INDUSTRY-SPECIFIC INTELLIGENT

FIRE MANAGEMENT SYSTEM

(TEAM ID: PNT2022TMID00383)

Submitted by

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1. INTRODUCTION

1.1 Project Overview

The goal of the Industry Specific Fire Management System is to provide early fire detection. When a flame or gas is detected, this project aims to activate the sprinklers and sound the alarm. To detect changes in the environment, the smart fire management system includes a gas sensor, a flame sensor, and temperature sensors. If the temperature or gas value exceeds a certain threshold, or if a flame is detected, the sprinklers will activate immediately, and an alarm will sound. This project also includes a facility where authorities and management can monitor temperature, gas levels, and flames.

1.2 Purpose

Designing, managing, planning, and coordinating appropriate fire safety measures to lower the risk of fire in industries and to assure the safety of building occupants is the primary goal of the industry-specific intelligent fire management system. A full fire management system guarantees adherence to the law and the safety of people's lives and property. The goal of this fire management system is to protect management property and staff lives. The main goal of a fire alarm system is to give people advance notice of a fire so they can escape and take swift action to minimize or completely stop the effects of the fire. Reduced financial loss to the industry is one of the key goals of the fire management system.

2. LITERATURE SURVEY

2.1 Existing problem

Various compounds that are used to make pyrotechnics in the oil and gas industry are extremely sensitive to friction, impact, heat, and static electricity. Fire mishaps are brought on by this friction and collision. The explosions or fire mishaps also happen either as a result of sparks from the processing segments or as a result of impact stimuli produced during the transportation process. These fire incidents seriously damage both the industry and the lives of those who work in it. Therefore, to address this issue, we have suggested a system that makes use of sensors to find fires before they cause damage, sprinklers to put out fires, and a fire alarm to notify employees when a fire breaks out.

TITLE: Development of a method for calculating fire and oil spills parameters

JOURNAL/CONFERENCE: AIP Conference Proceedings 2216, 070004 (2020) Published Online: 01 April 2020

AUTHORS: Azat A. Sharafutdinov,Fanil Sh. Khafizov, Ildar F. Khafizov,Anton V. Krasnov,Aidar V. Akhmethafizov,Veronika I. Zakirova,Amina N. Khafizova

At each stage of the production, storage, and transportation of petroleum products, environmental, industrial, and safety of the natural environment is the ultimate aim of the project. The paper revolves around the concept of development of modern methods of monitoring fires and accidental oil and petroleum products spills. There is an integration of the special software into a single emergency response system. It is done to ensure quick response of fire and rescue teams to prevent loss of life and property. The sensing is done through a comprehensive approach of problem solving, detection and prediction of the oil pollution which is based on the joint analysis of heterogeneous data obtained by unmanned aerial vehicles. This is due to the unmanned aerial vehicles having an advantage over manned systems in situations where efficiency and quick response time is required. Microwave radiometer sensor, radar, laser radar, infrared and ultraviolet spectrometers are widely used in this project.

TITLE: Identification of Key Factors of Fire Risk of Oil DepotBased on Fuzzy Clustering Algorithm

JOURNAL/CONFERENCE: ASME 2019 Pressure Vessel&Piping Conference, 2019

AUTHORS: Shuyi Xie, Shaohua Dong, Guangyu Zhang

The demand for oil is rising as the country's economy develops quickly. China has developed a number of oil depots recently, with the largest having a capacity of up to tens of millions of cubic metres, in order to fulfill the country's rising energy demand. The risk of fire in the oil depot region has significantly grown as the tank capacity of the storage tank area has increased due to the combustible and explosive character of the stored medium. The national oil depot has benefited from the expansion of the oil depot and the construction of very large - scaled oil storage tanks, but these developments have also had many disastrous side effects. The fuzzy C-means method and fuzzy maximum support tree clustering algorithm are introduced based on the created oil depot fire risk index system for identifying the key factors. Two fuzzy clustering mathematical methods allow for the identification of important elements in the created index system. First, the indicators in the oil depot fire risk index system a reevaluated using the expert scoring method, and the important degree assessment matrix of oil depot fire risk components is created using a fuzzy analysis of expert comments.

TITLE: Probability Analysis and Prevention of Offshore Oil and Gas Accidents: Fire as a Cause and a Consequence

JOURNAL/CONFERENCE: Fire, MDPI, Volume 4, Issue 4, 2021

AUTHORS: Dejan Brki´c and Pavel Praks

Although major offshore oil and gas mishaps caused by failures during the drilling and extraction of hydrocarbons are relatively uncommon, the effects can be disastrous in terms of human casualties and environmental harm. Therefore, the largest major offshore oil and gas mishaps, those with more than 10 fatalities or with a large environmental damage, are examined in this article to acquire insight into their prevention. Fire is given particular focus both as a source and an effect. The impact of relevant safety-related technological and legislative upgrades and modifications that have been made in response to these accidents are assessed. The American prescriptive method and the European goal-oriented approach are the two main approaches to safety that are compared. The statistical analysis of failure probability examines the primary causes of accidents, and the precise confidence intervals for the estimated probabilities are determined. There is no statistically significant difference between the parameters that were examined and characterise the primary causes of offshore oil and gas accidents, according to the results of the statistical test based on precise confidence intervals. It can be determined that there is no indication of a difference between the categories of the primary causes of accidents based on the small but carefully selected sample of 24 of the largest incidents.

TITLE: Nanostructures Management Technology to Reduce the Fire Risk in the Oil and Gas Industry

JOURNAL/CONFERENCE: Journal of applied engineering science, paper number: 19(2021)1,766, 84-91

AUTHORS: Aleksei V. Ivanov,Farid A. Dali ,Grigoriy K. Ivakhnyuk,Igor L. Skripnick,Marina A. Simonova,Denis V. Shikhalev

There is a higher risk of fire in oil and gas operations. When oil is produced, processed, transported, and stored, there is a great likelihood that huge flames will start and spread. There is a considerable likelihood that there will be significant fires when oil is being produced, processed, transported, and stored. The effectiveness of fire prevention and extinguishing systems must be increased, which calls for the development of new materials based on nanotechnology principles. The methods of functionalization and interaction of clusters of the base liquid and multilayer carbon nanotubes, methods for stabilizing nanofluids, and methods for changing the thermophysical, rheological, and electrostatic properties of substances and materials on their basis are the foundation of the technology for controlling the properties and performance characteristics of nanofluids based on liquid hydrocarbons and water. With the help of the suggested technology, it will be possible to develop nanomaterials based on various emergency situational development ascenarios and use them to lower the danger of fire in oil and gasfacilities.

2.2 References

1.Development of a method for calculating fire and oil spills parameters Azat A. Sharafutdinov,Fanil Sh. Khafizov, Ildar F. Khafizov,Anton V. Krasnov,Aidar V. Akhmethafizov,Veronika I. Zakirova,Amina N. Khafizova, AIP Conference Proceedings 2216, 070004 (2020) Published Online: 01 April 2020

2. Identification of Key Factors of Fire Risk of Oil Depot Based on Fuzzy Clustering Algorithm Shuyi Xie, Shaohua Dong, Guangyu Zhang, ASME2019 Pressure Vessels & Piping Conference,2019

3. Probability Analysis and Prevention of Offshore Oil and Gas Accidents: Fire as a Cause and a Consequence Dejan Brki´c and Pavel Praks, Fire MDPI, Volume 4, Issue 4, 2021

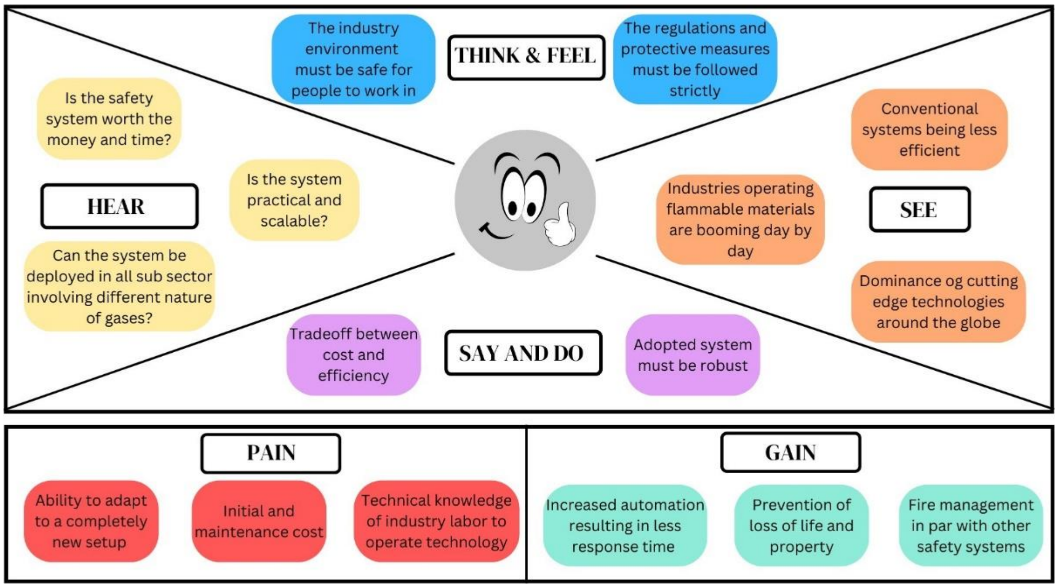
4. Nanostructures Management Technology to Reduce the Fire Risk in the Oil and Gas Industry Aleksei V. Ivanov,Farid A. Dali ,Grigoriy K. Ivakhnyuk, Igor L. Skripnick,Marina A. Simonova,Denis V. Shikhalev, Journal of applied engineering science, paper number: 19(2021)1,766, 84-91

2.3 Problem Statement Definition

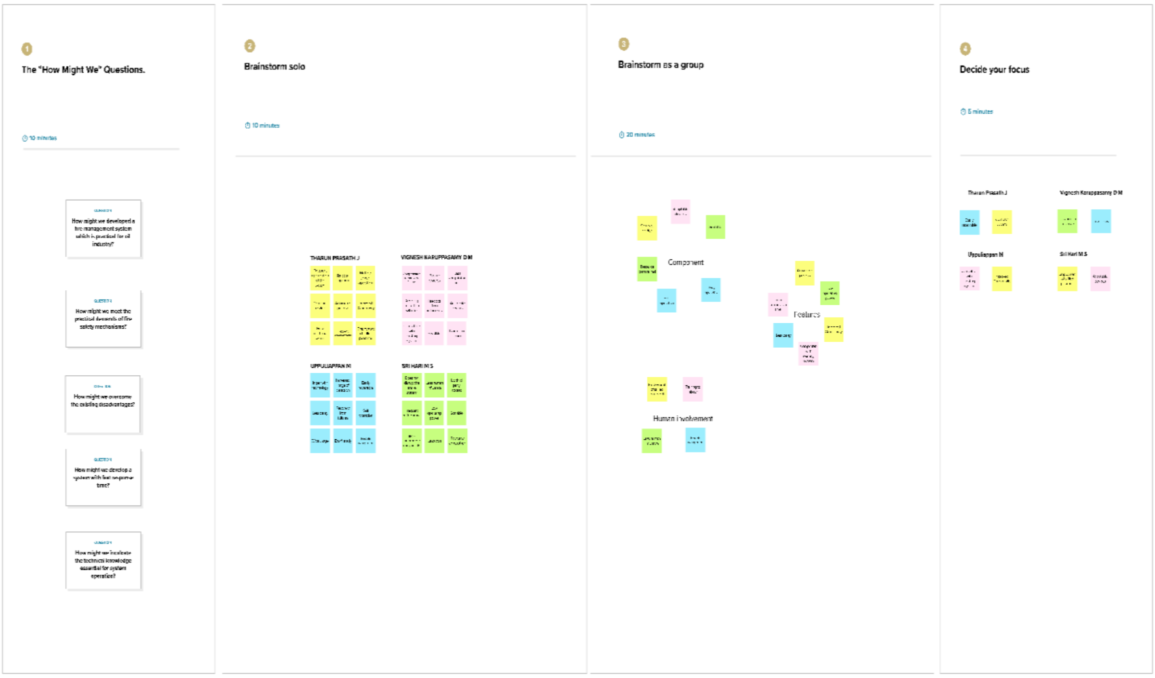
The existing fire management systems in oil and gas industry not being practical, robust and real-time. We propose an exclusive fire management system for the Oil and Gas Industry by deploying Internet of Things (IoT) technology using various sensors like Gas sensor, Flame sensor, and temperature sensor and send real-time information to the safety department and also fire services

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map



3.2 Ideation & Brainstorming

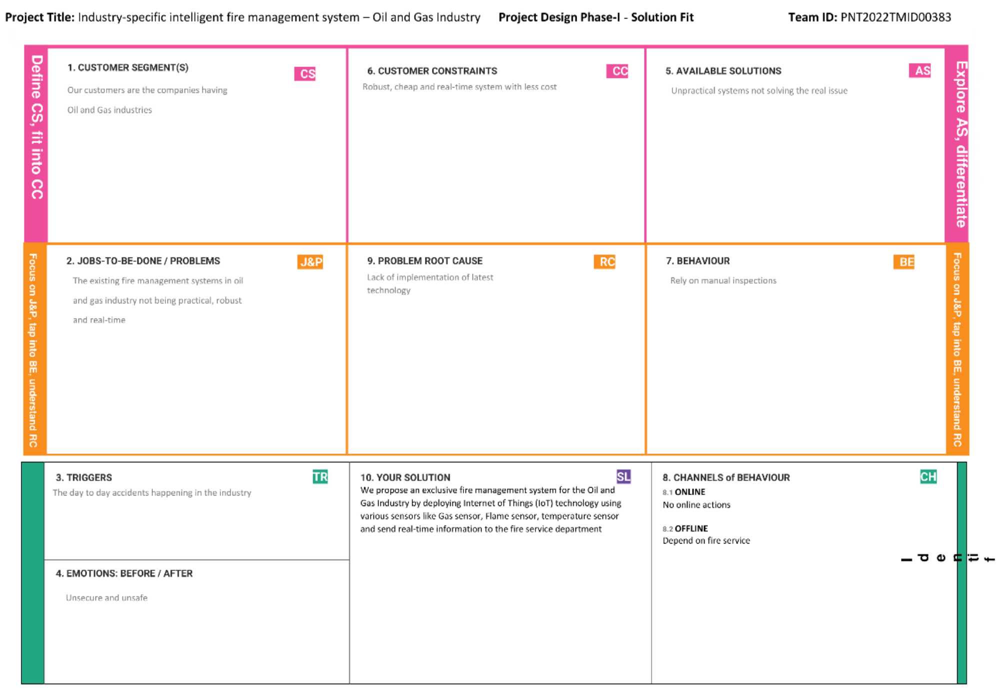


3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The existing fire management systems in oil and gas industry not being practical, robust and real-time
2.	Idea / Solution description	We propose an exclusive fire management system for the Oil and Gas Industry by deploying Internet of Things (IoT) technology using various sensors like Gas sensor, Flame sensor, temperature sensor and send real-time information to the safety department and also fire services
3.	Novelty / Uniqueness	Our novelty lies in the fact that based on the periodic monitoring of the number of accidents in a particular industry, the vulnerability level is set and frequent maintenance and safety checks are automatically intimated to the industry and also to safety department.

4.	Social Impact / Customer Satisfaction	• Our model can reduce fire accidents in oil and gas industry which when not done can bring about adverse effects. • Customer satisfaction would be achieved through regular feedback and maintenance.
5.	Business Model (Revenue Model)	Cost Structure – Rs. 10000/Model Customer segment – Client is government and Consumer is the Oil and gas industry Go-to-Market Strategy – Emphasis on after effects of implementation Market Size – Total Available Market (TAM) Technology Readiness Level – TR7
6.	Scalability of the Solution	As IoT technology is booming everywhere and need for such safety systems is increasing day- by-day, our model once implemented is easily scalable

3.4 Problem Solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Initialization	Each industry is registered in the database with all the details about it
FR-2	User Setup	The safety systems are installed in the companies after proper analysing
FR-3	User Training	Enhanced training and frequent drills would be conducted
FR-4	User Operation	During times of fire outbreak, it would be ensured that real time data would be communicated efficiently
FR-5	User Feedback	User feedback would be collected at frequent intervals for the upgradation of the system
FR-6	User Maintenance	System maintenance and bug fixing would be given high importance
FR-7	User Analysis	Analysis would be made on the finished process which would help the user to improve things from their side
FR-4	Automation and Autonomy	The system must be able to activate and function completely autonomously, without any external network or power and any human intervention.
FR-5	Web server	The system must have a web server for system monitoring and allow for remote control by designated persons .
FR-6	Cloud server	Cloud servers allows us to store information on the cloud and access this information using an internet connection. As the cloud provider is responsible for providing security, so they offer various backup recovery application for retrieving the lost data.

4.2 Non-Functional requirements

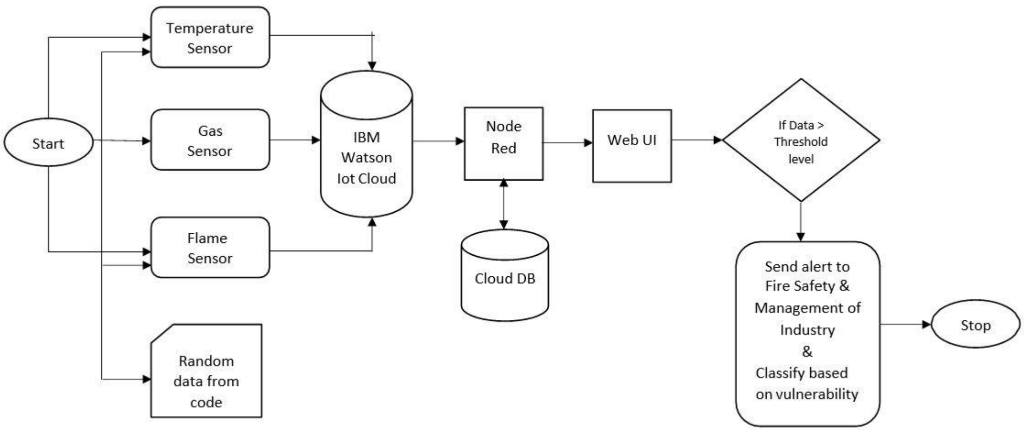
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Though the project is involving advanced technologies like IoT and clouds, entire process is made simple though simple construction
NFR-2	Security	Cloud is made fully encrypted and the design is in such a way that only the company and the fire safety department can only access the data
NFR-3	Reliability	As immediate alerts are sent to the fire management systems, the fire would be immediately ceased. Also, our method of classifying industries based on vulnerability makes the system vulnerable
NFR-4	Performance	As advanced technology is used, there is a fully automated response which results in a quick response time
NFR-5	Availability	The model is designed considering it to be available in all the sectors of the oil and gas industry
NFR-6	Scalability	The model can be rightly scaled due to its simple construction and ease of flow of process
		tests are done to secure the fire management system. Fire management systems should be discharged, disassembled, and

		inspected annually. Mock drills should be conducted periodically. It should be checked whether it includes all the fire safety standards.
NFR-3	Reliability	This is the highest quality and most innovative fire sprinklers and special systems on the market;distributes a full line of best-in-class system components; and backs it up with premier customer service
NFR-4	Performance	All the minimum durations of operations are here decided for every fire management system, according to the value of the flame sensor, gas, and temperature sensor. The emission of sprinklers shall start within a few seconds since the flame is detected and in case of any gas is detected, an alarm is turned on within a few seconds.
NFR-5	Availability	The fire management systems were effective in extinguishing fires 95% of the time. A new installation of the system shall be available for first-time use within 24 hours of the start of the

		installation.
NFR-6	Scalability	This model is not only used for small industries but it can also be used in large industries and buildings with proper infrastructure and technology.

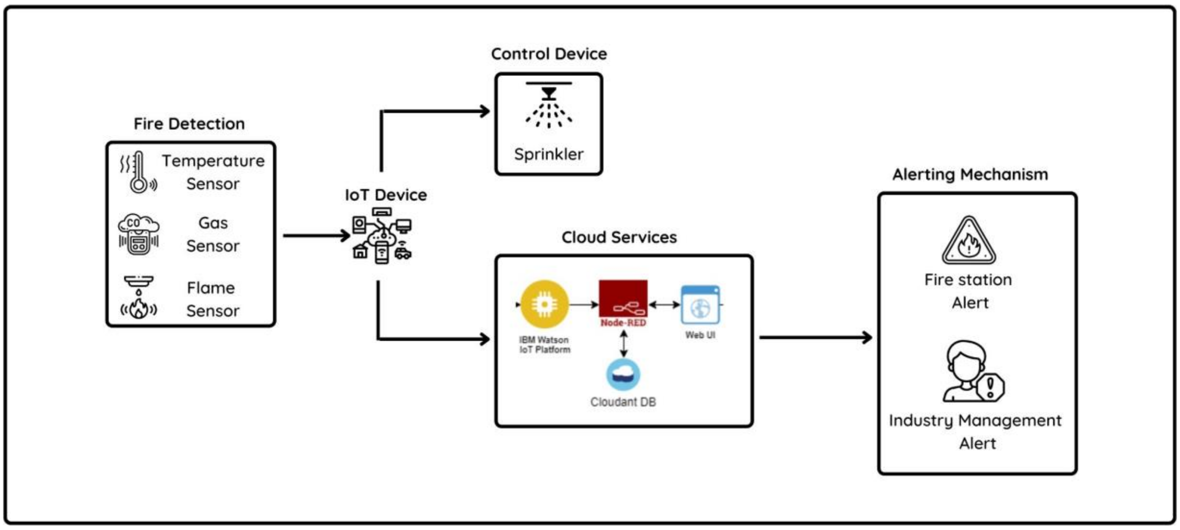
5. PROJECT DESIGN

5.1 Data Flow Diagrams

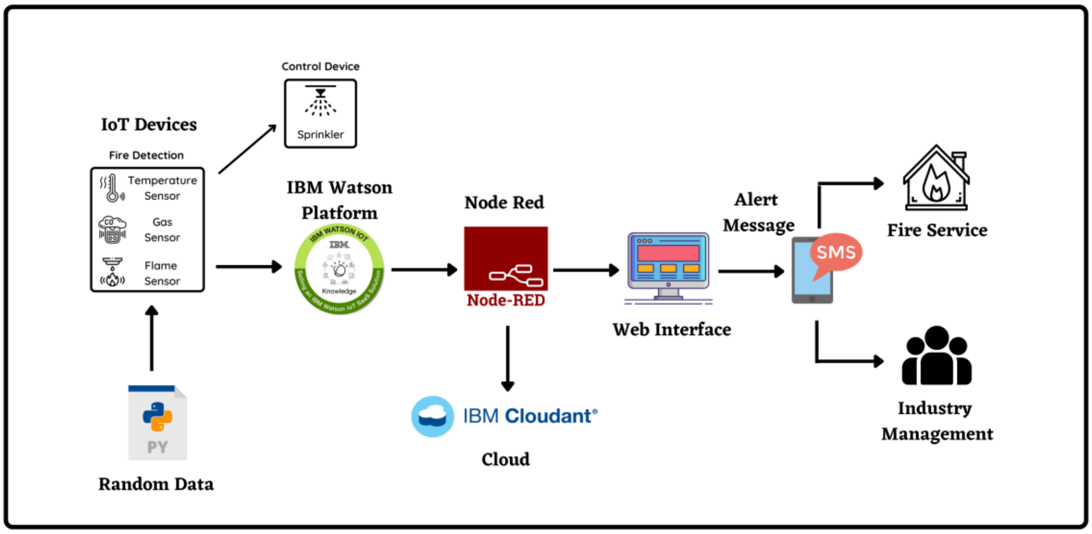


5.2 Solution & Technical Architecture

a. Solution Architecture



b. Technical Architecture



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	Download the application and register and receive the confirmation	Access the account	High	Sprint-1
Customer (Web user)	Registration	USN-2	Download the application and register and receive the confirmation	Access the account	High	Sprint-1
Customer (Industry Management)	Data view	USN-3	View the temperature readings	Data from sensor (random input is used here)	High	Sprint-2
Customer (Industry Management)	Data view	USN-4	View the gas level readings	Data from sensor (random input is used here)	High	Sprint-2

Customer (Industry Management)	Data view	USN-5	View the flame readings	Data from sensor (random input is used here)	High	Sprint-2
Administrator	Action	USN-6	View all the temperature readings	Data from various sensors	Medium	Sprint-3
Customer (Industry Management)	Core Moment	USN-7	Receive alert messages	Taking action based on received messages	High	Sprint-4
Administrator (Fire Service)	Core Moment	USN-8	Receive alert messages	Taking action based on received messages	High	Sprint-4
			c, accurate, and dynamic aiming	dynamically follow the flames if the fire grows		
Customer (Industrial user)	Cloud server	USN-6	As a user, I need a cloud server	I can store the data securely	Low	Sprint-3
Customer (Industrial user)	Alarm	USN-7	As a user, I need an alarm	I can be safe before the fire spreads	High	Sprint-2

Customer (Fire station)	Notification	USN-8	As a user, I need a notification about the fire	I can know about the nearby fire breakage	Low	Sprint-3

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	Gas temperature measurement	USN-1	As a user, I need to know the temperature of the Industry where I work.	6	High	Tharun Prasath J
		USN-2	As a user, I need to know the gas pressure around our surrounding.	7	High	Srihari M S
		USN-3	As a user, I need to know the status of exhaust fan and sprinkler.	7	High	Uppuliappan M
Sprint-2	Monitoring parameters	USN-4	In industry, sensor sense the flame and sprinkler.	10	High	Vignesh Karuppasamy D M
		USN-5	If the sensor detected the flame, next step is extinguishing the flame with the help of Sprinkler and Exhaust to clear smoke.	10	High	Uppuliappan M

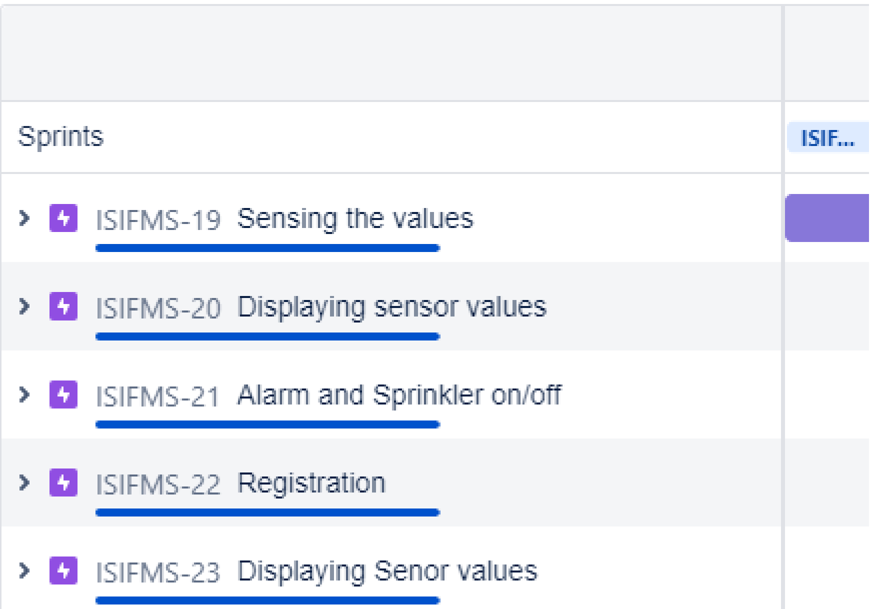
Sprint-3	Cloud and Node Red	USN-6	All the values are stored in the cloud database. The flow is setted in node red server and the web app is been set to monitor the status of the fire.	20	High	Tharun Prasath J
Sprint-4	App UI and Operation	USN-7	The app User Interface should be clean and user friendly.	10	High	Srihari M S
		USN-8	It should have a simple login and user should receive alerts based on the fire system indication.	10	High	Uppuliappan M

6.2 Sprint Delivery Schedule

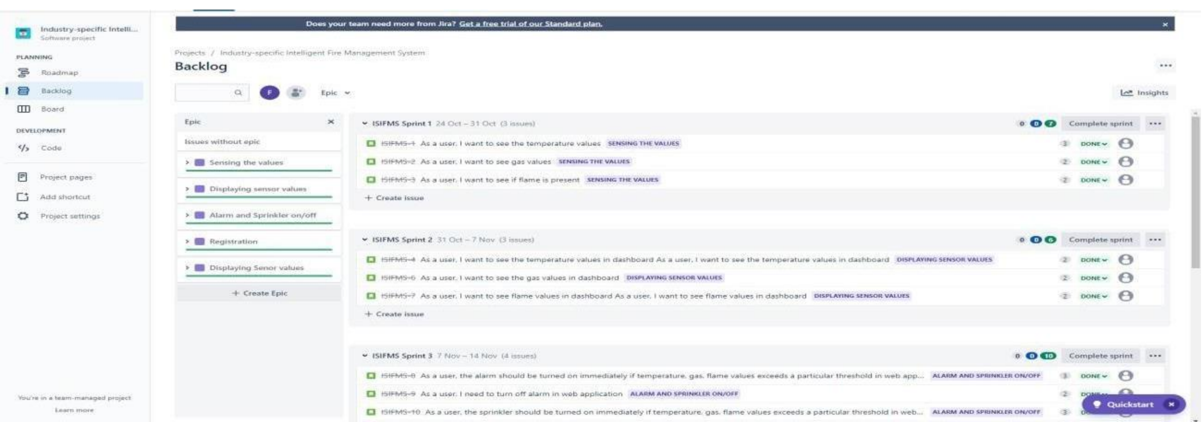
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022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

6.3 Reports from JIRA

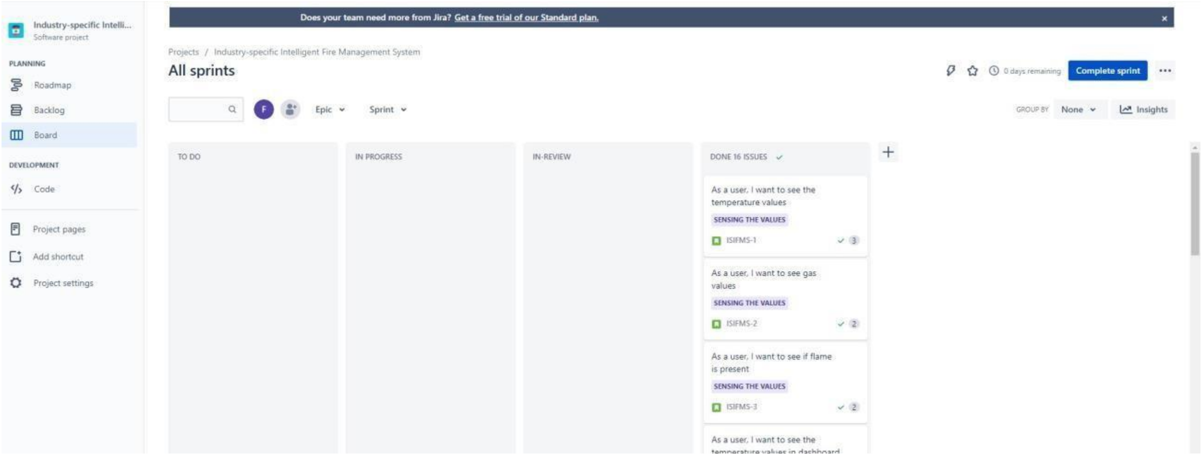
ROAD MAP IN JIRA



BACKLOG IN JIRA



BOARD IN JIRA



VELOCITY REPORT

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

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

7. CODING & SOLUTIONING (Explain the features added in the project along with code)

CODING

```
#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"
#define DEVICE_TYPE "fershidevicetype"
#define DEVICE_ID "fershideviceid"
#define TOKEN "fershiageona"
String data3;
float t;
//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/Data/fmt/json";
char subscribetopic[] = "iot-2/cmd/command/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);
void setup()
{
  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) {
```

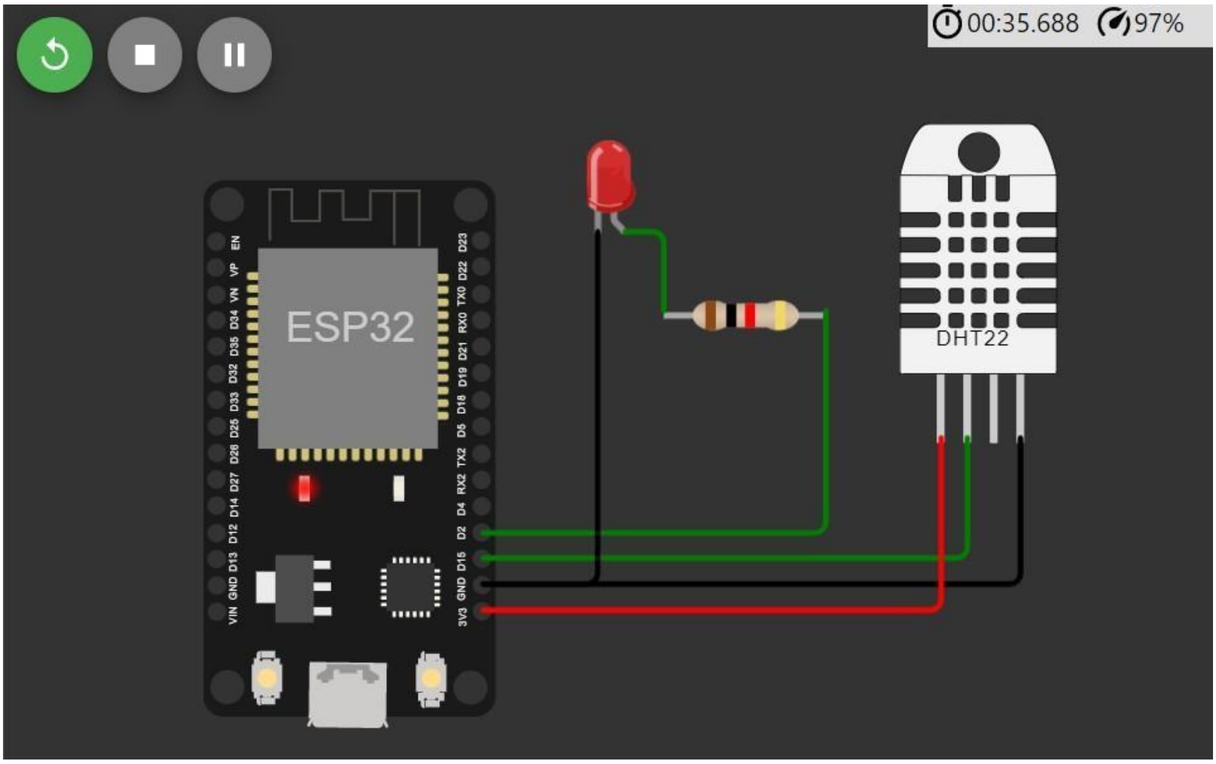
```
  mqttconnect();
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  String payload = "{\"temperature\":";
  payload += temp;
  payload += "}";
  Serial.print("Sending payload: ");
  Serial.println(payload);
  if (client.publish(publishTopic, (char*) payload.c_str())) {
    Serial.println("Publish ok");
  } 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()
{
  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 {
    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="";
}
```

SOLUTION



FEATURES

ALARM & SPRINKLER

In this project, we've developed an alarm that will sound whenever gas and temperature levels rise or if a flame is seen.As part of this project, we also built a sprinkler that will activate when gas and temperature levels are high or if a flame is needed, and that can be remotely shut off as needed.

8. TESTING

8.1 Test Cases Report

1. Fires nearby can be automatically found and put out by the system.

2. The system has the ability to instantly recognise and report the presence of smoke in the vicinity.

3. The system has the ability to instantly recognise and indicate the existence of flames in the vicinity.

4. In the case of a fire, the system has the ability to automatically turn off all gas and electricity sources.

5. In the event of a fire, the system can instantly alert the fire department.

6. In the case of a fire, the system can automatically alert the building's residents.

7. In the event of a fire, the system can automatically evacuate the building.

8.2 User Acceptance Testing

The user tests the ESP32-based IoT-based Intelligent Fire Management System to see if it performs as planned. The following ought to be visible to the user:

- The system must be able to recognise a fire and notify the user.
- When a fire is discovered, the system need to be able to activate the sprinklers automatically.
- The system must be able to follow the fire's progress and update the user.
- The system should be able to provide details regarding the fire's intensity.

9. RESULTS

Smart oil and gas industries can efficiently deploy our project. They notice the fire in the environment extremely quickly. By detecting smoke, fire, or heat, a device can sound an alert to warn others. It not only stops significant losses brought on by disastrous fires but can occasionally save lives by giving people enough time to take preventive action. A fire alarm is a device that recognises the presence of fire and smoke-related atmospheric disturbances. The purpose of the fire alarm is to warn people to leave a place where there is a fire or smoke buildup. When operating properly, if a fire alarm sounds excessively loud, five persons should immediately respond to the incident.

10. ADVANTAGES & DISADVANTAGES

10.1 ADVANTAGES

- ➢ The loss of life is avoided
- ➢ The loss of property is avoided
- ➢ Manual work is reduced
- ➢ Fire can be detected earlier

10.2 DISADVANTAGES

- ➢ Maintenance
- ➢ Training of skilled labor
- ➢ Privacy issues
- ➢ Implementation on a large scale

11. CONCLUSION

The proposed method illustrates how Internet technology has advanced in daily life. The system is appropriate for applications that require real-time monitoring and control of small-scale industrial processes. One of the greatest ways to develop IoT applications is with the suggested module, which is implemented on the ESP32. The module outline was tested, made actual, and the system's accuracy and functionality were confirmed.

12. FUTURE SCOPE

The future scope of our project is to deployment using real pieces of hardware and build the prototype for direct employment in the industry.

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"
#define DEVICE_TYPE "fershidevicetype"
#define DEVICE_ID "fershideviceid"
#define TOKEN "fershiageona"
String data3;
float t;
//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/Data/fmt/json";
```

```
char subscribetopic[] = "iot-2/cmd/command/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);
void setup()
{
  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();
  /*
     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");
  } 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()
{
  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 {
    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 & Project Demo Link

Github Link: https://github.com/IBM-EPBL/IBM-Project-11112-1659264010

Project Demo Link: https://youtu.be/K2_MhR8wZZY