PROJECT TITLE:

Emerging Methods for Early Detection of Forest Fires

TEAM ID:

PNT2022TMID12754

TEAM MEMBERS:

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3. BhanuSagar K V-19L205
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S.NO **TABLE OF CONTENT**

1. INTRODUCTION

a. Project 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 and 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.

b. Purpose

The forest fires destroys the wildlife habitat, damages the environment, affects the climate, spoils the biological properties of the soil, etc. So the forest fire detection is a major issue in the present decade. At the same time the forest fire have to be detected as fast as possible.

2. LITERATURE SURVEY

a. Existing problem

Every year, approximately 340,000 and 4,444 premature deaths from respiratory disease and 4,444 cardiovascular disease are associated with wildfire smoke. The increasing frequency and severity of wildfires is an increasing threat to biodiversity worldwide.

Individuals, corporations, and public institutions Fires cause huge economic losses. Fire behavior can be described in terms of how a fire responds to the interaction of fuel, weather, and terrain (fire behavior triangle). The four main parameters used to describe the behavior of fire include speed of propagation, intensity of fire line, flame length, and flame height.

b. References

i. PalaniappanS,AwangR.Intelligentheartdiseasepredictionsystem using data miningtechniques.IntJComputSciNetSecur.2008;8:343–350.

ii. SayadAT,HalkarnikarPP.Diagnosisofheartdiseaseusing neuralnetworkapproach.IntJAdvSciEngTechnol.2014;2:88–92

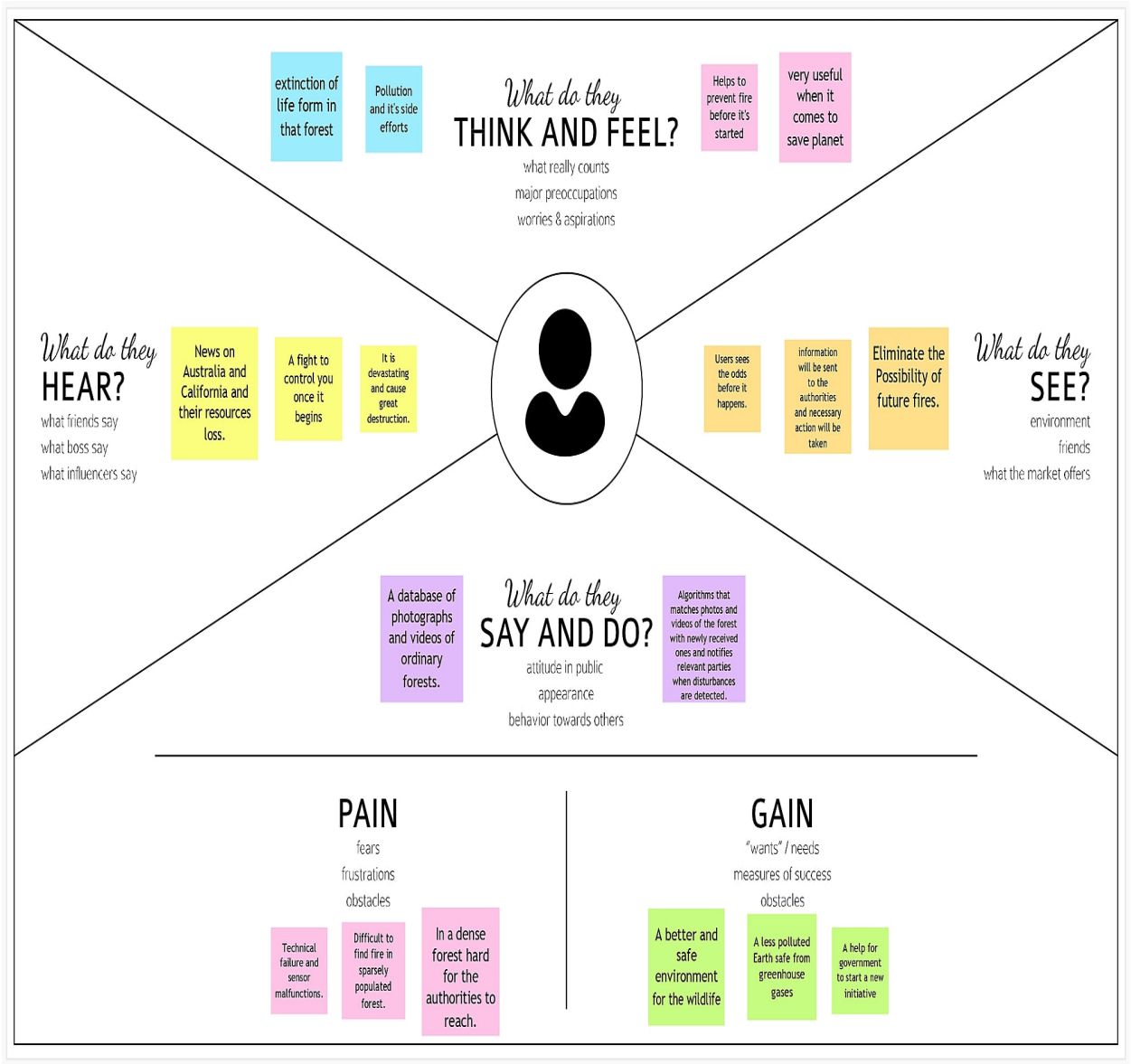
iii. GudadheM,WankhadeK,DongreS.Decisionsupportsystemforheartdiseasebasedonsupportvectormachineand ArtificialNeuralNetwork.ComputerandCommunicationTechnology(ICCCT),2010InternationalConferenceon;2010.pp.741–745

c. Problem Statement Definition

AI-based methods for early detection of forest fires.A solution is needed in the early stages of wildfires that detects smoke, hydrogen, and other gases emitted from pyrolysis to detect fires early, giving firefighters valuable time to put out the fire before it goes out of control.

3. IDEATION & PROPOSED SOLUTION

a. **Empathy Map Canvas**



b.Ideation & Brainstorming

Brainstorm

& idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare

1 hour to collaborate

2-8 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

A Team gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B Set the goal
Think about the problem you'll be focusing on solving in the brainstorming session.

C Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and

productive session.

Open article

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

Key rules of brainstorming

To run an smooth and productive session

Stay in topic.

Encourage wild ideas.

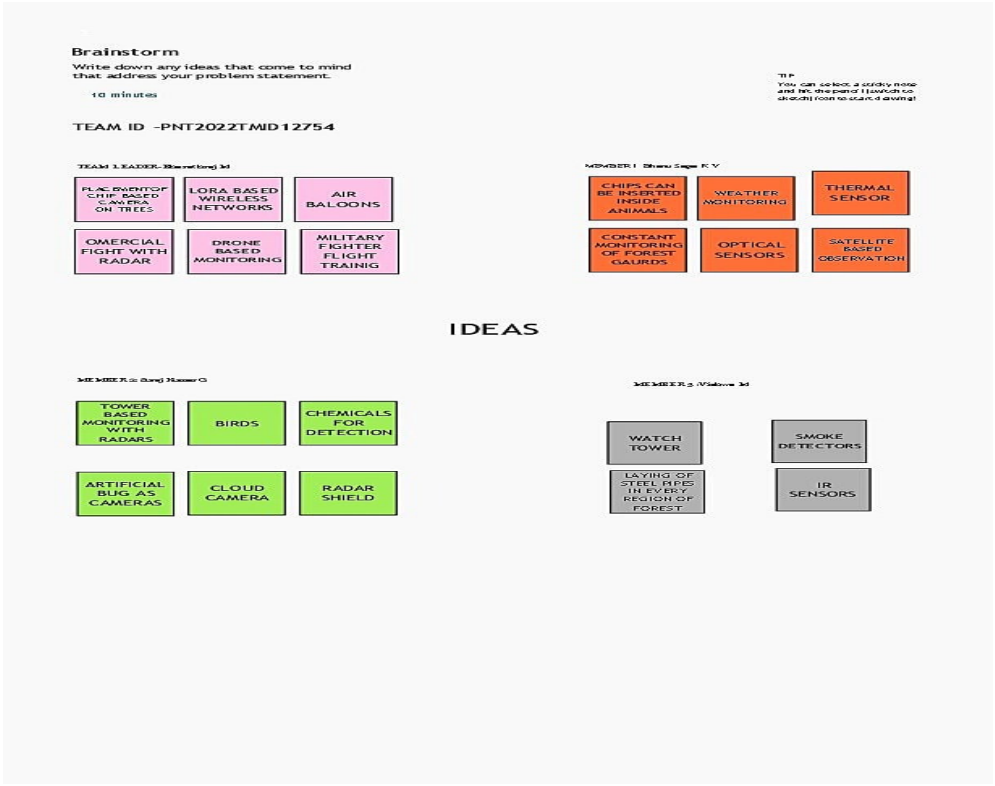
Defer judgment.

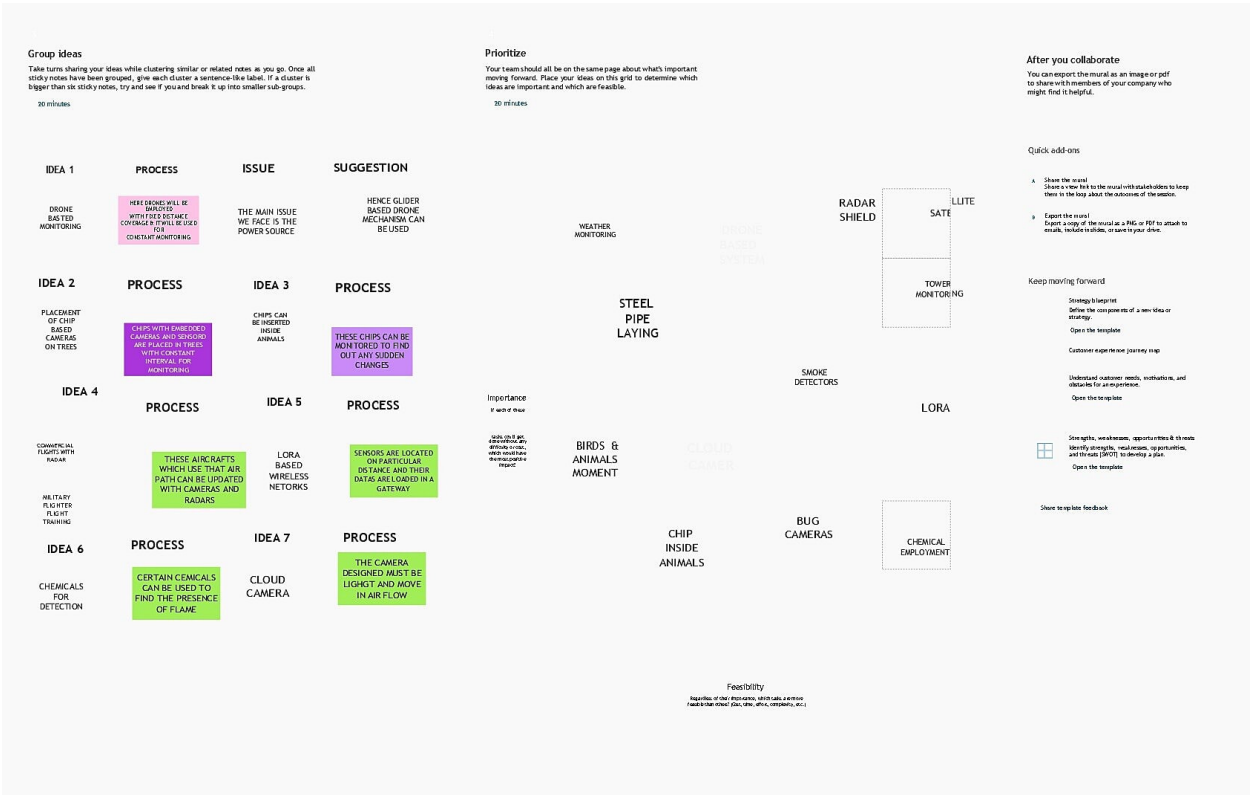
Listen to others.

Go for volume.

If possible, be visual.

Emerging Method for Early Detection Forest fire


Brainstorm
Write down any ideas that come to mind that address your problem statement.
10 minutes
TEAM ID -PNT2022TMID12754
PLACEMENT OF CHIP BASED CAMERA ON TREES
LORA BASED WIRELESS NETWORKS
AIR BALOONS
OMERCIAL FIGHT WITH RADAR
DRONE BASED MONITORING
MILITARY FIGHTER FLIGHT TRAINIG
CHIPS CAN BE INSERTED INSIDE ANIMALS
WEATHER MONITORING
THERMAL SENSOR
CONSTANT MONITORING OF FOREST GAURDS
OPTICAL SENSORS
SATELLITE BASED OBSERVATION
IDEAS
TOWER BASED MONITORING WITH RADARS
BIRDS
CHEMICALS FOR DETECTION
ARTIFICIAL BUG AS CAMERAS
CLOUD CAMERA
RADAR SHIELD
WATCH TOWER
SMOKE DETECTORS
LAYING OF STEEL PIPES IN EVERY REGION OF FOREST
IR SENSORS

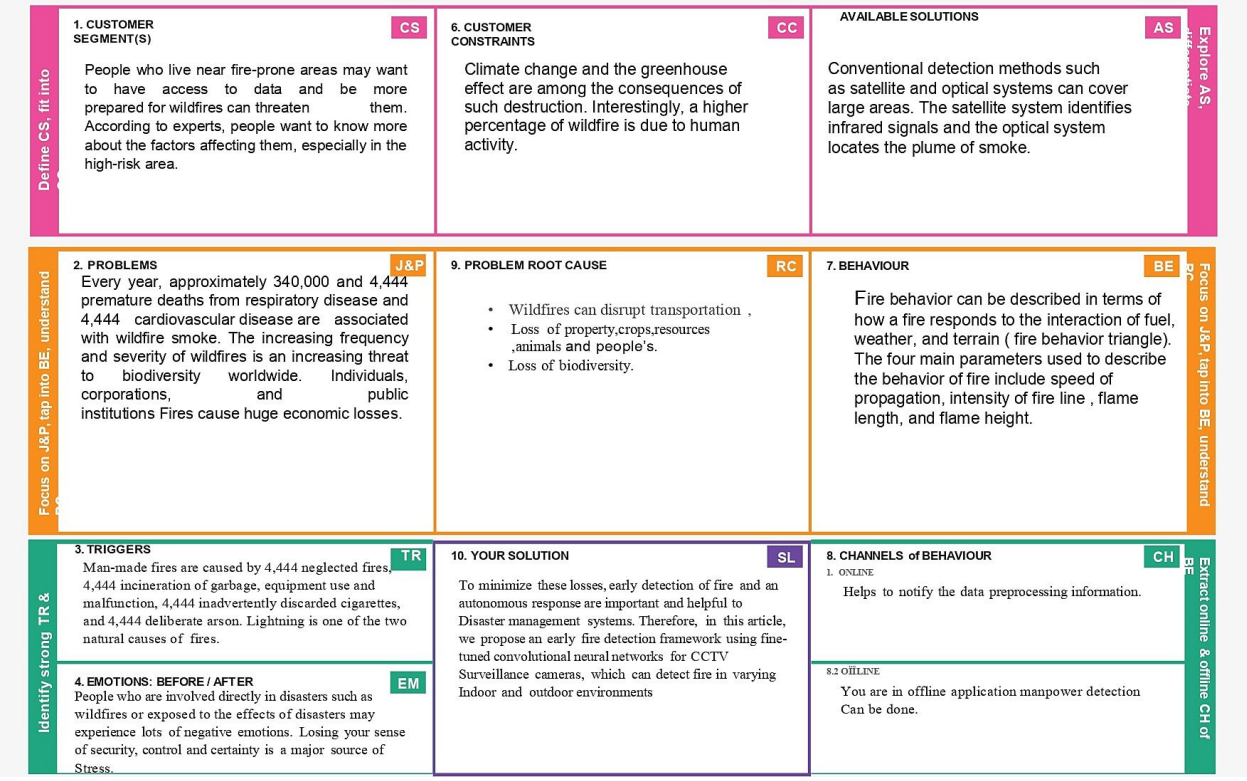

Group ideas
Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.
20 minutes
IDEA 1
PROCESS
ISSUE
SUGGESTION
DRONE BASED MONITORING
HERE DRONES WILL BE EMPLOYED WITH FIXED DISTANCE COVERAGE IT WILL BE USED FOR CONSTANT MONITORING
THE MAIN ISSUE WE FACE IS THE POWER SOURCE
HENCE GLIDER BASED DRONE MECHANISM CAN BE USED
IDEA 2
PROCESS
IDEA 3
PROCESS
PLACEMENT OF CHIP BASED CAMERAS ON TREES
CHIPS WITH EMBEDDED CAMERAS AND SENSORS ARE PLACED IN TREES WITH CONSTANT INTERVAL FOR MONITORING
CHIPS CAN BE INSERTED INSIDE ANIMALS
THESE CHIPS CAN BE MONITORED TO FIND OUT ANY SUDDEN CHANGES
IDEA 4
PROCESS
IDEA 5
PROCESS
COMMERCIAL FLIGHTS WITH RADAR
MILITARY FLIGHTER FLIGHT TRAINING
THESE AIRCRAFTS WHICH USE THAT AIR PATH CAN BE UPDATED WITH CAMERAS AND RADARS
LORA BASED WIRELESS NETORKS
SENSORS ARE LOCATED ON PARTICULAR DISTANCE AND THEIR DATAS ARE LOADED IN A GATEWAY
IDEA 6
PROCESS
IDEA 7
PROCESS
CHEMICALS FOR DETECTION
CERTAIN CEMICALS CAN BE USED TO FIND THE PRESENCE OF FLAME
CLOUD CAMERA
THE CAMERA DESIGNED MUST BE LIGHGT AND MOVE IN AIR FLOW
Prioritize
Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.
20 minutes
Importance
If each of these
looks do it get done without any difficulty or risk, which would have the biggest impact
WEATHER MONITORING
STEEL PIPE LAYING
BIRDS & ANIMALS MOMENT
CHIP INSIDE ANIMALS
RADAR SHIELD
SATE
LLITE
TOWER MONITORING
SMOKE DETECTORS
LORA
BUG CAMERAS
CHEMICAL EMPLOYMENT
Feasibility
Regardless of your importance, which tasks are the most feasible (low effort, high impact)?
After you collaborate
You can export the mural as an image or pdf to share with members of your company who might find it helpful.
Quick add-ons
Share the mural
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
Export the mural
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.
Keep moving forward
Strategy blueprint
Define the components of a new idea or strategy.
Open the template
Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.
Open the template
Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template
Share template feedback

3.3 Proposed Solution

S.No	Parameter	Description
1.	**Problem Statement (Problem to be solved)**	**AI-based** methods for early detection of forest fires
2.	**Idea / Solution description**	A solution is needed in the early stages of **wildfires that detects smoke, hydrogen, and other gases emitted from pyrolysis to detect fires early, giving** firefighters valuable time to **put out** the fire before it **goes** out of control.
3.	**Novelty / Uniqueness**	Remote **Sensing** Machine **Learning** Wildfire **Prediction AI** Data **Mining**
4.	**Social Impact / Customer Satisfaction**	The most important factors in fighting wildfires are fire detection as quickly as possible, Accurate fire classification, and prompt response from the fire department. Several different types of wildfires are known, including ground fires, ground fires, and crown/tree fires. Each of these types of wildfires is specific, and appropriate countermeasures must be considered and applied to successfully extinguish them. Over the years, forest fire detection has been done in a variety of ways, from the use of forest poles to fully automated solutions.
5.	**Business Model (Revenue Model)**	**Annual** losses from **wildfires cross** India **were** moderately estimated at Rs 440 **crores.**

6.	**Scalability of the Solution**	Aviation systems have recently received a lot of attention due to the rapid development of UAV technology. These systems provide a wider and more accurate awareness of fires, even in areas that are difficult to access or considered too dangerous for the fire brigade. UAVs are also flexible in that they can cover larger areas and monitor other areas as needed.

3.4 Problem solution fit



4. REQUIREMENT ANALYSIS

a. Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**User Registration**	Registration through Form Registration through Gmail
FR-2	**User Confirmation**	Confirmation via Email Confirmation via OTP
FR-3	**Data Prediction**	Scientists create computer models to predict the potential of wildlife and the range of potential climate prospects. Scientists use various temperature and fertilization forecasts to predict when and when 4.444 species of wildlife will be most likely to appear.
FR-4	**Using Sensors**	Installed on AI-enabled wildfire detection systems.these Bosch environmental sensors ar e being deployed as early warning tools for wildfires.

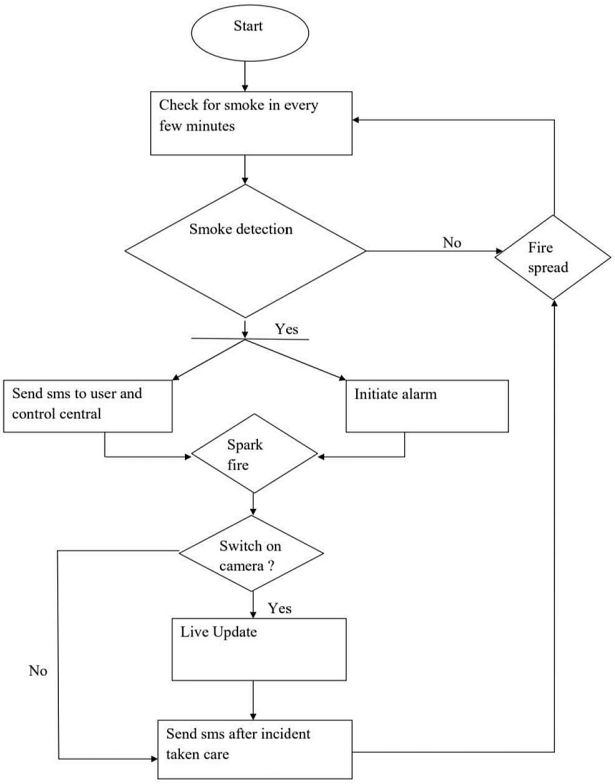
b. Non-Functional requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Many methods have been proposed using positive and negative aspects and detection performance metrics for forest fire detection. such as camera-based systems. WSN-based systems. and machine learning application-based systems.
NFR-2	**Security**	We developed this project to protect against wildfires.
NFR-3	**Reliability**	A classification time of 1.24 seconds was achieved with an accuracy of 91% and an F1 score of 0.91.
NFR-4	**Performance**	The main purpose of using dyons in the event of a fire is to gain situational awareness that can be used to guide the fighter's efforts to locate and control hotspots. As with enemies, it's best to keep an eye on your vehicles so you know what they're dealing with.
NFR-5	**Availability**	Wildfires (wildfires) are a common hazard in forests. especially in remote or unmanaged areas. AI can detect wildfires, high CO2 levels and temperatures.

NFR-6	Scalability	A widely used measure of fire strength is fire line strength, which is the rate of heat transfer per unit.

5. PROJECT DESIGN

a. Data Flow Diagram

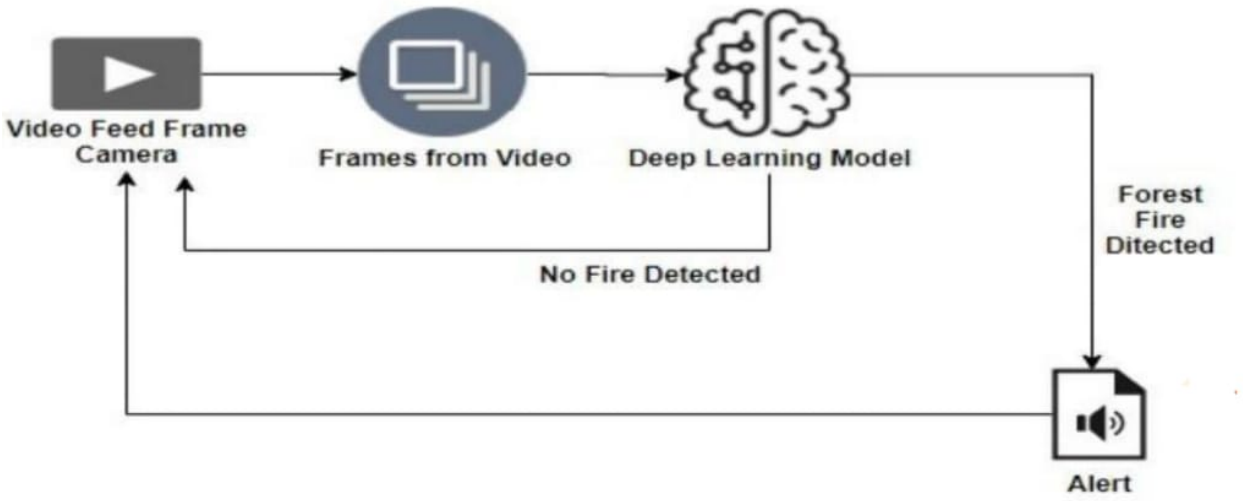


5.2 solution &Technical Architecture

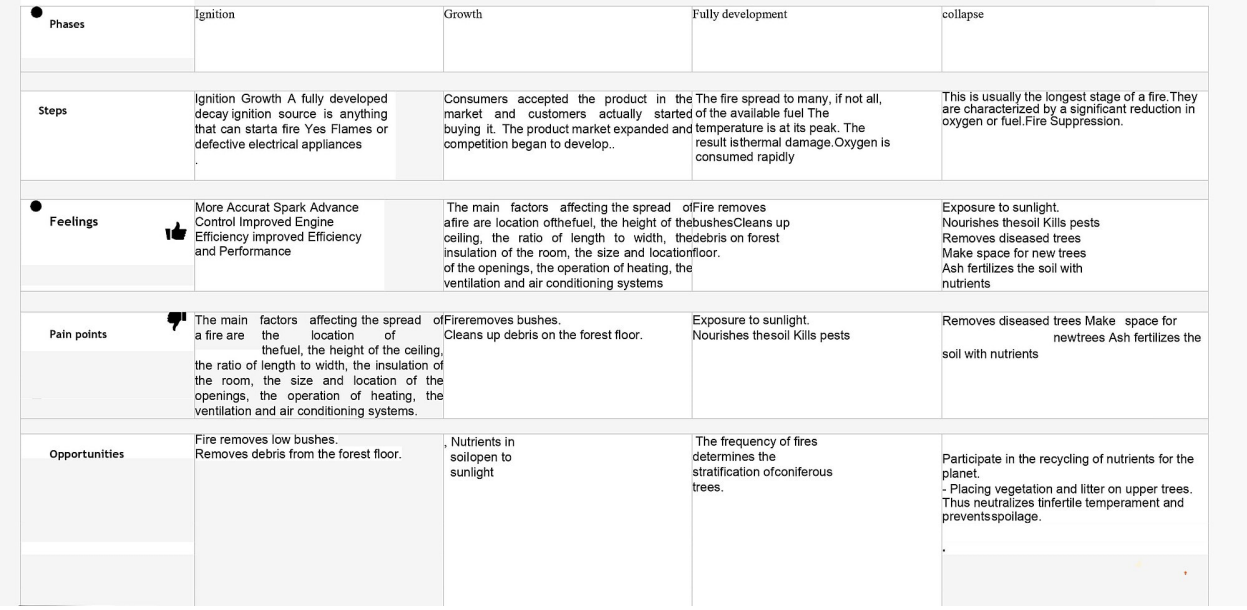
SOLUTION:

Conventional detection methods such as satellite and optical systems can cover large areas. The satellite system identifies infrared signals and the optical system locates the plume of smoke.To minimize these losses, early detection of fire and an autonomous response are important and helpful to Disaster management systems. Therefore, in this article, we propose an early fire detection framework using fine- tuned convolutional neural networks for CCTV Surveillance cameras, which can detect fire in varying Indoor and outdoor environments

ARCHITECTURE:



b. User Stories



Phases	Ignition	Growth	Fully development	collapse
Steps	Ignition Growth A fully developed decay ignition source is anything that can starta fire Yes Flames or defective electrical appliances .	Consumers accepted the product in the market and customers actually started buying it. The product market expanded and competition began to develop..	The fire spread to many, if not all, of the available fuel The temperature is at its peak. The result isthermal damage.Oxygen is consumed rapidly	This is usually the longest stage of a fire.They are characterized by a significant reduction in oxygen or fuel.Fire Suppression.
Feelings	More Accurat Spark Advance Control Improved Engine Efficiency improved Efficiency and Performance	The main factors affecting the spread ofa fire are location ofthefuel, the height of the ceiling, the ratio of length to width, the insulation of the room, the size and location of the openings, the operation of heating, the ventilation and air conditioning systems	Fire removes bushesCleans up debris on forest floor.	Exposure to sunlight. Nourishes thesoil Kills pests Removes diseased trees Make space for new trees Ash fertilizes the soil with nutrients
Pain points	The main factors affecting the spread of a fire are the location of thefuel, the height of the ceiling, the ratio of length to width, the insulation of the room, the size and location of the openings, the operation of heating, the ventilation and air conditioning systems.	Fireremoves bushes. Cleans up debris on the forest floor.	Exposure to sunlight. Nourishes thesoil Kills pests	Removes diseased trees Make space for newtrees Ash fertilizes the soil with nutrients
Opportunities	Fire removes low bushes. Removes debris from the forest floor.	, Nutrients in soilopen to sunlight	The frequency of fires determines the stratification ofconiferous trees.	Participate in the recycling of nutrients for the planet. - Placing vegetation and litter on upper trees. Thus neutralizes tinfertile temperament and preventsspoilage. .

6. PROJECTPLANNING& SCHEDULING

a. Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As an user, I can register for the application by entering my email, password, and confirming my password.	2	High	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M
Sprint-1	User Confirmation	USN-2	As an user, I will receive confirmation email once I have registered for the application	1	Medium	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M
Sprint-1	Login	USN-3	As an user, I can log into the application by entering email & password	2	High	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M
Sprint-2	Data Collection	USN-1	Download the dataset used in Digital Naturalist – AI Enabled tools for Biodiversity Researchers	2	High	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M

Sprint-2	Image Preprocessing	USN-1	Improving the image data that suppresses unwilling distortions or enhances some image features important for further processing, although performing some geometric transformations of images like rotation, scaling, etc.	1	High	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M
Sprint-3	Getting started with Convolutional Neural Network	USN-1	Neural network are integral for teaching computers to think and learn by classifying information, similar to how we as humans learn. With neural networks, the software can learn to recognize images, for example. Machines can also make predictions and decisions with a high level of accuracy based on data inputs.	2	High	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M
Sprint-3	Evaluation and model saving	USN-1	Well a model behaves after eachiteration of optimization. An accuracy metric is used to measure the algorithm's performance in an interpretable way. The accuracy of a model is usually determined after the model parameters and is calculated in the form of a percentage. Saving The Model get weights , set weights .	1	Medium	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M
Sprint-4	Application Building	USN-2	After the model is built, we will be integrating it to a web application so that normal users can also use it. The users need to give the images of species	1	High	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M
Sprint-4	Train the Model on IBM	USN-3	Build Deep learning model and computer vision Using the IBM cloud.	2	High	Bharathraj M Bhanu Sagar K V Suraj Kumar G Vishwa M

b. Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	4 Days	24 Oct 2022	27 Oct 2022	20	29 Oct 2022
Sprint-2	20	5 Days	28 Oct 2022	01 Nov 2022	20	04 Nov 2022
Sprint-3	20	8 Days	02 Nov 2022	09 Nov 2022	20	11 Nov 2022
Sprint-4	20	9 Days	10 Nov 2022	18 Nov 2022	20	19 Nov 2022

7. CODING & SOLUTIONING (Explainthefeaturesaddedintheprojectalongwithcode)

7.1 Features 1

1.IMAGE DATA GENERATOR:

Keras ImageDataGenerator is used for getting the input of the original data and further, it makes the transformation of this data on a random basis and gives the output resultant containing only the data that is newly transformed. It does not add the data.

```
from keras.preprocessing.image import ImageDataGenerator
```

2.PARAMETERS

2.1.Rescale:

The ImageDataGenerator class can be used to rescale pixel values from the range of 0-255 to the range 0-1 preferred for neural network models. Scaling data to the range of 0-1 is traditionally referred to as normalization.

2.2.Shear Range:

Shear range means that the image will be distorted along an axis, mostly to create or rectify the perception angles. It's usually used to augment images so that computers can see how humans see things from different angles.

2.3.Rotation range:

ImageDataGenerator class allows you to randomly rotate images through any degree between 0 and 360 by providing an integer value in the rotation_range argument. When the image is rotated, some pixels will move outside the image and leave an empty area that needs to be filled in.

2.4.Zoom Range:

The zoom augmentation method is used to zooming the image. This method randomly zooms the image either by zooming in or it adds some pixels aroundthe image to enlarge the image. This method uses the zoom_range argument of the ImageDataGenerator class. It can specify the percentage value of the zooms either in a float**,** range in the form of an array.

2.5.Horizontal Flip:

Horizontal flip basically flips both rows and columns horizontally. So for this, It have to pass the horizontal_flip=True argument in the ImageDataGenerator constructor.

3.CONVOLUTION NEURAL NETWORK:

A CNN is a kind of network architecture for deep learning algorithms and is specifically used for image recognition and tasks that involve the processing of pixel data. There are other types of neural networks in deep learning, but for identifying and recognizing objects, CNNs are the network architecture of choice. The layers used in the CNN is Convolutional ,maxpooling, and flatten layer.

3.1.Convolutional Layer:

A convolutional layer is the main building block of a CNN. It contains a set of filters (or kernels), parameters of which are to be learned throughout the training.

The size of the filters is usually smaller than the actual image. Each filter convolves with the image

Convolution layer is used for a image processing to blur and sharpen images, but also to perform other operations.

```
from keras.layers import Convolution2D
```

3.2.Maxpooling Layer:

Max pooling is a pooling operation that selects the maximum element from the region of the feature map covered by the filter.

```
from keras.layers import MaxPooling2D
```

3.3.Flatten Layer:

Flattening is used to convert all the resultant 2-Dimensional arrays from pooled feature maps into a single long continuous linear vector. The flattened matrix is fed as input to the fully connected layer to classify the image.

```
from keras.layers import Flatten
```

4.DENSE LAYER:

Dense Layer is used to classify image based on output from convolutional layers.

7.2.FEATURE 2(CODE):

Importing Keras libraries

```
import keras
```

Importing ImageDataGenerator from Keras

```
from matplotlib import pyplot as plt
from keras.preprocessing.image import ImageDataGenerator
```

Defining the Parameters

```
train_datagen=ImageDataGenerator(rescale=1./255,shear_range=0.2,rotation_range=180,zoom_r
```

```
ange=0.2,horizontal_flip=True)
test_datagen=ImageDataGenerator(rescale=1./255,shear_range=0.2,rotation_range=180,zoom_ra
nge=0.2,horizontal_flip=True)
```

Applying ImageDataGenerator functionality to train dataset

```
from google.colab import drive
drive.mount('/content/drive')

x_train=train_datagen.flow_from_directory('/content/drive/MyDrive/IBM
PROJECT/dataset/DATA
SET/archive/Dataset/Dataset/train_set',target_size=(64,64),batch_size=32,class_mode='binary')
```

Applying ImageDataGenerator functionality to test dataset

```
x_test=test_datagen.flow_from_directory('/content/drive/MyDrive/IBM
PROJECT/dataset/DATA
SET/archive/Dataset/Dataset/test_set',target_size=(64,64),batch_size=32,class_mode='binary')
```

Importing Model Building Libraries

```
#to define the linear Initialisation import sequential
from keras.models import Sequential
#to add layers import Dense
from keras.layers import Dense
#to create Convolutional 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')
```

Initializing the model

```
model = Sequential()
```

Adding CNN Layers

```
model.add(Convolution2D(32,(3,3),input_shape=(64,64,3),activation='relu'))
#add maxpooling layers
model.add(MaxPooling2D(pool_size=(2,2)))
#add faltten layer
model.add(Flatten())
```

Add Dense layers

```
#add hidden layers
model.add(Dense(150,activation='relu'))
#add output layer
model.add(Dense(1,activation='sigmoid'))
```

configuring the learning process

```
model.compile(loss='binary_crossentropy',optimizer="adam",metrics=["accuracy"])
```

Training the model

```
model.fit_generator(x_train,steps_per_epoch=14,epochs=10,validation_data=x_test,validation_st
eps=4)
```

Save the model

```
model.save("forest.h5")
```

Predictions

```
#import load model from keras.model
from keras.models import load_model
#import image from keras
from tensorflow.keras.preprocessing import image
import numpy as np
#import cv2
import cv2
#load the saved model
model=load_model("/content/drive/MyDrive/IBM PROJECT/dataset/forest.h5")
img=image.load_img('/content/drive/MyDrive/IBM PROJECT/dataset/DATA
SET/archive/Dataset/Dataset/test_set/with fire/FORESTFIRE (1).jpg')
x=image.img_to_array(img)
res=cv2.resize(x,dsize=(64,64),interpolation=cv2.INTER_CUBIC)
#expand the image shape
x=np.expand_dims(res,axis=0)

pred=model.predict(x)
pred = int(pred[0][0])
pred
int(pred)

pip install twilio

from twilio.rest import Client

if pred==0:
  print('Forest fire')
  account_sid='AC0f20fb7b8e71118fa14d874dc2384676'
  auth_token='74902c8f190f5a4d288bbf5e3b48c84e'
  client=Client(account_sid,auth_token)
  message=client.messages \
  .create(
```

```
        body='forest fire is detected,stay alert',
        #use twilio free number
        from_='+18608542959',
        #to number
        to='+916380889559')
    print(message.sid)
    print("Fire detected")
    print("SMS Sent!")
elif pred==1:
    print('No Fire')
```

Open cv for video processing

pip install twilio

```
 from logging import WARNING
#import opencv library
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
#import playsound package
```

Creating An Account in Twilio Service

Sending Alert Message

```
import cv2
import numpy as np
```

```
from google.colab.patches import cv2_imshow
from matplotlib import pyplot as plt
import librosa
from tensorflow.keras.preprocessing import image
from keras.models import load_model
# Create a VideoCapture object and read from input file
# If the input is the camera, pass 0 instead of the video file name
cap = cv2.VideoCapture('/content/drive/MyDrive/IBM PROJECT/dataset/datasetvideo.mp4')

# Check if camera opened successfully
if (cap.isOpened()== False):
  print("Error opening video stream or file")

# Read until video is completed
while(cap.isOpened()):
  # Capture frame-by-frame
  ret, frame = cap.read()
  if ret == True:

    cv2_imshow(frame)
    x=image.img_to_array(frame)

    res=cv2.resize(x,dsize=(64,64),interpolation=cv2.INTER_CUBIC)
    #expand the image shape
    x=np.expand_dims(res,axis=0)
    model=load_model("/content/drive/MyDrive/IBM PROJECT/dataset/forest.h5")
    pred=model.predict(x)
    pred = int(pred[0][0])
    pred
    int(pred)
    if pred==0:
      print('Forest fire')
```

```
        break
    else:
        print("no danger")
        break

# When everything done, release the video capture object
cap.release()

# Closes all the frames
cv2.destroyAllWindows()



from twilio.rest import Client
if pred==0:
  print('Forest fire')
  from twilio.rest import Client
  account_sid='AC0f20fb7b8e71118fa14d874dc2384676'
  auth_token='74902c8f190f5a4d288bbf5e3b48c84e'
  client=Client(account_sid,auth_token)
  message=client.messages \
  .create(
      body='forest fire is detected,stay alert',
      #use twilio free number
      from_='+18608542959',
      #to number
      to='+916380889559')
  print(message.sid)
  print("Fire detected")
  print("SMS Sent!")
elif pred==1:
  print('No Fire')
```

8. TESTING

Testing with no fire.

Predictions

In [28]:

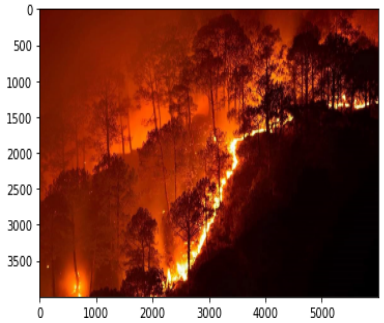
```
#import load model from keras.model
from keras.models import load_model
#import image from keras
from tensorflow.keras.preprocessing import image
import numpy as np
#import cv2
import cv2
#load the saved model
model=load_model("forest.h5")
img=image.load_img('/content/drive/MyDrive/IBM PROJECT/dataset/DATA SET/archive/Dataset/Dataset/test_set/forest/0.72918000_1559733279_forests1_gettyim
plt.imshow(img)
plt.show()
x=image.img_to_array(img)
res=cv2.resize(x,dsize=(64,64),interpolation=cv2.INTER_CUBIC)
#expand the image shape
x=np.expand_dims(res,axis=0)
```

Testing with fire

Predictions

In [31]:

```
#import load model from keras.model
from keras.models import load_model
#import image from keras
from tensorflow.keras.preprocessing import image
import numpy as np
#import cv2
import cv2
#load the saved model
model=load_model("/content/drive/MyDrive/IBM PROJECT/dataset/forest.h5")
img=image.load_img('/content/drive/MyDrive/IBM PROJECT/dataset/DATA SET/archive/Dataset/Dataset/test_set/with fire/Bandipur_fires_2019.jpg')
plt.imshow(img)
plt.show()
x=image.img_to_array(img)
res=cv2.resize(x,dsize=(64,64),interpolation=cv2.INTER_CUBIC)
#expand the image shape
x=np.expand_dims(res,axis=0)
```



9. RESULTS

As a threat of forest fire increases due to climate changes, the need for finding a detection system increases .The proposed Deep Learning-based model to predict early detection of forest fire. The Proposed model successfully classifies the images into fire and no fire, and sends an alert messages in case of fire. Thus, the Deep Learning algorithms proved their efficiency in detecting different objects.

9.1 Advantages and Disadvantages

Advantages

1.The results is quite accurate with the accuracy upto 95% .
2.Reliability - The model is very effective, inexpensive and easy to apply.
3.The model, it shows the 'fire' and 'no fire' images classified with high accuracy.
.Video analysis of this model leads to low degree of misjudgment of fire detection.

DISADVANTAGES:

1.Individual learner is responsible for learning global information to avoid false positives.
2.The limited learning and perception ability of individual learners is not sufficient to make them perform well in complex tasks.
3.Proper connectivity and maintenance will be a complex task.

CONCLUSION

This type of system is the first of its kind to ensure no further damage is then to forests when there is fire breakout and immediately a message is sent to the user through the App. Immediate response or early warning to a fire breakout is mostly the only ways to avoid losses and environmental, cultural heritage damages to a great extent. Therefore the most important goals in fire surveillance are quick and reliable detection of fire. It is so much easier to suppressfire while it is in its early stages. Information about progress of fire is highly valuable for managing fire during all its stages. Based on this information the firefighting staff can be guidedon target to block fire before it reaches cultural heritage sites and to suppress it quickly

by utilizing required firefighting equipment and vehicles. With further research and innovation, thisproject can be implemented in various forest areas so that we can save our forests and maintaingreat environment.

10. FUTURESCOPE

1. Integrate live satellite data and process real time processing of the fires.
2. Enchance the time complexity of the detection of forest fires to improve the speed.
3. These accidents can be controlled to a greater extend.
4. Forest fire leads to destruction of excess of species, by using this technique it will save the life and environment.

11. APPENDIX

Github link

https://github.com/IBM-EPBL/IBM-Project-29997-1660137589