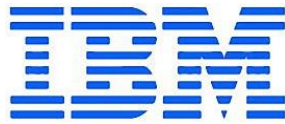




Anna University Regional Campus, Madurai

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executed by



Industry-specific intelligent fire management system

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1.

INTRODUCTION

1.1 Project Overview

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

1.2 Purpose

The purpose of the system is :

- To prevent life losses , assests damage and uncontrollable spread of fire.
- To ensure the safety of workers and alert the manager and fire department.
- To not to recklessly endanger the life of the fire workers. This can be done by taking the control measures automatically.

2.

LITERATURE SURVEY

2.1 Existing problem

The existing problems of the system are:

- Cost of ownership : The fire management system should be cost effective. In average, the fire management is expected to last 10 years. The biggest problem is when the system cannot be maintained any longer due to component non-availability or due to being unsupported by the manufacturer.
- Structural changes : The structure of the hospital changes over time. The fire management system should be easily able to upgrade and adaptable to the changing structure.
- Evacuation and fire strategy : The alert and the control measures are taken immediately, so that the building can be completely evacuated.
- System performance changes within specific environments : The industry will have unique or specified condition at some time. The major problem caused is the false fire alarm.

2.2 References

[1] Gazi weldesyase, Bahta G/meskel, Mekonen Abreha, Solomon Baynes, "GSM Based Fire and Smoke Detection and Prevention System", on 08/10/2010, Adigrat, Tigray, Ethiopia.

[2] May Zaw Tun, Htay Myint, "Arduino based Fire Detection and Alarm System Using Smoke Sensor", Volume 6, Issue 4, on April – 2020, Myanmar.

[3] Nitin Galugade, Mahesh Jakka, Devika Nair, Madhur Gawas, "Fire Monitoring and Controlling System based on Iot", 2020, Mumbai, India.

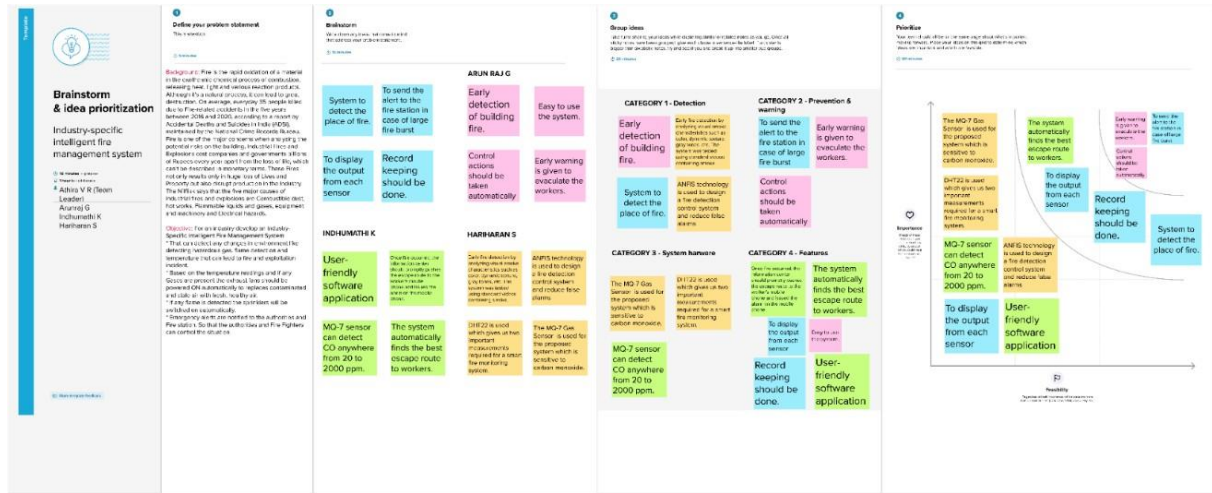
2.3 Problem Statement Definition

Background: Fire is the rapid oxidation of a material in the exothermic chemical process of combustion, releasing heat, light and various reaction products. Although it's a natural process, it can lead to great destruction. On average, everyday 35 people killed due to Fire-related accidents in the five years between 2016 and 2020, according to a report by Accidental Deaths and Suicides in India (ADSI), maintained by the National Crime Records Bureau. Fire is one of the major concerns when analyzing the potential risks on the building. Industrial Fires and Explosions cost companies and governments billions of Rupees every year apart from the loss of life, which can't be described in monetary terms. These Fires not only result only in huge loss of Lives and Property but also disrupt production in the Industry. The Nilfisk says that the five major causes of industrial fires and explosions are Combustible dust, hot works, Flammable liquids and gasses, equipment and machinery and Electrical hazards.

Objective: The objective of this Industry-Specific Intelligent Fire Management System is to detect any changes in environment like detecting hazardous gas, flame detection and temperature that can lead to fire and exploitation incident. Based on the temperature readings and if any Gasses are present the exhaust fans should be powered ON automatically to replace contaminated and stale air with fresh, healthy air. If any flame is detected the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and Fire station. So that the authorities and Fire Fighters can control the situation.



3.2 Ideation & Brainstorming



3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	this system can perform different parameter measurements early detection of building fires
2.	Idea / Solution description	This fire alarm system incorporates the heat and flame detector that are connected in parallel. The microcontroller is used as the heart of this fire alarm system that controls the entire operation involved . The fire alarm system is capable to locate and identified the place that is in fire where by its monitored using the monitoring system.
3.	Novelty / Uniqueness	In this paper, the installed Arduino device which was programmed with Android Studio receives gas smoke ,the temperature and humidity signal from the sensors . The sensor is connected to the input of the arduino with the help of connecting the cables or jumper cables . Further the circuit goes toward output where the buzzer is connected. If we differ the value of the buzzer then we get a variation in the buzzer sound.
4.	Social Impact / Customer Satisfaction	This product has huge social impact as presentation of the industry workers from fire related accidents. Prevention of the industry fire accident can also increases the industrial financial status
5.	Business Model (Revenue Model)	This product can be utilized by a industries .This can be thought of as a productive and helpful item as industries great many current rescuing people and machine from the fire accident
6.	Scalability of the Solution	It is trying to execute this technique as we need to introduce an arduino gadget which was modified with an arduino studio that takes received signals from sensors . This recognizes the fire from each area in turn assuming there is fire in other area the framework can not distinguish . So this item will be introduced in each required area independently.

3.4 Problem Solution fit

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS <ul style="list-style-type: none"> Factory/Industry managers or owners Entrepreneur Universities/ School management Government 	6. CUSTOMER CONSTRAINTS CC <ul style="list-style-type: none"> Less-efficiency fire management systems Budget Less knowledge on the availability of fire management system. Inexperienced staffs for handling these systems 	5. AVAILABLE SOLUTIONS AS <ul style="list-style-type: none"> Immediate dialing of fire service and fire extinguisher are the available solution when the customer face the problem in the past Pros of the existing solution is they get to operate powerful equipment which can easily stop the fire, maintains safety. The cons are the firefighters safety they undergo high risk, time delay and cannot predict the outbreak of fire. 	Explore AS, differentiate
	Focus on J&P, fit into BE, understand RC	2. JOBS-TO-BE-DONE / PROBLEMS J&P <p>Unavailability of access for fire officers and poor inconsistencies fire can't be controlled. Fires not only results only in huge loss of Lives and Property but also disrupt production in the Industry, so in this project early fire detection, automatic actions are taken immediately without risking anyone's life.</p>	9. PROBLEM ROOT CAUSE RC <p>Industries have a lot of flammable material, exposed wiring, overloaded outlets, overloaded circuits, static discharge etc. This can cause the outbreak of fire. Because of these problem, there will be huge loss of lives and property.</p>	7. BEHAVIOUR BE <p>Find the system that can do early detection of fire, automatically takes control actions when fire occurs, alerts the managers.</p>

	3. TRIGGERS TR <p>The loss of lives, damages to the property, disrupts production in the industry</p>	10. YOUR SOLUTION SL <p>This system gives an early warning of a developing or unexpected emergency situation when smoke or fire is detected. This permits a safe and speedy evacuation of the premises and helps to protect all workers. Then it takes automatic control measures based on the temperature readings and if any gasses are present the exhaust fans are powered ON, if any flame is detected the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and Fire station.</p>	8. CHANNELS of BEHAVIOUR CH <p>8.1 ONLINE</p> <p>The managers or staff can continuously monitor the reading like temperature, gas, flame level and can record these data.</p> <p>8.2 OFFLINE</p> <p>In offline, in case of fire, evacuation of workers, providing the best escape route can be taken.</p>
	4. EMOTIONS: BEFORE / AFTER EM <ul style="list-style-type: none"> Injury or Death : A fire in an industry that results in injury or death will have huge consequences on the business owner or manager responsible for the safety of their employees and, or customers, the family of anyone who is injured or dies and the businesses ability to trade and their reputation. Fire Insurance Claims : If a fire breaks out in a industry and the Fire Safety Legislation and recommendations have not been followed then this can and are likely to invalidate a businesses insurance. Cost : If an insurance claim is invalidated then the cost of the repairs to the property and claims can be huge. Operation : A fire can have serious consequences on an industry's ability to continue to operate at all or operate efficiently. Running any production is difficult and fire can result in you losing customers as they will go elsewhere and may never come back, as well as creating a reputation for not being able to deliver against legally binding contracts. 		

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User visibility	Emergency alerts via Fast SMS.
FR-2	User reception	The data like amount of gas levels, smoke content and temperature are received via SMS.
FR-3	User Understanding	Based on the data, the user understands that if any of the data is above the threshold value, then there is a fire burst.
FR-4	User action	In case of fire bursts, the user needs to take actions like find the best escape route, evacuate the workers and take necessary actions to control the fire.

4.2 Non-functional Requirements:

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

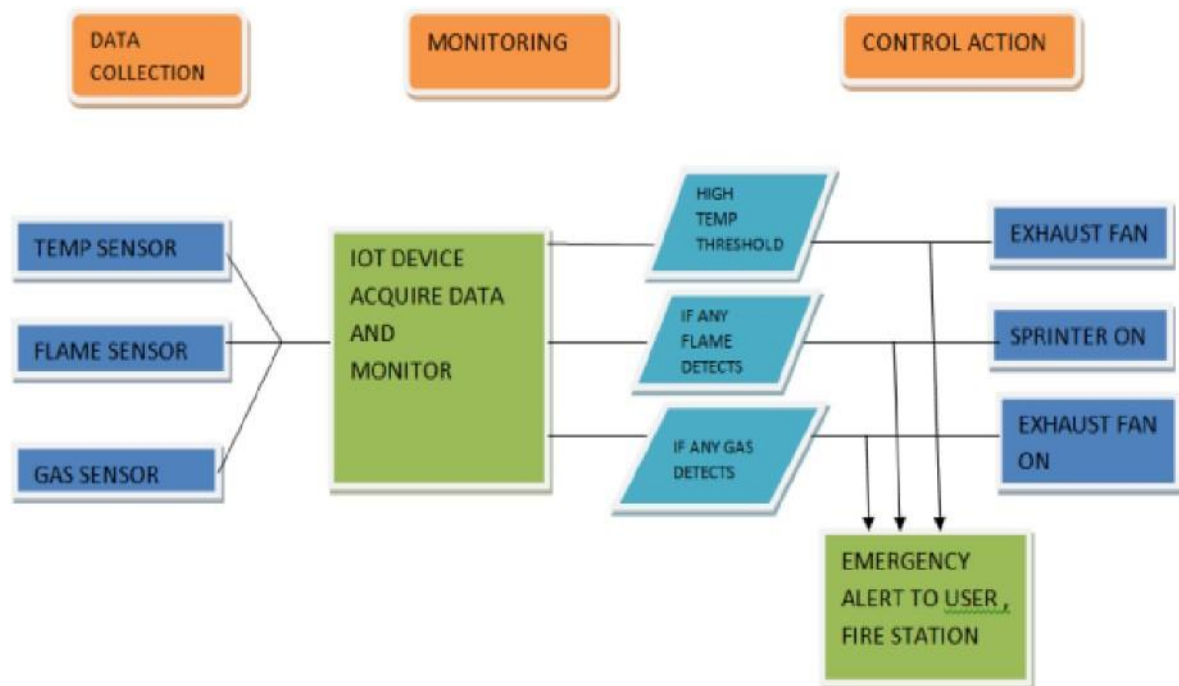
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	It ought to have the option to caution inhabitants of the structure the utilization of every perceptible and apparent alert.
NFR-2	Security	It ought to be utilized to guarantee the insurance of both important properties, as well as human existence.
NFR-3	Reliability	It might have a capacity to recognize the smoke accurately and doesn't give a false caution or signal.

NFR-4	Performance	It ought to have Programmed fire sprinklers combined with identification which distinguishes the flames, yet in addition smother the flames in the underlying stage itself.
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NFR-5	Availability	It could be accessible for day in and day out hours so it tends to be useful for individuals.
NFR-6	Scalability	The sensors and boards utilized in this framework ought to have the option to effortlessly change overhaul concurring to change and need in requirements

5 PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture

Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered

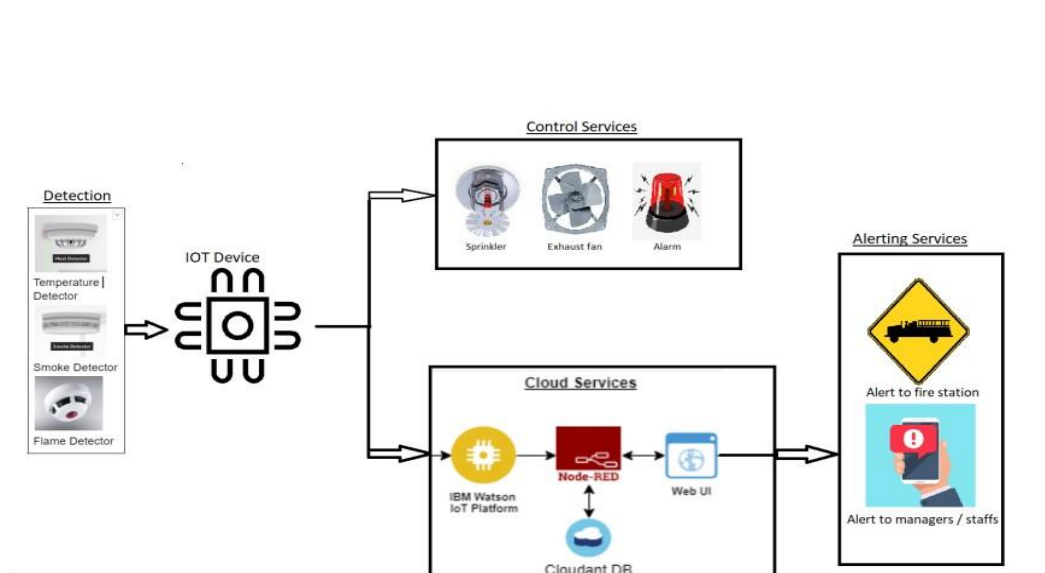


Fig. Solution Architecture of Industry-Specific Intelligent Fire Management System

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	As a user, I can download the application	I can view the data sent by the hardware.	High	Sprint-3
Customer (Web user)	Registration	USN-1	As a user, I can view the application web page	I can view the data sent by the hardware.	High	Sprint-3
Customer (Data types)	Data viewing	USN-1	As a user, I can view Temperature readings	Data by the hardware	High	Sprint-1
		USN-2	As a user, I can view level of gas content	Data by the hardware	High	Sprint-1
		USN-3	As a user, I can view if any flame is detected	Data by the hardware	High	Sprint-1
Customer	Actions	USN-1	As a user, I will have exhaust fan on and off button	Based on temperature and level of gas content data, actions are taken by the user	Medium	Sprint-2
		USN-2	As a user, I will have sprinkler on and off button	Based on the flame detected data, actions are taken by the user.	Medium	Sprint-2
Administrator	Storage	USN-1	As an administrator, I will store the data in Cloud database	All the data are stored in cloud database.	High	Sprint-4

6.

PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1		US-1	Create the IBM Cloud services which are being used in this project.	6	High	I S.Bhumika I K.janani I E.keerthana
Sprint-1		US-2	Configure the IBM Cloud services which are being used in completing this project.	4	Medium	I S.bhumika I A.B.Saritha I E.keerthana
Sprint-1		US-3	IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices, so create the IBM Watson IoT platform.	5	Medium	I S.Bhumika I E.keerthana I K.janani
Sprint-1		US-4	In order to connect the IoT device to the IBM cloud, create a device in the IBM Watson IoT platform and get the device credentials	5	High	I K.Janani I A.B.Saritha I E.keerthana
Sprint-2		US-1	Configure the connection security and create API keys that are used in the Node-RED service for accessing the IBM IoT Platform.	10	High	I s.bhumika I E.keerthana I K.janani
Sprint-2		US-2	Create a Node-RED service.	10	High	I S.Bhumika I K.janani I E.keerthana
Sprint-3		US-1	Develop a python script to publish random sensor data such as temperature, Flame level and Gas level to the IBM IoT platform	7	High	I S.bhumika I k.janani I A.B.saritha I E.Keerthana

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3		US-2	After developing python code, commands are received just print the statements which represent the control of the devices.	5	Medium	I n.s.bhumika I A.B.saritha I K.janani I E.keerthana
Sprint-3		US-3	Publish Data To The IBM Cloud	8	High	I n.s.bhumika I k.janani I E.keerthana
Sprint-4		US-1	Create Web UI in Node- Red	10	High	I n.s.bhumika I k.janani I A.B.saritha
Sprint-4		US-2	Configure the Node-RED flow to receive data from the IBM IoT platform and also use Cloudant DB nodes to store the received sensor data in the cloudant DB	10	High	I n.s.bhumika I k.janani I E.keerthana I A.B.saritha

6.2 Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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

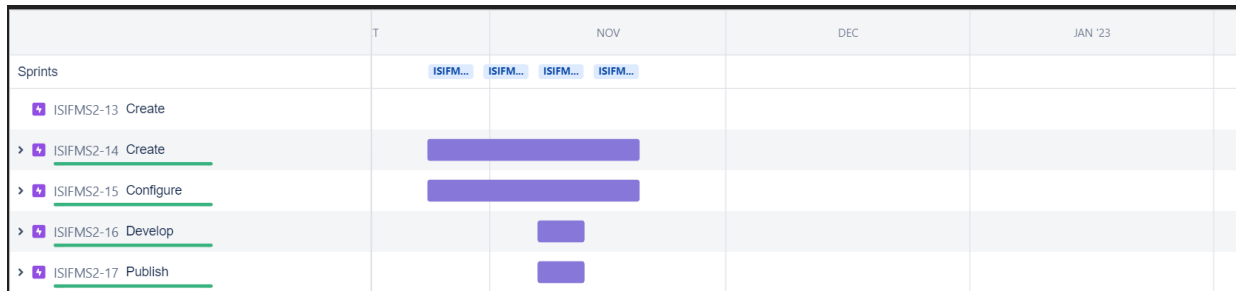
Project Tracker, Velocity & Burndown Chart: (4 Marks)

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)

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

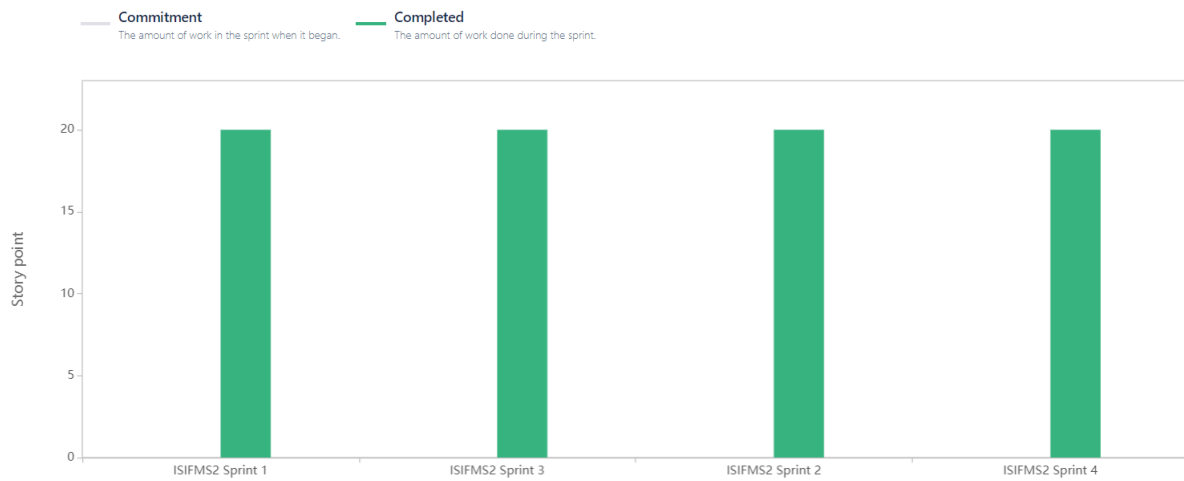
6.3 Reports from JIRA



<https://pnt2022tmid47460.atlassian.net/jira/software/projects/ISIFMS2/boards/2/roadmap>

Velocity report

[How to read this rep](#)



7. CODING & SOLUTIONING

7.1 Feature 1

Python script for generating the random sensor values - Temperature, Flame Level and Gas Level to the IBM Watson IoT Platform.

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

#Provide your IBM Watson Device Credentials

organization = "4aqwut"
deviceType = "12345678dt"
deviceId = "12345678did"
authMethod = "token"
authToken = "**PrtsGAO?B@_tTPEKT"

# Initialize GPIO

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="sprinkleron":
        print ("Sprinkler is on")
    elif status == "sprinkleroff":
        print ("Sprinkler is off")
    elif status == "exhaustfanon":
        print ("Exhaust Fan ON")
    elif status == "exhaustfanoff":
        print ("Exhaust Fan 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)
    flame_level=random.randint(0,100)
    gas_level = random.randint(0,100)

    data = { 'Temperature' : temp, 'Flame_Level' : flame_level, 'Gas_Level' : gas_level }

    #print data

    def myOnPublishCallback():
        print ("Published Temperature = %s C" % temp, "Flame_Level = %s %" % flame_level,
"Gas_Level = %s %" % gas_level ,"to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoT")
            time.sleep(1)

    deviceCli.commandCallback = myCommandCallback

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

```

7.2 Feature 2

Output :

Published Temperature = 3 C Flame_Level = 88 % Gas_Level = 30 % to IBM Watson
Published Temperature = 22 C Flame_Level = 51 % Gas_Level = 16 % to IBM Watson
Published Temperature = 80 C Flame_Level = 32 % Gas_Level = 88 % to IBM Watson
Published Temperature = 98 C Flame_Level = 81 % Gas_Level = 34 % to IBM Watson
Command received: sprinkleroff
Sprinkler is off
Command received: exhaustfanoff
Exhaust Fan OFF
Command received: sprinkleron
Sprinkler is on
Published Temperature = 93 C Flame_Level = 77 % Gas_Level = 43 % to IBM Watson
Command received: exhaustfanon
Exhaust Fan ON
Published Temperature = 18 C Flame_Level = 37 % Gas_Level = 88 % to IBM Watson
Published Temperature = 61 C Flame_Level = 53 % Gas_Level = 65 % to IBM Watson
Published Temperature = 95 C Flame_Level = 76 % Gas_Level = 90 % to IBM Watson
Published Temperature = 56 C Flame_Level = 14 % Gas_Level = 27 % to IBM Watson
Published Temperature = 34 C Flame_Level = 33 % Gas_Level = 51 % to IBM Watson
Published Temperature = 9 C Flame_Level = 56 % Gas_Level = 80 % to IBM Watson
Published Temperature = 42 C Flame_Level = 51 % Gas_Level = 18 % to IBM Watson

8.1 Test Cases

[illegible]

8.2 User Acceptance Testing

Purpose of Document : The purpose of this document is to briefly explain the test coverage and open issues of the Industry-specific intelligent fire management system project at the time of the release to User Acceptance Testing (UAT).

Defect Analysis :

Section	Total Cases	Not Tested	Fail	Pass
Print the Sensor values	7	0	0	7
Client Mobile Application	51	0	0	51
Security	2	0	0	2

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	0	0	1	8
Totals	24	14	13	26	70

Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4

9. RESULTS

9.1 Performance Metrics

NFT - Risk Assessment									
S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volumen Changes	Risk Score	Justification
1	Receiving sensor va	Existing	Moderate	No Changes	Moderate	No	>5 to 10%	ORANGE	As we have seen the changes
2	Sprinkler ON/OFF	Existing	Low	No Changes	Low	No	>5 to 10%	GREEN	As we have seen the changes
3	Exhaust Fan ON/OFF	Existing	Low	No Changes	Low	No	>5 to 10%	GREEN	As we have seen the changes
4	Fast SMS	New	Low	No Changes	No Changes	No	>5 to 10%	GREEN	As we have seen the changes
5	Cloudant DataBase	New	No Changes	No Changes	No Changes	No	>5 to 10%	GREEN	As we have seen the changes

NFT - Detailed Test Plan				
S.No	Project Overview	NFT Test approach	sumptions/Dependencies/R	Approvals/SignOff
1	Python 3.7.0	Developing Python Sor	Depends on the code	https://www.python.org/pst/sponsors/#heroku
2	IBM Watson IoT Platform	Creating and configuri	Depends on the Device Cred	https://4aqwut.internetofthings.ibmcloud.com/dashboard/
3	Node-Red	Creating Web-UI	Depends on the sensor valu	https://nodered.org/
4	MIT App Devoloper	Developing Mobile ap	Depends on the Sensor valu	https://appinventor.mit.edu/about/termsofservice
5	Cloudant DB	Storing Sensor values	Depends on the Sensor valu	https://2587b83c-debe-4618-8ea6-c3bd681110b4-bluemix.cloudant.com/dashboard.html

End Of Test Report					
S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	Identified Defects (Detected/Closed/Open)
1	Same sensor and te	This is done by devel Met	Pass	GO	Code working properly Closed
2	Based on the temp	This is done by creat Met	Pass	GO	Sprinkler is turning on and o Closed
3	If any flame is dete	This is done by creat Met	Pass	GO	Exhaust fan is turning on an Closed
4	Emergency alerts are notified to the autr	Met	Pass	GO	Emergency alerts are send vi Closed

10. ADVANTAGES & DISADVANTAGES

The Advantages of this Industry-Specific Intelligent Fire Management system are as follows

- The user need not require expertise knowledge to control this system. This system is simple. The user can easily view the sensor values and take control actions.
- The control actions are taken automatically.
- If it is implemented in hardware, then the cost of implementation will be affordable.
- As we are sensing the sensor values continuously, any slight change in the environment is detected
- This system is in User-Friendly format.

The Disadvantage of this Industry-Specific Intelligent Fire Management system are as follows

- This system will not be able to detect the origin of fire.
- This system will not provide the escape route if there is fire outbreak.
- If the industry has specific changes in the environment, then this system will give false alarm.

11.

CONCLUSION

An understanding and having Fire Management system in the industry is of utmost importance. This project is a fire management system that can be used in the industry based on IOT. This system creates a simulation device credentials in IBM WATSON IOT PLATFORM. In node-red, necessary nodes are installed and used. These nodes are installed and used. These nodes are deployed and the data is collected. In the event of fire, this system can issue sprinkler on, exhaust fan on. This remote user monitoring system can monitor the system status of each node in real time. This system monitors the data continuously so that any slight change in the environment can be easily detected. This ensures good control accuracy. This Industry-Specific Intelligent Fire Management ensures the protection of property, asset and the processes are cost-effective and the automatic measures are in control.

12.

FUTURE SCOPE

The future scope of this project is to add additional features like triggering the extinguisher automatically, predict the escape route if the fire outbreaks and to implement this system in real time using hardware.

13. APPENDIX

Source Code

<https://github.com/IBM-EPBL/IBM-Project-51318-1660978079>

GitHub & Project Demo Link

THANK YOU

