Emerging Methods for Early Detection of Forest Fires

PROJECT REPORT

HX8001

Professional Readiness for Innovation,

Employability and Entrepreneurship

Submitted by

ANU NIVETHA R P	**211719104017**
ASHWATHI S	**211719104021**
DHARISHINIE P	**211719104035**
JEEVITHA P	**211719104052**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING
IN

COMPUTER SCIENCE AND ENGINEERING

RAJALAKSHMI INSTITUTE OF TECHNOLOGY

ANNA UNIVERSITY: CHENNAI 600 025
NOVEMBER 2022

BONAFIDE CERTIFICATE

Certified that this project report "**Emerging Methods for Early Detection of Forest Fires**" is the bonafide work of "**JEEVITHA.P(211719104052), ASHWATHI.S(211719104021),DHARISHINIE.P(211719104035),ANU NIVETHA.R.P(211719104017)**", who carried out the project work under my supervision.

SIGNATURE:	**SIGNATURE:**
Dr. T.RAJENDRAN,	**Ms. R VIJAYALAKSHMI,**
M.E., Ph.D,	**M.E., (Ph.D)**
HEAD OF THE DEPARTMENT,	**MENTOR,**
Dept. of Computer Science and Engg.,	Dept. of Computer Science and Engg.,
Rajalakshmi Institute of Technology,	Rajalakshmi Institute of Technology,
Kuthambakkam Post,	Kuthambakkam Post,
Chennai - 600 124	Chennai - 600 124

The viva-voce is held on _____.

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

We express our sincere gratitude to our honorable Chairperson **Dr. (Mrs.)THANGAM MEGANATHAN, M.A., M.Phil., Ph.D.,** and Chairman **Thiru. S. MEGANATHAN, B.E., F.I.E.,** for their constant encouragement to do this project and also during the entire course period.

We thank our Principal **Dr. P. K. NAGARAJAN** and our Head of the department **Dr. T. RAJENDRAN, M.E., Ph.D.,** for their valuable suggestions and guidance for the development and completion of this project.

Words fail to express our gratitude to our Project Mentor **Ms. VIJAYALAKSHMI M.E., (Ph.D.)** who took special interest in our project and gave their consistent support and guidance during all stages of this project.

Finally, we thank all the teaching and non-teaching faculty members of the **DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING** of our college who helped us to complete this project.

Above all we thank our parents and family members for their constant support encouragement for completing this project

TABLE OF CONTENT

1. INTRODUCTION
- Project Overview
- Purpose

2. LITERATURE SURVEY
- Existing problem
- References
- Problem Statement Definition

3. IDEATION & PROPOSED SOLUTION
- Empathy Map Canvas
- Ideation & Brainstorming
- Proposed Solution
- Problem Solution fit

4. REQUIREMENT ANALYSIS
- Functional requirement
- Non-Functional requirements

5. PROJECT DESIGN
- Data Flow Diagrams
- Solution & Technical Architecture
- User Stories

6. PROJECT PLANNING & SCHEDULING
- Sprint Planning & Estimation
- Sprint Delivery Schedule
- Reports from JIRA

7. CODING & SOLUTIONING
- Explain the features added in the project along with code
  - Feature 1
  - Feature 2
- Database Schema (if Applicable)

8. TESTING
- Test Cases
- User Acceptance Testing

9. RESULTS
- Performance Metrics

10. ADVANTAGES & DISADVANTAGES

11. CONCLUSION

12. FUTURE SCOPE

13. APPENDIX
- Source Code
- GitHub & Project Demo Link

INTRODUCTION

Forest fires usually occur in areas remote from populated places, in order to that their detection at an early stage and timely reports to the competent services are of utmost importance. As stated by National Institute of Disaster Management, Ministry of Home Affairs in their latest report on Forest Fire Disaster Management, forest fire is the major cause of injury and loss to forest. This loss due to fire has a major impact on forest ecosystem their by indirectly affecting the nature's ecosystem.

Project Overview

The earliest possible detection enables a rapid response to attenuate the spread. Moreover, information the seat of the hearth is invaluable for the rapid deployment of fire- fighters. Therefore, early detection, containment at the primary stages and extinguishment of a fireplace before it spreads are crucial for wildfire Management

PURPOSE

Forest fires as of late have been annihilating both for normal biological system, biodiversity and woodland economy. With expanding populace weight and change in worldwide atmosphere situation, there is an expansion in level of fires that are a significant reason for declining Indian woodlands. As indicated by woodland study report of India, 50 % of backwoods regions in nation are fire inclined (going from 50 to 90 % in certain conditions of nation). Around 6 % of the woods are inclined to extreme fire harms.

The reason for this planned framework is to manufacture a dependable fire location framework so as to know dynamic status of back woods temperature in specific conditions. It is about the sensors and dynamic checking framework to dodge a significant fire and genuine harm to woods.

Literature survey

P. Tamil Mathi and Dr. L. Latha[1] Proposed this method and definition on fire detection.To detect fire at early stage we use smoke which is the good indicator of fire which is visible before flames. Characteristics of smoke need to be considered such as transparency, its response to environmental condition, its shape. In open environment smoke detection pose a serious challenge in such areas sensors may be used but this has limitations such as time and wide area coverage. To overcome this video fire detection systems are used.

P. Piccinini, S. Calderara, and R. Cucchiara [2] proposed a method based on the wavelet model and a color model of the smoke. The proposed method exploits two features: the variation of energy in wavelet model and a color model of the smoke. Smoke is detected based on the decrease of energy ratio in wavelet domain between background and current. The deviation of the current pixel color is measured by the color model. Bayesian classifier is used to combine these two features to detect smoke.

Ignacio Bosch, Soledad Gomez, Luis Vergara et al. [3] have proposed a paper based on a scheme of infrared sensors. This scheme based on infrared image processing performs the immediate detection of any fire in the forest to determine the presence or absence of fire. Sensor networks are widely used and help the human capabilities to monitor large forest areas. This paper describes a scheme for automatic forest surveillance with the help of IR sensors. The paper describes only about detecting the fire and sending images of detected fire using image processing

Yogesh Deshpande, Krishi Savla, Crispin Lobo, Jahnavi Patel & prof. Shivani Bhattacharjee et al. [4] has proposed a paper on Forest monitoring systems using sensors, wireless communication, and image processing. The forest monitoring system will keep a track of the conditions that are good for the fauna of the forest and collect data which includes temperature, humidity, entry and exit of animals and the various parts of the forest

Wen- Homg et al. [5], used HSI colour model to separate the fire pixels. They have developed the rules for brighter and darker environments. After segmenting the fire region based on HSI rules the lower intensity and lower saturation pixels are removed to avoid fire aliases (fire like region). They also formed a metric based on binary counter difference images to measure the burning degree of fire flames such as no fire, small, medium, and big fires. Their result includes false positives and false negatives.

Dimitropoulos (2015) [6] proposed an algorithm where a computer vision approach for fire-flame detection is used to detect fire at an early stage. Initially, background subtraction and color analysis is used to define candidate fire regions in a frame and this approach is a non-parametric model. Following this, the fire behavior is modeled by employing various Spatiotemporal features such as color probability, flickering, spatial and spatiotemporal energy. After flame modeling the dynamic texture analysis is applied in each candidate region using Linear Dynamical Systems, Histogram and Mediods. LDS is used to increase the robustness of the algorithm by analyzing temporal evolution of pixel intensities. Pre-processing is done after this to filter non-candidate regions. Spatio- temporal analysis is done to increase the reliability of the algorithm.

Reference:

[1]P. Tamil Mathi PG Student Department of Computer Science and Engineering, Kumaraguru College of Technology, Coimbatore, India Dr. L. Latha ASP Department of Computer Science and Engineering, Kumaraguru College of Technology, Coimbatore, India

[2] Surya.T.S, Suchithra.M.S. Survey on Different Smoke Detection Techniques Using Image Processing. International Journal of Research in Computer and Communication Technology, 16-19.

[3]Bosch, Ignacio & Gomez, Soledad & Vergara, Luis. (2007). Automatic Forest Surveillance Based on Infrared Sensors. 572- 577. 10.1109/SENSORCOMM.2007.4394981.

[4] Y. Deshpande, K. Savla, C. Lobo, S. Bhattacharjee, and J. Patel, "Forest Monitoring System Using Sensors, Wireless Communication, and Image Processing," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), Pune, India, 2018, pp. 1-6, DOI: 10.1109/ICCUBEA.2018.8697708.

[5]Wen-Bing Homg, Jim-wen Peng and ChinYuan Chen, “A new image based real time flame detection method using colour analysis”, Proc. of IEEE Network sensing and Control, ICNSC, pp. 100-105, 2005

[6] Kosmas Dimitropoulos, Panagiotis Barmpoutis, and Nikos Grammalidis (2015). Spatio Temporal Flame Modelling and Dynamic Texture Analysis for automatic video-based fire detection, IEEE transactions on circuits and systems for video technology, vol. 25, no. 2

Problem Statement Definition

Fires have been a source of trouble. Fires have notable influence over the ecological and economic utilities of the forest, being a prime constituent in a great number of forest ecosystems. Fires are considered as a significant environmental issue because they cause prominent economic and ecological damage despite endangering the human lives. Due to the forest fires, several hundred million hectares of forest and other vegetation are destroyed every year. Therefore, we monitoring and early detecting of forest fire.

IDEATION & PROPOSED SOLUTION

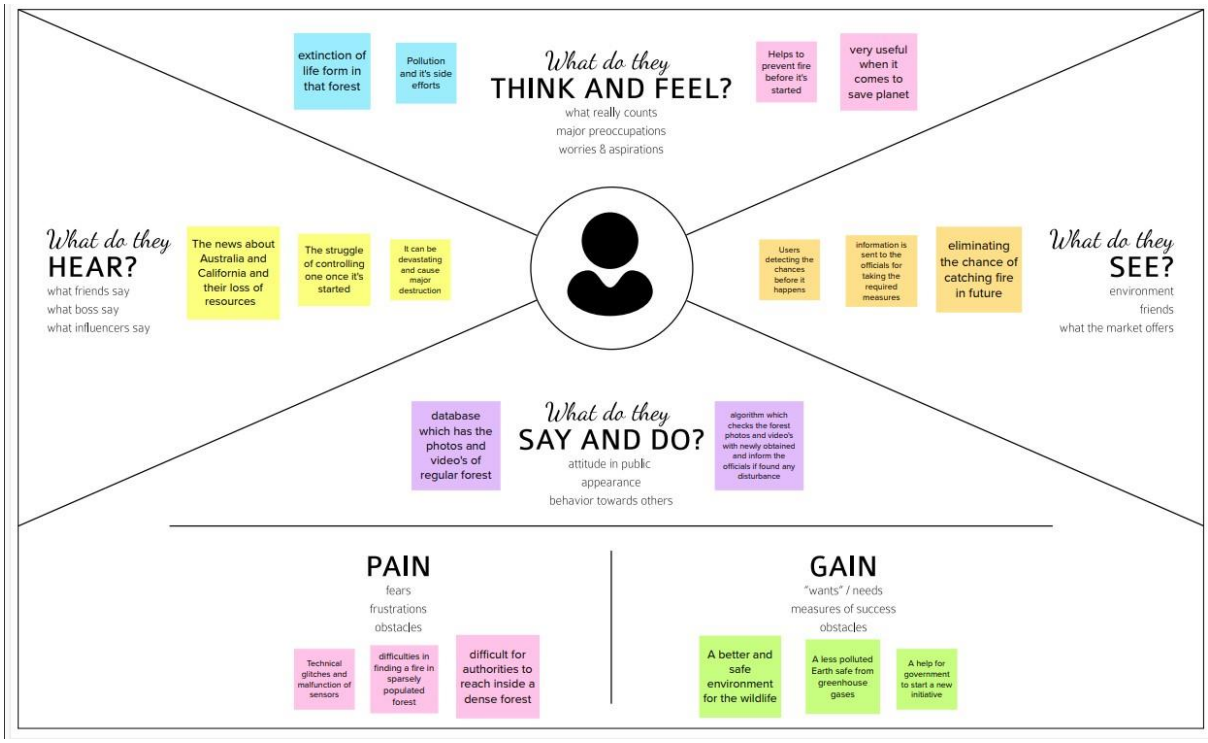
Empathy Map Canvas

1. An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community.

2. An empathy map is an effective visualization template that helps analyse the behaviour and emotions of customers and users. Empathy maps not only detect the behaviours but highlight possible mediums for brands to communicate with their customers in a better way

3. Empathy maps can also be used to collect data directly from the users. Used alongside user interviews, survey answers, etc., you can also have a user fill in an empathy map themselves. This often reveals aspects of the user that may have remained unsaid or not thought of.

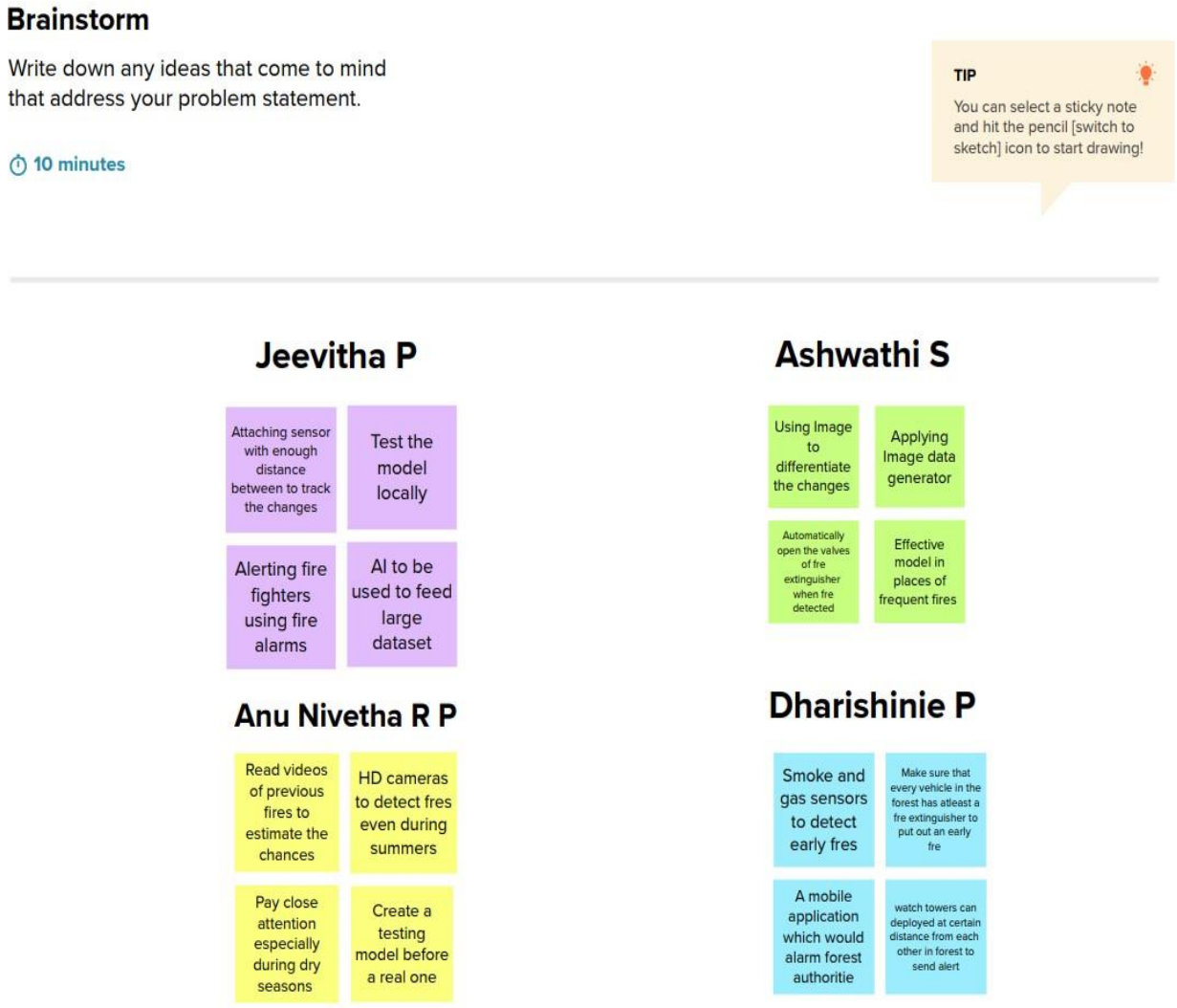
4. Each of the four quadrants comprises a category that helps us delve into the mind of the user. The four empathy map quadrants look at what the user says, thinks, feels, and does.



Ideation & Brainstorming

Brainstorming is a group problem-solving method that involves the spontaneous contribution of creative ideas and solutions. This technique requires intensive, freewheeling discussion in which every member of the group is encouraged to think aloud and suggest as many ideas as possible based on their diverse knowledge.

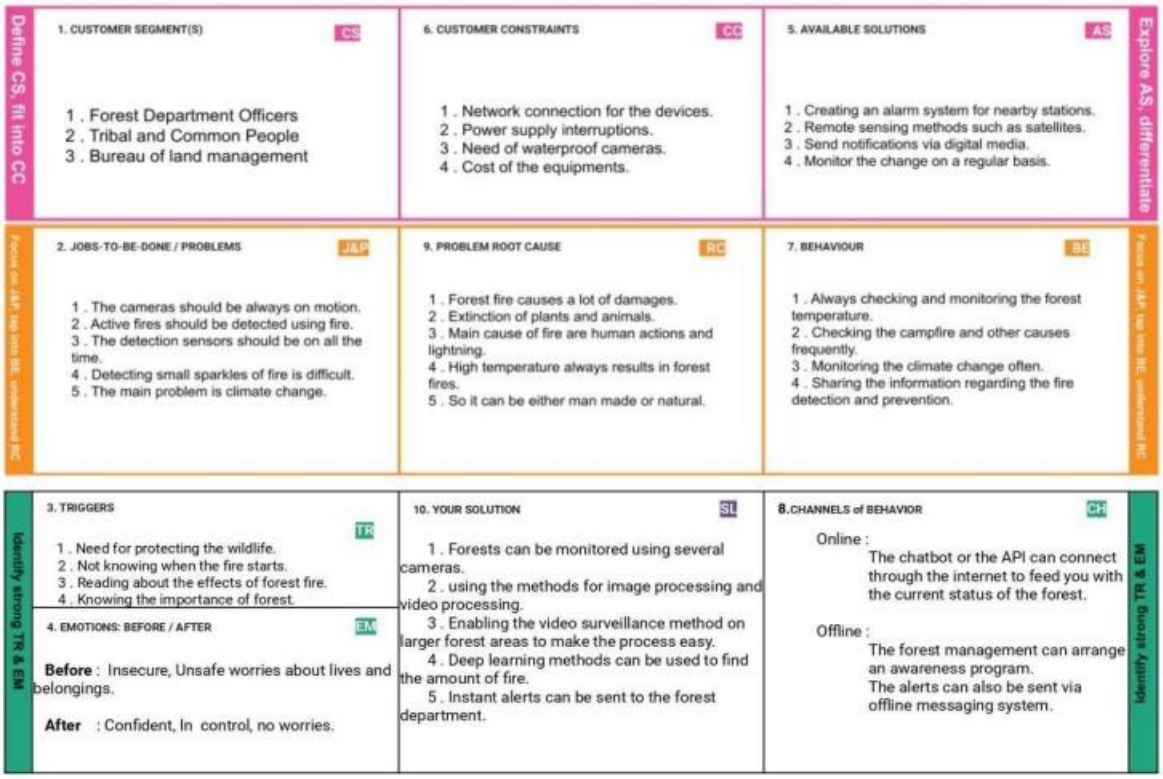
Brainstorming combines an informal approach to problem-solving with lateral thinking, which is a method for developing new concepts to solve problems by looking at them in innovative ways. Some of these ideas can be built into original, creative solutions to a problem, while others can generate additional ideas.



Proposed Solution

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	Fires have been a source of trouble. Fires have notable influence over the ecological and economic utilities of the forest, being a prime constituent in a great number of forest ecosystems. Fires are considered as a significant environmental issue because they cause prominent economical and ecological damage despite endangering the human lives
2	Idea/Solution description	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 cameras.
3	Novelty/Uniqueness	Using real-time monitoring, instant data allows pre-cursors to potential issues (such as corrosion) to be flagged up and immediately be addressed before major issues occur. The ability to make real-time decisions during critical moments can be vital in preventing forest fires.
4	Social Impact/Customer Satisfaction	It gives the early detection of smoke and other temperature issues. Reduce the potential damage as well as the cost of fire fighting. The wireless sensor networks and machine learning was found to be an effective method for fire detection in forests that provides more accurate results.
5	Business Model (Revenue Model)	The section presents the system deployment strategy and focuses on the sensor probes, wireless sensor networks and machine learning analysing the data obtained from the deployment environment
6	Scalability of the Solution	• Well monitoring system with accurate indication. • Easy maintenance. • Reasonable

Problem Solution fit



REQUIREMENT ANALYSIS

Functional Requirement

Following are the functional requirements of the proposed solution.

FR No:	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
1	Video surveillance	Setting up a 24/7 surveillance around the forest areas for monitoring
2	Data collection	Collection of previous forest fires images to comparison and future purposes use cameras for this
3	Detect fire	Fire is detected through CNN and sensors (for analysing fire smoke)
4	Alerting officers	If fire is detected alert all the nearby authorities and all the nearby areas for evacuation and further purposes

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution

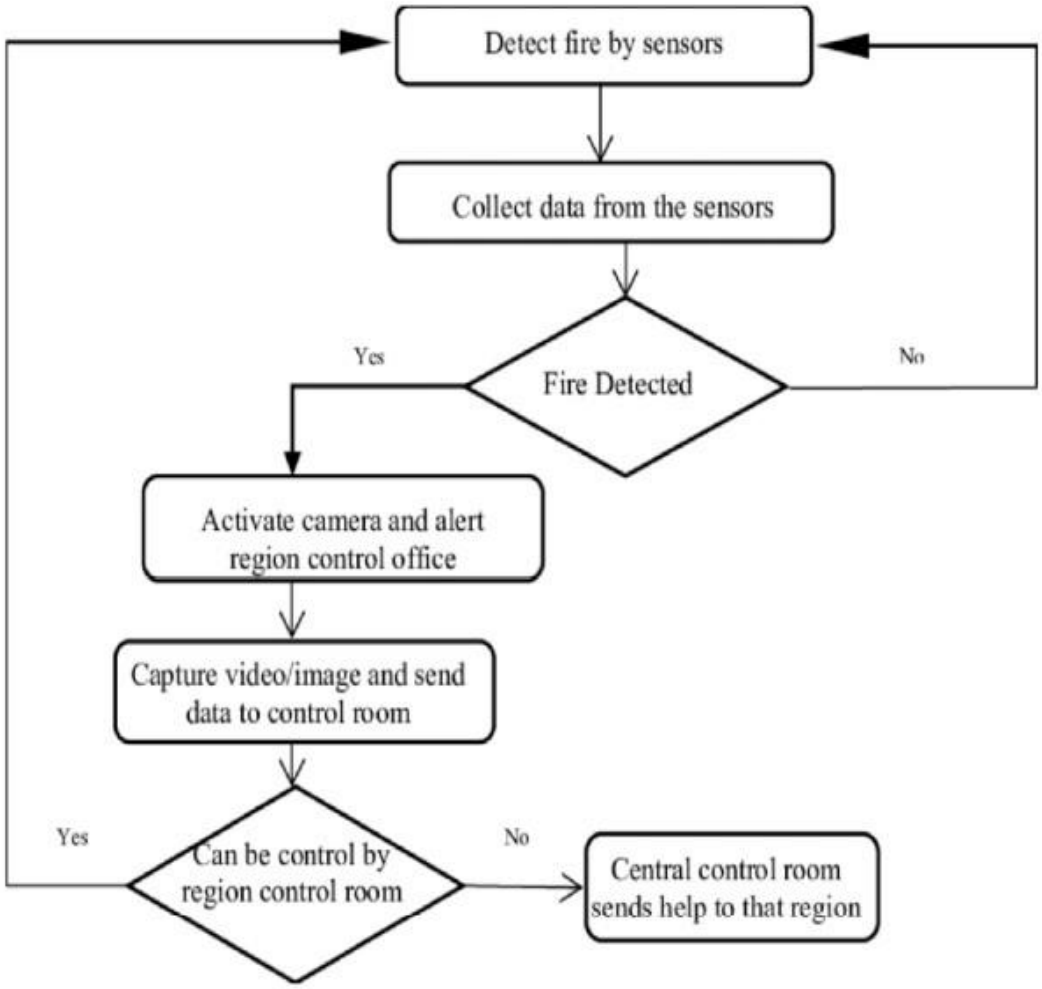
FR No:	Non-Functional Requirement	Description
1	Usability	Alerts according to the user location Early detection is helpful to avoid disaster
2	Security	24-hours security is available
3	Reliability	The prediction of the forest fire is pretty accurate with reliability
4	Performance	Early detection happens, so the performance is good, which is what we want.
5	Availability	The application gives alerts and live feeds 24/7
6	Scalability	The system provides the early detection as much as possible so scalability is done.

PROJECT DESIGN

Data Flow Diagrams

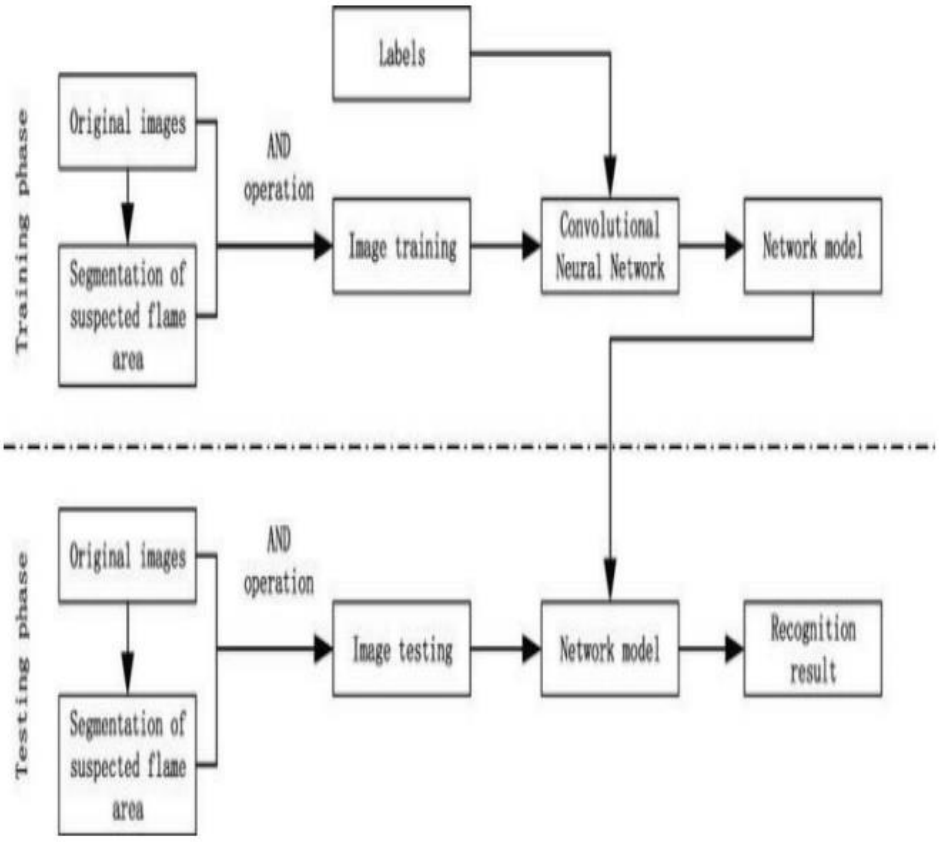
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Flow

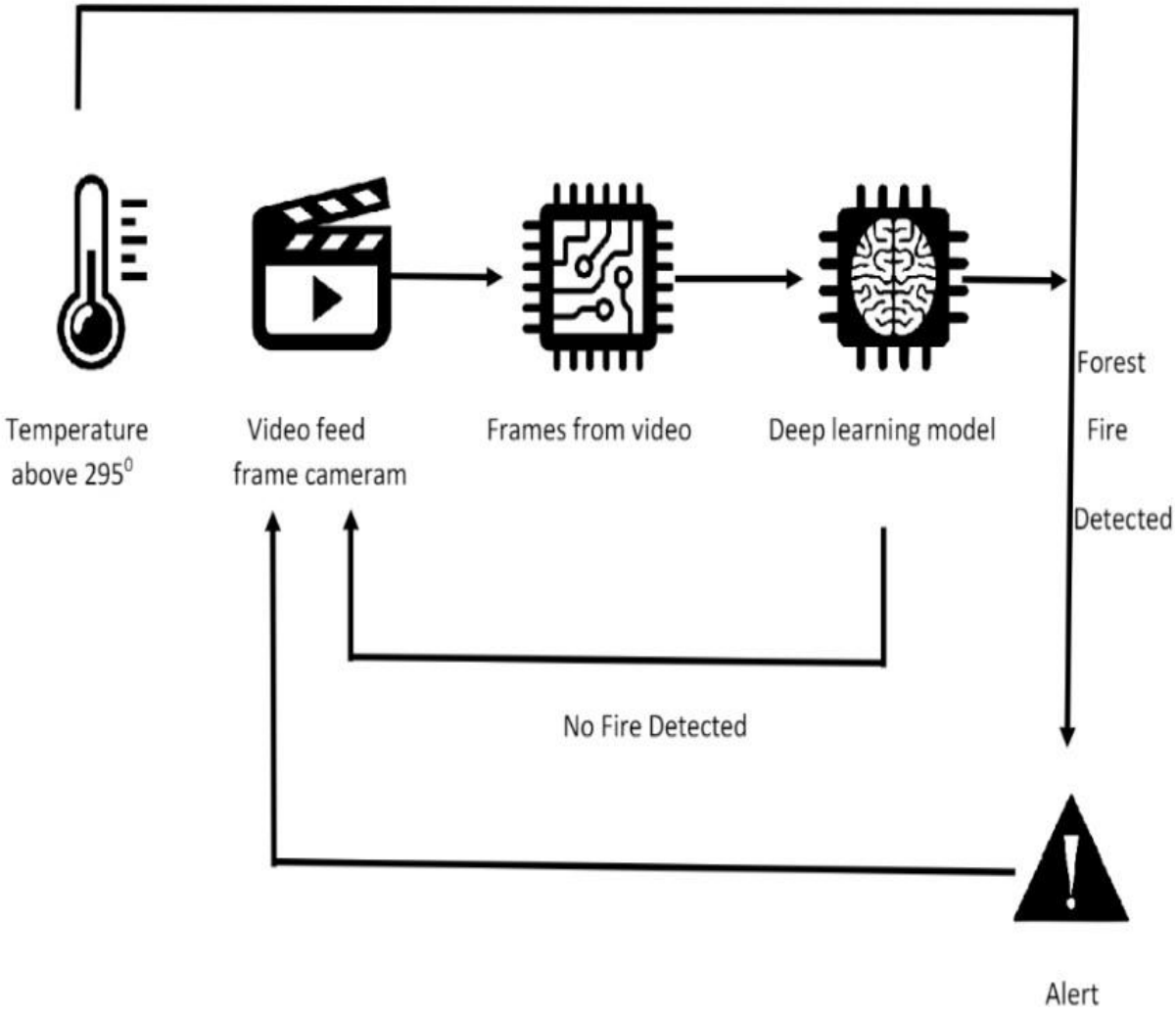


It is difficult to predict and detect Forest Fire in a sparsely populated forest area. it is more difficult if the prediction is done using ground-based methods like Camera or Video-Based approach. Satellites can be an important source of data prior to and also during the Fire due toits reliability and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

- A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system.
- A neat and clear DFD can depict the right amount of the system requirement graphically.
- It shows how data enters and leaves the system, what changes the information, and where data is stored.



Solution & Technical Architecture



Technical Architecture

Components & Technologies:

S.No	Component	Description	Technology
1	Application Logic	To detect the forest fire with the help of alarm through devices like mobile phone or physical device.	Python
2	Application Logic	To show the number of attempts are successfully detected or not	IBM Watson Assistant
3	Cloud Database	Database Service on Cloud	IBM DB2
4	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
5	External API-1	Air quality, weather, soil, Co2	getambee
6	External API-2	Purpose of External API used in the application	getambee
7	Machine Learning Model	Purpose of Machine Learning Model	Convolutional Neural Network
8	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration	Local, Cloud Foundry, Kubernetes, etc

User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story I Task	Acceptance criteria	Priority	Release
Customer officers	Data collection	USN-1	Data of the current situation in forest is to be collected	It is necessary for the data to be collected as a chance to prevent fires	High	Sprint-1
Users	Identification	USN-2	An algorithm is used to compare the changes and users to identify	It is very essential for the user to notice it before the alarm	Medium	Sprint-2
Customers	Implement Algorithm	USN-3	Identify the accuracy of each algorithms	Accuracy of each algorithm-calculated so that it is easy to obtain the most accurate output	Medium	Sprint-2
Experts	Comparison and accuracy	USN-4	Identify accuracy, Precision ,recall of each algorithms	These values are important for obtaining the right output	High	Sprint-3
Output and customer care	Displaying the output and taking necessary steps	USN-5	After compariso n the output is obtained and if positive a alert is sent	It is highly useful to predict the effect and to take precautionary measures	High	Sprint-4

PROJECT PLANNING & SCHEDULING

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Sprint	Functional Requirement (Epic)	User Story / Task	Priority	Team Members
Sprint-1	Input	Whenever the fire is detected, the information is given to the database.	High	All members
Sprint-2	Processing	When it is the wildfire then the alarming system is activated.	High	All members
Sprint-3	Output	And the alarm also sent to the corresponding departments and made them know that the wildfire is erupted	High	All members
Sprint-4	Action	Required actions will be taken in order to control erupted wildfire by reaching as early as possible to the destination with the help of detecting systems.	High	All members

Average Velocity = 4

VELOCITY: Sprint 1 - 4

Sprint duration = 20 days

Velocity of team = 80 points

$$\textbf{Average Velocity (AV)} = \frac{\text{Velocity}}{\text{Sprint duration}}$$

$$AV = 80/20 = 4$$

Total Average Velocity = 4

CODING & SOLUTIONING

(Explain the features added in the project along with code)

```
import keras

import tensorflow as tf

from tensorflow.keras.preprocessing.image import ImageDataGenerator

from tensorflow.keras.models import load_model

from tensorflow.keras.preprocessing import image

import numpy as np

import cv2

pip install twilio

pip install playsound

pip install pygobject

from google.colab.patches import cv2_imshow

from google.colab import drive

drive.mount('/content/drive')

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)

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

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

from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import Dense, Convolution2D, MaxPooling2D, Flatten
```

```
model = Sequential()

model.add(Convolution2D(32, (3,3), input_shape=(128, 128, 3), activation="relu"))

model.add(MaxPooling2D(pool_size=(2,2)))

model.add(Flatten())

model.add(Dense(150,activation="relu"))

model.add(Dense(1, activation="sigmoid"))

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

model.fit(x_train, steps_per_epoch=14, epochs=10, validation_data=x_test, validation_steps=4)

model.save('/content/drive/My Drive/ibm/fire/forest.h5')

img = image.load_img("/content/drive/MyDrive/ibm/fire/dataset/test_set/forest/abc364.jpg")

x = image.img_to_array(img)

res = cv2.resize(x, dsize=(128, 128), interpolation=cv2.INTER_CUBIC)

x = np.expand_dims(res, axis=0)

img

import cv2

import numpy as np

from tensorflow.keras.preprocessing import image

from keras.models import load_model

from twilio.rest import Client

from playsound import playsound

model=load_model(r"forest.h5")

name=['forest','with fire']
```

Feature 1:

```
cap=cv2.VideoCapture('/content/drive/MyDrive/ibm/fire/dataset/test_set/fire.mp4')


if (cap.isOpened()== False):
  print("Error opening video stream or file")



# Read until video is completed
while(cap.isOpened()):
  # Capture frame-by-frame
  success, frame = cap.read()
  if success == True:
    x=image.img_to_array(frame)
    res=cv2.resize(x,dsize=(128,128),interpolation=cv2.INTER_CUBIC)
    #expand the image shape
    x=np.expand_dims(res,axis=0)
    model=load_model("/content/drive/MyDrive/ibm/fire/forest.h5")
    cv2_imshow(frame)
    pred=model.predict(x)
    p = pred[0]
    p
    int(p)
    if p==0:
      print('Forest fire')
      break
    else:
      print("no danger")
```

```
    break

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

# Closes all the frames
cv2.destroyAllWindows()
```

Feature 2:

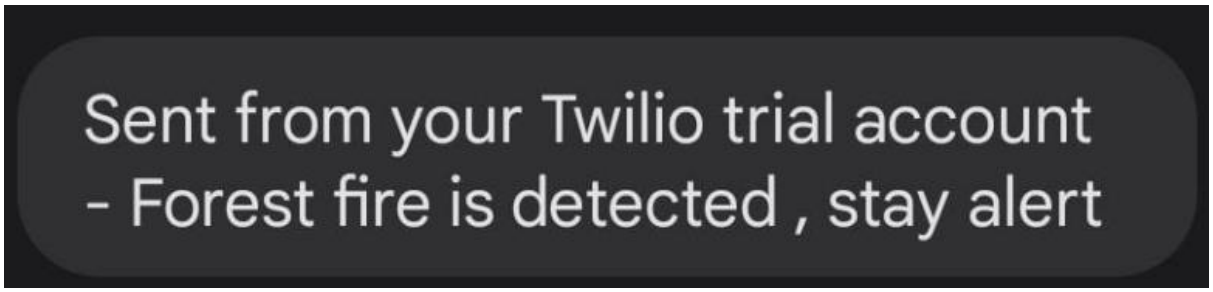
```
from twilio.rest import Client
from playsound import playsound
if p==0:
  print('Forest fire')
  account_sid='AC2562c987764917ec2ab3dd4596fb018f'
  auth_token='1dafa238a31a1a7fdf3913b7d6b09d93'
  client=Client(account_sid,auth_token)
  message=client.messages \
  .create(
     body='forest fire is detected,stay alert',
     #use twilio free number
     from_='+18583302139',
     #to number
     to='+919952802334')
  print(message.sid)
  print("Fire detected")
  print("SMS Sent!")
```

TESTING

```
1/1 [==============================] - 0s 172ms/step
no danger
```

No danger therefore no message is sent

If there is fire then



Message will be sent

User Acceptance Testing

1. This sort of testing is carried out by users, clients, or other authorised bodies to identify the requirements and operational procedures of an application or piece of software.

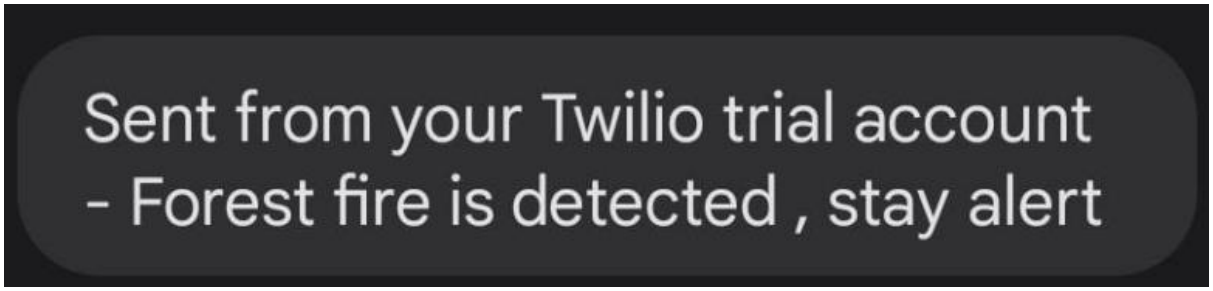
2. The most crucial stage of testing is acceptance testing since it determines whether or not the customer will accept the application or programmer.

3. It could entail the application's U.I., performance, usability, and usefulness. It is also referred to as end-user testing, operational acceptance testing, and user acceptance testing (UAT).

RESULT

Performance Metrics


```
Forest fire
SM3abc0aea655b59868d5acd8f9254a888
Fire detected
SMS Sent!
```



The above output is obtained by evaluating a video. If any infrared is detected like above then a message alert will be sent around the area for evacuating. This is possible by uploading a constant camera feed into the program

ADVANTAGES & DISADVANTAGES

Advantages:

1. It refreshes the habitat zones: Fire clears out plants and trees to make more natural resources available to the habitat. Fewer trees mean more water becomes available for the remaining plants and animals that call the area their home. New grass and shrubs are food sources for a number of animals as well. A ground cover that comes back after a fire becomes anew micro-habitat. Everything is refreshed with a fire.

2. Low-intensity fires don't usually harm trees: The bark of a tree is like an armored shell against fire, pests, and other things that could damage them. Most forest fires burn at low- temperature levels when conditions are optimal and this causes minimal damage to the trees ofthe forest when it occurs. The end result is a clearing of the ground floor of the forest while thetrees are able to continue standing majestically.

3. Decreases the Wastes on Forests: Forests have a lot of waste that ends up building up over time and these wastes can help create wildfires. If a large wildfire breaks out it might take weeks to control it and the damage it can cause is just too extensive to understand for us. Waste such as dead leaves on the ground can be pretty useful for wildfires to feed on and smallforest fires just deal with these wastes properly without going out of control.

Disadvantages:

1. A forest fire sets up the potential for soil erosion to occur: Forest fires clear the underbrush away and encourage new growth, but there is a period of time between the fire andthe new growth where the forest is vulnerable.

2. Forest fires always bring death in some form: Maybe it's just the weak plants of the forest that are killed during a fire, but there is always some sort of death that happens when afire occurs. Sometimes it is the firefighters who are tasked with stopping the fire. It could beanimals or pets.

3. Uncontrolled fires can cause localized air pollution: Despite the amount of global development that has occurred, there are many forests that are difficult or nearly impossible toreach. Fires in these areas are left to burn in an uncontrolled fashion and this creates air pollution which can affect the local environment and make it difficult to breathe.

CONCLUSION

This project will help in early detection of forest fire and the prevention. It also involves the risk factor of analysing the drone images of affected areas using machine learning algorithm which overcomes the existing project. This system detects the fire conditions in a short time before any fire accidents spreads over the forest area. The scope of using video frames in the detection of fire using machine learning is challenging as well as innovative. If this system with less error rate can be implemented at a large scale like in big factories, houses, forests, it is possible to prevent damage and loss due to random fire accidents by making use of the Surveillance System.

FUTURE SCOPE

In future with enabled feature and uses of drones and all the software we can make this into a potential design which will in future save a bunch of living beings. Adding sensor to sense the change in humidity and self-controlling fire extinguisher will save the forest even in deep where human interaction will be less. We will also include a high pitch sound system that will keep away the animals from the site of fire. The proposed system can be developed to more advanced system by integrating wireless sensors with CCTV for added protection and precision. This algorithm shows a great potential to develop into a big device in future

APPENDIX

Source Code:

```
import keras

import tensorflow as tf

from tensorflow.keras.preprocessing.image import ImageDataGenerator

from tensorflow.keras.models import load_model

from tensorflow.keras.preprocessing import image

import numpy as np

import cv2

pip install twilio

pip install playsound

pip install pygobject

from google.colab.patches import cv2_imshow

from google.colab import drive

drive.mount('/content/drive')

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)

x_train =
train_datagen.flow_from_directory('/content/drive/MyDrive/ibm/fire/dataset/tra
in_set',target_size=(128, 128),batch_size=     32,class_mode='binary')
```

```
x_test =
test_datagen.flow_from_directory('/content/drive/MyDrive/ibm/fire/dataset/test
_set',target_size=(128, 128),batch_size=32, class_mode='binary')

from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import Dense, Convolution2D, MaxPooling2D,
Flatten

model = Sequential()

model.add(Convolution2D(32, (3,3), input_shape=(128, 128, 3),
activation="relu"))

model.add(MaxPooling2D(pool_size=(2,2)))

model.add(Flatten())

model.add(Dense(150,activation="relu"))

model.add(Dense(1, activation="sigmoid"))

model.compile(loss="binary_crossentropy",optimizer="adam",metrics=["accura
cy"])

model.fit(x_train, steps_per_epoch=14, epochs=10, validation_data=x_test,
validation_steps=4)

model.save('/content/drive/My Drive/ibm/fire/forest.h5')

img =
image.load_img("/content/drive/MyDrive/ibm/fire/dataset/test_set/forest/abc36
4.jpg")

x = image.img_to_array(img)

res = cv2.resize(x, dsize=(128, 128), interpolation=cv2.INTER_CUBIC)

x = np.expand_dims(res, axis=0)

img

import cv2

import numpy as np
```

```
from tensorflow.keras.preprocessing import image
from keras.models import load_model
from twilio.rest import Client
from playsound import playsound
model=load_model(r"forest.h5")
name=['forest','with fire']
cap =
cv2.VideoCapture('/content/drive/MyDrive/ibm/fire/dataset/test_set/fire.mp4')


if (cap.isOpened()== False):
  print("Error opening video stream or file")



# Read until video is completed
while(cap.isOpened()):
  # Capture frame-by-frame
  success, frame = cap.read()
  if success == True:
    x=image.img_to_array(frame)
    res=cv2.resize(x,dsize=(128,128),interpolation=cv2.INTER_CUBIC)
    #expand the image shape
    x=np.expand_dims(res,axis=0)
    model=load_model("/content/drive/MyDrive/ibm/fire/forest.h5")
    cv2_imshow(frame)
```

```
    pred=model.predict(x)
    p = pred[0]
    p
    int(p)
    if p==0:
      print('Forest fire')
      break
    else:
      print("no danger")
      break

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

# Closes all the frames
cv2.destroyAllWindows()
from twilio.rest import Client
from playsound import playsound
if p==0:
  print('Forest fire')
  account_sid='AC2562c987764917ec2ab3dd4596fb018f'
  auth_token='1dafa238a31a1a7fdf3913b7d6b09d93'
  client=Client(account_sid,auth_token)
  message=client.messages \
```

```
  .create(
     body='forest fire is detected,stay alert',
     #use twilio free number
     from_='+18583302139',
     #to number
     to='+919952802334')
  print(message.sid)
  print("Fire detected")
  print("SMS Sent!")
```

GitHub & Project Demo Link:

GitHub- https://github.com/IBM-EPBL/IBM-Project-22708-1659856733

Project Demo Link- https://drive.google.com/file/d/18sKG2q8HMnN-dgJiXZsZL9pNvg9M-7FZ/view?usp=drivesdk