PROJECT REPORT

Project Name: EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

Team id: PNT2022TMID30362

Team Members: MAHESHWARI.K (611419104039)-TEAM LEADER

DHIVYABHARATHI.B(611419104009)

MAILI.K (611419104040)

MAHALAKSHMI.M (611419104037)

1. INTRODUCTION

a. 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 sparselypopulated 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 away to tackle the issue.

a. Purpose

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

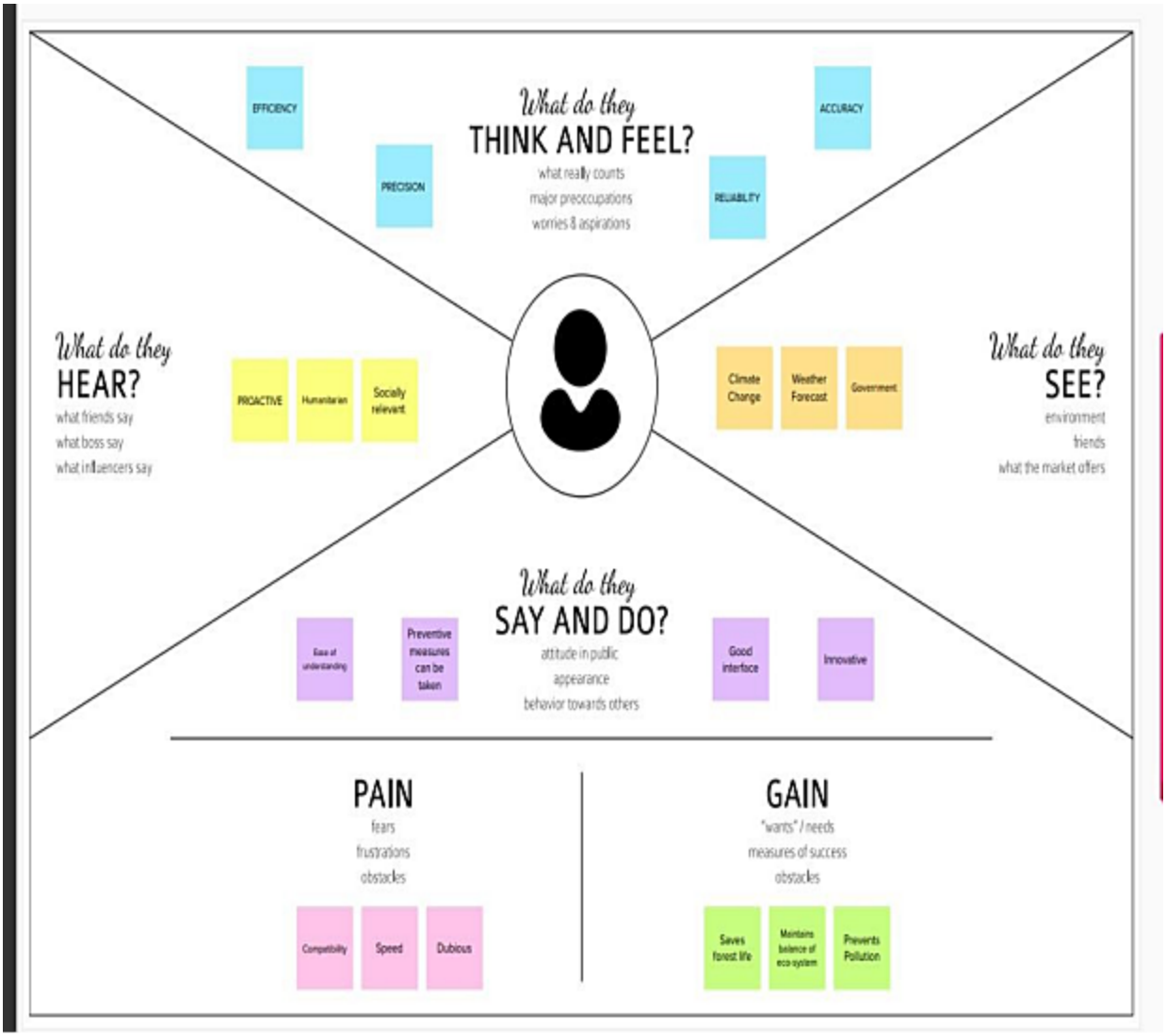
2. LITERATURE SURVEY

a. Reference

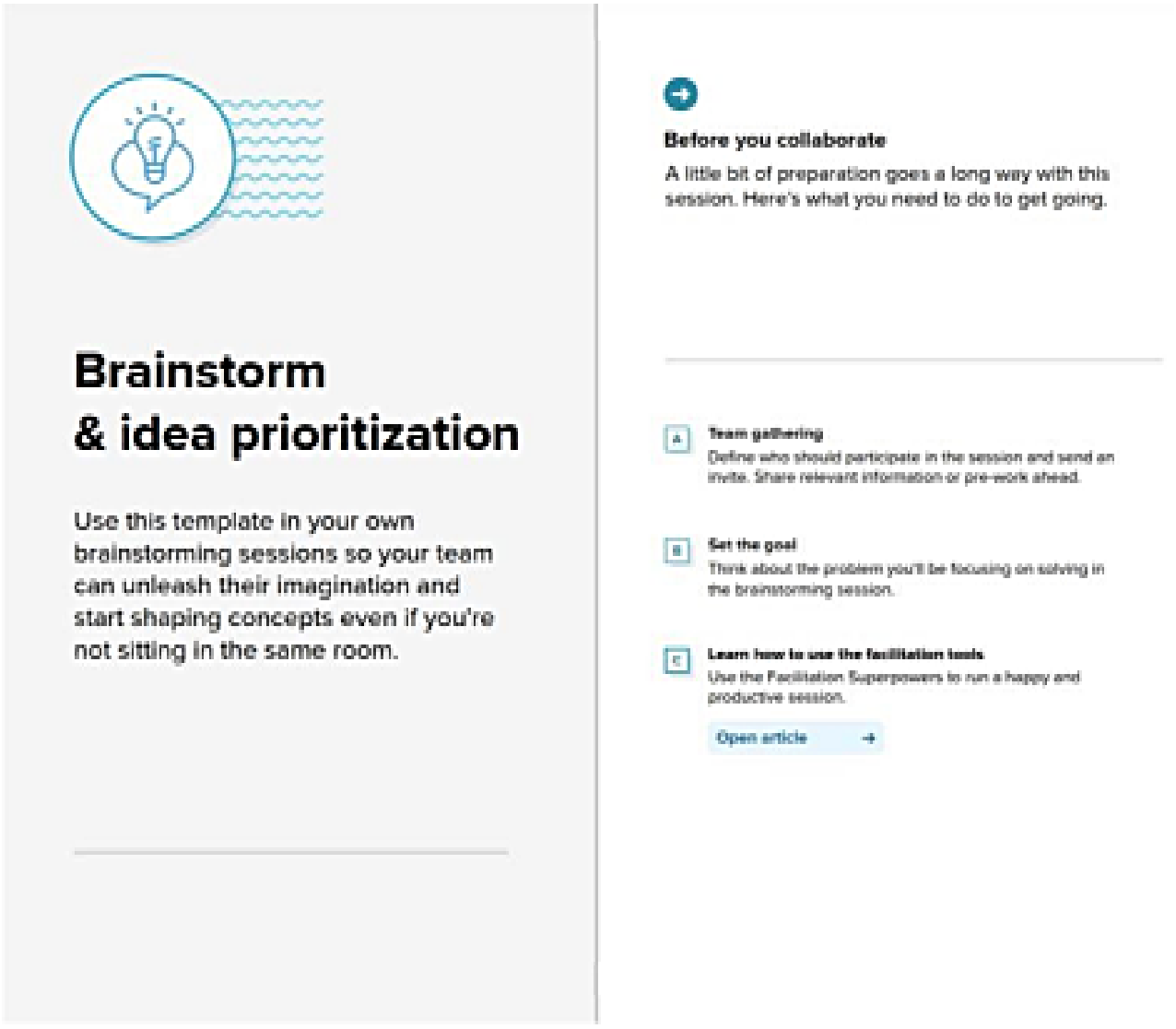
S. NO	TITLE	AUTHOR	YEAR
1.	Image Processing for Forest Fire Detection.	Priyadharshini	2016
2.	Forest fire prediction and detection system.	Faroudja Abid	2020
3.	systematic approaches in managingforest fires .	AdityaDhall	2020

1. IDEATION & PROPOSED SOLUTION

a. Empathy map



a. Ideation & Brainstorming



3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, 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.

a. **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.

1.

		• 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

REQUIREMENT ANALYSIS

a. Functional requirement

Proposed solution fit.

1.Customer Segment

-To adopt a new technology.

-For officers who works in forestry department.

2.Problems/Pains

-Deterioration of air quality,loss of property ,resources and animal.

-Sometimes devices may malfunction.

3.Triggers and emotions

-To get prior information of forest fire

-It would proceed the misinformation or late details about the forest fire.

4.Customer Limitations

-Should have knowledge about the devices.

-feature loaded device.

5.Problem Root/Cause

-The forest fire starts from natural cause such as lightning.

-Less humidity, high temperature may also cause forest fire

6.Your Solutions

-We train the model with required algorithm like CNN,images of smoke,fire

-Classifying the intensity of the flame using sensors.

7.Available Solution

-satellite based system give high resolution image but it provieds image of entire earth for every two days,that is long time for fire scanning.

8.Channels of Behavior

-They should monitor and checj the device functionalitiy, to alert the smokejumpers.

-They should be present at the fire spot with extinguisher and with all saftey precautions.

9.Behavior

-It emits a large amount of CO2 which may lead to increase in global warming.

-It measures the intensity,light,colour and defines according to its behaviour.

A. REQUIREMENT ANALAYSIS

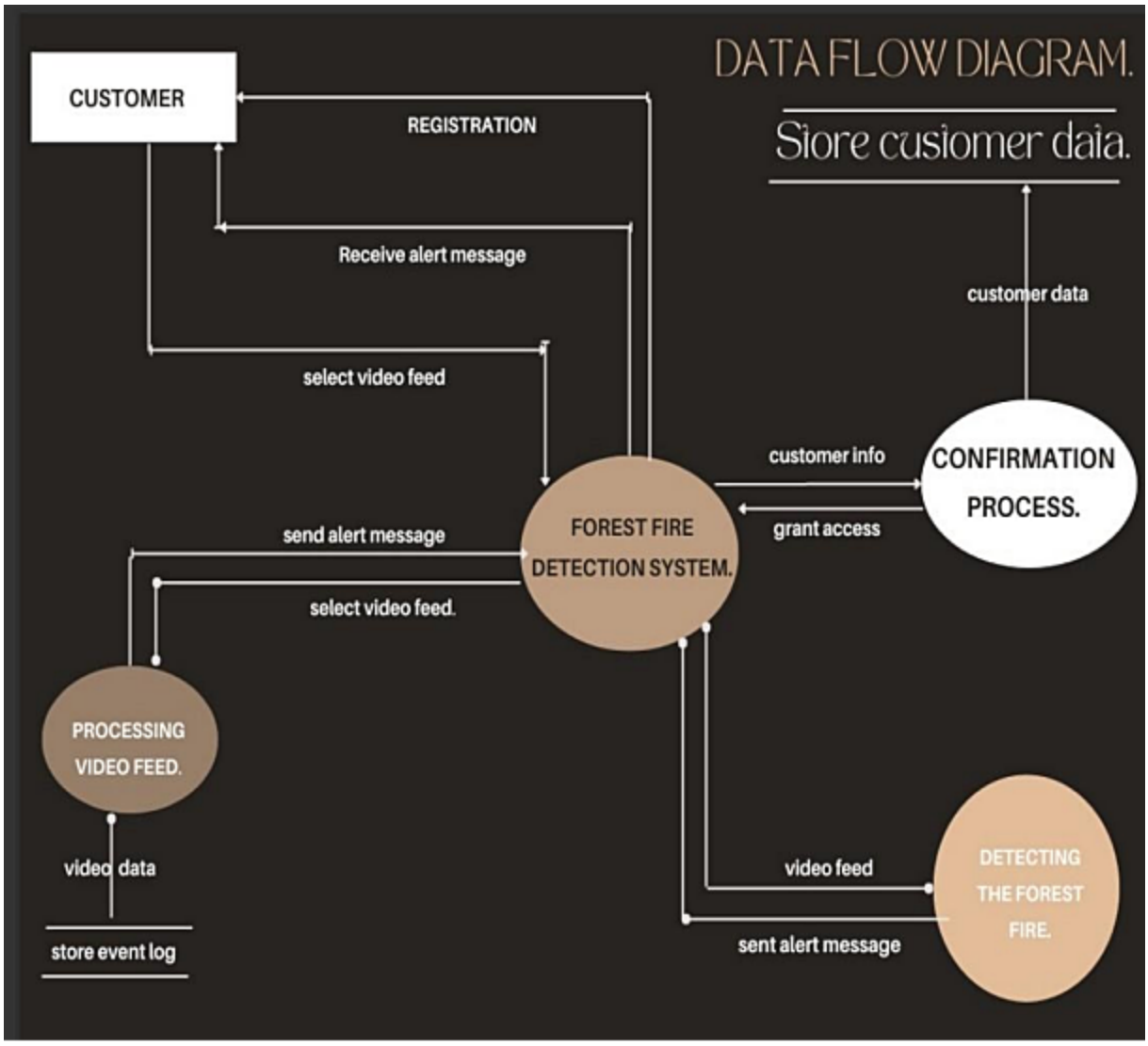
a.

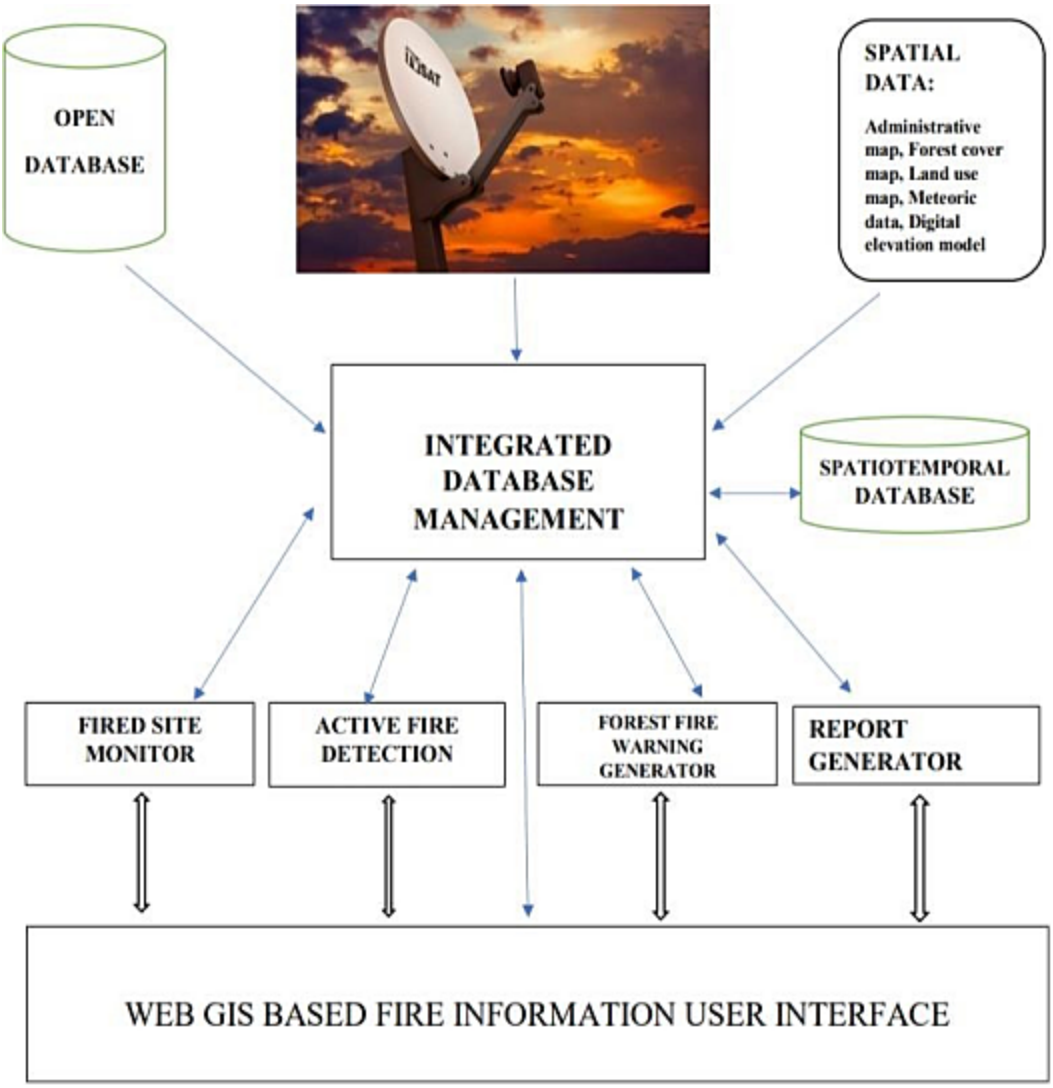
FR. NO.	Functional Requirement	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through wildfire portal.
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Data Prediction	Scientists create computer models to predict wildfire potential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

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.

a. PROJECT DESING

1. 


OPEN
DATABASE
SPATIAL
DATA:
Administrative map, Forest cover map, Land use map, Meteoric data, Digital elevation model
INTEGRATED
DATABASE
MANAGEMENT
SPATIOTEMPORAL
DATABASE
FIRED SITE
MONITOR
ACTIVE FIRE
DETECTION
FOREST FIRE
WARNING
GENERATOR
REPORT
GENERATOR
WEB GIS BASED FIRE INFORMATION USER INTERFACE

1. PROJECT PLANNING & SCHEDULING

a. 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

a. **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) periteration unit (story points per day)

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

a. 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}
```

a. **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=1/25
5)test =
ImageDataGenerator(rescale=1/25
5)


train_dataset = train.flow_from_directory(r"/content/drive/MyDrive/train_set",
                                          target_size=(1
                                          50,150),
                                          batch_size =
                                          32,
```

```
                                class_mode = 'binary')


test_dataset                                                    =
                                test.flow_from_directory(r"/content/driv
                                e/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 (MaxPooling2D)	(None, 36, 36, 64)	0
conv2d_2 (Conv2D)	(None, 34, 34, 128)	73856
max_pooling2d_2 (MaxPooling2D)	(None, 17, 17, 128)	0

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=['acc

uracy']) 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: 0.9256Epoch

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: 0.9917Epoch

4/10

14/14 [==============================] - 30s 2s/step - loss: 0.1594 - accuracy: 0.9457 - val

_loss: 0.0253 -

val_accuracy: 1.0000Epoch

5/10

14/14 [==============================] - 29s 2s/step - loss: 0.1493 - accuracy: 0.9434 - val

_loss: 0.0274 -

val_accuracy: 1.0000Epoch

6/10

14/14 [==============================] - 30s 2s/step - loss: 0.1211 - accuracy: 0.9548 - val

_loss: 0.0222 -

val_accuracy: 1.0000Epoch

7/10

14/14 [==============================] - 30s 2s/step - loss: 0.1200 - accuracy: 0.9525 - val

_loss: 0.1301 -

val_accuracy: 0.9256Epoch

8/10

14/14 [==============================] - 31s 2s/step - loss: 0.1361 - accuracy: 0.9434 - val

_loss: 0.0206 -

val_accuracy: 0.9917Epoch

9/10

14/14 [==============================] - 32s 2s/step - loss: 0.1498 - accuracy: 0.9412 - val

_loss: 0.0352 -

val_accuracy: 1.0000Epoch

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

pr

ed

ict

io

ns

arr

ay

([[

1.

],

[1.],

[0.],

[1.],

[0.],

[1.],

[0.],

[0.],

[1.],

[1.],

[0.],

[0.],

[0.],

[1.],

[0.],

[0.],

[0.],

[1.],

[0.],

[0.],

[1.],

[0.],

[0.],

[0.],

[0.],

[0.],

[0.],

[0.],

[0.],

[1.],

[0.],

[0.],

[0.],

[0.],

[0.],

[0.],

[0.],

[1.],

[1.],

[0.],

[0.],

[1.],

[1.],

[0.],

[1.],

[1.],

[0.],

[1.],

[1.],

[1.],

[0.],

[0.],

[0.],

[1.],

[0.],

[1.],

[0.],

[0.],

[1.],

[0.],

[0.],

[1.],

[0.],

[0.],

[0.],

[1.],

[0.],

[1.],

[0.],

[0.],

[0.],

[1.],

[1.],

[0.],

[1.],

[1.],

[0.],

[1.],

[0.],

[1.],

[1.],

[0.],

[0.],

[1.],

[1.],

[1.],

[0.],

[0.],

[0.],

[1.],

[0.],

[1.],

[0.],

[1.],

[0.],

[1.],

[1.],

[1.],

[1.],

[0.],

[0.],

[0.],

[0.],

[0.],

[1.],

[0.],

[0.],

[0.],

[1.],

[1.],

[1.],

[0.],

[0.],

[1.],

[0.],

[0.],

[1.],

[0.],

[0.],

[0.],

[1.]],

dtype=float32)

print(len(predict

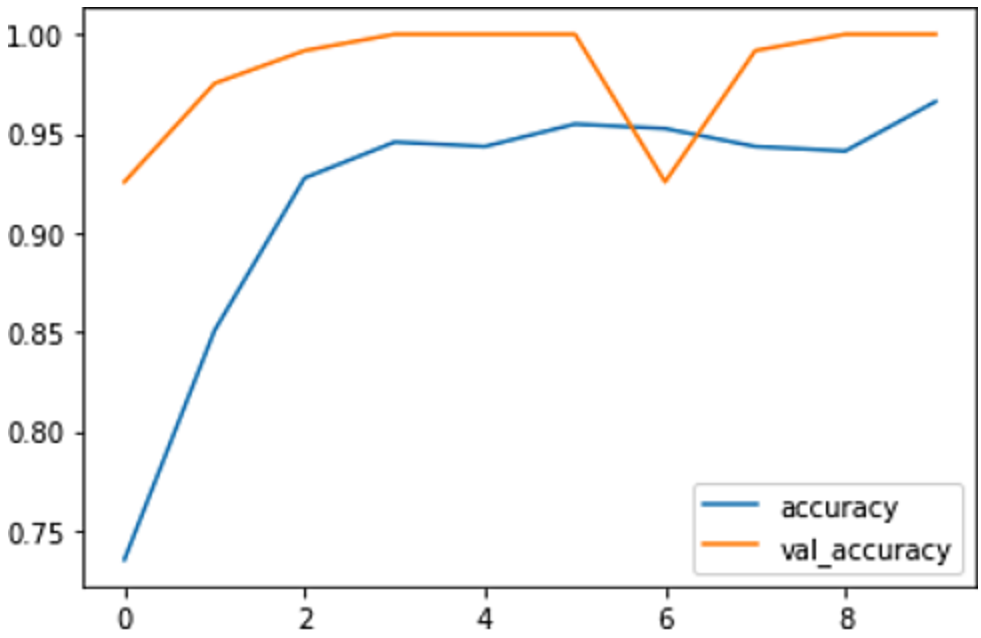
ions)) 121

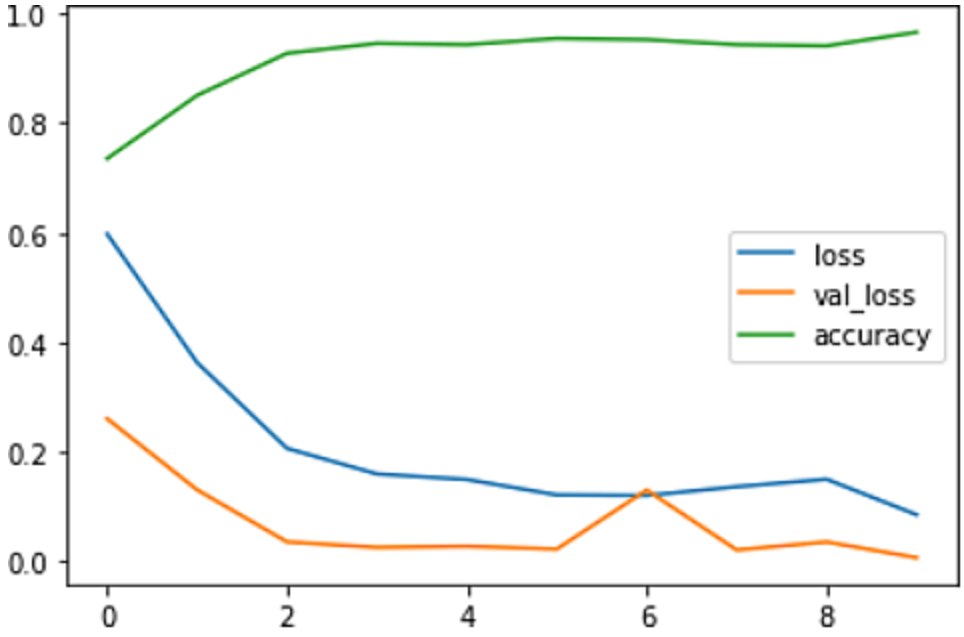
```
import matplotlib.pyplot as plt
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'],
```

label='val_loss')

plt.plot(r.history['accuracy'],

label='accuracy')plt.legend()




1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
loss
val_loss
accuracy

```
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(i
    mg1)X =
    np.expand_dims(Y,axi
    s=0)val =
    model.predict(X)
    print(val)
    if val == 1:
        plt.xlabe
        l("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.]]

[[1.]]

[[1.0]]

predictImage(r"/content/drive/MyDrive/test_set/forest/cold_daylight_environment_1423600_640x4 27.jpg")

1/1

[=====

=====

=====

=====

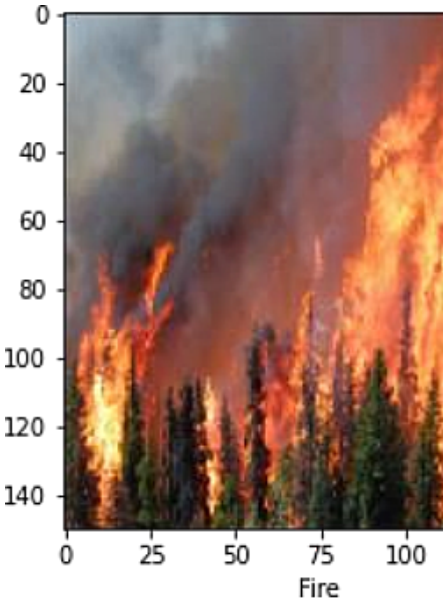
=====

=====]

- 0s

31ms/st

ep[[0.]]



predictImage(r"/content/dr

ive/MyDrive/test_set/with

fire/Fire_2_696x392.jpg")

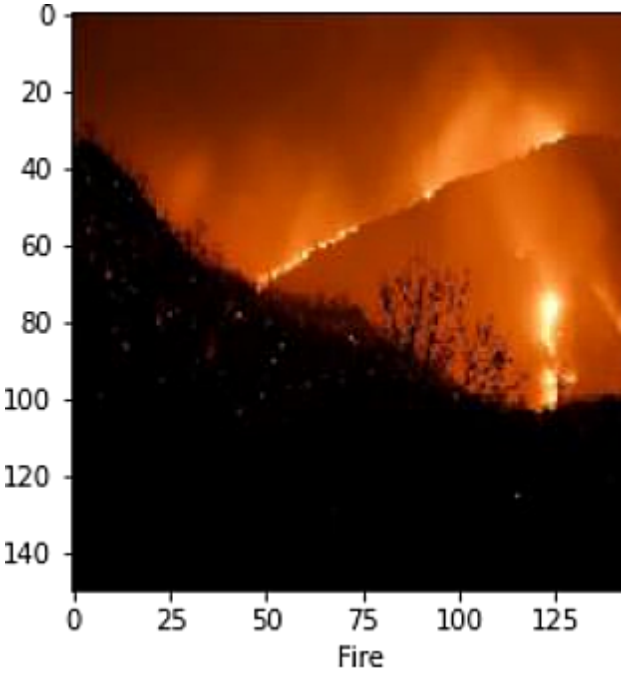
1/1

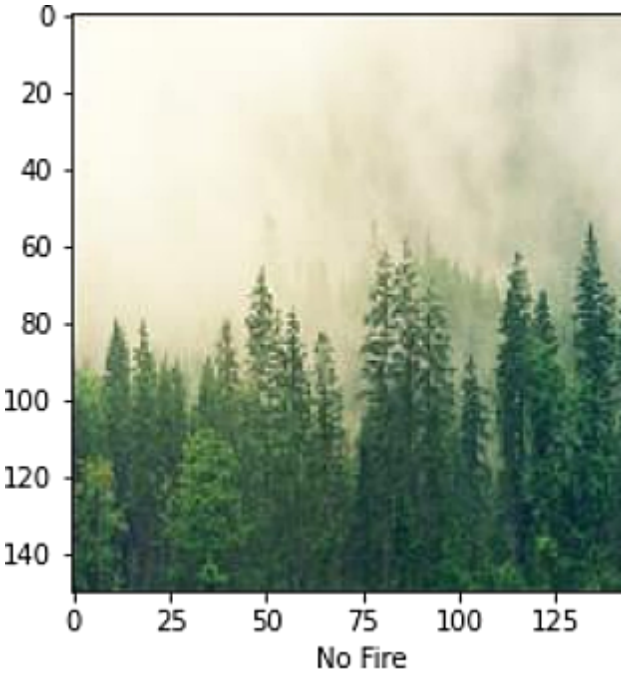
[==========

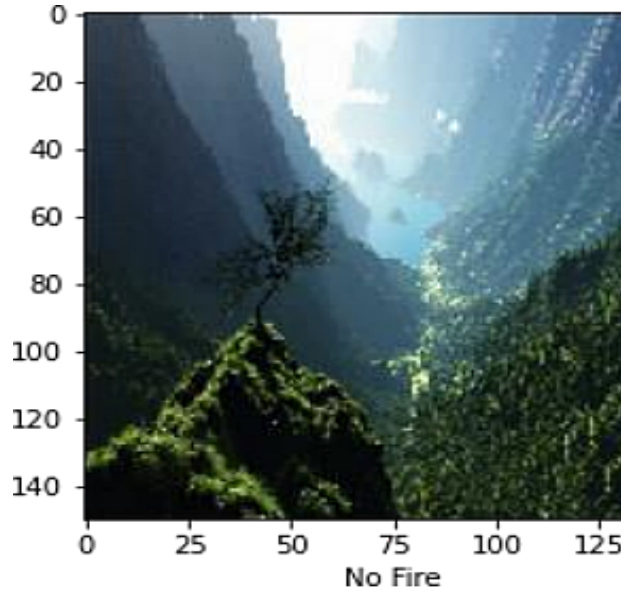
==========] - 0s

28ms/step

[[1.]]







predictImage(r"/content

/drive/MyDrive/train_se

t/forest/with_fire

(104).jpg")1/1

[==========

==========] -

0s 80ms/step

[[0.]]

predictImage(r"/content/drive/MyDrive/train_set/with fire/with fire (100).jpg")[[1.]]
1/1 [==============================] - 0s 31ms/step

(from tensorflow) (1.14.1)\n",

"Requirement already satisfied: packaging in /usr/local/lib/python3.7/dist-packages (fromtensorflow) (21.3)\n",

"Requirement already satisfied: tensorflow-estimator<2.10.0,>=2.9.0rc0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (2.9.0)\n",

"Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.7/dist-packages (from

a. **SPRINT 3:**


```
{
 "nbformat": 4,
 "nbformat_
 minor": 0,
 "metadata":
 {
  "colab": {
   "provenance": []
  },
  "kerne
   lspec
   ": {
   "nam
   e":
   "pyth
   on3",
   "display_name": "Python 3"
  },
```

```
"language_info":
{
"
n
a
m
e
"
:
"
p
y
t
h
o
n
"
},
"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.intrinsi
    c+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",
   "Requirement already satisfied: flatbuffers<2,>=1.12 in
```

/usr/local/lib/python3.7/dist-packages (from tensorflow) (1.12)\n",

"Requirement already satisfied: wrapt>=1.11.0 in /usr/local/lib/python3.7/dist-packages

tensorflow) (3.1.0)\n",

"Requirement already satisfied: absl-py>=1.0.0 in

/usr/local/lib/python3.7/dist-packages(from tensorflow) (1.3.0)\n",

"Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.7/dist

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

"Requirement already satisfied: typing-extensions>=3.6.6 in

/usr/local/lib/python3.7/dist-packages (from tensorflow) (4.1.1)\n",

"Requirement already satisfied: termcolor>=1.1.0 in

/usr/local/lib/python3.7/dist- packages(from tensorflow) (2.1.0)\n",

"Requirement already satisfied: grpcio<2.0,>=1.24.3 in

/usr/local/lib/python3.7/dist-packages (from tensorflow) (1.50.0)\n",

"Requirement already satisfied: google-pasta>=0.1.1 in

/usr/local/lib/python3.7/dist-packages (from tensorflow) (0.2.0)\n",

"Requirement already satisfied: opt-einsum>=2.3.2 in

/usr/local/lib/python3.7/dist- packages(from tensorflow) (3.3.0)\n",

"Requirement already satisfied: keras-preprocessing>=1.1.1 in

/usr/local/lib/python3.7/dist-packages (from tensorflow) (1.1.2)\n",

"Requirement already satisfied: numpy>=1.20 in

/usr/local/lib/python3.7/dist-packages(from tensorflow) (1.21.6)\n",

"Requirement already satisfied: setuptools in /usr/local/lib/python3.7/dist-

packages (fromtensorflow) (57.4.0)\n",

"Requirement already satisfied: tensorboard<2.10,>=2.9 in

/usr/local/lib/python3.7/dist-packages(from tensorflow) (2.9.1)\n",

"Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (0.27.0)\n",

"Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.7/dist-packages (from astunparse>=1.6.0->tensorflow) (0.38.3)\n",

"Requirement already satisfied: cached-property in /usr/local/lib/python3.7/dist-packages(from h5py>=2.9.0->tensorflow) (1.5.2)\n",

"Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.7/dist-packages (from tensorboard<2.10,>=2.9->tensorflow) (1.0.1)\n",

"Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.7/dist- packages(from tensorboard<2.10,>=2.9->tensorflow) (3.4.1)\n",

"Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.7/dist-packages (from tensorboard<2.10,>=2.9->tensorflow) (2.23.0)\n",

"Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.7/dist-packages(from tensorboard<2.10,>=2.9->tensorflow) (2.14.1)\n",

"Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /usr/local/lib/python3.7/dist-packages (from tensorboard<2.10,>=2.9->tensorflow) (1.8.1)\n","Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in /usr/local/lib/python3.7/dist-packages (from tensorboard<2.10,>=2.9->tensorflow) (0.4.6)\n","Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in /usr/local/lib/python3.7/dist-packages (from tensorboard<2.10,>=2.9->tensorflow) (0.6.1)\n", "Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.7/dist-packages (from google- <2.10,>=2.9>tensorflow) (5.2.0)\n",

“Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.7/dist-packages(fromgoogle-auth<3,>=1.6.3->tensorboard<2.10,>=2.9->tensorflow) (4.9)\n",

"Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.7/dist- packages(from google-auth<3,>=1.6.3->tensorboard<2.10,>=2.9->tensorflow) (0.2.8)\n",

"Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.7/dist-packages (from google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.10,>=2.9->tensorflow) (1.3.1)\n",

"Requirement already satisfied: importlib-metadata>=4.4 in /usr/local/lib/python3.7/dist-packages (from markdown>=2.6.8->tensorboard<2.10,>=2.9->tensorflow) (4.13.0)\n",

"Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-packages (fromimportlib-metadata>=4.4->markdown>=2.6.8->tensorboard<2.10,>=2.9->tensorflow) (3.10.0)\n",

"Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in /usr/local/lib/python3.7/dist-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.10,>=2.9->tensorflow) (0.4.8)\n",

"Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist- packages(from requests<3,>=2.21.0->tensorboard<2.10,>=2.9->tensorflow) (3.0.4)\n",

"Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist- packages (from requests<3,>=2.21.0->tensorboard<2.10,>=2.9->tensorflow) (2022.9.24)\n",

"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<3,>=2.21.0->tensorboard<2.10,>=2.9-

>tensorflow) (1.24.3)\n",

"Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (fromrequests<3,>=2.21.0->tensorboard<2.10,>=2.9->tensorflow) (2.10)\n",

"Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.7/dist-packages(fromrequests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1-
>tensorboard<2.10,>=2.9-
>tensorflow) (3.2.2)\n",

"Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /usr/local/lib/python3.7/dist-packages (from packaging->tensorflow) (3.0.9)\n",

"Looking in indexes: https:/ pypi.org/simple, https:/ us-python.pkg.dev/colab-wheels/public/simple/\n",

"Requirement already satisfied: opencv-python in /usr/local/lib/python3.7/dist-packages(4.6.0.66)\n",

"Requirement already satisfied: numpy>=1.14.5 in /usr/local/lib/python3.7/dist-packages(fromopencv-python) (1.21.6)\n"

]

}

]

},

{

"cell_type

": "code",

"source": [

"from keras.models import

Sequential\n","from keras.layers

import Dense\n",

```
  "from keras.layers import Convolution2D\n", "from keras.layers import MaxPooling2D\n", "from keras.layers import Flatten"
 ],
 "metadata": {
  "id": "LXQp5JUUy8by"
 },
 "execution_count": 3,
 "outputs": []
},
{
 "cell_type": "code",
 "source": [
  "from tensorflow.keras.preprocessing.image import ImageDataGenerator\n", "train = ImageDataGenerator(rescale=1/255)\n", "test = ImageDataGenerator(rescale=1/255)"
 ],
 "metadata": {
  "id": "-joU1JMNzBID"
 },
```

```
 "execution_
 count": 4,
 "outputs": []
},
{
 "cell_type
 ": "code",
 "source": [
  "pwd"
 ],
 "metadata": {
  "colab": {
   "base_uri": "https:/
   localhost:8080/","height":
   35
  },
  "id": "3zbBmApYzzob",
  "outputId": "fa8fb36a-473c-4662-dbf7-67598141fa83"
 },
 "execution_
 count": 8,
 "outputs": [
  {
   "output_type":
   "execute_result",
```

```
    "data": {
     "text/plain":
      [
       "'/content'"
      ],
     "application/vnd.google.colaboratory.intrinsi
      c+json": {"type": "string"
     }
    },
    "metadata":
    {},
    "execution_
    count": 8
   }
 ]
},
{
 "cell_type
 ": "code",
 "source": [
  "import os\n",
  "filenames = os.listdir('/content/drive/MyDrive/train_set')"
 ],
 "metadata": {
  "id": "hNu0gAxNz5wV"
 },
```

```
 "execution_
 count": 9,
 "outputs": []
},
{
 "cell_type
 ": "code",
 "source": [
  "x_train = train_dataset =
  train.flow_from_directory(\"/content/drive/MyDrive/train_set\",\n","target_size=
  (64,64),\n",

  "batch_size = 32,\n",
  "class_mode = 'binary')\n",
  "x_test = test_dataset =
                              test.flow_from_directory(\"/content/drive/MyDrive/test_set\",\n",
                              "target_size= (64,64),\n",
  "batch_size = 32,\n",
  "class_mode = 'binary')"
 ],
 "metadata": {
  "colab": {
   "base_uri": "https:/ localhost:8080/"

  },
  "id": "Ewd7ALq80I2h",
```

```
  "outputId": "707c55af-f9b0-4164-e2cf-d642448ec7d1"
 },
 "execution_c
 ount": 10,
 "outputs": [
  {
   "output_type":
   "stream",
   "name":
   "stdout",
   "text": [
    "Found 442 images belonging to 2
    classes.\n","Found 121 images
    belonging to 2 classes.\n"
   ]
  }
 ]
},
{
 "cell_type":
 "code",
 "source": [
 "x_test.class_i
 ndices"
 ],
 "metadata": {
```

```
  "colab": {
    "base_uri": "https:/ localhost:8080/"
  },
  "id": "Ypg9hbSD0VMb",
  "outputId": "ddf6fee2-231b-4b2a-fc45-156d2c968517"
 },
"execution_c
ount": 11,
"outputs": [
  {
    "output_type":
    "execute_result",
    "data": {
      "text/plain": [
        "{'forest': 0, 'with fire': 1}"
      ]
    },
    "metadata":
    {},
    "execution_c
    ount": 11
  }
 ]


},
```

```
{
 "cell_type
 ": "code",
 "source": [
  "model = Sequential()"
 ],
 "metadata": {
  "id": "qyQ20wPg0XZg"
 },
 "execution_count": 12,

 "outputs": []
},
{
 "cell_type
 ": "code",
 "source": [
  "model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))"
 ],
 "metadata": {
  "id": "3CCe1wJK0dq6"
 },
 "execution_c
 ount": 13,
 "outputs": []
},
```

```
{
 "cell_type
 ": "code",
 "source": [
  "model.add(MaxPooling2D(2,2))"
 ],
 "metadata": {
  "id": "KiB6bTwt0gYl"
 },
 "execution_c
 ount": 14,
 "outputs": []
},
{
 "cell_type":
 "code",
 "source": [
 "model.add(Fl
 atten())"
 ],
 "metadata": {
  "id": "gezPUvME0ixZ"
 },
 "execution_c
 ount": 15,
```

```
 "outputs": []
},
{
 "cell_type
 ": "code",
 "source": [
  "model.add(Dense(512,activation='relu'))\n",
  "model.add(Dense(1,activation='sigmoid'))"
 ],
 "metadata": {
  "id": "jlTuRAuQ0l7j"
 },
 "execution_c
 ount": 16,
 "outputs": []
},
{
 "cell_type
 ": "code",
 "source": [
  "model.compile(optimizer=\"adam\",loss=\"binary_crossentropy\",metrics=[\"accuracy\"]
  )"
 ],
 "metadata": {
  "id": "3VRs-oXD0quq"
 },
```

```
    "execution_c
    ount": 17,
    "outputs": []
   },
   {
    "cell_type
    ": "code",
    "source": [
     "model.fit(x_train,steps_per_epoch=14
,epochs=10,validation_data=x_test,validation_steps=4)"
    ],
    "metadata": {
     "colab": {
      "base_uri": "https:/ localhost:8080/"
     },
     "id": "7Ek-Gm6P0vpW",
     "outputId": "f6a1472f-709a-4f36-9d4f-fa1946838e10"
    },
    "execution_count": 18,

    "outputs": [
     {
      "output_type":
      "stream",
```

"name":

"stdout",

"text": [

"Epoch 1/10\n",

"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",

"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",
"14/14 [==============================] - 21s 1s/step - loss: 0.0835 - accuracy:
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"
]
},
{
"output_type":
"execute_result",
"data": {
"text/plain": [
"<keras.callbacks.History at 0x7f2c0d8ec590>"
},
```

```
    "metadata":
    {},
    "execution_c
    ount": 18
   }
},
{
 "cell_type
 ": "code",
 "source": [
  "model.save(\"forest1.h5\")"
 ,
 "metadata": {
  "id": "wqMJztaF00Qh"
 },
 "execution_c
 ount": 19,
 "outputs": []
},
{
 "cell_type
 ": "code",
 "source": [
  "!tar -zcvf image-classification-model_new.tgz forest1.h5"
 ],
```

```
 "metadata": {
  "colab": {
   "base_uri": "https:/ localhost:8080/"
  },
  "id": "3jah6H9-2Znl",
  "outputId": "ed7217d8-6994-4f98-b136-98b1ff5f6b8b"
 },
 "execution_c
 ount": 20,
 "outputs": [
  {
   "output_type":
   "stream",
   "name":
   "stdout",
   "text":
    "forest1.h5\n"
  }
},
{
 "cell_type
 ": "code",
 "source": [
  "ls -1"
 ],
```

```
 "metadata": {
  "colab": {
   "base_uri": "https:/ localhost:8080/"
  },
  "id": "V9oOmNUW2cWk",
  "outputId": "c706f1e1-1c8d-4b26-d8dd-a4bcdfe60e5c"
 },
 "execution_c
 ount": 21,
 "outputs":
  {
   "output_type":
   "stream",
   "name":
   "stdout",
   "text":
    "\u001b[0m\u001b[01;34mdrive\u001b[0m
    /\n","forest1.h5\n",
    "image-classification-model_new.tgz\n",
    "\u001b[01;34msample_data\u001b[0m/\n
  }
},
{
 "cell_type
 ": "code",
```

```
"source": [
  "!pip install watson-machine-learning-client -
-upgrade""metadata": {
  "colab": {
    "base_uri": "https:/
    localhost:8080/","height":
    1000
  },
  "id": "nQj_2bZ62ns3",
  "outputId": "103e599b-947e-46f0-eb02-0dd7142a2130"
},
"execution_count": 22,


"outputs": [

  {
    "output_type":
    "stream",
    "name":
    "stdout",
    "text": [
      "Looking in indexes: https:/ pypi.org/simple, https:/ us-python.pkg.dev/colab-wheels/public/simple/\n",
      "Collecting watson-machine-learning-client\n",
      " Downloading watson_machine_learning_client-1.0.391-py3-none-any.whl (538
      kB)\n","\u001b[K |████████████████████████████████| 538
```

kB 7.0 MB/s

\n","\u001b[?25hRequirement already satisfied: requests in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (2.23.0)\n",

"Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages (fromwatson-machine-learning-client) (4.64.1)\n",

"Requirement already satisfied: tabulate in /usr/local/lib/python3.7/dist-packages (fromwatson-machine-learning-client) (0.8.10)\n",

"Collecting lomond\n",

" Downloading lomond-0.3.3-py2.py3-none-any.whl (35 kB)\n",

"Requirement already satisfied: certifi in /usr/local/lib/python3.7/dist-packages (fromwatson-machine-learning-client) (2022.9.24)\n",

"Requirement already satisfied: urllib3 in /usr/local/lib/python3.7/dist-packages (fromwatson-machine-learning-client) (1.24.3)\n",

"Collecting boto3\n",

" Downloading boto3-1.26.11-py3-none-any.whl (132 kB)\n",

"\u001b[K|████████████████████████████████| 132 kB 53.7MB/s \n","\u001b[?25hRequirement already satisfied: pandas in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (1.3.5)\n","Collecting ibm-cos-sdk\n",

" Downloading ibm-cos-sdk-2.12.0.tar.gz (55 kB)\n",

"\u001b[K|████████████████████████████████| 55 kB 3.9MB/s \n","\u001b[?25hCollecting jmespath<2.0.0,>=0.7.1\n",

" Downloading jmespath-1.0.1-py3-none-any.whl (20 kB)\n","Collecting s3transfer<0.7.0,>=0.6.0\n",

" Downloading s3transfer-0.6.0-py3-none-any.whl (79 kB)\n",

"\u001b[K|████████████████████████████████| 79
kB 9.5MB/s \n","\u001b[?25hCollecting botocore<1.30.0,>=1.29.11\n",
" Downloading botocore-1.29.11-py3-none-any.whl (9.9 MB)\n",
"\u001b[K|████████████████████████████████| 9.9 MB
45.4 MB/s \n","\u001b[?25hRequirement already satisfied: python-
dateutil<3.0.0,>=2.1 in
/usr/local/lib/python3.7/dist-packages (from botocore<1.30.0,>=1.29.11-
>boto3->watson-machine-learning-client) (2.8.2)\n",

"Collecting urllib3\n",
" Downloading urllib3-1.26.12-py2.py3-none-any.whl (140 kB)\n",
"\u001b[K|████████████████████████████████| 140
kB 42.1MB/s \n","\u001b[?25hRequirement already satisfied: six>=1.5 in
/usr/local/lib/python3.7/dist-
packages (from python-dateutil<3.0.0,>=2.1->botocore<1.30.0,>=1.29.11-
>boto3->watson-machine-learning-client) (1.15.0)\n",
"Collecting ibm-cos-sdk-core==2.12.0\n",
" Downloading ibm-cos-sdk-core-2.12.0.tar.gz (956 kB)\n",
"\u001b[K|████████████████████████████████| 956
kB 51.7MB/s \n","\u001b[?25hCollecting ibm-cos-sdk-
s3transfer==2.12.0\n",
" Downloading ibm-cos-sdk-s3transfer-2.12.0.tar.gz (135 kB)\n",
"\u001b[K|████████████████████████████████| 135
kB 54.2MB/s \n","\u001b[?25hCollecting jmespath<2.0.0,>=0.7.1\n",
" Downloading jmespath-0.10.0-py2.py3-none-any.whl
(24 kB)\n","Collecting requests\n",
" Downloading requests-2.28.1-py3-none-any.whl (62 kB)\n",

"\u001b[K|████████████████████████████████| 62 kB 1.6 MB/s \n","\u001b[?25hRequirement already satisfied: charset-normalizer<3,>=2 in /usr/local/lib/python3.7/dist-packages (from requests->watson-machine-learning-client)(2.1.1)\n", "Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests->watson-machine-learning-client) (2.10)\n",

"Requirement already satisfied: pytz>=2017.3 in /usr/local/lib/python3.7/dist-packages (frompandas->watson-machine-learning-client) (2022.6)\n",

"Requirement already satisfied: numpy>=1.17.3 in /usr/local/lib/python3.7/dist-packages(frompandas->watson-machine-learning-client) (1.21.6)\n",

"Building wheels for collected packages: ibm-cos-sdk, ibm-cos-sdk-core, ibm-cos-sdk-s3transfer\n",

" Building wheel for ibm-cos-sdk (setup.py) ... \u001b[?25l\u001b[?25hdone\n", " Created wheel for ibm-cos-sdk: filename=ibm_cos_sdk-2.12.0-py3-none-any.whl size=73931 sha256=841189e9104158317d85f159529014a3c34da1db4455cc140ecfd657ba3ed2ef\n", " Stored in directory: /root/.cache/pip/wheels/ec/94/29/2b57327cf00664b6614304f7958abd29d77ea0e5bbece2ea57\n"," Building wheel for ibm-cos-sdk-core (setup.py) ... \u001b[?25l\u001b[?25hdone\n", " Created wheel for ibm-cos-sdk-core: filename=ibm_cos_sdk_core-2.12.0-py3-none-any.whl size=562962 sha256=6dd5fd11a6eb4cc566eefe7e82e573055238fbc5bdafc2604c164f8a6fa02255\n",

" 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=3c9215c3ddaa7fc31a8c3783a78b5e3aa7a4cb9ea8d7dc1178e709c1ccb39

2a8\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",

"Installingcollected 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-

i. 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": {

"pac

ka

ges

": [

"re

qu

est

s",

"ur

llib

3"

]

}

}

},

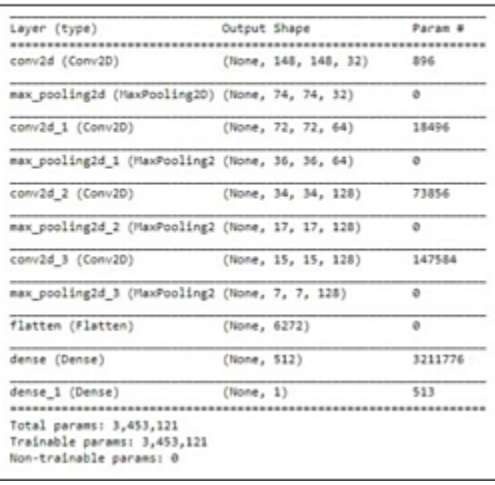
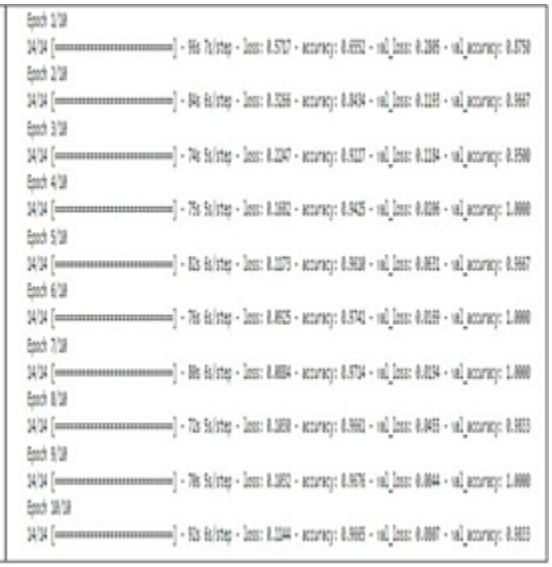
```
        "metadata": {}
       }
      ]


    },
    {
     "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_c
     ount": 25,
     "outputs": []
    }
  }
}
```

1. TESTING AND RESULTS

a. Performance Testing

S. No	Parameter	Values	Screenshot
1.	Model Summary	3,453,213	
2.	Accuracy	Training Accuracy - 0.9663 Validation Accuracy -0.9795	

```
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
```

B.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**

a. **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

1. **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_siz
e=(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 Flattenimport
warnings
warnings.filterwarnings('
ignore')#Initializing the
model
model = Sequential()
#Adding CNN Layers
model.add(Convolution2D(32,(3,3),input_shape=(64,64,3),activation='r
elu')) #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='sig

moid'))*#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,valid

ation_ steps=4)

Epoch 1/10

14/14 [==============================] - 152s 11s/step - loss: 1.2336 - accuracy: 0.6

244 - val_loss: 0.3944 -

val_accuracy: 0.8760Epoch 2/10

14/14 [==============================] - 23s 2s/step - loss: 0.3932 - accuracy: 0.839

4 - val_loss: 0.1940 -

val_accuracy: 0.9421Epoch 3/10

14/14 [==============================] - 22s 2s/step - loss: 0.2676 - accuracy: 0.891

4 - val_loss: 0.1266 -

val_accuracy: 0.9835Epoch 4/10

14/14 [==============================] - 23s 2s/step - loss: 0.2115 - accuracy: 0.907

2 - val_loss: 0.0966 -

val_accuracy: 0.9587Epoch 5/10

14/14 [==============================] - 22s 2s/step - loss: 0.1967 - accuracy: 0.923

1 - val_loss: 0.0950 -

val_accuracy: 0.9752Epoch 6/10

14/14 [==============================] - 24s 2s/step - loss: 0.1907 - accuracy: 0.925

3 - val_loss: 0.1514 -

val_accuracy: 0.9256Epoch 7/10

14/14 [==============================] - 23s 2s/step - loss: 0.2169 - accuracy: 0.907

1. - val_loss: 0.0874 - val_accuracy:

   0.9669Epoch 8/10

   14/14 [==============================] - 26s 2s/step - loss: 0.1809 - accuracy: 0.925

2. - val_loss: 0.0743 - val_accuracy:

   0.9669Epoch 9/10

   14/14 [==============================] - 23s 2s/step - loss: 0.1777 - accuracy: 0.929

   9 - val_loss: 0.0670 -

   val_accuracy: 0.9917Epoch 10/10

   14/14 [==============================] - 26s 2s/step - loss: 0.2067 -

```
accuracy: 0.909
5 - val_loss: 0.0617 - val_accuracy:
0.9917 #Save the model
model.save("/content/drive/MyDrive/for
est1.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_CUBI
C) #expand the image shape
x=np.expand_dims(res,a
xis=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/simple/

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) (2022.6)

Requirement already satisfied: requests>=2.0.0 in /usr/local/lib/python3.7/dist-packages (from twilio) (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='AC4c9a105651d0150d1b85af1bd4cf0
  90c'
  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(messa
ge.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 twilio) (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) (2022.6)
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)
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: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests>=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 APIfrom
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_arra
    y(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/forest
    1.h5")pred=model.predict(x)
    pred =
    int(pred[0][0
    ])pred
    int(pred)
    if pred==0:
      print('Forest fire')
      br
    e
    a
    k


    e
```

```
l
s
e
:

  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='AC4c9a105651d0150d1b85af1bd4
  cf090c'
  auth_token='ee06c7d5053b02ef2ee7689157b255
  ee' 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(me
ssage.sid)
print("Fi
re
detected
")
print("S
MS
Sent!")
```

elif

pred==1:

pri

nt('

No

Fire

')

For

est

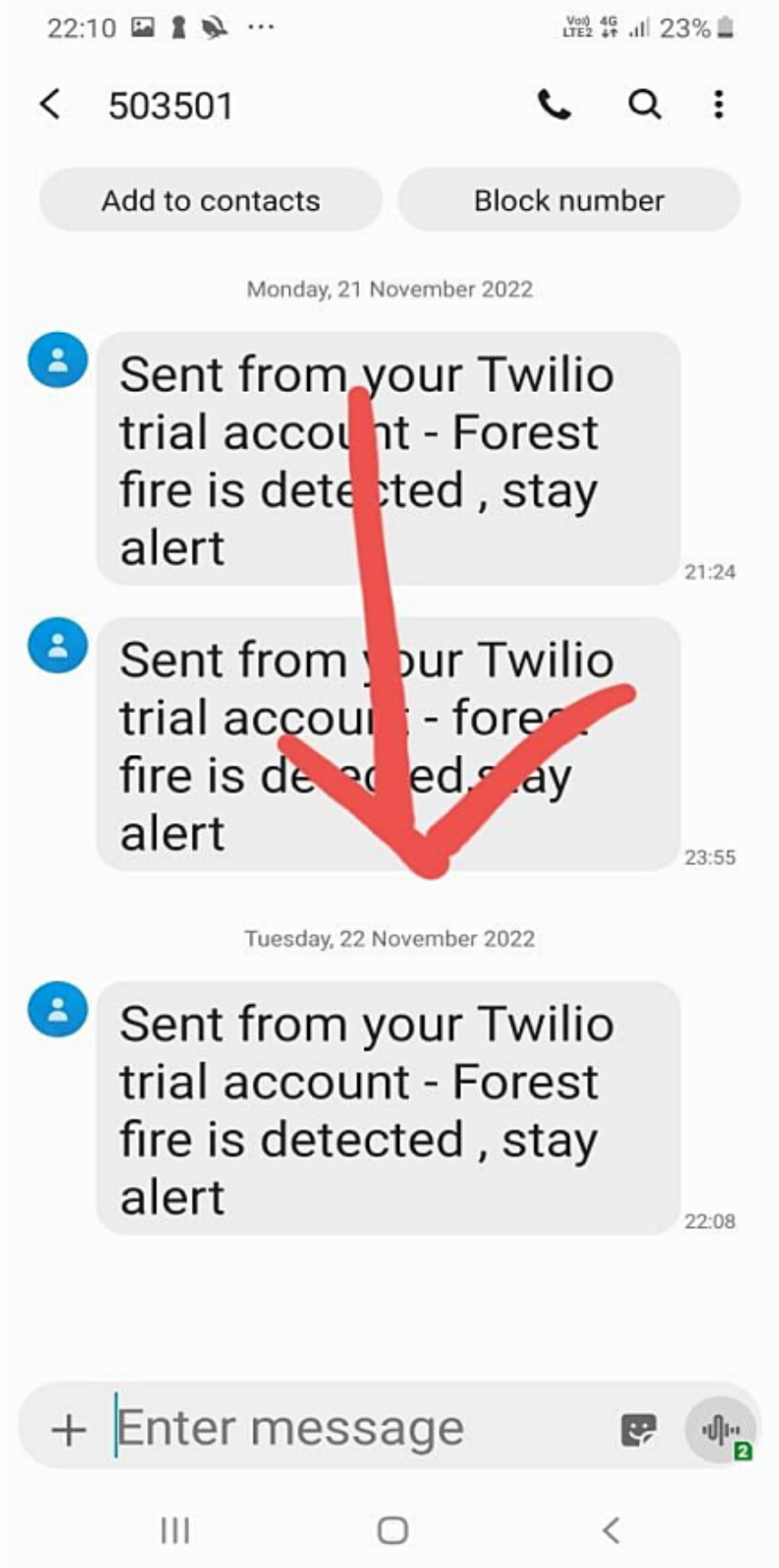
fire

SM6c3521055b9c8a7899bfb2

40b5ea1b51Fire detected

SMS Sent!

OUTPUT SCREENSHOT:



1. **ADVANTAGES & DISADVANTAGES**

1. 1/1 [==============================] - 0s 70ms/step**ADVANTAGES & DISADVANTAGES**

ADVANTAGES:

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

DISADVANTAGES:

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

2. 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 allits 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.

3. FUTURE SCOPE

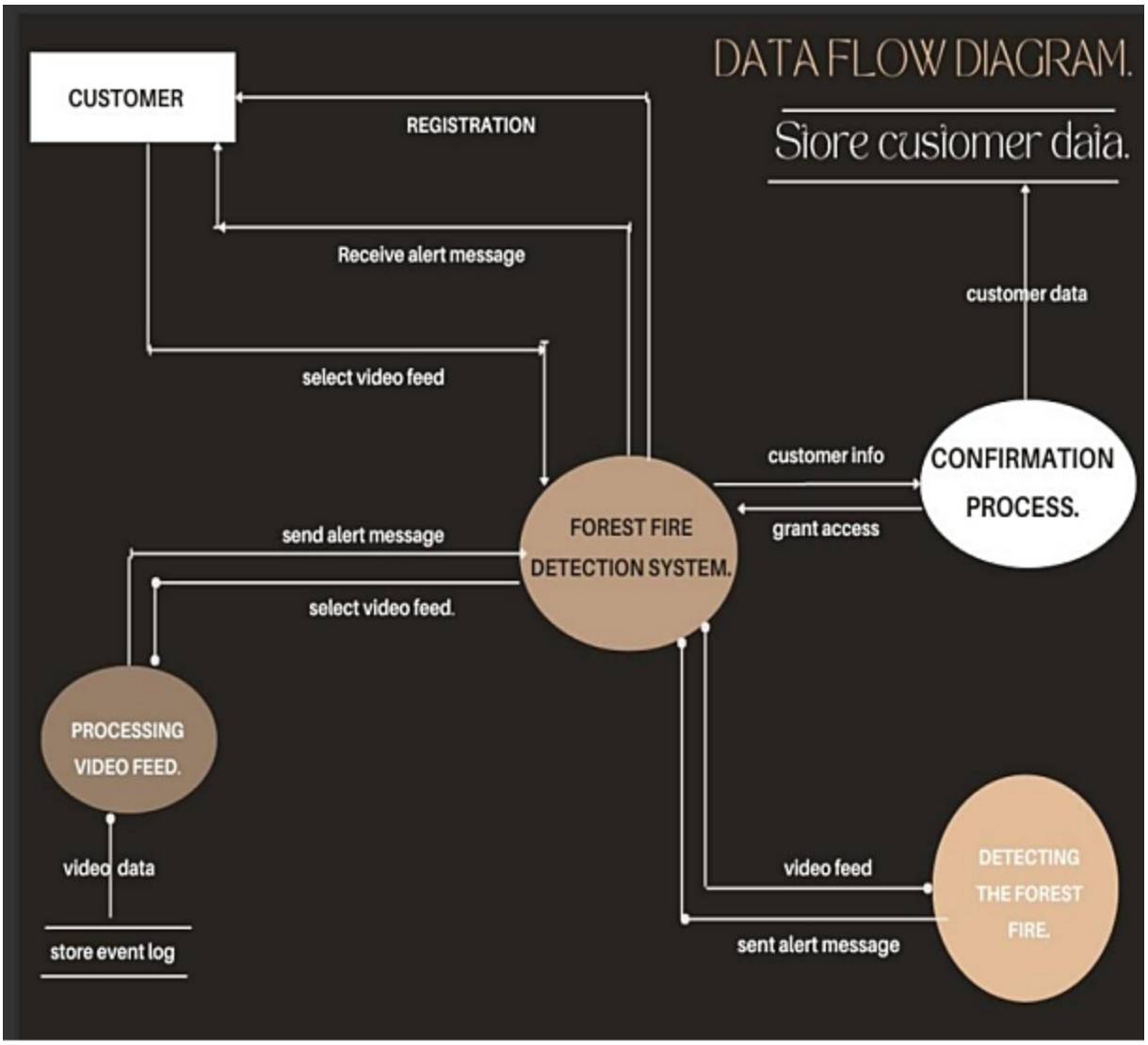
This project is far from complete and there is a lot of room for betterment. Some of thebetterment that can be made to this project are as follows:

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

1. This project has endless potential and can always be enhanced to become better.enforcethis 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-3490-1658570297


DATA FLOW DIAGRAM.
Store customer data.
CUSTOMER
REGISTRATION
Receive alert message
customer data
select video feed
customer info
CONFIRMATION PROCESS.
grant access
send alert message
FOREST FIRE DETECTION SYSTEM.
select video feed.
PROCESSING VIDEO FEED.
video data
store event log
video feed
DETECTING THE FOREST FIRE.
sent alert message