MADHA INSTITUTE OF ENGINEERING AND TECHNOLOGY

EMERGING METHODS FOR EARLY DETECTION FOREST FIRES

A PROJECT REPORT

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for the course

HX8001 – Professional Readiness for Innovation, Employment and Entrepreneurship

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BONAFIDE CERTIFICATE

Certified that this project report **"EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES"** is the Bonafide work of **N.Isravel(211219104004),D.Kevin Kumar (211219104005), S.Manivkam(211219104006) & B Immanuvel (211219105005)** who carried out the project work under my supervision.

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1. INTRODUCTION

PROJECT OVERVIEW

Over the past few years, the number of wildfires or forest fire across the globe has increased drastically. Forest Fire is defined as any unplanned, uncontrolled fire that is directly or indirectly dependent on the lighting, volcanic eruptions, spontaneous combustion of dry vegetation and stubble burning. Forest fire is a threat to human life, animals and vegetation in the current scenario. In the traditional methods, immediate response and large detection area is not possible to detect fire at reduced cost .

In general, the forest is an abode for several living and non-living resources, and also it controls the production of carbon dioxide. Forest fires are classified according to its motion, texture, andsize.

PURPOSE

To predict the forest fire early and to alarm the respected authorities to take immediate

2.LITERATURE SURVEY

PROBLEM STATEMENT DEFINITION

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. It is difficult to predict and detect Forest Fire in a sparsely populated forest area and it ismore 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.

REFERENCES

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- https://www.bosch.com/stories/early-forest-fire-detection-sensors Assessment on the use of meteorological and social media information for forest fire detection and prediction in Riau, Indonesiahttps://www.mdpi.com/1306746 10.23919/MIPRO.2019.8756696

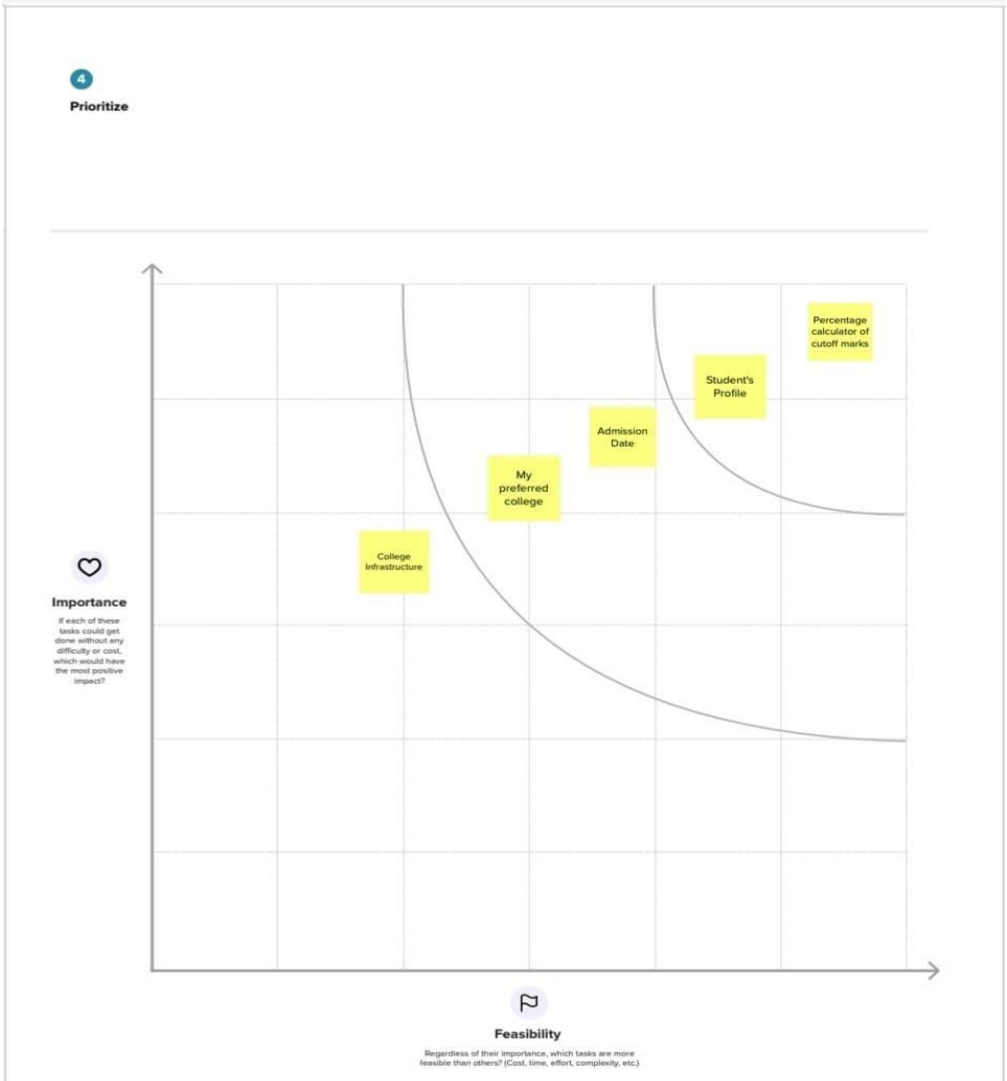
3.IDEATION & PROPOSED SOLUTION

EMPATHY MAP CANVAS

This map is created with view of the project in user's perspective, to find pain & gain points and to summarize it with a list of problem statements.

IDEATION & BRAINSTORMING

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions. 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.



PROPOSED SOLUTION

S.NO	PARAMETER	DESCRIPTION
1.	PROBLEM STATEMENT(PROBLEM TO BE SOLVED)	Forest fires are a major environmental issue creating economic and ecological damage while endangering human lives. To find forest fire detection and prediction approaches with the gal of informing the local fire authorities.
2.	IDEA / SOLUTION DESCRIPTION	The user interact with a web camera to read the video. Once the input image from the video frame is send to the model if the fire is detected it is showcase of the console and alerting sound will be generated and alert message will be send to be authorities.. To achieve classifies images using a Convolutional Neural Network and use other open CV tools.
3.	NOVELTY / UNIQUENESS	Decreasing the response time of total system that is increase the processing speed of the model.
4.	SOCIAL IMPACT / CUSTOMER SATISFACTION	Tribal people who live in forest & Forest department authorities or benefited. Saving the most essential forest cover and the wild life.
5.	BUSINESS MODEL (REVENUE MODEL)	We can generate the revenue by supply chain,power and supply,fire stations and government by providing services.
6.	SCALABILITY OF THE SOLUTION	We can further install smoke detecting sensors in highly Prone areas to increase accuracy of fire detection. Attaching GPS tracking to each cameras to find the exact location of fires.

PROBLEM SOLUTION FIT

4.REQUIREMENT ANALYSIS

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 Form Registration through LinkedIn Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Reporting	Gives alarm whenever fire is detected and send message to register mail.
FR-4	Changing Volume	Alarm sound varies with respect to intensity of forest fire detected.
FR-5	Variable Coverage Area	Coverage area can be varied by user.
FR-6	Stores Data	Stores information about frequency of occurrence of forest fires and this data can be accessed by registered user.

NON-FUNCTIONAL REQUIREMENTS:

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

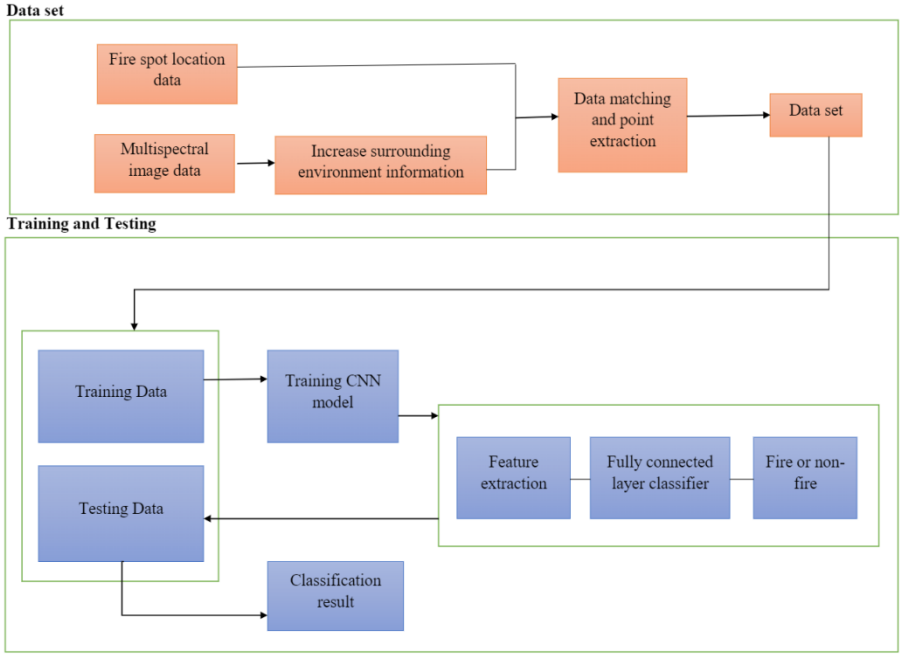
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	System would be user friendly and there is no need for user to know technical things to understanted system.
NFR-2	**Security**	Data stored in system can be accessed only by administrator.
NFR-3	**Reliability**	System automatically returns to normal state once alerm gets turn of which reduces hardware usages and failures.
NFR-4	**Performance**	With high accuracy and no response time performance is improved.
NFR-5	**Availability**	The proctoring will be available for 24/7
NFR-6	**Scalability**	The range of each camera can be scalable by making sure that ranges of to different cameras wont be overlapped to detect their location.

5.PROJECT DESIGN

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 datais stored.

Dataflow Diagram:

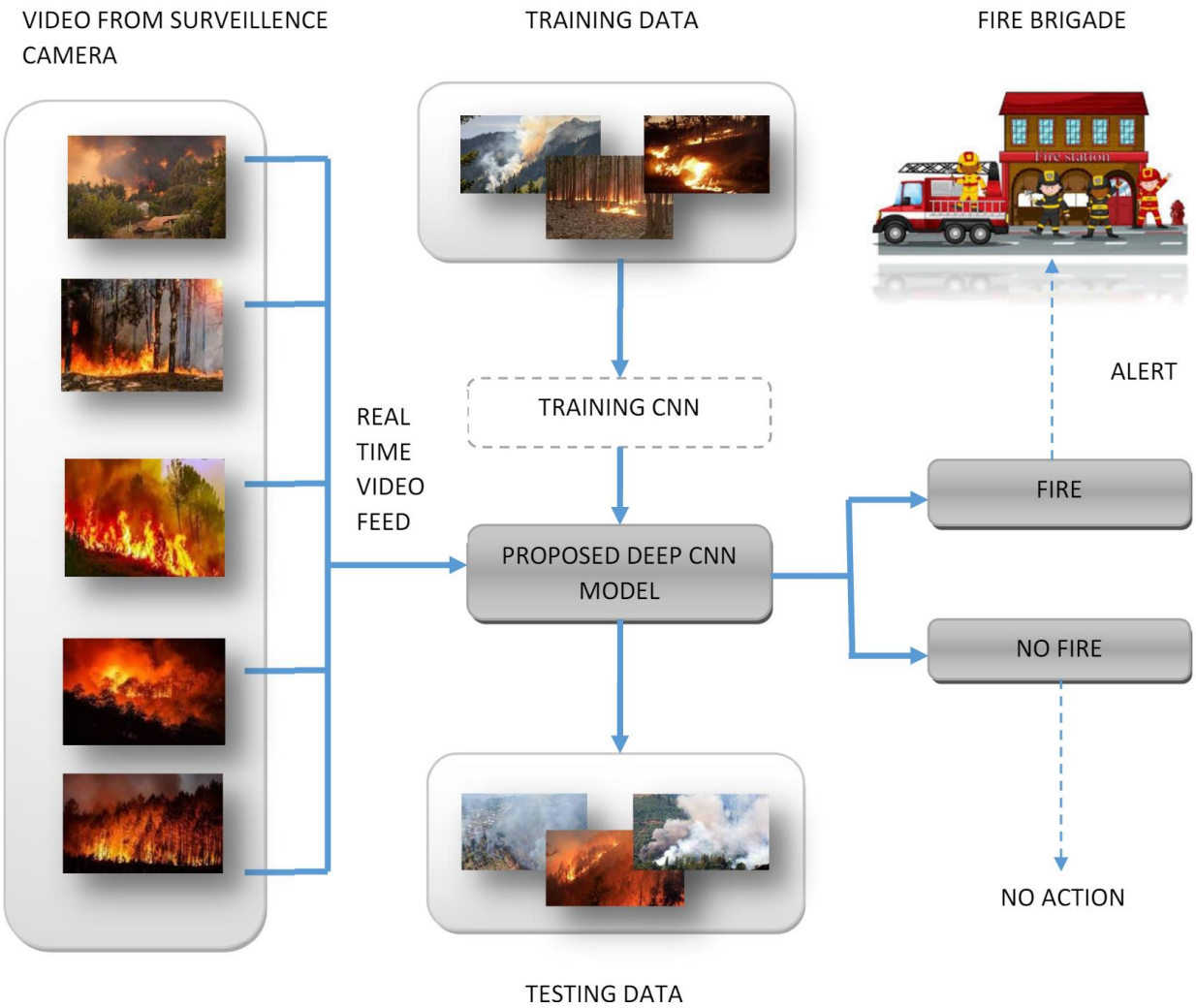


SOLUTION & TECHNICAL ARCHITECTURE

Solution Architecture is a complex process-with many sub-process-that bridges the gap between business problem and technologies solutions; It goals are to :

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

Solution Architecture for Fire Detection System :



USER STORIES

USER STORY NO	USER STORY/TASKS	ACCEPTANCE CRITERIA	PRIORITY	RELEASE
USN-1	The user, I can register for the application and give my phone number/mail to receive alert message.	I can receive confirmation mail that I am successfully registered.	High	Sprint-1
USN-2	As a user, I should be able to receive alert whenever forest fire is detected	I can get an alert message when fire is actually detected.	Very high	Sprint-1
USN-3	As a user I should have a user interface to monitor the live video stream from cameras install at remote places.	I can monitor to the live happenings in the forest through a web applications.	Low	Sprint-4
USN-4	As a user I can log in to the application by endering email and password.	I can log in and view my dashboard.	Medium	Sprint-2
USN-5	As a user I need to get support from developers in case of forest fires and failures of service provided.	I can have safe users experience and all the issues raised in sorted.	Medium	Sprint-3
USN-6	As a user I must be ale to access the website at any time.	I can view my dashboard at my demand on any time	Medium	Sprint-2
USN-7	As a user I must receive a detailed report of intensity of forest fire and also where exactly fire is detected.	I can receive the accurate location of forest fires and able to solve the problem at right time.	High	Sprint-3
USN-8	As a user I want detailed data of where fire is occurring frequently and applications should make predictions also in future.	I can be confidence when and where occurs and confidently and make necessary arrangements for it at correct time.	Medium	Sprint-4

6.PROJECT PLANNING & SCHEDULING

SPRINT PLANNING & ESTIMATION PRODUCT BACKLOG, SPRINT SCHEDULE, AND ESTIMATION

Use the below template to create product backlog and sprint schedule

SPRINT	FUNCTIONAL REQUIREMENT (EPIC)	USER STORY NUMBER	USER STORY / TASK	STORY POINTS	PRIORITY	TEAM MEMBERS
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirmingmy password.	20	High	NIVETHA R SIVASHALINI GPRIYANGA K ABIRAMI S
		USN-2	As a user, I will receive confirmation emailonce I have registered for the application	18	Medium	NIVETHA R SIVASHALINI GPRIYANGA K ABIRAMI S
Sprint-2	Input	USN-3	When ever the fire is detected, the information is given to the database.	20	High	NIVETHA R SIVASHALINI GPRIYANGA K ABIRAMI S
Sprint-2		USN-4	When it is the wildfire then the alarmingsystem is activated.	18	Medium	NIVETHA R SIVASHALINI GPRIYANGA K ABIRAMI S
Sprint-3	Output	USN-5	And the alarm also sent to the corresponding departments and made them know that the wildfire is erupted.	20	High	NIVETHA R SIVASHALINI GPRIYANGA K ABIRAMI S
Sprint-4	Action	USN-6	Required actions will be taken in order to control erupted wildfire by reaching as early as possible to the destination with the help of detecting systems.	20	High	NIVETHA R SIVASHALINI GPRIYANGA K ABIRAMI S

PROJECT TRACKER, VELOCITY &

BURNDOWN CHART:

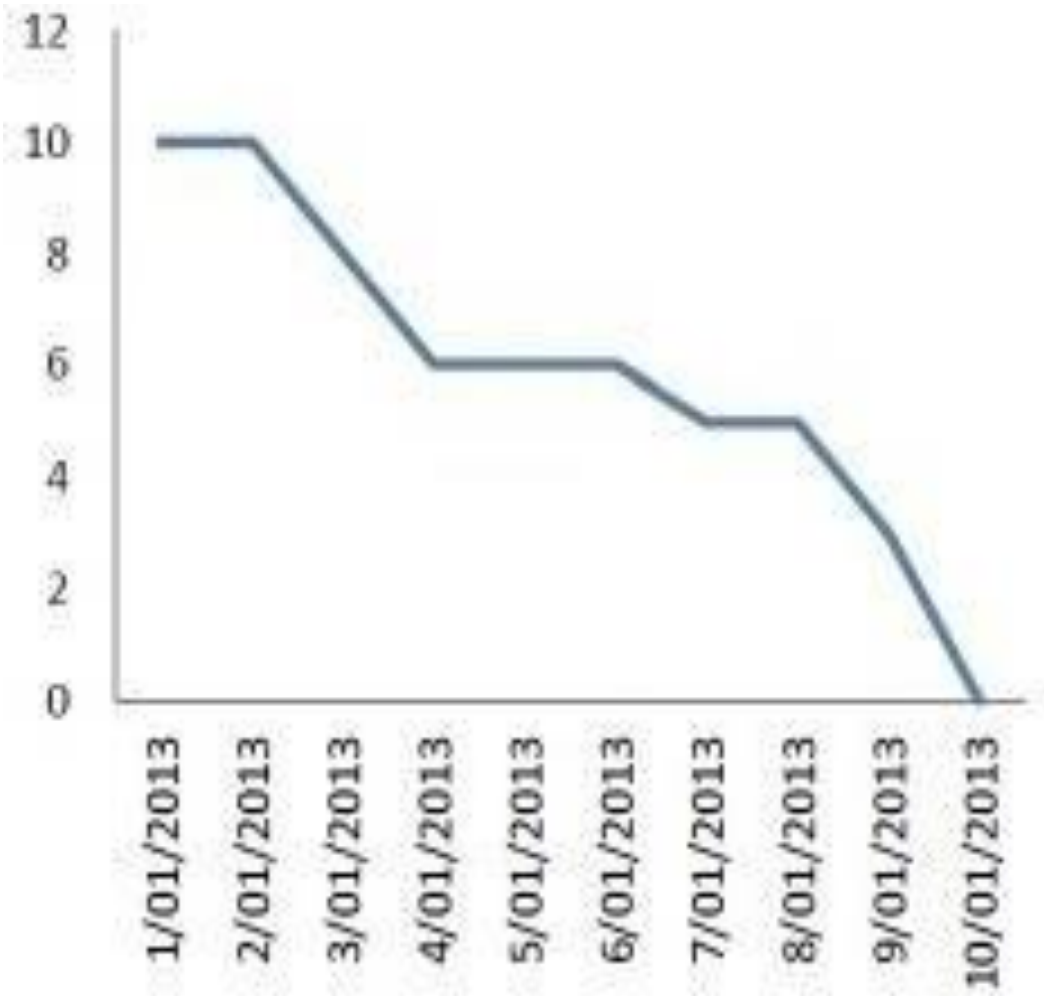
PROJECT TRACKER:

SPRINT	TOTAL STORY POINTS	DURATION	SPRINT START DATE	SPRINT END DATE (PLANNED)	STORY POINTS COMPLETED (AS ON PLANNED END DATE)	SPRINT RELEASEDATE (ACTUAL)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

REPORTS

BURNDOWN CHART:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies suchas Scrum. However, burn down charts can be applied to any project containing measurable progress from time.



7.CODING & SOLUTIONING (EXPLAIN THE FEATURES ADDED IN THE PROJECTALONG WITH CODE)

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

```
!unzip drive/MyDrive/archive\ \(1\).zip
```

```
import keras
```

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

```
train_datagen=ImageDataGenerator(rescale=1./255,shear_range=0.2,rotation_range=180,zoom_range=0.2,horizontal_flip=True)
test_datagen=ImageDataGenerator(rescale=1./255)
```

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

```
x_train=train_datagen.flow_from_directory('/content/drive/MyDrive/Dataset/Dataset/Dataset/train_set',
                                          target_size=(128,128),batch_size=32,class_mode='binary')
```

```
x_test=test_datagen.flow_from_directory('/content/drive/MyDrive/Dataset/Dataset/Dataset/test_set',
                                        target_size=(128,128),batch_size=32,class_mode='binary')
```

```
# MODEL BUILDING
#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')
```

```
model=Sequential()
```

```
model.add(Convolution2D(32,(3,3),input_shape=(128,128,3),activation='relu'))
#add maxpooling layers
model.add(MaxPooling2D(pool_size=(2,2)))
#add faltten layer
model.add(Flatten())
#add hidden layers
model.add(Dense(150,activation='relu'))
#add output layer
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=10,validation_data=x_test,validation_steps=4)
```

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

```
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/Dataset/Dataset/Dataset/test_set/forest/0.48007200_1530881924_final_forest.jpg')
x=image.img_to_array(img)
res=cv2.resize(x,dsize=(128,128),interpolation=cv2.INTER_CUBIC)
#expand the image shape
x=np.expand_dims(res,axis=0)
```

```
pred=model.predict(x)
```

```
pred
```

```
pip install twilio
```

```
pip install playsound
```

```
pip install pygobject
```

```
from twilio.rest import Client
from playsound import playsound
if pred==0:
  print('Forest fire')
  account_sid='AC80f3d03cdbb0f27e31568ed8e2ff4db4'
  auth_token='4f6aa521bfa0bf0d3d8508a139c946f3'
  client=Client(account_sid,auth_token)
  message=client.messages \
  .create(
      body='forest fire is detected,stay alert',
      #use twilio free number
      from_='+18304453233',
      #to number
      to='+919159572761')
  print(message.sid)
  print("Fire detected")
  print("SMS Sent!")
elif pred==1:
  print('No Danger')
```

```
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
from playsound import playsound
```

```
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/Dataset/Dataset/test_set/with fire/19464620_401.jpg')

# 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:
    x=image.img_to_array(frame)
    res=cv2.resize(x,dsize=(128,128),interpolation=cv2.INTER_CUBIC)
    #expand the image shape
    x=np.expand_dims(res,axis=0)
    model=load_model("/content/drive/MyDrive/Dataset/Dataset/Dataset/test_set/with fire/599857.jpg")
    cv2_imshow(frame)
    pred=model.predict(x)
    pred = int(pred[0][0])
    pred
    int(pred)
    if pred==0:
      print('No danger')
      break
    else:
      print("Forest fire")
      break
  # When everything done, release the video capture object
```

```
cap.release()

# Closes all the frames
cv2.destroyAllWindows
```

```
# SENDING ALERT MESSAGE
from twilio.rest import Client
from playsound import playsound
if pred==0:
  print('Forest fire')
  account_sid='AC80f3d03cdbb0f27e31568ed8e2ff4db4'
  auth_token='4f6aa521bfa0bf0d3d8508a139c946f3'
  client=Client(account_sid,auth_token)
  message=client.messages \
  .create(
      body='forest fire is detected,stay alert',
      #use twilio free number
      from_='+18304453233',
      #to number
      to='+919159572761')
  print(message.sid)
  print("No Danger")
  print("SMS Sent!")
elif pred==1:
  print('Fire Detected')
```

8.TESTING

TEST CASES

				Date	17-Nov-22								
				Team ID	PNT2022TMID37319								
				Project Name	Project - University Admit Eligibility Predictor								
				Maximum Marks	4 marks								
Test case ID	**Feature Type**	**Component**	**Test Scenario**	**Pre-Requisite**	**Steps To Execute**	**Test Data**	**https://127.0.0.1:5000**	**Actual Result**	**Status**	**Comments**	**TC for Automation(Y/N)**	**BUG ID**	**Executed By**
Homepage_TC_001	Functional	Home Page	Able to open the URL	1.URL 2.Internet Connection 3.Browser	1. Check internet connection 2.Check Browser is available 3.Enter URL	https://127.0.0.1:5000	Home page should be displayed.	Working as expected	Pass				Smirithi
HomePage_TC_002	UI	Home Page	Verify the UI elements in home page	1.URL 2.Internet Connection 3.Browser	1.Enter URL and press enter 2.Verify whether the background images are visible and the texts are aligned properly.	https://127.0.0.1:5000	Application should show below UI elements: a.Link or button for the predict chance page. b.background images c.proper alignment of the texts d.Logo of the website and name.	Not Working as expected	Fail	Bottom background is not available and no proper alignment of text.		BUG-1234	Sarojini
HomePage_TC_003	Functional	Home Page	Verify user is able to enter the prediction page Vis Predict your chance button	1.URL 2.Internet Connection 3.Browser	1.Enter URL and click go 2.Click on the Predict your chance button.	https://127.0.0.1:5000	User should able to go to the Prediction page	Working as expected	Pass				Raagavi
PredictPage_TC_004	Functional	Prediction page	Verify user is able to enter the values in the text field and shows pop up message when not filled .	1.URL 2.Internet Connection 3.Values to be entered.	1.Enter URL(https://127.0.0.1:5000) and click go 2.Click on the get started button. 3.Enter Valid scores in the respective field. 4.Click on the submit button.	University Rating:4 GRE Score: 337 TOEFL Score:118 SOP: 4.5 LOR: 4.5 CGPA: 9.65 Research:1	User should be navigated to the result page of prediction.	Working as expected	Pass				Vanshika
PredictionPage_TC_005	Functional	Prediction page	Verify user is able to get the prediction with InValid credentials	1.URL 2.Internet Connection 3.Incorrect values	1.Enter URL(https://127.0.0.5000/) and click go 2.Click on Get started button 3.Enter InValid values in the field. 4.Click on submit button.	University Rating:4 GRE Score: 337 TOEFL Score:118 SOP: o LOR: o CGPA: A+ Research:1	Application should show the popped up message "Enter the values in numbers".	Not Working as expected	Fail	There was such message popped up and it shows server error.		BUG ID-0002	Raagavi
PredictionPage_TC_006	UI	Prediction page	Able to view the box where the values has to be entered , background images,text aligned properly,submit button.	1.URL 2.Internet Connection 3.Browser	1.Enter URL(https://127.0.0.1:5000/) and click go 2.Click on Get started button or predict your chance button. 3.Enter the values the boxes. F10:F114.Click on submit button.	University Rating:4 GRE Score: 337 TOEFL Score:118 SOP: 4.5 LOR: 4.5 CGPA: 9.65 Research:1	Application should show the boxes to enter values, texts should be clearly visible, and background images should be available.	Working as expected.	Pass				Vanshika
PredictionPage_TC_007	Functional	result page	Able to view the chances in the University in the terms of %.	1.URL 2.Internet Connection	1.Enter the URL(https://127.0.0.1:5000) and click go. 2.Click on the Get Started or predict your value button. 3.Enter the correct values. 4.Click on the submit button.	University Rating:4 GRE Score: 337 TOEFL Score:118 SOP: 4.5 LOR: 4.5 CGPA: 9.65 Research:1	Application should show the predict value in the terms of %.	Not Working as expected	Fail	The values have not been showed in the terms of %.		BUD ID: 0003	Smirithi
PredictionPage_TC_008	UI	Result page	Able to see background images, proper text alignment and home or go back button.	1.URL 2.Internet Connection	1.Enter the URL(https://127.0.0.1:5000) and click go. 2.Click on the Get Started or predict your value button. 3.Enter the correct values. 4.Click on the submit button.	University Rating:4 GRE Score: 337 TOEFL Score:118 SOP: 4.5 LOR: 4.5 CGPA: 9.65 Research:1	Application should show the predicted result with background images, proper aligned text and home button	Working as expected	pass				Sarojini

USER ACCEPTANCE TESTING

PURPOSE OF DOCUMENT

The purpose of this document is to briefly explain the test coverage and open issues of the Emerging Methods for Early Detection of Forest Fires project at the time of the release to User Acceptance Testing (UAT).

DEFECT ANALYSIS

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

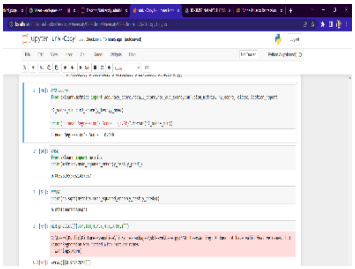
Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	11	4	2	3	20
Duplicate	1	0	3	1	5
External	2	3	1	1	7
Fixed	10	2	4	20	36
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	3	10
Totals	24	14	14	29	81

1.Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	1	50
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	1	8
Final Report Output	4	0	0	4
Version Control	2	0	0	2

PERFORMANCE TESTING

S.No.	Parameter	Values	Screenshot
1.	Metrics	**Regression Model:** Linear Regression R2 Score-0.85 RMSE –0.057 MSE-0.037 **Classification Model: None**	
2.	Tune The Model	Hyper parameter Tuning:(Grid Search CV) clf. Best _score_ - 0.921875 Validation Method – Grid Search CV(eestimator=SVC()	

9.RESULTS

10.ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Detecting early forest fires would reduce environmental pollution and save many lives
- System would be user friendly and there is no need for user to know technical things to understand system.

DISADVANTAGES:

- This model was trained with limited Open source dataset with limited training images, thus predictions may be inaccurate for diverse conditions.
- Here, the project is done with just one camera/test video but in reality we need to install cameras in various places of forest and we also need to exactly identify location of camera where fire is detected.
- The users (forest department officials) of our application should have a proper user interface to get registered and access more data and store the records for future predictions.

11.CONCLUSION

A Deep Learning based Convolutional Neural Network (CNN) model is presented to detect a forest fire. The following techniques such as Image Collection, Preprocessing, Image Classification, Model building and video streaming and alerting is done. Initially, the images in the dataset are pre-processed, and fed into the CNN for feature extraction and detection.

12.FUTURE SCOPE

- The scope of using video frames in the detection of fire using CNN is challengingas well as innovative. If this system with less error rate can be implemented at alarge 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 systems.
- The proposed system can be developed to more advanced system by integrating wireless sensors for added protection and precision. The algorithm shows greatpromise in adapting to various environment.
- Future studies may focus on deploying the model into Database and cloud storage and using necessary support packages to detect the real time fire by making challenging and specific scene understanding datasets for fire detection methods and detailed experimentswith Large datasets and training models.