NANDHA ENGINEERING COLLEGE
(AUTONOMOUS)

PROJECT
INDUSTRY SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

DOMAIN: INTERNET OF THINGS

DONE BY:

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Title

1. INTRODUCTION

Nowadays, fire incidents have become a critical issue, which must be dealt with on time without any unnecessary delay to avoid the loss in lives and belongings. According to the National Fire Protection Association (NFPA), two- third of U.S. household fires occur in premises with no working smoke alarms, alarms with no proper maintenance, or misplaced alarms. The appropriate allocation of fire alarms with a proactive warning could save lives and reduce property losses. The concept of Internet of things (IoT) nowadays is applied in many applications ranging from the smart industry, smart agriculture to smart healthcare , and smart home application .Nowadays, fires can get out of control because people intend to save money rather than installing proper fire alarm systems. Some problems are still on, such as affordability,effectiveness,and responsiveness . Many studies have been conducted to address these issues like ; however, fire detection issues are not addressed properly since these systems rely on machine vision, where the algorithms need more images to train, and the detection rate is not satisfactory Thus, this paper aims to minimize false alarms, provide faster response, and a new IoT approach that used Node-Red.

The contribution is as follows:

(1) To determine which combinations and algorithms of sensors can accurately and quickly detect fires,

(2) We have designed and then developed a system that detects fire and activates the fire alarm,

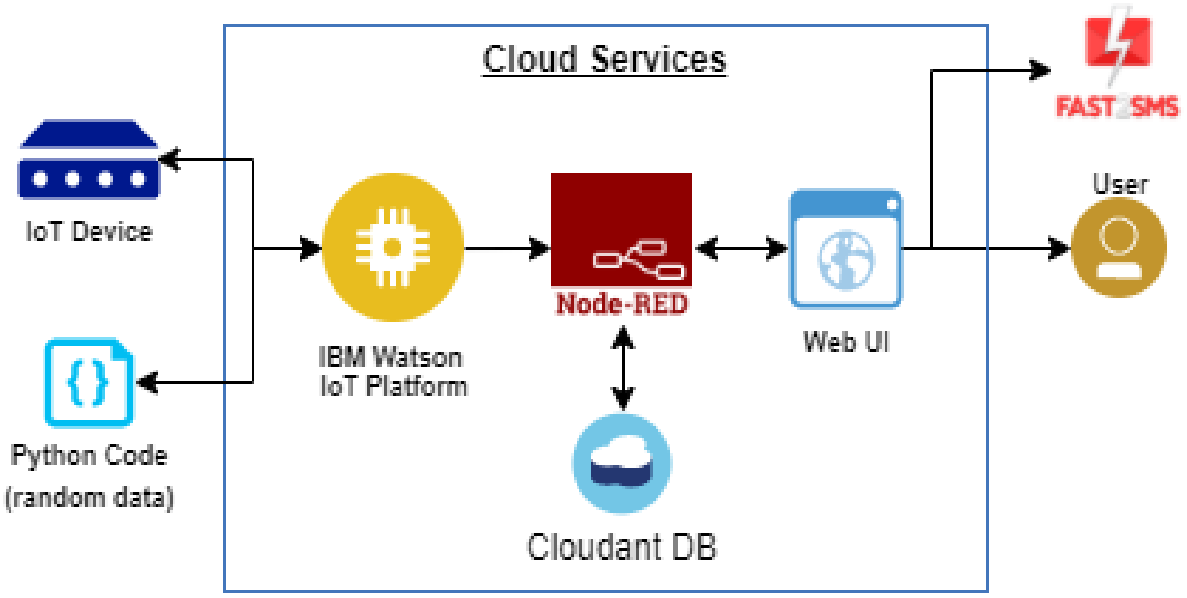
(3) the proposed system evaluates the situation and initiates an automatic water sprinkler where the water unit was designed separately, and

(4) the system analyses the collected data using IBM Watson platform which results in a faster response. Thus, the highlighted four points make the proposed system superior in terms of affordability, effectiveness, and responsiveness.

1.1 PROJECT OVERVIEW

Smart Fire Detection System with Automatic Water sprinkler has been developed to solve the slow response issue of fire accidents. The inputs provide readings for the system to

analyze , such as sensors and Wi-Fi module that works as a transmitter for the sensor readings. Temperature, gas, and flame sensors are inputs. The readings from the inputs are displayed on the web page. Updated readings are sent into a Wi-fi module that translates the data into a graphical and statistical manner. A web page created to analyze the data and a response extracted conditionally to launch a water sprinkler .If the sensor readings is greater than the threshold value , fast SMS notification will send to the user.



1.2 PURPOSE

● To implement 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 station to protect lives and their valuable asserts.

● It employs different integrated detectors such as heat, smoke and flame sensors.

● The IoT based sensors are smarter than conventional smoke detectors.

● Early detection will help to save lives and industry before the fire takes over the buildings.

2 LITERATURE SURVEY

In recent times, wireless sensor, wireless communications, wireless control and mobile digital technology became more and more prominent in our daily lives[1]. The wireless communication technology is mostly used in automatic centralized control of building. This paper is focused on a software build with the wireless technology to be handy and applicable for one safety mechanism. The safety mechanism that we are focussing on is fire detection.

The designed model shall monitor the fire alarm to long distances thus ultimately helping in evacuation procedure as well. Modern fire safety mainly focuses on fire alarm. However, the control centre can't take proper evacuation and response in time [1].

The existing system has disadvantages that it cannot connect to all existing devices in that particular area where fire has taken place and also that the monitor is not connected to a central main server. Therefore, this design is for transmitting the fire information to long distances within the building by using Zig-Bee Wi-Fi network and the detected signals are sent to monitoring centre by Wi-Fi network, which connects with personal terminal easily. A number of existing models were studied and their effectiveness was compared.

- **Ahmed Imteaj et.al.**

He Studied the problems faced by factory workers in times when fire breaks out. They proposed a system using Raspberry Pi 3 which is capable of detecting fire and providing information about area of fire. The Raspberry Pi controls multiple Arduino boards which are connected with several motors and cameras to capture the fire incident . In this, they discussed about the modern technology that can be used to reduce extremely unfortunate accidents caused by fire. We designed the whole system and calculated its effectiveness.

- **Ondrej Krejcar**

He proposed a model for location enhancement and personnel tracking using Wi-Fi networks. In this, he has represented the control system concept that is used in handling information of location and control unit operations. The location of the user present in the building, is obtained through WiFi access points . We have studied this to understand the usability of the Wi-Fi networks in live tracking and then have utilized this functionality to track fire and give information about location of fire to various devices intimating people about the mishap.

- **Karwan Muheden**

He have studied the safety features in home and industrial areas. They have designed new model using WSN. Not only have they incorporated temperature and humidity sensors but also included fire and smoke sensors while developing the model. They present a preceding study of WSN is able to detect fire alarm. It is for setting up a wireless sensor network with three sensors. An application was developed for getting home information.

- **Azka Ihsan Nurrahman, Kusprasapta Mutijarsa**

They have proposed a prototype for a centralized management system for homes or offices which helps better in managing the safety features. In this, home management system is

required. This system controls the room lights by turning on and off automatically, it keeps the record of use of electronic device status, turning on and off the ac regulator automatically, it displays the room temperature in home. If fire is detected in the house, it turn on sprinkler at home, it supervises at home via surveillance cameras, take photos and store them including recordings of surveillance at home, it detects the movements of people at home, and provide notification when someone enters the house.

2.1 EXISTING PROBLEM

After doing the literature survey we have listed some of the features that are existing in the now used fire alarm systems. The features of the existing system are as under.

- Identify status periodically - The system checks for a fire at particular intervals and not continuously or not in real time. This is a drawback as there will possibly be a time lag between the actual fire incident and when the fire will be reported due to periodic identification.
- Manual operation for transferring information Automatic operation is not facilitated in the pre sent systems.
- Not able to find the pressure point of the building which are likely to catch fire easily.
- Difficult to sense structural damage

2.2 REFERENCES

[1] Liu Yunhong, Qi Meini, "The Design of Building Fire Monitoring System Based on ZigBeeWiFi Networks" , Eighth International Conference on Measuring Technology and Mechatronics Automation, IEEE, 2016, pp-733-735

[2] Ahmed Imteaj, Tanveer Rahman, Muhammad Kamrul Hossain, Mohammed Shamsul Alam, Saad Ahmad Rahat, "An IoT based fire alarming and authentication system for workhouse using Raspberry Pi 3" , International Conference on Electrical, Computer and Communication Engineering (ECCE), IEEE, 2017

[3] Ondrej Krejcar, "Using of mobile device localization for several types of applications in intelligent crisis management",5th IEEE GCC Conference & Exhibition, IEEE, 2009

[4] Karwan Muheden, Ebubekir Erdem, Sercan Vançin, "Design and implementation of the mobile fire alarm system using wireless sensor networks", 17th International Symposium on Computational Intelligence and Informatics (CINTI), IEEE, 2016

[5] Azka Ihsan Nurrahman, Kusprasapta Mutijarsa, "Intelligent home management system prototype design and development", International Conference on Information Technology

Systems and Innovation (ICITSI), IEEE, 2015.

2.3 PROBLEM STATEMENT DEFINITION

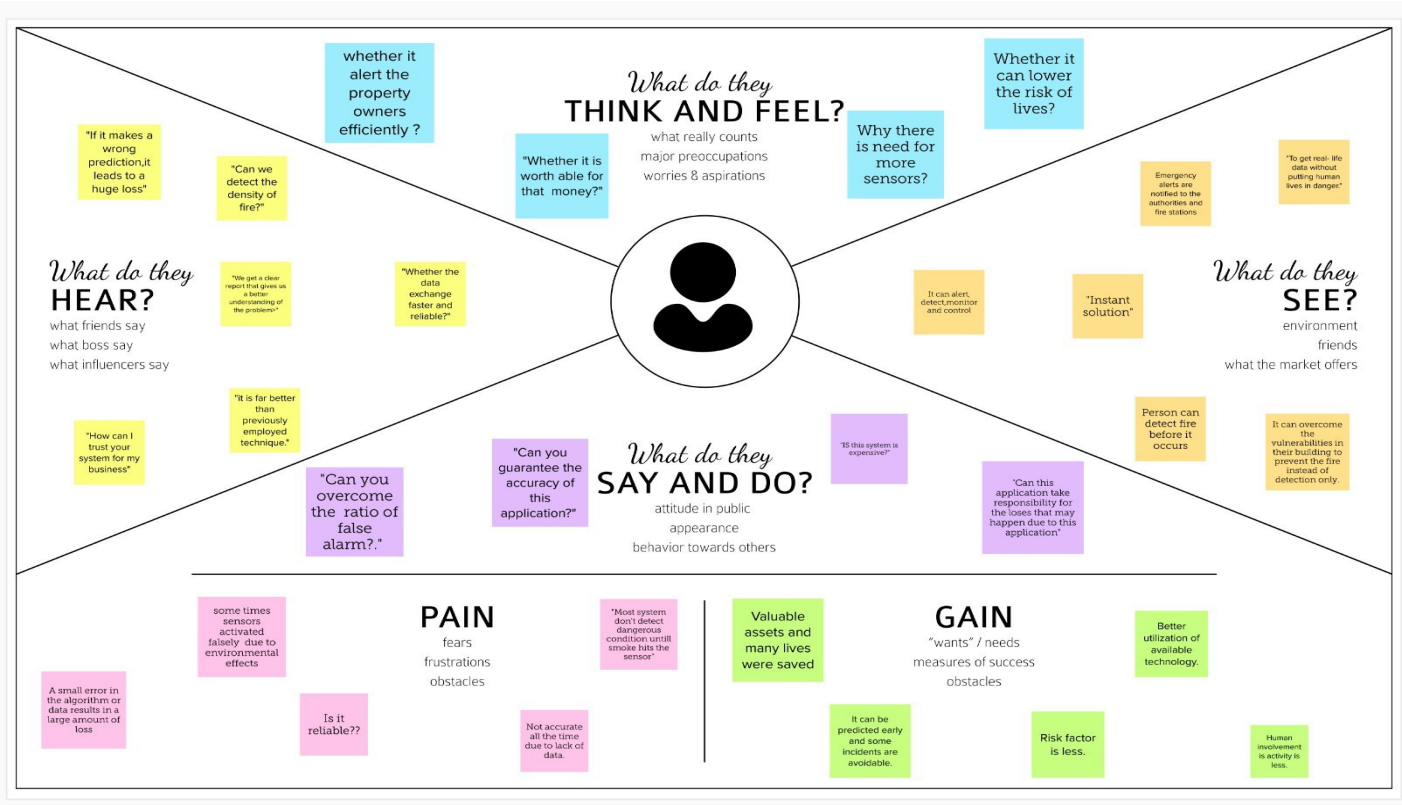
Industrial fires and explosions cost companies and government billions of rupees every year apart from the loss of lives, which cannot be described in monetary terms. These fires not only results in huge loss of lives and property but also disrupt production in the industry. Singular sensors were used for a long time in the event of detection of a fire, but these sensors can not measure the amount of fire to alert the emergency response units.

3.IDEATION AND PROPOSED SOLUTION

Ideation is expressed via graphical, written, or verbal methods , and arises from the past or present knowledge , influences , opinions, experiences and personal convictions.

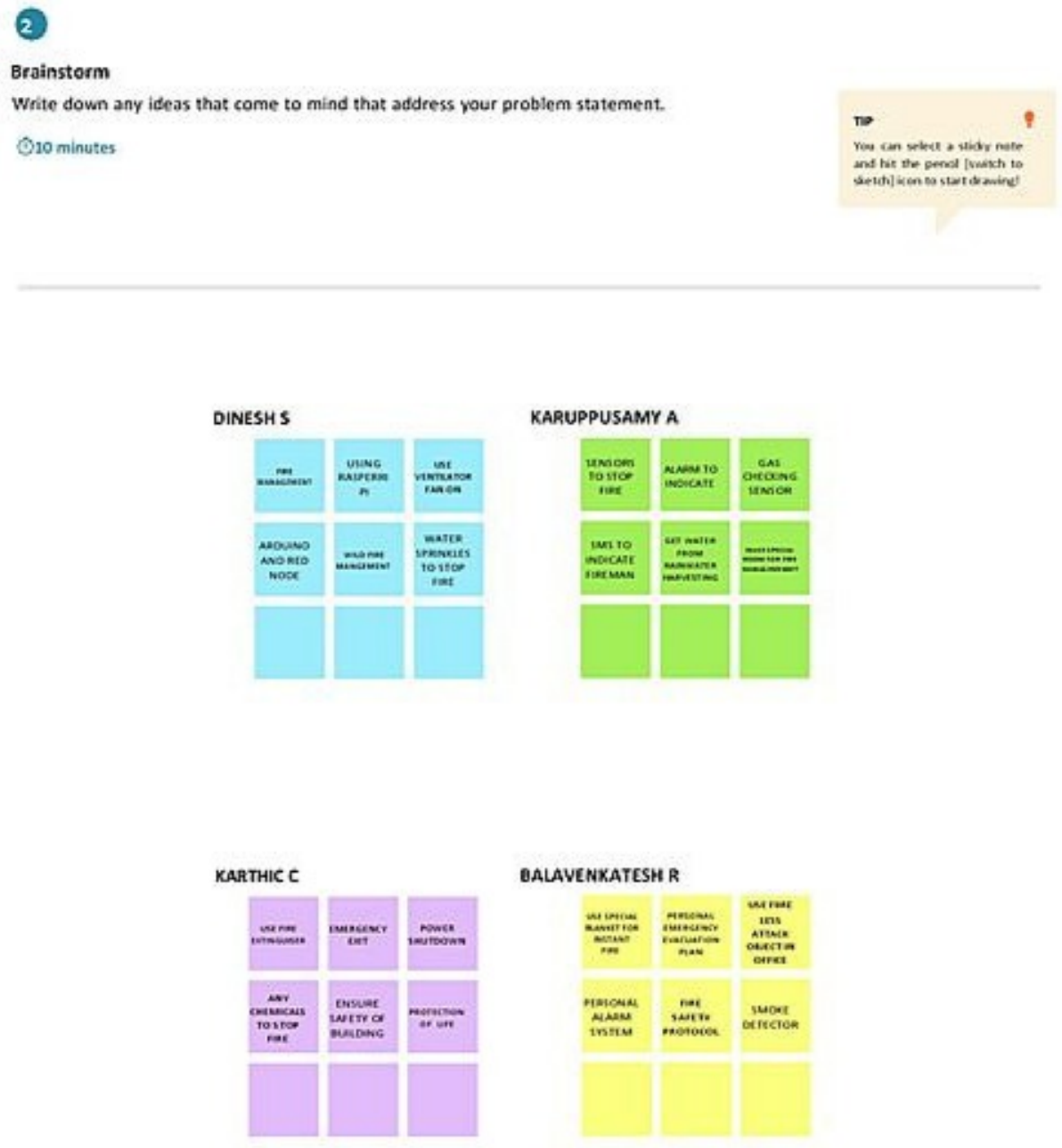
3.1 EMPATHY MAP CANVAS

It serves as a foundation for understanding user experiences , which focuses on providing the experience customer want rather than forcing design teams to relay on guess work



3.2 IDEATION AND BRAINSTORMING

Ideation is often closely related to the practice of brainstorming, a specific technique that is utilized to generate new ideas.



3

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

TIP

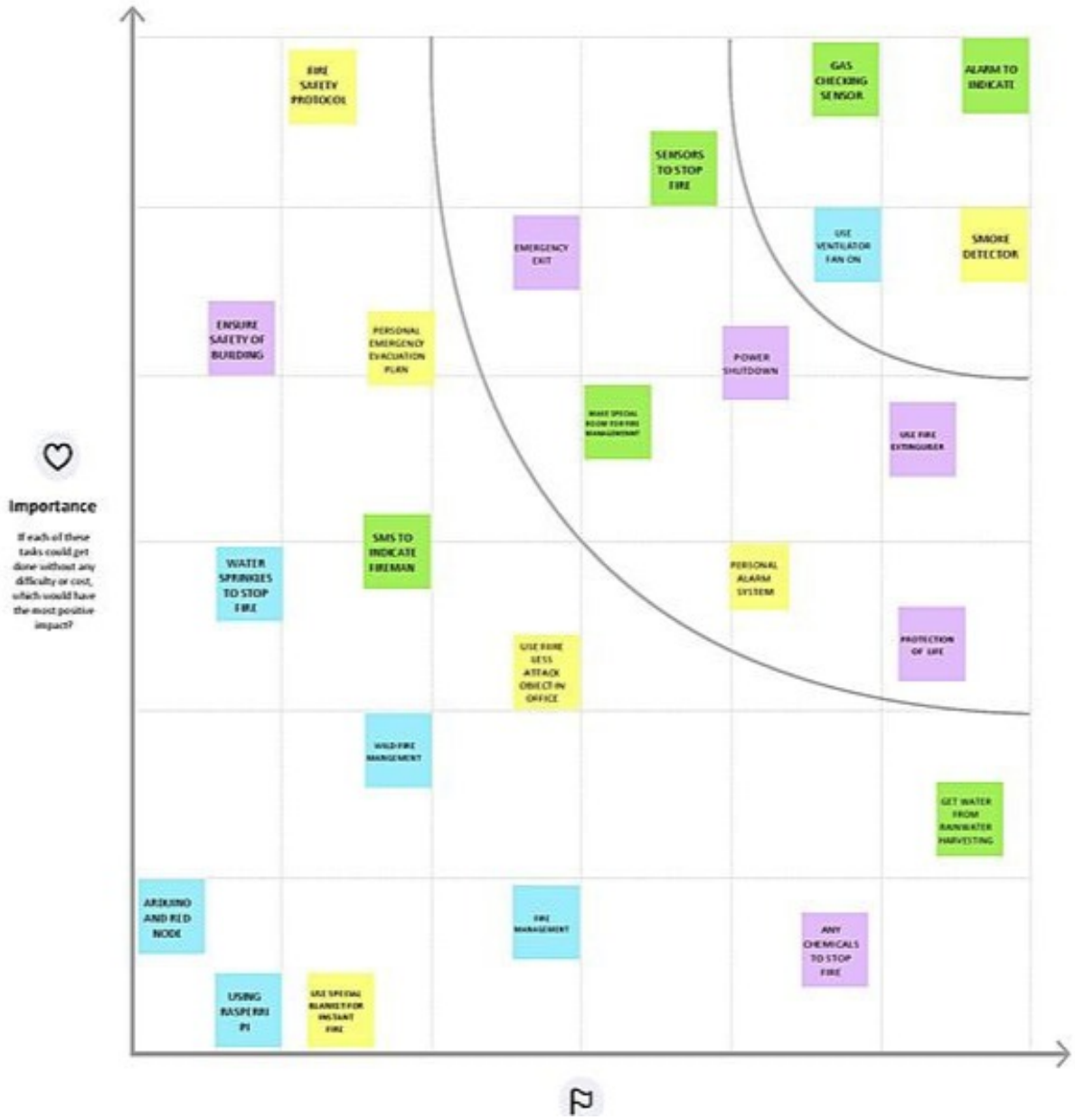
Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

4

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



3.3 PROPOSED SOLUTION

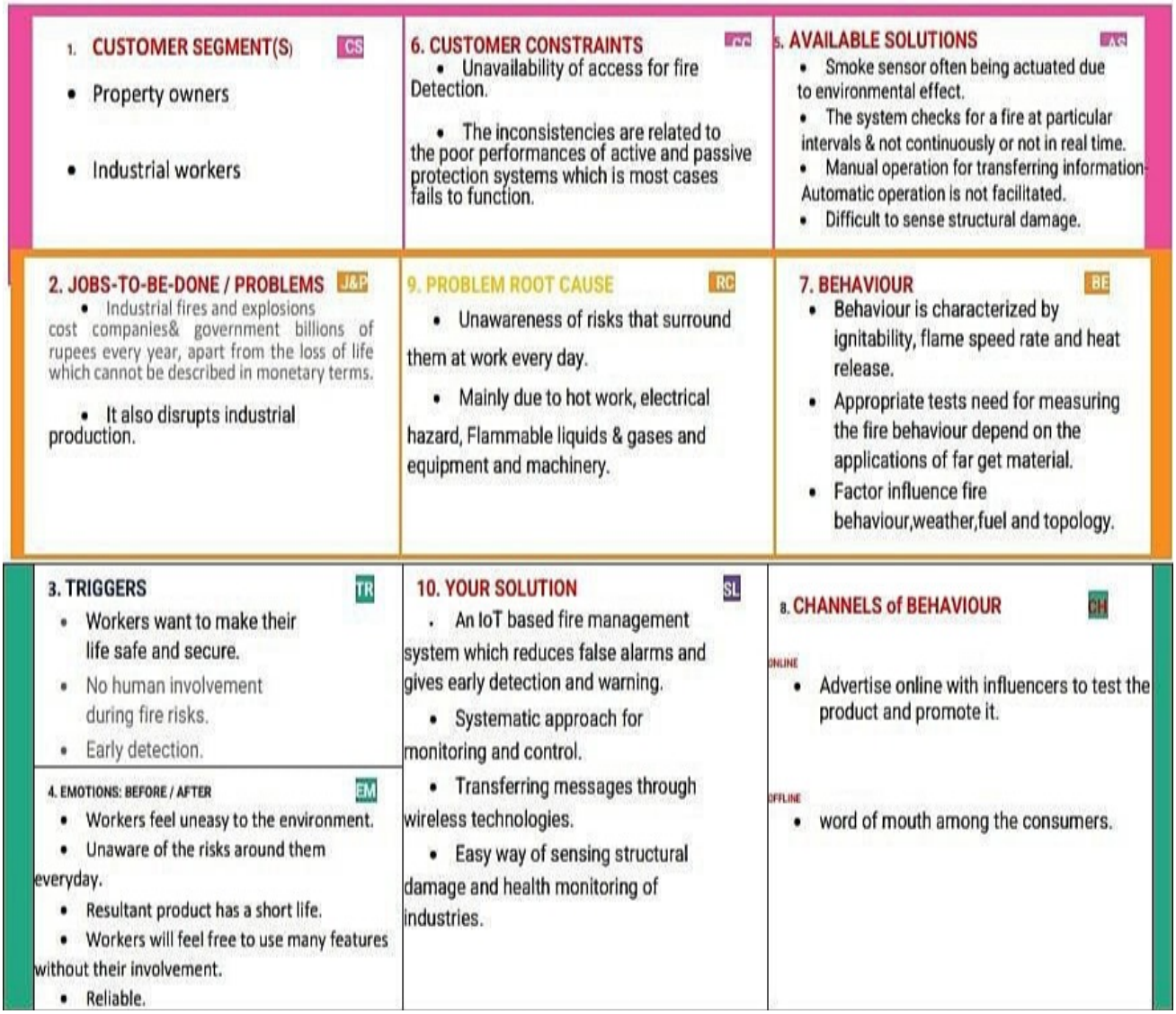
It should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To create a smart industry-specific fire management system using IoT. It should have all the basic features for handling fire and report the incident to the fire department
2.	Idea / Solution description	Our solution is to provide a reliable smart fire management system that consists of exhaust fans, and sprinklers. We also ensure the proper working of sprinklers with flow sensors and check the water level for easy maintenance. It also sends periodic data to the safety sector in the company, in case of a negative situation it sends an alert to the fire department. The toxic gases and excess hydrogen and oxygen from water vapour are redirected towards outdoors by using an exhaust fan to avoid further combustion or spreading of flames by those gases.
3.	Novelty / Uniqueness	As a sprinkler gives an instant and efficient way to put down fire, we need to check the water source and the connection to it with the sprinkler this increase additional work and maintenance. This is solved by our smart system
4.	Social Impact / Customer Satisfaction	This gives a simple and powerful system making the focus and time more towards safety and not maintenance. This cuts the cost spend on maintenance, as it can be invested in other sectors.

5.	Business Model (Revenue Model)	It will cost an installation fee then the cloud and maintenance of the devices are handled in the subscription model. An additional scaling fee is also charged
6.	Scalability of the Solution	In medium or large-scale industries it is scalable. They can add any number of devices which are handled coherently in the cloud.

3.4 PROBLEM SOLUTION FIT

It means we have to found a problem with our customer and that the solution we have realized for it actually solves our customers problem.



4.REQUIREMENT ANALYSIS

Solution requirements describe specific characteristics that a product must have to meet the needs of the stakeholders and the business itself.
They fall into two large groups.

- Functional requirements define what a product must do, what its features and functions are.
- Non-functional requirements describe the general properties of a system. They are also known as quality attributes.

4.1 FUNCTIONAL REQUIREMENT

Following are the functional requirements of the proposed solution.

S.NO	FUNCTIONAL REQUIREMENT(EPIC)	SUB REQUIREMENT(STORY/SUB TASK)
1	User Requirements	Workers and Product Protection Automatic Sprinkler System Monitors Smoke,Gas and Temperature
2	User registration	Manual Registration Registration through webpage Registration through Form Registration through Gmail
3	User Confirmation	Confirmation via Phone Confirmation viaEmail Confirmation via OTP
4	Payment Options	Options Cash on Delivery NetBanking/UPI Credit/Debit/ATM Card
5	Product Delivery and Installation	Door Step delivery Take away FreeInstallation and 1 year Warranty

6	Product Feedback	Through Webpage Through Phone callsThrough Google forms

4.2 NON-FUNCTIONAL REQUIREMENTS

Following are the Non-functional requirements of the proposed solution.

S.NO	NON-FUNCTIONALREQUIREMENT	DESCRIPTION
1	Usability	Have a clear and self-explanatory manual. Easier to use. Easilyaccessible by everyone.
2	Security	Security Are inspected monthly by the Fire Alarm Technician. Inspected and taggedby a contractor annually.
3	Reliability	Hardware requires a regular checking and service. Software may be updated periodically. Immediate alert is provided in case of any system failure.
4	Performance	The equipment must have a good user interface It should have a minimal energy requirement Ithas to save lives of people and things

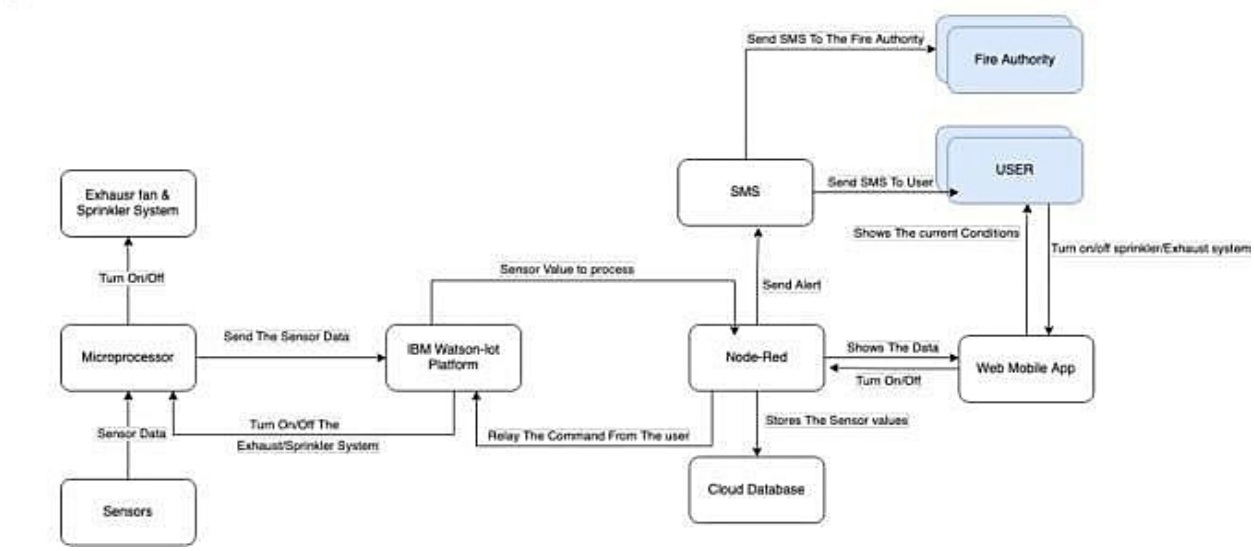
5	Availability	Availability All the features will be available when the user requires. It depends on the need of the user and the customization of the userhas done.
6	Scalability	The product has to cover all the spaceof industry irrespective of the size or area.

5.PROJECT DESIGN

Project design is an early phase of the project life cycle where ideas, processes,resources and deliverables are planned out.

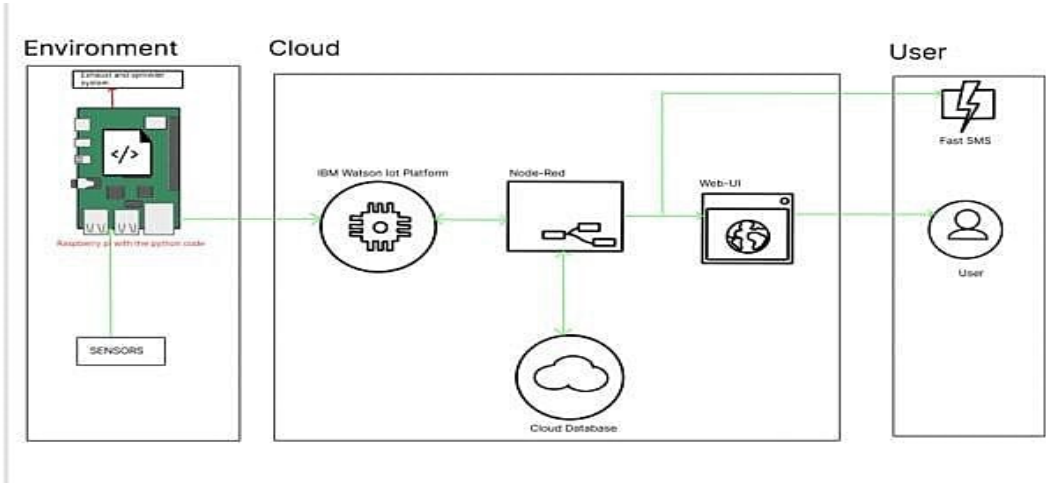
5.1 DATA FLOW DIAGRAMS

It is a graphical or visual representation using a standardized set of symbols and notations to describe a business's operation through data movement.



5.2 SOLUTION AND TECHNICAL ARCHITECTURE

Technical architecture is a form of IT architecture that is used to design computer systems.



5.3 USER STORIES

User story is an informal, general explanation of a sftware featurereturn from the perspectiveof the end user/customer

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web user)	Monitor The Environment	USN-1	User can monitor the sensor data receiving from the microprocessor	User Can See the dashboard with sensor information	Medium	Sprint 4
	Turn on or off the sprinkler and exhaust fan.	USN-2	User can turn on / off exhaust fan and sprinkler if need in that circumstance	Can turn on / off the sprinkler and exhaust fan	Medium	Sprint 4
	Authentication	USN-2	User needed to be authenticated while turning on/off the exhaust and sprinkler system	Authenticate the user for USN-2 Fuctionality	Medium	Sprint 4
Sensing	Sensing The Environment	-USN 3	Need to Sense the environment using the sensors attached to the microprocessor	Getting Data from the sensors	High	Sprint 1
Extinguish	Actuators	USN 4	If the sensors sense the fire then the immediate next step is to turn on the exhaust fan and the sprinkler system	Extinguishing the fire	High	Sprint 1
Data	Sending data to ibm Watson Hot platform	USN 5	All the sensor Data received from the microprocessor are send to the IBM Watson Lot platform	Showing in the Watson Dashboard	Medium	Sprint 2
	Node-red	USN 6	Sending the data to further process in the cloud for storing and alert purpose		High	Sprint 3
	Data Storing	USN 7	All the sensor values are stored in an cloud database	Storing the data	Low	Sprint 3
Notification	Event notification	USN 8	FIre alertMessage will send to fire department	Notifying the authorities	High	Sprint 4

6.PROJECT DESIGN AND PLANNING

6.1 SPRINT PLANNING AND ESTIMATION

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 application by entering my email password and confirming it.	5	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	5	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C
Sprint-1	Login	USN-3	As a user, I can log into the application by entering email & password	5	Medium	Dinesh S Karuppusamy A Balavenkatesh R Karthick C
Sprint-2	Post Job	USN-6	As a room temperature data controller, I log into my profile and start monitoring the room temperature	6	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C

Sprint-2	Job Search	USN-4	I receive all the information about room temperature from web from room temperature API. Whenever there is change in room temperature , corresponding updates are made on sign boards.	9	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C
Sprint-3	Apply	USN-5	As a data sender ,I will send the information to the fire station.	6	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C
Sprint-3	Send Confirmation	USN-7	With the data, updates I will tell them the room temperature.	4	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C
Sprint-4	Dashboard	USN-8	I will alert the employees and workers to escape from the fire management.	6	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C
Sprint-4	Recruiter Review	USN -9	As an administrator, I ensure that all departments work co-ordinates and ensure the accuracy and efficiency	3	High	Dinesh S Karuppusamy A Balavenkatesh R Karthick C

Sprint-4	Chat bot	USN-10	As a user, I can send my queries via mail	1	Low	Dinesh S Karuppusamy A Balavenkatesh R Karthick C

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	15	7 Days	24 Oct 2022	31 Oct 2022	15	31 Oct 2022
Sprint-2	15	7 Days	1 Nov 2022	07 Nov 2022	15	07 Nov 2022
Sprint-3	10	6 Days	08 Nov 2022	13 Nov 2022	10	13 Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	20 Nov 2022	10	19 Nov 2022

7 CODING AND SOLUTIONING

7.1FEATURE CODE 1: This setof code checks for falsealarm

```
//find the accident status 'cause fake alert may be caused by some mischief activities
if(temp < 45 ){ if(flame >
650){
accidentstatus = "Need Auditing"; isfanon = true;
issprinkon = false;
}
else if(flame <= 10){
accidentstatus = "nothing happened"; isfanon = false;
issprinkon = false;
```

```
}
}else if(temp >= 45 && temp <= 55 ){ if(flame <=650 && flame >100 ){
issprinkon = true; accidentstatus = "moderate"; if(gas > 150){
isfanon = true;
}
else{
isfanon = false;
}
}
else if(flame <= 100 && flame > 10){ issprinkon = true;
isfanon = false; accidentstatus = "moderate";
}
}else if
(temp > 55){ if(flame > 650){
gas = 500 + rand()%500;
accidentstatus = "severe"; issprinkon = true; isfanon = true;
}
else if(flame < 650 && flame > 400 ){ gas = 300 + rand()%500; accidentstatus = "severe";
issprinkon
= true;
isfanon = true;
}
}
else {
accidentstatus = "Need Auditing"; isfanon = false;
issprinkon = false;
}
if
(issprinkon){ if(flow){
```

```
sprinkstatus= "working";
}
else{
sprinkstatus = "not working";
}
}
else if(!issprinkon){ sprinkstatus = "ready";
}
else {
sprinkstatus= "something's wrong";
}
```

7.2 FEATURE CODE 2: It sends the data to IBM IoT Watson platform

```
        void PublishData(float temp, int gas ,int flame ,int flow,bool isfanon,bool
issprinkon) {
  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 += ","
  "\"gas\":";
  payload +=
  gas;
  payload += ",""\"flame\":";

  payload += flame;
  payload += ",""\"flow\":";
  payload += ((flow)?"true":"false");
  payload += ",""\"isfanon\":";
  payload +=
  ((isfanon)?"true":"false");
  payload += ","
  "\"issprinkon\":";
```

```
payload +=
((issprinkon)?"true":"false"); payload
+= "," "\"accidentstatus\":"; payload
+= "\""+accidentstatus+"\""; payload
+= "," "\"sprinkstatus\":"; payload
+= "\""+sprinkstatus+"\""; 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 willprintpublish ok
in Serial monitor or else it will print publishfailed
} else {
    Serial.println("Publish failed");
}

}
```

8. TESTING

8.1 TEST CASES

SL.NO	INPUT	OUTPUT	RESULT
1.	Gas:0 Temperature:60.65 Flame:45	Exhaust fan on:FALSE Sprinklers:FALSE	Sent
2.	Gas:444 Temperature:28.59 Flame:654	Exhaust fanon:TRUE Sprinklers:FALSE	Sent
3	Gas:25 Temperature:74.00 Flame:920	Exhaust fanon:FALSE Sprinklers:FALSE	Sent

4	Gas:750 Temperature:85.10 Flame:703	Exhaust fanon:TRUE Sprinklers:TRUE	Sent
5	Gas:335 Temperature:38.56 Flame:956	Exhaust fanon:TRUE Sprinklers:FALSE	Sent
6	Gas:429 Temperature:62.67 Flame:684	Exhaust fanon:TRUE Sprinklers:TRUE	Sent
7	Gas:424 Temperature:59.76 Flame:503	Exhaust fanon:TRUE Sprinklers:FALSE	Sent
8	Gas:932 Temperature:56.86 Flame:163	Exhaust fanon:TRUE Sprinklers:FALSE	Sent
9	Gas:101 Temperature:24.56 Flame:647	Exhaust fan on:TRUE Sprinklers:FALSE	Sent
10	Gas:300 Temperature:7 0 Flame:50	Exhaust fanon:TRUE Sprinklers:FALSE	Sent
11	Gas:724 Temperature:29.56 Flame:788	Exhaust fanon:TRUE Sprinklers:FALSE	Sent
12	Gas:522 Temperature:38.45 Flame:450	Exhaust fan on:TRUE Sprinklers:FALSE	Sent
13	Gas:941 Temperature:59.30 Flame:143	Exhaust fan on:TRUE Sprinklers:TRUE	Sent

8.2 USER ACCEPTANCE

TESTING (UAT) DEFECT ANALYSIS

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	11	5	2	3	21
Duplicate	1	0	3	0	4
External	4	5	0	1	10
Fixed	10	2	3	20	35
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	26	17	12	26	81

TEST ANALYSIS

9 RESULTS

9.1 PERFORMANCE METRICES CPU USAGE

The micro version of c++ is make the best use of the CPU. For every loop the program runs in one time, neglecting the network and communication. The program sleeps for every 1 second for better communication with MQTT. As the program takes O(1) time and the compiler optimizes the program during compilation there is less CPU load for each cycle. The upcoming instructions are on the stack memory, so they can be popped after execution .

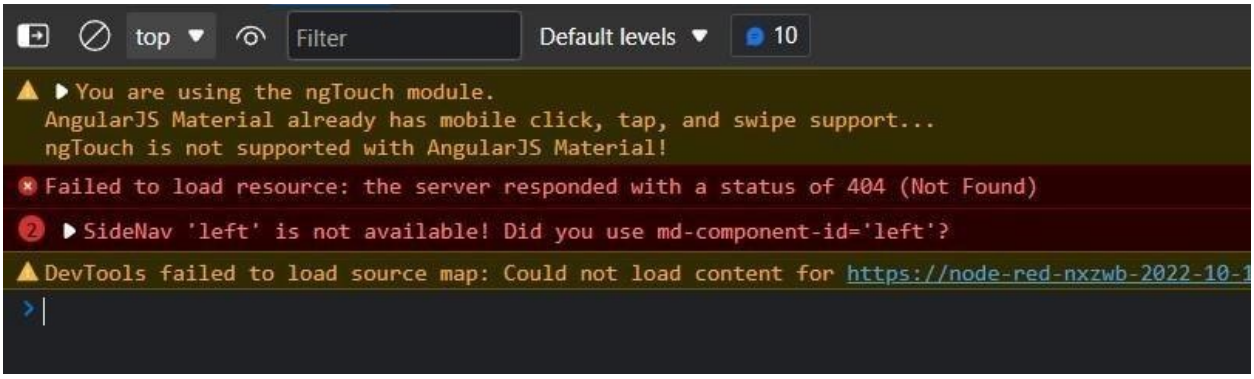
MEMORY USAGE

The sensor values , networking data are stored in sram of the ESP32 . It’s a lot of data

because ESP32 has only limited amount of memory (520 KB) .For each memory cycle the exact addresses are overwritten with new values to save memory and optimal execution of the program.

ERROR RATES

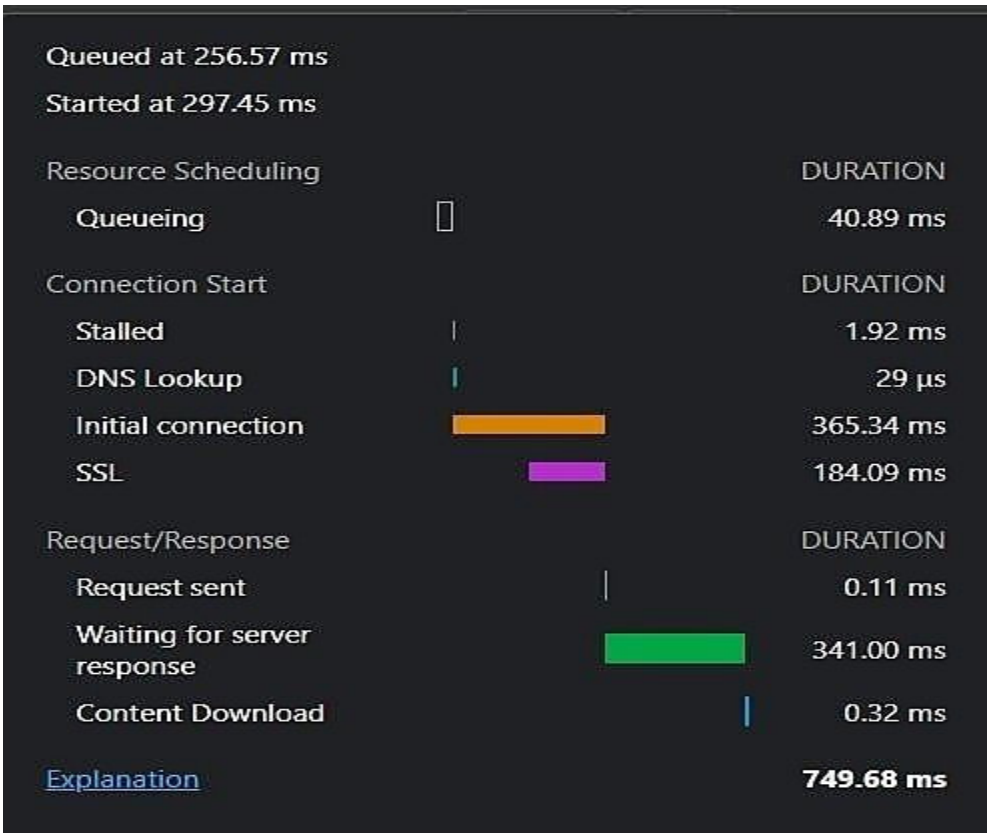
The errors rates are very low as the backend and dashboard is handled with node-red.The exceptions are handled in a proper way as it does not affect the usability of the system



LATENCY AND RESPONSE TIME:

The DOM handling of the received data is optimal and latency is low .After the DOM is loaded the entire site is loaded to the browser

The server also responses quickly . The average time of response is respectable

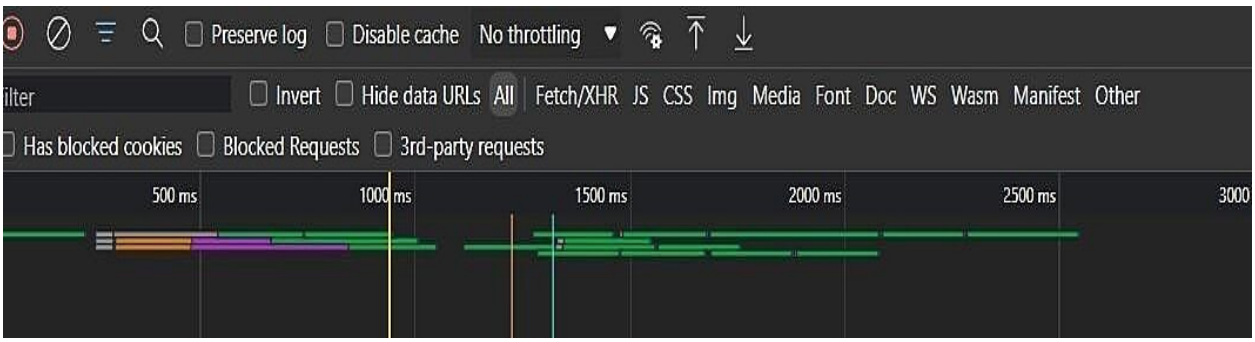


For the data sent from the IoT device (considering the sleep of one second from the IoT), the response is much quicker .

We can easily see the delay caused by the sleep function The average time is well over optimal value

Average time = $(5ms + 2600ms)/2$

= 1302.5



10.ADVANTAGES AND DISADVANTAGES

ADVANTAGES

1) It reducesfalse alarms.

2) It has a minimal installation cost, and continuously scans the area.Itenhances security in workplaces and businesses.

DISADVANTAGES

1) Large-scale industries cannot use this system.

2) If the controlpanel is damaged,it needs to be replaced.

11.CONCLUSION

This technology notifies the authorities of the situationat the appropriate moment, decreasing the number of false warnings.Since the technology is affordable, small scale industries can readily implement it.

12.FUTURE SCOPE

With the addition artificial intelligent technology, Fire management system can be made automated. With the use of PIR(Passive Infrared Sensor) the count of human can be detectedin that area and prioritize it, which helps in humanlifesaving.

13 .APPENDIX

Esp32 - Microcontroller : ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth

Memory	:	320 KiB SRAM
CPU	:	Tensilica Xtensa LX6 microprocessor @ 160 or 240
MHz Power	:	3.3 V DC
Manufacturer	:	Espressif Syste s
Predecessor	:	ESP8266

SENSORS:

DHT22 - Temperature and Humidity sensor:

The DHT22 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed).

Flow Sensors :

A flow sensor (more commonly referred to as a “flow meter”) is an electronic device that measures or regulates the flow rate of liquids and gasses within pipes and tubes.

MQ5 - Gas sensor :

Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gasses. They are commonly used to detect toxic or explosive gasses and measure gas concentration.

Flame sensors :

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting

SOURCE CODE:

```
#include
<WiFi.h>#include
<PubSubClient.
h>#include
<time.h>
#include
"DHTesp.h"
#definetemp_p
in15
void callback(char* subscribetopic,byte* payload,unsigned intpayloadLength);#define
ORG " gltlhd"
```

```
#define DEVICE_TYPE
"ggg"#defineDEVICE_ID
"123"
#define TOKEN "12345678"
String data3;

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);const

intDHT_PIN= 15;

DHTesp dhtSensor;



bool exhaust_fan_on =
false;bool sprinkler_on =
false;

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

String flame_status = "";

String accident_status =
""; Stringsprinkler_status
= "";
```

```
void setup(){
    Serial.begin(99900);

wificonn
ect();
mqttcon
nect();

  dhtSensor.setup(DHT_PIN, DHTesp::DHT22);
}




void
  loop()    {
  srand(ti
  me(0));

    //initial variable

    temperature =
    random(-20,125);gas
    =
    random(0,1000);
    int flamereading = random(200,1024);

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

  TempAndHumidity  data = dhtSensor.getTempAndHumidity();

Serial.println("Temperature: "+ String(data.temperature, 2) +
"°C");Serial.println("Humidity: " + String(data.humidity, 1) +

"%"); Serial.println("---");
  delay(1000);
if(data.temperature<38){PublishData1(data.temperature);
        flame_status = "No Fire";
```

```
    Serial.println("Flame Status : "+flame_status);
}
else{PublishData2(data.temperature);
    flame_status = "Fire is Detected";
    Serial.println("Flame Status :
    "+flame_status);

}
if(data.humidity<30){PublishData3(data.humidity);
    Serial.println("Gas Status: Gas leakage Detected");
}
else{PublishData4(data.humidity);exh
    aust_fan_on = false;
    Serial.println("Gas Status: No Gas leakageDetected");
}

//send the sprinkler
status
if(data.temperature<3
8){
    sprinkler_status = "not working";
    Serial.println("Sprinkler Status : "+sprinkler_status);
}
else{
    sprinkler_status = " working";
    Serial.println("Sprinkler Status : "+sprinkler_status);
}

//toggle the fan according to

gasif(data.humidity<30){

    exhaust_fan_on = true;
    Serial.println("Exhaust fan Status : Working");
}
```

```
    else{
        exhaust_fan_on = false;


        Serial.println("Exhaust fan Status : Not Working");
    }


    Serial.println("");
    Serial.println("");
    Serial.println("_____**********_____");
    Serial.println("");
    Serial.println("");
```

```
delay(1000
);
if(!client.lo
op()){
mqttconnect(
);
}
}void
  PublishData1(float
  temp){mqttconnect();
  String payload =

"{\"temp\":";payload +=
temperature;
payload += ",\"nrml!\":""\"temperature less than
38\"";payload += "}";
```

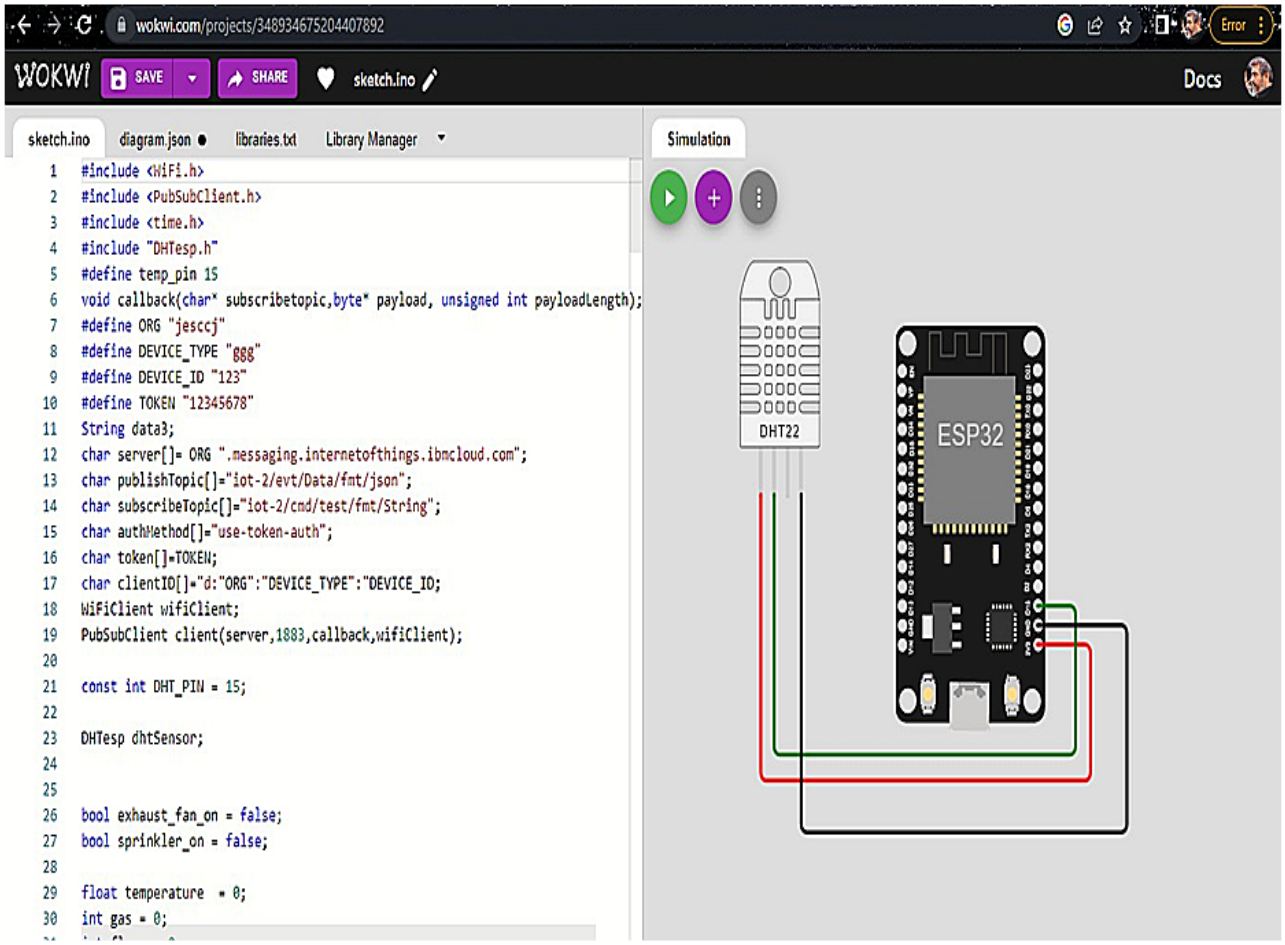
```
Serial.print("Sending payload:");
Serial.println(payload);



  if(client.publish(publishTopic,(char*)payload.c_str())){
    Serial.println("publish ok");
  } else{
    Serial.println("publish failed");
  }
}
void
  PublishData2(floattemperature){mqttcon
  nect();
  String payload =
"{\"temp\":";payload +=
temperature;
payload += ",\"ALERT!!\":""\"temperature greaterthan
38\"";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
  PublishData3(floathumidity){mqttconnec
  t();

  String payload =
"{\"hum\":";payload +=
humidity;
payload += ",\"ALERT!!\":""\"humidity less than
```

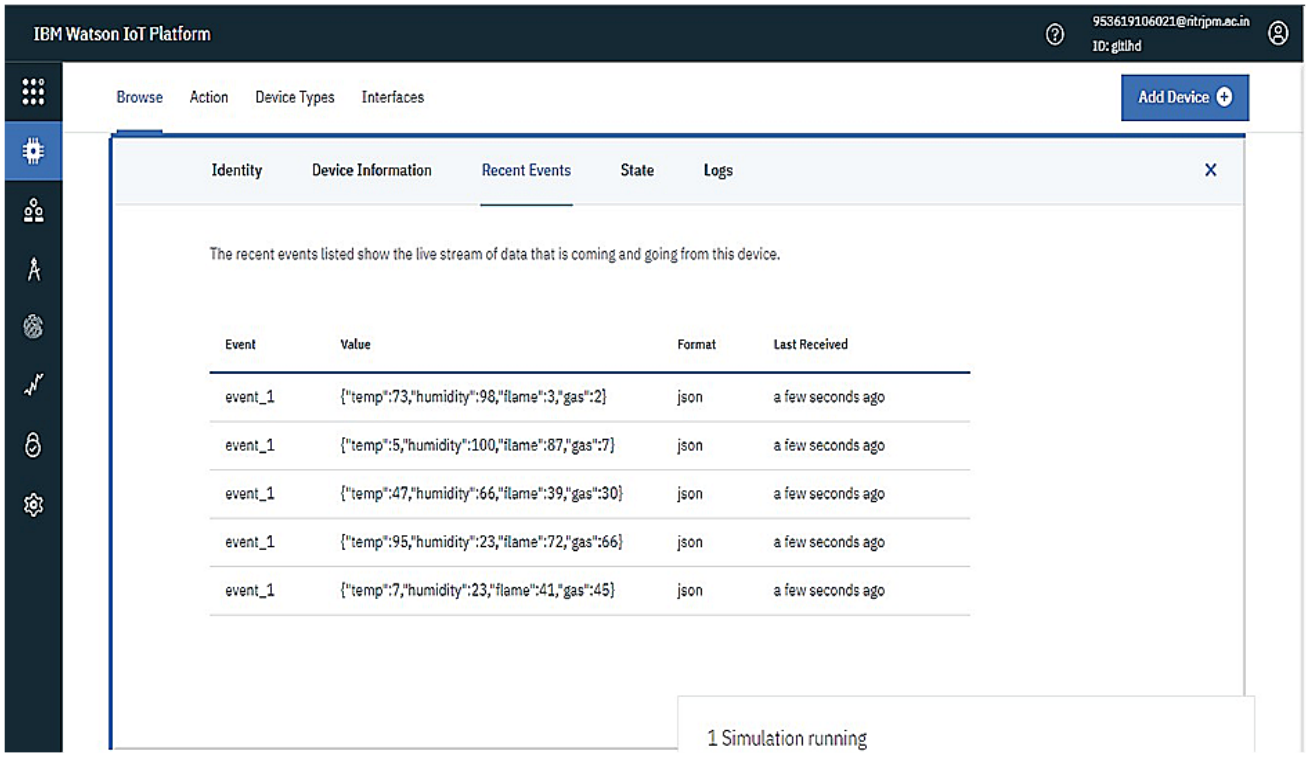
```
30\"";payload += "}";
Serial.print("Sending payload: "); Serial.println(payload);
if(client.publish(publishTopic,(char*)payload.c_str()
)){
    Serial.println("publish ok");
  } else{
    Serial.println("publish failed");
  }
}
void
PublishData4(floathumi
dity){mqttconnect();
String payload =
"{\"hum\":";payload +=
humidity;
payload += ",\"nrml!!\":""\"humidity greaterthan
30\"";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.printl
  n();
  Serial.print("Connecti
  ngto");

  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{
    Serial.println("subscribe to cmd failed");
  }
```

```
}


void callback(char* subscribeTopic, byte* payload,
unsignedintpayloadLength){
  Serial.print("callback invokedfor topic:");
  Serial.println(subscribeTopic);
  for(int i=0; i<payloadLength;
  i++){data3 += (char)payload[i];
  }
}
```

OUTPUT:





GITHUB LINK :https://github.com/IBM-EPBL/IBM-Project-32165-1660208478