INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

IBM PROJECT REPORT

submitted by:

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1 Introduction

1.1 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 paper to 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 in ANFIS 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.

1.2 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, while newer 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 disabled and 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 requires a 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 one to 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 in which 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

2 LITERATURE SURVEY:

1)Efficient fire detection for uncertain surveillance environment :

CNN technology is used to interconnect all the IOT devices present in the area.By capturing the video the features are detected and tests are done.Cost efficient.

2) Intelligent Multi-Sensor Detection system for monitoring indoor building fires :

The real fire data is collected from the developed sensing system is described.Then the collected sensor datas are used to analyze the performance of proposed fire detection algorithm in comparison to existing algorithm.

3)Smart performance-based design for building fire safety: Prediction of smoke motion via AI :

The datas are noted from various fire scenarios, atrium volumes, and ventilation conditions.After the conduction of test the results are used to develop the AI for accurate smoke visibility. Cost of making is more.

4)Event Classification and Intensity Discrimination for Forest Fire Inference With IoT :

Fire index is considered by using 256 fuzzy rules focusing on temperature,humidity,smoke,wind speed.

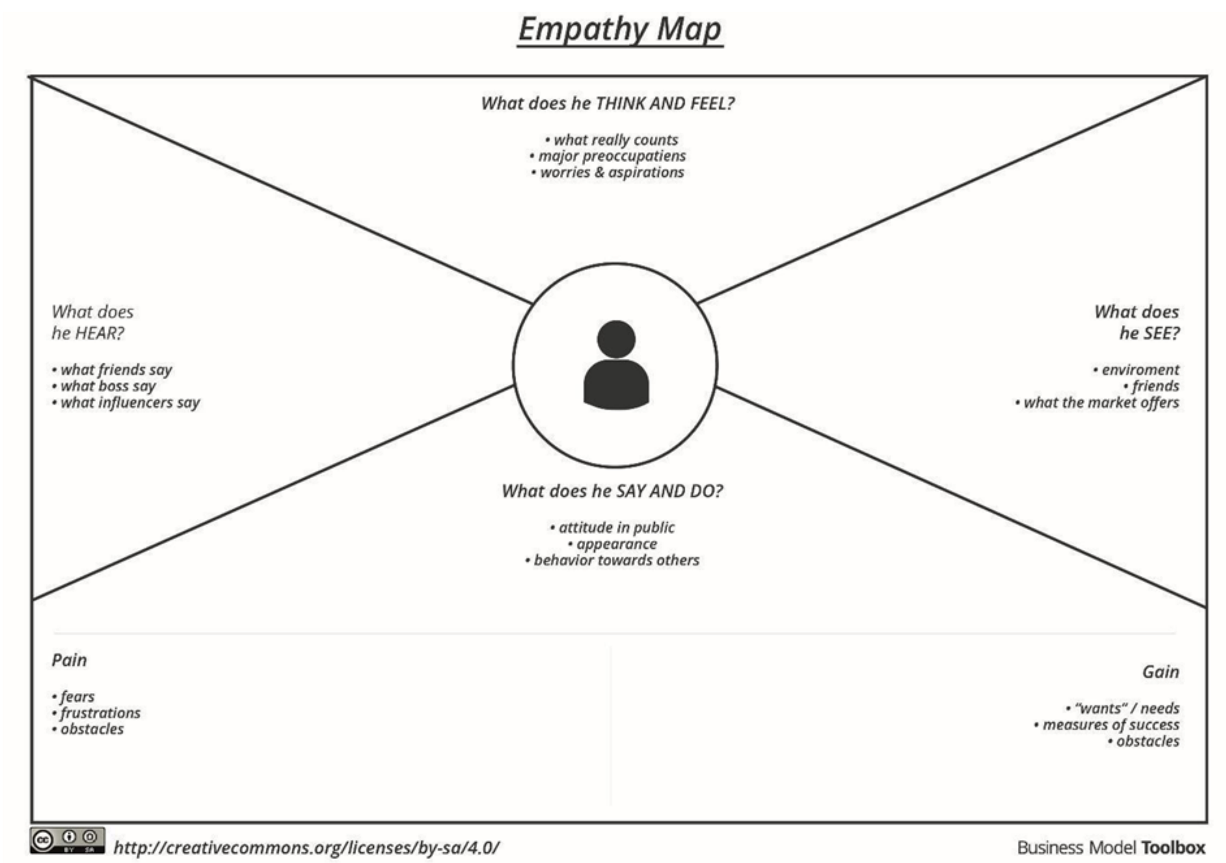
2.1 Problem Statement Definition:

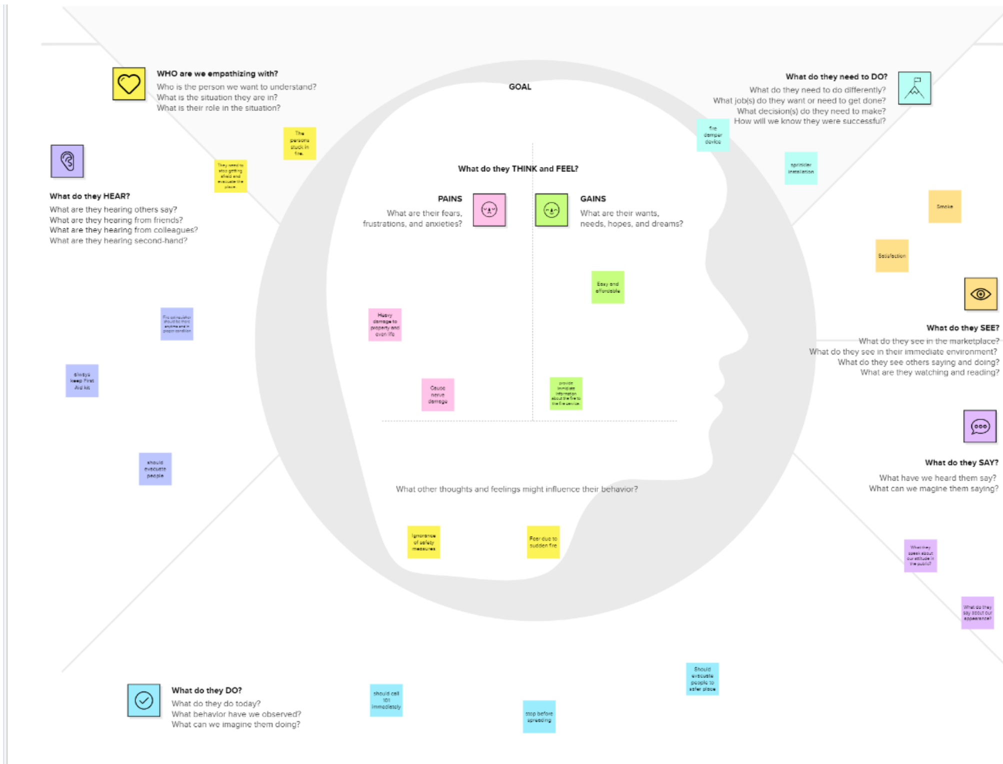
Fire is one of the major concerns when analyzing the potential risks on buildings. To face undesired situations it is common to install fire safety systems in a way to prevent fire occurrence or to protect buildings against such events. In these cases it is usual to have well designed systems as well 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.

3 IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:

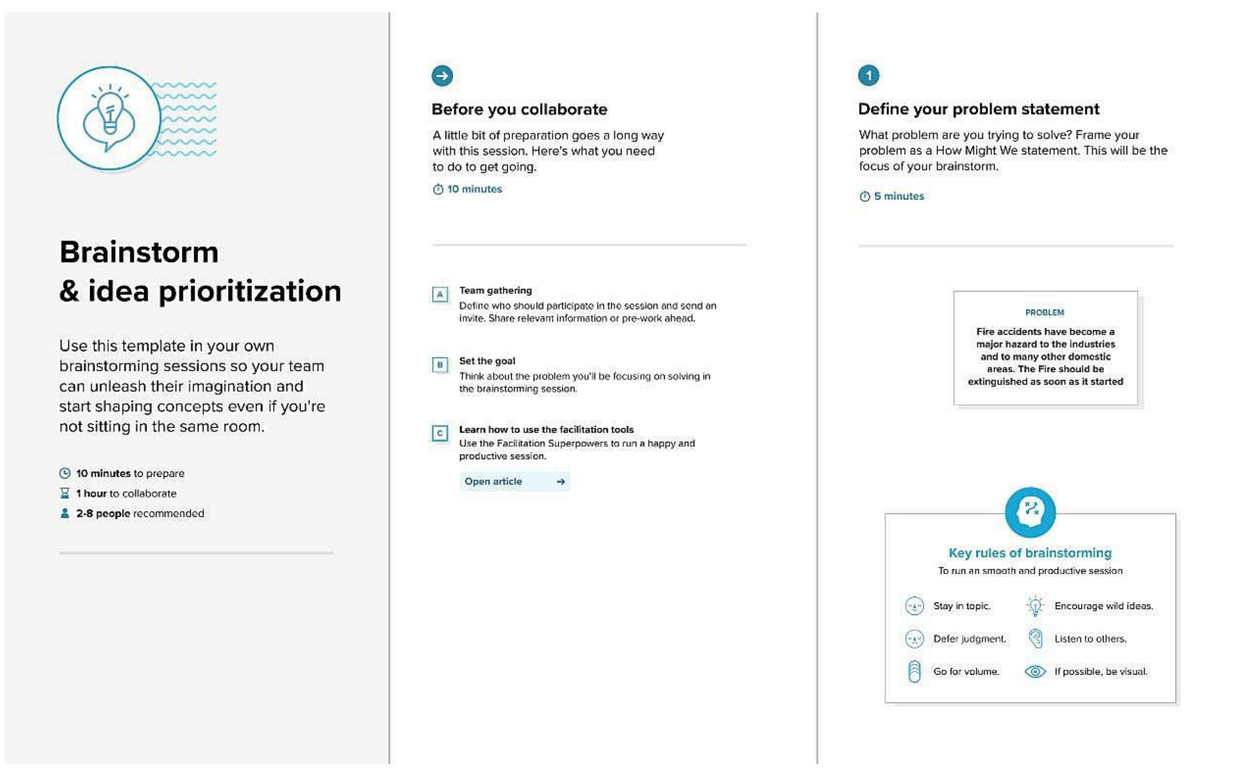
An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes. It is a useful tool to helps teams better understand theirusers. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise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





Empathy map canvas

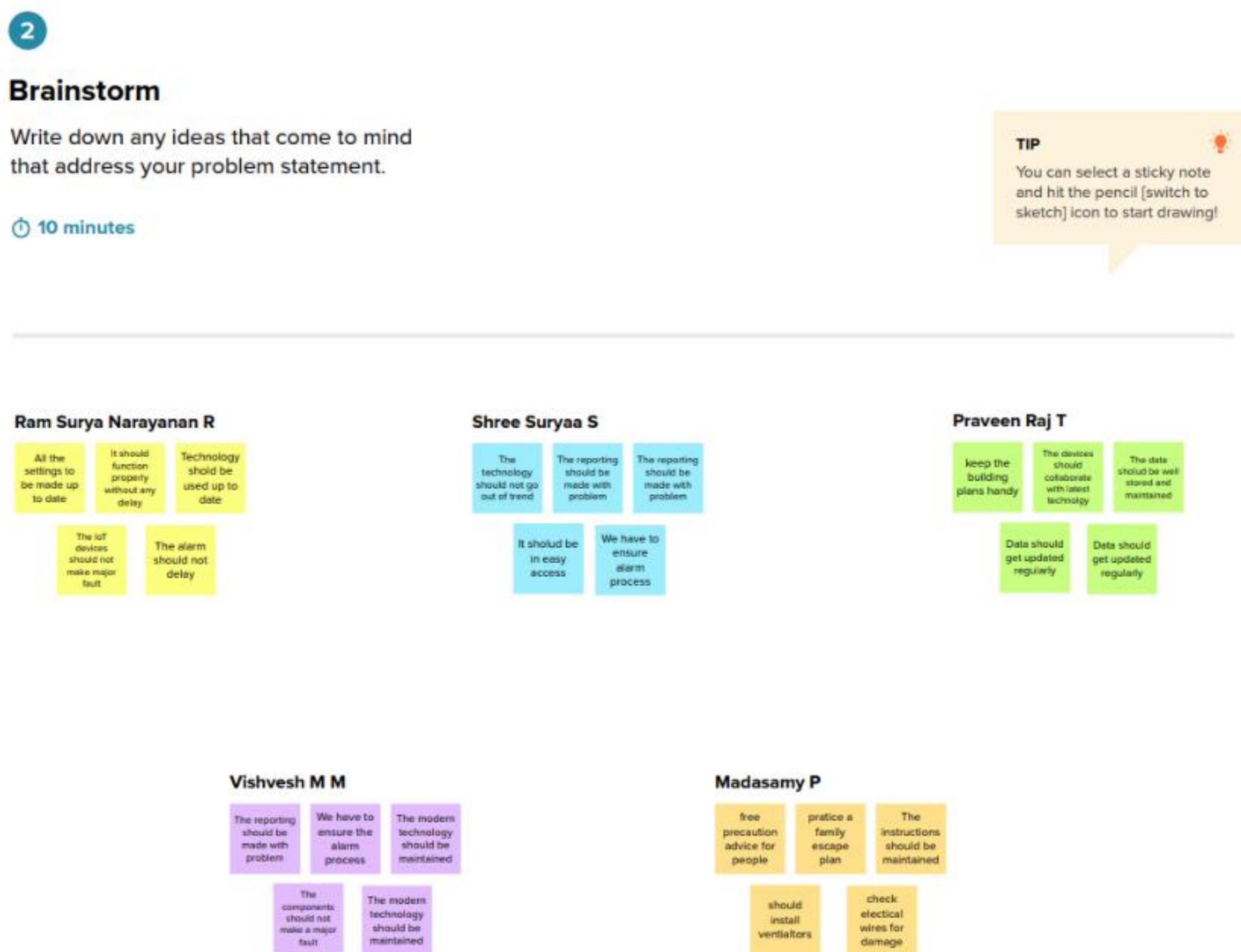
3.2 Ideation & Brainstorming:



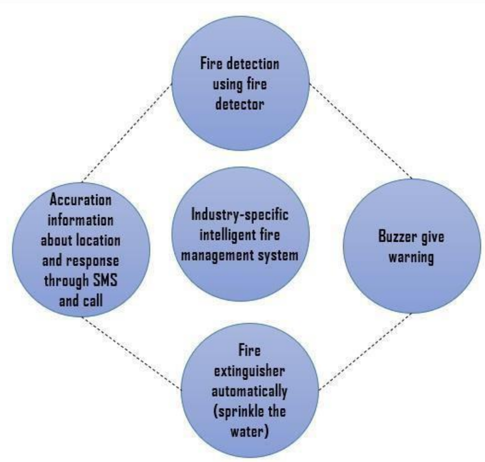
Brainstorm

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

Brainstorming Solution

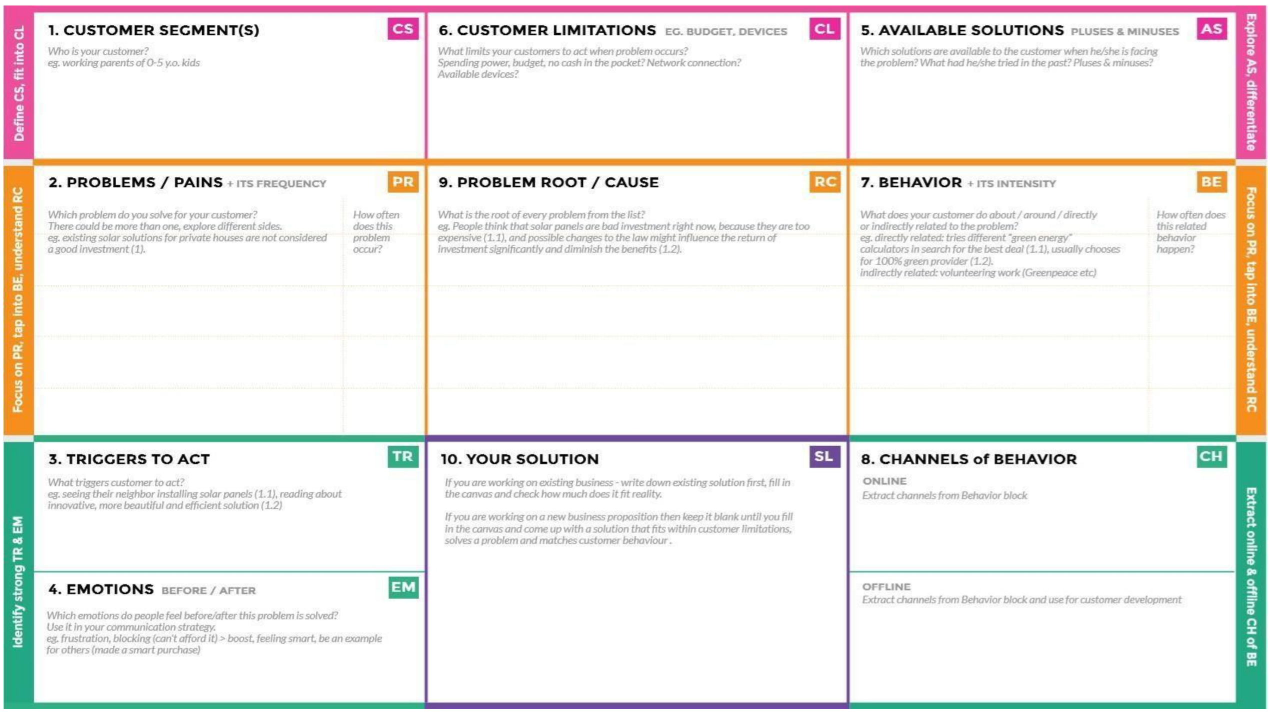


Proposed Solution:

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.

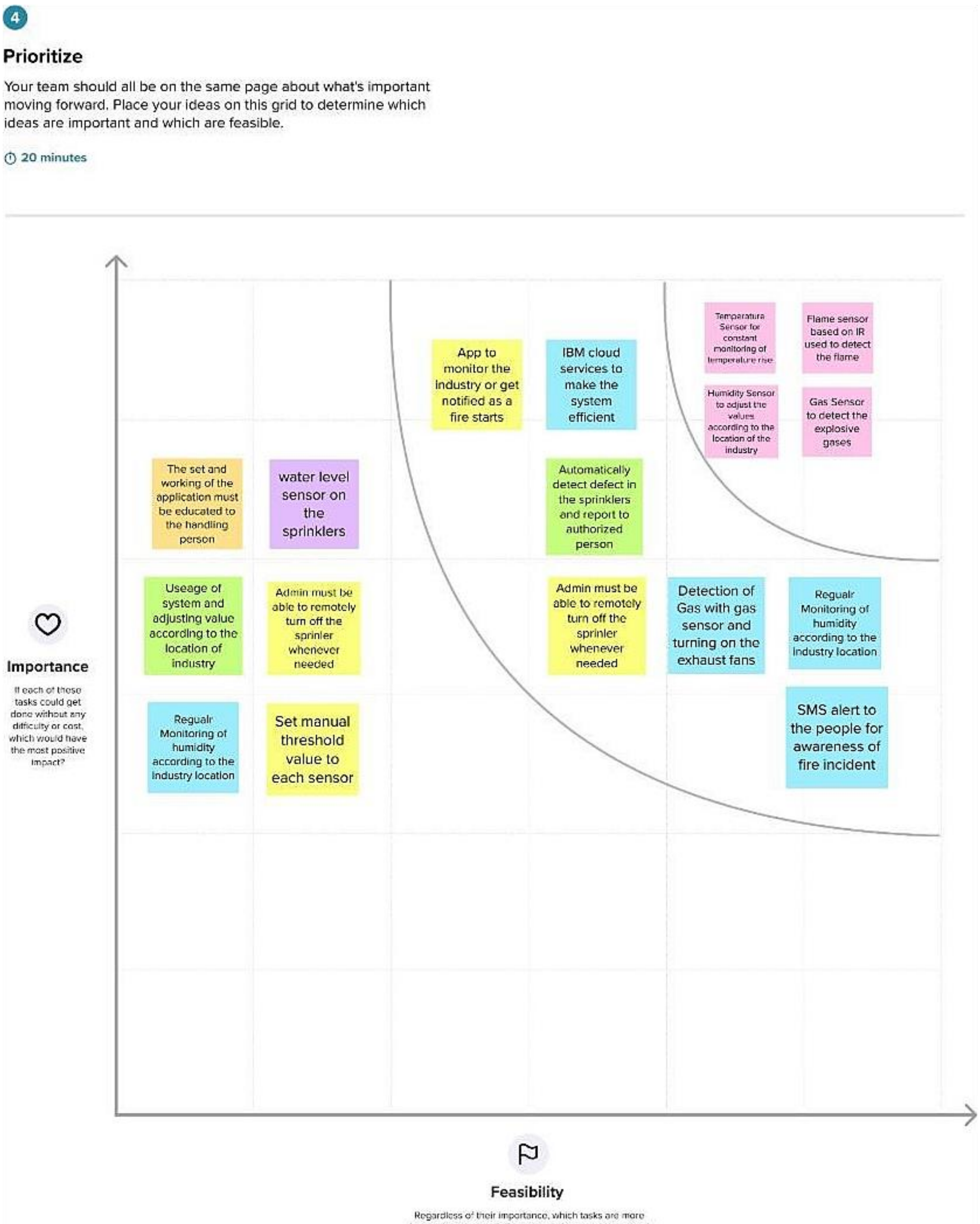
		■ Required lowtime for maintain ■ Cost is reasonable value.

3.3 Problem Solution fit:



Proposed Solution Diagram

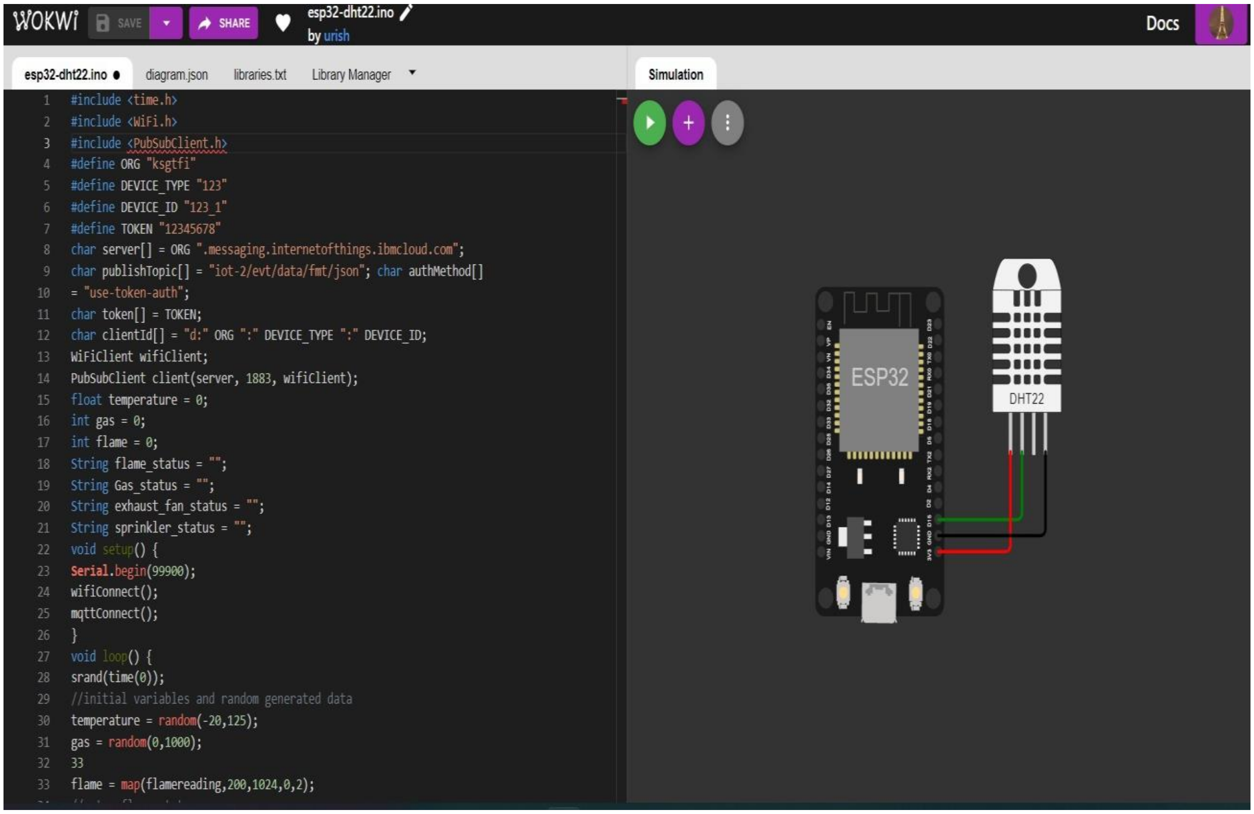
3.4 IDEA PRIORITIZATION:



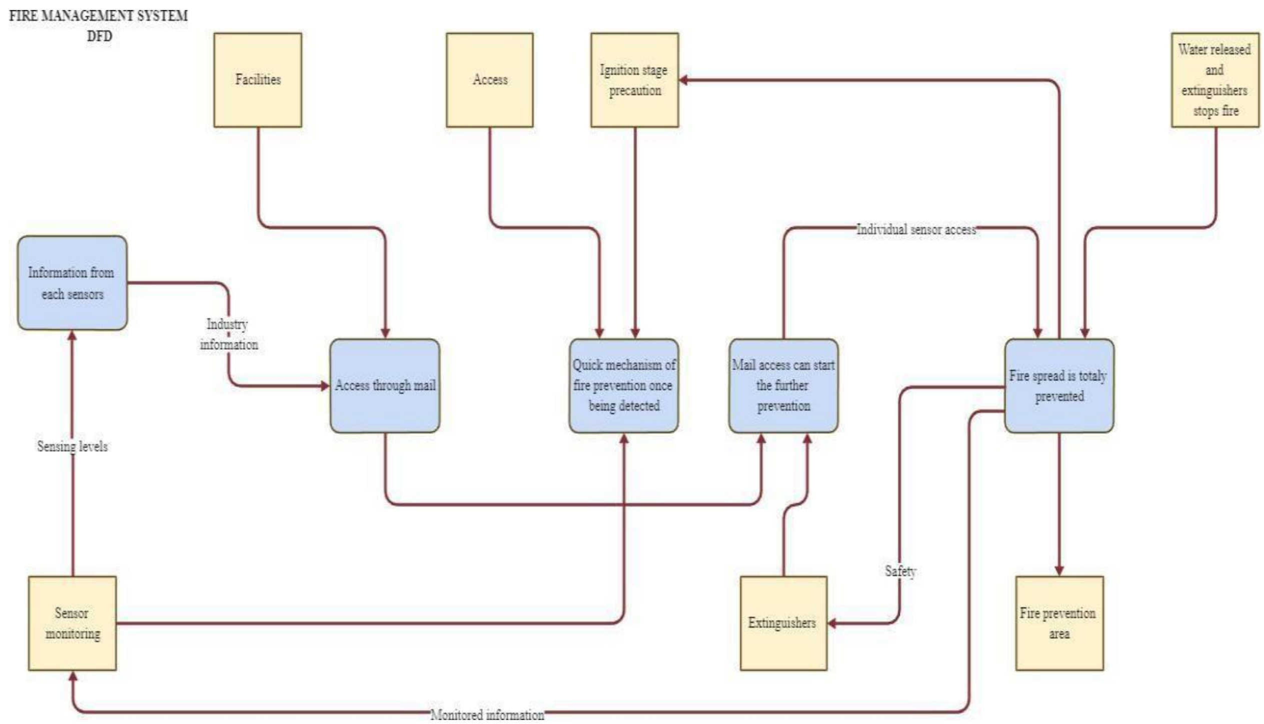
4 REQUIREMENT ANALYSIS

4.1 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

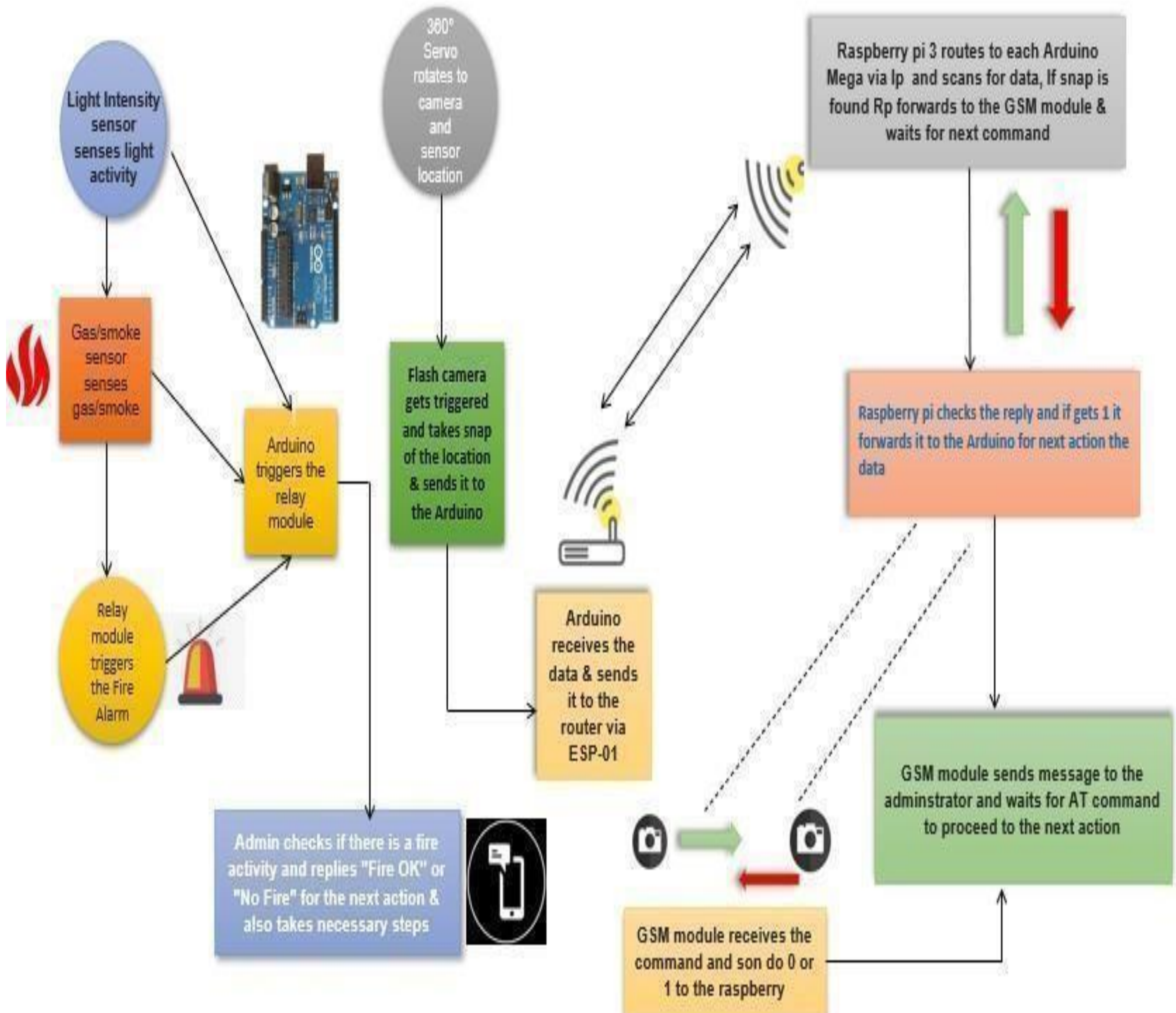

WOKWi
SAVE
SHARE
esp32-dht22.ino
by urish
Docs
esp32-dht22.ino
diagram.json
libraries.txt
Library Manager
Simulation
#include <time.h>
#include <WiFi.h>
#include <PubSubClient.h>
#define ORG "ksgtfi"
#define DEVICE_TYPE "123"
#define DEVICE_ID "123_1"
#define TOKEN "12345678"
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
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

5 Project Design
5.1 Data Flow Diagrams:



Solution & Technical Architecture:

Solution Architecture



5.2 User Stories:

User Type	Functional requirement	User story number	User story/task	Accept 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

6 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 sensors to 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 structure enhances the efficiency and effectiveness of fire detection. Moreover, using the Ubidots platform 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 to predict the potentiality of fire based on the collected data from different sources. Machinelearning may help the operators find and overcome the vulnerabilities in their building to prevent fire 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.

7 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.