EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

IBM-Project-16320-1659611452

NALAIYA THIRAN PROJECT BASED LEARNING ON PROFESSIONAL READLINESS FOR INNOVATION, EMPLOYNMENT AND ENTERPRENEURSHIP

A PROJECT REPORT

Submitted by

SUDHARSHAN S
RAJKUMAR M
MANOJKUMAR M
SHEYAM SUNDAR B

TEAM ID : PNT2022TMID32812

INDUSTRY MENTOR : SHANTHI

FACULTY MENTOR : V.MOHAN

BACHELOR OF ENGINEERING

ELECTRONICS AND COMMUNICATION ENGINEERING

SARANATHAN COLLEGE OF ENGINEERING

TIRUCHIRAPPALLI - 620012

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1. INTRODUCTION

1.1 Project overview:

Fire can make major hazards in this hectic world. All buildings and vehicles used in public transportation have fire prevention and fire protection systems due to the accelerated number in the fire incidents. Also, many of the firms conduct a mock fire drill in every occurrence of months to protect their employees from the fire. This would help them to understand what to do or what not to do when a fire situation happens. Forests are one of the main factors in balancing the ecology. It is very harmful when a fire occurs in a forest. But mostof the time, the detection of forest fire happens when it spread over a wide region. Sometimes,it could not be possible to stop the fire. As a result, the damage of the environment is higherthan predictable. The emission of large amount of carbon dioxide (CO2) from the forest fire damages the environment. As well as it would lead to complete disappearance of rare species inthe world. Also, it can make an impact on the weather, and this make major issues like earthquakes, heavy rains, floods and so on.

A research study shows an automatic fire detection can be divided into three groups: aerial, ground and borne detection. The ground-based systems use several staring black and white video cameras are used in fire detection which detect the smoke and compares it with the natural smoke. The main benefit of using this system is high temporal resolution and spatial resolution. So that, the detection is easier.2But these mechanisms still have some drawbacks in detecting the early stage of the fire. So that, it is highly important to introduce a system to detect the fire early as possible.

Moreover, information regarding the seat of the hearth is invaluable for the rapid deployment of fire- fighters. Therefore, early detection, containment at the primary stages and extinguishment of a fireplace before it spreads are crucial for wildfire Management.

1.2. Purpose

Forest fires as of late have been annihilating both for normal biological system, biodiversity and woodland economy. With expanding populace weight and change in worldwide atmosphere situation, there is an expansion in level of fires that are a significant reason for declining Indian woodlands. As indicated by woodland study report of India, 50 % ofbackwoods regions in nation are fire inclined (going from 50 to 90 % in certain conditions of nation). Around 6 % of the woods are inclined to extreme fire harms. The reason for this planned framework is to manufacture a dependable fire location framework so as to know dynamic status of backwoods temperature in specific conditions. It is about the sensors and dynamic checking framework to dodge a significant fire and genuine harm to woods.

2. LITERATURE SURVEY

2.1. Existing problem

The existing system for detecting fire are smoke alarms and heat alarms. The main disadvantage of the smoke sensor alarm and heat sensor alarms are that just one module is not enough to monitor all the potential fire prone places. The only way to prevent fire is to cautious at the time. Even if they are installed in every nook and corner, it just is not sufficient for an efficient output consistently. As the number of smoke sensor requirement increase the cost will also increase to its multiple. The proposed system can produce consistent and highly accurate alerts within seconds of accident of the fire. It reduces cost because only one software is enough to power the entire network of surveillance. Research is active on thisfield by data scientists and machine learning researchers. The real challenge is to minimize the error in detection of fire and sending alerts at the right

time. The idea of this research is to fabricate a system through IoT sensors, which is arbitrarily spread in the forest and to make a self-sorted out powerful system between the sensors to cover all the enormous territories in the forest that will used to maintain a strategic distance from the fire harm whenever. The capacity of the sensor is to identify fire in the inclusion region between the time intermission of each 5-10 minutes. At the point when the fire is recognized the entirety of the sensor in the region will be dynamic and order to stop the normal assignment. The concept is to build early fire detector using Arduino which is connected with different IoT sensors. Putting all efforts to develop a smarter system by connecting it to a webpage and monitoring the developed system statistics controlled by the Arduino programming. The use of latest technology can help to prevent the catastrophic accidents in forests. The aim is to early detect the fireplace in forest by considering the several factor like smoke, temperature, humidity, flame and based on the data we get from this programming, the forest department will be able to take an appropriate decision and the rescue team will be able to arrive on time at exact location. Consider, if it is a large region and it produces more carbon monoxide than the ordinary vehicle traffic. Surveillance of the danger areas and an early detection of fireplace can appreciably shorten the response time and additionally decrease the practicable injury as nicely as the fee of firefighting. Known rule applies here:1 minute – 1 cup of water, 2 minutes - 100 liters of water, 10 minutes - 1000 liters of water. The goal is to notice the fireplace as quicker as possible, its actual localization and early notification to the fire devices. When fire starts then the flammable texture may likewise issues fuel to the hearth focal spot. The spot at that point will expand and more extensive. The first phase of start is alluded as "surface fire‟ stage. This may feed on abutting bushes and the fire will turn into higher and transforming into "crown fire‟. Generally, at this

stage the hearth transforms into wild and injury which end up being extreme that could stay for quite long time while depending on atmosphere conditions and the territory. Forest fire detection using optimized solar–powered ZigBee wireless sensor networks- In this paper, they have developed system for Forest Fire Detection which overcomes the demerits of the Existing technologies of Forest Fire Detection. It can be ensured that the systemdeveloped can be implemented on a large scale with its promising results. Thesystem is provided with low-power elements, higher versions of Zigbee,Maximum power point tracking Algorithm is used in order to make the system run for longer periods efficiently. Forest fires are a very serious problem in many countries, and global warming may contribute to make this problem worse. Experts agree that, in order to prevent these tragedies from happening, it is necessary to invest in new technologies and equipment that enable a multifaceted approach. This paper describes a WSN for early detection of forest fires. This network can be easily deployed at areas of special interest or risk. There are two types of nodes from the physicalstructure point of view: SNs, to collect data from the environment, and CNs, to gather data from the SNs and transmit the information to a Control Centre. The nodes also can be in different functioning modes. This enables a proper and seamless configuration of the network, provides redundancy, and ensures there will be full temporal and geographical coverage in the deployment zone. The information gathered is related not only to early detection purposes but also to environment monitoring to maximize the WSN usage. Thisenvironmental data can also be employed to firefighting preventive tasks such as vegetation modelling, microclimate studies, and propagation model parametrization.

Characteristics	Flaming	Smoldering
Emissions	Light gases Particles high in EC	Hydrocarbons, PAH's, mercaptans, partially oxidized gases, particles lower in EC
Flames	visible	not visible
Extent of reaction (combustion efficiency)	Reactions tend to go to completion (90-95%)	Incomplete combustion reactio (60-90%)
O_2 concentrations	>= 15%	>= 5%
Temperature	>300°C (peak of 1800°K)	< 300°C
Combustion efficiency [1]	About 90-95%	About 60-90%

TABLE 1. Comparison of different techniques

In this paper, a forest fire detection algorithm is proposed. The algorithm uses YCbCr color space since it effectively separates luminance from chrominance and is able to separate high temperature fire center pixels because the fire at the high temperature center region is white. The final results show that the proposed system has good detection rates and fewer false alarms, which are the main crucial problems of the most existing algorithms. The presences of fire in video streamsare indicated by semantic events. Most of the existing systems can only be used forthe videos obtained from stationary cameras and videos obtained from the controlled lightening conditions. These existing automatic fire detection systems cannot be used for video streams obtained from mobile phones or any hand held devices. It was decried as a global tragedy. Lit by farmers, the fires raged through villages, destroyed ecosystems and pumped climate-warming pollution into the atmosphere.

2.2 References

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2.3. Problem Statement Definition

- In earlier times fires were detected with the help of watching towers or using satellite images.
- Satellites collect images and send it to the monitoring authority which will decide by seeing images that it is a fire or not.
- But this approach was very slow as the fire may have spread in the large areas and caused so much damage before the rescue team came.
- In the watching tower method, there was a man always standing on the tower who would monitor the area and inform if there was fire.
- This method was also slow because before the man got to know about the fire it may have spread in the inner parts of forest, also it always requires a man who must be present there.

- Since, we know that some areas, especially forest areas are large so it is practically impossible to put a man in every part of forest from where they can monitor the forest area.
- So, both these approaches of watching towers and satellite images failed to detect fire as early as possible to reduce the damage done by fire Problems in fire detection:
- There were mainly two problems in fire detection as discussed:
- (a). Judging criteria for the fire: Edge is set, on the off chance that the worth is more noteworthy than edge, it is a fire, else not.
- So, this problem was removed by using machine learning techniques by many researchers.
- (b). Connection of nodes: Traditional systems used cables to connect alarm with the detectors.
- Cable was mainly of copper. But copper wire may be costly or it can suffer from fault in the mid-way.
- So, this problem was removed using wireless sensor networks.
- So, with the advancement in technology researchers find an efficient method to detect forest fire with the help of Wireless Sensor Network.
- Fire can be identified by conveying sensor hubs in timberland regions by which they illuminate about fire.
- Conveying sensor hubs in the timberland regions means placing sensors in every part of the forest and mostly in the prone areas where risk of 9 catching fire is more. With the use of wireless sensor networks, now it is easy to detect the fire in large areas as soon as possible.

3.IDEATION & PROPOSED SOLUTION

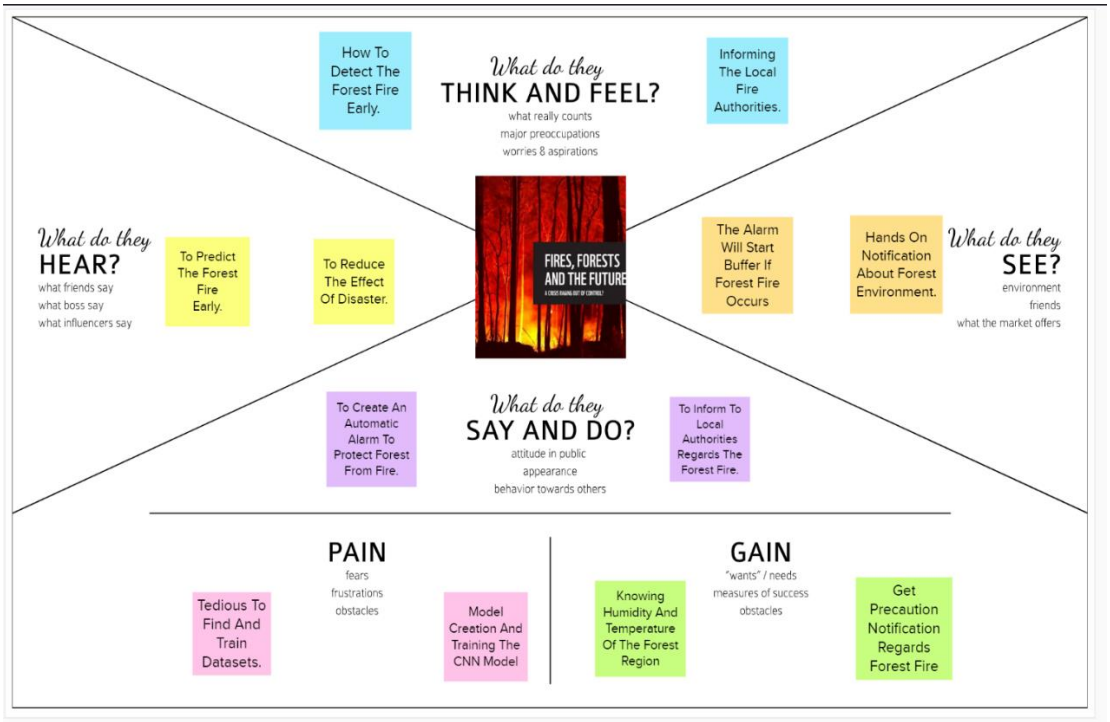
3.1 Empathy Map Canvas

1. An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community.

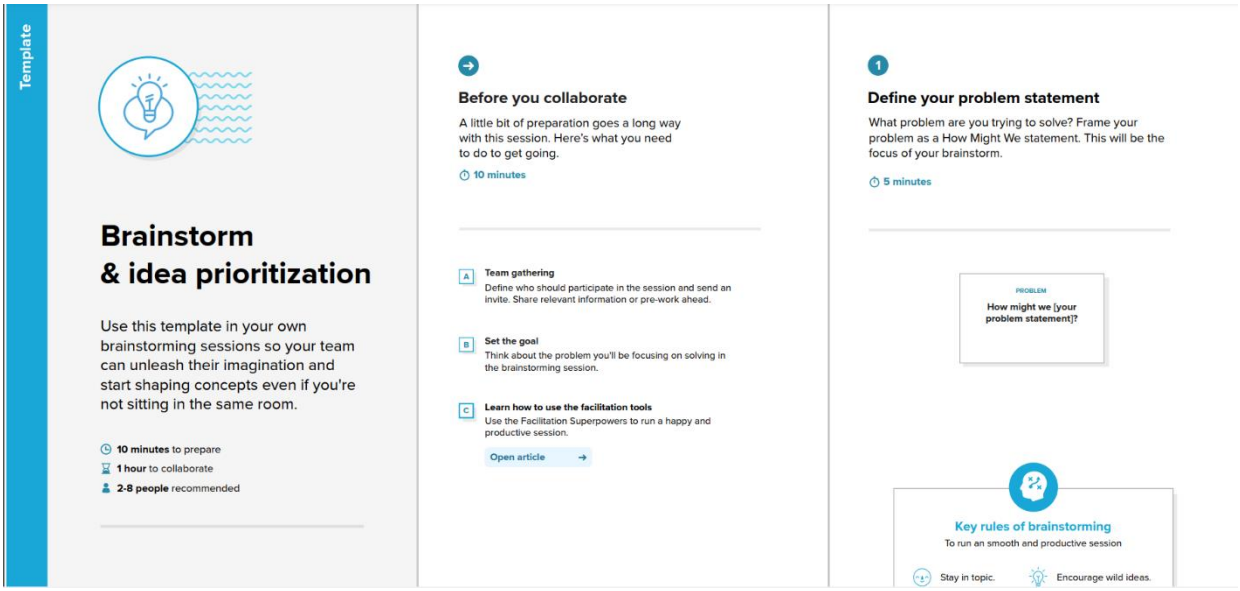
2. An empathy map is an effective visualization template that helps analyze the behavior and emotions of customers and users. Empathy maps not only detect the behaviors but highlight possible mediums for brands to communicate with their customers in a better way

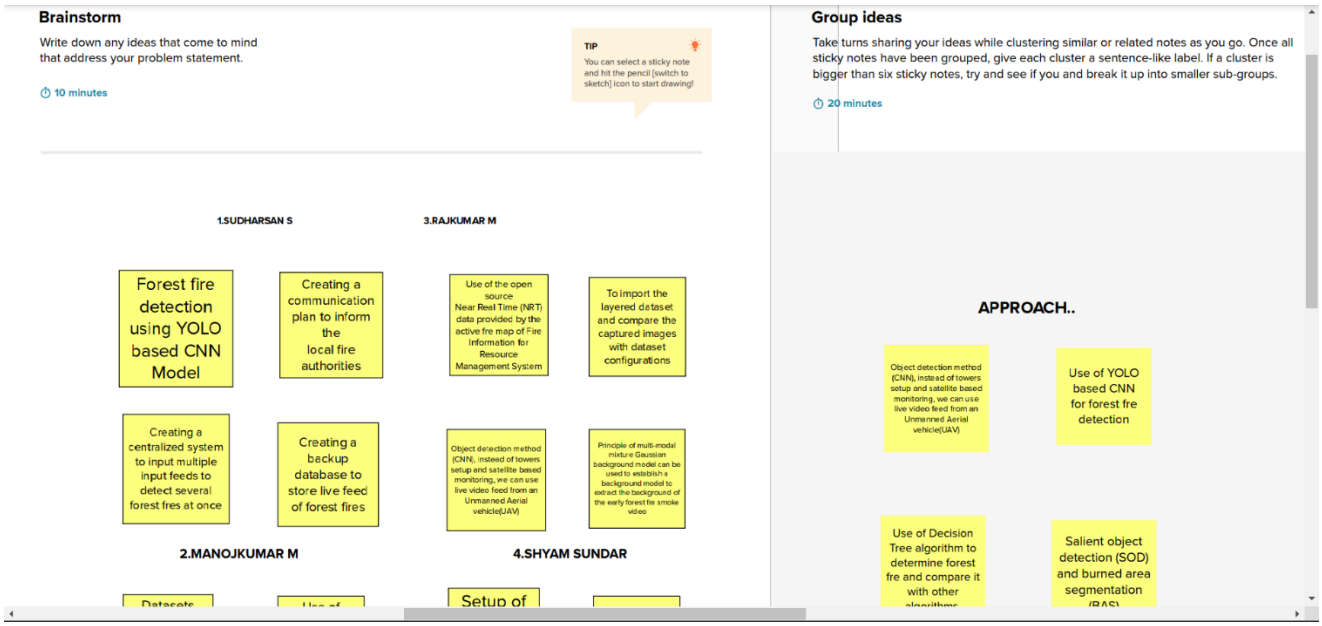
3. Empathy maps can also be used to collect data directly from the users. Used alongside user interviews, survey answers, etc., you can also have a user fill in an empathy map themselves. This often reveals aspects of the user that may have remained unsaid or not thought of.

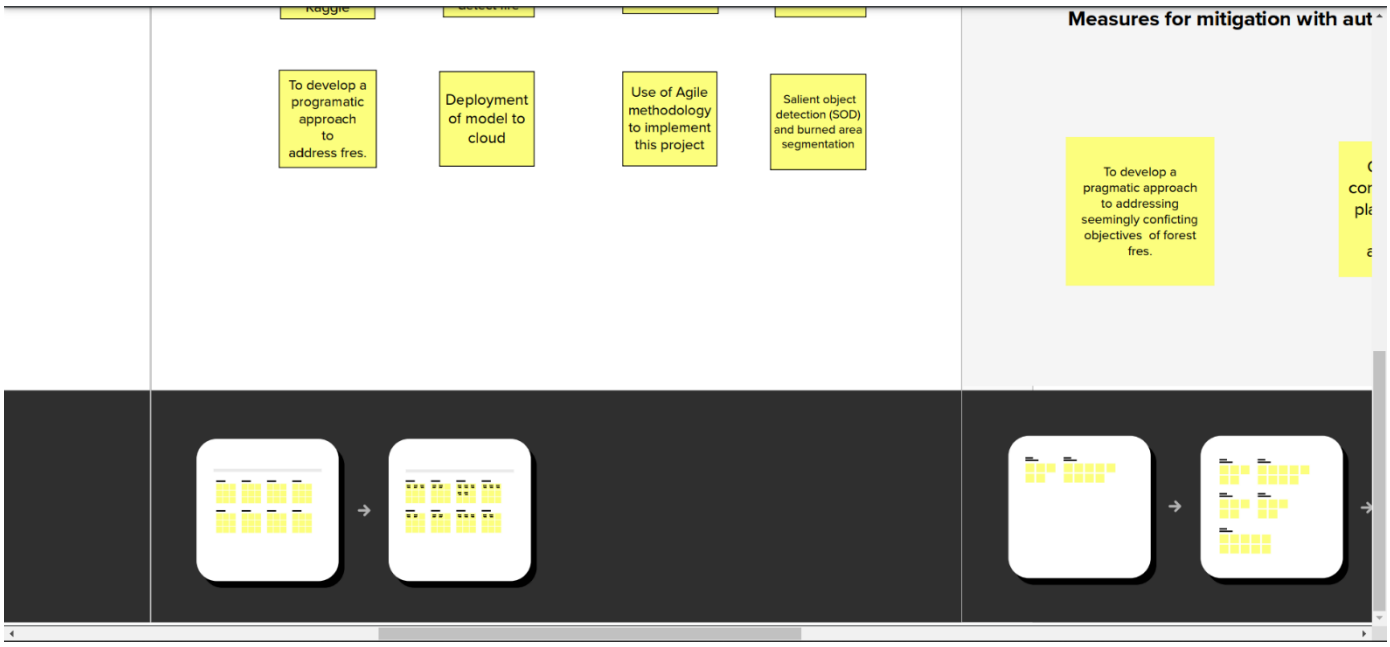
4. Each of the four quadrants comprises a category that helps us delve into the mind of the user. The four empathy map quadrants look at what the user says, thinks, feels, and does.

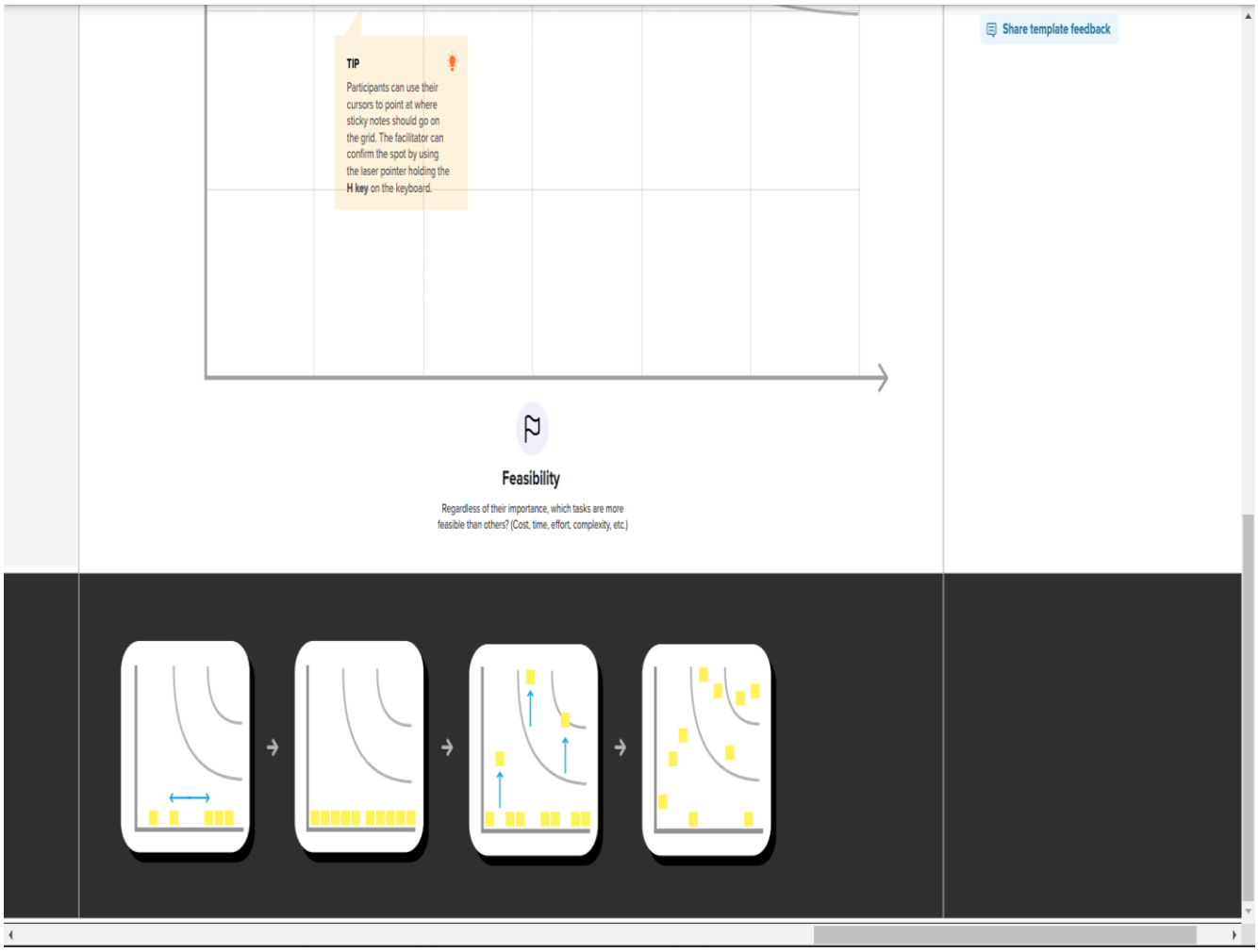


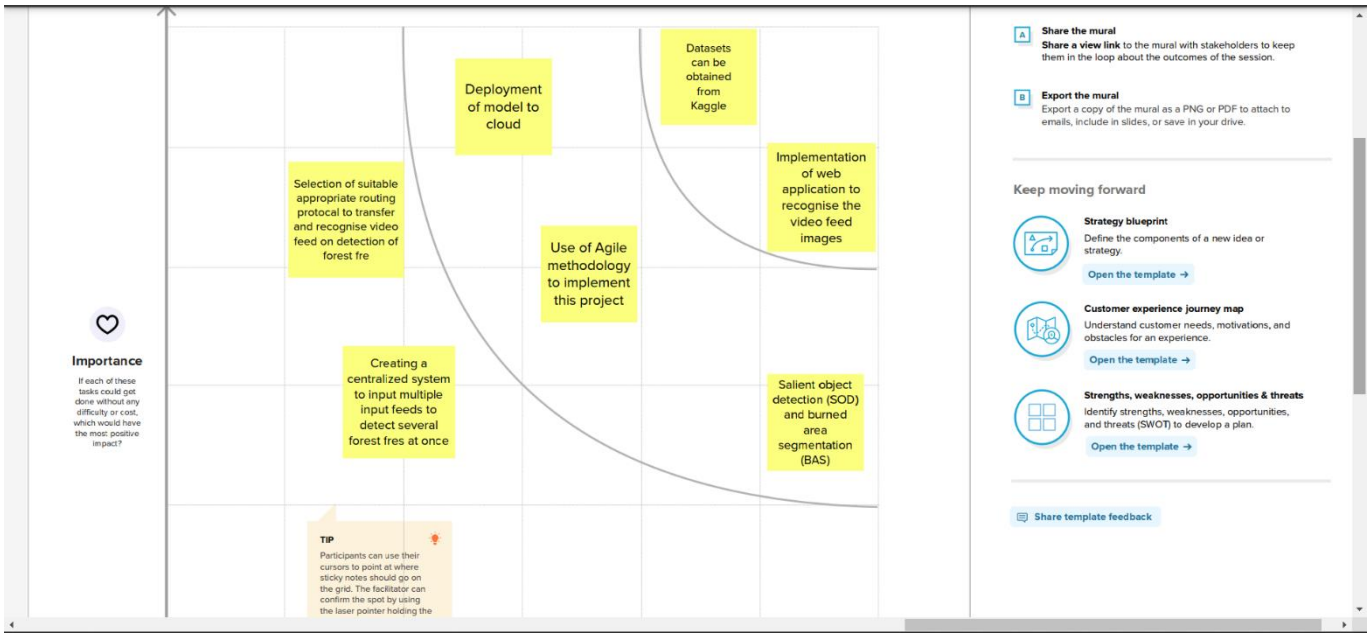
Ideation & Brainstorming




Brainstorm
Write down any ideas that come to mind that address your problem statement.
10 minutes
TIP
You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!
1.SUDHARSAN S
3.RAJKUMAR M
Forest fire detection using YOLO based CNN Model
Creating a communication plan to inform the local fire authorities
Use of the open source Near Real Time (NRT) data provided by the active fre map of Fire Information for Resource Management System
To import the layered dataset and compare the captured images with dataset configurations
Creating a centralized system to input multiple input feeds to detect several forest fres at once
Creating a backup database to store live feed of forest fires
Object detection method (CNN), instead of towers setup and satellite based monitoring, we can use live video feed from an Unmanned Aerial vehicle(UAV)
Principle of multi-modal mixture Gaussian background model can be used to establish a background model to extract the background of the early forest fie smoke video
2.MANOJKUMAR M
4.SHYAM SUNDAR
Setup of
Group ideas
Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.
20 minutes
APPROACH..
Object detection method (CNN), instead of towers setup and satellite based monitoring, we can use live video feed from an Unmanned Aerial vehicle(UAV)
Use of YOLO based CNN for forest fre detection
Use of Decision Tree algorithm to determine forest fre and compare it with other
Salient object detection (SOD) and burned area segmentation


To develop a programatic approach to address fres.
Deployment of model to cloud
Use of Agile methodology to implement this project
Salient object detection (SOD) and burned area segmentation
Measures for mitigation with aut
To develop a pragmatic approach to addressing seemingly conflicting objectives of forest fres.


TIP
Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the H key on the keyboard.
Share template feedback
Feasibility
Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)



3.2. Proposed Solution

1

Overview

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. There are typically about 100,000 wildfires in the United States every year. Over 9 million acres of land have been destroyed due to treacherous wildfires. It is difficult to predict and detect Forest Fire in a sparsely populated forest area

Aim

1. We can find forest fire early to avoid vulnerability and upcoming disaster.
2. Early Warning system to alert the officers and people to save lot of lives.
3. It is real time detection of forest fire.

Specifications

HARDWARE SPECIFICATION

The hardware requirements may serve as the basis for a contract for the implementation of the system and should therefore be a complete engineer as the starting point for the system design.

Ram	: 8GB Ram or more
Processor	: Any Processor
GPU	: 8GB or more
Hard Disk	: 10GB or more
Speed	: 1.4GHZ or more

SOFTWARE SPECIFICATION

The software requirements give detailed description of the system and all its features.

- Python
- Keras
- Tensorflow
- OpenCV
- Numpy
- Pandas

- Visual studio code
- Python-Flask
- IBM cloud
- Keras-tuner

BUSINESS MODEL

SOLUTION

- Fetch data from cctv and drones
- Image Preprocessing
- Image classification using CNN
- Video Analysis
- If fire detected send alert messages

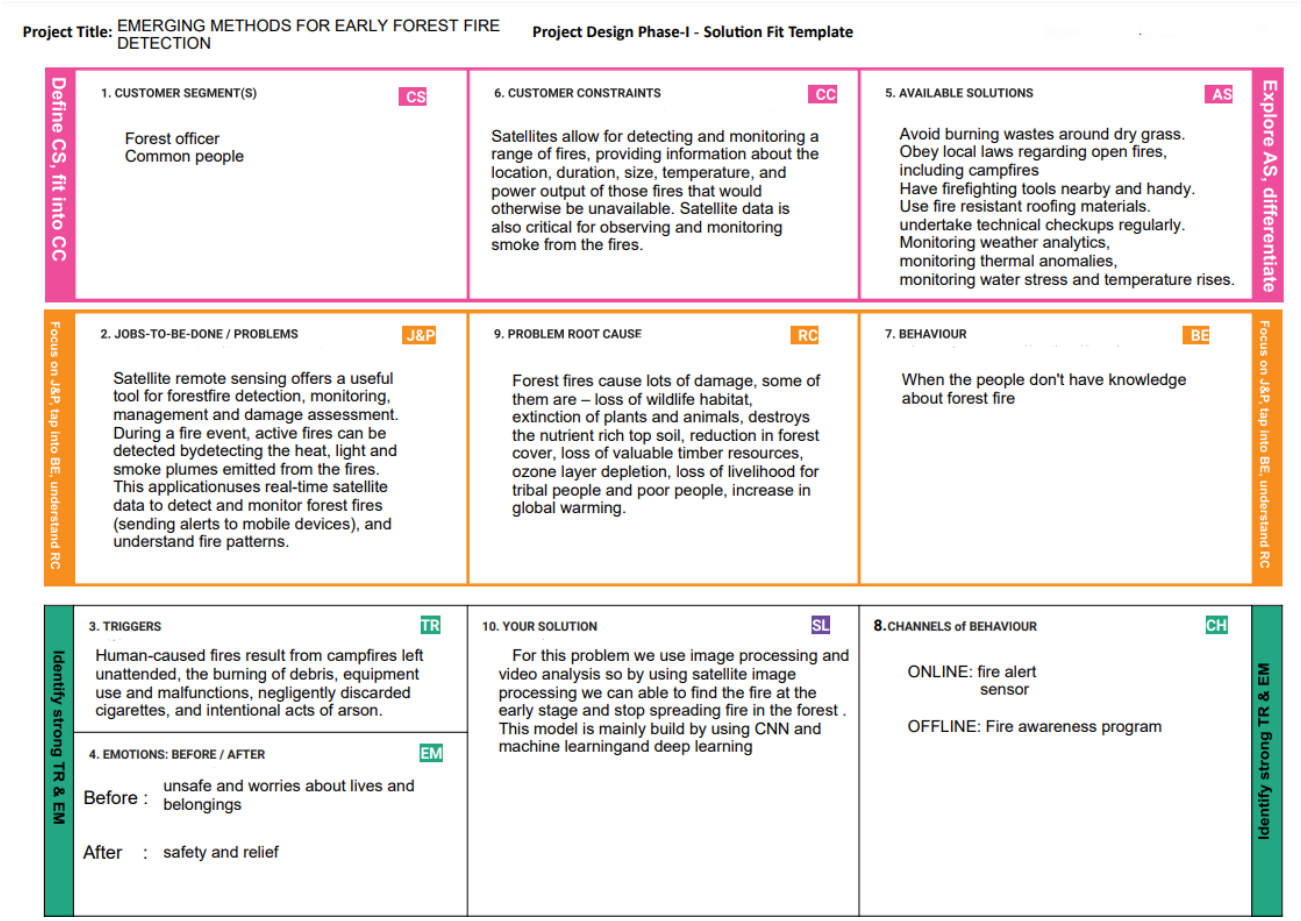
CONCLUSION

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. Our project aims to overcome this issue ,in order to reduce loss of life, damage and reduce vulnerability.

SOLUTION

- Fetch data from cctv and drones
- Image Preprocessing
- Image classification using CNN
- Video Analysis
- If fire detected send alert messages

3.2. Problem Solution fit



4. REQUIREMENT ANALYSIS

Project Design Phase-II
Solution Requirements (Functional & Non-functional)

Date	14 October 2022
Team ID	PNT2022TMID32813
Project Name	Emerging Methods for Early Detection Of Forest Fires

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Login	Login using credentials
FR-4	User Search	Search for Info on forest fire occurrence
FR-5	User Profile	User shall be given a live feed of the forest
FR-6	User Application	User is alerted if there is an forest fire occurrence in their surroundings

Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Alerts according to the user location
NFR-2	**Security**	Instant live feed with alert of the situation
NFR-3	**Reliability**	The prediction of the forest fire is 87% accurate
NFR-4	**Performance**	The feed and the alert message is an immediate action without a lag
NFR-5	**Availability**	The application gives alerts and live feeds 24/7
NFR-6	**Scalability**	Early detection and alerting users are done efficiently and in a faster means

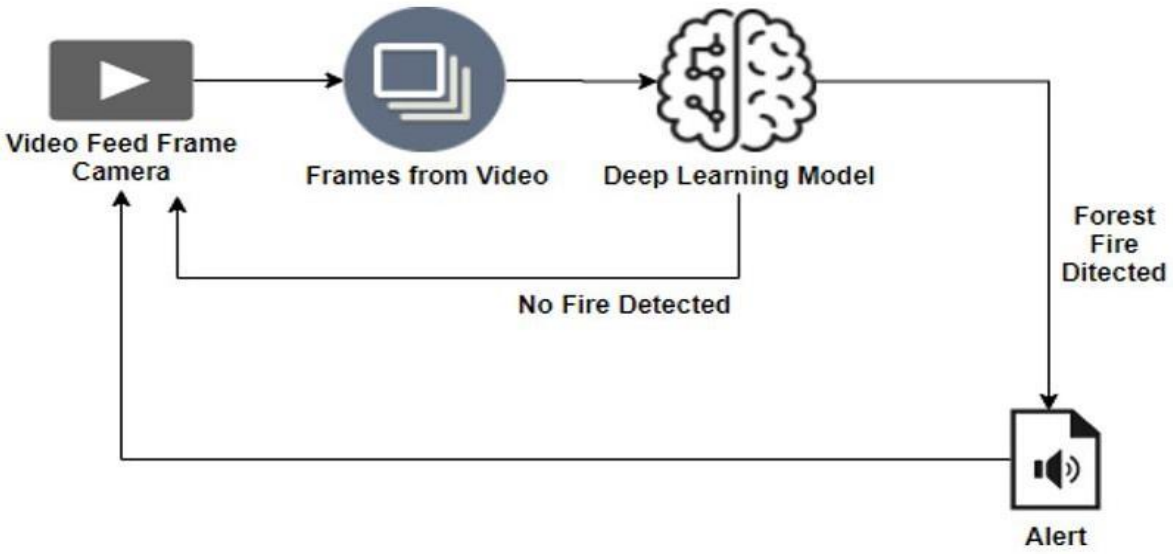
5. PROJECT DESIGN

5.1. Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Example:

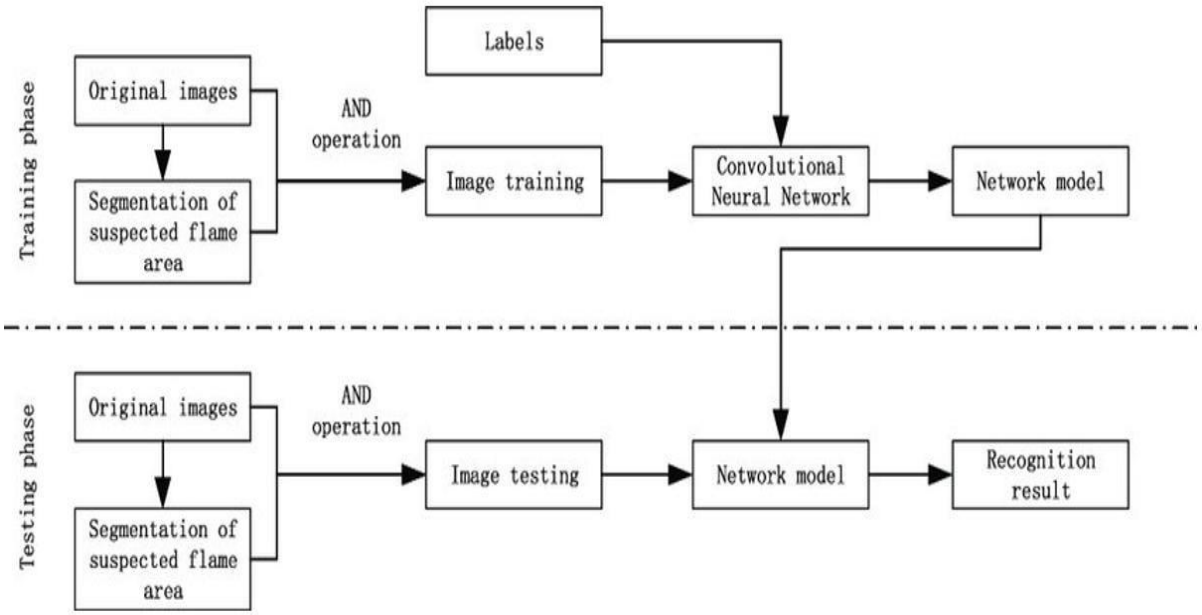
FLOWCHART



- It is difficult to predict and detect Forest Fire in a sparsely populated forest area.

- It is more difficult if the prediction is done using ground-based methods like Camera or Video-Based approach.
- Satellites can be an important source of data prior to and also during the Fire due to its reliability and efficiency.
- The various real-time forest fire detection and prediction approaches, with the goal of informing the local fire authorities.
- If the fire is not detected, it will send the result to the frame camera. If the forest fire will detected the alert will go to the video feed frame camera.

DFD:



5.2. Solution & Technical Architecture

Project Design Phase-I

Solution Architecture

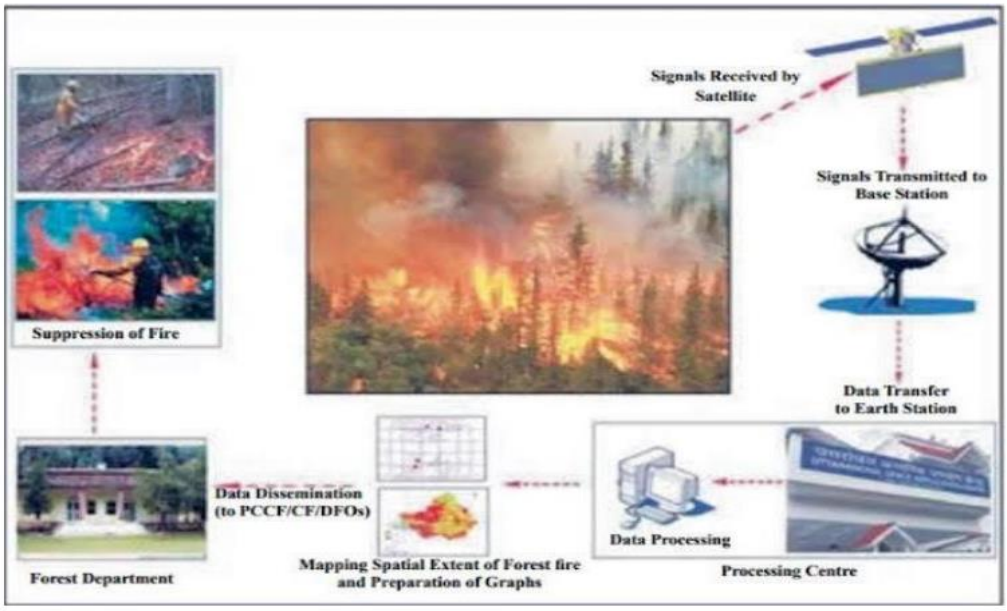
Project Name	Emerging Methods for Early Detection of Forest Fires.

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 thesoftware to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed,and delivered.

SOLUTION ARCHITECTURE DIAGRAM :



5.3 User Stories

Use the below template to list all the user stories for the product

User Type	Functional Requirement (Epic)	User Story Number	User Story I Task	Acceptance criteria	Priority	Release
Environmentalist	Collect the data	USN-1	As an Environmentalist.it is necessary to collect the data of the forest which includes temperature,humidity,wind and rain of the forest	It is necessary to collect the right data else the prediction may become wrona	High	Sprint-1
		USN-2	Identify algorithms that can be used for prediction	To collect the algorithm to identify the accuracy level of each algorithms	Medium	Sprint-2
	Implement Algorithm	USN-3	Identify the accuracy of each algorithms	Accuracy of each algorithm-calculated so that it is easy to obtain the most accurate output	High	Sprint-2
		USN-4	Evaluate the Dataset	Data is evaluated before processing	Medium	Sprint-1
	Evaluate Accuracy of Algorithm	USN-5	Identify accuracy,precision,recall of each algorithms	These values are important for obtaining the riaht output	High	Sprint-3

6. PROJECT PLANNING & SCHEDULING

6.1.Sprint Planning & Estimation

Team ID	PNT2022TMID32813
Project Name	Emerging Methods for Early Detection of Forest Fires

MILESTONE LIST

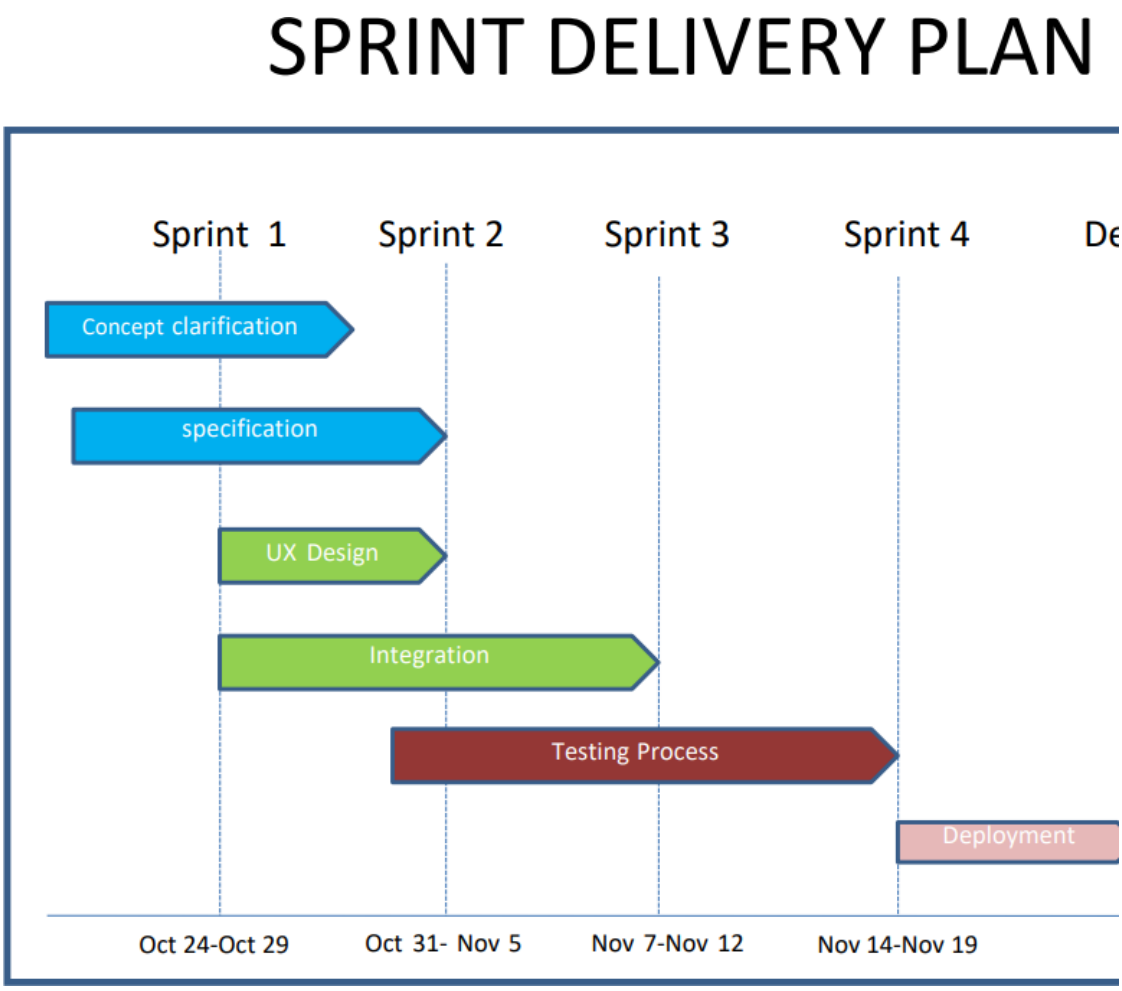
Milestone Name	Milestone Number	Description	Mandatory	
Project Objectives	M-01	We will be able to learn to prepare dataset, image processing, working with CNN layers, read images using OpenCV and CNNfor computervision AI	Yes	-
Project Flow	M-02	A project management process flowchart is a graphical aid, designed to visualize the sequence of steps to be followed throughout the project management process	Yes	
Pre-Requisites	M-03	To complete this project, we should have known following project such as Keras, TensorFlow, Python ,Anaconda, OpenCV, Flask, Scikit-learn etc....	Yes	
Prior Knowledge	M-04	One should have knowledge on the Supervised Learning ,CNN and Regression Classification and Clustering, ANN	Yes	
Data collection	M-05	We can collect dataset from different open sources like kaggle.com, UCI machine learning etc.	Yes	
Image Preprocessing	M-06	Importing the ImageDataGenerator libraries, Define Parameters/Arguments for ImageDataGenerator class, Applying Image Data Generator Functionality to trainset and test set	Yes	
Model Building	M-07	Importing the model building libraries, Initializing the model, Adding CNN layers, Adding Dense layers, Configuring the learning Process, Train the model, Save the model, Predictions.	Yes	
Video Analysis	M-08	Opencv for video processing, creating an account in twilio service and sending alert message	Yes	
Train CNN model	M-09	Register for IBM Cloud and train Image Classification Model	Yes	
Ideation Phase	M-10	Prepare Literature Survey on the selected Project and Information Gathering, empathy map and ideation	Yes	
Project Design Phase-I	M-11	Prepare Proposed solution , problem-solution fit and Solution Architecture	Yes	
Project Design Phase-II	M-12	Prepare Customer journey ,functional requirements, Dataflow diagram and Technology Architecture	Yes	
Project Planning Phase	M-13	Prepare Milestone list , Activity list and Sprint Delivery Plan	Yes	
Project Development Phase	M-14	Project Development delivery of Sprint 1, Sprint 2, Sprint 3, Sprint 4	Yes	

ACTIVITY LIST

Activity Number	Activity	Sub Activity	Assigned To	Status
1.	PROJECT OBJECTIVES		All Members	Completed
2.	PROJECT FLOW		All Members	Completed
3.	PRE-REQUISITES		All Members	Completed
4.	DATA COLLECTION	4.1 Download the Dataset	SUDHARSHAN	Completed
5.	IMAGE PREPROCESSING	5.1 Import the ImageDataGenerator Library. 5.2 Define the Parameters/Arguments for ImageDataGenerator class. 5.3 Applying ImageDataGenerator Functionality to trainset and testset.	All Members	In Progress
6.	MODEL BUILDING	6.1 Importing the model building libraries. 6.2 Initializing the model. 6.3 Adding CNN layers. 6.4 Adding dense layers. 6.5 Configuring the learning process. 6.6 Training the model. 6.7 Saving the model. 6.8 Predictions.	All Members	In Progress
7.	VIDEO ANALYSIS	7.1 OpenCV for video processing. 7.2 Creating an account in Twilio service. 7.3 Sending alert message.	SUDHARSHAN	In Progress
8.	TRAIN CNN MODEL ON IBM	8.1 Train image classification model. 8.2 Register for IBM cloud.	SUDHARSHAN	In Progress
9.	IDEATION PHASE	9.1 Literature Review. 9.2 Empathy map. 9.3 Ideation.	All Members	Completed
10.	PROJECT DESIGN PHASE – I	10.1 Proposed Solution. 10.2 Problem solution fit. 10.3 Solution Architecture.	All Members	Completed
11.	PROJECT DESIGN PHASE -II	11.1 Customerjourney. 11.2 Functional requirement. 11.3 Data flow Diagrams. 11.4 Technology Architecture.	All Members	Completed
12.	PROJECT PLANNING PHASE	12.1 Prepare milestone and activity list. 12.2 Sprint delivery plan.	All Members	Completed

13.	PROJECT DEVELOPMENT PHASE	13.1 Project development-Delivery of Sprint-1. 13.2 Project development-Delivery of Sprint-2. 13.3 Project development-Delivery of Sprint-3. 13.4 Project development-Delivery of Sprint-4.	All Members	In Progress

6.2 Sprint Delivery Schedule



6.3 Reports from JIRA

JIRA has categorized reports in four levels, which are −

1.6.1. Agile
1.6.2. Issue Analysis
1.6.3. Forecast & Management
1.6.4. Others

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)

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

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

1. Feature 1

```
!pip install tensorflow
!pip install opencv-python
!pip install opencv-contrib-python
import tensorflow as tf
import numpy as np
from tensorflow import keras
import os
import cv2
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
   from tensorflow.keras.preprocessing import image
train=ImageDataGenerator(rescale=1./255,
                                 shear_range=0.2,
                                 rotation_range=180,
                                 zoom_range=0.2,
                                 horizontal_flip=True)
train = ImageDataGenerator(rescale=1/255)
test = ImageDataGenerator(rescale=1/255)
train_dataset = train.flow_from_directory("/content/drive/MyDrive/Dataset/train_set",
                                          target_size=(128,128),
                                          batch_size = 32,
                                          class_mode = 'binary' )
test_dataset = test.flow_from_directory("/content/drive/MyDrive/Dataset/test_set",
                                          target_size=(128,128),
                                          batch_size = 32,
                                          class_mode = 'binary' )
test_dataset.class_indices
#to define linear initialisation import sequential
from keras.models import Sequential
#to add layer import Dense
from keras.layers import Dense
#to create convolution kernel import convolution2D
from keras.layers import Convolution2D
#import Maxpooling layer
from keras.layers import MaxPooling2D
#import flatten layer
from keras.layers import Flatten
import warnings
warnings.filterwarnings('ignore')
model =Sequential()
#add convolutional layer
model.add(Convolution2D(32,(3,3),input_shape=(128,128,3),activation='relu'))
#add maxpooling layer
model.add(MaxPooling2D(pool_size=(2,2)))
#add flatten layer
model.add(Flatten())
model.add(Dense(150,activation='relu'))

model.add(Dense(1,activation='sigmoid'))
model.compile(loss = 'binary_crossentropy',
              optimizer = "adam",
              metrics = ["accuracy"])
model.fit_generator(x_train,steps_per_epoch=14,epochs=5,validation_data=x_test,valida
tion_steps=4)
model.save("/content/drive/MyDrive/archive(1)/forest1.h5")
predictions = model.predict(test_dataset)
predictions = np.round(predictions)
predictions
```

```
print(len(predictions))
#import load_model from keras.model
from keras.models import load_model
#import image class from keras
import tensorflow as tf
from tensorflow.keras.preprocessing import image
#import numpy
import numpy as np
#import  cv2
import cv2
#load the saved model
model = load_model("/content/drive/MyDrive/archive(1)/forest1.h5")
def predictImage(filename):
  img1 = image.load_img(filename,target_size=(128,128))
  Y = image.img_to_array(img1)
  X = np.expand_dims(Y,axis=0)
  val = model.predict(X)
  print(val)
  if val == 1:
    print(" fire")
  elif val == 0:
      print("no fire")
predictImage("/content/drive/MyDrive/Dataset/test_set/with fire/19464620_401.jpg")
```

2. Feature 2

```
!pip install tensorflow
!pip install opencv-python
!pip install opencv-contrib-python
import tensorflow as tf
import numpy as np
from tensorflow import keras
import os
import cv2
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.preprocessing import image
train=ImageDataGenerator(rescale=1./255,
                                    shear_range=0.2,
                                    rotation_range=180,
                                    zoom_range=0.2,
                                    horizontal_flip=True)
train = ImageDataGenerator(rescale=1/255)
test = ImageDataGenerator(rescale=1/255)
train_dataset = train.flow_from_directory("/content/drive/MyDrive/Dataset/train_se
t",
```

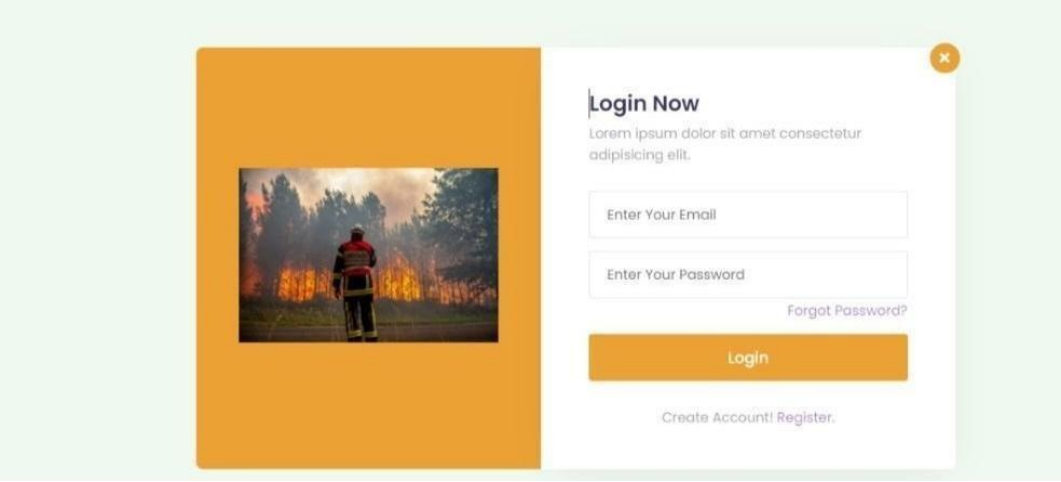
```
                                                target_size=(128,128),
                                                batch_size = 32,
                                                class_mode = 'binary' )
test_dataset = test.flow_from_directory("/content/drive/MyDrive/Dataset/test_set",
                                                target_size=(128,128),
                                                batch_size = 32,
                                                class_mode = 'binary' )
test_dataset.class_indices
#to define linear initialisation import sequential
from keras.models import Sequential
#to add layer import Dense
from keras.layers import Dense
#to create convolution kernel import convolution2D
from keras.layers import Convolution2D
#import Maxpooling layer
from keras.layers import MaxPooling2D
#import flatten layer
from keras.layers import Flatten
import warnings
warnings.filterwarnings('ignore')
model =Sequential()
#add convolutional layer
model.add(Convolution2D(32,(3,3),input_shape=(128,128,3),activation='relu'))
#add maxpooling layer
model.add(MaxPooling2D(pool_size=(2,2)))
#add flatten layer
model.add(Flatten())
model.add(Dense(150,activation='relu'))

model.add(Dense(1,activation='sigmoid'))
model.compile(loss = 'binary_crossentropy',
              optimizer = "adam",
              metrics = ["accuracy"])
model.fit_generator(x_train,steps_per_epoch=14,epochs=5,validation_data=x_test,val
idation_steps=4)
model.save("/content/drive/MyDrive/archive(1)/forest1.h5")
predictions = model.predict(test_dataset)
predictions = np.round(predictions)
predictions
print(len(predictions))
#import load_model from keras.model
from keras.models import load_model
#import image class from keras
import tensorflow as tf
from tensorflow.keras.preprocessing import image
#import numpy
import numpy as np
#import cv2
```

```
    import cv2
    #load the saved model
    model = load_model("/content/drive/MyDrive/archive(1)/forest1.h5")
    def predictImage(filename):
      img1 = image.load_img(filename,target_size=(128,128))
      Y = image.img_to_array(img1)
      X = np.expand_dims(Y,axis=0)
      val = model.predict(X)
      print(val)
      if val == 1:
        print(" fire")
      elif val == 0:
          print("no fire")
    predictImage("/content/drive/MyDrive/Dataset/test_set/with fire/19464620_401.jpg")
pip install twilio
pip install playsound
#import opencv librariy
import cv2
#import numpy
import numpy as np
#import image function from keras
from keras.preprocessing import image
#import load_model from keras
from keras.models import load_model
#import client from twilio API
from twilio.rest import Client
#imort playsound package
from playsound import playsound
#load the saved model
model = load_model(r'/content/drive/MyDrive/archive(1)/forest1.h5')
#define video
video = cv2.VideoCapture('/content/Fighting Fire with Fire _ Explained in 30 Seconds.
mp4')
#define the features
name = ['forest','with forest']
account_sid='ACfb4e6d0e7b0d25def63044919f1b96e3'
auth_token='f9ae4fc4a617a527da8672e97eefb2d8'
client=Client(account_sid,auth_token)
message=client.messages \
.create(
      body='Forest Fire is detected, stay alert',
      from_='+1 302 248 4366',
      to='+91 99400 12164'
)
print(message.sid)
pip install pygobject
def message(val):
  if val==1:
```

```
    from twilio.rest import Client
    print('Forest fire')
    account_sid='ACfb4e6d0e7b0d25def63044919f1b96e3'
    auth_token='f9ae4fc4a617a527da8672e97eefb2d8'
    client=Client(account_sid,auth_token)
    message=client.messages \
     .create(
        body='forest fire is detected, stay alert',
        #use twilio free number
        from_='+1 302 248 4366',
        #to number
        to='+91 99400 12164')
    print(message.sid)
    print("Fire detected")
    print("SMS Sent!")
  elif val==0:
    print('No Fire')
from matplotlib import pyplot as plt
#import load model from keras.model
from keras.models import load_model
#import image from keras
from tensorflow.keras.preprocessing import image
img1 = image.load_img('/content/drive/MyDrive/Dataset/test_set/with fire/Wild_fires.j
pg',target_size=(128,128))
Y = image.img_to_array(img1)
x = np.expand_dims(Y,axis=0)
val = model.predict(x)
plt.imshow(img1)
plt.show()
message(val)
img2 = image.load_img('/content/drive/MyDrive/Dataset/test_set/forest/1200px_Mountain
area.jpg',target_size=(128,128))
Y = image.img_to_array(img2)
x = np.expand_dims(Y,axis=0)
val = model.predict(x)
plt.imshow(img2)
plt.show()
message(val)
```

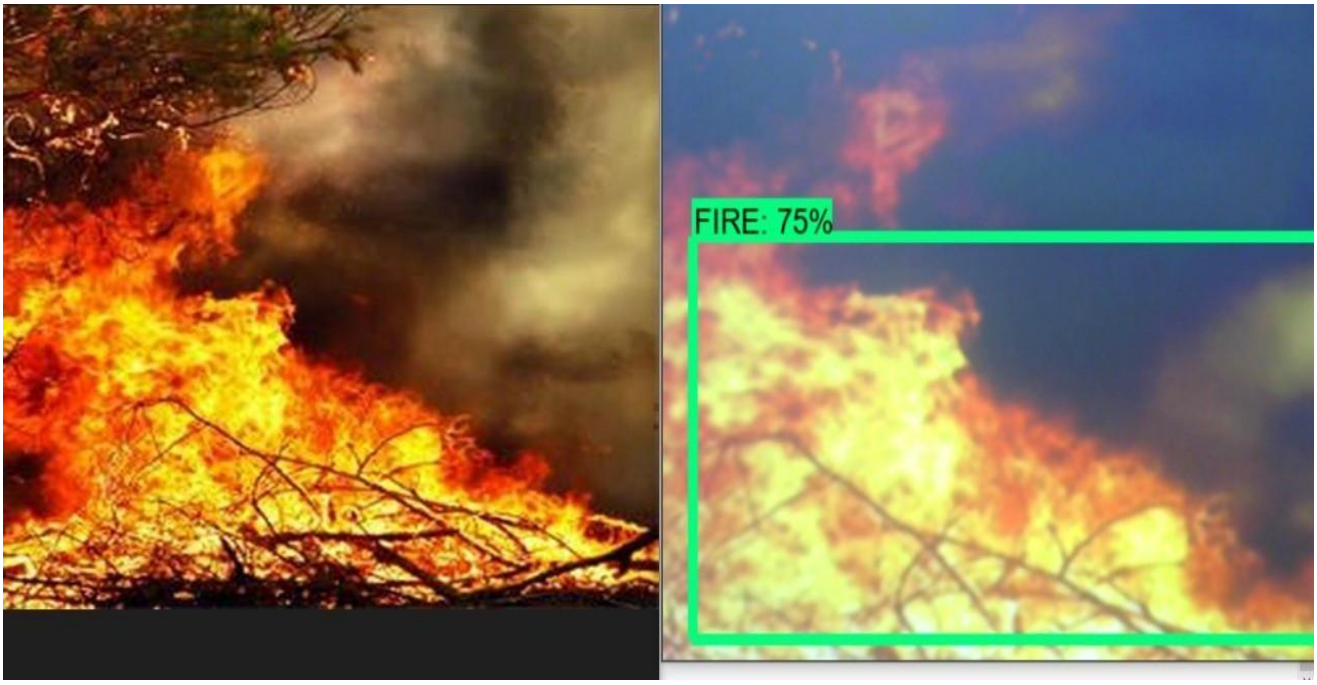
8. TESTING

8.1. Test Cases



9. RESULTS

9.1. Performance Metrics



Value obtained from three sensor, if any Infrared ray detected, it gives output as IR detected, Sensor activated! Similarly, if there is any temperature change it will show Abnormal temperature and its intensity. For any smoke detection it output as Smoke detected and sensor value.Above image is result obtained from the trained ML model showing count for damaged and intact homes

10. ADVANTAGES & DISADVANTAGES

Advantages:

1. It refreshes the habitat zones:

Fire clears out plants and trees to make more natural resources available to the habitat. Fewer trees mean more water becomes available for the remaining plants and animals that call the area their home. New grass and shrubs are food sources for a number of animals as well. A ground cover that comes back after a fire becomes a new micro-habitat. Everything is refreshed with a fire.

2. Low-intensity fires don't usually harm trees:

The bark of a tree is like an armored shell against fire, pests, and other things that could damage them. Most forest fires burn at low- temperature levels when conditions are optimal and this causes minimal damage to the trees of the forest when it occurs. The end result is a clearing of the ground floor of the forest while the trees are able to continue standing majestically.

1. Decreases the Wastes on Forests:

Forests have a lot of waste that ends up building up over time and these wastes can help create wildfires. If a large wildfire breaks out it might take weeks to control it and the damage it can cause is just too extensive to understand for us. Waste such as dead leaves on the ground can be pretty useful for wildfires to feed on and small forest fires just deal with these wastes properly without going out of control.

Disadvantages:

1.A forest fire sets up the potential for soil erosion to occur:

Forest fires clear the underbrush away and encourage new growth, but there is a period of time between the fire and the new growth where the forest is vulnerable.

2.Forest fires always bring death in some form:

Maybe it's just the weak plants of the forest that are killed during a fire, but there is always some sort of death that happens when a fire occurs. Sometimes it is the firefighters who are tasked with stopping the fire. It could be animals or pets.

3.Uncontrolled fires can cause localized air pollution:

Despite the amount of global development that has occurred, there are many forests that are difficult or nearly impossible to reach. Fires in these areas are left to burn in an uncontrolled fashion and this creates air pollution which can affect the local environment and make it difficult to breathe.

11. CONCLUSION

This project will help in early detection of forest fire and the prevention. It also involves the risk factor of analyzing the drone images of affected areas using machine learning algorithm which overcomes the existing project. This system detects the fire conditions in a short time before any fire accidents spreads over the forest area. The scope of using video frames in the detection of fire using machine learning is challenging as well as innovative. If this system with less error rate can be implemented at a large scale like in big factories, houses, forests, it is possible to prevent damage and loss due to random fire accidents by making use of the Surveillance System.

12. FUTURE SCOPE

Future Scope In future, we are planning to install smart water tank system in dense forest where reachability of resources and firefighters is difficult. In addition to that we will be updating the system with more features and reliability. We will also include a high pitch sound system that will keep away the animals from the site of fire.The proposed system can be developed to more advanced system by integrating wireless sensors with CCTV for added protection and precision. The algorithm shows great promise in adapting to various environment.

12.Appendix

Github:

Github repository link : https://github.com/IBM-EPBL/IBM-Project-16320-1659611452