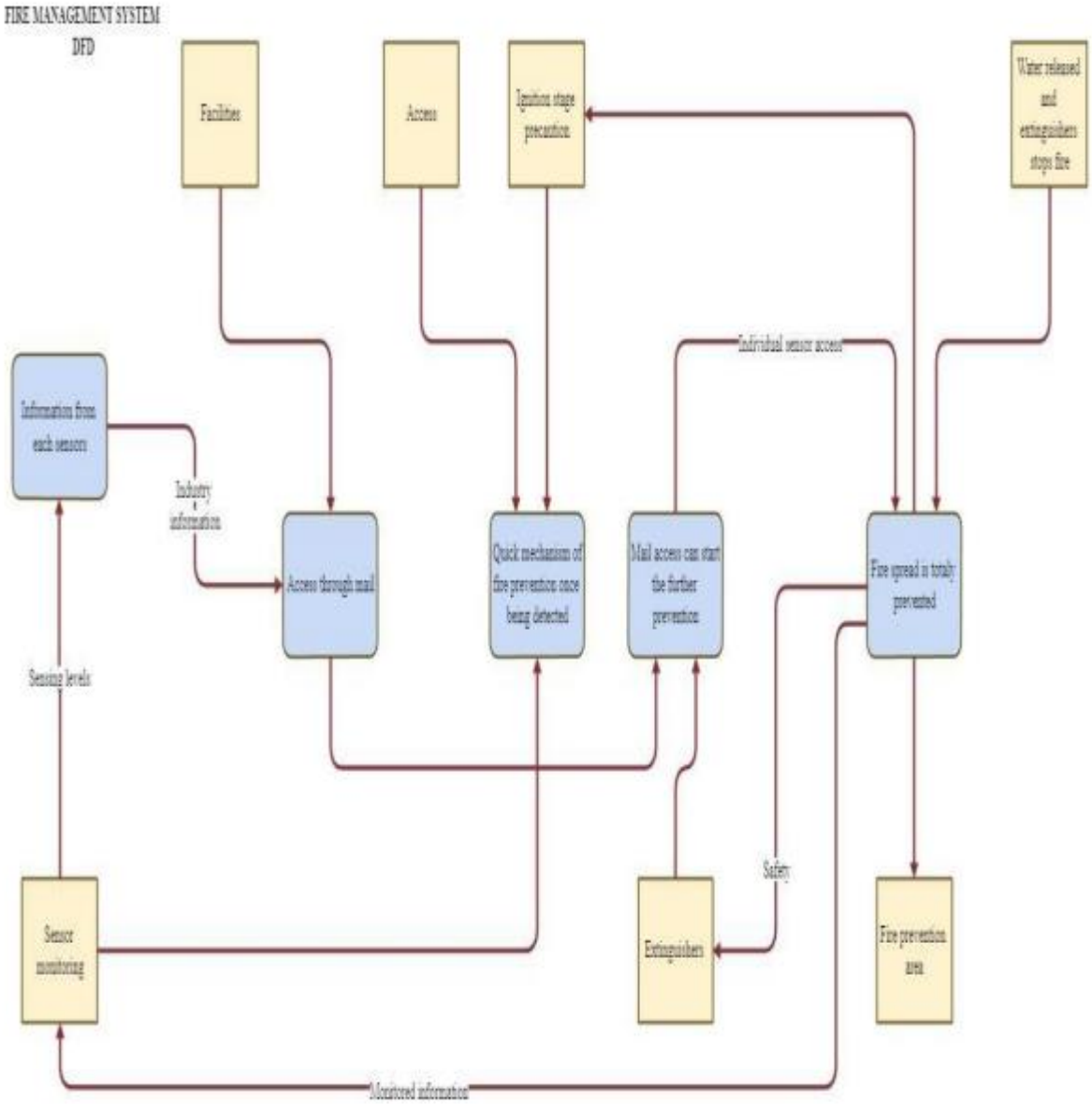
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through website or application Registration through Social medias Registration through LinkedIN
FR-2	User Confirmation	Verification via Email or OTP
FR-3	User Login	Login through website or App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

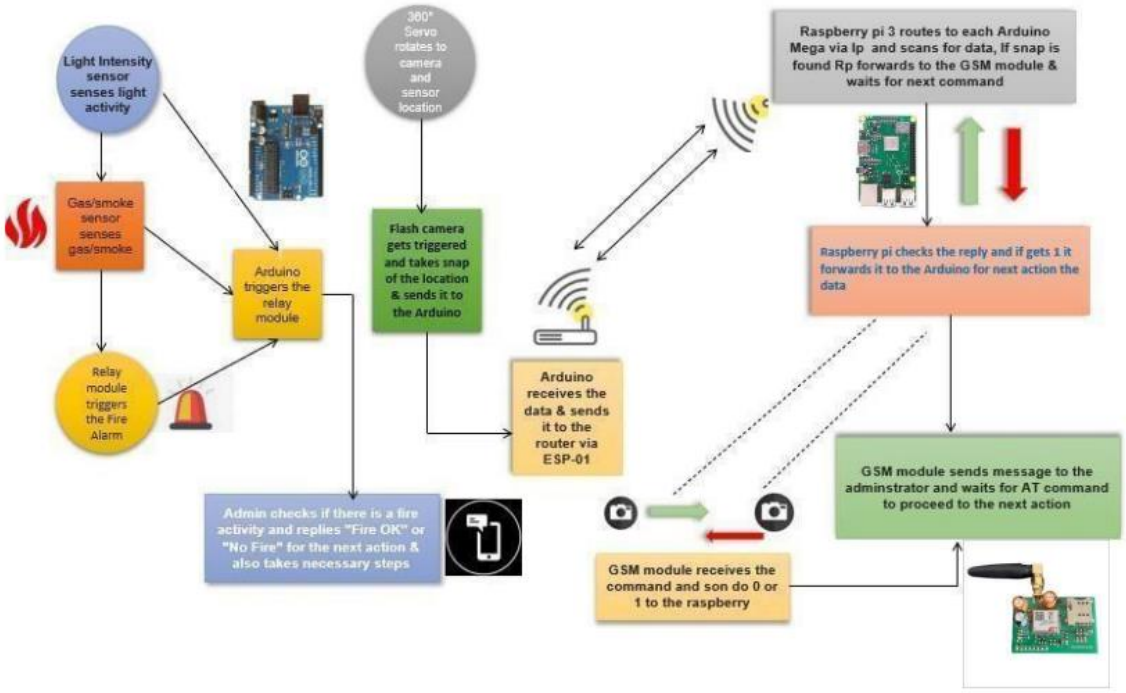
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability requirements includes language barriers and localization tasks. Usability can be assessed by Efficiency of use.
NFR-2	**Security**	Access permissions for the particular system information may only be changed by the system's data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

5.PROJECT DESIGN

5.1 Data Flow Diagram



5.2Solution Architecture



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 Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	IDE	USN-1	Installing all the softwares which is required like python IDE and Node RED	2	High	Poornima R Lingamoorthy L Manojkumar G Manikandan S
Sprint-2	Software	USN-2	- IBM Watson Iot - NodeRed integration/ Test the browser device and workflow.	2	High	Poornima R Lingamoorthy L Manojkumar G Manikandan S
Sprint-3	Application Development/ Testing	USN-3	Using MIT App Inventor we have to create an App/ Testing the Application.	2	High	Poornima R Lingamoorthy L Manojkumar G Manikandan S
Sprint-4	WEB UI	USN-4	User interface with the Software	2	High	Poornima R Lingamoorthy L Manojkumar G Manikandan S

7.CODING & SOLUTIONING

7.1 Feature 1

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

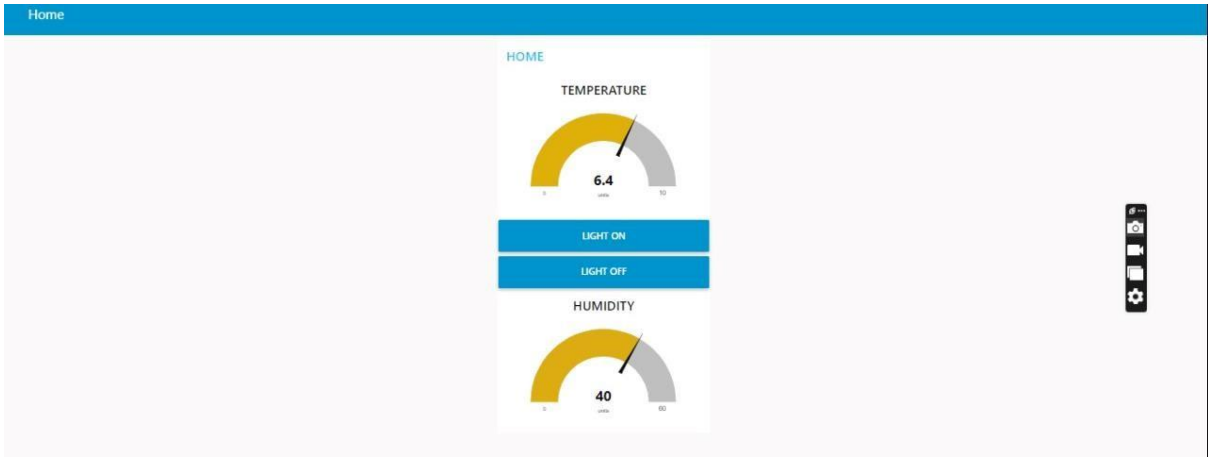
7.2 Feature 2

- Login
- Wokwi

8.TESTING AND RESULTS

8.1 Test Cases

TEST CASE 1



TEST CASE 2

9.ADVANTAGES

- Reduced installation cost.
- They monitor 24/7.
- Improved security in homes, industries and Offices.
- It pin points location of the fire.

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.

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>

#include <PubSubClient.h>

#include "DHT.h"

#define DHTPIN 15

#define DHTTYPE DHT22

#define LED 2

DHT dht (DHTPIN, DHTTYPE);


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


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


#define ORG "zbgr67"//IBM ORGANITION ID

#define DEVICE_TYPE "fershidevicetype"//Device type mentioned in ibm watson IOT Platform

#define DEVICE_ID "fershideviceid"//Device ID mentioned in ibm watson IOT

Platform

#define TOKEN "fershiageona"     //Token

String data3; float 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[] = "usetoken-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

{

t = dht.readTemperature();

Serial.print("temperature:");

Serial.println(t);

PublishData(t); delay(1000); if

(!client.loop()) { mqttconnect();

}

}

```
/*.....retrieving to  Cloud.....*/
 void PublishData(float temp) {  mqttconnect();//function call for connecting to ibm
  /*  creating the String in in form JSon to update the data to ibm cloud */

  String payload = "{\"temperature\":";  payload += temp;  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="";



}
int LED_PIN = 3;
int Motor_PIN= 10;
int mq2 = 4; int value = 0;
int flame_sensor_pin = 10 ;
int flame_pin = HIGH ;
#define PIN_LM35 39
#define ADC_VREF_mV 3300.0
#define ADC_RESOLUTION 4096.0
void setup()
```

```
{
Serial.begin(115200);
pinMode(LED_PIN, OUTPUT);
pinMode(mq2, INPUT);
pinMode ( flame_sensor_pin , INPUT );
pinMode(BUZZER_PIN, OUTPUT);
}
void temperature()
{
int adcVal = analogRead(PIN_LM35);
float milliVolt = adcVal * (ADC_VREF_mV /
ADC_RESOLUTION); float tempC = milliVolt / 10;
Serial.print("Temperature: ");
Serial.print(tempC);
Serial.print("°C");
if(tempC > 60)
{
Serial.println("Alert");
digitalWrite(Motor_PIN, HIGH); // turn on
}
else
{
digitalWrite(Motor_PIN, LOW); // turn off
}
}
void GasSensors()
{int gassensorAnalogmq2 = analogRead(mq2);
Serial.print("mq2 Gas Sensor: ");
```

```
Serial.print(gassensorAnalogmq2);
Serial.print("\t");
Serial.print("\t");
Serial.print("\t");
if (gassensorAnalogmq2 > 1500)
{
Serial.println("mq2Gas");//message to user
Serial.println("Alert");
}
else
{
Serial.println("No mq2Gas");//message to user
}
}
void flamesensor()
{
flame_pin = digitalRead ( flame_sensor_pin ) ;
if (flame_pin == LOW )
{
Serial.println ( " ALERT: FIRE DETECTED" ) ;
digitalWrite ( Motor_PIN , HIGH ) ;
}
else
{
Serial.println ( " NO FIRE DETECTED " ) ;
digitalWrite ( Motor_PIN , LOW ) ;
} }
void loop() {
```

temperature();

GasSensors();

flame}

13.2 GitHub

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-10256-1659153151