PROJECT REPORT

INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

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1.INTRODUCTION:

1.1.Project Overview:

There are situations where people's lives and livelihoods are disrupted by natural factors, non-natural factors, or human factors that cause deaths, environmental damage, property losses, and psychological impacts [1]. Every fire process always produces smoke and heat, and the temperature will rise when there is a fire [2]. Through combustion, flammable materials chemically react with oxygen to cause fires. A fire will be more likely to ignite with a high oxygen concentration. Historically, fire disasters have been most prevalent in densely populated areas [3]. From January to September 2021, the rescue 1122 fire head station in Punjab, Pakistan, reported 60 fire cases in Lahore, including 22 in the densely populated residential areas of West Lahore [4]. There is a serious need for fire prevention and mitigation in urban areas, especially since fire commonly occurs in urban areas. Statistically, this incident happened in Pakistan due to people's unawareness of fires. There are more deaths, and the owner is experiencing a higher loss rate. A Fire and Rescue Department (FRD) study shows that about two children are burned to death every two weeks. Most of these burns occur at home. There are about 6000 houses destroyed by fires every year [4]. Therefore, a proper solution is required to tackle this problem. In the following system, the communication is established using the GSM module; Arduino UNO

acts as a microcontroller where the coding needs to be uploaded [5]. A SIM card is needed to operate this GSM module [6]. The fire station will receive notifications about the fire.

Furthermore, flame sensors detect fire in a specific spectrum between 760 nm and 100 nm. Among fire's major characteristics is its exponential growth [7]. It is, therefore, critical to detect fires when they are still small to prevent major accidents. It is obvious, therefore, how important it is to have a sophisticated fire alarm and monitoring system. It is possible to detect fire early by monitoring the increase in temperature, smoke, and flame [8].
Consequently, appropriate sensors must be installed at vulnerable places to monitor the physical quantities. Comparison of these values with predefined thresholds generates alarm information sent to a central processor, such as a microcontroller. Additionally, the first part of this paper deals with developing and testing an IoT-based fire alarm navigation system and application. The second part evaluates the response time of a fire incident by fire head stations in Punjab, Pakistan, not using IOT [9, 10]. A survey through a questionnaire was conducted at the factory named "Sheikh of Sialkot" (Sialkot Pakistan) and assessed the data as to what the factory workers and firefighters think about the installation and functioning of an "IOT-based fire alarm navigation system." Lastly, we demonstrate a real-time fire alarm navigation system using IOT technology in a multinational sports goods factory in Sialkot and compare the results with current fire rescue data from Punjab. In this paper, we developed and reviewed the real-time testing on the "IOT-based fire alarm navigation system" with the collaboration of "Rescue 1122 Sialkot, Pakistan" [11]. A survey is conducted through a questionnaire in "Sheikh of Sialkot." We installed the system in the same production unit and compared the results with manual fire alerts.

1.2.Purpose

The aim of a fire protection system is **to protect a building's occupants and minimise the damage associated with fire**. Overall, the goal is to provide the widest possible window for a safe evacuation, whilst also reducing potential repair costs. Fire protection systems can be categorised as either active or passive

2.LITERATURE SURVEY:

2.1.Existing Problem:

Some of the problems related to fire protection in buildings are **problems in law enforcement, lack of automatic systems, poor planning, maintenance, and management of fire safety issues** [8]. Preventing fire incidents in buildings contributes to preserving the functioning and existence of the building itself.

2.2.Reference

[1] 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

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

[3] 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

[4] Azka Ihsan Nurrahman, Kusprasapta Mutijarsa, "Intelligent home management system prototype design and development", International Conference on Information Technology Systems and Innovation (ICITSI), IEEE, 2015

[5]Al Mamari, A. R. M. H., Al Mamari, H., Kazmi, S. I. A., Pandey, J., & Al Hinai, S. (2019). IoT based Smart Parking and Traffic Management System for Middle East College. Paper presented at the 2019 4th MEC International Conference on Big Data and Smart City (ICBDSC).

[6] Ahmed, A.-K., Kazmi, S. I. A., & Pandey, J. (2018). IoT Based Smart Network for Blood Bank. Paper presented at the 2018 7th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO).

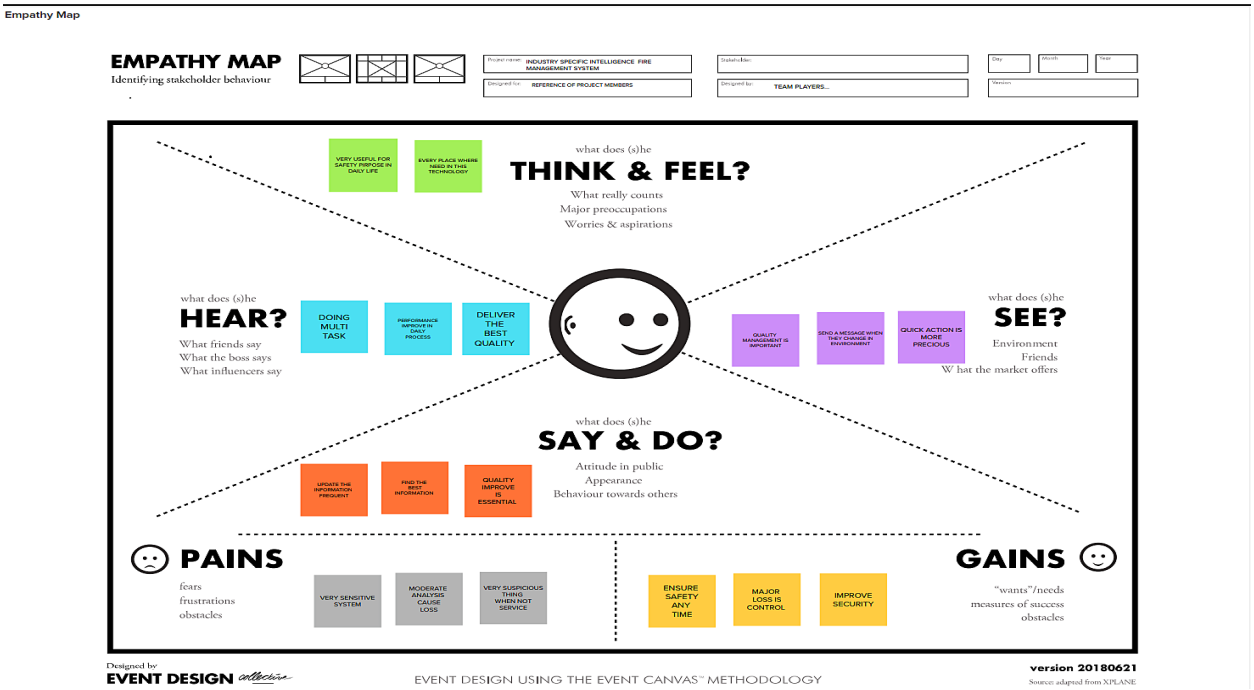
2.3.Problem Statement Defenition

Create a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love. A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Household	Using gas for household and small fluctuation in electrical	Don't know about gas during instant timing	Don't know about gas during instant timing	frustrated
PS-2	Industry	Using high level gases for machine to factory and also electrical cause fluctuation	Don't know gaseous round thousand s of square feet factoryl and electricity Problems	Total of thousand above employers and million cost of things will be losses	indecisive

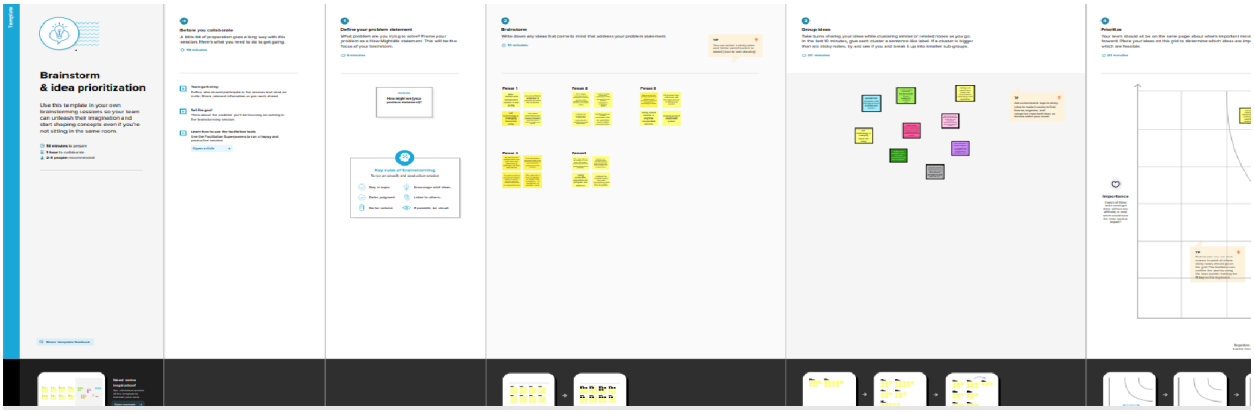
3.IDEATION & PROPOSED SOLUTION:

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

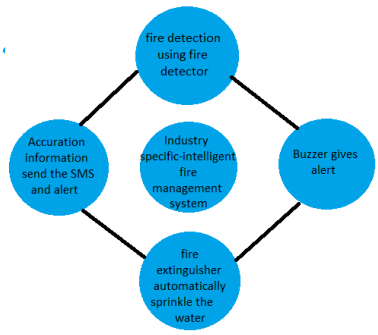
Brainstorming is prepared to convey



the opinion to team members about the project

3.3 Proposed Solution

S.no	Parameter	Description
1	Problem Statement (Problem statement to be solved)	To improve the safety management system in industries.Improving the safety management system against the fire incidents in industries.
2	Idea / Solution description	To implement the fire safety management in industry based on IOT using Arduino uno board with fire detection and fire extinguisher system. And using some sensors (Humidity sensor, Flame sensor, smoke sensor) with GPS tracking system.
3	Novelty / Uniqueness Social	An Integrated system of temperature monitoring, gas monitoring, fire detection automatically fire extinguisher with accuration of information about locations and response through SMS notification and

		call.
4	Impact / Customer Satisfaction	1.It early prevents the accident cost by fire in industries. 2.Nearby locations so maximum extend more accurate reliability 3.Compatability design integrated system.
5	Business Model (Revenue Model)	
6	Scalability of the Solution	This project can be used more efficiently with accurate information requiring. Easy operatability and maintenance. Required low time for maintain Cost is reasonable value

3.4 Problem Solution fit

4. REQUIREMENT ANALYSIS

4.1.Functional requirement

FR No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
1	User Registration	Registration through website or application Registration through Social medias Registration through LinkedIN
2	User Confirmation	Verification via Email or OTP
3	User Login	Login through website or App using the respective username and password
4	User Access	Access the app requirements
5	User Upload	User should be able to upload the data
6	User Solution	Data report should be generated and delivered to

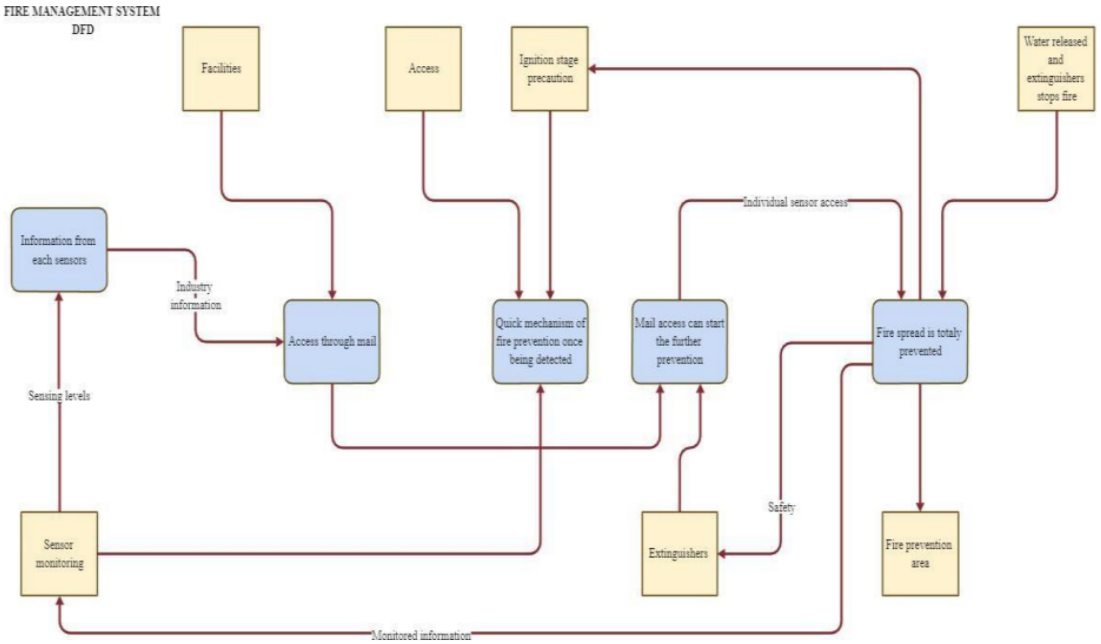
		user for every 24 hours
7	User Data Sync	API interface to increase to invoice system

4.2 Non-Functional requirements

FR No	Non-Functional Requirement	Description
1	Usability	Usability requirements includes language barriers and localization tasks. Usability can be assessed by Efficiency of use
2	Security	Access permissions for the particular system information may only be changed by the system's data administrator.
3	Reliability	The database update process must roll back all related updates when any update fails.
4	Performance	The front-page load time must be no more than 2 seconds for users that access the website using an VoLTE mobile connection.
5	Availability	New module deployment must not impact front page, product pages, and check out pages availability and mustn't take longer than one hour.
6	Scalability	We can increase scalability by adding memory, servers, or disk space. On the other hand, we can compress data, use optimizing algorithms.

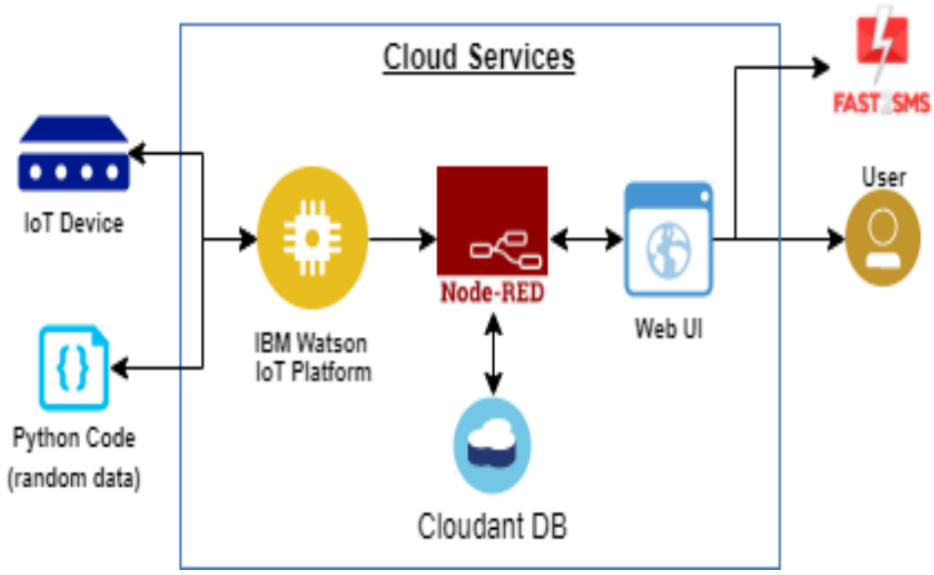
5. PROJECT DESIGN

5.1 Data Flow Diagrams

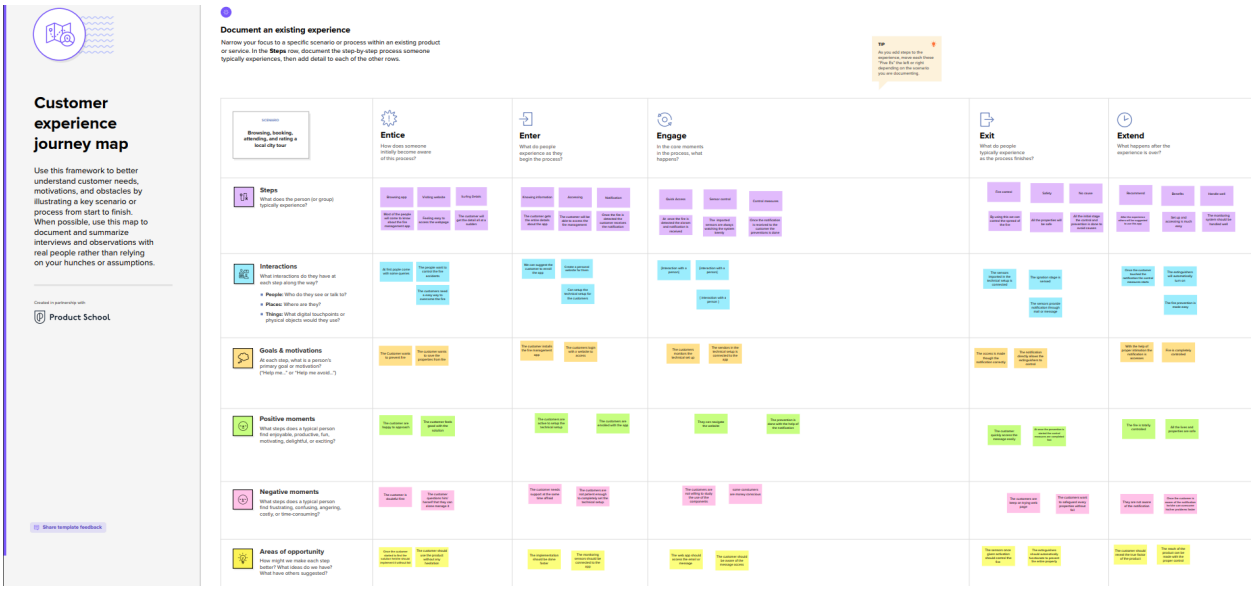


5.2 Solution & Technical Architecture

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2



5.3 User Stories



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	Registration & Login	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	6	high	Dineshkumar Karpaganathan
		USN-2	As a user, I will receive confirmation email once I have registered for the application	7	high	Jayaseelan Kiankishore
		USN-3	As a user, I can log into the application by entering email & password	7	high	Jerryjoeshelton
Sprint-2	Sensor & Actuators	USN-4	In industry, sensor sense the fire and smoke.	10	high	Dineshkumar Jayaseelan
		USN-5	If the sensor detected the fire, next step is extinguishing the fire with the help of Sprinkler.	10	high	Kirankishore Jerryjoeshelton

Sprint-3	Cloud	USN-6	All the values are stored in the cloud database.	20	high	Karpaganathan Dineshkumar
Sprint-4	Siren & Event managem ent	USN-7 USN-8	If the fire is detected, employee should Evacuate by the intimation by Siren/Buzzer. Notification message will be sent to the fire Department, proprietor.	10 10	high high	Dineshkumar Karpaganathan Jayaseelan Kirankisore Jerryjoeshelton

6.2 Sprint Delivery Schedule

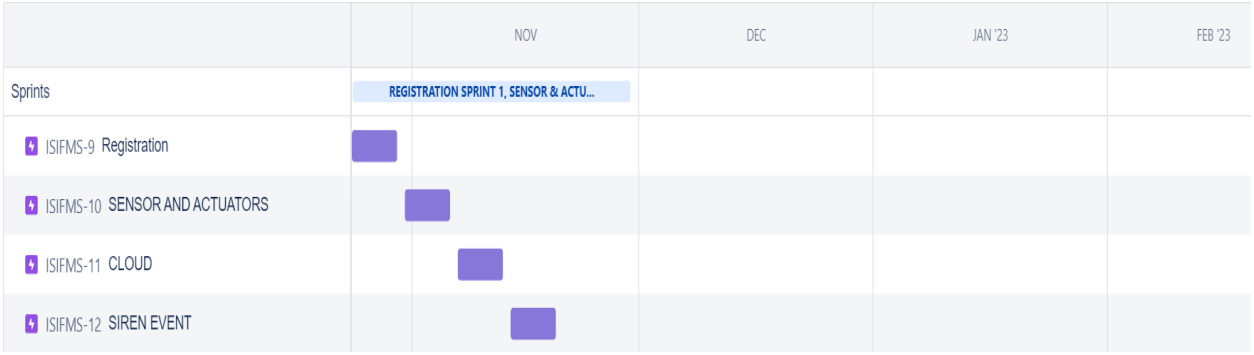
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-1	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-1	20	6 Days	07 Nov 2022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

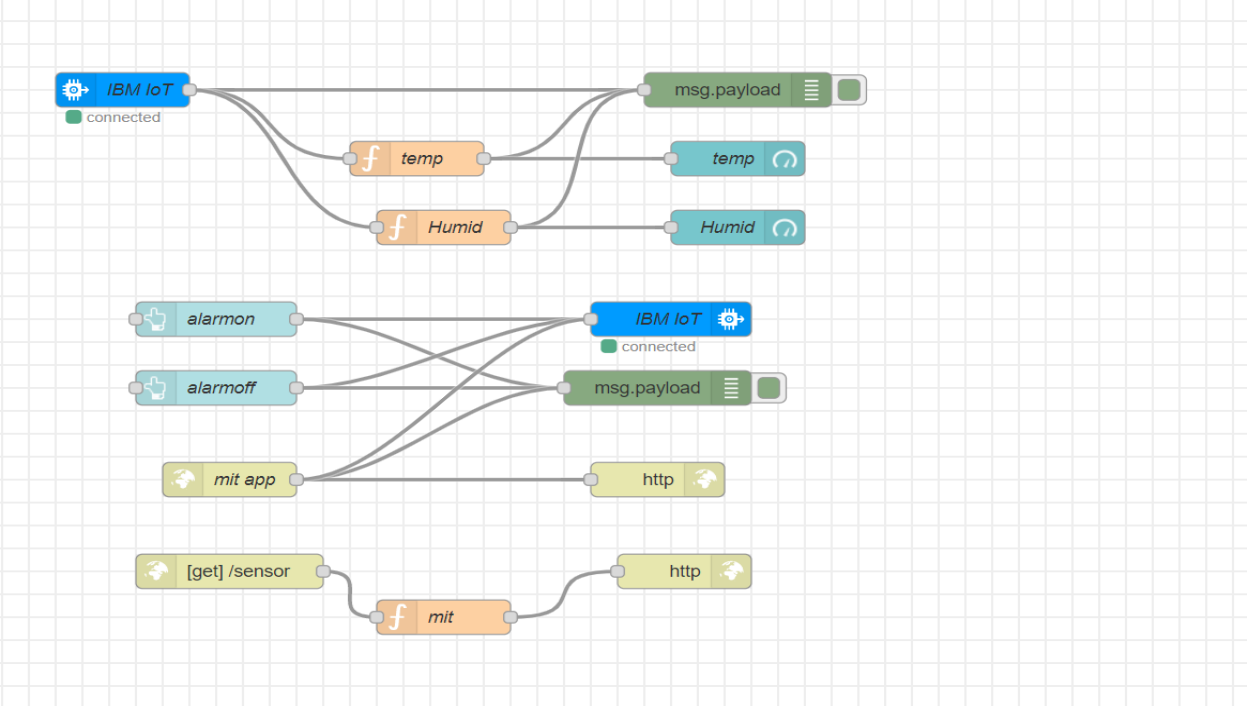
$$AV = \text{sprint duration/velocity} = 20/10 = 2$$

6.3 Reports from JIRA

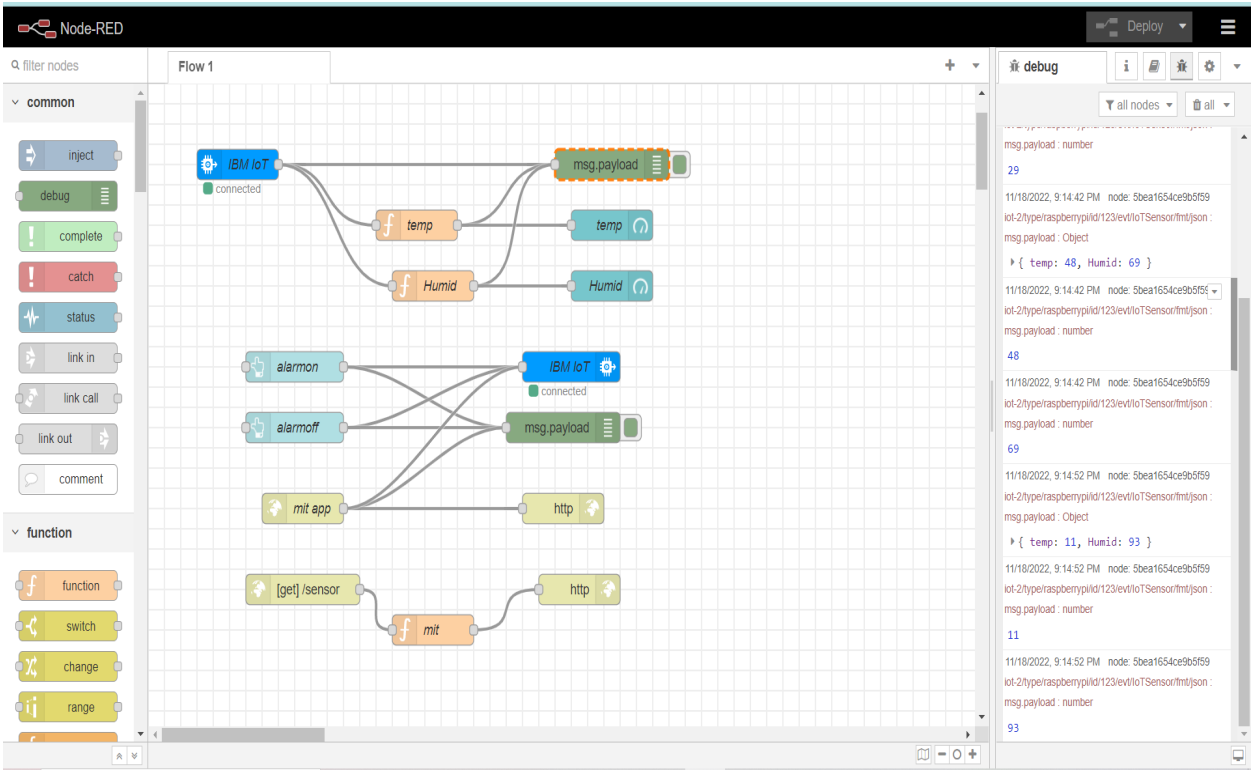


7. CODING & SOLUTIONING

7.1.Node-Red service associated with IBM cloud



output



8. TESTING

8.1 Test Case Analysis

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	15	0	0	15
Client Application	45	0	0	45
Security	1	0	0	1
Outsource Shipping	2	0	0	2
Exception Reporting	10	0	0	10
Final Report Output	4	0	0	4
Version Control	3	0	0	5

8.2 User Acceptance Testing

Testing of app is successfully executed result

Test case id	Feature	Component	Test Scenario	Steps to Execute	Test Data	Actual Result	Status
Login page	Functional	Home page	Verify user is able to see the Given app	1.Download the given APK File 2.Click on download button 3.Verify login popup displayed or not"	APK File	Working as expected	Pass
Login page	Functional	Home page	Verify user is able to see the Login/Signup popup when user open the fire_management	1. Download the given APK File 2.Click on download button 3.Verify login popup displayed or not"	APK File	Working as expected	Pass
Login page	Functional	Home page	Verify the UI elements in Login/Signup popup	1. Download the given APK File 2.Click on download button 3.Verify login popup with below UI elements: A .Username text box A .password text box B	APK File	Working as expected	Pass

				.Submit button			
Login page	Functional	Home page		Verify user is able to log into application with Valid credentials "1 Download the given APK File 2.Click on download button 3.Enter Valid “Given “ Username: karpaganathan Password: NK16 Working as Expected Pass username in Username text box 4.Enter valid password in password text box 5.Click on Submit button"	Username: karpaganathan Password: NK16	Working as expected	Pass
Login page	Functional	Home page	Verify user is able to see the output	output displayed	APK File	Working as expected	Pass

9. RESULTS

9.1 Performance Metrics

Date	17-Nov-22
Team ID	PNT2022TMID32982
Project Name	Industry specific intelligent fire management system

NFT - Risk Assessment

S.No	Scenario Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score
1	Detection accuracy - Response	New	New	Low	Moderate	Moderate	No Changes	Green
2	Temperature and Humidity below threshold limit	New	New	No	NO	low	No Changes	Green

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/SignOff
1	Detection Accuracy and response	Using python and Node Red	Dependency- Cloud client / Risk- Moderate	
2	Temperature and Humidity below threshold limit	Using python and Node Red	Dependency- Cloud client / Risk- Low	
3	User Mobile Application	Using MIT App Inventor	Dependency- Cloud client / Risk- Low	

End Of Test Report

S.No	Project Overview	FT Test approa	NFR - Met	Test Outcome	GO/NO-GO decision	Identified Defects (Detected/Closed/Open)	Approvals/SignOff
1	Detection accuracy - Response	Using Python and NodeRed	yes	Expectaions partially met	No-Go	Observed intermittent performance issue sometimes . Bug is open	
2	Temperature and Humidity below threshold limit	Using Python and NodeRed	Yes	Expectations met	Go	Observed response for the leakage detection in the UI and its accuracy is	

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES

The main advantage and function of a fire alarm system is to **ensure ultimate safety**. They help warn and keep people safe and reduce the amount of destruction to a building. This is probably the major reason as to why a business will install a fire detection system.

In the event that there is an immediate threat to life, property, or mission, the fire alarm system will **sound the alarm, notifying occupants to escape, and letting the authorities know they need to respond**.

DISADVANTAGES

Whilst acknowledging the benefits of heat detectors in helping to reduce false alarms, it must be borne in mind that a major disadvantage of heat detectors is the fact **they rely on heat to actuate**.

When fire alarm panels are in trouble condition, it can be difficult to find the root cause of the problem. Trouble signals occur due to **ground faults, circuit problems, battery faults, or other failures within the system**.

The main drawback with conventional panels is that **one cannot tell which device has been activated within a circuit**. The fire may be in one small room, but as far as emergency responders can tell, a fire could exist anywhere within a zone.

11.CONCLUSION

Hence electronic circuits can be designed for the fire based alarms and they provide very high efficiency and can be used for the security reasons.Early fire detection is best achieved by the installation and maintenance of fire detection equipment in all rooms and areas of the house or building. The various circuits described in the paper can be used.

12.FUTURE SCOPE

Fire detection technologies have been slow to evolve compared to rapidly advancing smart devices. Understandably, global companies focus their efforts on developing high-return products, especially ones that connect consumers with popular trends. While fire alarms aren’t

exactly at the forefront of social advancement, innovative companies are developing new methods of approaching fire and gas-related threats.

Upcoming Technologies
Fortunately for fire device dealers, there are a handful of emerging technologies that will reframe how consumers think about detecting and extinguishing fires.

Sensor-Assisted Fire Fighting
The way firefighters put out fires in a burning building changes once there are smart sensors installed inside. Connected to the internet, these sensors allow firefighters to get a live feed into the progress of the fire, thereby helping them strategize the best way to handle the situation. Using building schematics and rendered computer models from the sensor technology, firefighters are much more prepared to act effectively and safely.

High-Pressure Water Mist
A significant apprehension that consumers have towards commercial fire systems is having a thousand gallons of water spewed all over their electronics. Although water is one of the most effective agents in fighting fires, it can cause a lot of damage to the buildings, often rendering it unusable after it has done its job. High-pressure mist effectively blocks radiant heat and oxygen from reaching the fire, effectively isolating problem areas while protecting others.

Drones
Teams in the USA and even Australia are deploying drones that help firefighters identify hotspots by sending them real-time data, including images and video. Other drone models are used to provide aerial vision, among other things, to those directing the firefighting process. Providing unique insight to those who would typically require expensive helicopters to do the same work. Better yet, more advanced, and expensive, drones are being developed to fly up to 900 feet to spray water that would be typically unreachable by truck-mounted ladders.

Fireballs
Although their name suggests the opposite of what they do, fireballs actually take the place of a traditional fire extinguisher, covering more space and doing it much faster. If you don't believe it, you should check out the video in the link. Created by a company called Elide, the fireball can even fight fires when a user cannot be present to use it. As their website states, "When a fire occurs and no one is present, Fire Extinguishing Ball will self-activate when it comes into contact with fire and give a loud noise as a fire alarm. Because of this feature, it can be placed in a fire prone area such as near an electrical circuit breaker or in a kitchen."

Wireless Devices
Perhaps most applicable to dealers looking to grow their RMR, wireless devices provide mobile capabilities to homeowners looking to install themselves, or even to take with them when relocating. According to firesystemsltd.co.uk, "Some of the systems on the market are using

mesh network for the first time in wireless fire detection technology. The detectors are connected to each other and are using different frequencies on different bandwidths.” For those who look for something truly reliable in any situation, many devices can be connected in wired and non-wired formats. This dual connectivity provides unprecedented coverage and ultimate reliability. Yet, for buildings that are difficult to wire, or consumers who want something simple, wire-free systems will take the market by storm.

13. APPENDIX

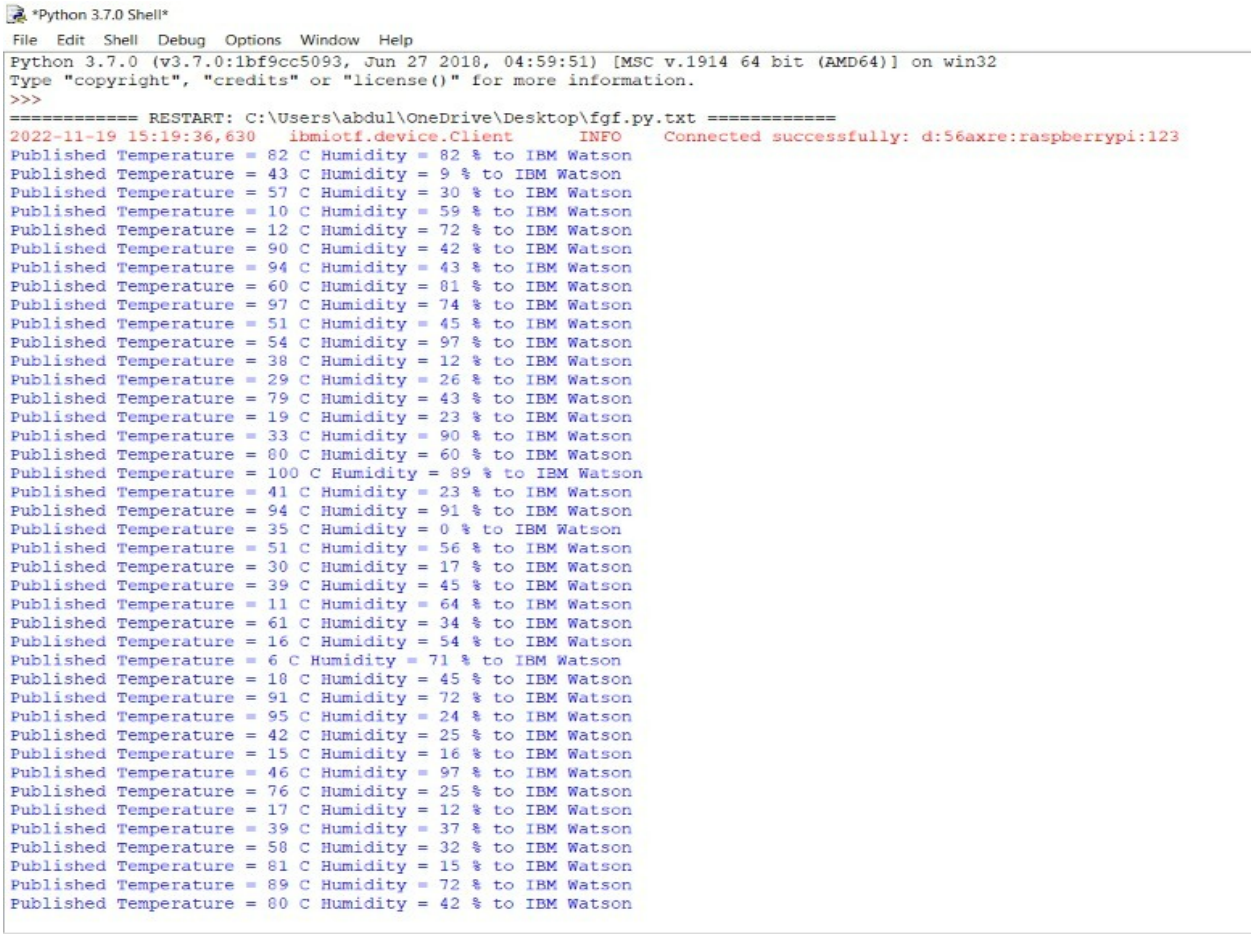
13.1.Source code

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random


#Provide your IBM Watson Device Credentials
organization = "56axre"
deviceType = "raspberrypi"
deviceId = "123"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO


def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="alarmon":
```

```
        print ("Alarm is on")
    else:
        print ("Alarm is off")

    #print(cmd)




try:
    deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-
method": authMethod, "auth-token": authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)
                                            #.....................................

except Exception as e:
    print("Caught exception connecting device: %s" % str(e))
    sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event of
type "greeting" 10 times
deviceCli.connect()

while True:
        #Get Sensor Data from DHT11

    temp=random.randint(0,100)
    Humid=random.randint(0,100)

    data = { 'temp' : temp, 'Humid': Humid }
        #print data
    def myOnPublishCallback():
        print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "to
IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
```

```
on_publish=myOnPublishCallback)
        if notsuccess:
            print("Not connected to IoTF")
            time.sleep(10)

        deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

OUTPUT:



GitHub : https://github.com/IBM-EPBL/IBM-Project-41257-1660640664

Project Demo Link : https://youtu.be/m6WhKs2MfCA