PROJECT REPORT

Project Name**: EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES.**

Team id: **PNT2022TMID07050**

Team members: **DEVI SRAVANTI GUBBALA -TEAM LEAD.**

AKSHARA YUVARAJ

DIVYASRI.P

ESTHER JANET.S

1. INTRODUCTION

1.1 Project overview

Wildfire, also called forest fire, bush or vegetation fire, can be described as any uncontrolled and non-prescribed combustion or burning of plants in a natural setting such as a forest, grassland, brush land or tundra, which consumes the natural fuels and spreads based on environmental conditions (e.g., wind, topography). 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 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.
This is a huge problem which needs to be tackled and thus through this project we provide a way to tackle the issue.

1.2 Purpose

The purpose of the project is to detect the forest fire earlier.

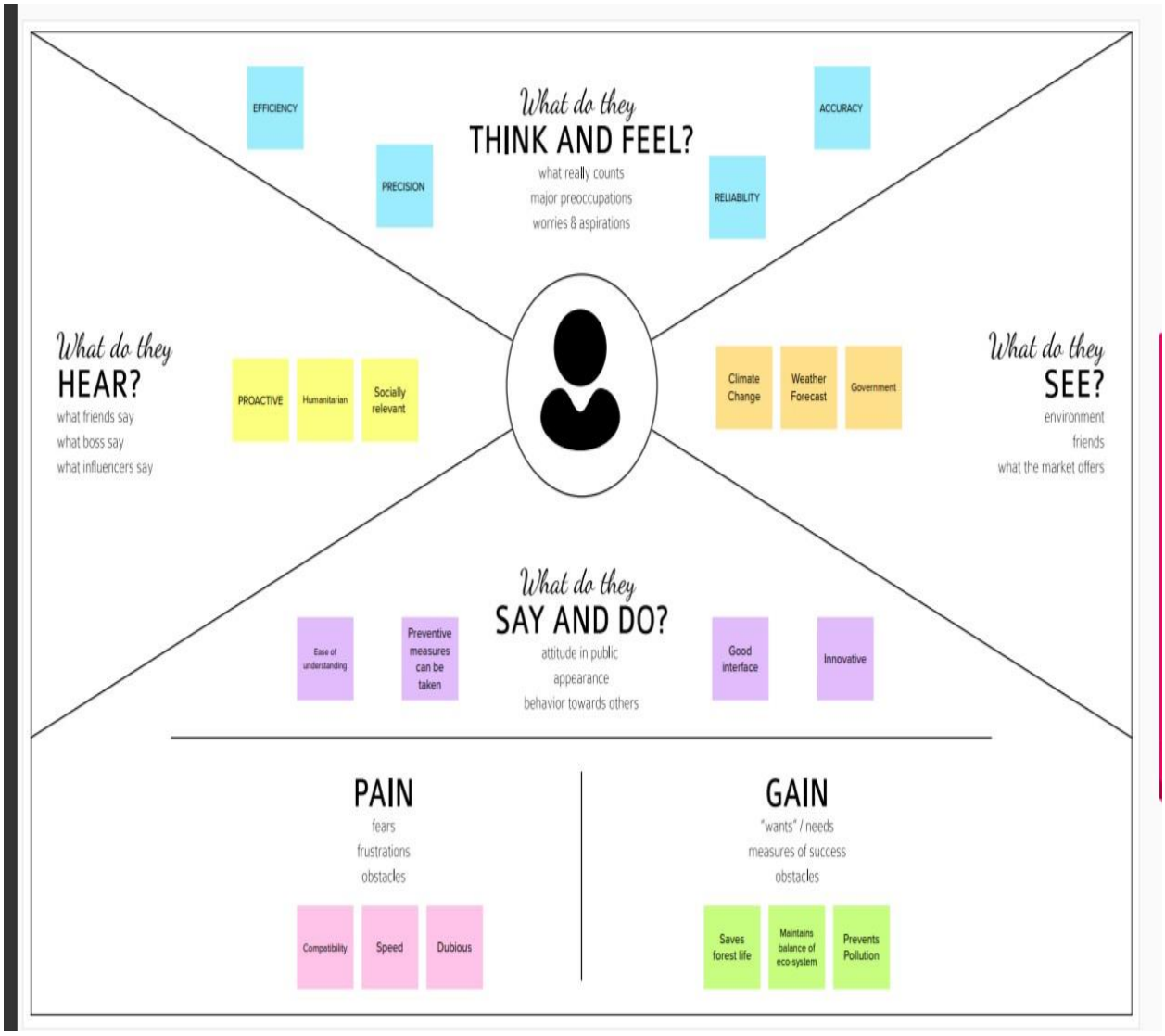
2. LITERATURE SURVEY

2.1 Reference

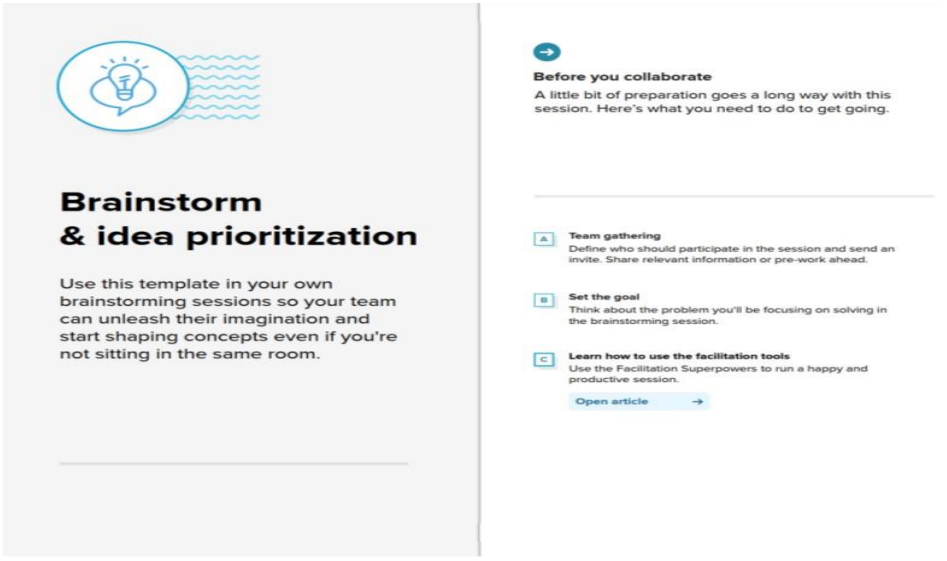
S. NO	TITLE	AUTHOR	YEAR
1.	Image Processing for Forest Fire Detection.	Priyadharshini	2016
2.	Forest fire prediction and detection system.	Faroudja Abid	2020
3.	systematic approaches in managing forest fires .	AdityaDhall	2020

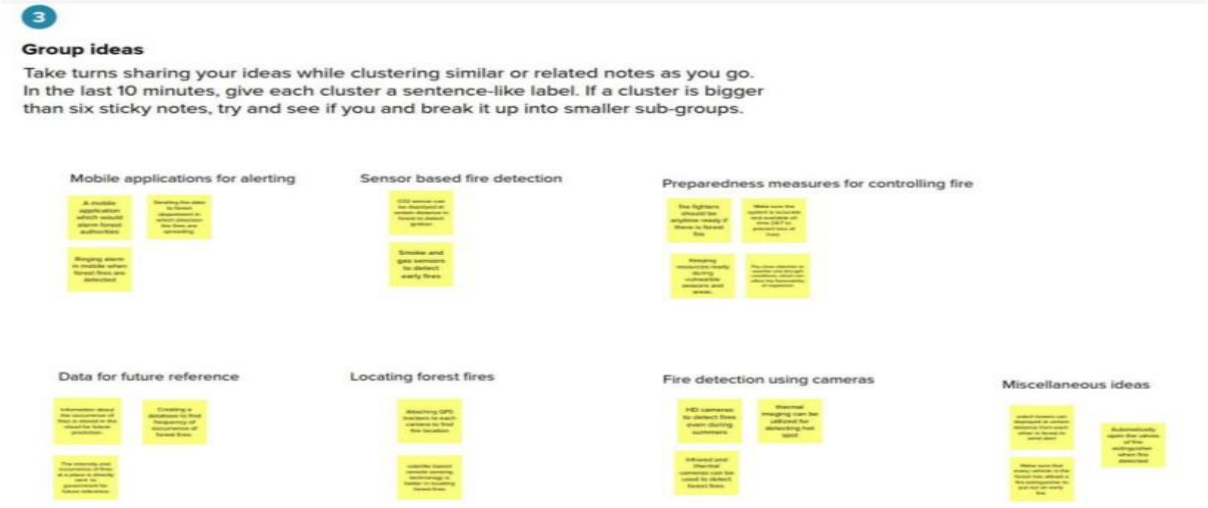
3. IDEATION & PROPOSED SOLUTION

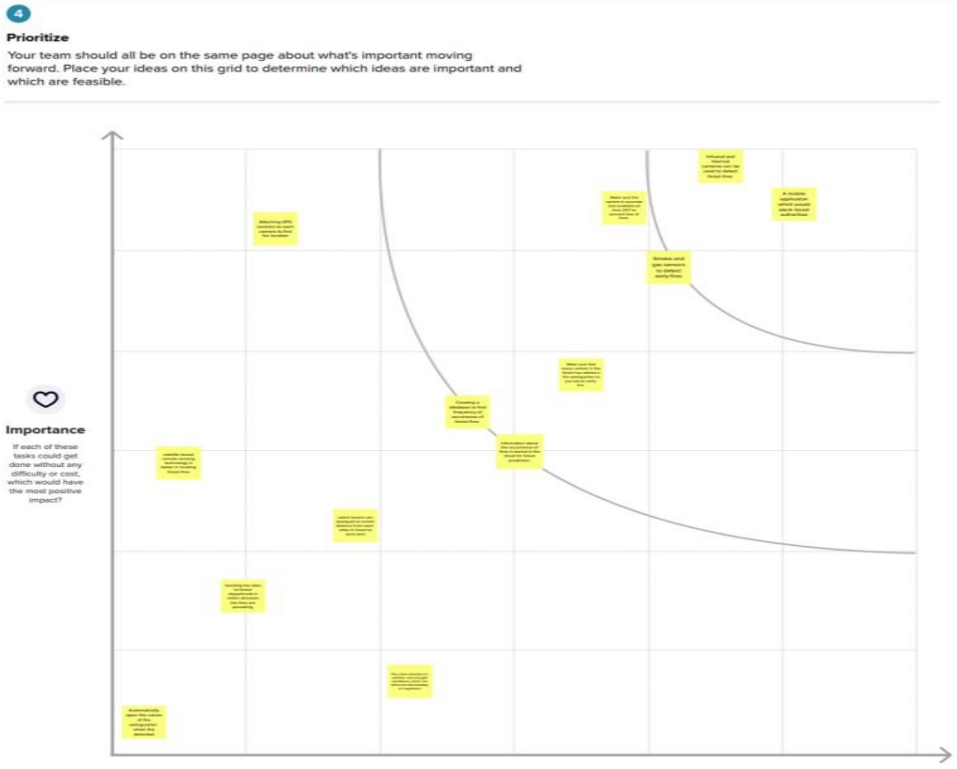
3.1 Empathy map



3.2 Ideation & Brainstorming





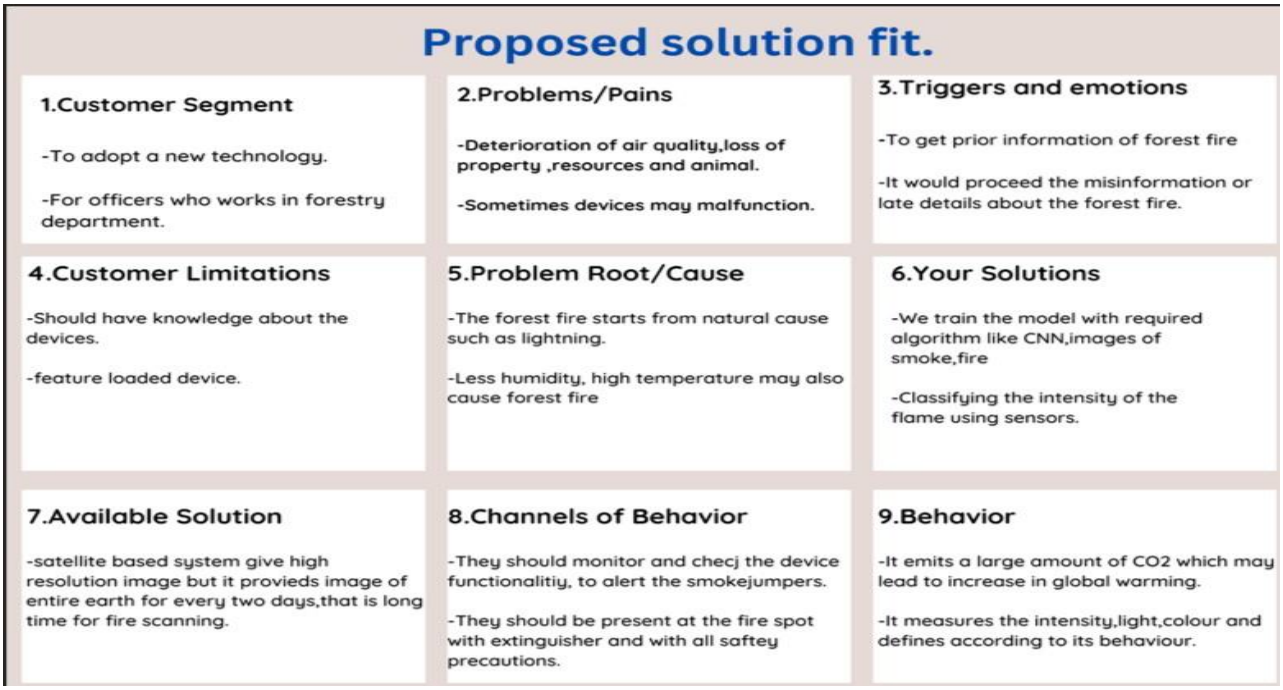


3.3 Proposed solution

S.NO:	PARAMETERS	REPRESENTATION
1.	**Problem Statement (Description of an issue to be addressed)**	• Fire was one of the first and greatest invention of man. But these days due to global warming and climate change, fires have become very violent and destructive. • Forest fires are one such evil looming the Earth destroying all the flora and fauna with the devastating fumes and flares it carries with itself. • Recent forest fires in California is an evident example of the intensity of the issue and the immediate action that needs to be taken.
2.	**Plan of Design and Execution**	• The propose a platform that uses Unmanned Aerial Vehicles (UAVs), which constantly patrol over potentially threatened by fire areas. • The UAVs also utilize the benefits from Artificial Intelligence(AI) and are equipped with on-board processing capabilities. • This allows them to use computer vision methods for recognition and detection of smoke or fire, based on the still images or the video input from the drone cameras. • The system is designed for monitor the causing factors of forest fires such as temperature, humidity , air pressure level,oxygen and Carbon dioxide on the surface of air. • The user interacts with a web camera to read the video.

		• Once the input image from the video frame is sent to the model, if the fire is detected, it is showcased on the console, and alerting sound will be generated and an alert message will be sent to the Authorities. • We classify images using a Convolutional Neural Network and use other open CV tools.
3.	**Peculiarity/ Novelty**	• Makes use of real time monitoring and allows pre-cursors to potential issues (such as corrosion) to be flagged up and immediately be addressed before major issues occur.
4.	**Social Outlook / Customer Friendly**	• Will warn the customers before any fire outbreak. • Prevents any potential devastation and issues precautions. • Protects the flora and fauna from any unfortunate accidents. • Saves forest and human life prevents desertification.
5.	**Business Model**	• Focuses more on sensor probes, wireless sensor networks and machine learning which makes the deployment more easier.
6.	**Feasibility of Solution**	• Cost effective • More performance measure • Economical • Accurate • Effective • Reliable • Socially intact

3.4 Problem solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

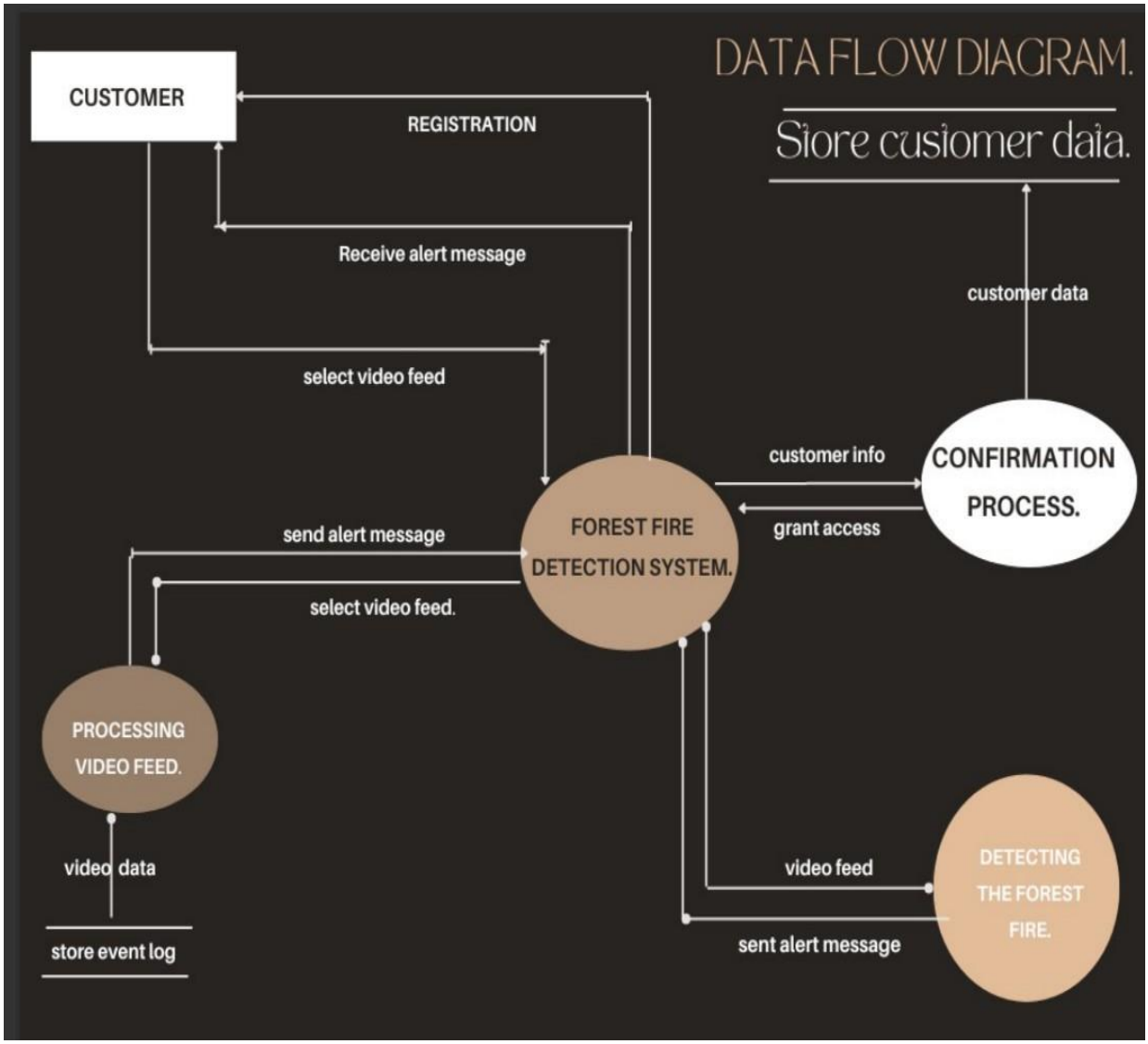
FR. NO.	Functional Requirement	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through wildfire portal.
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Data Prediction	Scientists create computer models to predict wildfire potential under a range of potential climate futures. Using different projections of temperature and downfall, scientists predict where and when wildfires are likely to occur

4.2 Non-Functional requirement

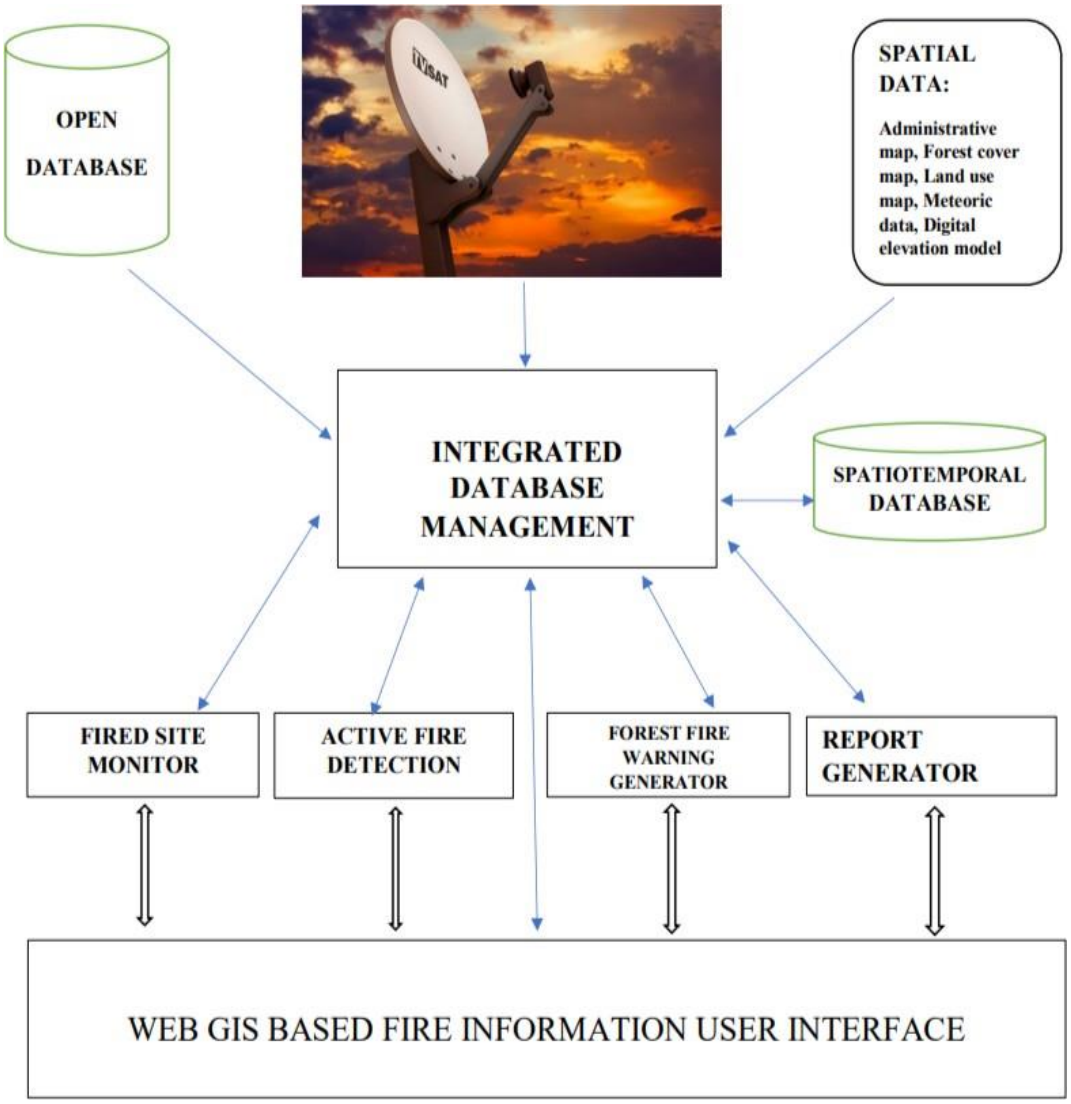
FR. NO.	Non-Functional Requirement	Description
NFR-1	Usability	Many methods have been proposed to detect forest fires, such as camera-based systems, WSN-based systems, and machine learning coating-based systems, with both positive and negative aspects and performance figures of detection.
NFR-2	Protection	We have designed this project to secure the forest from wild fires.
NFR-3	Performance	In the event of a fire, the primary objective of using drones is to gather situational consciousness, which can be used to direct the efforts of the firefighters in locating and controlling hot spots. Just like urban fires, forest fires to require monitoring so that firefighters know what they are dealing with.

PROJECT DESIGN

4.3 Data Flow Diagrams



4.4 Solution Architecture



5. PROJECT PLANNING & SCHEDULING

5.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Image Processing	USN-1	Processing the image to find the fire is detected or not.	1	Medium	1.Devi Sravanti 2.Esther 3.Divya Sri 4.Akshara
Sprint-1		USN-2	The output would have to give high accuracy.	2	High	1.Devi Sravanti 2.Esther 3.Divya Sri 4.Akshara
Sprint-2	Video Processing	USN-3	The drone videos will be split into frames to detect the fire.	3	High	1.Devi Sravanti 2.Esther 3.Divya Sri 4.Akshara
Sprint-3	Alerting	USN-4	After the fire is detected the alert message have to be sent.	2	High	1.Devi Sravanti 2.Esther 3.Divya Sri 4.Akshara
Sprint-4	Location tracking	USN-5	The exact location of the drone will be predicted and sent along with the alert message.	2	High	1.Devi Sravanti 2.Esther 3.Divya Sri 4.Akshara

5.2 Sprint delivery schedule

Project Tracker, Velocity & Burndown Chart:

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	6 Days	25 Oct 2022	30 Oct 2022	30	30 Oct 2022
Sprint-2	20	6 Days	1 Nov 2022	06 Nov 2022	20	06 Nov 2022
Sprint-3	20	6 Days	08 Nov 2022	13 Nov 2022	20	13 Nov 2022
Sprint-4	20	6 Days	15 Nov 2022	20 Nov 2022	20	20 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's now calculate the team's average velocity (AV) per iteration unit (story points per day)

AV=Sprint duration/Velocity
=20/6=3

5.3 SPRINT-1 (COLLECTION OF DATATSET)

In [1]:
```
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
import matplotlib.pyplot as plt
```

In [2]:
```
train = ImageDataGenerator(rescale=1/255)
test = ImageDataGenerator(rescale=1/255)

train_dataset = train.flow_from_directory("/content/drive/MyDrive/train_set",
                                          target_size=(150,150),
                                          batch_size = 32,
                                          class_mode = 'binary')

test_dataset = test.flow_from_directory("/content/drive/MyDrive/test_set",
                                          target_size=(150,150),
                                          batch_size =32,
                                          class_mode = 'binary')
```

```
Found 442 images belonging to 2 classes.
Found 121 images belonging to 2 classes.
```

In [3]:
```
test_dataset.class_indices
```

Out[3]:
```
{'forest': 0, 'with fire': 1}
```

5.4 SPRINT-2 (MODEL BUILDING AND CLASSIFICATION)

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

import matplotlib.pyplot **as** plt

train = ImageDataGenerator(rescale=1/255)

test = ImageDataGenerator(rescale=1/255)

train_dataset = train.flow_from_directory(r"/content/drive/MyDrive/train_set",

target_size=(150,150),

batch_size = 32,

```
                                    class_mode = 'binary')


test_dataset = test.flow_from_directory(r"/content/drive/MyDrive/test_set",
                                    target_size=(150,150),
                                    batch_size =32,
                                    class_mode = 'binary')
```

Found 442 images belonging to 2 classes.

Found 121 images belonging to 2 classes.

```
test_dataset.class_indices
```

{'forest': 0, 'with fire': 1}

```
model = keras.Sequential()
model.add(keras.layers.Conv2D(32,(3,3),activation='relu',input_shape=(150,150,3)))
model.add(keras.layers.MaxPool2D(2,2))
model.add(keras.layers.Conv2D(64,(3,3),activation='relu'))
model.add(keras.layers.MaxPool2D(2,2))
model.add(keras.layers.Conv2D(128,(3,3),activation='relu'))
model.add(keras.layers.MaxPool2D(2,2))
model.add(keras.layers.Conv2D(128,(3,3),activation='relu'))
model.add(keras.layers.MaxPool2D(2,2))
model.add(keras.layers.Flatten())
model.add(keras.layers.Dense(512,activation='relu'))
model.add(keras.layers.Dense(1,activation='sigmoid'))
model.summary()
```

Model: "sequential"

```
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 148, 148, 32)      896
```

```
max_pooling2d (MaxPooling2D  (None, 74, 74, 32)       0
)
conv2d_1 (Conv2D)           (None, 72, 72, 64)        18496
max_pooling2d_1 (MaxPooling  (None, 36, 36, 64)       0
2D)
conv2d_2 (Conv2D)           (None, 34, 34, 128)       73856
max_pooling2d_2 (MaxPooling  (None, 17, 17, 128)      0
2D)
conv2d_3 (Conv2D)           (None, 15, 15, 128)       147584
max_pooling2d_3 (MaxPooling  (None, 7, 7, 128)        0
2D)
flatten (Flatten)           (None, 6272)              0
dense (Dense)               (None, 512)               3211776
dense_1 (Dense)             (None, 1)                 513
=================================================================
Total params: 3,453,121
Trainable params: 3,453,121
Non-trainable params: 0
_________________________________________________________________
model.compile(optimizer='adam',loss='binary_crossentropy',metrics=['accuracy'])
r = model.fit(train_dataset,
        epochs = 10,
        validation_data = test_dataset)
Epoch 1/10
14/14 [==============================] - 156s 11s/step - loss: 0.5977 - accuracy: 0.7353 -
val_loss: 0.2603 - val_accuracy: 0.9256
Epoch 2/10
14/14 [==============================] - 31s 2s/step - loss: 0.3629 - accuracy: 0.8507 - val
_loss: 0.1304 - val_accuracy: 0.9752
```

Epoch 3/10

14/14 [==============================] - 29s 2s/step - loss: 0.2061 - accuracy: 0.9276 - val_loss: 0.0353 - val_accuracy: 0.9917

Epoch 4/10

14/14 [==============================] - 30s 2s/step - loss: 0.1594 - accuracy: 0.9457 - val_loss: 0.0253 - val_accuracy: 1.0000

Epoch 5/10

14/14 [==============================] - 29s 2s/step - loss: 0.1493 - accuracy: 0.9434 - val_loss: 0.0274 - val_accuracy: 1.0000

Epoch 6/10

14/14 [==============================] - 30s 2s/step - loss: 0.1211 - accuracy: 0.9548 - val_loss: 0.0222 - val_accuracy: 1.0000

Epoch 7/10

14/14 [==============================] - 30s 2s/step - loss: 0.1200 - accuracy: 0.9525 - val_loss: 0.1301 - val_accuracy: 0.9256

Epoch 8/10

14/14 [==============================] - 31s 2s/step - loss: 0.1361 - accuracy: 0.9434 - val_loss: 0.0206 - val_accuracy: 0.9917

Epoch 9/10

14/14 [==============================] - 32s 2s/step - loss: 0.1498 - accuracy: 0.9412 - val_loss: 0.0352 - val_accuracy: 1.0000

Epoch 10/10

14/14 [==============================] - 32s 2s/step - loss: 0.0850 - accuracy: 0.9661 - val_loss: 0.0065 - val_accuracy: 1.0000

```
model.save("forest1.h5")
```

```
predictions = model.predict(test_dataset)
```

```
predictions = np.round(predictions)
```

4/4 [==============================] - 6s 1s/step

```
predictions
```

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array([[1.],
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[1.]], dtype=float32)

```
print(len(predictions))
```

121

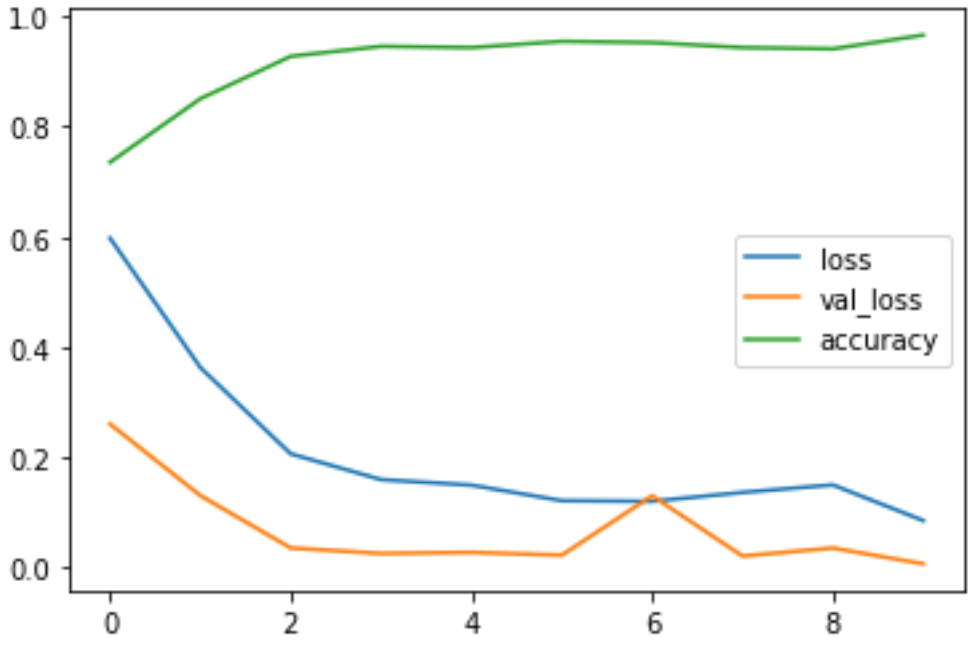
```
import matplotlib.pyplot as plt

plt.plot(r.history['loss'], label='loss')

plt.plot(r.history['val_loss'], label='val_loss')

plt.plot(r.history['accuracy'], label='accuracy')

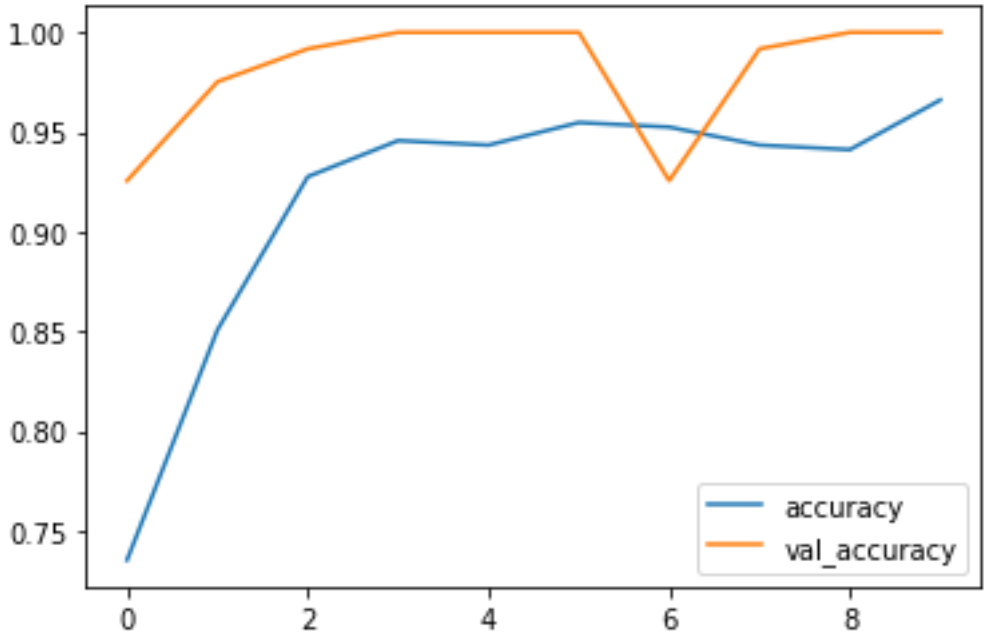
plt.legend()
```




```
plt.plot(r.history['accuracy'], label='accuracy')

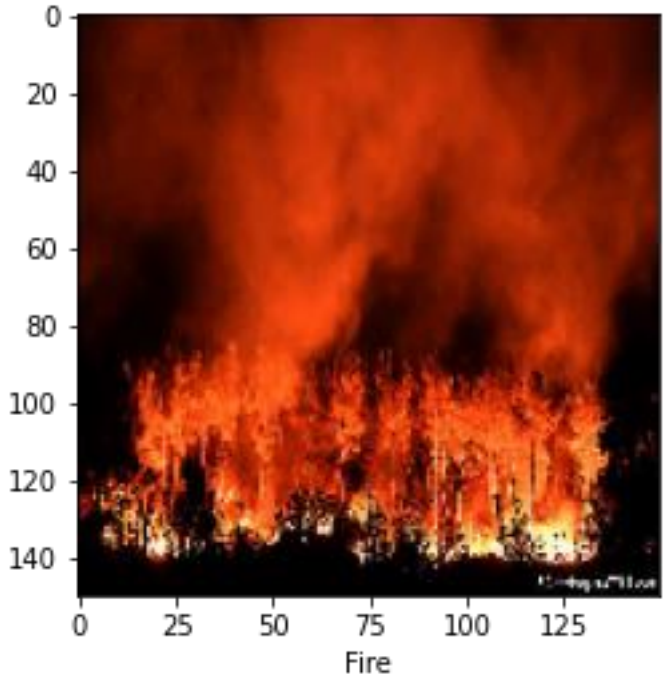
plt.plot(r.history['val_accuracy'], label='val_accuracy')

plt.legend()
```




```
def predictImage(filename):
    img1 = image.load_img(filename,target_size=(150,150))
    plt.imshow(img1)
    Y = image.img_to_array(img1)
    X = np.expand_dims(Y,axis=0)
    val = model.predict(X)
    print(val)
    if val == 1:
        plt.xlabel("Fire")
    elif val == 0:
        plt.xlabel("No Fire")
predictImage(r"/content/drive/MyDrive/test_set/with fire/19464620_401.jpg")
```

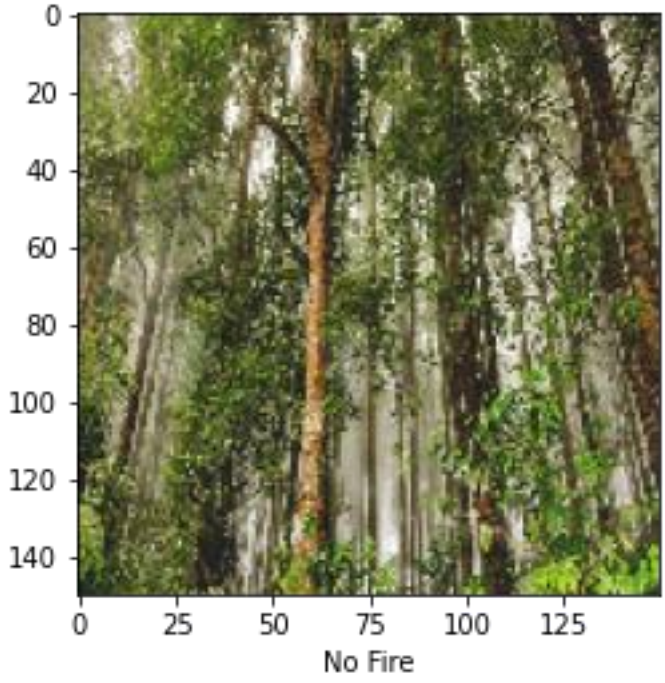
```
1/1 [==============================] - 0s 147ms/step
[[1.]]
```



predictImage(r"/content/drive/MyDrive/test_set/forest/091318_LH_forest_loss_main_FREE.jpg")

1/1 [==============================] - 0s 32ms/step

[[0.]]



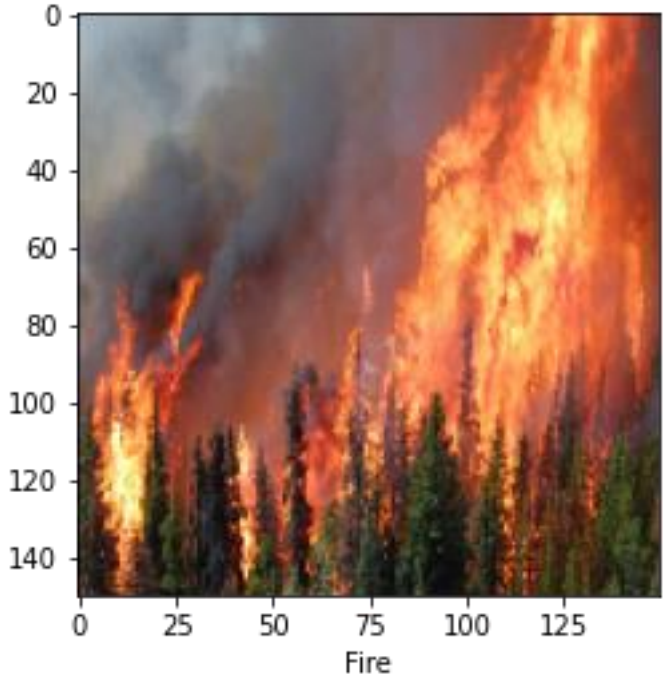
predictImage(r"/content/drive/MyDrive/train_set/with fire/with fire (100).jpg")

[[1.]]

1/1 [==============================] - 0s 31ms/step

[[1.]]

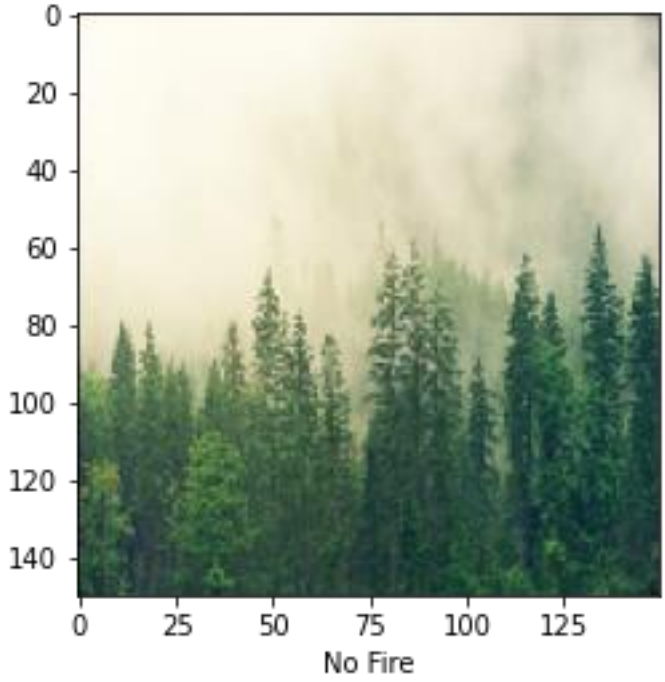
[[1.0]]



predictImage(r"/content/drive/MyDrive/test_set/forest/cold_daylight_environment_1423600_640x427.jpg")

1/1 [==============================] - 0s 31ms/step

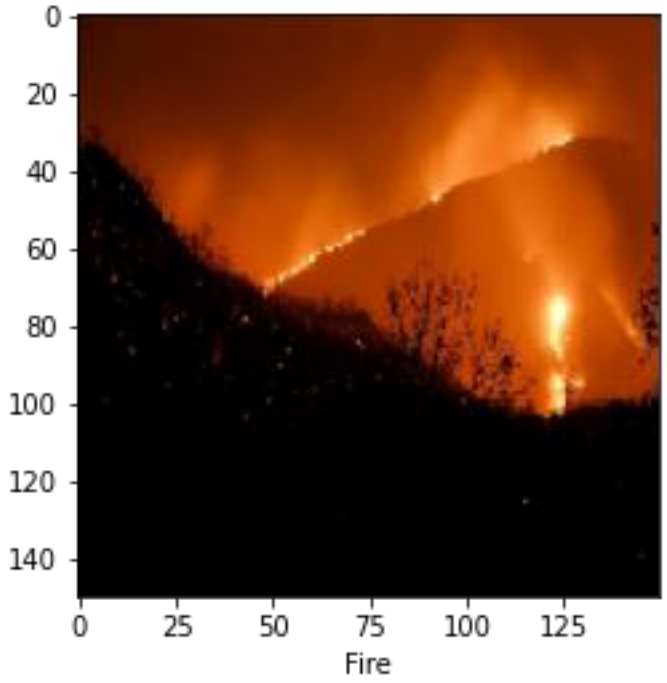
[[0.]]



predictImage(r"/content/drive/MyDrive/test_set/with fire/Fire_2_696x392.jpg")

1/1 [==============================] - 0s 28ms/step

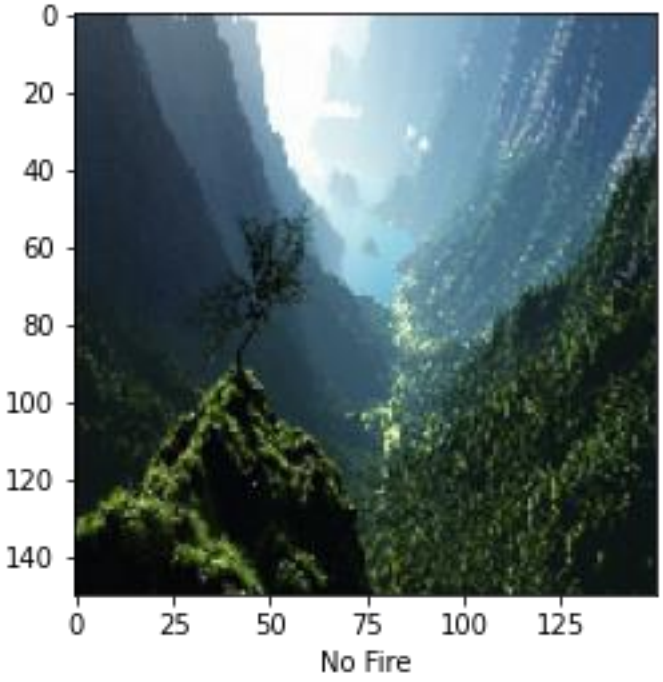
[[1.]]



predictImage(r"/content/drive/MyDrive/train_set/forest/with_fire (104).jpg")

1/1 [==============================] - 0s 80ms/step

[[0.]]



5.5 SPRINT 3:


```
  {
   "nbformat": 4,
   "nbformat_minor": 0,
   "metadata": {
    "colab": {
     "provenance": []
    },
    "kernelspec": {
     "name":
     "python3",
     "display_name": "Python 3"
    },
    "language_info":
     {"name":
     "python"


},
   "cells": [
    {
     "cell_type": "code",
     "execution_count": 1,
     "metadata": {
      "colab": {
       "base_uri": "https:/ localhost:8080/",
       "height": 35
      },
      "id": "cm0cXpbvyyBp",
      "outputId": "4bffc3ff-b763-4d6d-c12b-02b62f8c32fa"
     },
     "outputs": [
      {
```

```
    "output_type": "execute_result",
    "data": {
     "text/plain":
      [
       "'/content'"
      ],
     "application/vnd.google.colaboratory.intrinsic+json": {
      "type": "string"
     }
    },
    "metadata": {},
    "execution_count": 1
   }
  ],
  "source":
   ["pwd"
  ]
 },
 {
  "cell_type": "code",
  "source": [
   "!pip install keras\n",
   "!pip install tensorflow\n",
   "!pip install opencv-python"
  ],
  "metadata": {
   "colab": {

    "base_uri": "https:/ localhost:8080/"
   },
   "id": "UnpPHFm0y4lm",
   "outputId": "543ceb28-d9f5-4c1c-9934-02075c827323"
```

```
},
"execution_count": 2,
"outputs": [
 {
  "output_type": "stream",
  "name": "stdout",
  "text": [
   "Looking in indexes: https:/ pypi.org/simple, https:/ us-python.pkg.dev/colab-wheels/public/simple/\n",
   "Requirement already satisfied: keras in /usr/local/lib/python3.7/dist-packages (2.9.0)\n",
   "Looking in indexes: https:/ pypi.org/simple, https:/ us-python.pkg.dev/colab-wheels/public/simple/\n",
   "Requirement already satisfied: tensorflow in /usr/local/lib/python3.7/dist-packages (2.9.2)\n",
   "Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.15.0)\n",
   "Requirement already satisfied: keras<2.10.0,>=2.9.0rc0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (2.9.0)\n",
   "Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (14.0.6)\n",
   "Requirement already satisfied: gast<=0.4.0,>=0.2.1 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (0.4.0)\n",
   "Requirement already satisfied: protobuf<3.20,>=3.9.2 in /usr/local/lib/python3.7/dist- packages (from tensorflow) (3.19.6)\n",
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```

tensorflow) (3.1.0)\n",

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packages (from tensorflow) (1.6.3)\n",

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"from keras.layers import Dense\n",
"from keras.layers import Convolution2D\n",
"from keras.layers import MaxPooling2D\n",
"from keras.layers import Flatten"
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  "test = ImageDataGenerator(rescale=1/255)"
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    "execution_count": 8
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```

```
   "                                batch_size = 32,\n",
   "                                class_mode = 'binary')\n",
   "x_test = test_dataset = test.flow_from_directory(\"/content/drive/MyDrive/test_set\",\n", "
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   "                                class_mode = 'binary')"
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     "Found 121 images belonging to 2 classes.\n"
    ]
   }
  ]
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   "execution_count": 11
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 ]

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        "14/14 [==============================] - 157s 11s/step - loss: 3.7764 - accuracy:
0.5928 - val_loss: 0.3833 - val_accuracy: 0.8182\n",
        "Epoch 2/10\n",
        "14/14 [==============================] - 22s 2s/step - loss: 1.0376 - accuracy:
0.6855 - val_loss: 0.1756 - val_accuracy: 0.9339\n",
        "Epoch 3/10\n",
        "14/14 [==============================] - 21s 1s/step - loss: 0.2968 - accuracy:
0.8688 - val_loss: 0.1248 - val_accuracy: 0.9835\n",
        "Epoch 4/10\n",
        "14/14 [==============================] - 21s 2s/step - loss: 0.2413 - accuracy:
0.9072 - val_loss: 0.1233 - val_accuracy: 0.9504\n",
        "Epoch 5/10\n",
        "14/14 [==============================] - 21s 2s/step - loss: 0.1790 - accuracy:
0.9321 - val_loss: 0.0887 - val_accuracy: 0.9669\n",
        "Epoch 6/10\n",
        "14/14 [==============================] - 21s 2s/step - loss: 0.1427 - accuracy:
0.9457 - val_loss: 0.0762 - val_accuracy: 0.9752\n",
```

```
        "Epoch 7/10\n",
        "14/14 [==============================] - 21s 2s/step - loss: 0.1059 - accuracy:
0.9706 - val_loss: 0.0514 - val_accuracy: 0.9917\n",
        "Epoch 8/10\n",
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0.9774 - val_loss: 0.0272 - val_accuracy: 1.0000\n",
        "Epoch 9/10\n",
        "14/14 [==============================] - 21s 2s/step - loss: 0.0657 - accuracy:
0.9774 - val_loss: 0.0266 - val_accuracy: 0.9917\n",
        "Epoch 10/10\n",
        "14/14 [==============================] - 23s 2s/step - loss: 0.0465 - accuracy:
0.9819 - val_loss: 0.0153 - val_accuracy: 1.0000\n"
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   "name": "stdout",
   "text":
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  }
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  "ls -1"
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  "colab": {
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     "image-classification-model_new.tgz\n",
     "\u001b[01;34msample_data\u001b[0m/\n
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```


```
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```
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" Stored in directory: /root/.cache/pip/wheels/64/56/fb/5cd6f4f40406c828a5289b95b2752a4d142a9afb359244ed8

d\n",

" Building wheel for ibm-cos-sdk-s3transfer (setup.py) ... \u001b[?25l\u001b[?25hdone\n",

" Created wheel for ibm-cos-sdk-s3transfer: filename=ibm_cos_sdk_s3transfer-2.12.0-py3-none-any.whl size=89778 sha256=3c9215c3ddaa7fc31a8c3783a78b5e3aa7a4cb9ea8d7dc1178e709c1ccb392a8\n",

" Stored in directory: /root/.cache/pip/wheels/57/79/6a/ffe3370ed7ebc00604f9f76766e1e0348dcdcad2b2e32df9e1

\n",

"Successfully built ibm-cos-sdk ibm-cos-sdk-core ibm-cos-sdk-s3transfer\n", "Installing

collected packages: urllib3, requests, jmespath, ibm-cos-sdk-core, botocore, s3transfer, ibm-cos-sdk-s3transfer, lomond, ibm-cos-sdk, boto3, watson-machine-learning-client\n",

" Attempting uninstall: urllib3\n",

" Found existing installation: urllib3 1.24.3\n",

" Uninstalling urllib3-1.24.3:\n",

" Successfully uninstalled urllib3-1.24.3\n","

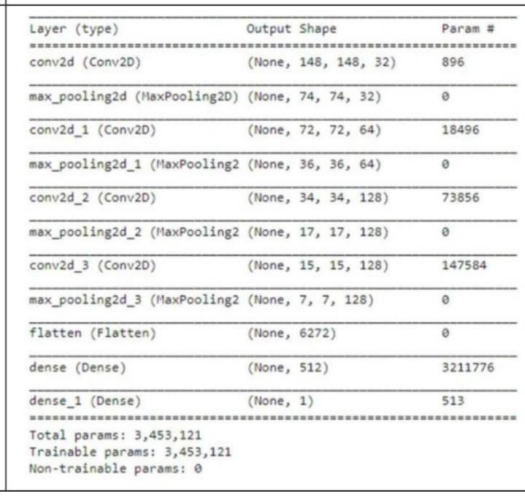
```
        Attempting uninstall: requests\n",
        "   Found existing installation: requests 2.23.0\n", "
            Uninstalling requests-2.23.0:\n",
        "     Successfully uninstalled requests-2.23.0\n",
        "Successfully installed boto3-1.26.11 botocore-1.29.11 ibm-cos-sdk-2.12.0 ibm-cos-sdk-core-2.12.0 ibm-cos-sdk-s3transfer-2.12.0 jmespath-0.10.0 lomond-0.3.3 requests-2.28.1 s3transfer-0.6.0 urllib3-1.26.12 watson-machine-learning-client-1.0.391\n"
       ]
      },
      {
       "output_type": "display_data",
       "data": {
        "application/vnd.colab-display-data+json": {
         "pip_warning": {
          "packages": [
           "requests",
           "urllib3"
          ]
         }
        }
       },
       "metadata": {}
      }
     ]

    },
    {
     "cell_type": "code",
     "source": [
      "def guid_from_space_name(client, space_name):\n",
      "    space = client.spaces.get_details()\n",
      "    #print(space)\n",
```

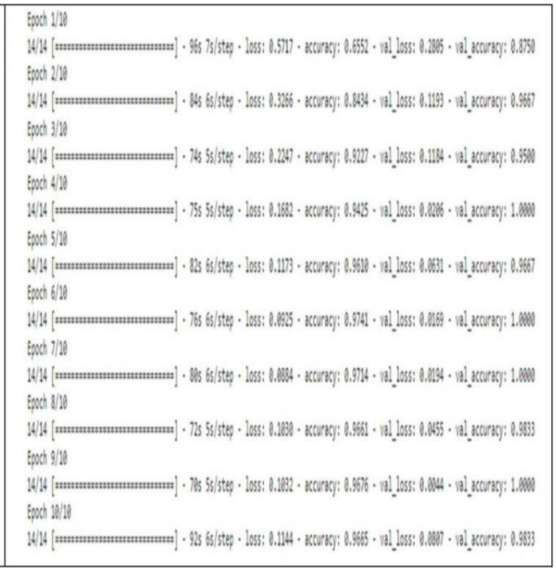
```
      "    return(next(item for item in space['resources']if item['entity'][\"name\"] ==
space_name)['metadata']['id'])"
     ],
     "metadata": {
       "id": "QSDKfvy_3H8Q"
     },
     "execution_count": 25,
     "outputs": []
    }
  }
}
```

6 TESTING AND RESULTS

6.1 Performance Testing

S. No	Parameter	Values	Screenshot
1.	Model Summary	3,453,213	

```
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 148, 148, 32)      896
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 74, 74, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 72, 72, 64)        18496
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 36, 36, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 34, 34, 128)       73856
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 17, 17, 128)       0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 15, 15, 128)       147584
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 7, 7, 128)         0
_________________________________________________________________
flatten (Flatten)            (None, 6272)              0
_________________________________________________________________
dense (Dense)                (None, 512)               3211776
_________________________________________________________________
dense_1 (Dense)              (None, 1)                 513
=================================================================
Total params: 3,453,121
Trainable params: 3,453,121
Non-trainable params: 0
```

2.	Accuracy	Training Accuracy - 0.9663 Validation Accuracy -0.9795	

6.2 User acceptance testing

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	1	1	2	0	4
Duplicate	0	0	0	0	0
External	0	0	2	1	3
Fixed	4	2	4	1	11
Not Reproduced	0	0	0	0	0
Skipped	0	0	1	1	2
Won't Fix	0	0	0	1	1
Totals	5	3	9	4	21

a. Test case

				Date	08-Nov-2022			
				Team ID	PNT2022TMID07050			
				Project Name	Emerging Methods for Early Detection of Forest fire			
				Maximum Marks	4 marks			
Test case ID	**Feature Type**	**Component**	**Test Scenario**	**Expected Result**		**Actual Result**	**Status**	**BUGID**	**Executed By**
Home Page_ TC_OO1	UI	Home Page	Display the Emerging Methods of Forest Fires	Displaying the Home Page		Home Page displayed	Pass	-	Devi, Esther
Home Page_ TC_OO2	UI	Home Page	Displayed the Prediction ForestFires	Displaying the content ofhome page		Content of Homepage is displayed	Pass	-	Divya, Akshara
Home Page_ TC_OO3	Functional	Home page	Checks whether the Drop theImage Here! Button is visible	Displays the Button		Drop the Image Here! Button is pops up.	Pass	-	Devi, Esther
PredictiedPageTC_OO4	Functional	Predicted page	Display the Prediction Page and Choose Image Button	Displays the Prediction Page and the Choose Image Button		Prediction page displayed. Choose image button was clicked.	Pass	-	Divya, Akshara, Devi, Esther.
PredictedPage_TC_OO4	Functional	Predicted page	Select the Image and Click the Predict Button	Display the selected Image		Displays the Selected Image	Pass	-	Devi, Esther

b. Test case analysis

Section	Total Cases	Not Tested	Fail	Pass
Client Application	10	0	0	10
Security	2	0	0	2
Performance	2	0	0	2
Exception Reporting	2	0	0	2
Final Report Output	3	0	0	3

7. ENTIRE MODEL:

```
#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_range=0.2,horizontal_flip=True)
test_datagen=ImageDataGenerator(rescale=1./255,shear_range=0.2,rotation_range=180,zoom_range=0.2,horizontal_flip=True)
#Applying ImageDataGenerator functionality to train dataset
x_train=train_datagen.flow_from_directory('/content/drive/MyDrive/train_set',target_size=(64,64),batch_size=32,class_mode='binary')
Found 442 images belonging to 2 classes.
```

```
x_test=test_datagen.flow_from_directory('/content/drive/MyDrive/test_set',target_size=(64,64),
batch_size=32,class_mode='binary')
Found 121 images belonging to 2 classes.
#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_steps=4)
Epoch 1/10
14/14 [==============================] - 152s 11s/step - loss: 1.2336 - accuracy: 0.6244 - val_loss: 0.3944 - val_accuracy: 0.8760
Epoch 2/10
14/14 [==============================] - 23s 2s/step - loss: 0.3932 - accuracy: 0.8394 - val_loss: 0.1940 - val_accuracy: 0.9421
Epoch 3/10
14/14 [==============================] - 22s 2s/step - loss: 0.2676 - accuracy: 0.8914 - val_loss: 0.1266 - val_accuracy: 0.9835
Epoch 4/10
14/14 [==============================] - 23s 2s/step - loss: 0.2115 - accuracy: 0.9072 - val_loss: 0.0966 - val_accuracy: 0.9587
Epoch 5/10
14/14 [==============================] - 22s 2s/step - loss: 0.1967 - accuracy: 0.9231 - val_loss: 0.0950 - val_accuracy: 0.9752
Epoch 6/10
14/14 [==============================] - 24s 2s/step - loss: 0.1907 - accuracy: 0.9253 - val_loss: 0.1514 - val_accuracy: 0.9256
Epoch 7/10
14/14 [==============================] - 23s 2s/step - loss: 0.2169 - accuracy: 0.9072 - val_loss: 0.0874 - val_accuracy: 0.9669
Epoch 8/10
14/14 [==============================] - 26s 2s/step - loss: 0.1809 - accuracy: 0.9253 - val_loss: 0.0743 - val_accuracy: 0.9669
Epoch 9/10
14/14 [==============================] - 23s 2s/step - loss: 0.1777 - accuracy: 0.9299 - val_loss: 0.0670 - val_accuracy: 0.9917
Epoch 10/10
14/14 [==============================] - 26s 2s/step - loss: 0.2067 - accuracy: 0.9095 - val_loss: 0.0617 - val_accuracy: 0.9917
#Save the model
model.save("/content/drive/MyDrive/forest1.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/forest1.h5")
img=image.load_img('/content/drive/MyDrive/test_set/with
fire/Forest_fire_MNRF_esize_IMG_6743.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)
1/1 [==============================] - 0s 139ms/step
1
pip install twilio
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/sim
ple/
Collecting twilio
  Downloading twilio-7.15.3-py2.py3-none-any.whl (1.4 MB)
     |████████████████████████████████| 1.4 MB 6.5 MB/s
Requirement already satisfied: pytz in /usr/local/lib/python3.7/dist-packages (from twilio) (202
2.6)
Requirement already satisfied: requests>=2.0.0 in /usr/local/lib/python3.7/dist-packages (from t
wilio) (2.23.0)
Collecting PyJWT<3.0.0,>=2.0.0
  Downloading PyJWT-2.6.0-py3-none-any.whl (20 kB)
```

Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests>=2.0.0->twilio) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packages (from requests>=2.0.0->twilio) (2022.9.24)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-packages (from requests>=2.0.0->twilio) (3.0.4)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/python3.7/dist-packages (from requests>=2.0.0->twilio) (1.24.3)
Installing collected packages: PyJWT, twilio
Successfully installed PyJWT-2.6.0 twilio-7.15.3

```
from twilio.rest import Client
if pred==0:
  print('Forest fire')
  account_sid='AC4c9a105651d0150d1b85af1bd4cf090c'
  auth_token='d18b90389f18b6069775b89c5c10ca1f'
  client=Client(account_sid,auth_token)
  message=client.messages \
  .create(
      body='forest fire is detected,stay alert',
      #use twilio free number
      from_='+15134660214',
      #to number
      to='+919361632961')
  print(message.sid)
  print("Fire detected")
  print("SMS Sent!")
elif pred==1:
  print('No Fire')
```

No Fire

```
#Open cv for video processing
pip install twilio
```

Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: twilio in /usr/local/lib/python3.7/dist-packages (7.15.3)

Requirement already satisfied: requests>=2.0.0 in /usr/local/lib/python3.7/dist-packages (from t
wilio) (2.23.0)
Requirement already satisfied: PyJWT<3.0.0,>=2.0.0 in /usr/local/lib/python3.7/dist-packages (
from twilio) (2.6.0)
Requirement already satisfied: pytz in /usr/local/lib/python3.7/dist-packages (from twilio) (202
2.6)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-packages (fro
m requests>=2.0.0->twilio) (3.0.4)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/python
3.7/dist-packages (from requests>=2.0.0->twilio) (1.24.3)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packages (fro
m requests>=2.0.0->twilio) (2022.9.24)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from req
uests>=2.0.0->twilio) (2.10)

In [36]:

```
#Creating An Account in Twilio Service
#Sending Alert Message
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
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('/FOREST  FIRE.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/forest1.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()
```

```
1/1 [==============================] - 0s 70ms/step
Forest fire
from twilio.rest import Client
if pred==0:
  print('Forest fire')
  from twilio.rest import Client
  account_sid='AC4c9a105651d0150d1b85af1bd4cf090c'
  auth_token='ee06c7d5053b02ef2ee7689157b255ee'
  client=Client(account_sid,auth_token)
  message=client.messages \
  .create(
      body='forest fire is detected,stay alert',
      #use twilio free number
      from_='+15134660214',
      #to number
```

```
    to='+919361632961')
  print(message.sid)
  print("Fire detected")
  print("SMS Sent!")
elif pred==1:
  print('No Fire')
```

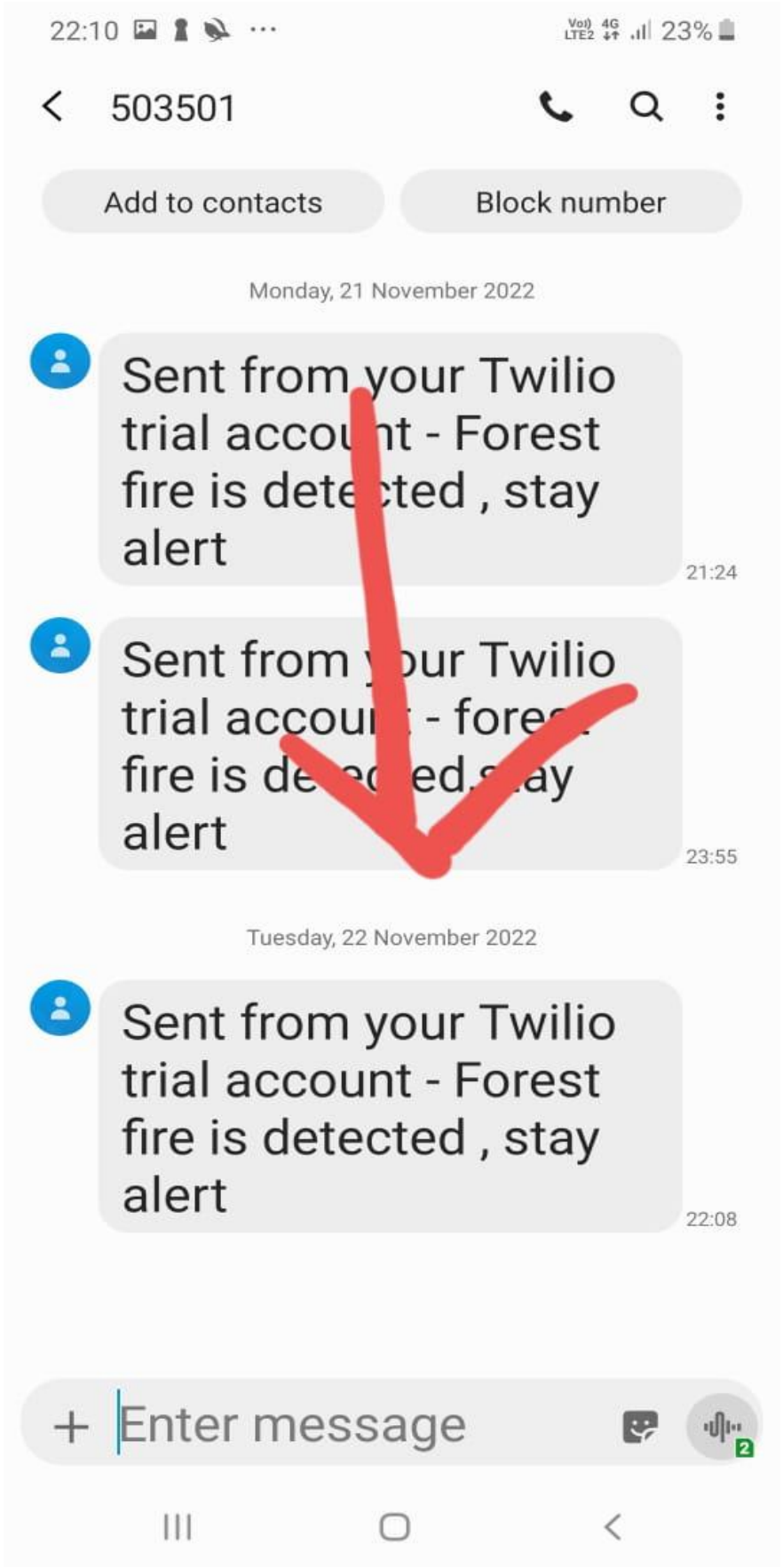
Forest fire

SM6c3521055b9c8a7899bfb240b5ea1b51

Fire detected

SMS Sent!

OUTPUT SCREENSHOT:



8. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- The proposed system detects the forest fire at a faster rate compared to existing system. It has enhanced data collection feature.
- The major aspect is that it reduces false alarm and also has accuracy due to various sensors present.
- It minimize the human effort as it works automatically. This is meagre -cost due to whichcan be easily accessed.
- The main objective of our project is to receive an alert message through an app to the respective user.

DISADVANTAGES:

- The electrical interference diminishes the potency of radio receiver.
- The main drawback is that it has less coverage range areas

9. CONCULSION

This type of system is the first of its kind to ensure no further damage is then to forests when there is a fire breakout and instantly a message is sent to the user through the App. Immediate response or early warning to a fire breakout is mostly the only way to avoid losses and biology, cultural heritage damages to a great extent. Therefore the most important goals in fire surveillance are quick and authentic detection of fire. It is so much easier to suppress fire while it is in its early stages. info about the progress of fire is highly valuable for managing fire during all its stages. Based on this data the firefighting staff can be guided on 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 invention, this project can be implemented in various forest areas so that we can save our forests and maintain great environs.

10. FUTURE SCOPE

This project is far from complete and there is a lot of room for betterment. Some of the betterment that can be made to this project are as follows:

An Additional pump can be added so that it automatically sends water when there isa fire breakout. Also industrial sensors can be used for better ranging and accuracy.

➔ This project has endless potential and can always be enhanced to become better.enforce this concept in the real world will benefit several industries and reduce the workload on many workers, enhancing overall work efficiency.

GitHub :

https://github.com/IBM-EPBL/IBM-Project-19171-1659694051