PROJECT TITLE : Industry-Specific Intelligent Fire Management System

TEAM ID : PNT2022TMID32732

PROJECT REPORT BY

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Project Report

1. INTRODUCTION

Industry-Specific Intelligent Fire Management System is used because Fire and smoke kill more people every year than many other forces. While controlled fire serves us in so many instances, uncontrolled fire can be of harm, however, the rapid detection of fire and its control can save lives and property damage worth millions. Conventional and addressable are two main types of fire alarm systems, but unfortunately, these fire alarm systems often generate false alarms. The ratio of false alarm is higher in conventional alarm systems compared to addressable, but addressable alarm fire systems are more expensive. The most likely cause of a false warning is different for distinct types of detection systems, such as a smoke sensor often being activated falsely due to an environmental effect. So, there is a need for a cost-effective multi-sensors expert alarm system that is artificially trained and assists FDWS (fire detection and warning system) to make the right decisions and to reduce the number of false alarms. A false alarm can burden the fire brigade and can turn out to be a costly event; so many studies conducted to reduce them. Previous studies proposed different methods such as autonomous firefighting robots, fire alarm systems with notification appliances, and wireless warning systems. Fire alarm systems with notification appliances can be costly because they use visible and audible stimuli to notify residents. Thus an intelligent and smart fire warning system for smart buildings. This system not only analyses the fire presence, but also notifies the concerned people for severe fire chances in case of an emergency or critical situation.

1.1 Project Overview

To achieve the aforementioned goal, in this project, we introduced a Industrial -based FDMS that uses a micro controller Arduino UNO . It is easily available and programmed using the Python (IDE) with a set of cost-effective sensors. The proposed solution effectively uses a smoke sensor with flame sensors with a particular increase in room temperature; to further investigate the true presence of fire and to avoid false alarm, the FDWS is trained with a neuro-fuzzy designer. The purpose of this intelligent fire alarm system is to sense true occurrences of fire, alert the proper authorities, and notify the occupants via Fast2Sms to take necessary action immediately.

1.2 Purpose

1. The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment.
2. Based on the temperature readings and if any Gases are present the exhaust fans are powered ON.
3. If any flame is detected the sprinklers will be switched on automatically.
4. Emergency alerts are notified to the authorities and Fire station.

2. LITERATURE SURVEY

2.1 Existing problem

When a building is attacked by fire, its sustainability is directly affected, which in turn affects the surrounding environment and the welfare of the community. Therefore, the hazards associated with fire outbreaks in buildings need to be addressed efficiently and effectively. The main issues are unavailability of access for fire officers and poor roads. The inconsistencies are also related to the poor performance of the active and passive protection system, which in most cases fails to function in accordance with fire safety standards.

2.2 References

1) Name of the paper: Review of Recent Development in Fire Detection Technologies Published year : 2003

Author : Zhigang Liu, General Fire Technologies, Inc. Canada Andrew Kim , National Research Council Canada

2.) Name of the paper : Design and Implementation of Automatic Fire Alarm System based on Wireless Sensor Networks

Published year : 2015

Authors : * Mr. Santosh P. Patange M.E. Student, Aditya College of Engineering, Beed

* Mr. Sagar V.Yadav M.E. Student, Aditya College of Engineering, Beed

3.) Name of the paper : Assessing the Operation System of Fire Alarm Systems for Detection Line and Circuit Devices with Various Damage Intensities

Published year : 2022

Authors : Marek Stawowy ,Warsaw University of Technology

Michał Wiśnios ,Military University of Technology

Jacek Paś ,Military University of Technology

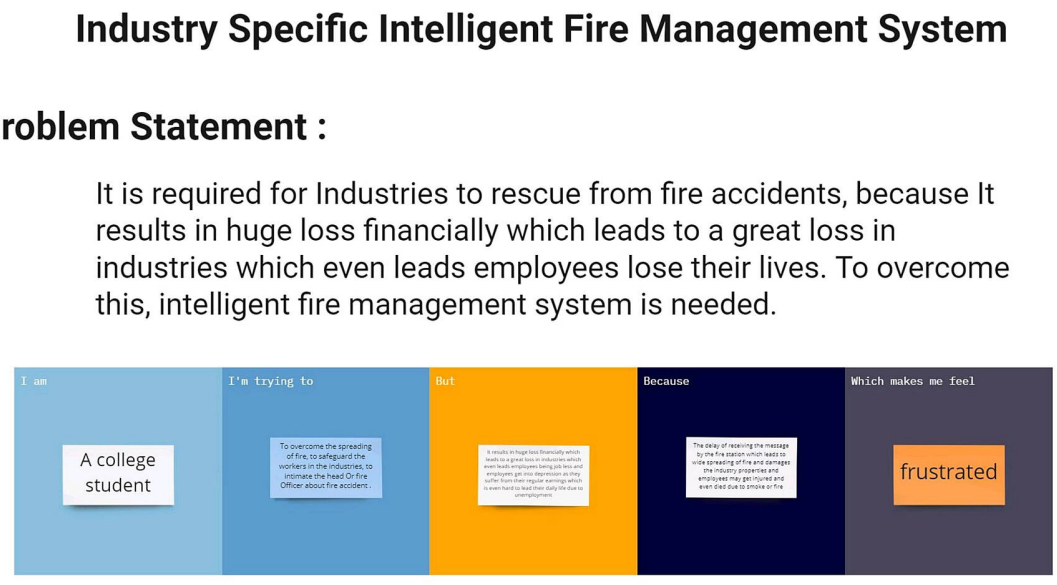
Adam Rosiński ,Warsaw University of Technology

4.) Name of the Paper : Intelligent Fire Alert and Escaping Systems

Published Date : 2017

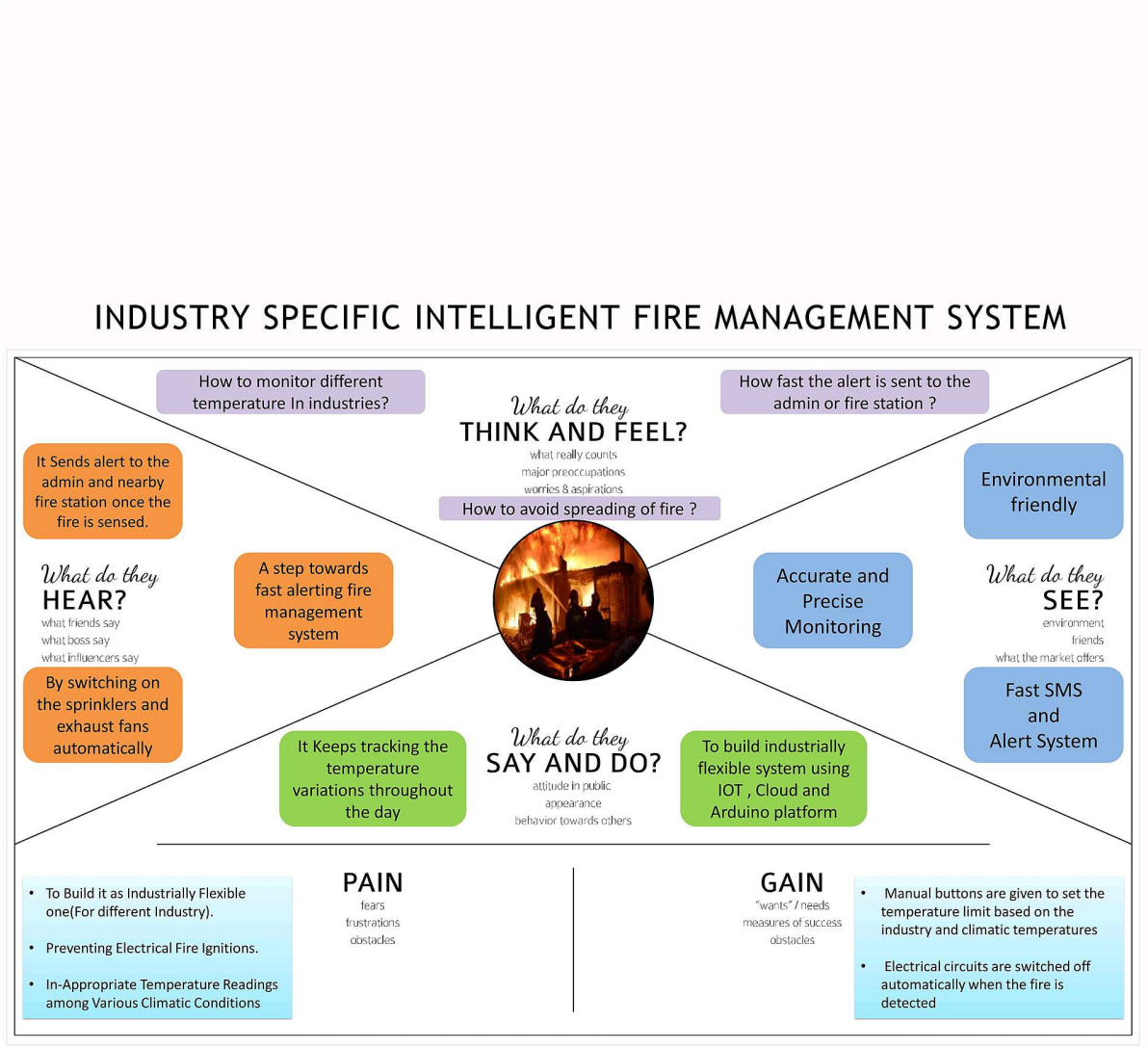
Authors : · Saurabh Joshi ,Divyanshu Sharma ,Yashpal Sammal ,Satyajit Das

2.3 Problem Statement Definition

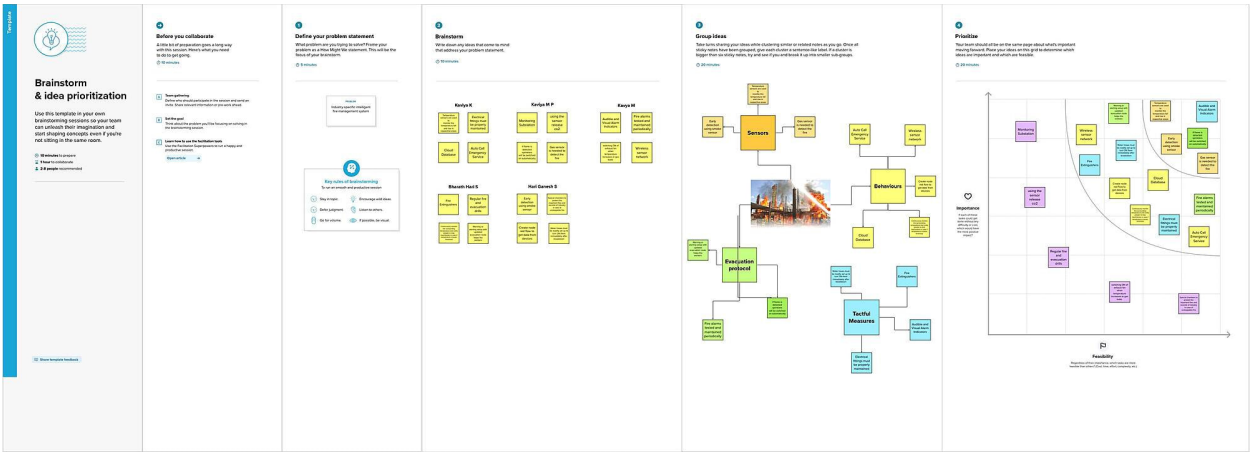


3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

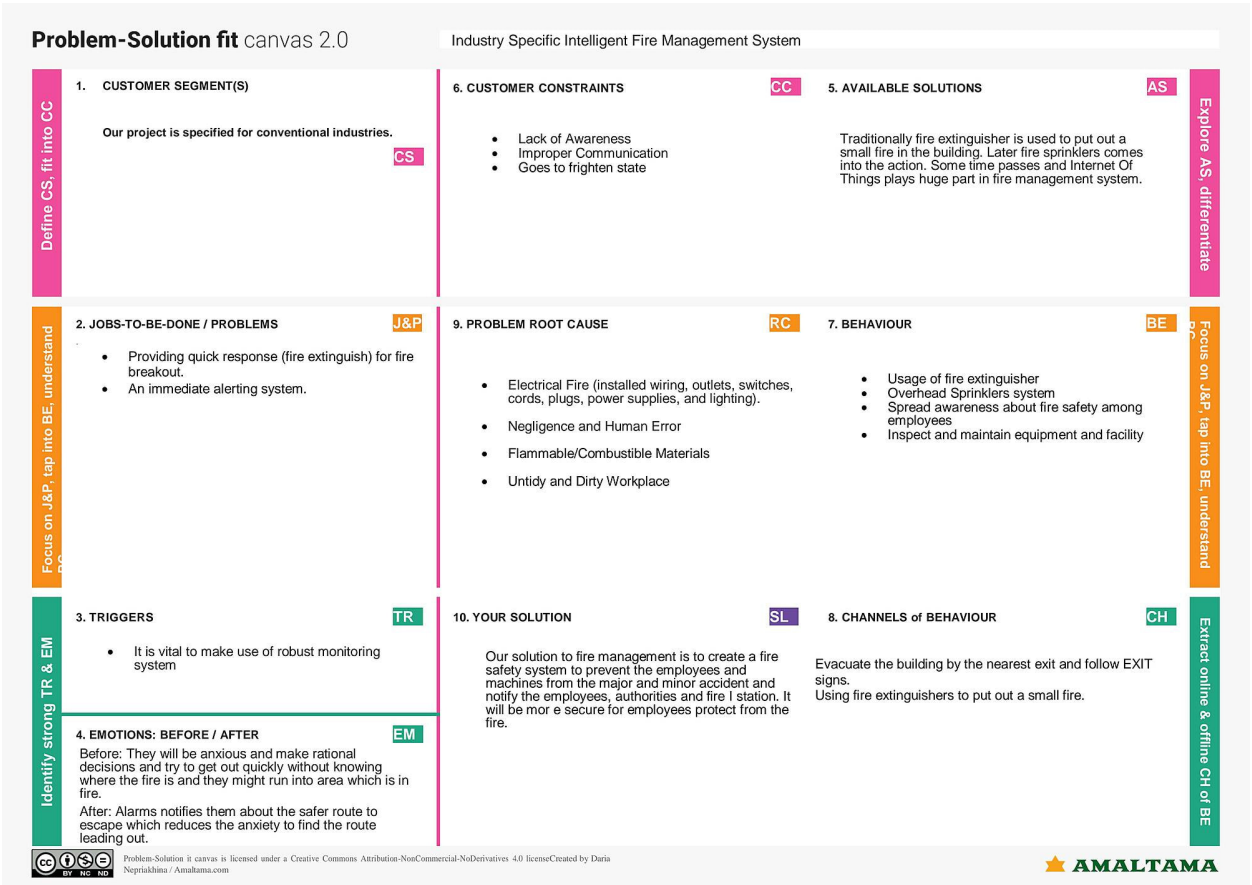


3.3 Proposed Solution

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	To enhance the industry's safety management system and To improve the safety management system in industries. Enhancing the safety management system to prevent industrial fireoccurrences and Improving the safety management system against the fire incidents in industries.
2	Idea / Solution description	Combining an Arduino Uno board with a firedetection and fire extinguisher system, toestablish IOT-based fire safety management inthe industrial sector. Additionally, a GPS tracking system is used with some sensors (such as a humidity, flame, and smoke sensor).In the proposed model, a gas sensor, flame sensor and temperature sensors are usedfor the detection of fire.

3	Novelty / Uniqueness	A fire detection system uses a smoke detector to detect a fire before it actually starts. Aneffective fire detection systemeliminates damage by ensuring that a fire can be prevented before it even starts. A fire detector may also have a direct connection to an alarmmonitoring centre. The smart fire management system includes a Gas sensor, Flame sensor andtemperature sensors to detect any changes inthe environment. Based on the temperaturereadings and if any gases are present thenthealarm is triggered. If any flame is detectedthesprinklers will be switched on automatically. Emergency alerts are notified to the authorities and fire station
4	Social Impact / Customer Satisfaction	The number one reason to install a fire alarmis to make the building safe for your employees, customers, and tenants. A combination of smoke and heat detectors, sirens and bells, andstrobe lights detect fires and alert building occupants, giving them ample time to evacuatein an orderly fashion. Using automatic fire sprinklers protects the environment while further verifying that they reduce property damage and protect lives. It reduces financial loss in industries. It early prevents the accident cost by fire inindustries . It acts very accurately, finely anduser friendly. As the automation of fire extinguishing .
5	Business Model (Revenue Model)	Many sectors can use this product. Given thenumerous sectors that are currently involvedinsaving people and machinery fromfire accidents, this might be seen as a useful andproductive item and It can be used in many industries. If it is made at easy installationtherewill lot of use of this device and it should beuser friendly and eco- friendly as well.
6	Scalability of the Solution	The proposed model can be used in textile industries, paper industries, automobile industries, mining industries, cracker industries, cement industries etc and It could be doneincost effective and work effective. As we areusing normal sensors we can make it less cost , effective and with good compatibility.

3.4 Problem Solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR No 1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR No 2	User Confirmation	Confirmation via Email Confirmation via OTP
FR No 3	User Login and User Access	Login through website or App using the respective username and password and Access the app requirements
FR No 4	Fire Detection Monitoring	In Industry we monitor the fire detection using sensors like temperature sensor, flame sensor etc
FR No 5	Intimating fire in industry	In case, fire occurs in industry we intimate the message through mobile application
FR No 6	Solution and Data Sync	Data report should be generated and delivered to user for every 24 hours and API interface to increase to invoice system

4.2 Non-Functional requirements

NFR No.	Non-Functional Requirement	Description
NFR No.1	Usability	Simple,economic and easy to use. Usability requirements includes language barriers and localization tasks. Usability can be assessed by Efficiency of use.
NFR No.2	Security	Access permissions for the particular system information may only be changed by the system's data administrator and The mobile application is highly secured .
NFR No.3	Reliability	It is highly reliable and the web application runs accurately and The database update process must roll back all related updates when any update fails.
NFR No.4	Performance	The front-page load time must be no more than2seconds for users that access the website using an VoLTE mobile connection and Sensors maintain the records and sends it to the cloud.
NFR No.5	Availability	If fire occurs in industry we intimate the information to people through message. The sensors detects 24hours and intimate quickly to the management ,fire station and New module deployment must not impact front page, product pages, and check

		out pages availability and mustn't take longer than one hour
NFR No.6	Scalability	We can increase scalability by adding memory, servers, or disk space and we can compress data and use optimizing algorithms

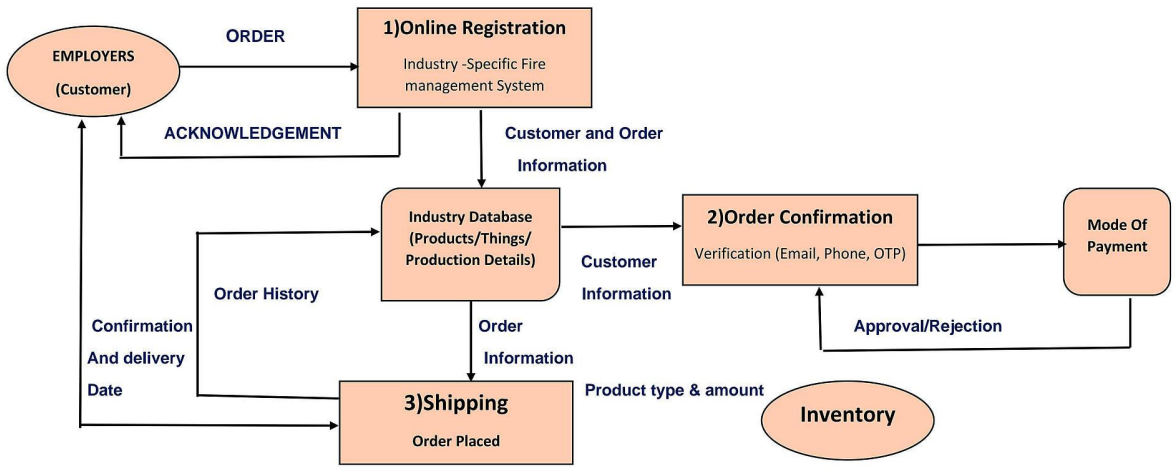
5. PROJECT DESIGN

5.1 Data Flow Diagrams

Project Design Phase-II
Data Flow Diagram & User Stories

Date	15 October 2022
Team ID	PNT2022TMID32732
Project Name	Industry Specific Intelligent Fire Management System
Maximum Marks	4 Marks

Data Flow Diagrams:

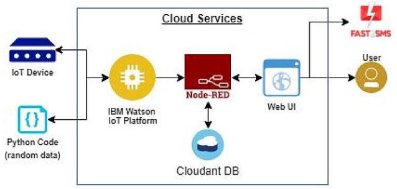


5.2 Solution & Technical Architecture

Project Design Phase-II
Technology Stack (Architecture & Stack)

Date	15 October 2022
Team ID	PNT2022TMID32732
Project Name	Project - Industrial specific Intelligent fire management system
Maximum Marks	4 Marks

Technical Architecture:



Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud)
3. Indicate external interfaces (third party API's etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models (if applicable)

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interface with the Web UI	IBM IoT Platform, IBM Node red, IBM Cloud
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	Ibm Watson, ibm cloudant service,ibm node-red
4.	Application Logic-3	Develop python script to publish and subscribe to IBM IoT Platform	python
5.	Database	Data Type, Configurations etc.	MySQL
6.	Cloud Database	Database Service on Cloud	IBM Cloudant
7.	File Storage	File storage requirements	IBM Block Storage or other Storage Service or Local filesystem.
8.	Infrastructure (Server / Cloud)	Application Deployment on Local System / cloud Local Server Configuration: Cloud Server Configuration:	Cloud Foundry
9.	Protocol	How data exchanged on Web	HTTP

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Appypie app Inventor	Appypie
2.	Security Implementations	IBM Services	Encryptions , IBM Controls
3.	Scalable Architecture	Sensor – IOT Cloud based architecture	Cloud Computing and AI
4.	Availability	Mobile , Desktop, Laptop	Appypie app
5.	Performance	Detects the Fire , Temperature , Smoke	Sensors

5.3 User Stories

User Stories

User Type	Functional Requirement (Epic)	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 email, 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 Facebook	I can register & access the dashboard with Facebook 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 with my id and password	High	Sprint-1

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning & 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 the application by entering my email, password, and confirming my password.	2	High	Hari Ganesh,Bharath Hari,Kaviya MP,Kaviya K, Kavya M
Sprint-1	Simulation	USN-2	Connect sensors and Arduino with python.	1	High	Kaviya MP,Kaviya K, Kavya M
Sprint-2	Software	USN-3	Creating device in the IBM Watson IoT platform, and workflow using Node-Red.	2	Low	Hari Ganesh,Bharath Hari
Sprint-1	MIT App Inventor	USN-4	Develop a mobile application for the Fire Management System using MIT app inventor.	2	Medium	Hari Ganesh,Bharath Hari,Kaviya MP,Kaviya K, Kavya M
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Hari Ganesh,Bharath Hari,Kaviya MP,Kaviya K, Kavya M

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint - 1	Dashboard	USN-6	As a user,I can get notification alert	1	Medium	Hari Ganesh,Bharath Hari,Kaviya MP,Kaviya K, Kavya M
Sprint-3	Testing and Development Phase 1	USN-7	Testing the system performance ,For an emergency case and its deployed	2	High	Hari Ganesh,Bharath Hari,Kaviya MP,Kaviya K, Kavya M
Sprint-3	Linking	USN-8	Link the app with the IBM cloud.	2	High	Hari Ganesh,Bharath Hari,Kaviya MP,Kaviya K, Kavya M
Sprint-4	Implementation	USN-9	Deployment of IOT based industrial specific fire management system . I can see and use the system for 24/7.	2	High	Hari Ganesh,Bharath Hari,Kaviya MP,Kaviya K, Kavya M

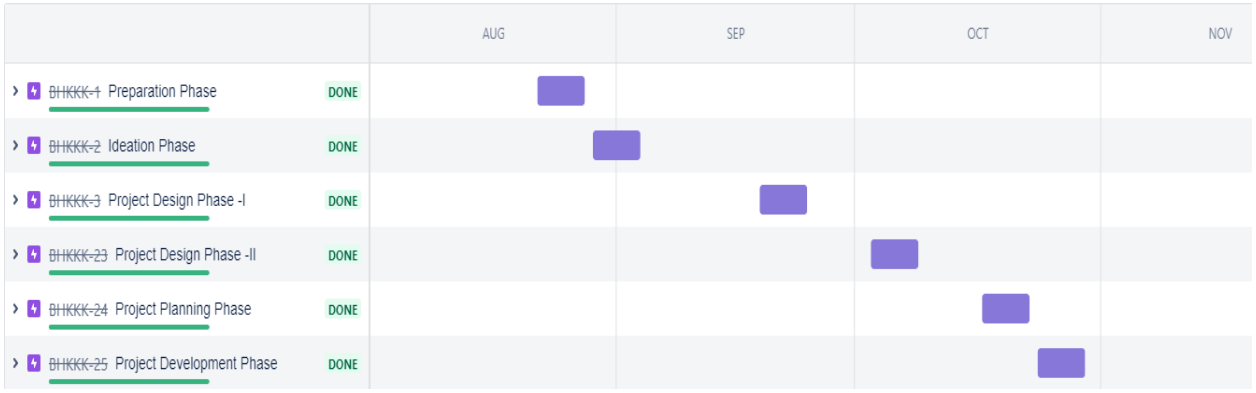
6.2 Sprint Delivery Schedule

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

Velocity:
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)

$$AV = \text{SPRINT DURATION} = \frac{20}{\text{VELOCITY}} = \frac{20}{6} = 3.33$$

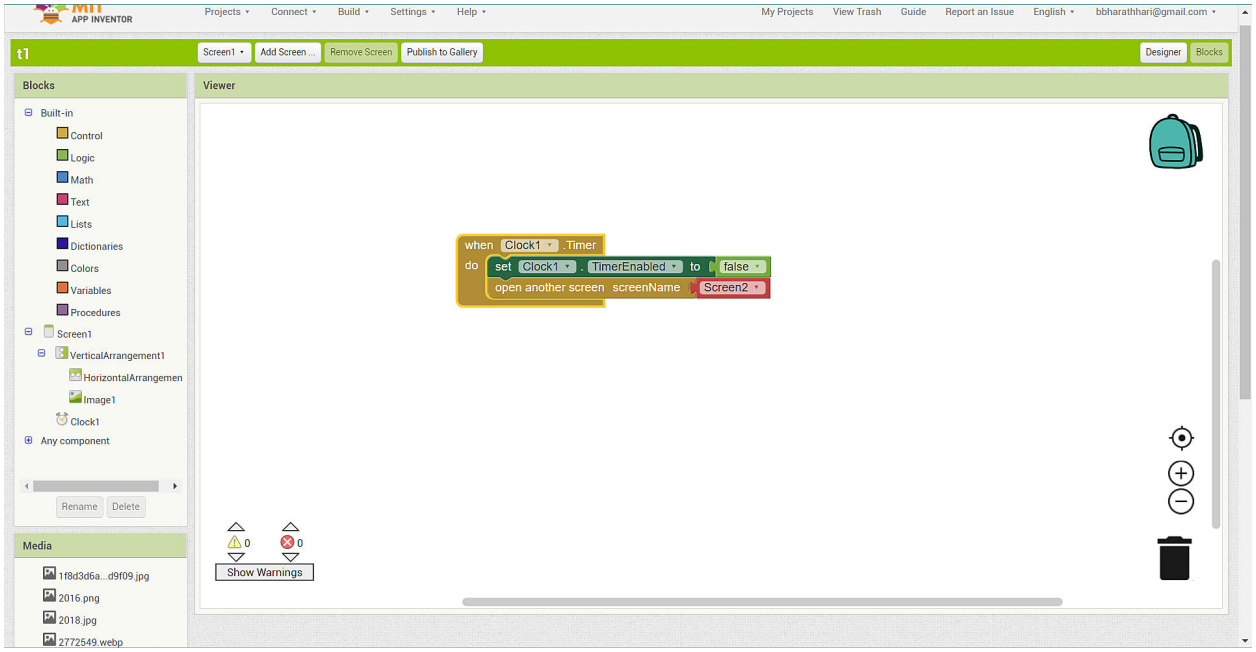
6.3 Reports from JIRA

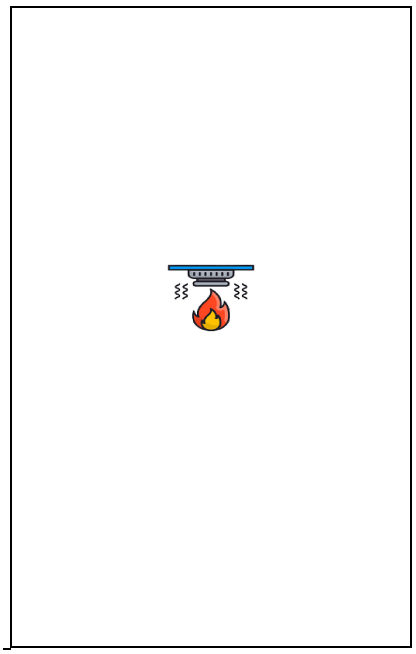


7. CODING & SOLUTIONING (Explain the features added in the project along with code)

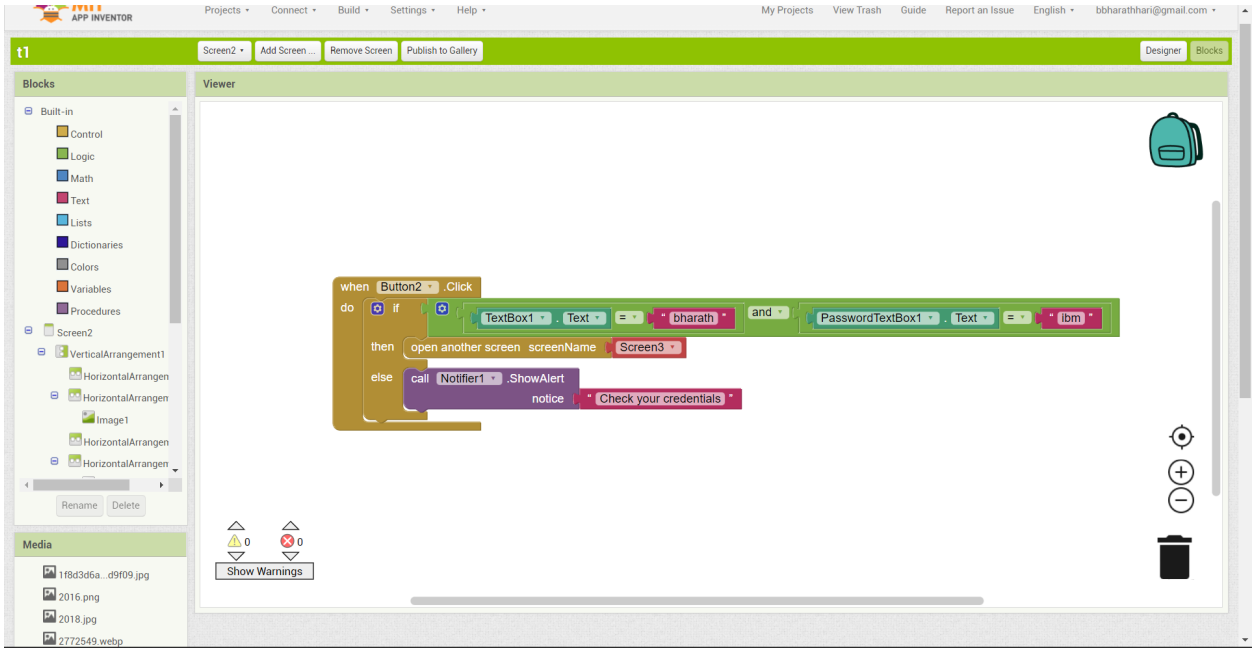
7.1 Feature 1- Web Application Using Node Red

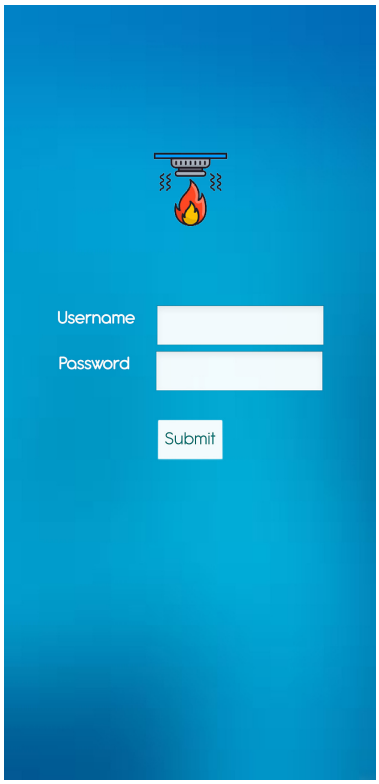
Step 1 : Front Page

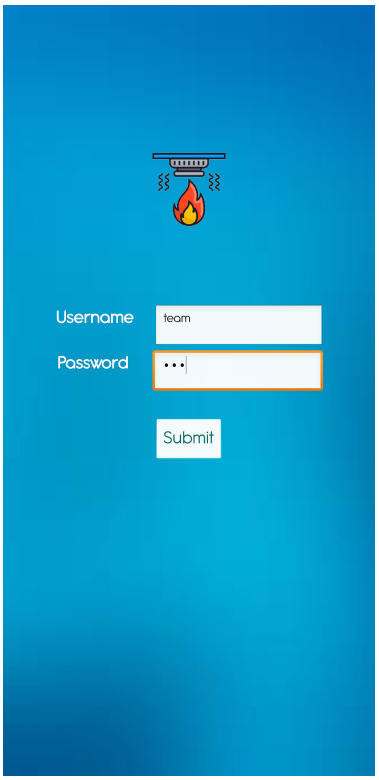




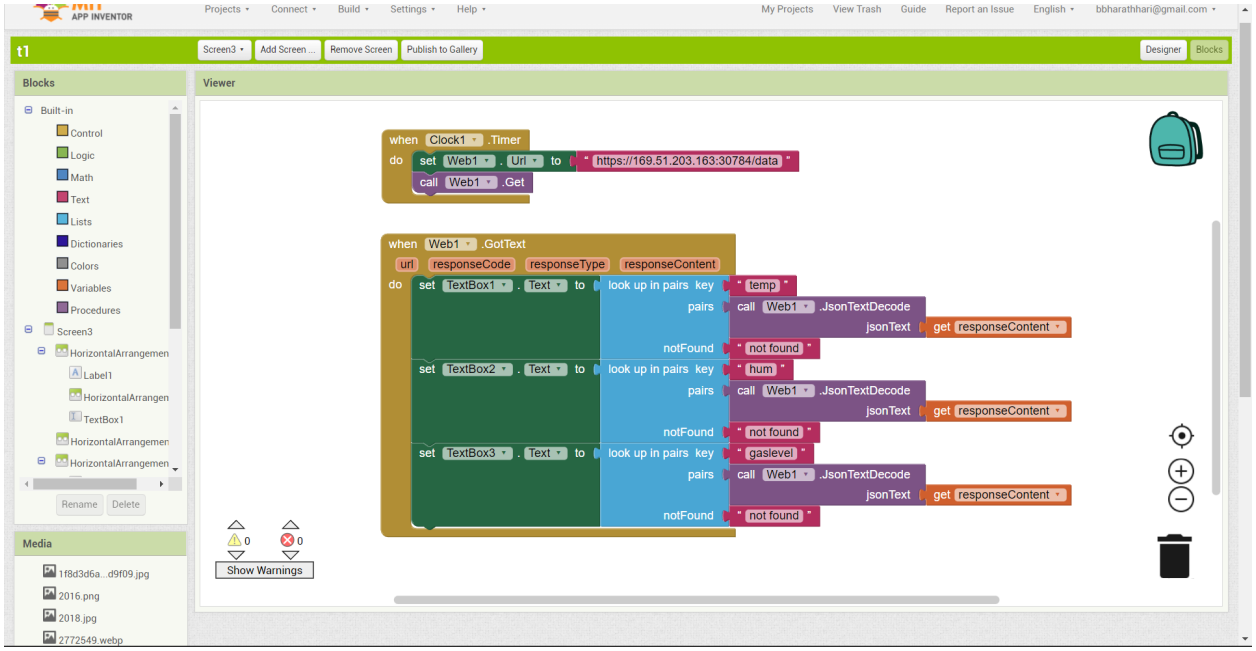
Step 2 : Login Page

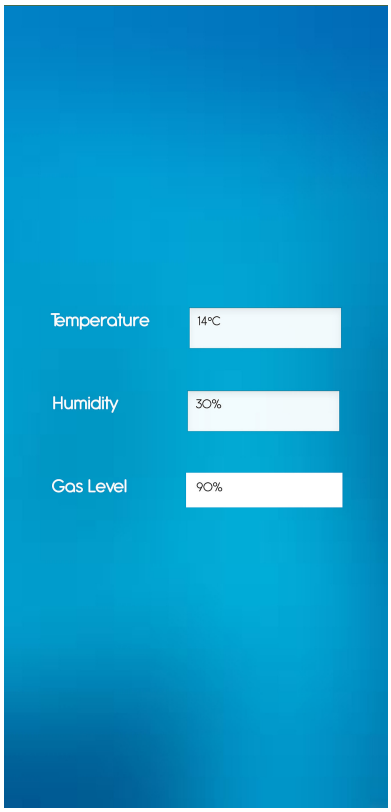


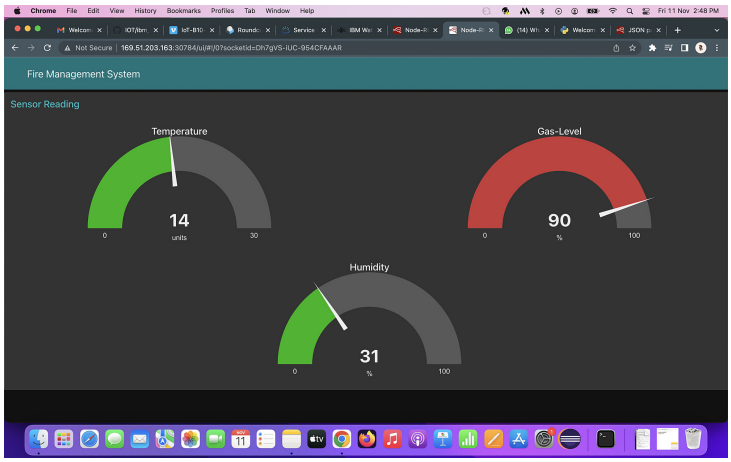




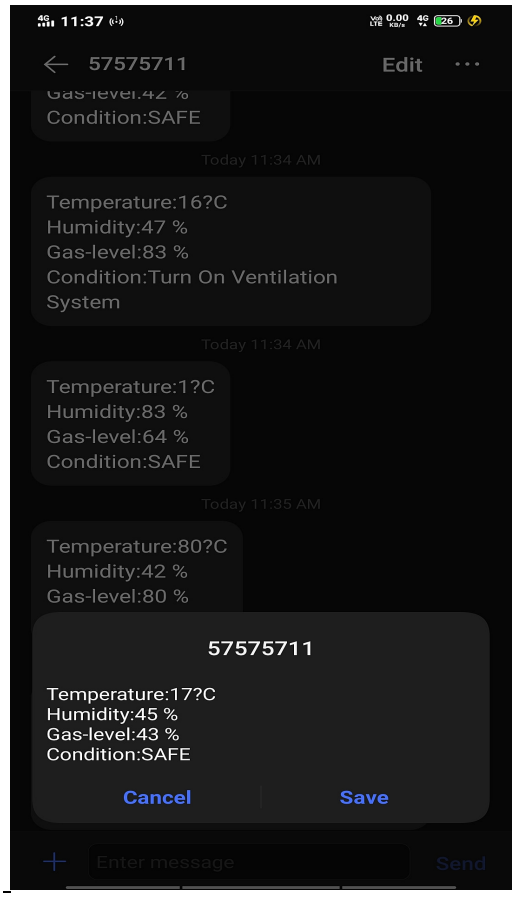
Step 3 : The App and the Node Red Is Connected Using HTTP Request (Json File)



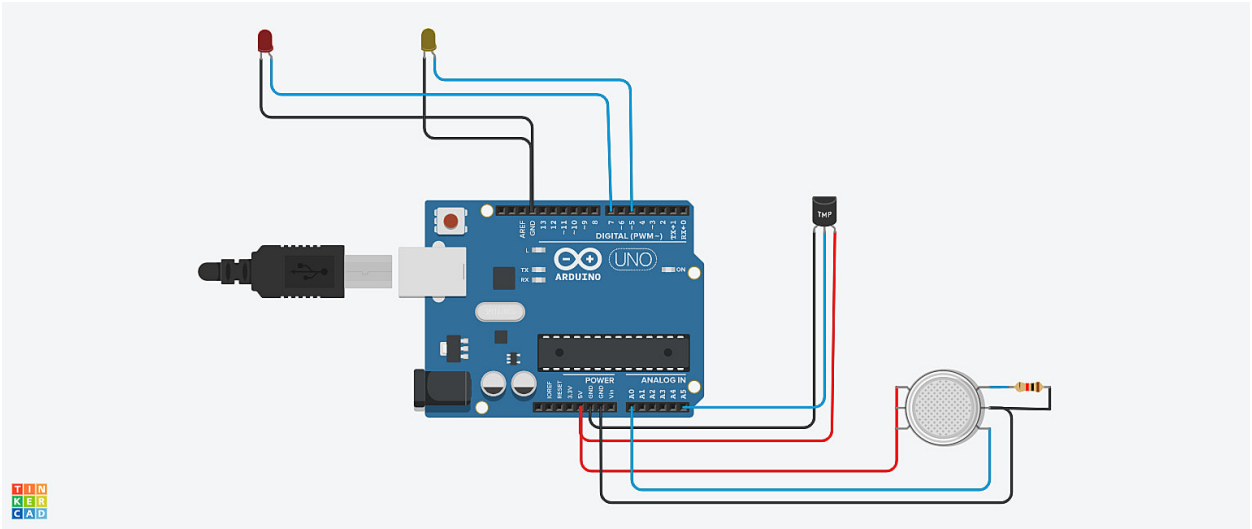




7.2 Feature 2- Sending Message Alerts To The User Via Fast2SMS



7.3 Feature 3- Designing using Tinkercad



8. TESTING

8.1 Test Cases

A test case has components that describe input, action and an expected response, in order to determine if a feature of an application is working correctly. A test case is a set of instructions on “HOW” to validate a particular test objective/target, which when followed will tell us if the expected behavior of the system is satisfied or not.

Characteristics of a good test case:

●Accurate: Exacts the purpose.

●Economical: No unnecessary steps or words.

●Traceable: Capable of being traced to requirements.

●Repeatable: Can be used to perform the test over and over.

●Reusable: Can be reused if necessary.

S.NO	INPUT	Test Scenario	EXPECTED OUTPUT	ACTUAL OUTPUT
1	Python script_TC_OO1	Input to virtual device	Application should show below UI elements: a.email text box b.password text box c.Login button with orange colour d.New customer? Create account link e.Last password? Recovery password link	Working as expected
2	IBM cloud_TC_OO2	Get data from ibm cloud and displays it in UI.	UI format	As expected
3	Node red_TC_OO3	Verify user is able to log into application with InValid credentials	Redirect do application dashboard	As expected
4	Application_TC _OO4	Display the data	Display the output.	As expected
5	Application dashboard_TC_O O4	Send SMS while the code condition is running	Receiving fast sms	As expected

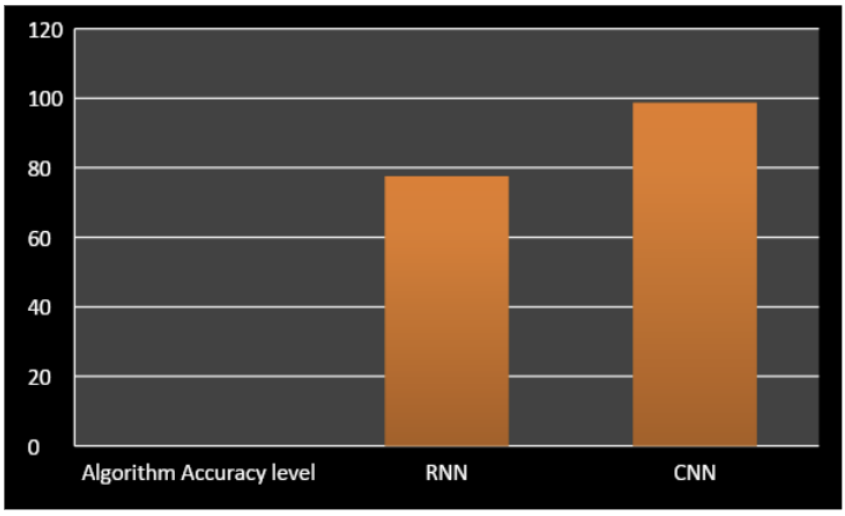
8.2 User Acceptance Testing

—

In this work, we have presented an approach for acceptance testing of UI-equipped IoT systems and evaluated it on a realistic IoT based Industry-Specific Intelligent Fire Management System and composed of local sensors and actuators, a cloud-based system and an Android application. To the best of our knowledge, no other approaches have been proposed for the acceptance testing of IoT systems. Our approach is not focused on only fire detction but also detects the temerature . IT can be applied to all the IoT systems that rely on a UI as a principal way of interaction between the user and the system.

9. RESULTS

9.1 Performance Metrics



10. **ADVANTAGES & DISADVANTAGE**

Advantages of Intelligent Fire Systems in Industries :

- Addressable fire alarm systems give information about individual detectors, whereas conventional systems only give information about specific circuits (zones).
- Addressable systems allow a courtesy text label to allow easy identification of any event. For instance, detector 1 may be given the label ‘Bedroom 1’.
- Most addressable systems allow an early ‘prealarm’ warning, which allows the responsible person to investigate potential alarms before the system activates its sirens.
- Many addressable systems can alter the alarm threshold of the detectors, in order to meet the needs of different environments in different areas of the system.
- Addressable systems are usually wired in a loop.
- Conventional systems are usually wired as radial circuits.
- Addressable systems usually have a real time clock & event log to record system events.
- Larger addressable systems usually have the ability to use sophisticated programming options to operate certain outputs only with specific events

Disadvantages

a. Maintaining the integrity of fire alarm systems in any building, while integrating them building automation systems (BAS) requires more than just communication standards the technology of building automation and control systems has advanced at much faster pace and more rapidly over the past many years

b. In spite of these advances in BAS, due to non-availability of any standard interfacing protocol, fire alarm systems have been finding it difficult to get integrated with BAS

c. There are many concerns in automatic fire detection, of which the most important onesare about different sensor combinations and appropriate techniques for quick and noisetolerant fire detection. Researchers have been studying fires taking place in variousplaces such as residential area

d. This is because these elements are operated in different internal and external environments. Probability distributions with various damage and recovery intensity values must, hence, be taken into account for the FAS operation process and todetermine the R(t) reliability.

e. false alarms, increasing sensitivity and dynamic response, as well as providing protections for highly expensive and complex installations to bettersafeguard the public and meetevolving regulations.

11. CONCLUSION

Thus we came up with an Industry-Specific Intelligent Fire Management System . This system not only analyses the fire presence, but also notifies the concerned people for severe fire chances in case of an emergency or critical situation more efficient, robust and reliable; and reduces false alarms; the proposed system used easily available, lightweight and cost-effective sensors and is more reliable than conventional fire detection systems. This system can be used at the commercial level and results are reproducible. Further advancement in the proposed system can be achieved by researching more into precise and lightweight sensors that provide more accurate signals for analysis. Furthermore, the use of IoT (internet-of-things) can enhance the system by talking with various other devices and smart systems like sending the message to smart gas meters to stop the supply of gas in critical conditions, etc. This system is particularly designed for indoors, as the flame sensor is sensitive to sunlight and, secondly, the reading and training data may differ in open areas, but the minor change in training can overcome this problem.

12. FUTURE SCOPE

In a fire, smoke and deadly gases tend to spread farther and faster than heat, leading to death from inhalation of smoke and toxic gases.The smart smoke detector market will touch USD 1,533 million at an 8.2% CAGR states the recent Market Research Future (MRFR) analysis. Fire alarm and detection systems are arranged such that they cover an entire area and are capable of detecting smoke, heat, or gas leaks. The implementation of stringent regulations regarding fire safety by governments across regions is a key factor driving market growth. Other factors such as increasing smart city projects and rising awareness regarding safety and security are also expected to contribute to the growth of the fire alarm and detection market.

13. APPENDIX

13.1 Source Code :

```
import wiotp.sdk.device
import time
import random
import requests
myConfig = {
    "identity": {
        "orgId": "ewzh7u",
        "typeId": "fire-management",
        "deviceId":"222030"
    },
    "auth": {
        "token": "17171717"
    }
}

def myCommandCallback(cmd):
```

```
17     print("Message received from IBM IoT Platform: %s" %
   cmd.data['command'])
18     m=cmd.data['command']
19
20 client = wiotp.sdk.device.DeviceClient(config=myConfig,
   logHandlers=None)
21 client.connect()
22 count=0
23 while True:
24     temp=random.randint(-40,84)
25     hum=random.randint(0,100)
26     gas=random.randint(0,100)
27
28     if(temp>68 and gas>80):
29
30         myData={'temperature':str(temp)+chr(176)+"C",
   'humidity':str(hum)+" %", 'gaslevel':str(gas)+" %",
   'condition':"Turn On Harzard-Protection System" }
31
32         message='Temperature:'+str(temp)+"
   C"+'\nHumidity:'+str(hum)+" %"+'\nGas-level:'+str(gas)+"
   %"+"\nCondition:Turn On Harzard-Protection System"
33
```

```
34          url =
    "https://www.fast2sms.com/dev/bulkV2?authorization=hdp6viwr
    XqKO43ZSAEG2tNCY8my7LbBWkx1anQgszu0HRD5FPIPRgf7ZDrviQT6d9q1
    NWHXJ2emU5tBI&route=q&message="+message+"&language=unicode&
    flash=1&numbers=8925008868"
35
36          response = requests.request("GET", url)
37
38          print(response.text)
39
40          print("Turn On Harzard-Protection System")
41
42      elif(temp>68 and gas<80):
43
44          myData={'temperature':str(temp)+chr(176)+"C",
    'humidity':str(hum)+" %", 'gaslevel':str(gas)+" %",
    'condition':"Turn On Fire-Protection System" }
45
46          message='Temperature:'+str(temp)+"
    C"+'\nHumidity:'+str(hum)+" %"+'\nGas-level:'+str(gas)+"
    %"+"\nCondition:Turn On Fire-Protection System"
47
48          url =
    "https://www.fast2sms.com/dev/bulkV2?authorization=hdp6viwr
```

```
XqKO43ZSAEG2tNCY8my7LbBWkx1anQgszu0HRD5FPIPRgf7ZDrviQT6d9q1
NWHXJ2emU5tBI&route=q&message="+message+"&language=unicode&
flash=1&numbers=8925008868"

        response = requests.request("GET", url)

        print(response.text)

        print("Turn On Fire-Protection System")

    elif(temp<68 and gas>80):

        myData={'temperature':str(temp)+chr(176)+"C",
'humidity':str(hum)+" %", 'gaslevel':str(gas)+" %",
'condition':"Turn On Ventilation System" }

        message='Temperature:'+str(temp)+"
C"+'\nHumidity:'+str(hum)+" %"+'\nGas-level:'+str(gas)+"
%"+"\nCondition:Turn On Ventilation System"

        url =
"https://www.fast2sms.com/dev/bulkV2?authorization=hdp6viwr
XqKO43ZSAEG2tNCY8my7LbBWkx1anQgszu0HRD5FPIPRgf7ZDrviQT6d9q1
NWHXJ2emU5tBI&route=q&message="+message+"&language=unicode&
```

```
flash=1&numbers=8925008868"

        response = requests.request("GET", url)

        print(response.text)

        print("Turn On Ventilation-Protection System")

    else:

        myData={'temperature':str(temp)+chr(176)+"C",
'humidity':str(hum)+" %", 'gaslevel':str(gas)+" %",
'condition':"SAFE" }

        message='Temperature:'+str(temp)+"
C"+'\nHumidity:'+str(hum)+" %"+'\nGas-level:'+str(gas)+"
%"+"\nCondition:SAFE"

        url =
"https://www.fast2sms.com/dev/bulkV2?authorization=hdp6viwr
XqKO43ZSAEG2tNCY8my7LbBWkx1anQgszu0HRD5FPIPRgf7ZDrviQT6d9q1
NWHXJ2emU5tBI&route=q&message="+message+"&language=unicode&
flash=1&numbers=8925008868"

```

```
78          response = requests.request("GET", url)
79
80          print(response.text)
81
82          print("SAFE")
83
84
85      client.publishEvent(eventId="status", msgFormat="json",
    data=myData, qos=0, onPublish=None)
86      print("Published data Successfully: %s", myData)
87      client.commandCallback = myCommandCallback
88      time.sleep(10)
89
90  client.disconnect()
```

13.2 GitHub Link :

https://github.com/IBM-EPBL/IBM-Project-16718-1659620977

Project Demo Link :

https://drive.google.com/file/d/12sR0v-D5VkeCu_64Chaq5mT7Y2wWKtf8/view?usp=drivesdk