

# **Emerging Methods for Early Detection of Forest Fires**

## **PROJECT REPORT**

*Submitted by*

**TEAM MEMBERS**

<b>TEAM LEAD</b>	<b>: N.S.NITHIKSHA (112619104011)</b>
<b>TEAM MEMBER 1</b>	<b>: V. HARINI (112619104005)</b>
<b>TEAM MEMBER 2</b>	<b>: THEEBBABU (112619104014)</b>
<b>TEAM MEMBER 3</b>	<b>: M. VIKRAM (112619104016)</b>

**TEAMID: PNT2022TMID36539**

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**SRIRAM ENGINEERING COLLEGE**

**ANNA UNIVERSITY: 600 025**

**NOVEMBER 2022**

## BONAFIDE CERTIFICATE

Certified that this project entitled "**EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES**" is the bonafide work of

<b>N.S.NITHIKSHA</b>	<b>112619104011</b>
<b>V.HARINI</b>	<b>112619104005</b>
<b>S.THEEBAN BABU</b>	<b>112619104014</b>
<b>V.VIKRAM</b>	<b>112619104016</b>

who carried the project under the supervision of

SIGNATURE

**Ms.K.SUDHA, A.P**  
**HEAD INCHARGE OF**  
**DEPARTMENT OF CSE**

SIGNATURE

**Ms.N.BELINA, A.P**  
**MENTOR**  
**DEPARTMENT OF CSE**

SIGNATURE

**Dr. L.SIVAGAMI, A.P**  
**EVALUAOTR**  
**DEPARTMENT OF ECE**

The project examination is to be held on.....

**INTERNAL EXAMINER**

**EXTERNAL EXAMINER**

## ACKNOWLEDGEMENT

"Thanks" is a simple word but its eloquence is magnified when it comes from the depth of the Heart.

We wholeheartedly thank the Almighty for having showered his blessings on us, which helped us to finish our project successfully. We are highly indebted to thank our parents and all our well-wishers who have been the major driving force behind our work.

We would like to express our sincere thanks to our management,

**OUR PRINCIPAL, Dr.C.P. KARTHIKEYAN.,M.Tech., Ph.D.,**

Our Head Incharge Ms. K. SUDHA M.E.,  
Department of Computer Science and Engineering, for inspiring and extending moral support to us.

We are very grateful to our mentor Ms. N. BELINA  
Assistant Professor , for being instrumental in the completion of our project with her complete guidance.

We also extend our heartfelt thanks to Evaluator Dr. L.SIVAGAMI,  
Assistant Professor, for being our continuous support in guiding us through each mile stone which was very helpful in the completion of our project through her constant guidance.

We also thank all the staff members of our college and technicians for their help in making this project a successful one

Finally, we take this opportunity to our deep appreciation to our family and friends , for all that they meant to us during the crucial times of the completion of our project.

## TABLE OF CONTENTS

### ABSTRACT

#### 1. INTRODUCTION

1.1Project Overview

1.2Purpose

#### 2. LITERATURE SURVEY

2.1Existing problem

2.2References

2.3Problem Statement Definition

#### 3. IDEATION &PROPOSED SOLUTION

3.1Empathy Map Canvas

3.2Ideation & Brainstorming

3.3Proposed Solution

3.4Problem Solution fit

#### 4. REQUIREMENT ANALYSIS

4.1Functional Requirements

4.2Non-Functional Requirements

## **5. PROJECT DESIGN**

5.1 Data Flow Diagrams

5.2 Solution & Technical Architecture

## **6. PROJECT PLANNING & SCHEDULING**

6.1 Sprint Planning & Estimation

6.2 Sprint Delivery Schedule

6.3 Reports from JIRA

## **7. CODING & SOLUTIONING (Explain the features add in the project along with code)**

7.1 Feature1

7.2 Feature2

7.3 Feature 3

## **8. TESTING**

8.1 Test Cases

8.2 User Acceptance Testing

## **9. RESULTS**

9.1 Performance Metrics

**10.      ADVANTAGES & DISADVANTAGES**

**11.CONCLUSION**

**12.FUTURE SCOPE**

**13.APPENDIX**

## ABSTRACT

**The environmental challenges the world faces nowadays have never been greater or more complex. Global areas covered by forests are threatened by natural disasters that have increased dramatically during the last decades, in terms of both frequency and magnitude. Large-scale forest fires are one of the most harmful natural hazards affecting climate change and life around the world. Thus, to minimize their impacts on people and nature, Fire detection at an early stage is important for the safety of the people. Detection of forest fire should be fast and accurate as they may cause damage and destruction at a large scale. Lack of information due to manual detection is the main cause of failure of fire detection.**

**It is difficult to predict and detect Forest Fire in a sparsely populated forest area and it is more difficult if the prediction is done using ground-based methods like Camera or Video-Based approach. Satellites can be an important source of data prior to and also during the Fire due to its reliability and efficiency. The various real-time forest fire detection and prediction approaches, with the goal of informing the local fire authorities.**

# 1 INTRODUCTION

## 1.1 PROJECT OVERVIEW

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. There are typically about 100,000 wildfires in the United States every year. Over 9 million acres of land have been destroyed due to treacherous wildfires. Regardless of the reasons for the ignition of the forest fires, they normally cause withering damage to both nature and humans.

Forest fires are also considered as a main contributor to the air pollution, due to the fact that during every fire huge volume of gases and particle matter are released in the atmosphere. To fight forestfires, different solutions were employed throughout the years. They were primarily aimed at the early detection of the fires. The simplest of these solutions is the formation of a network of observance posts - both cheap and easy to accomplish, but also time-consuming for the involved people.

It is difficult to predict and detect Forest Fire in a sparsely populated forest area and it is more difficult if the prediction is done using ground-based methods like Camera or Video-Based approach. Satellites can be an important source of data prior to and also during the Fire due to its reliability and efficiency. The various real-time forest fire detection and prediction approaches, with the goal of informing the local fire authorities.

The constant evolution of the info and communication applied science has led to the debut of a new generation of solutions for early detection and even prevention of forest fires. ICT-based networks of cameras and sensors and even satellite-based solutions were developed and used in the last decades. These solutions have greatly decreased the direct involvement of humans in the forest fire detection process, but have also proven to be expensive and hard to maintain.



## 1.2 PURPOSE

Detection of forest fire and smoke in wild land areas is done through remote sensing- based methods such as satellites, high-resolution static cameras fixed on the ground, and unmanned aerial vehicles. Optical/thermal cameras deployed on the observation towers together with the other sensors such as smoke, temperature, and humidity sensors might detect the hazards in the closed environment rather than in the open environment as these sensors need vicinity to the fire or smoke.

The information obtained through these sensors is not appropriate. Distance covered by these methods could be limited, and to cover a large area, more sensors have to be deployed that might incur expenses. Through the deployment of UAV, large areas could be covered, and the images with high spatial and temporal resolutions could be captured properly.

## 2 LITERATURE SURVEY

### 2.1 EXISTING PROBLEM



#### Literature survey-1

Different fire detection techniques have been proposed for safety and protection of the people and environment.

- Wavelet based smoke detection-smoke detection in video sequences
- Covariance method - flame detection.
- Neural Network - produces accurate result as it uses temperature, smoke density and CO concentration

#### Literature survey-2

The proposed system uses YCbCr colour spaces. Because YCbCr colour space separates luminance from chrominance, hence it is robust to changing illumination than other colour spaces like RGB and rgb (normalized RGB). The proposed method not only separates fire



## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

flame pixels but also separates high temperature fire centre pixels by taking in to account of statistical parameters of fire image in YCbCr colour space like mean and standard deviation

### Literature survey-3

This paper proposes a large-scale monitoring system and deep learning-based forest fire detection model that can detect forest fires from video frames captured by UAV drones. The proposed CNN model successfully detects forest fires with 97.29% accuracy.

## 2.2 REFERENCES

- 1) Author Name - Ms.Tamil Mathi, Dr.L.Latha - A SURVEY ON FOREST FIRE DETECTION
- 2) Author Name - Priyadarshini Hanamaraddi - A Literature Study on Image Processing for Forest Fire Detection
- 3) Author Name - Abhay Chopde , Ansh Magon , Shreyas Bhatkar - Forest Fire Detection and Prediction from image processing using RCNN

## 2.3 PROBLEM STATEMENT DEFINITION

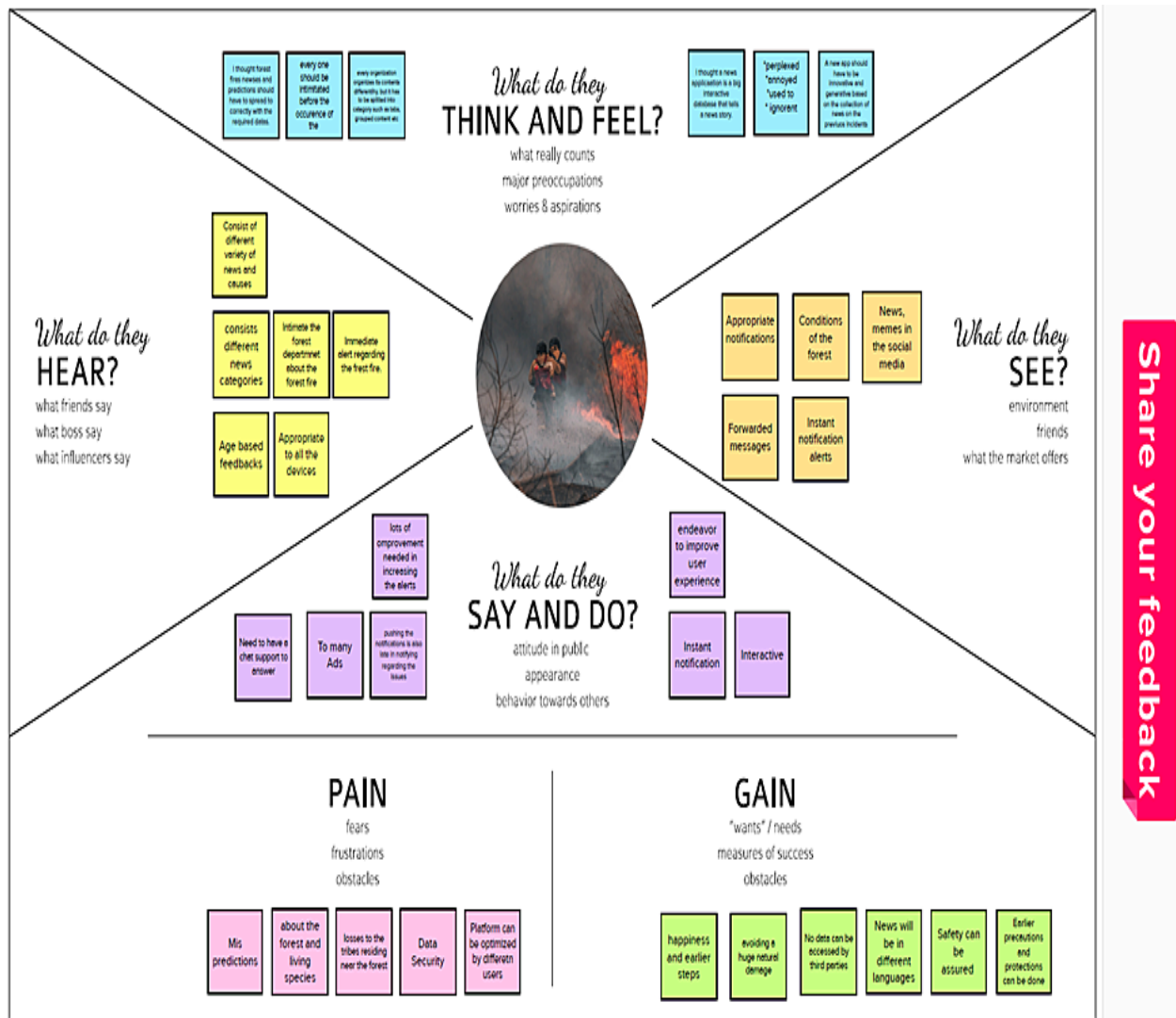
S.No.	Parameter	Description
1.	Problem Statement (problem to be solved)	Forest fires are one of the most vulnerable natural disaster. It affects thousand acres of land and natural resources, which also affects the thousands of living organisms and affects the livelihood of tribes and other forest workers.

## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

2.	Idea / Solution description	<p>The earlier detection of forest fires requires 24/7 monitoring of the forest which is not possible manually. To avoid the delay and manual monitoring</p> <ol style="list-style-type: none"> <li>1. We can use image processing to monitor forest.</li> <li>2. 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</li> </ol>
3.	Novelty / Uniqueness	<ol style="list-style-type: none"> <li>1. Real time computer detects the forest fires at the earliest before being spread or to occur.</li> <li>2. Satellite images of forests will be processed for identifying the fire.</li> </ol>
4.	Social Impact / Customer Satisfaction	<p>Early detection will helps to</p> <ol style="list-style-type: none"> <li>1. Prevent the loss of natural resources and wildlife.</li> <li>2. It can prevent the livelihood of the surroundings and the people getting affected after the occurrence of forest fires.</li> </ol>
5.	Business Model (Revenue Model)	<ol style="list-style-type: none"> <li>1. The proposed method was implemented using the Python programming language on a Corei3 or greater.</li> <li>1. The prediction might be right and the can have high reliability.</li> </ol>
6.	Scalability of the Solution	<ol style="list-style-type: none"> <li>1. In future we can include machine learning and robotics many other advance technologies to detect the smoke coming from the forest.</li> <li>1. Computer vision models enable land cover classification and</li> </ol>

---

---



### 3.2 IDEATION & BRAINSTORMING:

**Brainstorm & Idea Prioritization**

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

1. 15 minutes to prepare  
2. 15 minutes to collaborate  
3. 15 minutes to present

**Brainstorm**

Write down any ideas that come to mind. Don't edit your problem statement.

1. 15 minutes

**Define your problem statement**

What problem are you trying to solve? Frame your problem as a clear, specific statement. This will be the focus of your brainstorm.

1. 15 minutes

**Brainstorm**

Write down any ideas that come to mind. Don't edit your problem statement.

1. 15 minutes

**Group ideas**

Start brainstorming your ideas with sticky notes or index cards as you go. Once all sticky notes have been grouped, give each cluster a written label that fits the ideas in the sticky notes, by and sort if you'd like to group the sticky notes together.

1. 15 minutes

**Prioritize**

Your team should sit around the same table about which is important, using the template. Then your team at the table's discussion will have an important and clear one to build.

1. 15 minutes

**After you collaborate**

The completed template is a record of your team's ideas. It's a record of your team's ideas. It's a record of your team's ideas.

1. 15 minutes

**Brainstorm**

Write down any ideas that come to mind. Don't edit your problem statement.

1. 15 minutes

**Define your problem statement**

What problem are you trying to solve? Frame your problem as a clear, specific statement. This will be the focus of your brainstorm.

1. 15 minutes

**Brainstorm**

Write down any ideas that come to mind. Don't edit your problem statement.

1. 15 minutes

**Group ideas**

Start brainstorming your ideas with sticky notes or index cards as you go. Once all sticky notes have been grouped, give each cluster a written label that fits the ideas in the sticky notes, by and sort if you'd like to group the sticky notes together.

1. 15 minutes

**Prioritize**

Your team should sit around the same table about which is important, using the template. Then your team at the table's discussion will have an important and clear one to build.

1. 15 minutes

**After you collaborate**

The completed template is a record of your team's ideas. It's a record of your team's ideas. It's a record of your team's ideas.

1. 15 minutes

## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

### 3.3 PROPOSED SOLUTION:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (problem to be solved)	Forest fires are one of the most vulnerable natural disaster. It affects thousand acres of land and natural resources, which also affects the thousands of living organisms and affects the livelihood of tribes and other forest workers.
2.	Idea / Solution description	The earlier detection of forest fires requires 24/7 monitoring of the forest which is not possible manually. To avoid the delay and manual monitoring <ol style="list-style-type: none"><li>3. We can use image processing to monitor forest.</li><li>4. 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</li></ol>
3.	Novelty / Uniqueness	<ol style="list-style-type: none"><li>3. Real time computer detects the forest fires at the earliest before being spread or to occur.</li><li>4. Satellite images of forests will be processed for identifying the fire.</li></ol>
4.	Social Impact / Customer Satisfaction	Early detection will helps to <ol style="list-style-type: none"><li>3. Prevent the loss of natural resources and wildlife.</li><li>4. It can prevent the livelihood of the surroundings and the people getting affected after the occurrence of forest fires.</li></ol>
5.	Business Model (Revenue Model)	<ol style="list-style-type: none"><li>2. The proposed method was implemented using the Python programming language on a Corei3 or greater.</li><li>2. The prediction might be right and the can have high reliability.</li></ol>

## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

6.	Scalability of the Solution	<ol style="list-style-type: none"><li>2. In future we can include machine learning and robotics many other advance technologies to detect the smoke coming from the forest.</li><li>2. Computer vision models enable land cover classification and smoke detection from satellite and ground cameras.</li></ol>

# EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

## 3.4 PROBLEM SOLUTION FIT

Define CS, fit into CL	<b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span> Who is your customer? eg. working parents of 0-5 yo. kids	<b>6. CUSTOMER LIMITATIONS</b> EG. BUDGET, DEVICES <span>CL</span> What limits your customers to act when problem occurs? Spending power, budget, no cash in the pocket? Network connection? Available devices?	<b>5. AVAILABLE SOLUTIONS</b> PLUSES & MINUSES <span>AS</span> Which solutions are available to the customer when he/she is facing the problem? What had he/she tried in the past? Pluses & minuses?	Explore AS, differentiate
Focus on PR, tap into BE, understand RC	<b>2. PROBLEMS / PAINS + ITS FREQUENCY</b> <span>PR</span> Which problem do you solve for your customer? There could be more than one, explore different sides. eg. existing solar solutions for private houses are not considered a good investment (1).	<b>9. PROBLEM ROOT / CAUSE</b> <span>RC</span> What is the root of every problem from the list? eg. People think that solar panels are bad investment right now, because they are too expensive (1.1), and possible changes to the law might influence the return of investment significantly and diminish the benefits (1.2).	<b>7. BEHAVIOR + ITS INTENSITY</b> <span>BE</span> What does your customer do about / around / directly or indirectly related to the problem? eg. directly related: tries different "green energy" calculators in search for the best deal (1.1), usually chooses for 100% green provider (1.2). indirectly related: volunteering work (Greenpeace etc)	Focus on PR, tap into BE, understand RC
Identify strong TR & EM	<b>3. TRIGGERS TO ACT</b> <span>TR</span> What triggers customer to act? eg. seeing their neighbor installing solar panels (1.1), reading about innovative, more beautiful and efficient solution (1.2)	<b>10. YOUR SOLUTION</b> <span>SL</span> If you are working on existing business - write down existing solution first, fill in the canvas and check how much does it fit reality.  If you are working on a new business proposition then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.	<b>8. CHANNELS of BEHAVIOR</b> <span>CH</span> ONLINE Extract channels from Behavior block	Extract online & offline CH of BE
	<b>4. EMOTIONS</b> BEFORE / AFTER <span>EM</span> Which emotions do people feel before/after this problem is solved? Use it in your communication strategy. eg. frustration, blocking (can't afford it) > boost, feeling smart, be an example for others (made a smart purchase)		OFFLINE Extract channels from Behavior block and use for customer development	



## 4 REQUIREMENT ANALYSIS

### 4.1 FUNCTIONAL REQUIREMENT

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

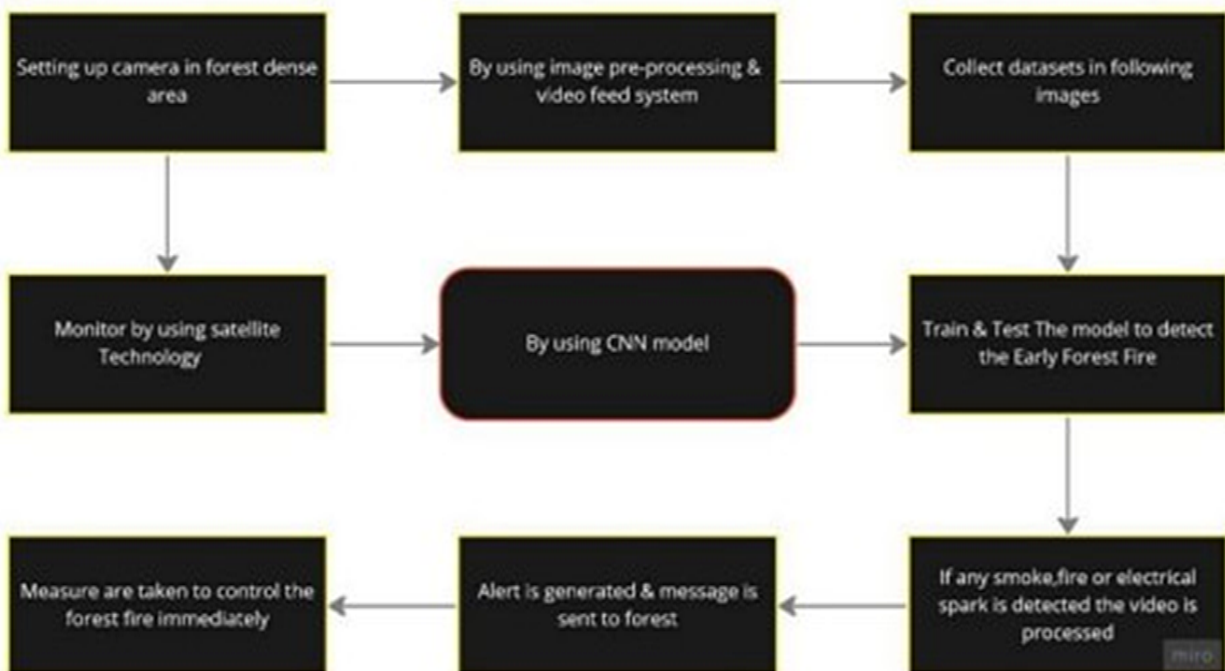
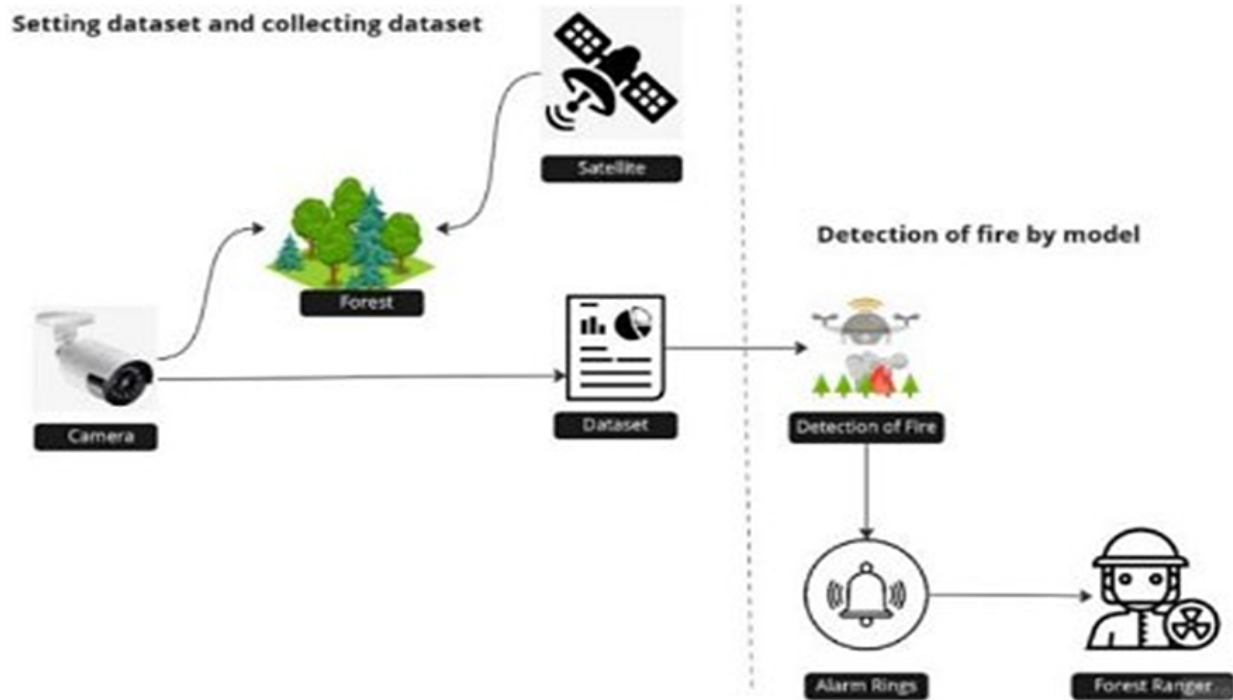
## 4.2 NON- FUNCTIONAL REQUIREMENTS

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 dronesis to gather situational consciousness, which can beused 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.

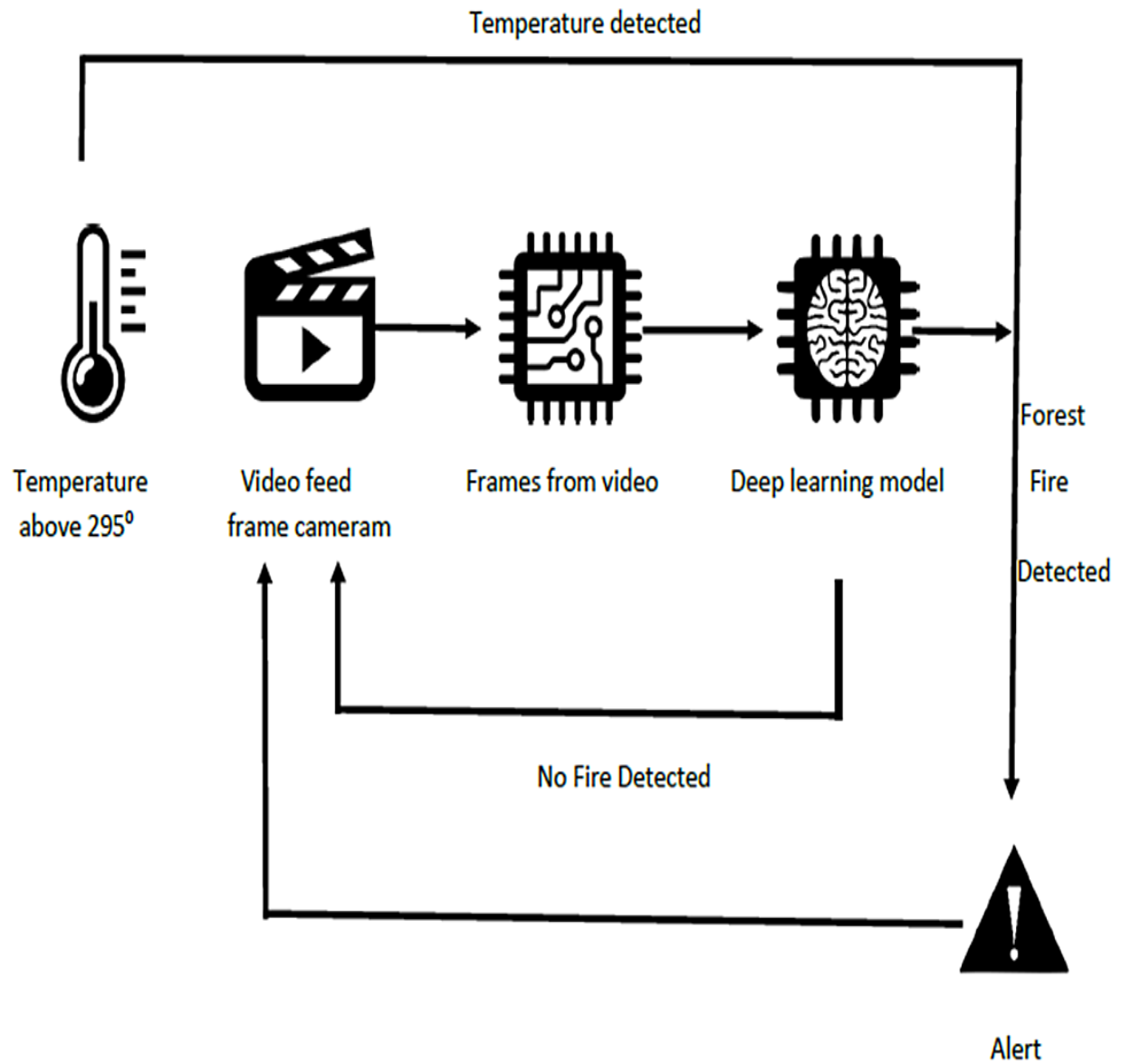
# EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

## 5 PROJECT DESIGN

### 5.1 DATAFLOW DIAGRAMS



## 5.2 SOLUTION & TECHNICAL ARCHITECTURE



## 6 PROJECT PLANNING & SCHEDULING

### 6.1 SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	DATA COLLECTION	USN-1	Data collected by sensors aboard orbiting satellites, carried aboard aircraft, or installed on the ground provide a wealth of data that can be used to assess conditions before a burn and track the movement of a wildfire in near real-time.	10	High	N.S.NITHIKSHA V.HARINI M.VIKRAM S.THEEBAN BABU
Sprint-1	IMAGE PREPROCESSING	USN-2	Image processing- Image processing technique automatically detect forest fires around the world by using infrared(IR) images sourced from satellites and CNN used for image recognition and tasks that involve the processing of pixel data.	7	Medium	N.S.NITHIKSHA V.HARINI M.VIKRAM S.THEEBAN BABU

## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

Sprint-2	TRAINING AND TESTING	USN-3	The model is trained for detecting the fire by training with real time work and the testing is done according the accuracy of the model	10	high	N.S.NITHIKSHA V.HARINI M.VIKRAM S.THEEBAN BABU
----------	----------------------	-------	---	----	------	--

Sprint-3	REVIEWING THE MODEL	USN-4	The main task is to check that the model is efficient to work in real time to ensure there is no error in the model	7	Medium	N.S.NITHIKSHA V.HARINI M.VIKRAM S.THEEBAN BABU
Sprint-4	IMPLEMENTATION	USN-5	After completing every step the model is implemented on the forest and the quick responses is collected from forest organization	10	High	N.S.NITHIKSHA V.HARINI M.VIKRAM S.THEEBAN BABU

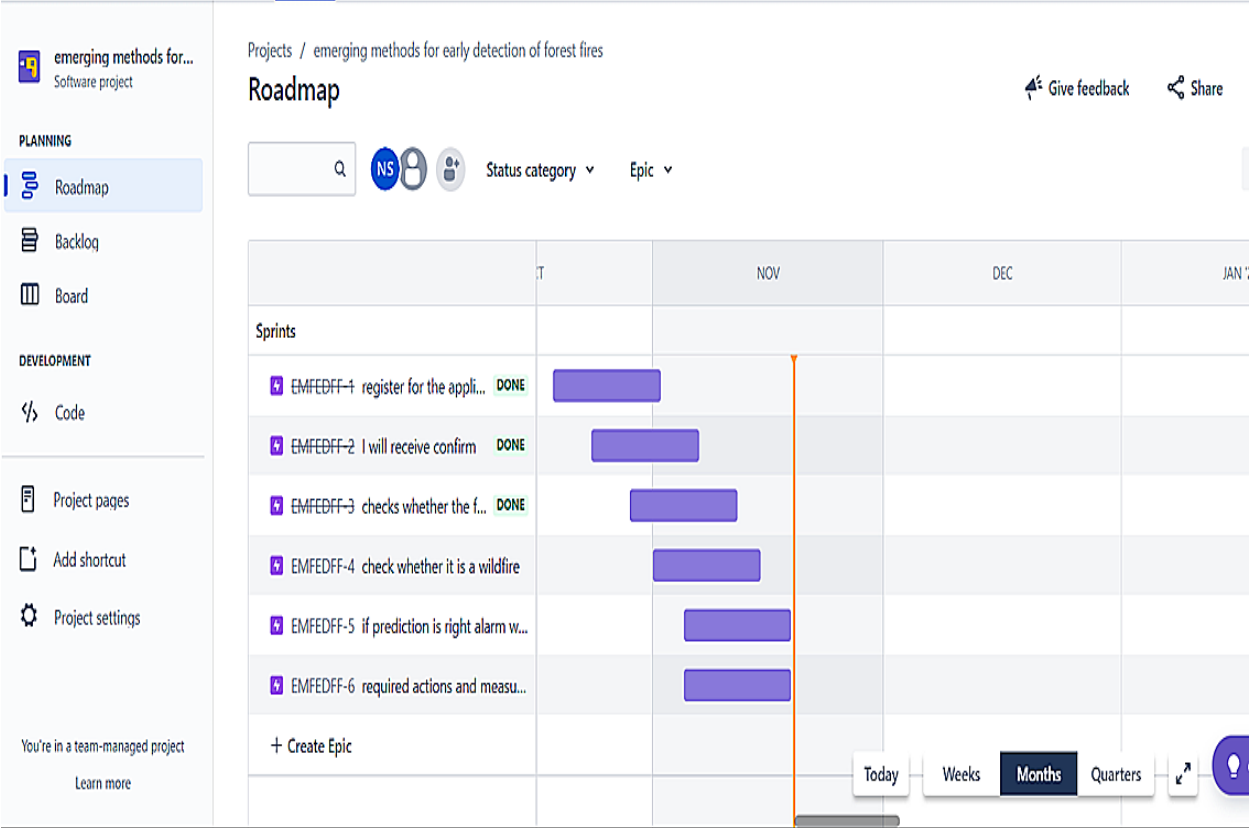
## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

### 6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	27 Oct 2022	8	27 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	7	08 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	8	16 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	7	20 Nov 2022

EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

6.3 REPORT FROM JIRA





## 7 CODING & SOLUTIONING (EXPLAIN THE FEATURES ADDED IN THE PROJECT ALONG WITH CODE)

### 7.1 FEATURE 1

```
In [2]: 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 [3]: #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)

In [6]: #
        x_train = train_datagen.flow_from_directory('C:/Users/nithi/OneDrive/Desktop/project ibm/Dataset/train_set',
                                                    target_size=(150,150),
                                                    batch_size = 32,
                                                    class_mode = 'binary')

Found 458 images belonging to 2 classes.

In [7]: x_test = test_datagen.flow_from_directory('C:/Users/nithi/OneDrive/Desktop/project ibm/Dataset/test_set',
                                                  target_size=(150,150),
                                                  batch_size=32,
                                                  class_mode = 'binary')

Found 122 images belonging to 2 classes.
```

### 7.2 FEATURE 2

## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

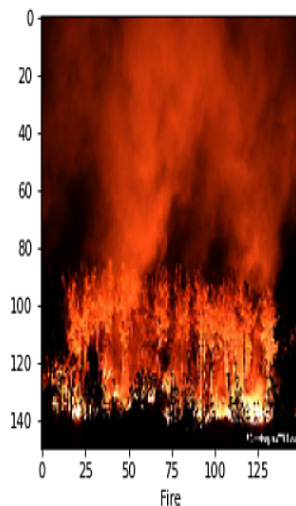
```
In [205]: pred = np.argmax(x,axis=1)
if pred[0].all() != 1:
    account_sid='AC73b617c990de0f236a076c8b62159383'
    auth_token='a61c60722933897f61a555b0a6d84b09'
    Client = Client(account_sid, auth_token)
    message= client.messages\
        .create(body="Forest fire is detected, stay alert and stay safe",
            from_ = "+15134808332",
            to="8825499159")
    print(message.sid)
    print('Fire Detected')
    print('SMS SENT!')
    playsound('C:/Users/nithi/OneDrive/Desktop/project ibm/Melody Message.mp3')
else:
    print('NO DANGER')
    #break
video.release()
cv2.destroyAllWindows()
```

NO DANGER

### 7.3 FEATURE 3

```
In [152]: predictImage("C:/Users/nithi/OneDrive/Desktop/project ibm/Dataset/test_set/with fire/19464620_401.jpg")
```

```
1/1 [=====] - 1s 817ms/step
[[1.]]
```



```
In [95]: pip install twilio
```

Defaulting to user installation because normal site-packages is not writeable  
Collecting twilio

Downloading twilio-7.15.3-py2.py3-none-any.whl (1.4 MB)

Requirement already satisfied: PyJWT<3.0.0,>=2.0.0 in c:\programdata\anaconda3\lib\site-packages (from twilio) (2.1.0)

Requirement already satisfied: requests>=2.0.0 in c:\programdata\anaconda3\lib\site-packages (from twilio) (2.27.1)

Requirement already satisfied: pytz in c:\programdata\anaconda3\lib\site-packages (from twilio) (2021.3)

Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\programdata\anaconda3\lib\site-packages (from requests>=2.0.0->twilio)

## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

### TESTING

FeatureType	Component	Test Scenario	Steps To Execute	Expected Result	Actual Result	Status
UI	Home Page	Display the Emerging Methods of Forest Fires	Enter URL(http://127.0.0.1:5000)	Displaying the Home Page	Home Page displayed	Pass
UI	Home Page	Displayed the Prediction Forest Fires	1.Enter URL(http://127.0.0.1:5000) 2.Content of the Home Page should be Displayed	Displaying the content of Home page	Content of Homepage is displayed	Pass
Functional	Home	Checks whether the Drop the Image Here! Button is visible	Enter URL(http://127.0.0.1:5000) Content of the Home Page should be Displayed 3.Click Drop the Image Here! Button	Displays the Button	Drop the Image Here! Button is pops up.	Pass
Functional	Predict edpage	Display the PredictionPage and Choose Image Button	Enter URL(http://127.0.0.1:5000) Content of the Home Page should be Displayed 3.Click Drop the Image Here! Button 4.Click Choose Image	Displays the Prediction Page and the Choose Image Button	Predicti on page displayed. Choose image button was clicked.	Pass

## EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

### 8.2 USER ACCEPTANCE TESTING

#### DEFECT ANALYSIS

Resolution	severity 1	severity 2	severity 3	badness 4	subtotal
ByDesign	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

#### 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

## 9 RESULTS

### 9.1 PERFORMANCE METRICES

S. No	Parameter	Values	Screenshot
1.	Model Summary	3,453,121	<pre> 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 </pre>
2.	Accuracy	<p>Training Accuracy - 0.9665</p> <p>Validation Accuracy -0.9833</p>	<pre> Epoch 1/10 14/14 [=====] - 96s 7s/step - loss: 0.5717 - accuracy: 0.1652 - val_loss: 0.2085 - val_accuracy: 0.4750 Epoch 2/10 14/14 [=====] - 84s 5s/step - loss: 0.3266 - accuracy: 0.8434 - val_loss: 0.1193 - val_accuracy: 0.9667 Epoch 3/10 14/14 [=====] - 74s 5s/step - loss: 0.2247 - accuracy: 0.9227 - val_loss: 0.1184 - val_accuracy: 0.9900 Epoch 4/10 14/14 [=====] - 75s 5s/step - loss: 0.1882 - accuracy: 0.9425 - val_loss: 0.1006 - val_accuracy: 1.0000 Epoch 5/10 14/14 [=====] - 82s 5s/step - loss: 0.1173 - accuracy: 0.9618 - val_loss: 0.1031 - val_accuracy: 0.9667 Epoch 6/10 14/14 [=====] - 76s 5s/step - loss: 0.0925 - accuracy: 0.9741 - val_loss: 0.1018 - val_accuracy: 1.0000 Epoch 7/10 14/14 [=====] - 80s 5s/step - loss: 0.0884 - accuracy: 0.9774 - val_loss: 0.1034 - val_accuracy: 1.0000 Epoch 8/10 14/14 [=====] - 72s 5s/step - loss: 0.1009 - accuracy: 0.9663 - val_loss: 0.1045 - val_accuracy: 0.9833 Epoch 9/10 14/14 [=====] - 70s 5s/step - loss: 0.1052 - accuracy: 0.9676 - val_loss: 0.1044 - val_accuracy: 1.0000 Epoch 10/10 14/14 [=====] - 92s 5s/step - loss: 0.1144 - accuracy: 0.9665 - val_loss: 0.1007 - val_accuracy: 0.9833 </pre>

## 10 ADVANTAGES & DISADVANTAGES

### ADVANTAGES:

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

### DISADVANTAGE:

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

## 11 CONCLUSION

This type of system is the first of its kind to ensure no further damage is then to forests when there is fire breakout and instantly a message is sent to the user through the App. Immediate response or early warning to a fire breakout is mostly the only ways to avoid losses and 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 progress of fire is highly valuable for managing fire.

During all its stages. Basedon this data the firefighting staff can be guided on target to block firebefore it reaches cultural heritage sites and to suppress it quickly by utilise 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.

## 12 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:

Additional pump can be added so that it automatically sends water when there is a 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.



## 13 APPENDIX TEMPLATE

**digital.html**

**<!DOCTYPE html>**

**<html>**

**<head>**

**<title>Early Detection of Forest Fires</title>**

**<meta charset="utf-8">**

**<meta name="viewport" content="width=device-width,  
initial-scale=1">**

**<link rel="stylesheet"  
href="https://maxcdn.bootstrapcdn.com/bootstrap/4.5.2/css/  
bootstrap.min.css">**

**<script  
src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.m  
in.js"></script>**

**<script  
src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></  
script>**

**<link rel="stylesheet"  
href="https://www.w3schools.com/w3css/4/w3.css">**

```
<link rel="stylesheet" href="/static/style.css">
<style>

</style>
</head>

<body style="background-color:black;">
  <!-- <div class="header">Early Detection of Forest
  Fires</div> -->
  <div class="container text-center mb-10"
  style="padding-top:50px;">
    <div>
      <h1 style="font-size: 46px; color:
      white;">EARLY DETECTION OF <span
      style="color:firebrick">FOREST FIRES
      </span></h1>
    </div>
  </div>

  <section class="site-section" id="section-about"
  style="padding-top: 200px;">
    <div class="container">
      <div class="row mb-5 align-items-center">
        <div class="row mb-5">
          <div class="section-heading text-
```

center text-align">

<h2 style="color:  
red;">PREDICTION <strong  
style="color:#FFD700;">FOREST FIRE</strong></h2>  
</div>

<p style="color: white;"> Forest  
fires are increasing in prevalence, damaging ecosystems, and  
costing lives.

Early detection systems are vital  
to preventing the detrimental impact of these fires that  
rapidly spread across  
landscapes.

Over recent years, several  
optical systems have been developed that can act as early  
warning

systems.</p>

<p style="color: white;"> Forest  
fires are a major Environmental issue,Creating economic  
and

ecological damage while  
endangering human lives

</p>

</div>

<div class="row mb-5" style="padding-  
left: 450px;">

```
<a href="#section2"> <button  
class="button button3 text-center">DROP THE IMAGE  
HERE!</button> </a>
```

```
<style>
```

```
    .button {  
        background-color:  
#4CAF50;  
  
        /* Green */  
        border: none;  
        color: white;  
        padding: 16px 32px;  
        text-align: center;  
        text-decoration: none;  
        display: inline-block;  
        font-size: 16px;  
        margin: 4px 2px;  
        transition-duration: 0.4s;  
        cursor: pointer;  
        border-radius: 4px;  
    }
```

```
    .button3 {  
        background-color: white;  
        color: black;
```

```
        border: 2px solid #f44336;
    }

    .button3:hover {
        background-color: #f44336;
        color: white;
    }
</style>
</div>
</div>

</div>
</section>

</div>

<div class="predictimg" id="section2"
style="background-color:beige;">
    <section id="main">
        <div class="text-center mb-8">
            <p>
                <h2 class="mb-5" style="font-
size:25px; font-weight: bolder;">PREDICTION ON <span
style="color:firebrick;">IMAGE </span></h2>
```

**<h3 style="font-size:25px; font-weight: bolder;"> CLICK ON CHOOSE AND <span style="color: firebrick;"> UPLOAD THE IMAGE .... </span></h3>  
</p>**

**</div>**

**</section>**

**<div class="container border border-danger rounded ">**

**<div class="text-center">**

**<h4 class="mb-5" style="font-size:25px; font-weight: bolder;">UPLOAD YOUR IMAGE</h4>**

**<form action="http://localhost:5000/" id="upload-file" method="post" enctype="multipart/form-data">**

**<label for="imageUpload" class="button button3">**

**CHOOSE IMAGE**

**</label>**

**<input type="file" name="image" id="imageUpload" accept=".png, .jpg, .jpeg">  
</form>**

```

<div class="image-section mb-5"
style="display:none; padding-left:400px;">
    <div class="img-preview">
        <div id="imagePreview">
        </div>
    </div>
</div>

<div class="image-section mb-5"
style="display:none;">
    <div>
        <button type="button"
class="button button3" id="btn-
predict">PREDICT!</button>
    </div>
</div>

<div class="loader "
style="display:none;"></div>
<div >
    <h4 class="text-center " >
        <span id="result" class="alert
alert-primary mb-10" role="alert" style="font-size:35px;">

```

**</span>**

**</h4>**

**</div>**

**</div>**

**</div>**

**</div>**

**<script>**

**window.onscroll = function () { myFunction() };**

**\$(document).ready(function () {**

**// Init**

**\$('.image-section').hide();**

**\$('.loader').hide();**

**\$('#result').hide();**

**// Upload Preview**

**function readURL(input) {**

**if (input.files && input.files[0]) {**

**var reader = new FileReader();**

**reader.onload = function (e) {**

**\$('#imagePreview').css('background-image', 'url(' +  
e.target.result + ');**



```
        $('#imagePreview').hide();
        $('#imagePreview').fadeIn(650);
    }

    reader.readAsDataURL(input.files[0]);
    }
}

$("#imageUpload").change(function () {
    $('.image-section').show();
    $('#btn-predict').show();
    $('#result').text('');
    $('#result').hide();
    readURL(this);
});

// Predict
$('#btn-predict').click(function () {
    var form_data = new
FormData($('#upload-file')[0]);

    // Show loading animation
    $(this).hide();
    $('.loader').show();

    // Make prediction by calling api /predict
```

```
$.ajax({
  type: 'POST',
  url: '/predict',
  data: form_data,
  contentType: false,
  cache: false,
  processData: false,
  async: true,
  success: function (data) {
    // Get and display the result
    $('.loader').hide();
    $('#result').fadeIn(600);
    $('#result').text('PREDICTION
: ' + data);

    console.log('Success!');
  },
});
});
</script>
```

```
</body>
```

**</html></title>**

**</head>**

**<body>**

**</body>**

**</html>**

**app.py**

```
from __future__ import division, print_function  
import os  
import numpy as np  
import tensorflow as tf  
from tensorflow.keras.preprocessing import image  
from tensorflow.keras.models import load_model  
from flask import Flask, request, render_template  
from werkzeug.utils import secure_filename  
from twilio.rest import Client  
  
global graph  
# graph=tf.get_default_graph()  
# Define a flask app  
app = Flask(__name__)  
model = load_model('forest1.h5')
```

```
@app.route('/', methods=['GET'])
def index():
    # Main page
    return render_template('digital.html')

@app.route('/predict', methods=['GET', 'POST'])
def upload():
    if request.method == 'POST':
        # Get the file from post request
        f = request.files['image']

        # Save the file to ./uploads
        basepath = os.path.dirname(__file__)
        file_path = os.path.join(
            basepath, 'uploads', secure_filename(f.filename))
        f.save(file_path)
        img1 = image.load_img(file_path, target_size=(150,
150))

        y = image.img_to_array(img1)
        x = np.expand_dims(y, axis=0)
        val = model.predict(x)
```

```
print(val)  
if val == 1:  
    send_message()  
    result = "Fire"  
elif val == 0:  
    result = "No Fire"  
return result
```

```
def send_message():  
    < --- "Enter your Twilio address" -->
```

```
if __name__ == '__main__':  
    app.run(threaded=False)
```

**style.css**

```
predictimg{  
    background-color: #565961;  
    background-size: cover;  
    background-position:center;
```

```
background-attachment: absolute;  
height: 100%;  
margin-top: 49.6%;  
}
```

```
#showcase{  
height: 300px;  
margin-bottom: 30px;  
}  
html {  
scroll-behavior: smooth;  
}  
#main{  
float: center;  
color: black;  
width: 100%;  
padding: 0 30px;  
padding-top: 7%;  
box-sizing: border-box;  
font-family: Georgia, serif;  
text-align: center;  
}
```

```
#sidebar{
float:right;
width:50%;
background-color: transparent;
color:#000;
font-family:Georgia, serif;
padding-left:0px;
padding-right:0px;
padding-top:1px;
box-sizing: border-box;
}

.img-preview {
width: 300px;
height: 300px;
position: relative;
border: 5px solid #F8F8F8;
box-shadow: 0px 2px 4px 0px rgba(0, 0, 0, 0.1);
margin-top: 1em;
margin-bottom: 1em;
}

.topnav-right a.active {
background-color: #565961;
color: white;
```

}

```
.topnav-right {  
float: right;  
padding-right:100px;  
}
```

```
.img-preview>div {  
width: 100%;  
height: 100%;  
background-size: 300px 300px;  
background-repeat: no-repeat;  
background-position: center;  
}
```

```
input[type="file"] {  
display: none;  
}
```

```
.loader {  
border: 8px solid #f3f3f3; /* Light grey */  
border-top: 8px solid #161616;  
border-radius: 50%;  
width: 50px;
```



```
height: 50px;  
animation: spin 1s linear infinite;  
}
```

```
@keyframes spin {  
0% { transform: rotate(0deg); }  
100% { transform: rotate(360deg); }  
}
```

## **GITHUB & PROJECT DEMO LINK**

### **GITHUB LINK**

[IBM-EPBL/IBM-Project-31285-1660198652](https://github.com/IBM-EPBL/IBM-Project-31285-1660198652)

### **PROJECTDEMO LINK**

[\*\*https://drive.google.com/file/d/17Ffpk\\_DPybQvW1Q8kHFIocD63Cld45Gp/view?usp=share\\_link\*\*](https://drive.google.com/file/d/17Ffpk_DPybQvW1Q8kHFIocD63Cld45Gp/view?usp=share_link)