INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSYTEM

NALAIYA THIRAN - PROJECT REPORT

PROJECT ID:PNT2022TMID00837

Submitted by

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Of

BACHELOR OF ENGINEERING

IN

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PANIMALAR ENGINEERING COLLEGE, CHENNAI-600123.

(AN AUTONOMOUS INSTITUTION , AFFILIATED TO ANNA UNIVERSITY)

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PANIMALAR ENGINEERING COLLEGE, CHENNAI-600123.

(AN AUTONOMOUS INSTITUTION , AFFILIATED TO ANNA UNIVERSITY)

BONAFIDE CERTIFICATE

Certified that this project report

“INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM – PNT2022TMID00837”

is the bonafide work of

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CHAPTER 1

INTRODUCTION

Project Overview:

Under the rather broad heading of fire protection systems, this module will examine the main components of alerting, suppression, and containment features and systems. Consideration of these systems is a natural adjunct to a discussion of hazards and building construction features. The primary components we will examine are fire alarm systems, fire detection and notification systems, suppression agents and systems, water distribution systems, automatic sprinkler systems, standpipe and hose systems, and portable fire extinguishers. This module will cover a lot of basic material meant to provide the novice inspector a solid foundation on which to build. As was said in the earlier modules, it is only a beginning.

In the recent past, a few fire warning and alarm systems have been presented based on a combination of a smoke sensor and an alarm device to design a life-safety system. However, such fire alarm systems are sometimes error-prone and can react to non- actual indicators of fire presence classified as false warnings. There is a need for high- quality and intelligent fire alarm systems that use multiple sensor values (such as a signal from a flame detector, humidity, heat, and smoke sensors, etc.) to detect true incidents of fire. An Adaptive neuro-fuzzy Inference System (ANFIS) is used in this paperto calculate the maximum likelihood of the true presence of fire and generate fire alert. The novel idea proposed in this paper is to use ANFIS for the identification of a true fire incident by using change rate of smoke, the change rate of temperature, and humidity in the presence of fire. The model consists of sensors to collect vital data from sensor nodes where Fuzzy logic converts the raw data in a linguistic variable which is trained inANFIS to get the probability of fire occurrence. The proposed idea also generates alerts with a message sent directly to the user’s smartphone. Our system uses small size, cost-effective sensors and ensures that this solution is reproducible. MATLAB-based simulation is used for the experiments and the results show a satisfactory output.

Heat Detectors:

Heat detectors commonly are used to detect fires. They are not as prone to false alarms and are less expensive than smoke detectors. However, the response of heat detectors may not be adequate in many instances, which limits their usefulness. Heat detectors are slower to respond to fires than are smoke detectors because heat detectors cannot respond to smoke. Heat detectors typically are best suited for detecting fast-growing fires in small spaces. Heat detectors are also a means of fire detection in locations that smoke detectors cannot protect due to such environmental effects as mist, normally occurring smoke, and high humidity. Heat detectors have several different operating mechanisms.

Flame Detectors:

Another method of fire detection is detectors that are sensitive to the light waves emitted by fires. These typically operate by detecting ultraviolet (UV) or infrared (IR) energy. These detectors are extremely quick to operate and typically are used only in high hazard areas such as industrial process facilities, fuel-loading areas, and areas where explosions may occur. Explosion suppression systems protect them. One problem with IR detectors is that they will respond to sunlight, creating an unwanted alarm problem. Besides, both types of flame detectors must "see" the flame to detect it so they usually have to be pointed toward the locations where fires are likely to originate.

Purpose:

Conventional vs. Addressable (Intelligent/Smart):

Conventional fitems have indeed been around a long time and have proven their reliability & credibility yet in today's digital world, people often think of analog devices or systems as old fashioned or with out-dated technology. Many businesses today still use them with. And, whilenewer technologies now exist, conventional systems still remains a good option. Conventional systems are highly reliable, cost-effective, and affordable for small buildings where just one or two zones could cover the entire area.

Reliability:

An addressable system is generally more reliable than a conventional system mainly due to how the different systems are wired. With a conventional system, if a device's wire is damaged or severed, its signal and the signal of other devices down the line cannot be transmitted to the control panel.With an addressable system, both ends of the wire connect to the control panel. Therefore, if one end becomes damaged or severed, signals can still reach the control panel through the other end of the loop. In addressable systems, a device can be removed or disabledand it will not affect the other devices in the loop.

Scalability:

Addressable systems provide a great deal of flexibility in comparison to conventional systems. While the number of devices either system can accommodate is determinant on the manufacturer of the alarm panels, every type of device added to a conventional system requiresa new circuit.Because they require less wire, an addressable alarm control panel can accommodate far more devices than a conventional system. They can have anywhere from oneto 30 loops, commonly referred to as a signalling line circuit (SLC), each of which can monitor and control several hundred devices.

Life Cycle Cost:

The equipment required for conventional systems usually comes with a much lower price tag than addressable systems, which is why conventional systems are still a popular choice for small businesses. However, it is wise to look beyond the initial costs. Even for small buildings, the lower initial costs to purchase the equipment needed for a conventional system are often offset by higher installation costs. Remember that conventional systems require a single circuit for each zone, one which can lead to much more complex wiring than an addressable system inwhich all the devices are wired into a single loop. This increase in complexity not only drives up the cost of installation but also introduces a greater risk of human error. While both types of systems require regular inspections and testing, trouble-shooting and maintenance are easier and less expensive with addressable systems. With independently wired zones in a conventional system, each device must be checked separately to find the problematic device.

CHAPTER 2
LITERATURE SURVEY

Existing problem:

A system renovation often only replaces sections of the system. Equipment such as detector heads and the control panel are likely to be replaced only if proven to be troublesome or prone to false alarms. Ideally the fire detection system will have forward and backwards compatibility meaning that a modern control panel can replace the ageing one without changing the detectors and modern higher reliability detectors can be used in the current control panel to address false alarms. Thus, areas of the system can be updated and will work seamlessly with the original system. This gives the ability to manage specific issues and to be able to renovate the system in phases, spreading the cost and minimising disruption. It also ensures that even if some components have been made obsolete, there is a modern replacement available, that will work reliably on the old infrastructure. Otherwise, it is possible that the whole system will require a full and immediate overhaul due to an unforeseen component obsolescence or non-compliance.

- ## Structural challenges

There are usually a number of construction and renovation works happening across a hospital complex at any one time, which often creates additional challenges for the fire system. Any works being carried out must be done without any downtime and minimal disruption as hospitals are operational 24 hours a day 365 days a year. Contractors can create copious amounts of dust that can set off smoke detectors, causing false alarms. This combined with maintenance work being carried out at night can cause a headache for healthcare estates staff as personnel must be called out of hours to correct it. One option to prevent these false alarms while ensuring fire safety is to temporarily replace smoke detectors for heat detectors in the area being worked in. Heat detectors or CO/ heat detectors are not prone to contamination and therefore are less likely to falsely activate due to dust. It is important to consider that smoke detectors' coverage area is larger than a heat detectors and therefore a point for point replacement will result in a loss of coverage. Another option is to use a multisensor with multiple modes of sensitivity such as Apollo Soteria, this detector is much more resilient to false alarms due to its advanced chamber design and can, if required be switched to a heat only mode.

- ## False alarms

The single largest reason for false alarms in hospitals, is due to the system itself. This is directly related to the typical age of the fire detection system but also poor original system design. Advanced detectors have in-built drift compensation; this feature adjusts the alarm threshold as dirt build-up increases. This allows them to function within EN 54 standards for a longer time before needing replacement/ maintenance due to going into false alarm. Another benefit of more advanced detectors is the application of multiple modes. These provide a variation in sensitivity to better detect relevant smoke particles and help reject transient signals. Improved detector casing design can also significantly reduce insect ingress within the detectors. These advancements further aid in the quest of ever reducing the UwFS and maintenance costs. The Apollo Soteria range of detectors encompasses all of these beneficial features to reduce false alarms.

References:

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

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

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

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

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

Problem Statement Definition:

Fire is one of the major concerns when analyzing the potential risks on buildings. To face undesired situations it is common to install fire safety systems in a way to prevent fire occurrence or to protect buildings against such events. In these cases it is usual to have well designed systems as well as good installation procedures. However the problem relies after this stage where it is needed some attention to issues related to test and maintenance that are not meet. This article states this problem presenting the risk of not identifying possible hidden failures that will prevent the safety barrier of having a successfully operation when it will be needed in a real fire situation. It is also shown the importance of having a test and maintenance planning and how to establish the frequency of those activities. Along the years some standards and regulations have been developed to assure a proper design, installation, maintenance and operation of such systems and avoid, limit or mitigate fire events. In this particular aspect a reference should be done to the National Fire Protection Association (NFPA) that has been for more than a century the leader on research and development of devices and on the publication of standards and regulation about fire safety. Usually these systems rely inactive for long periods or, in case of automatic systems, in a dormant mode. The so-called hidden failures are only often detected through periodic inspections or tests and thus it is very important to assure such procedures in a way to guarantee high fire safety levels. Concerning fire safety systems it is observed that equipment design and installation are not a problem. Based on this, it is important to pay attention to the remaining life time of such equipment and on their effective operation.

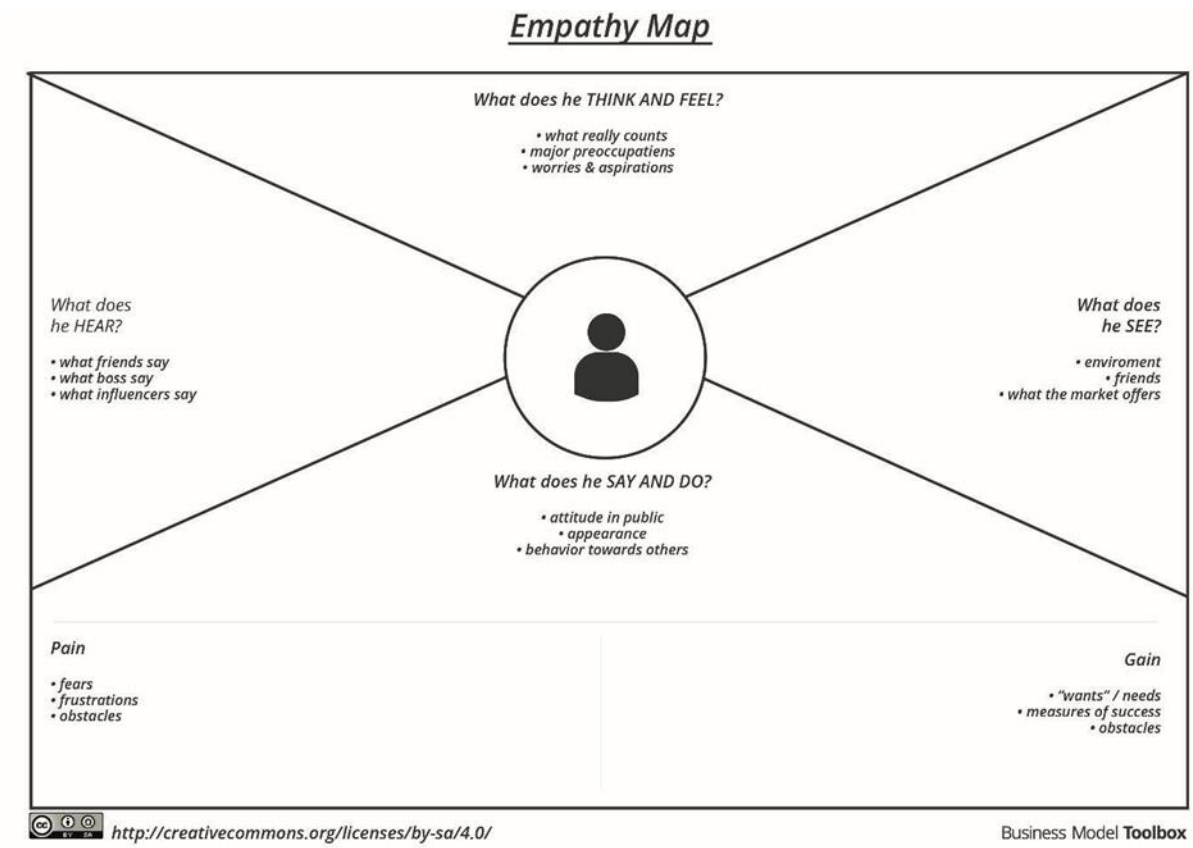
I'm trying to	*List their outcome or "job" the care about - what are they trying to achieve?*	List the thing they are trying to achieve here
but	Describe what problems or barriers stand in the way – *what bothers them most?*	Describe the problems or barriers that get in the way here
because	Enter the "root cause" of why the problem or barrier exists – *what needs to be solved?*	Describe the reason the problems or barriers exist
which makes me feel	Describe the emotions from the customer's point of view – *how does it impact them emotionally?*	Describe the emotions the result from experiencing the problems or barriers

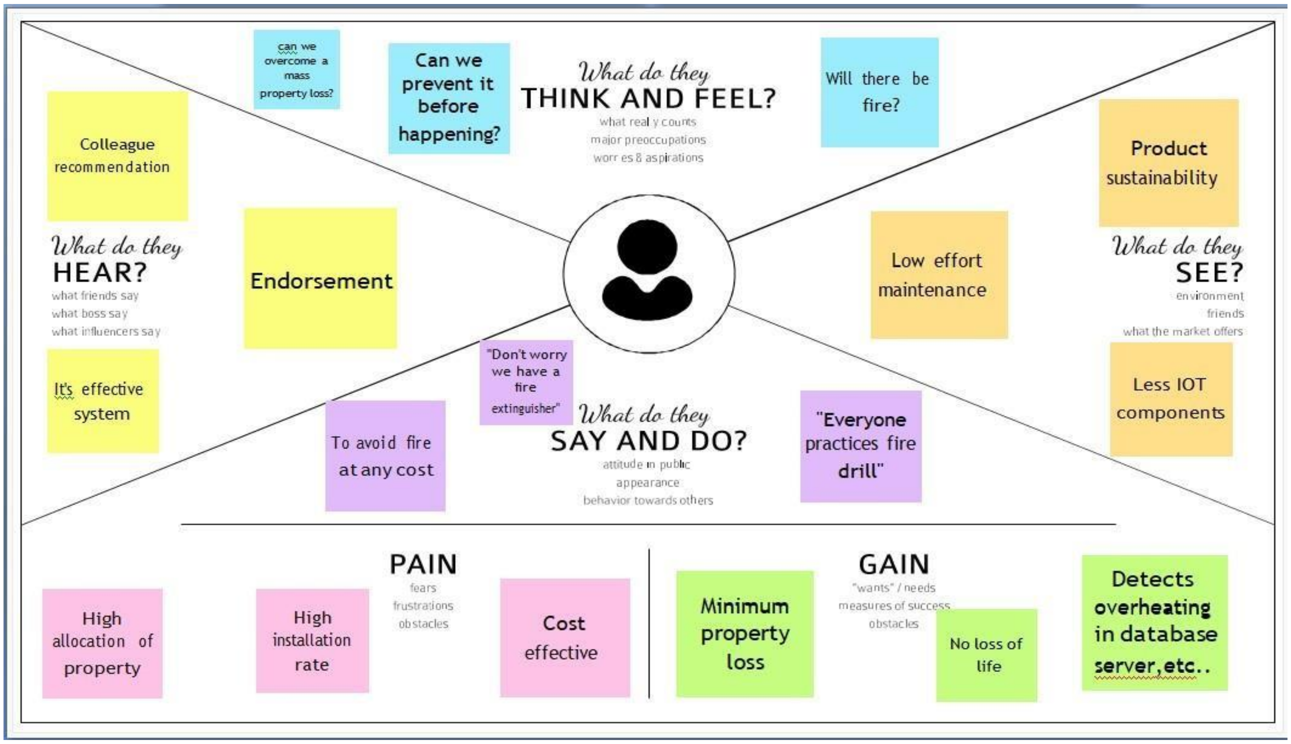
Problem Statement (PS)	I am (Customer)	I'm tryingto	But	Because	Which makes me feel
PS-1	An industrialist Who 1. care for the workers. 2. Take high risk to improving the safety measures in the industry 3. Have some basic knowledge about the fire managem entsystemin the industry	To implement thefire detection and management systemin industry	There is no sufficient technology to alert the fireaccident	There is no availablesensors and proper communication facilities	Frustrated

CHAPTER 3
IDEATION & PROPOSED SOLUTION

Empathy Map Canvas:

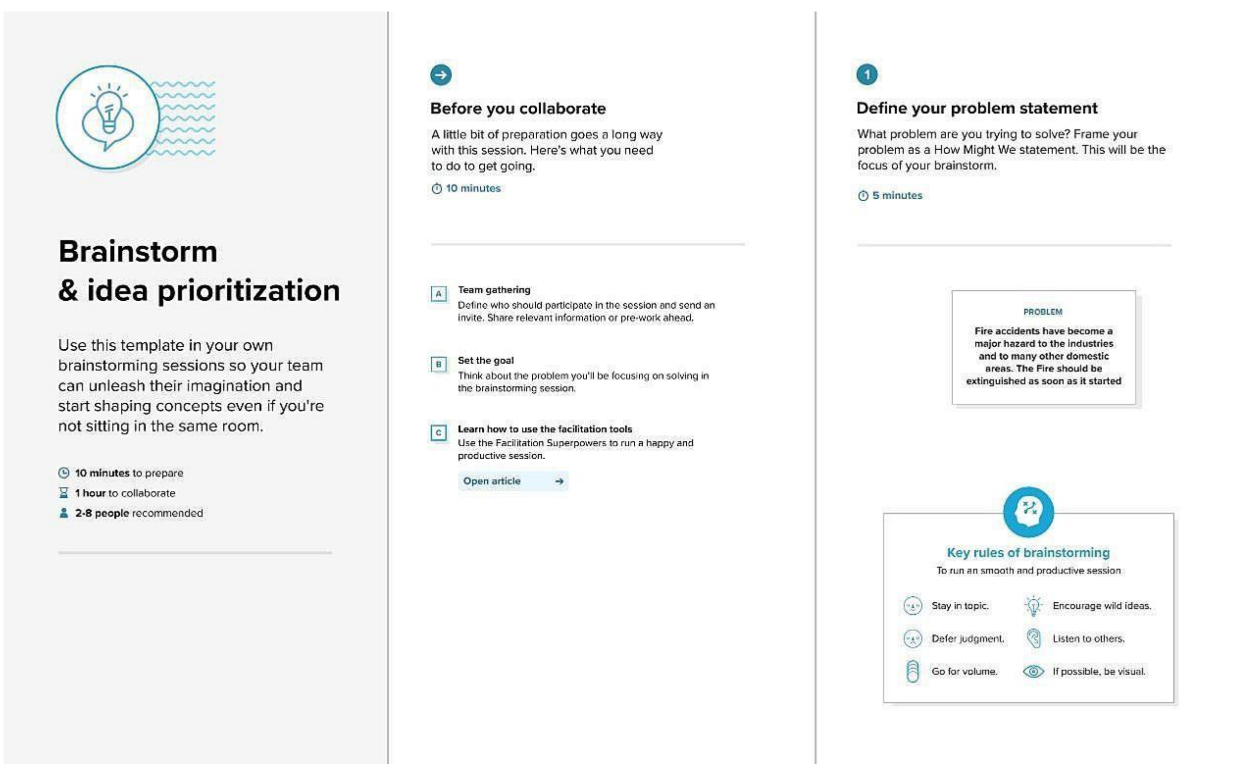
An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes. It is a useful tool to helps teams better understand theirusers. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.





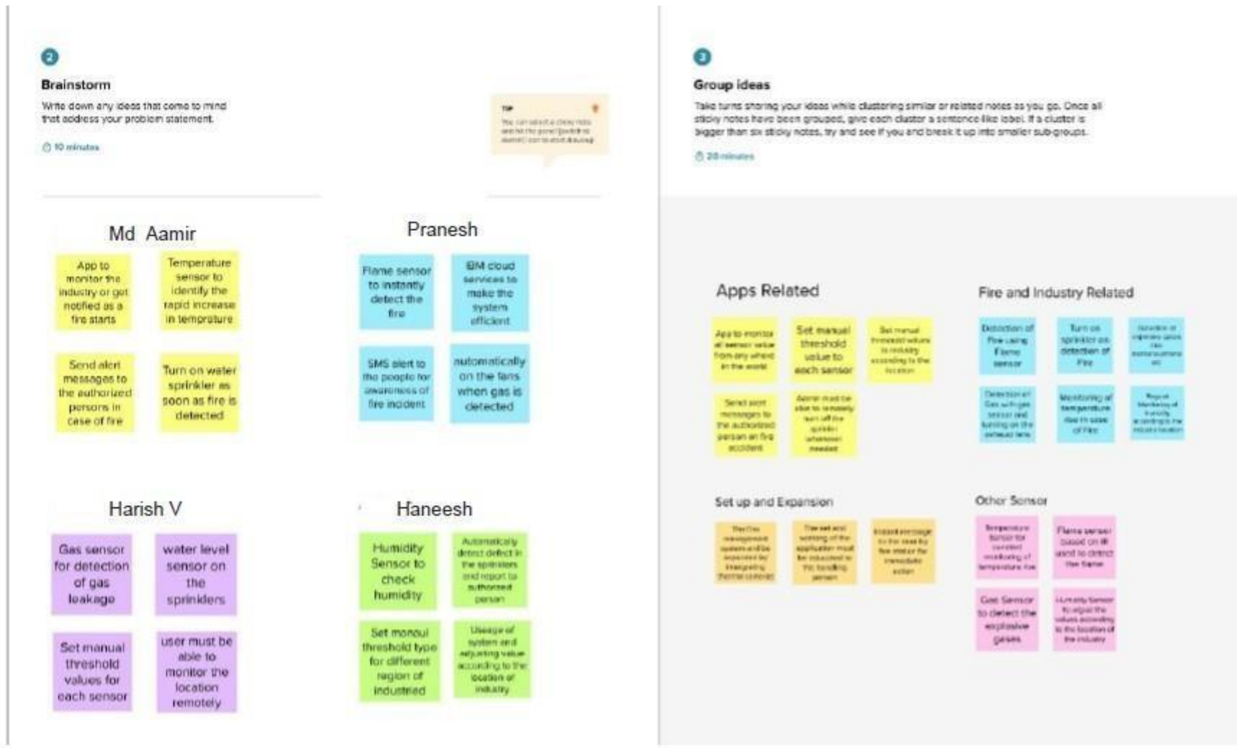
Empathy map canvas

Ideation & Brainstorming:



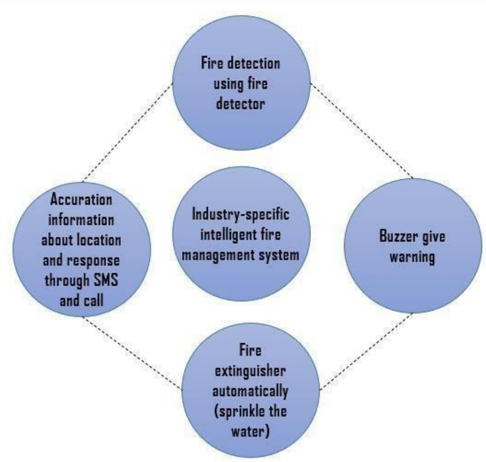
Brainstorm

Brainstorming solution for industry specific intelligent fire management system is shown asdiagram below.



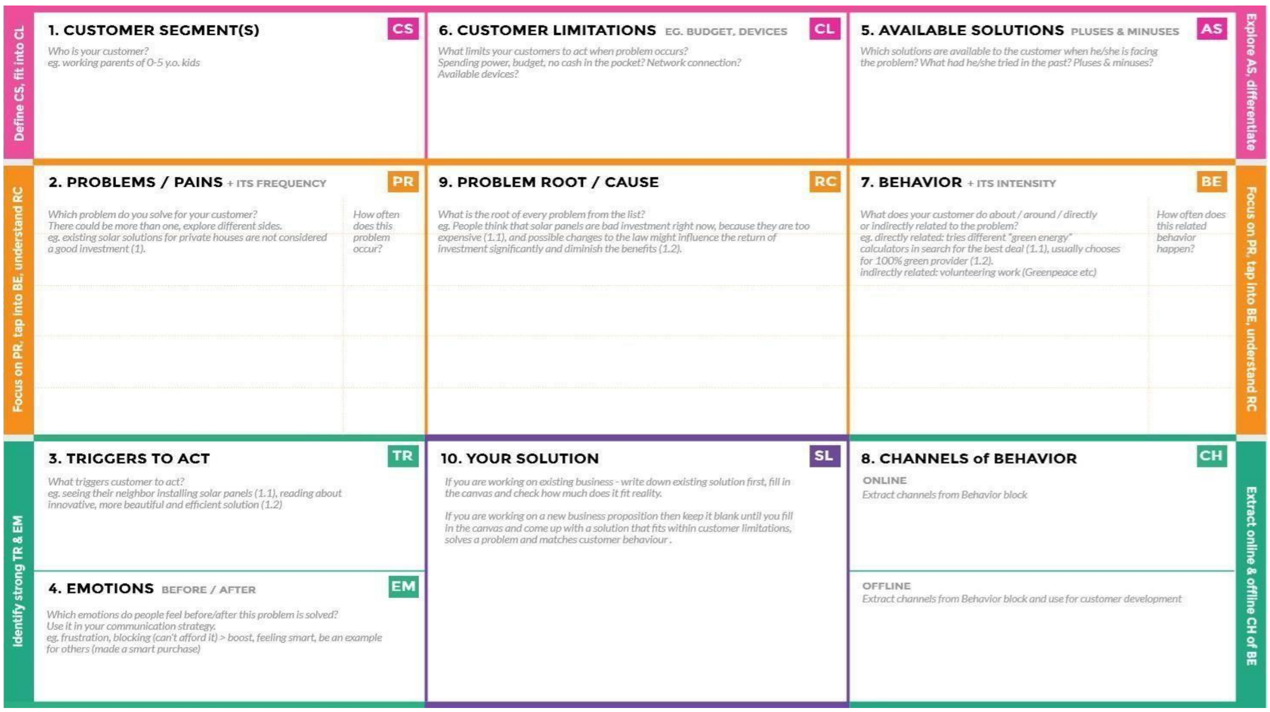
Brainstorming Solution

Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to besolved)	To improve the safetymanagement system inindustries. 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 firedetection and fireextinguisher system. Andusing some sensors(Humidity sensor, Flame sensor, smokesensor) with GPS tracking system.
3.	Novelty / Uniqueness	An integrated system of temperature monitoring, gas monitoring, fire detection automatically fire extinguisher withaccusation of information aboutlocations and response through SMS notification and call.
4.	Social Impact/ Customer Satisfaction	■ It early prevents the accident cost byfire in industries. ■ Nearby locations so maximum extendmoreaccurate reliability. ■ Compatibility designintegrated system.
5.	Business Model(Revenue Model)	
6.	Scalability of the Solution	■ This project can be used more efficientlywithaccurate information requiring. ■ Easy operability and maintenance.

		■ Required lowtime for maintain ■ Cost is reasonable value.

Problem Solution fit:



Proposed Solution Diagram

IDEA PRIORITIZATION:

CHAPTER 4
REQUIREMENT ANALYSIS

Functional requirement:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through website or application Registration through Social medias(like Instagram, Facebook) Registration through LinkedIN
FR-2	User Confirmation	Verification via EmailVerification via OTP
FR-3	User Login	Login through website or App using the respective username and password
FR-4	User Access	Allows the app requirement
FR-5	User Guide	Guides the basic stepsof using the application
FR-6	User Upload	User should be able to send the data
FR-7	UserSolution	Data reportshould be generated and delivered to user for per every 24 hours
FR-8	UserData Sync	API interface to increase to invoice system

HARDWARE DEVICES:

ARDUINO

Arduino UNO

5V Relay Supply

Buzzer

Flame Sensor

Mini Water Pump

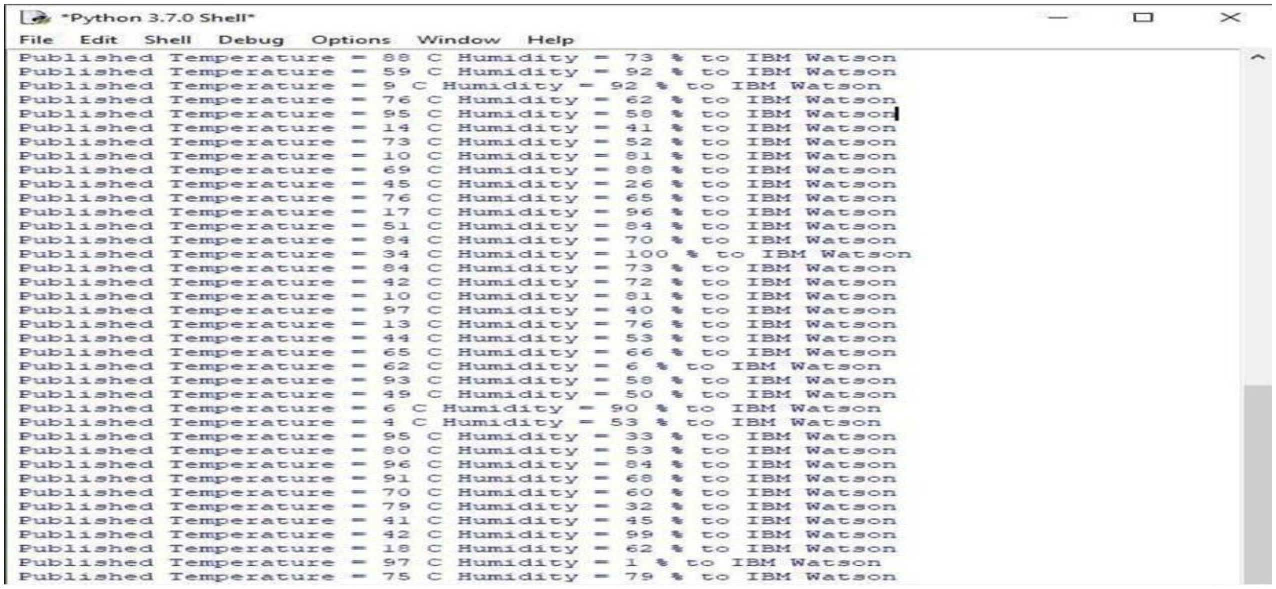
Battery Holders

Non-Functional requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability requirements can consider language barriers and localization tasks. Usability can be assessed from the belowfunctions. Efficiency of use.Lowperceived workload. Easy and simpleUI.
NFR-2	**Security**	Access permissions for the particular system information may only be changed by the system's data administrator.
NFR-3	**Reliability**	The database update process mustroll back allrelated updates whenany update fails.
NFR-4	**Performance**	The front-page load time must be no more than 2 seconds for users that access the website using anVoLTE mobileconnection.
NFR-5	**Availability**	New moduledeployment mustn't impactfront page,product pages, and check out pages availability and mustn't take longer than one hour. The rest of the pages that may experience problems must display anotification with a timershowing when the system isgoing to be up again.
NFR-6	**Scalability**	We can increase scalability by adding memory, servers, or disk space. On the other hand, we can compress data, use optimizing algorithms. The website attendance limit must be scalable enoughtosupport 500,000 users at a time.

SOFTWARE APPLICATION:

Arduino IDE


Python 3.7.0 Shell
File Edit Shell Debug Options Window Help
Published Temperature = 88 C Humidity = 73 % to IBM Watson
Published Temperature = 59 C Humidity = 92 % to IBM Watson
Published Temperature = 9 C Humidity = 92 % to IBM Watson
Published Temperature = 76 C Humidity = 62 % to IBM Watson
Published Temperature = 95 C Humidity = 58 % to IBM Watson
Published Temperature = 14 C Humidity = 41 % to IBM Watson
Published Temperature = 73 C Humidity = 52 % to IBM Watson
Published Temperature = 10 C Humidity = 81 % to IBM Watson
Published Temperature = 69 C Humidity = 88 % to IBM Watson
Published Temperature = 45 C Humidity = 26 % to IBM Watson
Published Temperature = 76 C Humidity = 65 % to IBM Watson
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Published Temperature = 51 C Humidity = 84 % to IBM Watson
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Published Temperature = 34 C Humidity = 100 % to IBM Watson
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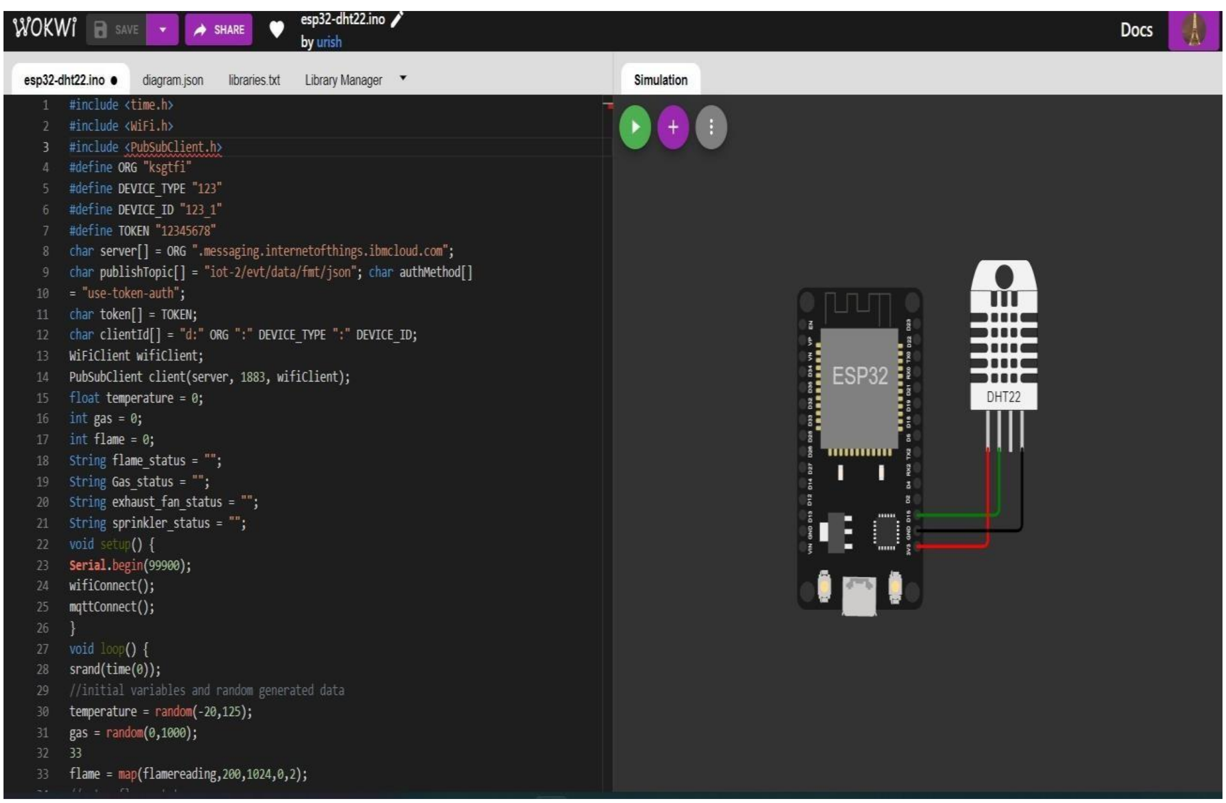
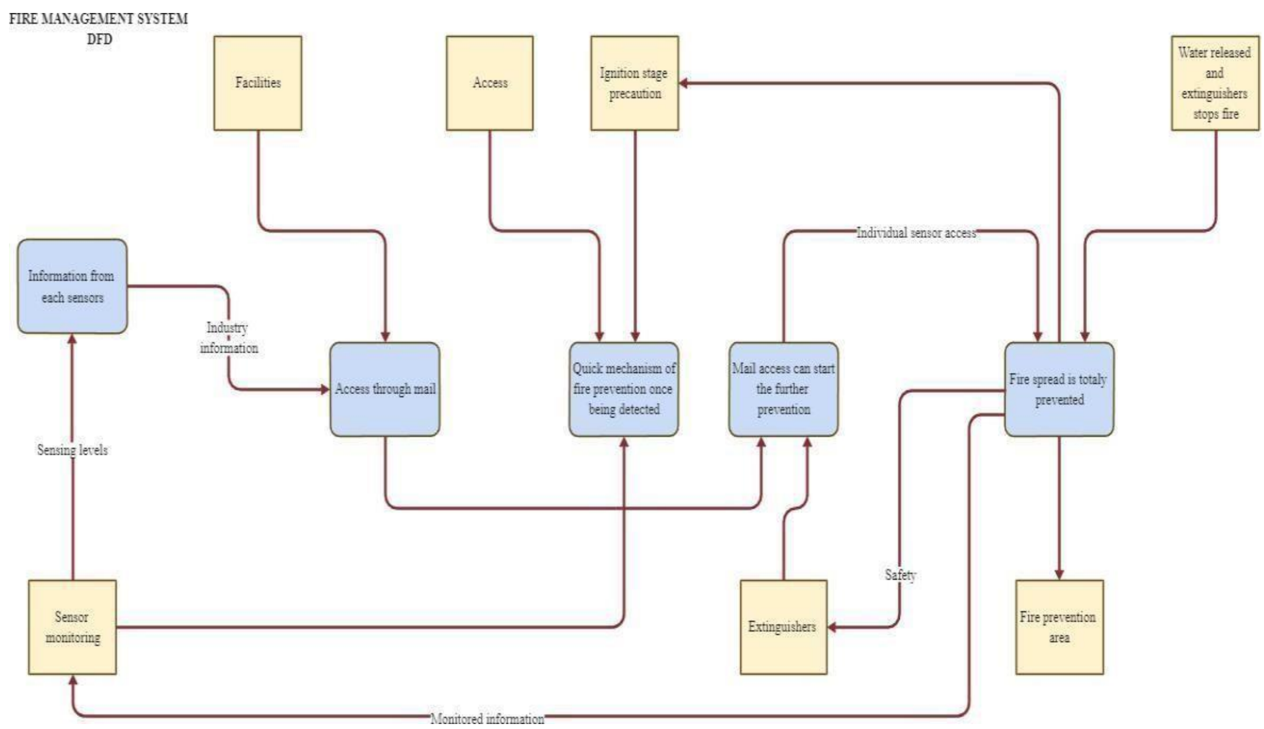
Published Temperature = 49 C Humidity = 50 % to IBM Watson
Published Temperature = 6 C Humidity = 90 % to IBM Watson
Published Temperature = 4 C Humidity = 53 % to IBM Watson
Published Temperature = 95 C Humidity = 33 % to IBM Watson
Published Temperature = 80 C Humidity = 53 % to IBM Watson
Published Temperature = 96 C Humidity = 84 % to IBM Watson
Published Temperature = 91 C Humidity = 68 % to IBM Watson
Published Temperature = 70 C Humidity = 60 % to IBM Watson
Published Temperature = 79 C Humidity = 32 % to IBM Watson
Published Temperature = 41 C Humidity = 45 % to IBM Watson
Published Temperature = 42 C Humidity = 99 % to IBM Watson
Published Temperature = 18 C Humidity = 62 % to IBM Watson
Published Temperature = 97 C Humidity = 1 % to IBM Watson
Published Temperature = 75 C Humidity = 79 % to IBM Watson


WOKWi
SAVE
SHARE
esp32-dht22.ino
by urish
Docs
esp32-dht22.ino
diagram.json
libraries.txt
Library Manager
Simulation
#include <time.h>
#include <WiFi.h>
#include <PubSubClient.h>
#define ORG "ksgtfi"
#define DEVICE_TYPE "123"
#define DEVICE_ID "123_1"
#define TOKEN "12345678"
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/data/fmt/json"; char authMethod[]
= "use-token-auth";
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;
WiFiClient wifiClient;
PubSubClient client(server, 1883, wifiClient);
float temperature = 0;
int gas = 0;
int flame = 0;
String flame_status = "";
String Gas_status = "";
String exhaust_fan_status = "";
String sprinkler_status = "";
void setup() {
Serial.begin(99900);
wifiConnect();
mqttConnect();
}
void loop() {
srand(time(0));
//initial variables and random generated data
temperature = random(-20,125);
gas = random(0,1000);
33
flame = map(flamereading,200,1024,0,2);
ESP32
DHT22

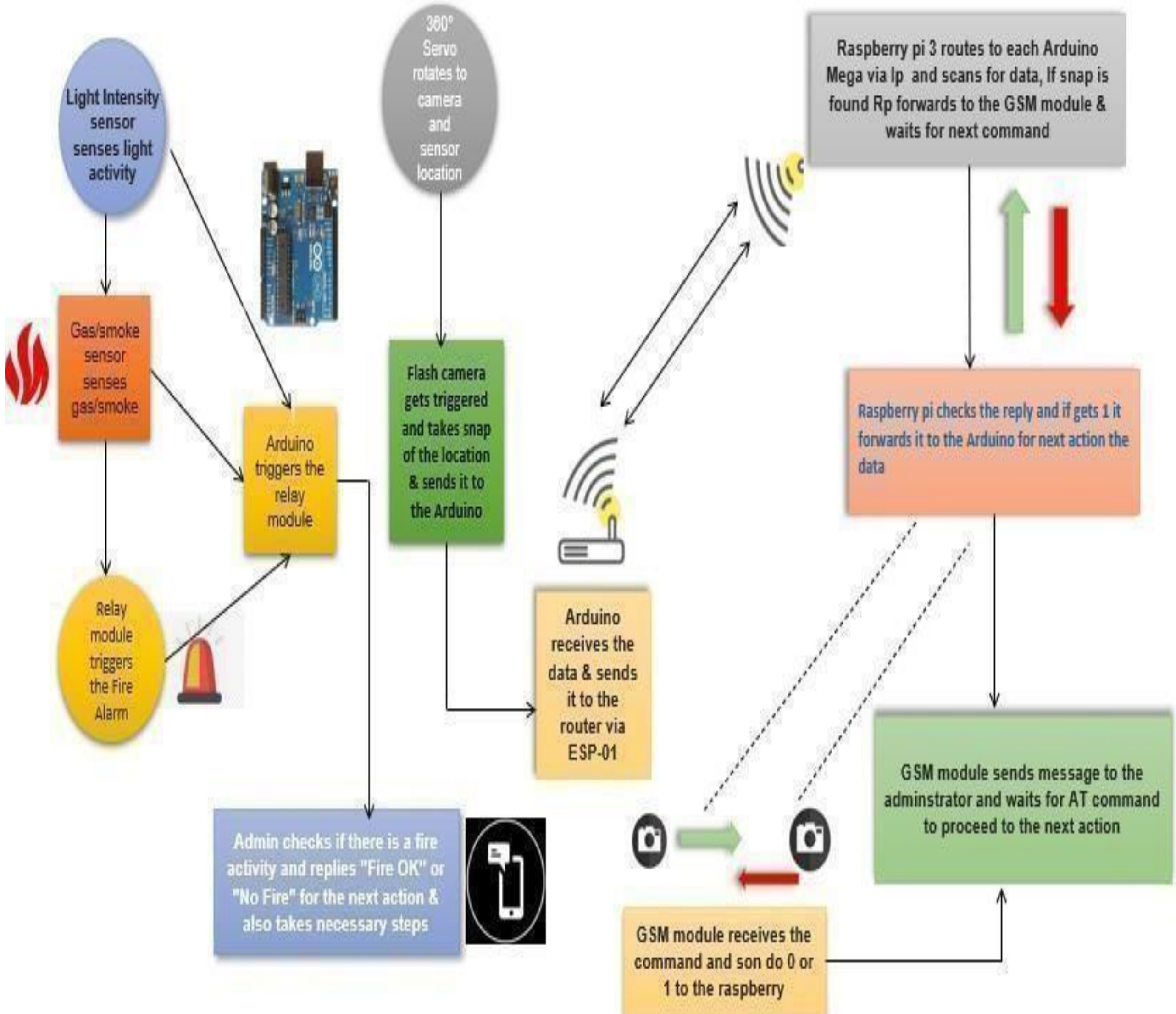
CHAPTER 5
PROJECT DESIGN

Data Flow Diagrams:



Data FLow Diagram

Solution & Technical Architecture:



Solution Architecture

User Stories:

User Type	Functional requirement	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 mail, 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 internet	I can register & access the dashboard with Internet 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 mail and password	I can login with my id and password	High	Sprint-1

CHAPTER 6

PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As a customer I might be able to ensure login credential through Gmail ease manner for the purpose of sending alertmessage to the owner...	2	High	KARAN AM HANEESH
Sprint-2	Registration	USN-2	As a user, I have to register my details andtools details in a simpleand easy mannerin case of a fire.	2	High	MD AAMIR
Sprint-3	Dashboard	USN-3	As a user, in case of Fire in the industry I need thesprinkler to spraywater on the fire automatically.	2	Low	DASARATHA PRANESH K

Sprint-3	Dashboard	USN-4	As a user, I need to safeguard my properties as well as and it will be better to send alert message to the fire department.	2	Medium	DASARATHA PRANESH K

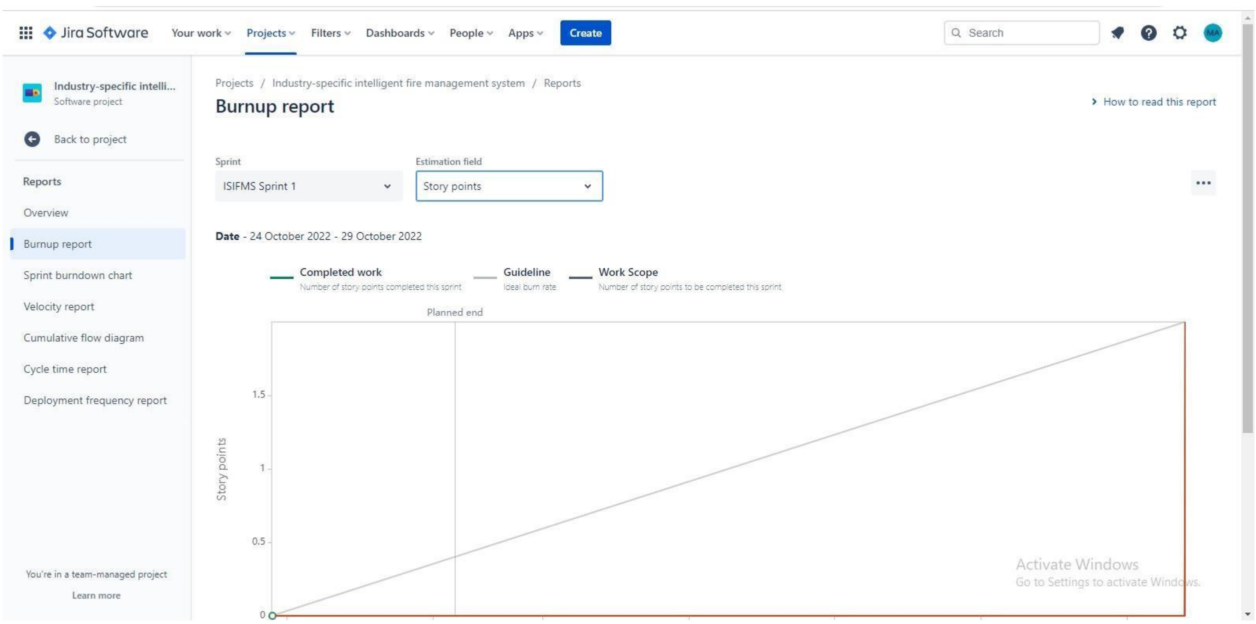
Sprint-4	Dashboard	USN-5	As a user , Its good to have a IOT based systemto extinguish the fire without human presence.	2	High	HARISH V

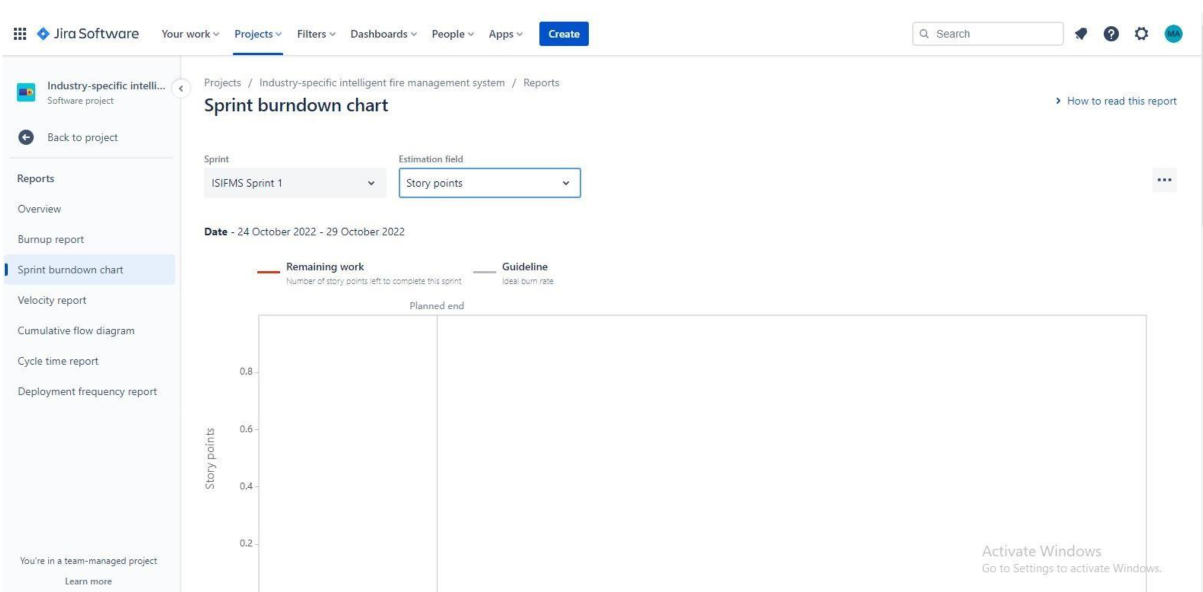
SPRINT DELIVERY SCHEDULE

Sprint	**Total Story Points**	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Story PointsCompleted (as on Planned End Date)**	**Sprint Release Date(Actual)**
Sprint-1	20	6 Days	24 Oct2022	29 Oct 2022	20	29 Oct2022
Sprint-2	20	6 Days	31 Oct2022	09 Nov 2022	20	09 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

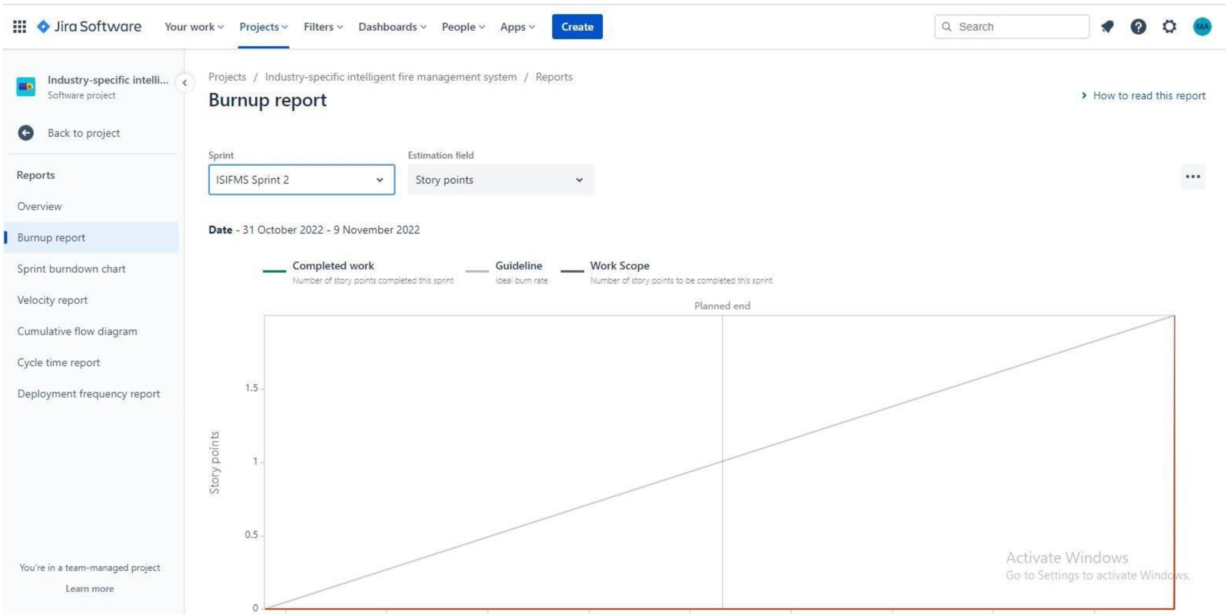
REPORTS FROM JIRA

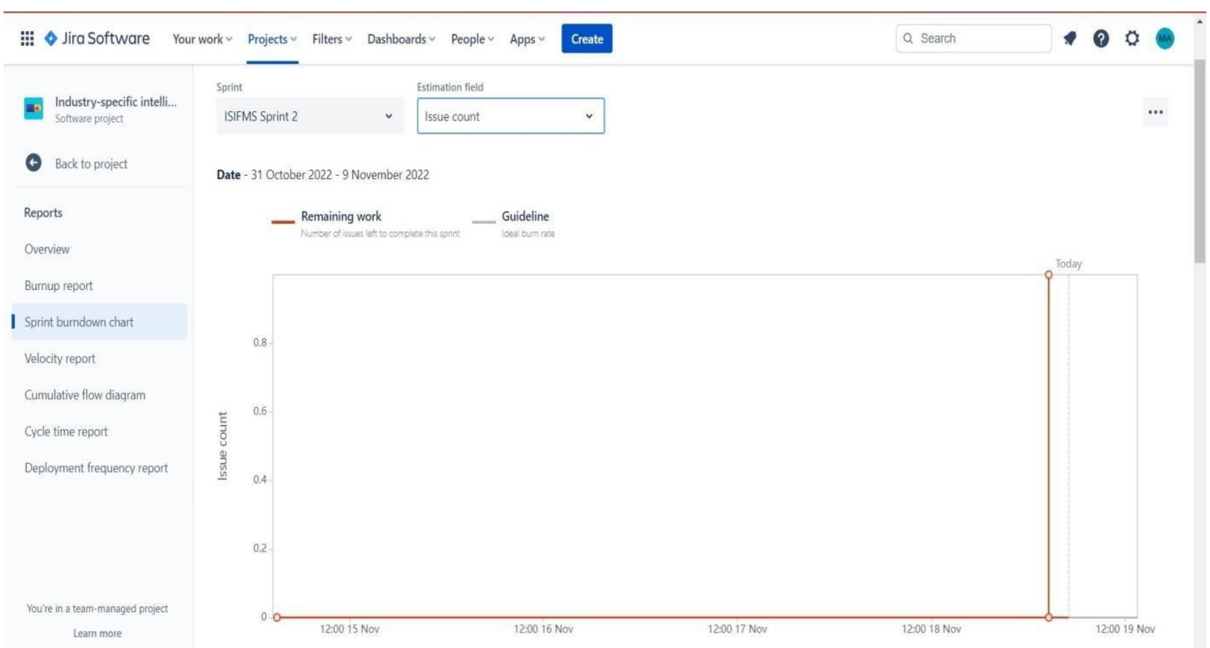
SPRINT 1:





SPRINT 2:


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Industry-specific intelli...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
Learn more
Projects / Industry-specific intelligent fire management system / Reports
Burnup report
How to read this report
Sprint
ISIFMS Sprint 2
Estimation field
Story points
Date - 31 October 2022 - 9 November 2022
Completed work
Number of story points completed this sprint
Guideline
Ideal burn rate
Work Scope
Number of story points to be completed this sprint
Planned end
Story points
1.5
1
0.5
0
Activate Windows
Go to Settings to activate Windows.


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Industry-specific intelli...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
Learn more
Sprint
ISIFMS Sprint 2
Estimation field
Issue count
Date - 31 October 2022 - 9 November 2022
Remaining work
Number of issues left to complete this sprint
Guideline
Ideal burn rate
Today
Issue count
0.8
0.6
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0.2
0
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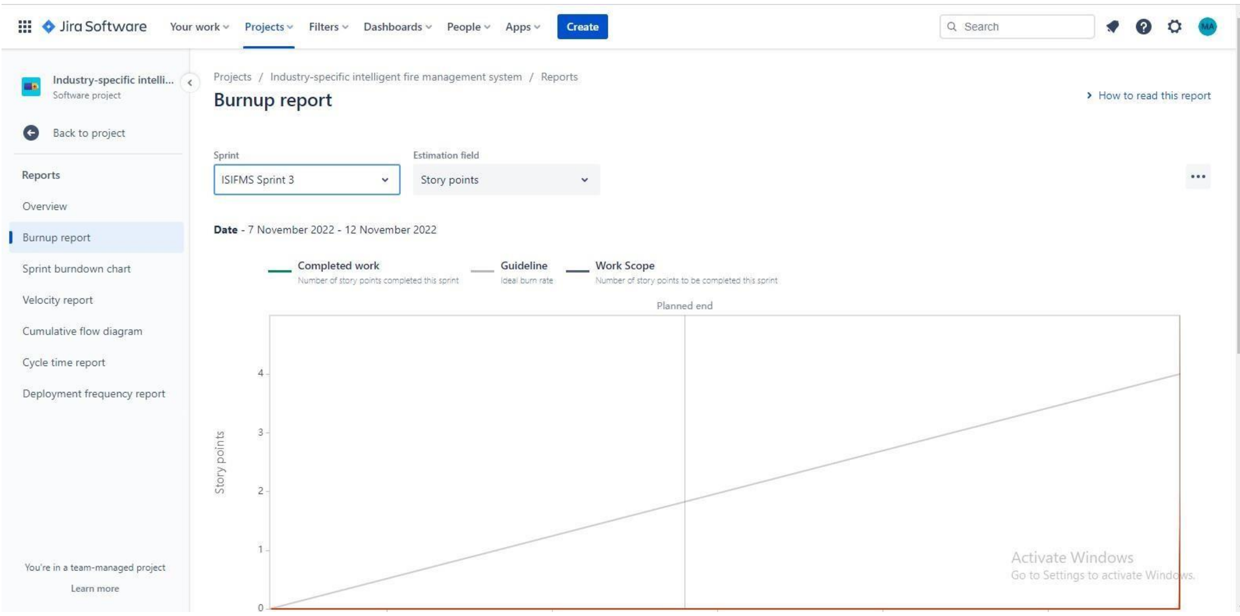
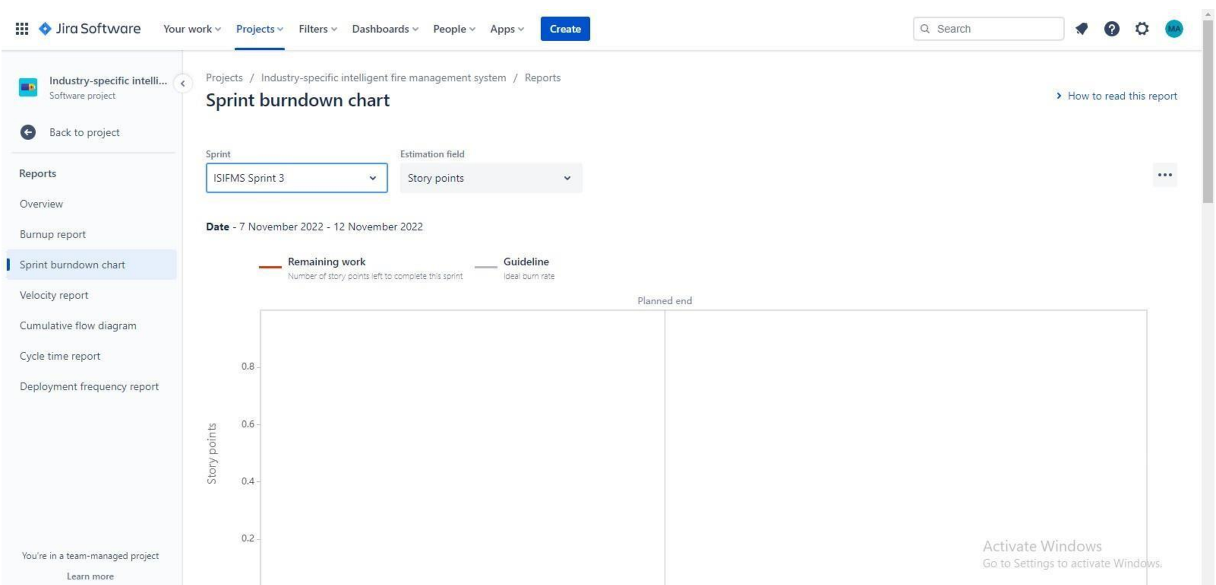
SPRINT 3:


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Industry-specific intelli...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
Learn more
Projects / Industry-specific intelligent fire management system / Reports
Burnup report
How to read this report
Sprint
ISIFMS Sprint 3
Estimation field
Story points
Date - 7 November 2022 - 12 November 2022
Completed work
Number of story points completed this sprint
Guideline
Ideal burn rate
Work Scope
Number of story points to be completed this sprint
Planned end
Story points
4
3
2
1
0
Activate Windows
Go to Settings to activate Windows.


Jira Software
Your work
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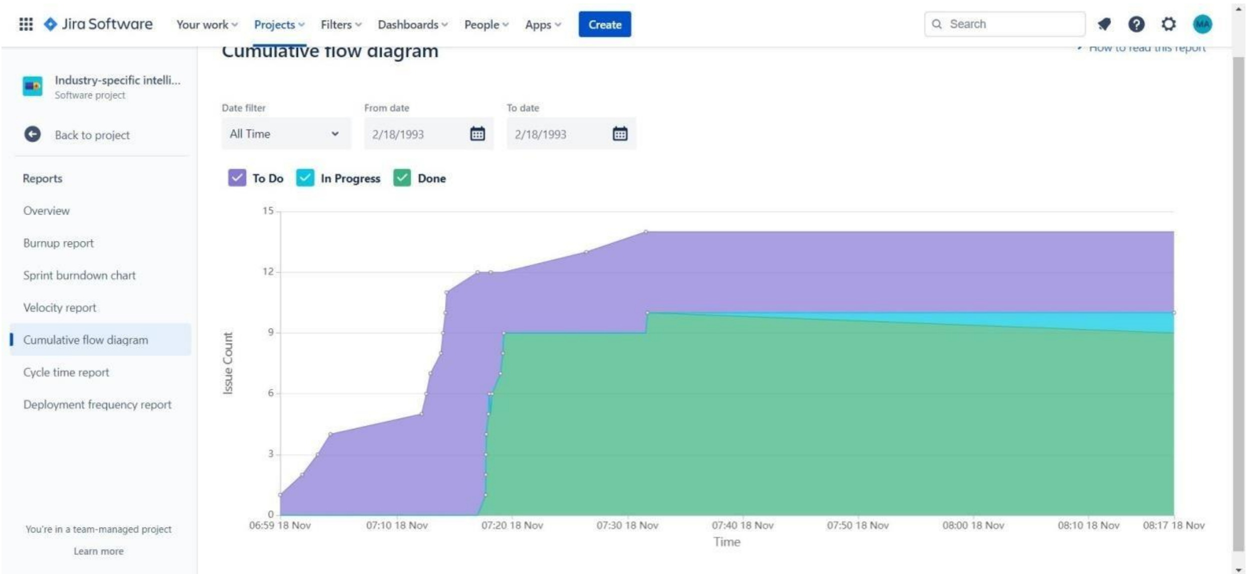
Filters
Dashboards
People
Apps
Create
Search
Industry-specific intelli...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
Learn more
Projects / Industry-specific intelligent fire management system / Reports
Sprint burndown chart
How to read this report
Sprint
ISIFMS Sprint 3
Estimation field
Story points
Date - 7 November 2022 - 12 November 2022
Remaining work
Number of story points left to complete this sprint
Guideline
Ideal burn rate
Planned end
Story points
0.8
0.6
0.4
0.2
0
Activate Windows
Go to Settings to activate Windows.

SPRINT 4: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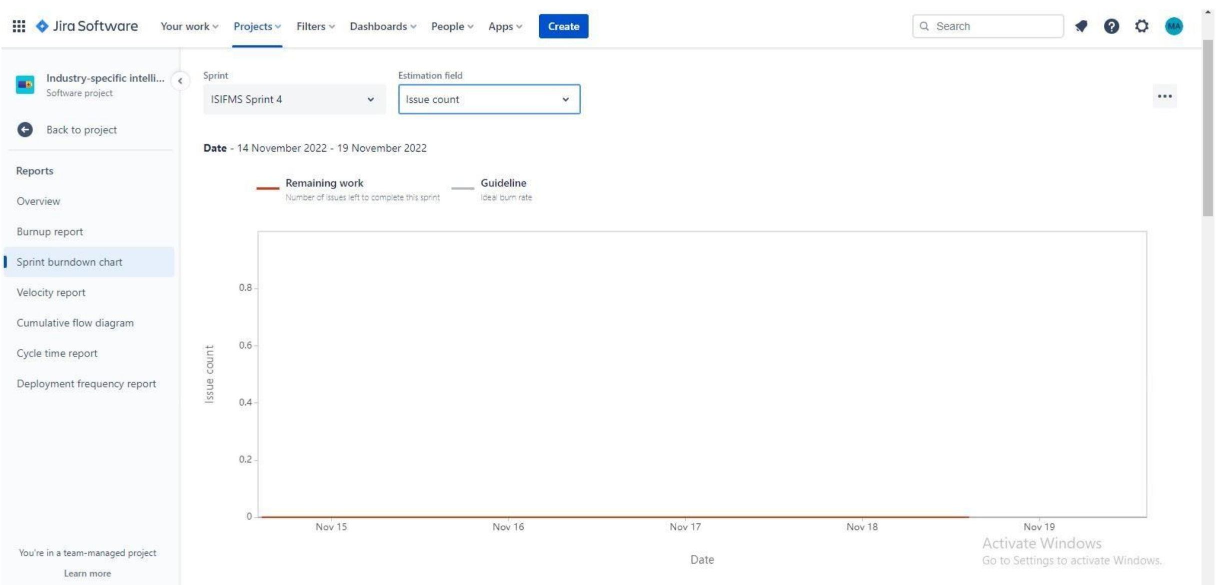
Date filter
All Time
From date
2/18/1993
To date
2/18/1993
To Do
In Progress
Done
Issue Count
Time
06:59 18 Nov
07:10 18 Nov
07:20 18 Nov
07:30 18 Nov
07:40 18 Nov
07:50 18 Nov
08:00 18 Nov
08:10 18 Nov
08:17 18 Nov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Overview
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Deployment frequency report
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Sprint
ISIFMS Sprint 4
Estimation field
Issue count
Date - 14 November 2022 - 19 November 2022
Remaining work
Number of issues left to complete this sprint
Guideline
Ideal burn rate
Issue count
Date
Nov 15
Nov 16
Nov 17
Nov 18
Nov 19
Activate Windows
Go to Settings to activate Windows.

CHAPTER 7
CODING & SOLUTIONING

CODING :

HARDWARE CODING:

int flame=0;/ select analog pin 0 for the sensorint

Beep=9;/ select digital pin 9 for the buzzer int

val=0;/ initialize variable

int relay= 13;

/* The setup() function is called when a sketch starts. It is used to initialize variables, pin modes, start using libraries, etc. This function will only run once, after each power up or reset ofthe Arduino board. */

void setup()

{

pinMode(Beep,OUTPUT);/ set buzzer pin as “output”

pinMode(relay,OUTPUT);/ set LED pin as “output”

pinMode(flame,INPUT);/ set flame pin as “input”

Serial.begin(9600);/ set baud rate at “9600”

}

/* The loop() function executes the program repeatedly until Specified. */

void loop()

```
{
 val=analogRead(flame);/  read the analog value of the sensor
 Serial.println(val);/ output and display the analog value
 if(val>=500)/ when the analog value is larger than 600, the buzzer will buzz
 {
 digitalWrite(Beep,HIGH);
 digitalWrite(relay,HIGH);
 }else
 {
 digitalWrite(Beep,LOW);
 digitalWrite(relay,LOW);
 }
 delay(500);
}
```

SOLUTIONS:

CODING 2:

```
#include <time.h> #include
<WiFi.h> #include
<PubSubClient.h>#define
ORG "ksgtfi"
#define DEVICE_TYPE "123"
#define DEVICE_ID "123_1"
#define TOKEN "12345678"
char server[] = ORG ".messaging.internetofthings.ibmcloud.com"; char
publishTopic[] = "iot-2/evt/data/fmt/json"; char authMethod[]
= "use-token-auth"; char
token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;
WiFiClient wifiClient;
PubSubClient client(server, 1883, wifiClient);
float temperature = 0;
int gas = 0;
int flame = 0;
String flame_status = "";
String Gas_status = "";
String exhaust_fan_status = "";
String sprinkler_status = ""; void
setup() { Serial.begin(99900);
wifiConnect();
mqttConnect();
}
void loop() {
srand(time(0));
/ initial variables and random generated data
temperature = random(-20,125);
gas = random(0,1000);
```

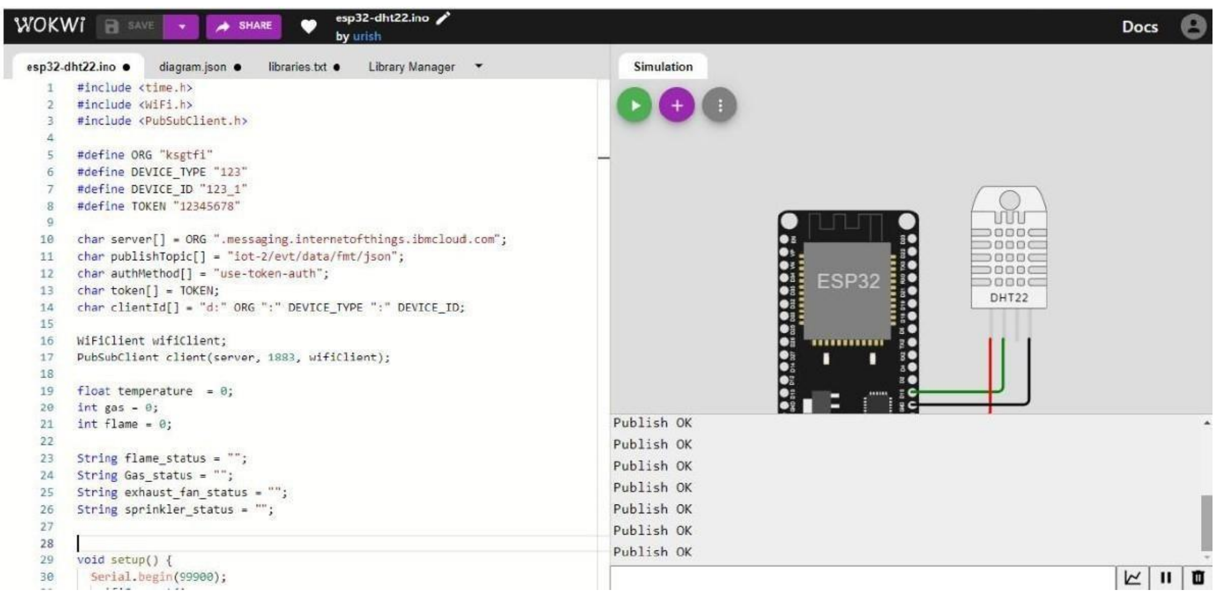
33

```
flame = map(flamereading,200,1024,0,2);
/ set a flame status
int flamereading = random(200,1024);
switch (flame) {
case 0:
flame_status = "No Fire";
break;
case 1:
flame_status = "Fire is Detected";break;
}
/ send the sprinkler status
if(flame==1){  sprinkler_status
= "Working";
}
else{
sprinkler_status = "Not Working";
}
/ toggle the fan according to gas reading
if(gas > 100){
Gas_status = "Gas Leakage is Detected";
exhaust_fan_status = "Working";
}
else{
Gas_status = "No Gas Leakage is Detected";
exhaust_fan_status = "Not Working";
}
/ json format for IBM Watson
String payload = "{";
payload+="\"gas\":";
payload+=gas;
payload+=",";
payload+="\"temperature\":";
```

```
payload+=(int)temperature;
payload+=",";
payload+="\"flame\":";
payload+=flamereading;
payload+=",";
payload+="\"fire_status\":\""+flame_status+"\",";
payload+="\"sprinkler_status\":\""+sprinkler_status+"\","; 34
payload+="\"Gas_status\":\""+Gas_status+"\",";
payload+="\"exhaust_fan_status\":\""+exhaust_fan_status+"\"}";
if(client.publish(publishTopic, (char*) payload.c_str()))
{
Serial.println("Publish OK");
}
else{
Serial.println("Publish failed");
}
delay(1000);
if (!client.loop())
{
mqttConnect();
}
}
void wifiConnect()
{
Serial.print("Connecting to ");
Serial.print("Wifi");
WiFi.begin("Wokwi-GUEST", "",
6);
while (WiFi.status() != WL_CONNECTED)
{
delay(500);
Serial.print(".");
}
Serial.print("WiFi connected, IP address: ");
```

```
Serial.println(WiFi.localIP());
}
void mqttConnect()
{
if (!client.connected())
{
Serial.print("Reconnecting MQTT client to ");
Serial.println(server);
while (!client.connect(clientId, authMethod, token))
{
Serial.print(".");
delay(500);
}
Serial.println();
}
```

OUTPUT:



FEATURE 1:

-Monitoring and detection of fire: The system can constantly monitor the environment for potential fire hazards and provide early warning in theevent ofafire.

-Automatic fire suppression: In the event of a fire, the system can automaticallydeployfire suppression systemssuch as sprinklers or fire extinguishers.

-Remote monitoring and control: The system can be monitored and controlled remotely, allowing for quick and effective response to fires.

-Integrated security: The system can be integrated with security systemstoprovide additional protectionagainst fire hazards.

Feature 2:

-The cloud platform enables the iot based intelligent fire management system to remotely monitorand managefire safety devicesand systems in real-time. It also providesdata analysis and reporting capabilities to help improve fire safety.

-The fire detectionand suppression systemis fully automatedand cloud based. It uses advancedsensors to detect fire and notify the concerned personnel. The system is also equipped with intelligent video analytics that can identify the fire and its location. The fire management system is also equippedwith a fire suppression systemthat can automatically extinguish the fire.

CHAPTER 8

TESTING

TEST CASES:

Defect Analysis:

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	5	2	1	8
Totals	**24**	**14**	**13**	**26**	**77**

User Acceptance Testing:

Test Case Analysis:

Section	**Test Cases**	**Not Tested**	**Fail**	**Pass**
Arduino UNO	7	0	0	7
Flame Sensor	5 1	0	0	51
Relay Services	2	0	0	2
Reproduced Factor	3	0	1	2
Exception Reporting	9	0	0	9
Fixed Report Output	4	0	0	4
Output	5	0	2	3

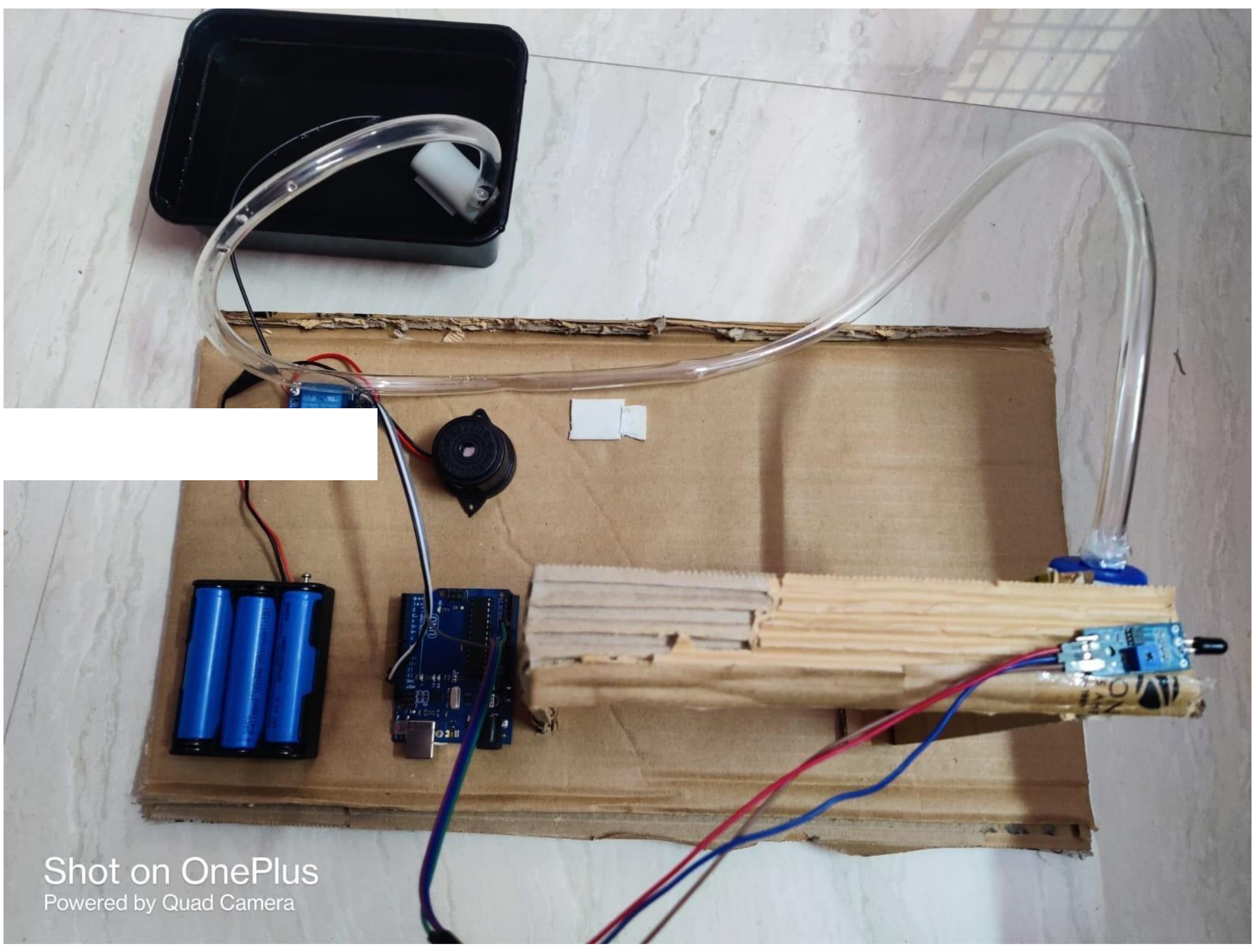
CHAPTER 9
PERFORMANCE MATRICES

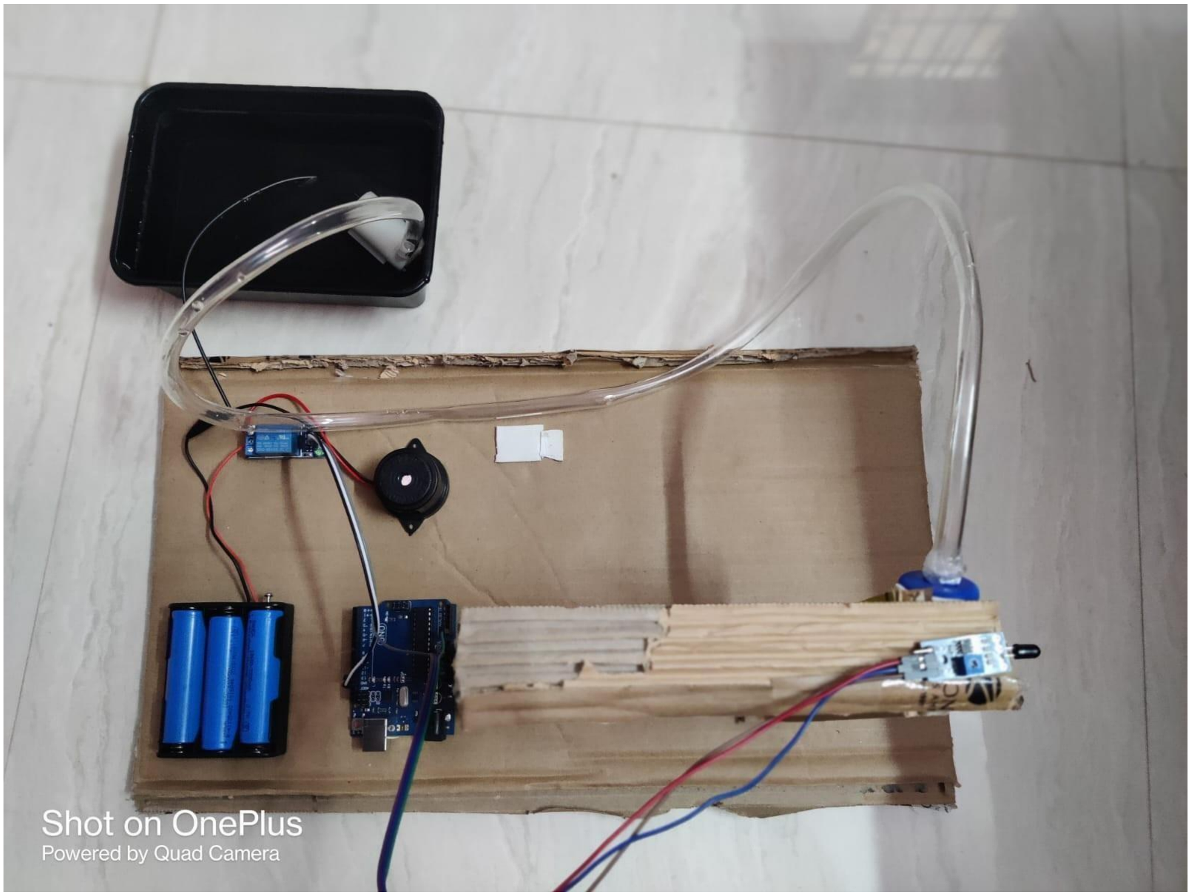
9.1 Performance Matrices:

There are many performance matrices that can be used to evaluate the performance of an IoT- based intelligent fire management system. Some of the most important performance matrices include:

1. Response time: This is the time taken for the system to detect a fire and activate the fire suppression system.
2. Accuracy: This is the percentage of fires that are accurately detected by the system.
3. False positive rate: This is the percentage of times that the system incorrectly detects a fire.
4. False negative rate: This is the percentage of times that the system fails to detect a fire.
5. system availability: This is the percentage of time that the system is operational.
6. MTBF: This is the mean time between failure of the system.
7. Maintainability: This is the ease with which the system can be maintained.

HARDWARE CONNECTED IMAGES:




Shot on OnePlus
Powered by Quad Camera

CHAPTER 10

ADVANTAGES & DISADVANTAGES

ADVANTAGES OF INTELLIGENT FIRE ALARM SYSTEM:

- Cost effective for larger applications.
- The location of a fire condition is detected and recorded at each individual device, identifying exactly where the fire is occurring. This will improve response time for emergency responders.
- Lower ongoing service cost, because when a device goes into trouble (i.e. needs cleaning, repair or replacement), the panel will tell you the exact location of the device needing service.

DISADVANTAGES OF ADDRESSABLE FIRE ALARM SYSTEM:

- Cost, not as competitively priced for smaller applications.
- Typically with an intelligent panel, your peripheral devices (i.e. smoke detectors, etc…) tend to be more expensive than conventional devices.
- This panel is computer like and at times there maybe issues caused by the firmware (panel software). However, this is not common and the advantages of intelligent panel far outweigh any of these firmware issues.

CHAPTER 11
CONCLUSION

CONCLUSION:

The fire detection systems proposed in the literature served fire stopping with no care of the responsiveness. Thus, this study considers the existing issues and build an efficient andeffective fire detection system based on IoT technology, gas, temperature, and smoke sensorsto collect the data accurately and rapidly. The continuous readings sent over WIFI modules tothe central unit to analyze the data and trigger the water sprinkle. This system structureenhances the efficiency and effectiveness of fire detection. Moreover, using the Ubidotsplatform in this system made the data exchange faster and reliable. However, this study'sproposed approach obtained an average response of 5 seconds to detect the fire and alert theproperty owner. Meanwhile, the water pump activated to suck water from the tank and release itinto the water sprinkler to minimize the fire until the property owners and emergency servicesreached. Hence, the proposed system overcame the challenges of the issues of affordability,effectiveness, and responsiveness. The proposed system still needs further enhancements.Thus, one of the enhancement directions is integrating machine learning with the system topredict the potentiality of fire based on the collected data from different sources. Machine learning may help the operators find and overcome the vulnerabilities in their building to preventfire instead of detection only.

Our system is a flexible one that offers the users all kinds of accessibility that would make the system a more viable than most other systems available in the market. But still we are aware ofthe limitations of our system. We look forward to improving the issues and make it an even better and cost-effective fire safety solution that can be helpful for mass people in the long run. Keeping in mind all kinds of sudden fire incidents the system will be optimized in future.

CHAPTER 12
FUTURE SCOPE

FUTURE SCOPE:

This project proposed 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. ANFIS architecture model makes the proposed system 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 stopthe 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.

In future, we want to adopt a more robust privacy measure, prevent data mining, implement a secondary medium of operation for the device, and implement a better debugging tool alongside a well flowing user interface that is easy to navigate and use. Some of the
possible ways that the project could be improved is given below:

- **Robust privacy measures:**

As described before, the device has possibility of getting breached. So, the privacy measures to prevent such attacks have to be taken. Varied authentication solutions have to be implementedin this regard.

CHAPTER

13

APPENDIX

SOURCE CODE:

```
int flame=0;/ select analog pin 0 for the sensorint

Beep=9;/ select digital pin 9 for the buzzer int

val=0;/ initialize variable

int relay= 13;

 /* The setup() function is called when a sketch starts. It is used to initialize variables, pin modes, start
using libraries, etc. This function will only run once, after each power up or reset ofthe Arduino board. */

 void setup()

{

 pinMode(Beep,OUTPUT);/ set buzzer pin as “output”

pinMode(relay,OUTPUT);/ set LED pin as “output”

pinMode(flame,INPUT);/ set flame pin as “input”

Serial.begin(9600);/ set baud rate at “9600”

}

 /* The loop() function executes the program repeatedly until Specified. */
```

```
void loop()

{

 val=analogRead(flame);/  read the analog value of the sensor

 Serial.println(val);/ output and display the analog value

 if(val>=500)/ when the analog value is larger than 600, the buzzer will buzz

 {

 digitalWrite(Beep,HIGH);

 digitalWrite(relay,HIGH);

 }else

 {

 digitalWrite(Beep,LOW);

 digitalWrite(relay,LOW);

 }

 delay(500);

}
```

GITHUB AND PROJECT DEMO LINK:

https:/ github.com/IBM-EPBL/IBM-Project-3438-1658561385

DEMO LINK:

https:/ drive.google.com/drive/folders/1nW0gYSNaBdPTZxdbrGOBgJNgZK5t4rNb