Emerging methods for early detection of forest fire detection

Team ID: PNT2022TMID48861

Mentor: Dr. T. Venish kumar

Presented by

1.Mohamed kathar mohaideen A(Leader)-(921019106022)

2.Mohamed anas A – (921019106021)

3.Hari haran S – (921019106008)

4.Jeya sheelan J – (921019106014)

5.Hemananth P – (921019106010)

CONTEXT

7. CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Feature 1

7.2 Feature 2

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

Source Code

GitHub & Project Demo Link

1.Introduction

1.1 Project Overview

ABSTRACT

The explosive growth of spatial data and extensive utilization of spatial databases emphasize the necessity for the automated discovery of spatial knowledge. In modern times, spatial data mining has emerged as an area of voluminous research. Forest fires are a chief environmental concern, causing economic and ecological damage while endangering human lives across the world. The fast or early detection of forest fires is a vital element for controlling such phenomenon. The application of remote sensing is at present a significant method for forest fires monitoring, particularly in vast and remote areas. Different methods have been presented by researchers for forest fire detection. The motivation behind this research is to obtain beneficial information from images in the forest spatial data and use the same in the determination of regions at the risk of fires by utilizing Image Processing and Artificial Intelligence techniques. This paper presents an intelligent system to detect the presence of forest fires in the forest spatial data using Artificial Neural Networks. The digital images in the forest spatial data are converted from RGB to XYZ color space and then segmented by employing anisotropic diffusion to identify the fire regions. Subsequently, Radial Basis Function Neural Network is employed in the design of the intelligent system, which is trained with the color space values of the segmented fire regions. Extensive experimental assessments on publicly available spatial data illustrated the efficiency of the proposed system in effectively detecting forest fires.

1.2 Purpose

- The forest fires destroy the wildlife habitat, damages the environment, affects the climate, spoils the biological properties of the soil, etc. So, the forest fire detection is a major issue in the present decade. At the same time the forest fire has to be detected as fast as possible.

- A fire in the workplace should be detected quickly and a warning given so that people can escape safely. Early discovery and warning will increase the time available for escape and enable people to evacuate safely before the fire takes hold and blocks escape routes or makes escape difficult.

- appliance intended to detect combustion, or the products thereof, and to activate an alarm or signal, whether audio, visual, or otherwise, including all equipment used to transmit fire alarm activations and related signals to a remote location.

2. LITERATURE SURVEY

2.1 Existing problem

In forest, there is some burnable substances and dried leaves make combustion while small fire spark this will lead to destroy the forest living things Forest fires cause lots of damage, some of them are – loss of wildlife habitat, extinction of plants and animals, destroys the nutrient rich top soil, reduction in forest cover, loss of valuable timber resources, ozone layer depletion, loss of livelihood for tribal people and poor people, increase in global warming, increase in carbon dioxide content in the atmosphere, degradation of catchment areas, loss of biodiversity, increase in diseases etc.

- loss of valuable timber resources
- degradation of catchment areas
- loss of biodiversity and extinction of plants and animals
- loss of wildlife habitat and depletion of wildlife
- loss of natural regeneration and reduction in forest cover
- global warming
- loss of carbon sink resource and increase in percentage of CO2 in atmosphere
- change in the microclimate of the area with unhealthy living conditions
- soil erosion affecting productivity of soils and production
- ozone layer depletion

- health problems leading to diseases

2.2 References

1. Detection and Monitoring of Forest Fire with a Wireless Sensor Network System," in Procedia Engineering 5,2010, pp. 248 251.

2. Zhang, D., et al. Image based forest fire detection using dynamic characteristics with artificial neural networks. in Artificial Intelligence, 2009. JCAI'09. International Joint Conference on. 2009. IEEE.

3. Chowdary, V. and M.K. Gupta, Automatic Forest Fire Detection and Monitoring Techniques: A Survey, in Intelligent Communication, Control and Devices2018, Springer. p. 1111-1117

2.3 Problem Statement Definition

- In forest, due to friction of trees there occur forest fire in summer and autumn and before happening forest fire we want emerging system to get quick information for taking action to avoid forest fire as soon as possible.

- In autumn season, the fire is spread one tree to another by touching their branches.

- Make the receiver get information easily.

- Convenient to any environmental situations

- The system will process accurately

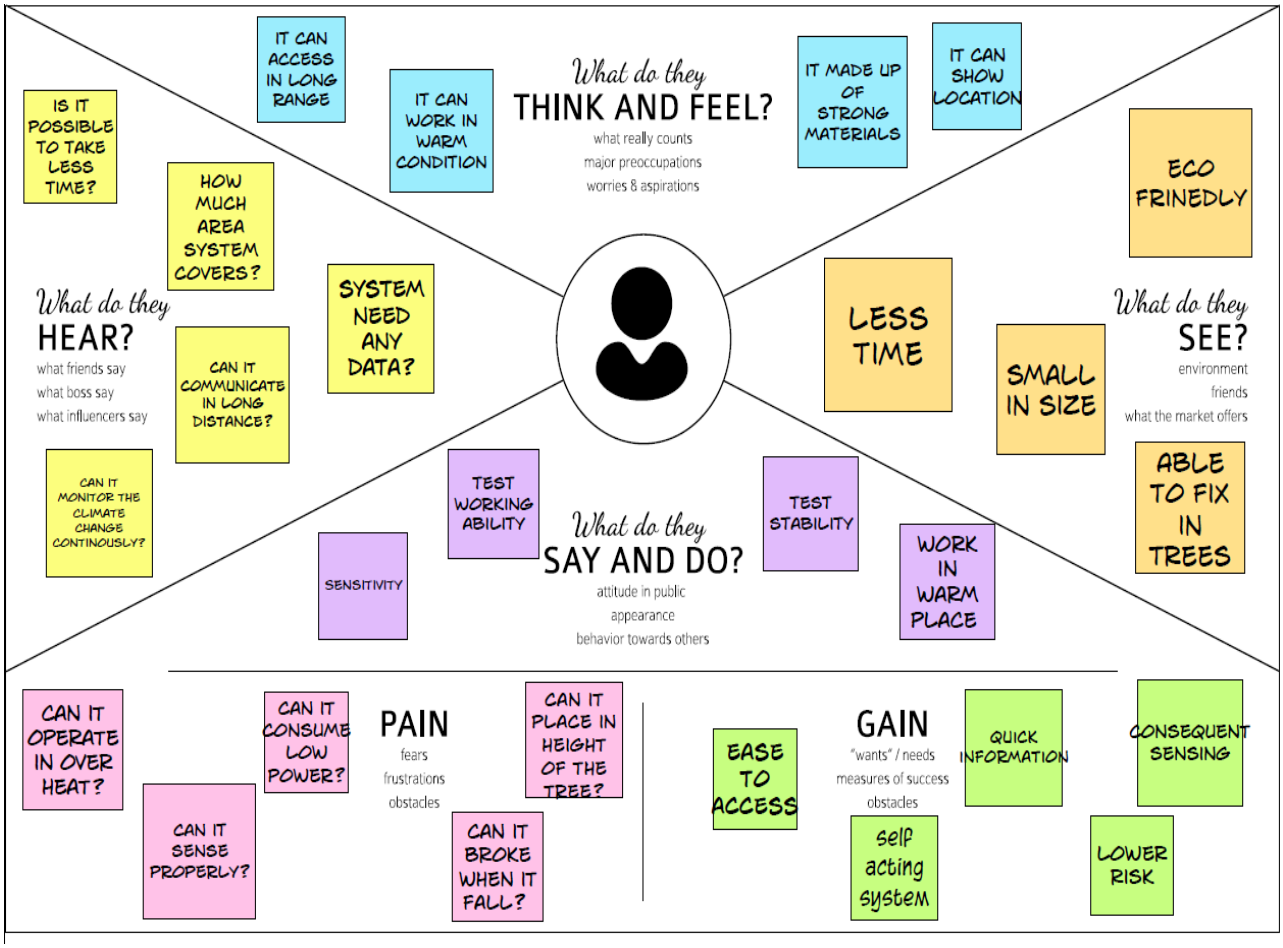
- It can provide information at any time

- It reduces the deep monitoring

- It must consume low power

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

In forest, due to friction of trees there occur forest fire in summer and autumn and before happening forest fire we want emerging system to get quick information for taking action to avoid forest fire as soon as possible.
In autumn season, the fire is spread one tree to another by touching their branches.

Key rules of brainstorming

To run an smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

2 Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

HEMANANTH P

contribution to the Forest Fire Fighting strategy, providing critical data to improve their safety and efficiency

early detection of Forest Fires, alarm management, and real time reporting about the Fire evolutio

MOHAMMAD ANAS A

The various real-time Forest fire detection and prediction approaches, with the goal of informing the local Fire authorities.

search messages; search for an initial node link

A "deploy and forget" policy. Nodes will not need any kind of maintenance or battery recharging

MOHAMMAD KATHAR MOHAIDEEN A

An efficient and robust 3P modeling is used to augment the accuracy of the detection.

Usage of the satellite images to observe, detect, and report fire events

specific data messages, messages containing sensor data in response to a higher level node request

New requirements in the ecological environment arise due to the expeditious development of society.

JEYASHEELAN J

Continuous information about the status of the Forest could not be obtained due to the restrictions in the monitoring of Forests

Collisions are avoided, and the obstacles such as birds, trees, poles, and so on in the Forest Farms are detected

HARIHARAN S

There is no need for the exposure of humans to perilous activities when remote sensing is deployed

Implementation of the wireless sensor networks to observe the fire events exist in all areas

Advanced features such as pathway planning and depth deployment are included and play a crucial role in autonomous navigation

Weather might not be stable in all situations as it might vary, and thus, it results in the collection of noisy images

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.

20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

Image recognition:

Observation subsystem consists of a network of sensor stations and a central station that are interconnected by telecommunications network

Sensory stations transfer the data from the cameras to the central station for further analysis. The operator in the command operations center checks the signal obtained from thermal (infrared)

Frames from video:

The fire detect by red color than normal color of yellow and green condition

one fire region can slowly break into several small parts, or the small fires can burn into one region, matching algorithm has the ability to detect such changes.

Deep learning model:

Presenting a framework for active fire detection based on deep learning called active-fire-net (fire-Net)

High efficiency against detection of small fires using freely available data

Accurate and automatic detection of active fires with the potential of being applied as real time

Alert:

The web application can be accessed on the computers of all emergency offices. The information of the fire in the forest and the fire accident can be accessed from this application.

This application will also be connected to the database of the Forest PC. There will be information regarding temperature in the form of a graph

4 Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	**Problem Statement:** • Trees want protection • Living this are destroyed by this hazard **Problem solving**: • we produce consequent monitoring in automation • we can provide quick information before the forest fire occur
2.	Idea / Solution description	**Idea:** • Image Recognition **Solution description:** • It will store actual image on database • When the image is varied as different image • It will send the information to central gateway
3.	Novelty / Uniqueness	**Novelty:** • It can access any condition • Low data rate and minimum power consumption
4.	Social Impact / Customer Satisfaction	**Social impact:** • The information reached to base station before forest fire occur the people can know the location to be hazard happen. **Customer satisfaction:** • It is not only used in forest • It can suitable to use in Shabdkosh (land and gardens) • Customer can protect their Tree lands and Gross lands
5.	Business Model (Revenue Model)	**Business Model:** • Business to Consumer (B2C) model
6.	Scalability of the Solution	**Scalability of the Solution:** • Intermediate cost • Communication equipment's

3.4 Problem Solution fit

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

- Our Project mainly useful for forest presiders
- Owners of group of plants and tress flats

6. CUSTOMER CONSTRAINTS CC

- Low cost
- Low power consumption
- Low data requirement

5. AVAILABLE SOLUTIONS AS

- It will able to calculate and measure multiple parameters (Temperature, Humidity, etc.)
- It will process in any situation

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

- It can place in anywhere to access in any distance
- Information rate is constant

9. PROBLEM ROOT CAUSE RC

In forest, due to friction of trees there occur forest fire in summer and autumn and before happening forest fire we want emerging system to get quick information for taking action to avoid forest fire as soon as possible.

7. BEHAVIOUR BE

- It's working depends on climate changes and heat.
- It will measure parameters continuously
- When the changes in parameters the deviating reading will send as alert to base station

Focus on J&P, tap into BE, understand RC

3. TRIGGERS TR

- It has more efficiency lifetime use
- Secured information.
- Public reach is easy

4. EMOTIONS: BEFORE / AFTER EM

- No need to feel about inconvenience
- It can reach its power
- Work in heat condition

10. YOUR SOLUTION SL

- Fire detection in forest is hard, when a person monitor forest continuously is impossible
- So only we introduce that in automation the device can monitor the forest time to be set.
- No need too much power

8. CHANNELS of BEHAVIOUR CH

- Customers can buy the equipment's through online by amazon.
- They can visit website and submit their quarries that will be solved more as possible.

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Image recognition	The system shall be able to take real inputs of satellites images and determine whether image contains fire or not.
FR-4	Forest Monitoring	Forest is monitored 24/7 through
FR-5	Alert	The system will send notification to the user when fire is detected
FR-6	Detection	The system shall take training sets of fire and checks for fire or no fire or smoke
FR-7	Operating system	The system can run as a service on Windows or Linux operating system.

4.2 Non-Functional requirements

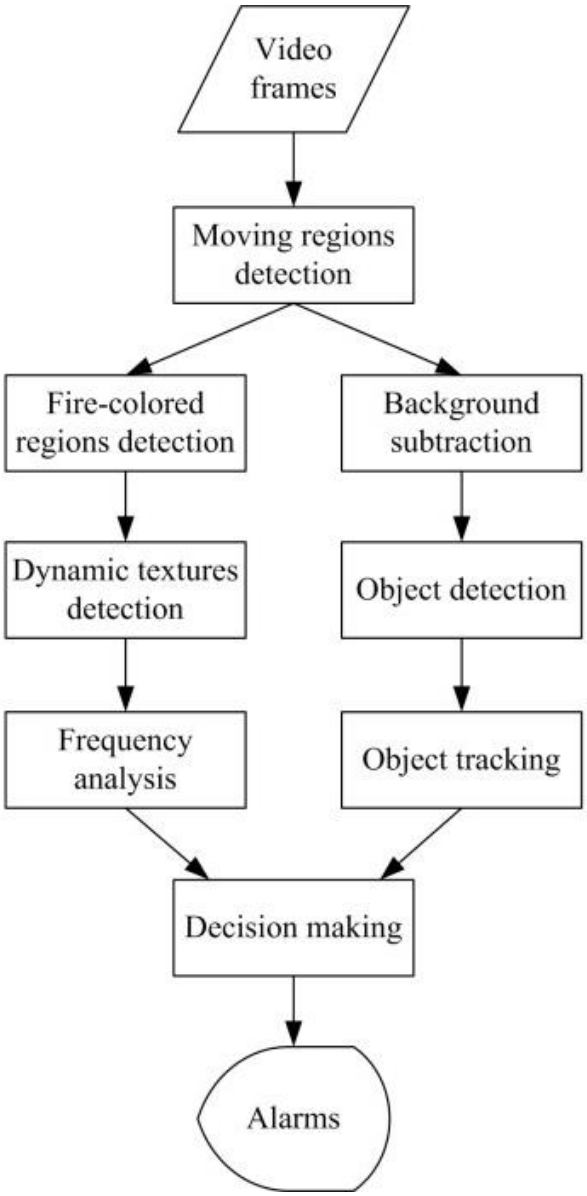
Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Model is user friendly to use and very effective.
NFR-2	**Security**	More secure environment
NFR-3	**Reliability**	Model is safe to install
NFR-4	**Performance**	Model will achieve high accuracy
NFR-5	**Availability**	Build model is available in all the time
NFR-6	**Scalability**	Model can handle large amount of data and can easily adapt to every environment.
NFR-7	**Testability**	Putting in more training data into the model can improve the accuracy level of the system.

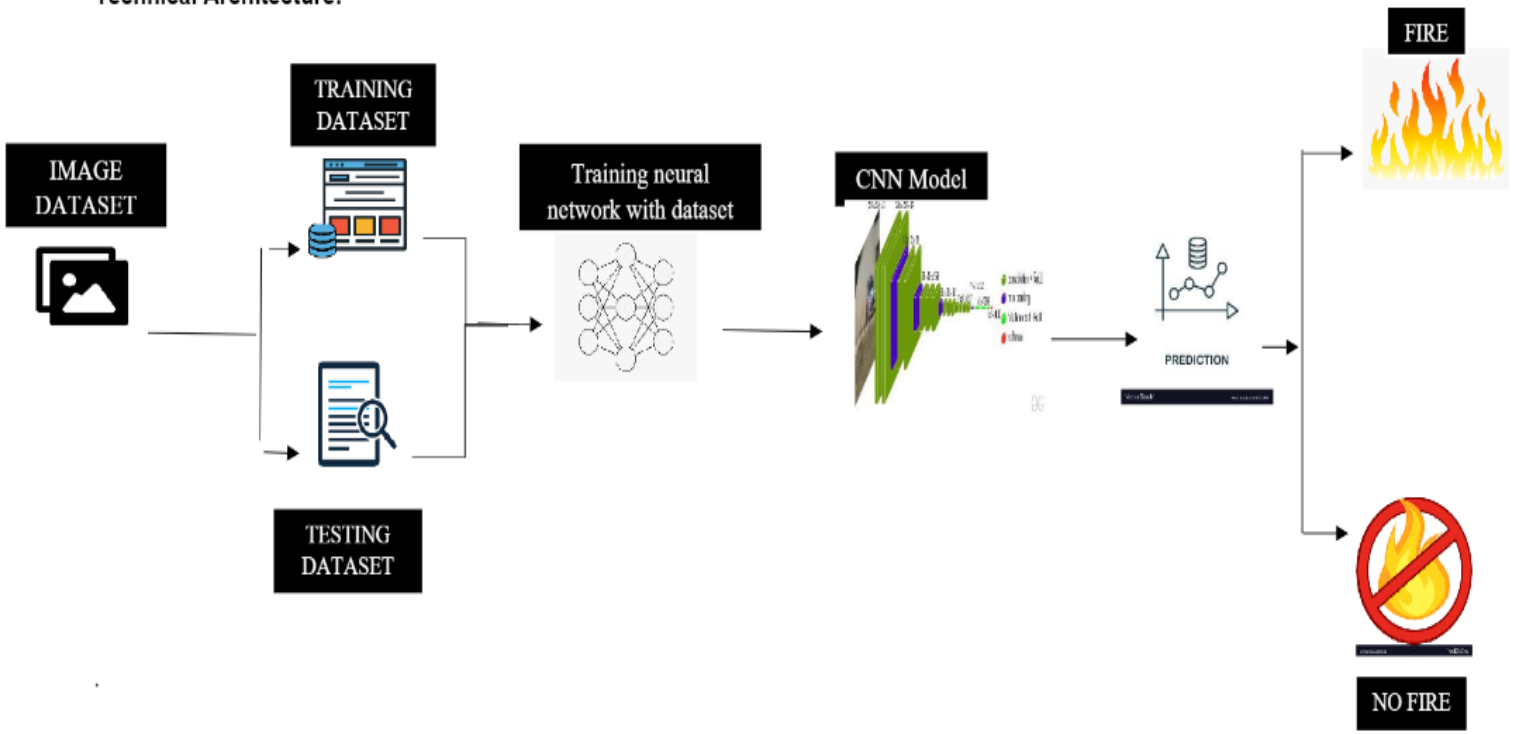
5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture

Technical Architecture:



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release

Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint1-DATA COLLECTION:

Collect the dataset or create the dataset.

- Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes.
- The data collection component of research is common to all fields of study including physical and social sciences, humanities, business, etc. While methods vary by discipline, the emphasis on ensuring accurate and honest collection remains the same.
- The importance of ensuring accurate and appropriate data collection Regardless of the field of study or preference for defining data (quantitative, qualitative), accurate data collection is essential to maintaining the integrity of research.
- Both the selection of appropriate data collection instruments (existing, modified, or newly developed) and clearly delineated instructions for them correct use reduces the likelihood of errors occurring.

Sprint2-IMAGE PREPROCESSING:

- Pre-processing is a common name for operations with images at the lowest level of abstraction — both input and output are intensity images.
- These iconic images are of the same kind as the original data captured by the sensor, with an intensity image usually represented by a matrix of image function values (brightness).
- The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformations of images (e.g., rotation, scaling, translation) are classified among pre-processing methods here since similar techniques are used.
- Import Image Data Generator Library.
- Define the parameters /arguments for Image Data Generator class.
- Applying Image Data Generator on trainset and test set.

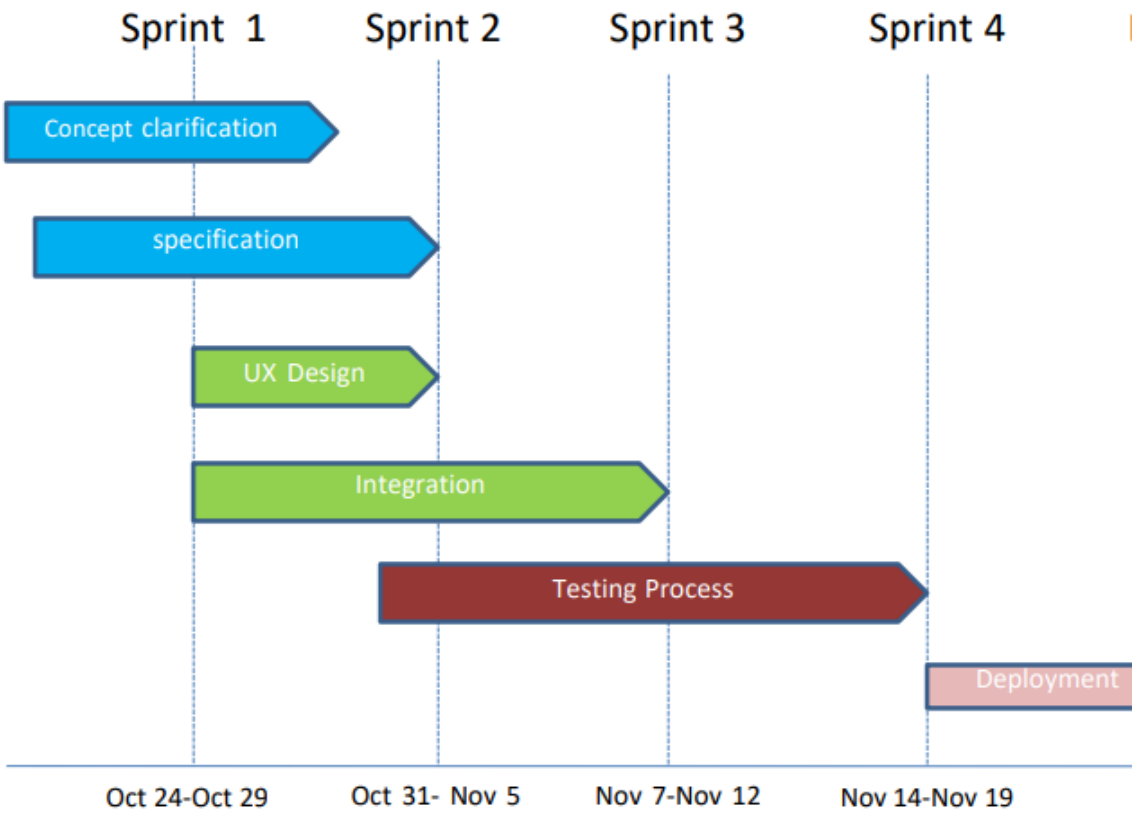
Sprint3-MODEL BUILDING:

- Project Modeling is an entirely new approach to the sales and initiation phase of a project.
- It allows you to develop more accurate plans in less time, accelerate the sales process, and ultimately, drive better outcomes for your customers.
- Project Modeling creates a streamlined planning and estimating process that enables project-based companies to scale and automate best practices from project sales through execution.
- Import the model building Libraries
- Initializing the model
- Adding CNN Layers
- Adding Hidden Layer
- Adding Output Layer
- Configure the Learning Process
- Training and testing the model
- Optimize the Model
- Save the Model

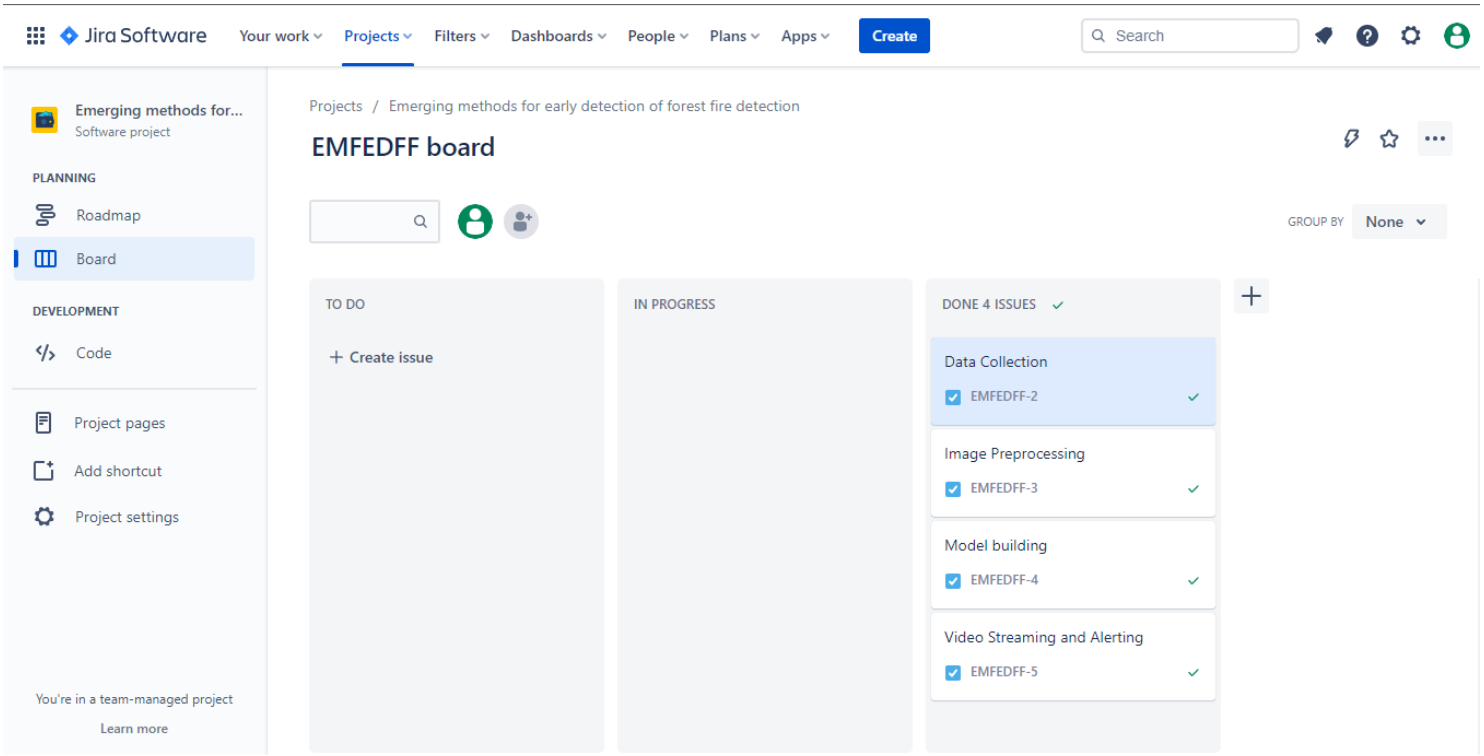
Sprint4-VIDEO STREAMING AND ALERTING:

- OpenCV for video processing
- Creating an account in Twilio service
- Use Twilio API to send messages.

6.2 Sprint Delivery Schedule



6.3 Reports from JIRA



7. CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Feature 1

APP.py

```
import os
import cv2         # Library for OpenCV
import threading   # Library for threading -- which allows code to run
in backend
import playsound   # Library for alarm sound
import twilio     # Library for SMS sending
from twilio.rest import Client
import keys
import time
from flask import Flask,request, render_template, redirect
fire_cascade =
cv2.CascadeClassifier('fire_detection_cascade_model.xml') # To access
xml file which includes positive and negative images of fire. (Trained
images)

def play_alarm_sound_function():
    play_alarm_sound_function =
playsound.playsound('C://Users//lucky//buttonpython//buttonpython//alar
m-sound.mp3',True)
    print("Fire alarm end")

app = Flask(__name__)

@app.route('/')
def base():
    return render_template('index.html')

@app.route('/result')
def result():
# File is also provided with the code.
    vid = cv2.VideoCapture('HD Slow Motion Fire(1080P_HD)') # To start
camera this command is used "0" for laptop inbuilt camera and "1" for
USB attahed camera
    runOnce = False # created boolean
    while(True):
        Alarm_Status = False
        ret, frame = vid.read() # Value in ret is True # To read video
frame
        gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY) # To convert
frame into gray color
        fire = fire_cascade.detectMultiScale(frame, 1.2, 5)
         # to provide frame resolution

        ## to highlight fire with square
        for (x,y,w,h) in fire:
            cv2.rectangle(frame,(x-20,y-
20),(x+w+20,y+h+20),(255,0,0),2)
            roi_gray = gray[y:y+h, x:x+w]
            roi_color = frame[y:y+h, x:x+w]

            if runOnce == False:
```

```
                print("Fire alarm initiated")

threading.Thread(target=play_alarm_sound_function).start()  # To call
alarm thread
                runOnce = True
            if runOnce == True:
                print("Alarm is on")
                runOnce = True
            if runOnce == True:
                print("Fire is detected")
                runOnce = True
            if runOnce == True:
                print("SMS is already sent once")
                runOnce = True
            if runOnce == True:
                    client= Client(keys.account_sid, keys.auth_token)
                    messages = client.messages.create(
                        body = "Fire Deteced,ALERT!!!",
                        from_= keys.twilio_number,
                        to = keys.my_phone_number
                        )
                    print(messages.body)

        cv2.imshow('frame',frame)
        if cv2.waitKey(1) & 0xFF == ord('q'):
                return render_template('index.html', pred = "The demo
has started running!!! Plz check the background")
                exit()
if __name__ == "__main__":
    app.run(debug=True)
```

7.2 Feature 2

Keys.py

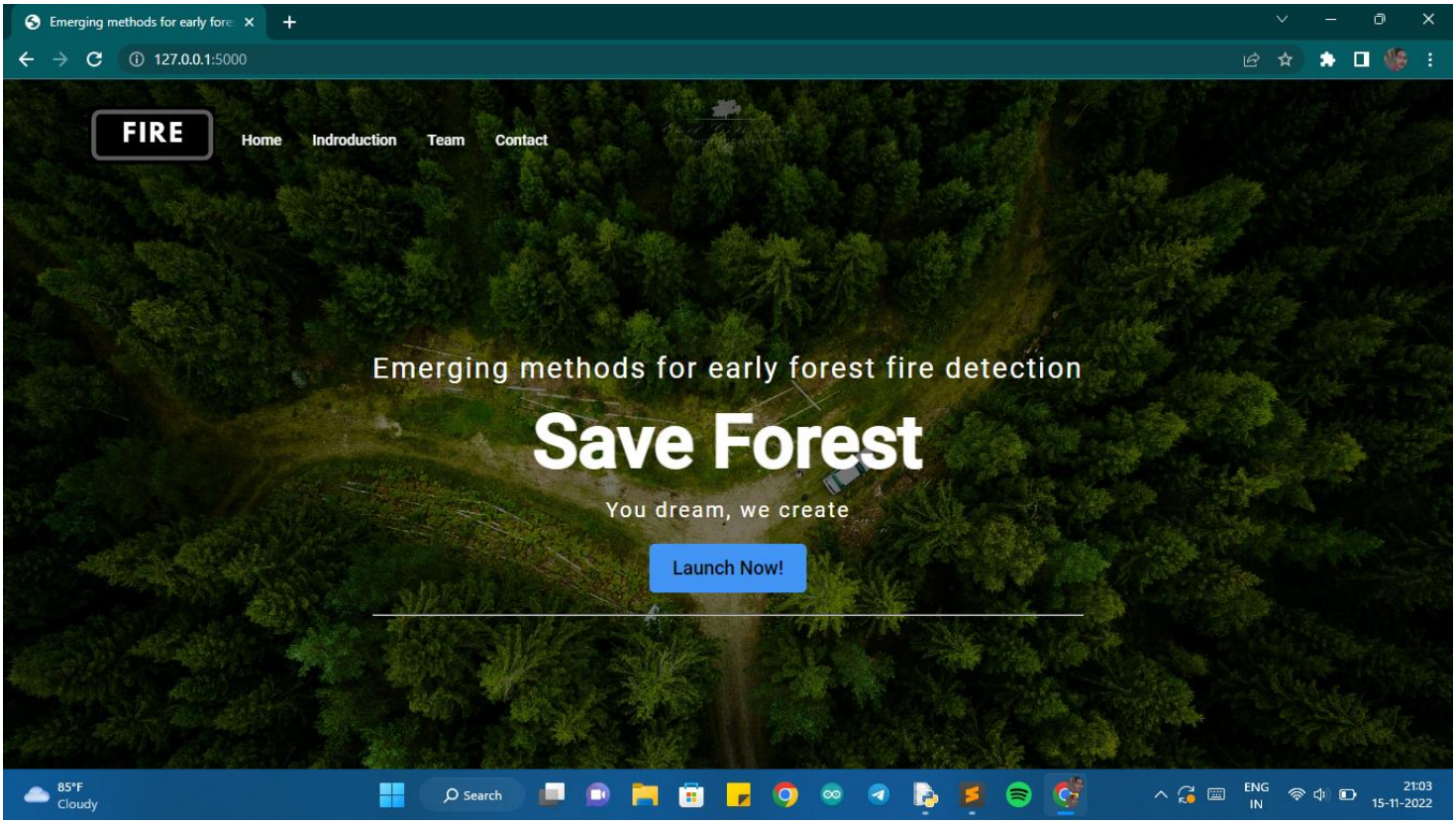
```
from twilio.rest import Client

import keys




account_sid ='ACbd3378ff1edd53401b372051bc646e39'


auth_token =' 8d9420b9790810c70493dd00ea1ef74f'


twilio_number ='+17262274505'


my_phone_number =' +447893920177 '
```

8. TESTING

8.1 Test Cases

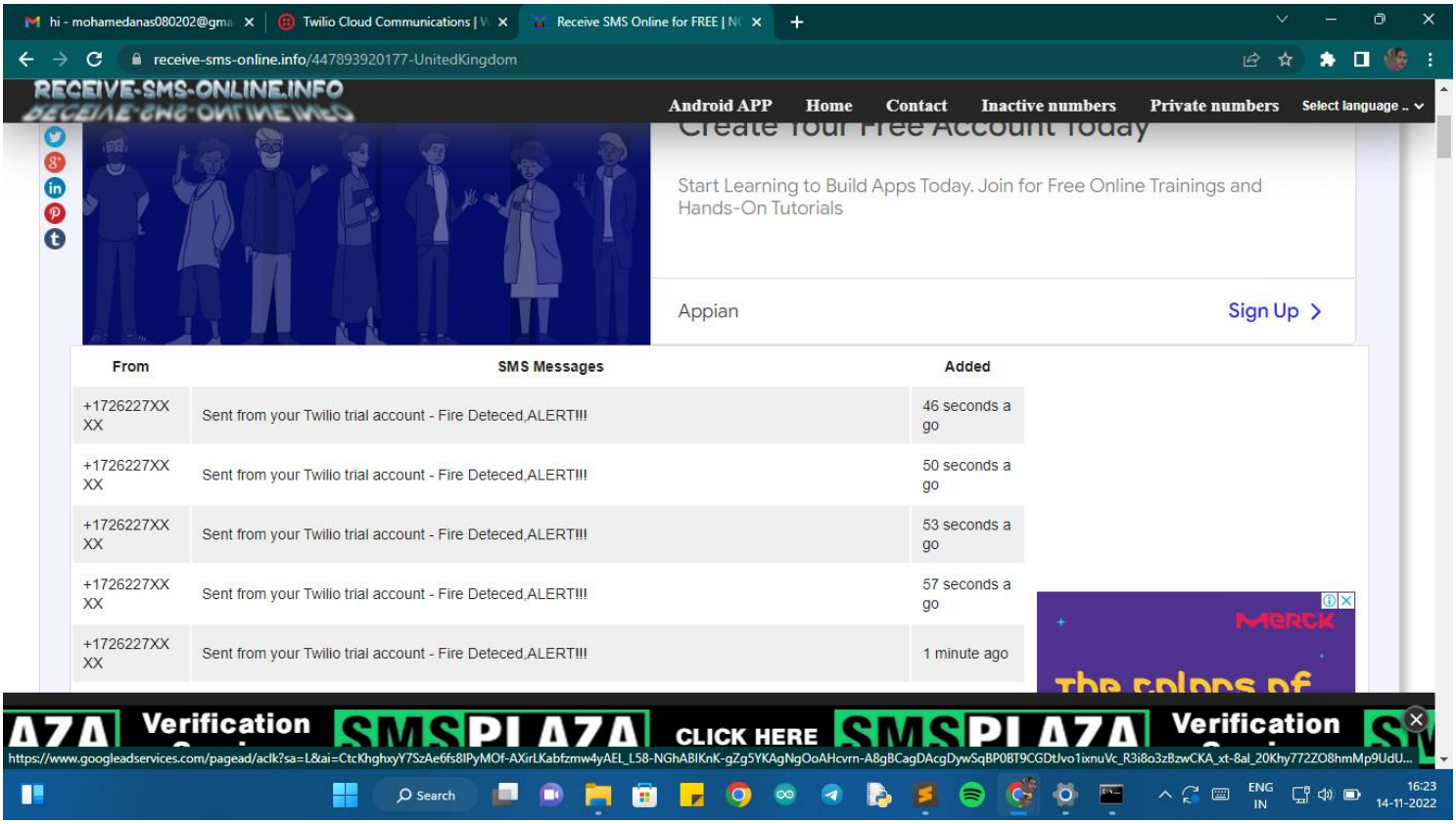
Motivation for analyzing the forest fires early detection and prevention systems are the positive aspects of one such system present in a country. The existence of such a system requires certain conditions to be fulfilled. First, there have to be a good coverage of automated measuring stations, suitable for obtaining meteorological data on the territory that is aimed at protection. Then an access to the data from the satellites is required to calculate the designated parameters. Additionally, detection system in the area is needed, consisted of a combined set of cameras, sensors and extended with a crowd-sourcing modules, such as citizens' smart phones. All of these real time data should be merged with the static data (vegetation map, demographic maps, orthophoto maps, etc.) into one integrated system. The system should give all necessary items required for early warning and prevention of forest fires. Fig. 1 shows a general architecture of a Forest Fire System, with a server-side computational unit, data providers and users

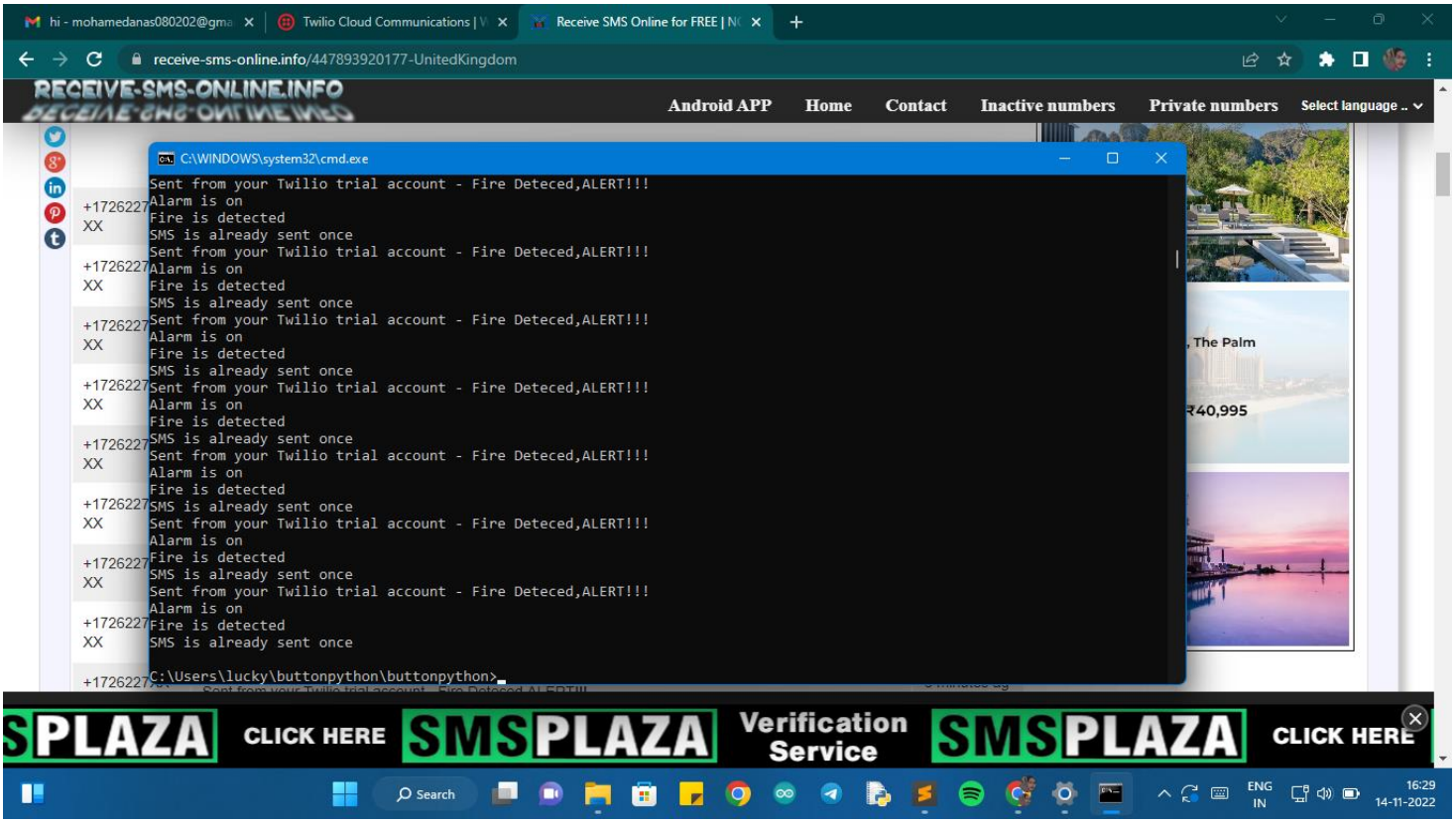
8.2 User Acceptance Testing



9. RESULTS

9.1 Performance Metrics





10. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Database not required
- Easy to use
- Detects fire and gives immediate results
- Gives alerts through SMS
- Friendly user interface

DISADVANTAGES:

- It is an software based prototype
- Placed in Fixed location
- Discovering area is low in range

11. CONCLUSION

A real-time and reliable fire detection method for an early warning system is required so that an immediate response to an incident can be made effective. In this study, methods based on color probabilities and motion features were successfully implemented to achieve this goal. The proposed method exploits the characteristics of the color of fire by developing a probability model using a multiple Gaussian. On the other hand, other fire characteristics, namely, dynamic fire movement modeled with motion features based on moment invariants, were also applied. The experiment found that the processing time required on average reached 21.70 FPS with a relatively high true positive rate of 89.92%. These results indicate that the proposed method is suitable for a real-time early warning system. Nonetheless, one of the greatest challenges in implementing the module is physically installing the camera, which may be very difficult.

12. FUTURE SCOPE

- To avoid more implementation and reproduction of hardware components
- In this case we don’t need require any hardware components software can predict correct state of certain area
- To limit the damage caused by forest fires and to control the start of
- fires and its spread, we have presented in this study a method of early detection of forest fires. This method is based on three steps: Estimate the
- general risk level of the forest, assess and predict in several places the
- existence or not of fires, and alert the necessary first responders to quell
- the spread of the fires.

13. APPENDIX

1. Summary of Functional Requirements:

The goal is to implement a fixed land-based early forest fire detection system capable of detecting forest fire within a few seconds with range of at least 200 feet. Warning would be issued wirelessly upon detection of a fire. The whole system needs to be powered from a for automatic monitoring all day long. The whole unit needs to be enclosed in a casing to prevent damage to the camera and electronics in case of hazardous environmental conditions. Lon wave Infrared camera would be used as preliminary steps to help us detect the fire in different environments and at different times of a day. The warning would be issued based on fire detection to alert the fire department beforehand.

2. Primary Constraints:

Significant challenges included implementing automatic frame grabbing software and complex algorithm to accurately detect fire. The range of detection depends on the fire size, and once the warning is sent the time to receive the email depends on the internet connection of the user, which sometimes might add up to a minute or even more, which is enough for the fire to grow. Another big constraint was the short amount of time to complete the project, since there is so much potential to make it better.

3. Economic:

This project can potentially reduce fire damage in terms of money and property. It could help save government millions of dollars because fire in early stage can be easily contained and the property damage would be lot smaller. Also, the fire causes lot of damage to the natural habitat, like trees, animals living in the area. All this can be reduced with an early fire detection system. The initial cost of the project is the infrared cameras, which cost up to couple thousand dollars.

4. Environmental:
Preventing forest fire through small fire detection is the biggest environmental impact associated
with the use of this project. This project uses forest ecosystems directly while sweeping the forest
area with a thermal camera looking for signs of early fire. We specifically aim to preserve all the
forest ecosystems which provide natural resources such as wood, many plant products such as
fruits, nuts, latex for rubber etc. Forests also help in cleaning air and preventing floods which indeed
adds to the welfare of human beings.

5. Manufacturability
The system is manually put together as a prototype and if we happen to mass produce it, additional
labor costs would add up. A detailed cost analysis including case studies would be done, to
determine a cheapest way to get parts in bulk to do a successful business. Intuitively, the cost per bulk

6. Ethical:

The project is design to help save lives and reduce the damaged caused by the fire. The system
detects early signs of fire; therefore, there is no way to misuse of this product.

7. Health and Safety:

Since the camera will be installed on a tower, the biggest safety concern would be the camera falling
and hitting someone on the ground when in the field working. Since the system is mostly
automated, there aren't any health concerns in terms of using the product.

8. Social and Political:

The political and social issue associated with the project is that forest fire every year does millions
and millions in damage to property, and destroys the habitat for many animals. Therefore, if us
system can detect even 20% of the fires before it gets out of hand, then we can save many lives and
homes. The project directly impacts the firefighters, people living in dry forest areas, and the
government; because it can alert the firefighters early enough, who can then alert the near
residences, and also save government money if the fires can be controlled in its early stages.
the taxes, the money that government spends on the fires also goes from our pocket. This project

will benefit everybody because it will help save lives, and save natural resources.

10. Development:

This project teaches about the infrared camera technology and how efficiently it can be used to detect objects at distances. For a real-life implementation of this product, cooled infrared cameras would do a more accurate job with higher consistency as the camera response would not change much due to temperature. Using a more sophisticated algorithm along with the telescope and some kind of rotation mechanism for monitoring all around would turn this system into a real-life product.

Source Code :

```
import cv2         # Library for openCV
import threading   # Library for threading -- which allows code to run in backend
import playsound   # Library for alarm sound
import twilio     # Library for SMS sending
from twilio.rest import Client

fire_cascade = cv2.CascadeClassifier('fire_detection_cascade_model.xml') # To
access xml file which includes positive and negative images of fire. (Trained
images)
                                                                          # File is
also provided with the code.

vid = cv2.VideoCapture('fire.mp4') # To start camera this command is used "0" for
laptop inbuilt camera and "1" for USB attahed camera
runOnce = False # created boolean

def keys():
    keys = keys(keys.account_sid, keys.auth_token)

def play_alarm_sound_function(): # defined function to play alarm post fire
detection using threading
    playsound.playsound('alarm-sound.mp3',True) # to play alarm # mp3 audio file is
also provided with the code.
    print("Fire alarm end") # to print in console

while(True):
    Alarm_Status = False
    ret, frame = vid.read() # Value in ret is True # To read video frame
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY) # To convert frame into gray
color
    fire = fire_cascade.detectMultiScale(frame, 1.2, 5) # to provide frame
resolution

    ## to highlight fire with square
    for (x,y,w,h) in fire:
        cv2.rectangle(frame,(x-20,y-20),(x+w+20,y+h+20),(255,0,0),2)
        roi_gray = gray[y:y+h, x:x+w]
        roi_color = frame[y:y+h, x:x+w]

        if runOnce == False:
            print("Fire alarm initiated")
            threading.Thread(target=play_alarm_sound_function).start()  # To call
alarm thread
            runOnce = True
        if runOnce == True:
            print("Alarm is on")
            runOnce = True
        if runOnce == True:
            print("Fire is detected")
            runOnce = True
        if runOnce == True:
            print("SMS is already sent once")
            runOnce = True
        if runOnce == True:
            client = Client(keys.account_sid, keys.auth_token)
            messages = client.messages.create(
                body = "Fire Deteced,ALERT!!!",
                from_= keys.twilio_number,
                to = keys.my_phone_number
                )
            print(messages.body)

    cv2.imshow('frame', frame)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break
```

GitHub link:

https://github.com/IBM-EPBL/IBM-Project-35456-1660284926

Demo link:

https://drive.google.com/file/d/1NZOpvoMAY75iiCLzsPCiIVqL0cWlCTwm/view?usp=drivesdk

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