EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRE

Submitted by

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CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

Machine learning and deep learning play an important role in computer technology and artificial intelligence. With the use of deep learning and machine learning, human effort can be reduced in recognizing, learning, predictions and in many more areas.

Forest fire detection is the ability of computer systems to recognise Fire from various region of forest , such as fire, smoke, and so on. This project aims to let users take advantage of machine learning to reduce manual tasks in Detecting the forest fire.

1.2 PURPOSE

The main aim of our project is detection and monitoring the forest fire To minimize the effect of fire breakout by controlling in its early stage also to protect Domestic by informing about the breakout to the respective forest department as early as possible . We have implemented the IOT technology to achieve our objective.

Chapter 2

LITERATURE SURVEY

2.1 EXISTING SOLUTIONS

There are many existing solutions deployed for this use case.

A. IQ Firewatch

- IQ Firewatch is a multi-spectral sensor able to process data in chronological synchronicity, which means it can be perfectly calibrated for all regions, vegetation as well as for all operating and weather conditions.
- The system is also unique in its software, due to the combination of the classic feature-based approach, which has been delivering very good results for years, and the newly introduced approach of Artificial Intelligence in smoke detection.

B. ALERT Wildfire

- ALERT Wildfire is a consortium of three universities – The University of Nevada, Reno (UNR), University of California San Diego (UCSD), and the University of Oregon (UO) – providing access to state-of-the-art Pan-Tilt-Zoom (PTZ) fire cameras and associated tools to help firefighters and first responders:
  1. *discover/locate/confirm fire ignition*
  2. *quickly scale fire resources up or down appropriately*
  3. *monitor fire behavior through containment*
  4. *during firestorms, help evacuations through enhanced situational awareness, and*
  5. *ensure contained fires are monitored appropriately through their demise.*

2.2 REFERENCES

- Forest-Fire Response System Using Deep-Learning-Based Approaches With CCTV and Weather Data
  - Using Popular Object Detection Methods for Real Time Forest Fire Detection

EXISTING PRODUCTS

- FireTIR Early Fire Detection System- https://visiontir.com/forest-fire-detection/
- SmokeD- https://smokedsystem.com/

2.3 PROBLEM STATEMENT :

The most common hazard in forests is forests fire. Forests fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark. The Himalayan forests, particularly, Garhwal Himalayas have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region.

Forest fires are increased due to deforestation and global warming. Many trees and animals in the forest are affected by forest fires. Technology can be efficiently utilized to solve this problem. Forest fire detection is inevitable for forest fire management.

Customer Problem Statement

I am	IBM
I'm trying to	Detection of Forest fire
but	People are using sensors to detect the fire but this is not case for large acres of forest
because	Forest area cover large acres of land so it is not easy to find the fire easily
which makes me feel	Stress, Helplessness, frustration

EFFECT OF FOREST FIRE

Fires are a major cause of forest degradation and have wide ranging adverse ecological, economic and social impacts, including:

- 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

- loss of carbon sink resource and increase in percentage of CO_2 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

CAUSES OF FOREST FIRE

Forest fires are caused by Natural causes as well as Man-made causes.

- Natural causes- Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start.
- Man made causes- Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material.

Traditionally Indian forests have been affected by fires. The menace has been aggravated with rising human and cattle population and the consequent increase in demand for Forest products by individuals and communities. Causes of forest fires can be divided into two broad categories: environmental (which are beyond control) and human related (which are controllable).

Environmental causes are largely related to climatic conditions such as temperature, wind speed and direction, level of moisture in soil and atmosphere and duration of dry spells. Other natural causes are the friction of bamboos swaying due to high wind velocity and rolling stones that result in sparks setting off fires in highly inflammable leaf litter on the forest floor.

Vulnerability :

The youngest mountain ranges of Himalayas are the most vulnerable stretches of the world susceptible to forest fires. The forests of Western are more frequently vulnerable to forest fires as compared to those in Eastern Himalayas. This is because forests of Eastern Himalayas grow in high rain density. With

large scale expansion of chirr (Pine) forests in many areas of the Himalayas the frequency and intensity of forest fires has increased.

Chapter 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP

3.2 BRAINSTORMING:

List of ideas:-

- To save past forest fire data for future prediction.
- Frames will be fed through neural net. On positive detection of fire metrics are extracted. Ignore smoke for MVP. Try various architectures & parameters to establish a 'good' baseline model.
- Yolo present both options, yolo4 lite for mobile and yolo5 for GPU.
- Alternatively, there is mobile net and tf-object-detection-api.
- Custom Object detection using YOLOv3 on the cloud. It is trained to detect Fire in a givenframe. It can be largely used for Wildfires, fire accidents, etc.
- dataset collected by scraping Google images (provides link to dataset with 1315 fire images), binary Fire/Non-fire classification with tf2 & keras sequential CNN, achieve 92%accuracy, concludes that better datasets are required
- Aerial Imagery dataset for fire detection: classification and segmentation using Unmanned Aerial Vehicle (UAV) - binary classifier
- Convolutional neural network model based on the architecture of the Faster-RCNN forwildfire smoke detection
- Training fast.ai model and deploying via gradio app
- perform forest fire recognition on UAV using ResNet50 and EfficientNetB7

Top 3 Ideas:-

- Yolo present both options, yolo4 lite for mobile and yolo5 for GPU.
- Aerial Imagery dataset for fire detection: classification and segmentation using Unmanned Aerial Vehicle (UAV) - binary classifier
- dataset collected by scraping Google images (provides link to dataset with 1315 fire images), binary Fire/Non-fire classification with tf2 & keras sequential CNN, achieve 92%accuracy, concludes that better datasets are required.

3.3 PROPOSED SOLUTION

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. It is difficult to predict and detect Forest Fire in a sparsely populated forest area

Goals

1. We can find forest fire early to avoid vulnerability and upcoming disaster.
2. Early Warning system to alert the officers and people to save lot of lives.
3. It is real time detection of forest fire.

Specifications

HARDWARE SPECIFICATION

The hardware requirements may serve as the basis for a contract for the implementation of the system and should therefore be a complete engineer as the starting point for the system design.

Ram	: 8GB Ram or more
Processor	: Any Processor GPU
	: 8GB or more Hard
Disk	: 10GB or more
Speed	: 1.4GHZ or more

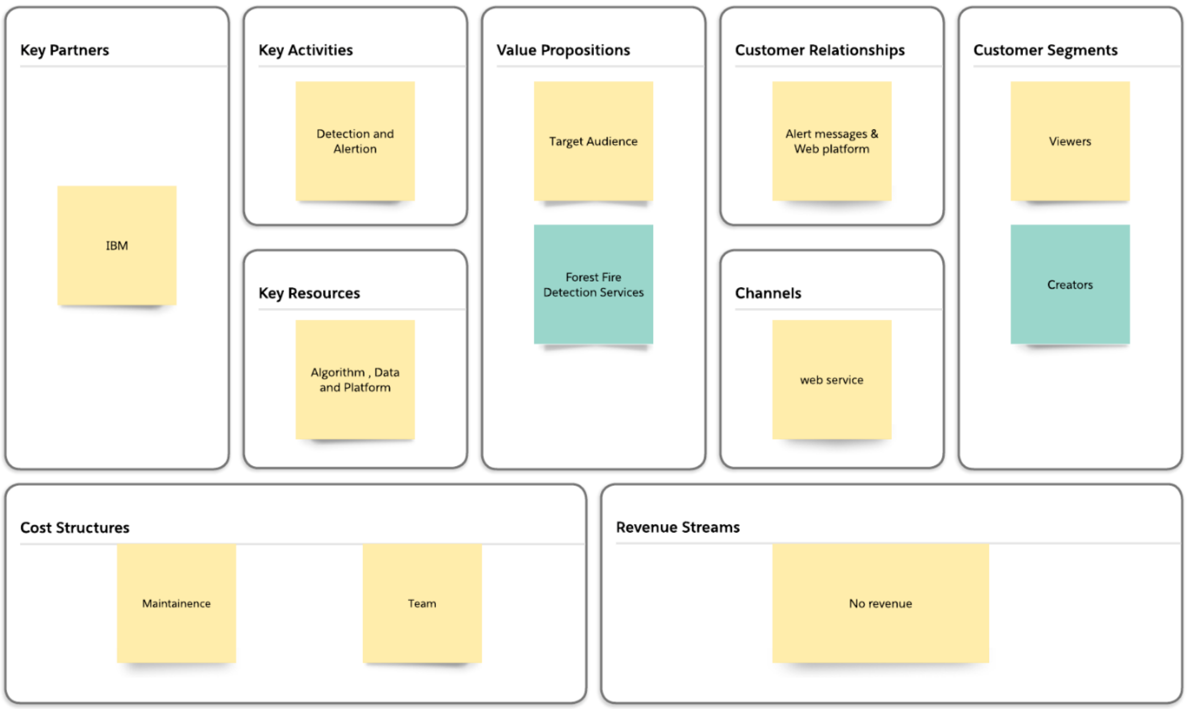
SOFTWARE SPECIFICATION

The software requirements give detailed description of the system and all its features.

- ➜ Python
- ➜ Keras
- ➜ Tensorflow
- ➜ OpenCV
- ➜ Numpy
- ➜ Pandas

- ➜ Visual studio code
- ➜ Python-Flask
- ➜ IBM cloud
- ➜ Keras-tuner

BUSINESS MODEL



SOLUTION

- ❖ **Fetch data from cctv and drones**
- ❖ **Image Preprocessing**
- ❖ **Image classification using CNN**
- ❖ **Video Analysis**
- ❖ **If fire detected send alert messages**

CONCLUSION

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. Our project aims to overcome this issue ,in order to reduce loss of life, damage and reduce vulnerability.

3.4 Problem-Solution Fit

Purpose / Vision

Version:

Define CS, fit into CL

1. CUSTOMER SEGMENT(S) CS

IBM

6. CUSTOMER LIMITATIONS EG. BUDGET, DEVICES CL

Can be only used in laptop or personal computer

5. AVAILABLE SOLUTIONS PLUSES & MINUSES AS

Real time detection of forest fire
Alerting the officers via messages

Explore AS, differentiate

Focus on PR, tap into BE, understand RC

2. PROBLEMS / PAINS + ITS FREQUENCY PR

People are using sensors to detect the fire ,but this case is not possible for large acres of forest.
we proposed a platform of Artificial Intelligence
The computer vision methods for recognition and detection of smoke and fire, based on the still images or the video input from the cameras

9. PROBLEM ROOT / CAUSE RC

Many forest fires start from natural causes such as lightning which set trees on fire.
High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start.
Forest area cover large acres of land so it is not easy to find the fire easily

7. BEHAVIOR + ITS INTENSITY BE

Compare the existing product in the market

Ask for expert opinion

Focus on PR, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TO ACT TR

Due to increase vulnerability of forest fire
Difficult to control the forest fire after it spread to wide area

4. EMOTIONS BEFORE / AFTER EM

Before : Stress,Helplessness,frustration
After : Less stress, sense of relief ,feeling

10. YOUR SOLUTION SL

Fetch the data from cctv or drones
Image preprocessing
Image classification using CNN model
Video Analysis using OpenCV
If fire detected, send alert messages

8. CHANNELS of BEHAVIOR CH

ONLINE

Extract online channels from Behavior Block

OFFLINE

Extract offline channels from Behavior Block

Extract online & offline CH of BE

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Table of Contents

1. Introduction

• Purpose of Document

This is a Requirements Specification document for Emerging methods for early detection of forest fire. This project is used to detect forest fire early so that it could reduce vulnerability of upcoming disaster. This document describes the scope, objectives and goal of the new system. In addition to describing non-functional requirements, this document models the functional requirements with use cases, interaction diagrams, and class models.

• Project Summary

Project Name	:	Emerging methods for early detection of forest fire
Project Leader	:	Balamurugan G
Project Members	:	Mithun Suriyaa K
		Manikandan S
		Bharath Kumar M K

• Background

Trees are valuable carbon repositories and play an important role for the climate. It takes decades to reforest areas ravaged by wildfires. Much of this ground lies fallow for a very long time, which takes a further toll on the climate

forest fire, uncontrolled fire occurring in vegetation more than 1.8 meters (6 feet) in height. These fires often reach the proportions of a major conflagration and are sometimes begun by combustion and heat from surface and ground fires. A big forest fire may crown—that is, spread rapidly through the topmost branches of the trees before involving undergrowth or the forest floor. As a result, violent blowups are common in forest fires, and they may assume the characteristics of a firestorm. *See* wildfire.

Though forest fire is often seen as harmful, a number of forests are specifically fire-adapted: the species of plants and animals native to those ecosystems are enhanced by or dependent on the occurrence of fire to persist and reproduce. Lightning strikes in a dry forest occur naturally, and fire can improve ecosystem health by reducing competition, fertilizing the soil with ash, and decreasing diseases and pests. Some plant species even require fire for their seeds to germinate. In many regions that have historically experienced forest fires, such as forested areas of the western United States, years of fire exclusion and suppression in the 19th and 20th centuries allowed fuels to accumulate, altering the vegetation communities present and leading to more extreme conflagrations when fires do occur. The use of prescribed fire, in which areas are burned intentionally and under controlled conditions, can restore those ecosystems and promote the conditions that were present historically prior to the removal of wildfire.

There are a number of detection and monitoring systems used by authorities. These include observers in the form of patrols or monitoring towers, aerial and satellite monitoring and increasingly promoted detection and monitoring systems based on optical camera sensors, and different types of detection sensors or their combination.

The following part presents a brief overview of automatic and semiautomatic detection and monitoring systems of fire protection in the world, experience with these systems in practical operation, and their evaluation in terms of efficiency, accuracy, versatility, and other key attributes.

The most frequently used fire detection and suppression techniques employed by authorities can be summarized as follows:

- **(i)** controlled burning,
- **(ii)** fire weather forecasts and estimates of fuel and moisture,
- **(iii)** watch towers,
- **(iv)** lightning detectors which detect the coordinates of the strike,
- **(v)** infrared and spotter planes
- **(vi)** water tankers ,mobile/smart phone calls becoming increasingly common for detecting fires

Problems with the current system include

- ➢ The detection mechanism used today is like watching towers, satellite imagery, video recording over long distances, etc. However, these do not provide a solution to improve the effectiveness for the detection of forest fire
- ➢ In the case of outdoor applications, abundance of sensors is required for high accuracy of fire detection systems. Every sensor also requires large battery capacity in a large open space to keep it operate. If and only if it is close to fire, sensors detect fire, but this will damage the sensor instead

- ## Project Scope

The scope of this project is to provide the customer an early warning system of forest fire and it delivers the alert message to customer about the fire detected using cctv or drones.

Customer login or sign up the website and connect webcam links , it gives view of webcam.

Event log details are stored in database and customer details are also stored in database.

- ## System Purpose

1.5.1 Users

Those who will primarily benefit from the new system and those who will be affected by the new system include

Customers:

Those who will use this system to detect forest fire.

1.5.2 Location

The system will be available to any potential customer using the Internet. Customers may also use the system from any location.

1.5.3 Responsibilities

The primary responsibilities of the system:

- allow customers to connect webcam through the website
- allow access to use camera
- send alert messages to customer
- provide services to customer

1.5.4 Need

This system is needed in order to real-time forest fire detection and prediction approaches,with the goal of informing the local fire authorities.

- ## Overview of Document

The rest of this document gives the detailed specifications for the new sales system. It is organized as follows:

- Section 2: Functional Objectives
  Each objective gives a desired behavior for the system, a business justification, and a measure to determine if the final system has successfully met the objective. These

objectives are organized by priority. In order for the new system to be considered successful, all high priority objectives must be met.

- Section 3: Non-Functional Objectives
  This section is organized by category. Each objective specifies a technical requirement or constraint on the overall characteristics of the system. Each objective is measurable.
- Section 4: Context Model
  This section gives a text description of the goal of the system, and a pictorial description of the scope of the system in a context diagram. Those entities outside the system that interact with the system are described.
- Section 5: Use Case Model
  The specific behavioral requirements of the system are detailed in a series of use cases. Each use case accomplishes a business task and shows the interaction between the system and some outside actor. Each use case is described with both text and an interaction diagram. An interface prototype is also shown. The system use case diagram depicts the interactions between all use cases and system actors.
- Section 6: An appendix containing a glossary that defines terms specific to this project

2. Functional Objectives

• High Priority

1. The system shall take training sets of fire images and recognize whether there is a fire or the beginning of a fire (smoke) or if there is no fire
2. The system shall send a notification to the admin when it recognizes a fire in the image given
3. The system shall take real inputs of camera images and determine whether the image contains a fire or not
4. The system shall be able to take images with a variety of sizes and convert it to one fixed image to be used throughout the application.
5. The system shall run as a service on either a Windows or Linux operating system.
6. In the event that the computer on which the system is running shuts down, the system service should start automatically when the computer restarts

• Medium Priority

1. The system shall provide following facility that will allow web pages that the user is permitted to access. The system must support the following facility:
   a. Send alert message
   b. Customer data management

• Low Priority

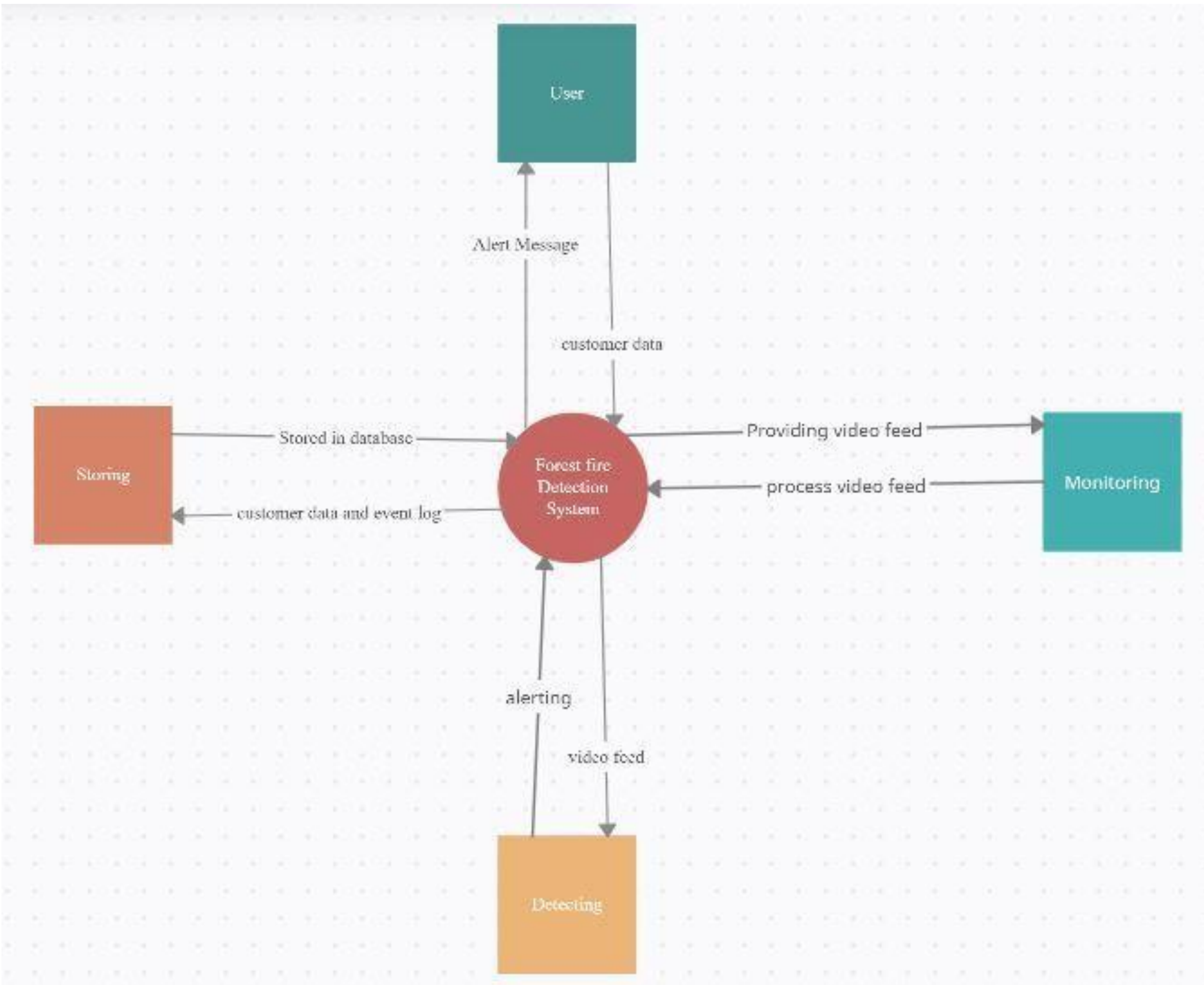
1. The system shall allow the user's status to be stored for the next time he returns to the web site. This will save the user x minutes per visit by not having to reenter already supplied data.
2. The system shall provide information about event log of forest.

3. The Context Model

3.1 Goal Statement

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

3.2Context Diagram



- System

ExternalsCustomer

A customer is any user of the system . A customer provides video feed and monitor the forest.

Monitoring

The system monitoring the forest by video feed and do further processing.

Detecting

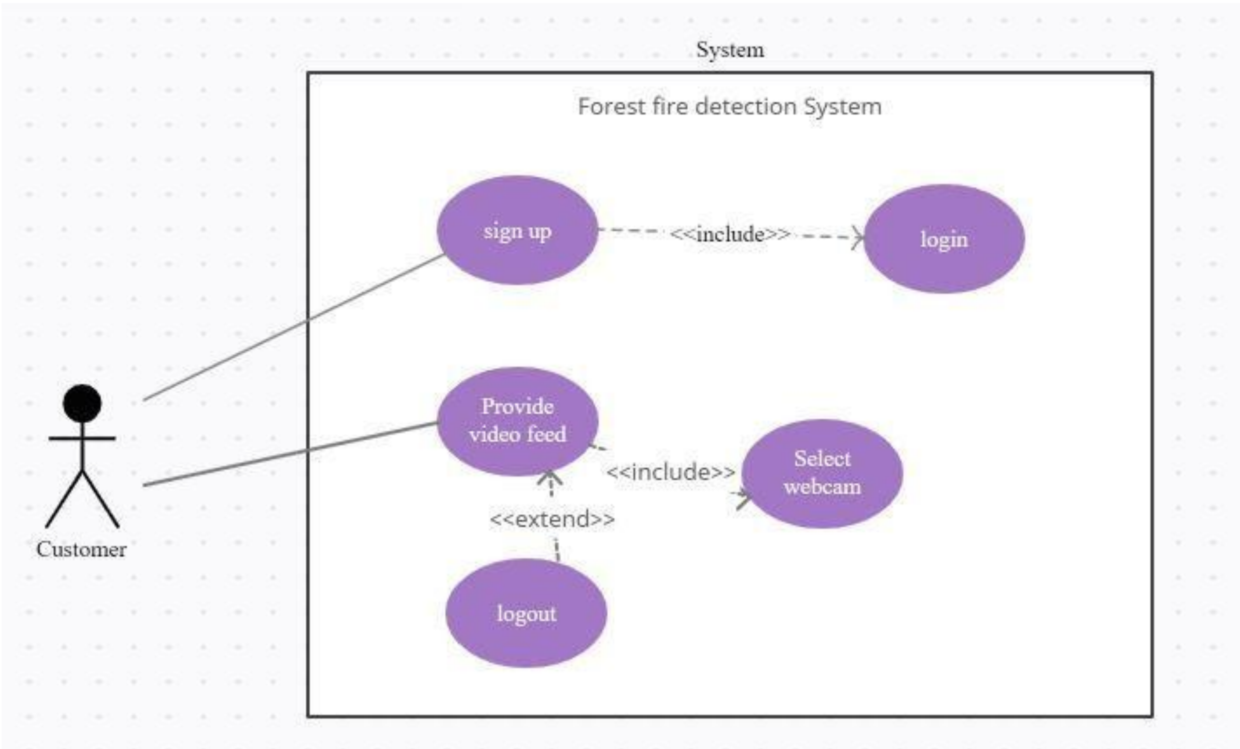
The System takes video feed and process the feed. It sends alert message if fire detected.

Storing

The system stores the customer data and event log in database.

3. The Use Case Model

- ## System Use Case Diagram



- ## Use Case Descriptions

Notes:

(i) For all use cases, the user can cancel the use case at any step that requires user input. This action ends the use case. Any data collected during that usecase is lost.

(ii) For all use cases that require a logged in user, the current login session is updated during the use case to reflect the navigation paths through the usecase.

Login(Sign up)

Use Case Name:	Login
Summary:	In order to get personalized or restricted information, a user must login so that the
	system can determine his access level.
Basic Flow:	1. The use case starts when a user indicates that he wants to login. 2. The system requests the username and password. 3. The user enters his username and password. 4. The system verifies the username and password against all registered users. 5. The system starts a login session and displays a welcome message based on the user's preferences.
Alternative Flows:	Step 4: if username is invalid, the use case goes back to step 2. Step 4: if the password is invalid the system requests that the user re-enter the password. When the user enters another password the use case continueswith step 4 using the original username and new password.
Extension Points:	login
Preconditions:	The user is registered.
Postconditions:	The user can now obtain data and perform functions according to his registered access level.
Business Rules:	Some data and functions are restricted to certain types of users or users with a particular access level.

Sign up(Customer)

Use Case Name:	Sign up
Summary:	In order to get personalized or restricted information, a new user must sign up a username and password.
Basic Flow:	1. The use case starts when a user indicates that he wants to register. 2. The system requests a username and password. 3. The user enters a username and password. 4. The system checks that the username does not duplicate any existing registered usernames. 5. The system requests a name (*), street, city, state, zip code(*), phone and email address. Items marked by (*) are required. 6. The user enters the information. 7. The system determines the user's location and access level and stores all user information.

	8. The system starts a login session and displays a welcome message based on the user's preferences
Alternative Flows:	• Step 4: If the username duplicates an existing username the system displays a message and the use case goes back to step 2. • Step 5: If the user does not enter a required field, a message is displayed and the use case repeats step 4.
Extension Points:	*Register Preferences*
Preconditions:	none
Postconditions:	The user can now obtain data and perform functions according to his registered access level.
Business Rules:	. Access levels are ○ 0: A user can access only data classification 0 ○ 1: The user can access data classification <= 1 ○ 2: The user can access data classification <= 2 The default access level is 0.

Provide Video feed (Customer)

Use Case Name:	Provide video feed Scenario: Customer provide video feed
Summary:	This use case allows a registered customer to provide video feed.
Basic Flow:	1. The use case starts when a customer indicates he provides the feed . 2. The customer may add or change any webcam. 3. The system tells the customer to select the webcam. 4. The system displays camera view.
Alternative Flows:	Step 6: If the selected camera could not be validated, go to step 8 to get another camera.
Extension	None

Preconditions:	The customer is logged in and has completed a selection of the camera
Postconditions:	The camera view is displayed.
Business Rules:	If a customer has selected correct camera.

Select video feed(Provide video feed)

Use Case Name:	Select video feed Scenario: Customer Select video feed.
Summary:	This use case allows Customer Select video feed.
Basic Flow:	1. The use case starts when a customer indicates he provides the feed. 2. The customer may add or change any webcam. 3. The system tells the customer to select the webcam. 4. The system displays camera view.
Alternative Flows:	None.
Extension Points:	*None*
Preconditions:	The Customer provides video feed.
Postconditions:	The camera view is displayed.
Business Rules:	None

Logout(Customer)

Use Case Name:	Logout
Summary:	This system log out.
Basic Flow:	1.The use case allows user to logout.
Alternative Flows:	none
Extension Points:	none
Preconditions:	The system is executing use case logout.
Postconditions:	None.
Business Rules:	None

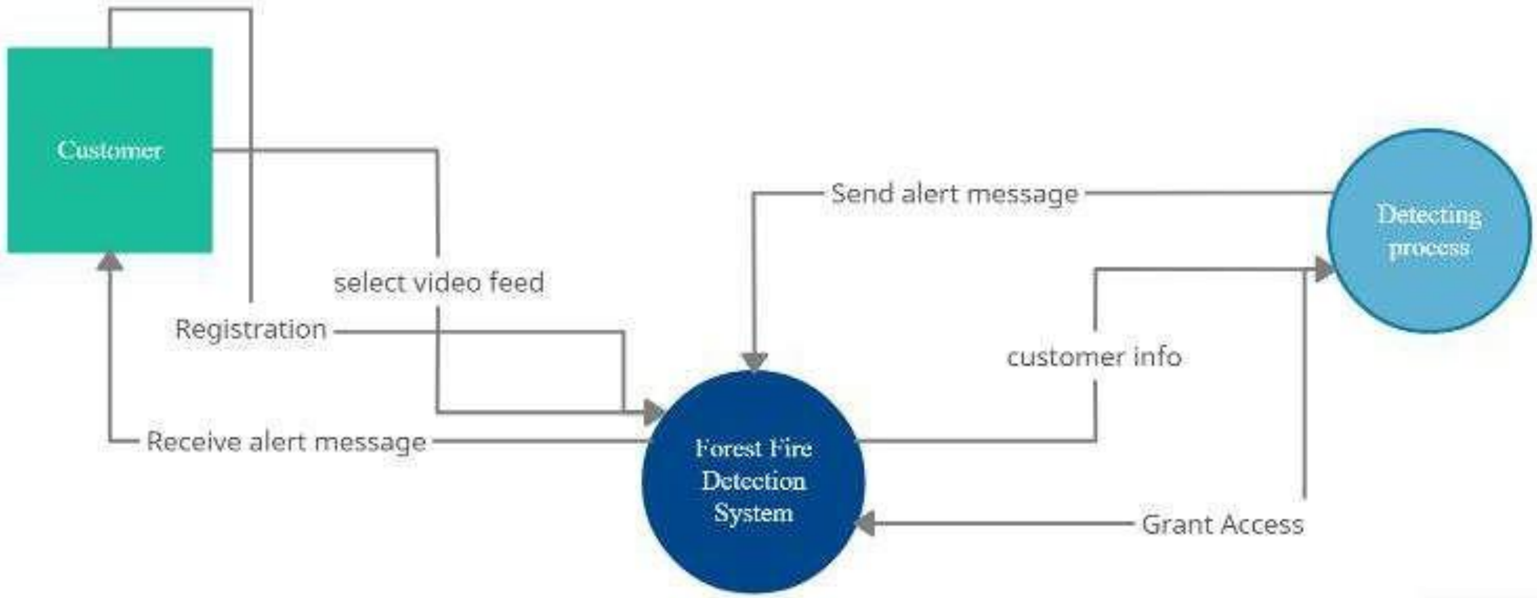
4.2 Non-Functional Requirements

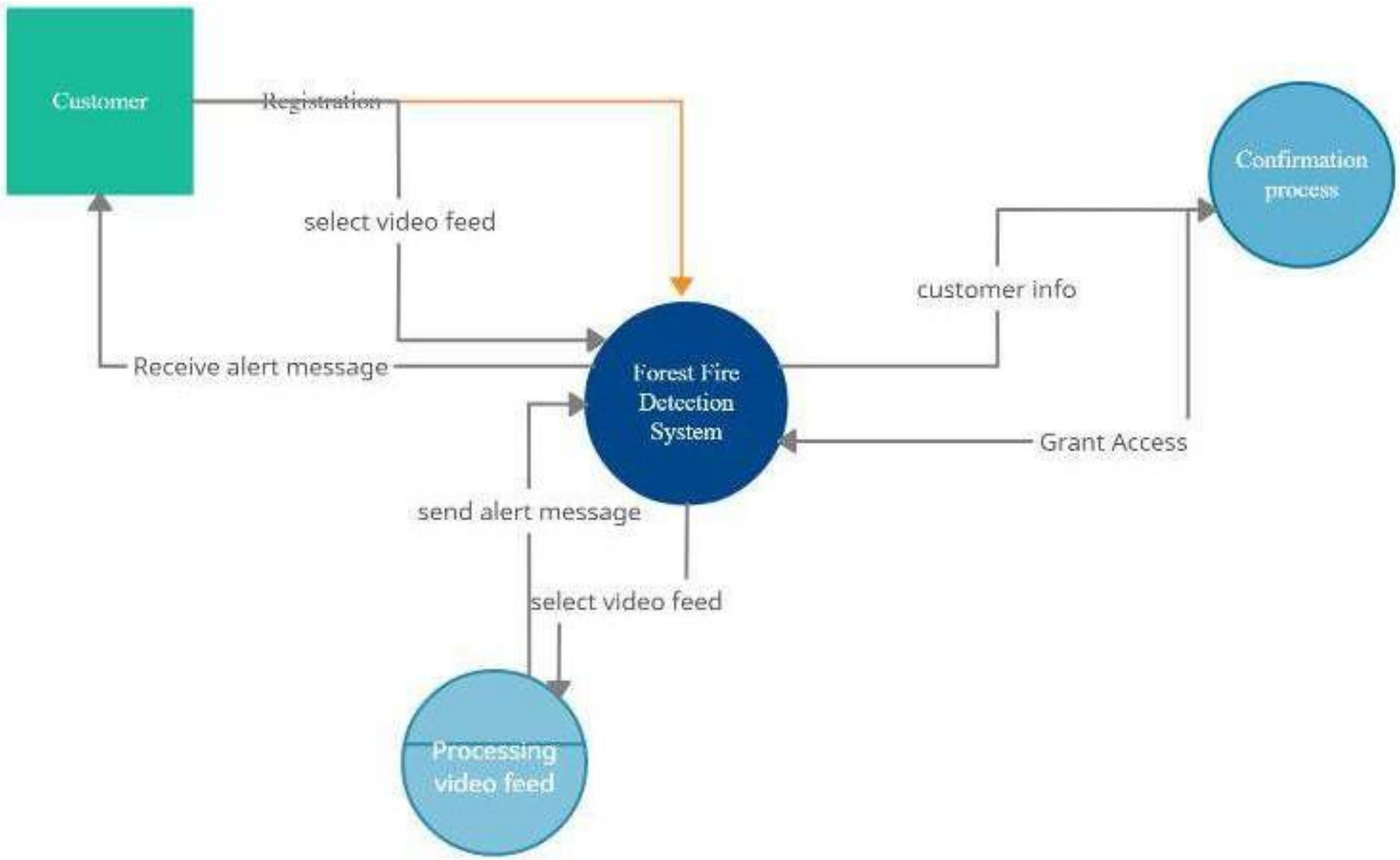
- Reliability
  - **(i)** The system shall be completely operational at least x% of the time.
  - **(ii)** Down time after a failure shall not exceed x hours.
- Usability
  - **(i)** Customer should be able to use the system in his job for x days .
  - **(ii)** A user who already knows what camera he is using should be able to connect and viewthat page in x seconds.
- Performance
  - **(i)** The system should be able to support x simultaneous users.
  - **(ii)** The mean time to view a web page over a 56Kbps modem connection shall not exceed xseconds.
- Security
  - **(i)** The system shall provide password protected access to web pages that are to be viewedonly by users.
- Supportability
  - **(i)** The system should be able to accommodate many camera links.
  - **(ii)** The system web site shall be viewable from chrome or any browser.

CHAPTER 5

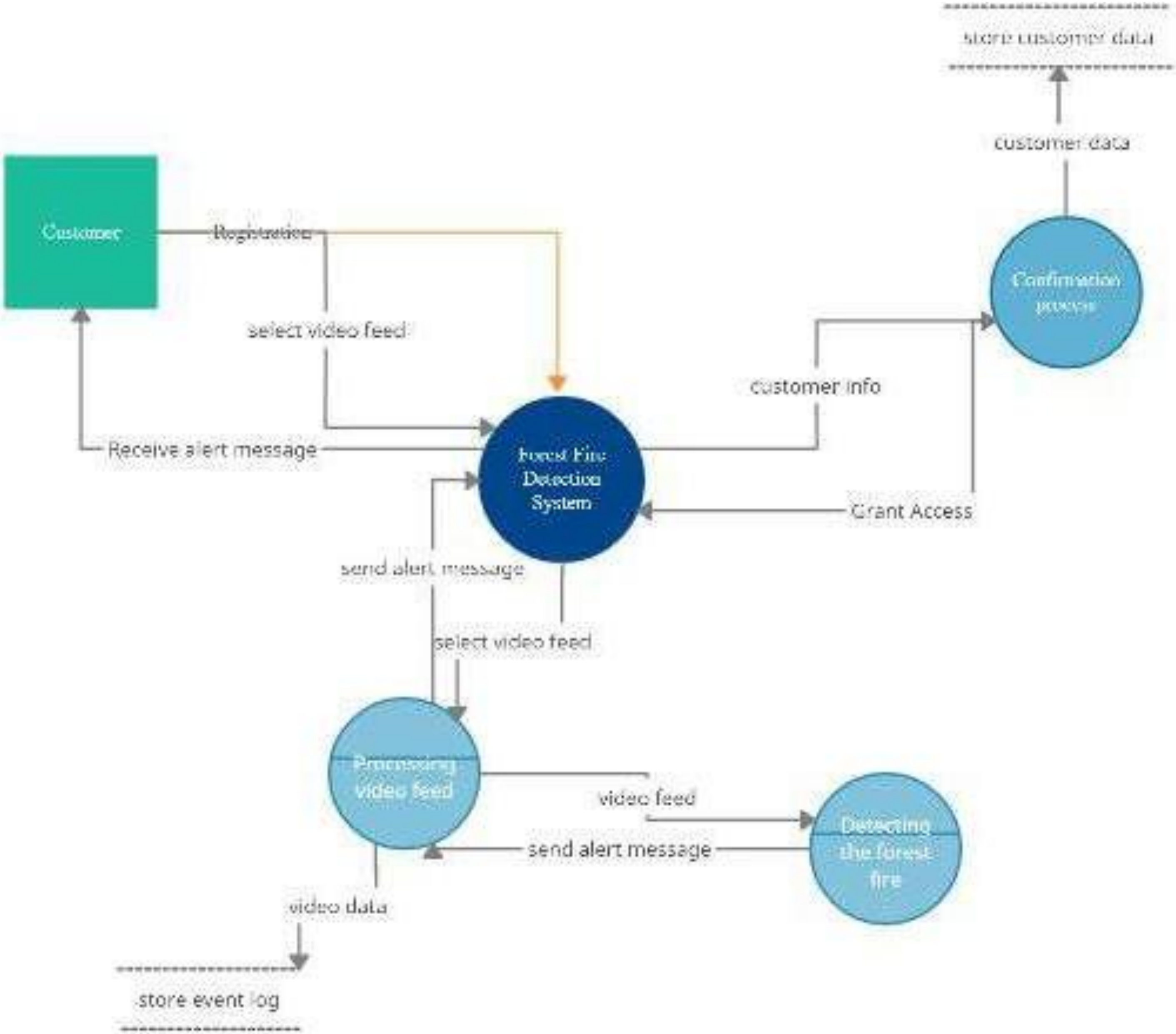
PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

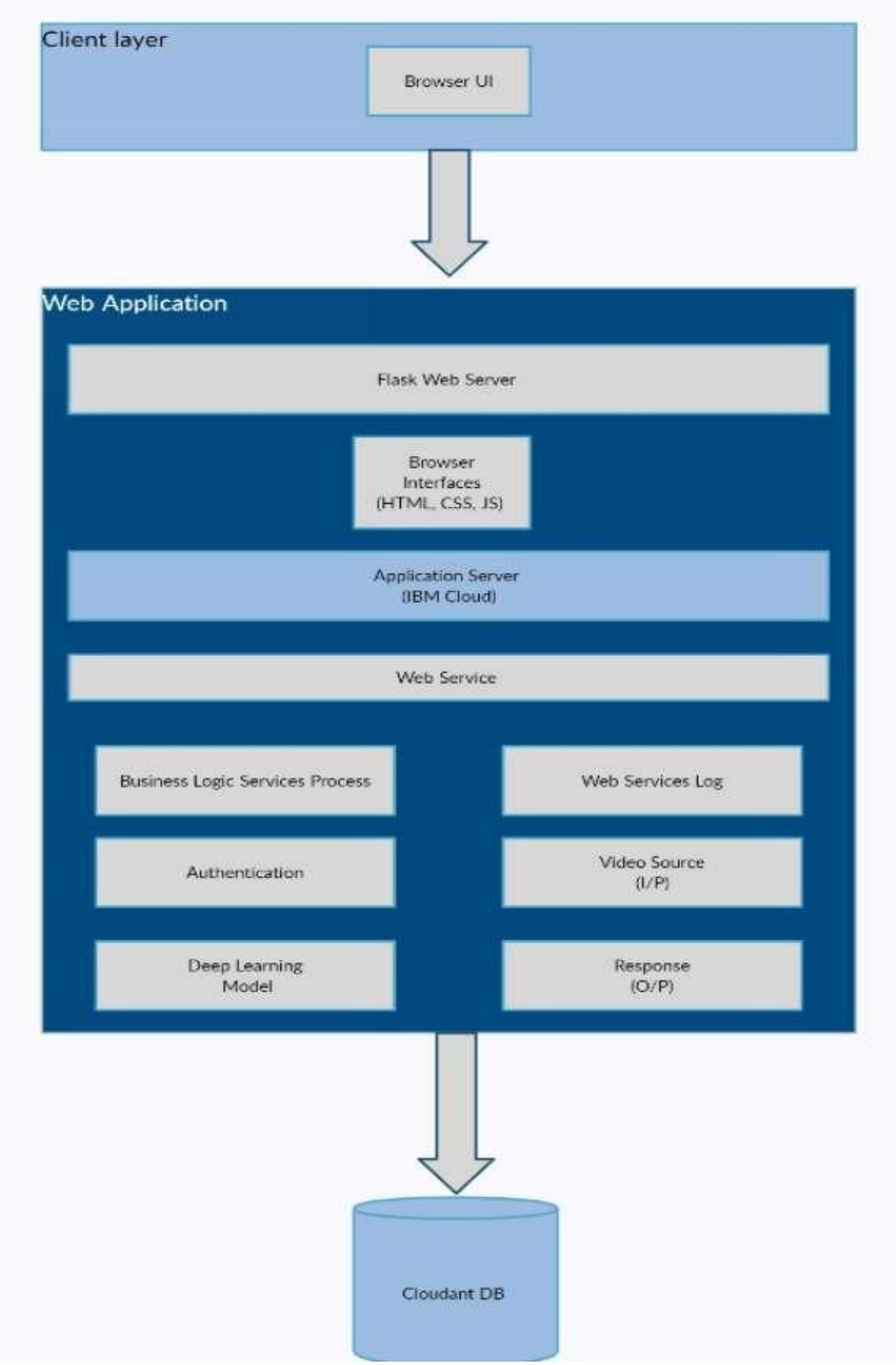




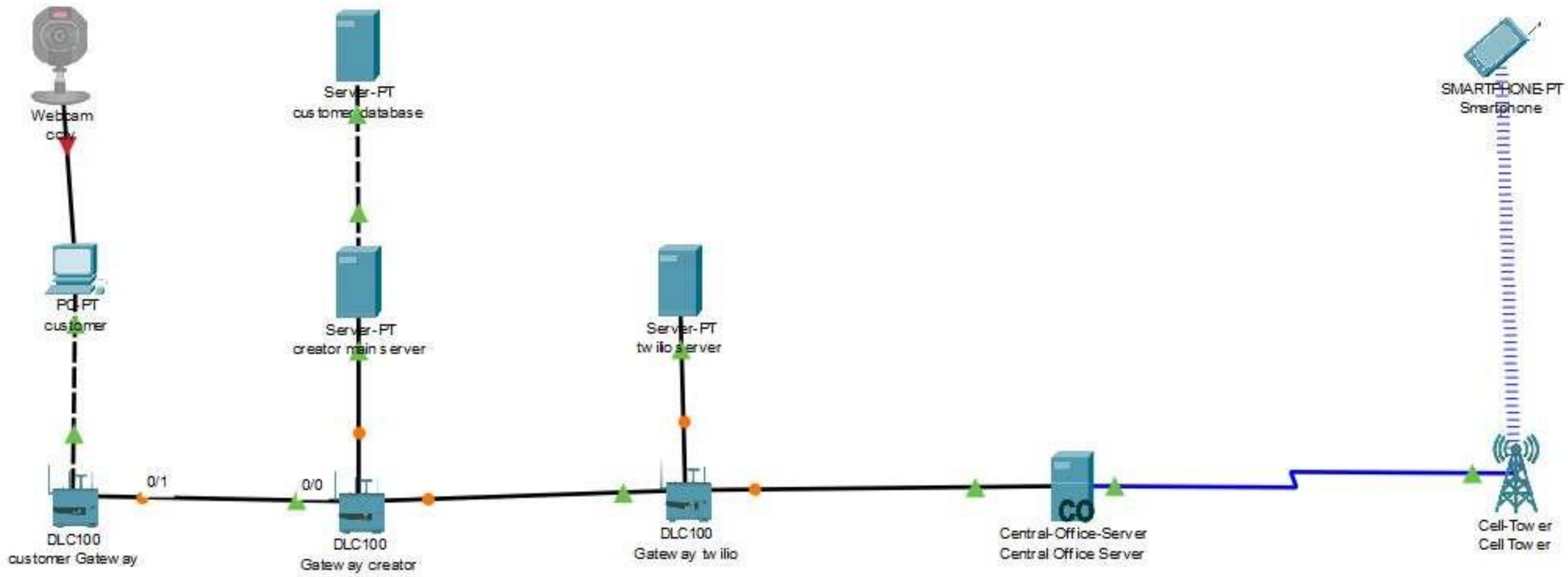
Customer
Registration
select video feed
Receive alert message
Forest Fire Detection System
customer info
Confirmation process
Grant Access
send alert message
select video feed
Processing video feed


store customer data
customer data
Customer
Registration
select video feed
Confirmation process
customer info
Receive alert message
Forest Fire Detection System
Grant Access
send alert message
select video feed
Processing video feed
video feed
Detecting the forest fire
send alert message
video data
store event log

5.2 SOLUTION ARCHITECTURE



5.2 TECHNICAL ARCHITECTURE



5.3 USER STORIES

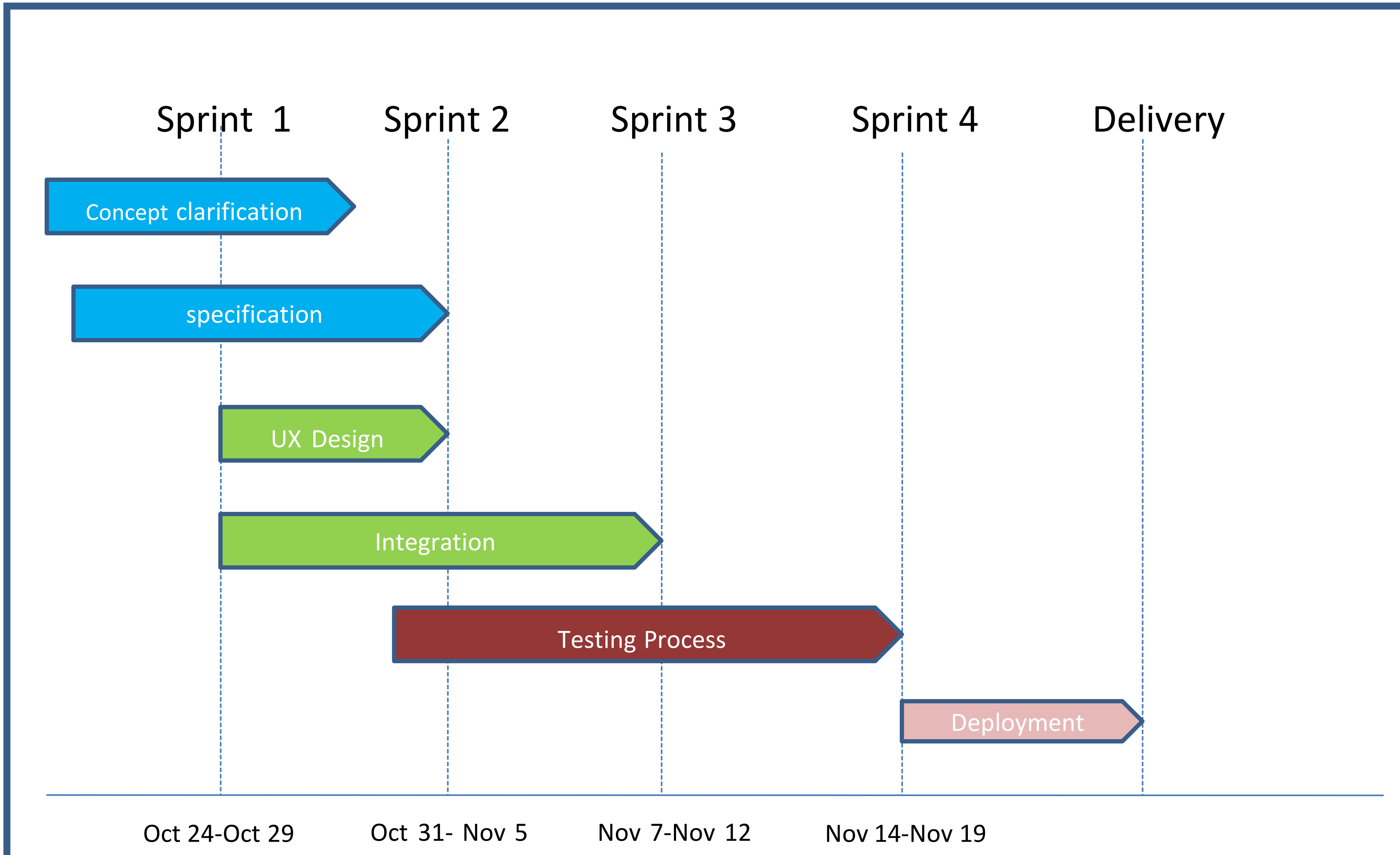
User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Forest Management Team	Setting up a camera	USN-1	As a user, the forest management team has to survey the forest by adding camera to the fire prone areas.	The live video captured can be monitored	High	Sprint-1
		USN-2	As a user, the forest management team can get video feed which is used for processing	The camera sends video or image to the forest centre	High	Sprint-2
		USN-3	Along with forest team, the NGO can also get access of the video to take some early measurement of forest fires.	They can also get the view of the live monitoring of forest	Low	Sprint-1
Technical Team	Image Classification	USN-4	By using CNN Model, the images captured by the camera is classified accordingly by testing & training the model	The model should be able to identify the difference between fire and a normal smoke	Medium	Sprint-2
	Using Open CV	USN-5	The recorded video is under monitoring continuously to determine the detection of early video	Therefore, by using CNN we can determine the input layer, classify the hidden layers and send warnings through output layer	High	Sprint-2
Alert Team	Dashboard	USN-6	Thus, after successful detection of fire by processing images. This, API sends the alert by buzzing the alarm and sends messages through chatbot	Thus, the immediate response which is required for earlier determination through sending quick responses	High	Sprint-2
Fire Management	Twilio API		They play the most important role to cool the	They take the following measures to	High	Sprint-2

			fire and manage the excess spread of fire further	stop fire from spreading		
User Type	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Acceptance criteria**	**Priority**	**Release**
Media & Nearby Residing People	News, Radio, Alerts,	USN-7	Protecting wildlife, human from the disaster caused	Thus, helping unit should be sent to protect lives	Medium	Sprint-2

Chapter 6
Project Planning and Scheduling
6.1 SPRINT PLANNING AND SCHEDULING

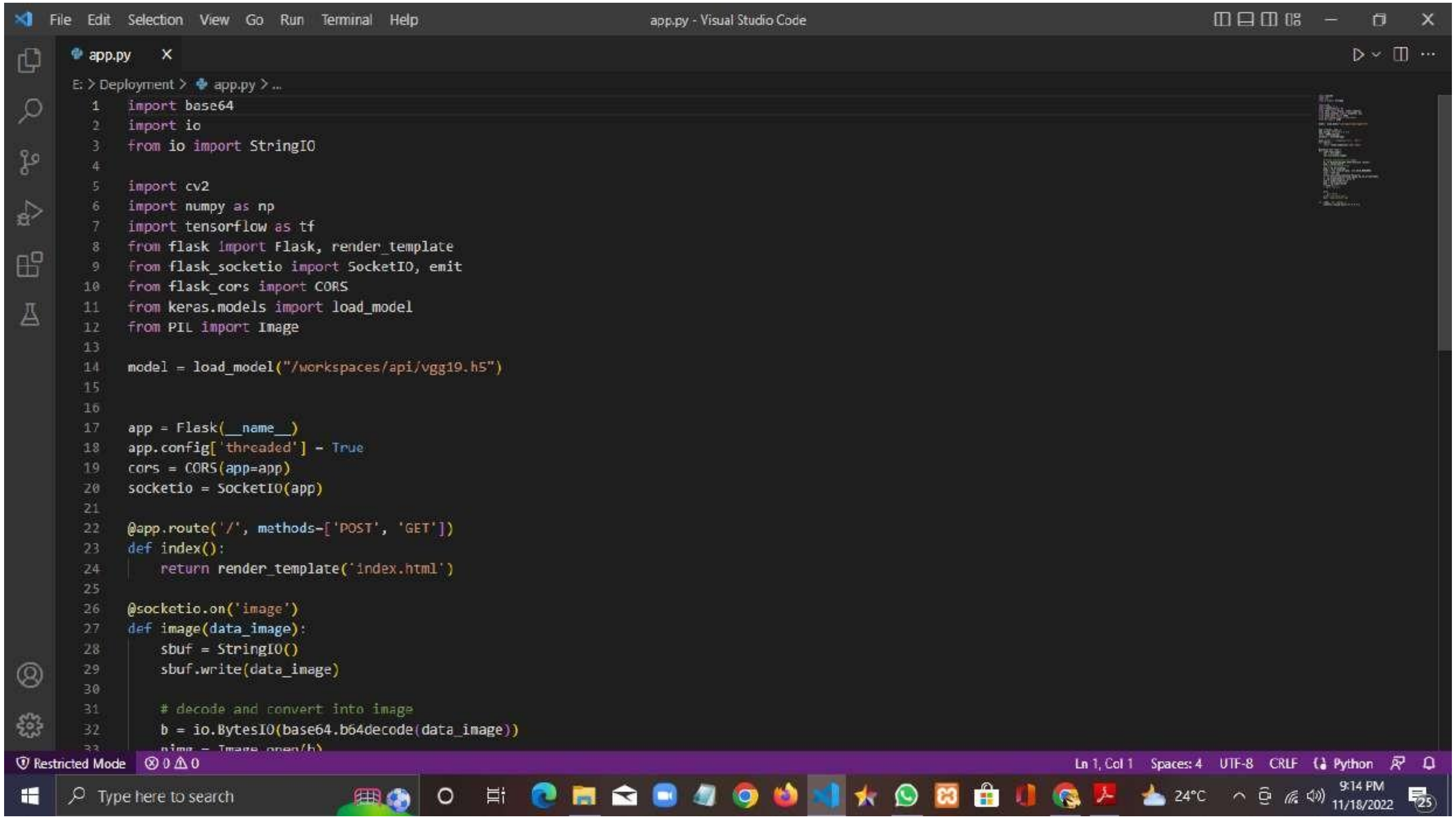
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	UI/UX design	USN-1	The model should connect with Twilio service and implement the code	2	High	Balamurugan G Mithun Suriyaa K Bharath Kumar M K Manikandan S
Sprint-2	Model building	USN-2	Model is built using CNN algorithm and train it, store the trained model	1	Medium	Balamurugan G Mithun Suriyaa K Bharath Kumar M K Manikandan S
Sprint-3	Testing	USN-3	Testing the project with valid and invalid input and verify with desired output	2	High	Balamurugan G Mithun Suriyaa K Bharath Kumar M K Manikandan S
Sprint-4	Deployment	USN-4	Deploy the project in cloud for providing services	2	High	Balamurugan G Mithun Suriyaa K Bharath Kumar M K Manikandan S

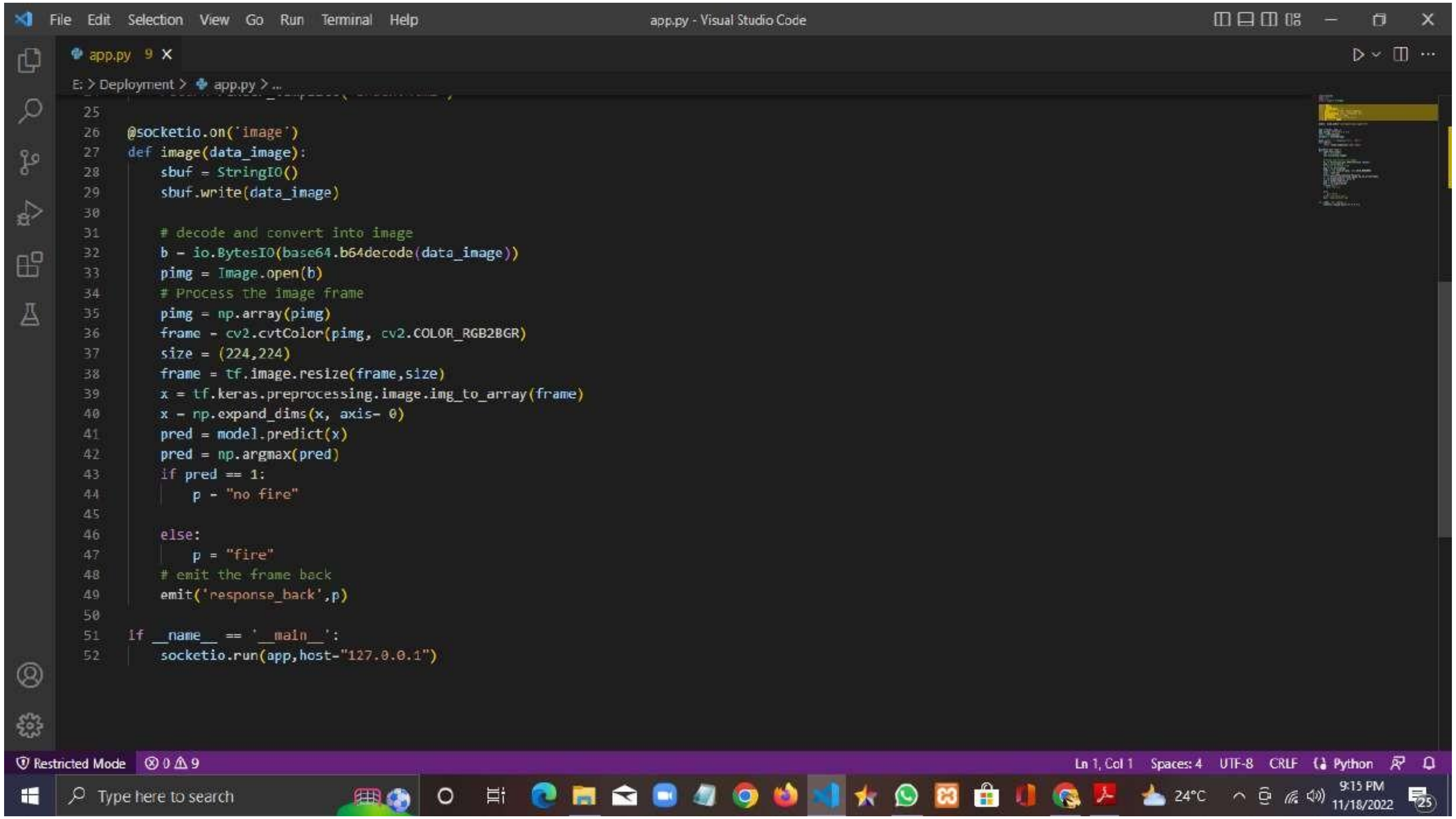
6.2 SPRINT DELIVERY PLAN



7 CODING AND SOLUTIONING

7.1 FEATURE CODE 1




File Edit Selection View Go Run Terminal Help
app.py - Visual Studio Code
app.py 9
E: > Deployment > app.py > ...
@socketio.on('image')
def image(data_image):
sbuf = StringIO()
sbuf.write(data_image)
# decode and convert into image
b = io.BytesIO(base64.b64decode(data_image))
pimg = Image.open(b)
# Process the image frame
pimg = np.array(pimg)
frame = cv2.cvtColor(pimg, cv2.COLOR_RGB2BGR)
size = (224,224)
frame = tf.image.resize(frame,size)
x = tf.keras.preprocessing.image.img_to_array(frame)
x = np.expand_dims(x, axis= 0)
pred = model.predict(x)
pred = np.argmax(pred)
if pred == 1:
p = "no fire"
else:
p = "fire"
# emit the frame back
emit('response_back',p)
if __name__ == '__main__':
socketio.run(app,host="127.0.0.1")
Restricted Mode
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Type here to search
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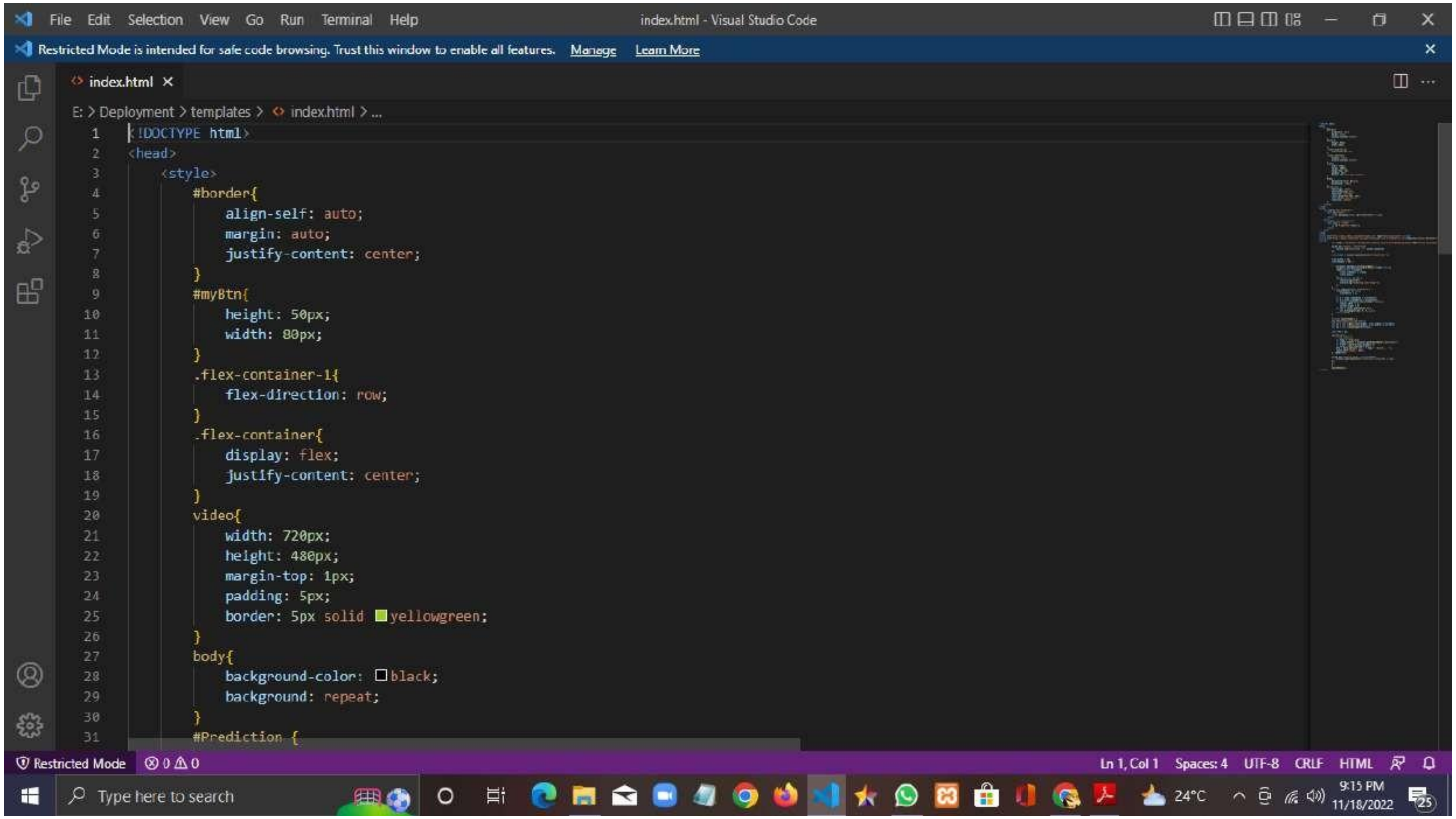
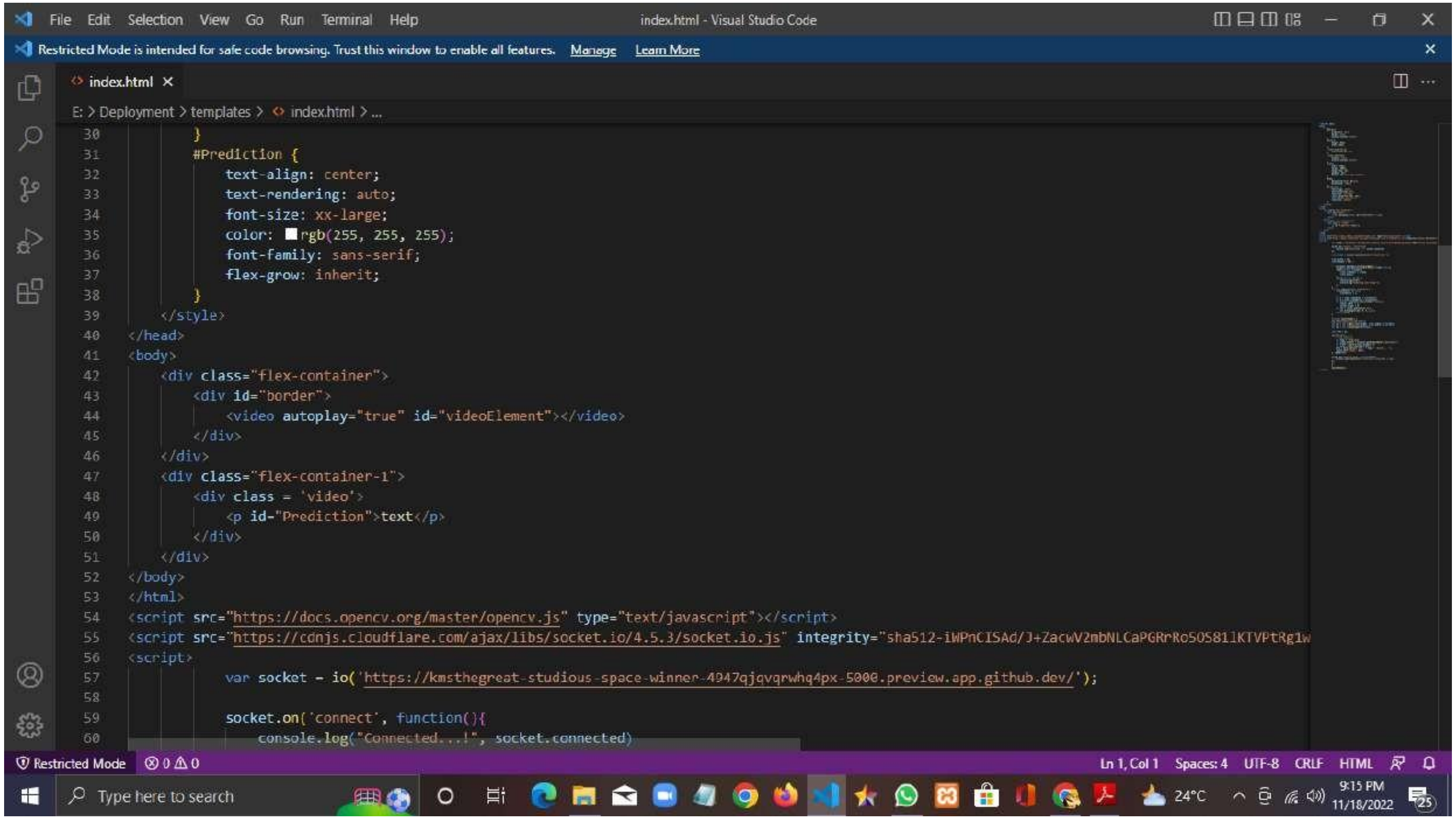
11/18/2022

7.2 FEATURE CODE 2



```
<!DOCTYPE html>
<head>
    <style>
        #border{
            align-self: auto;
            margin: auto;
            justify-content: center;
        }
        #myBtn{
            height: 50px;
            width: 80px;
        }
        .flex-container-1{
            flex-direction: row;
        }
        .flex-container{
            display: flex;
            justify-content: center;
        }
        video{
            width: 720px;
            height: 480px;
            margin-top: 1px;
            padding: 5px;
            border: 5px solid yellowgreen;
        }
        body{
            background-color: black;
            background: repeat;
        }
        #Prediction {
```



File Edit Selection View Go Run Terminal Help
index.html - Visual Studio Code
Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More
index.html
E: > Deployment > templates > index.html > ...
}
#Prediction {
text-align: center;
text-rendering: auto;
font-size: xx-large;
color: rgb(255, 255, 255);
font-family: sans-serif;
flex-grow: inherit;
}
</style>
</head>
<body>
<div class="flex-container">
<div id="border">
<video autoplay="true" id="videoElement"></video>
</div>
</div>
<div class="flex-container-1">
<div class = 'video'>
<p id="Prediction">text</p>
</div>
</div>
</body>
</html>
<script src="https://docs.opencv.org/master/opencv.js" type="text/javascript"></script>
<script src="https://cdnjs.cloudflare.com/ajax/libs/socket.io/4.5.3/socket.io.js" integrity="sha512-iWPnCISAd/J+ZacwV2mbNLCaPGRrRo5O581lKTVPtRg1w
<script>
var socket = io('https://kmsthegreat-studious-space-winner-4947qjqvqrwhq4px-5000.preview.app.github.dev/');
socket.on('connect', function(){
console.log("Connected...!", socket.connected)
Restricted Mode
Ln 1, Col 1 Spaces: 4 UTF-8 CRLF HTML
Type here to search
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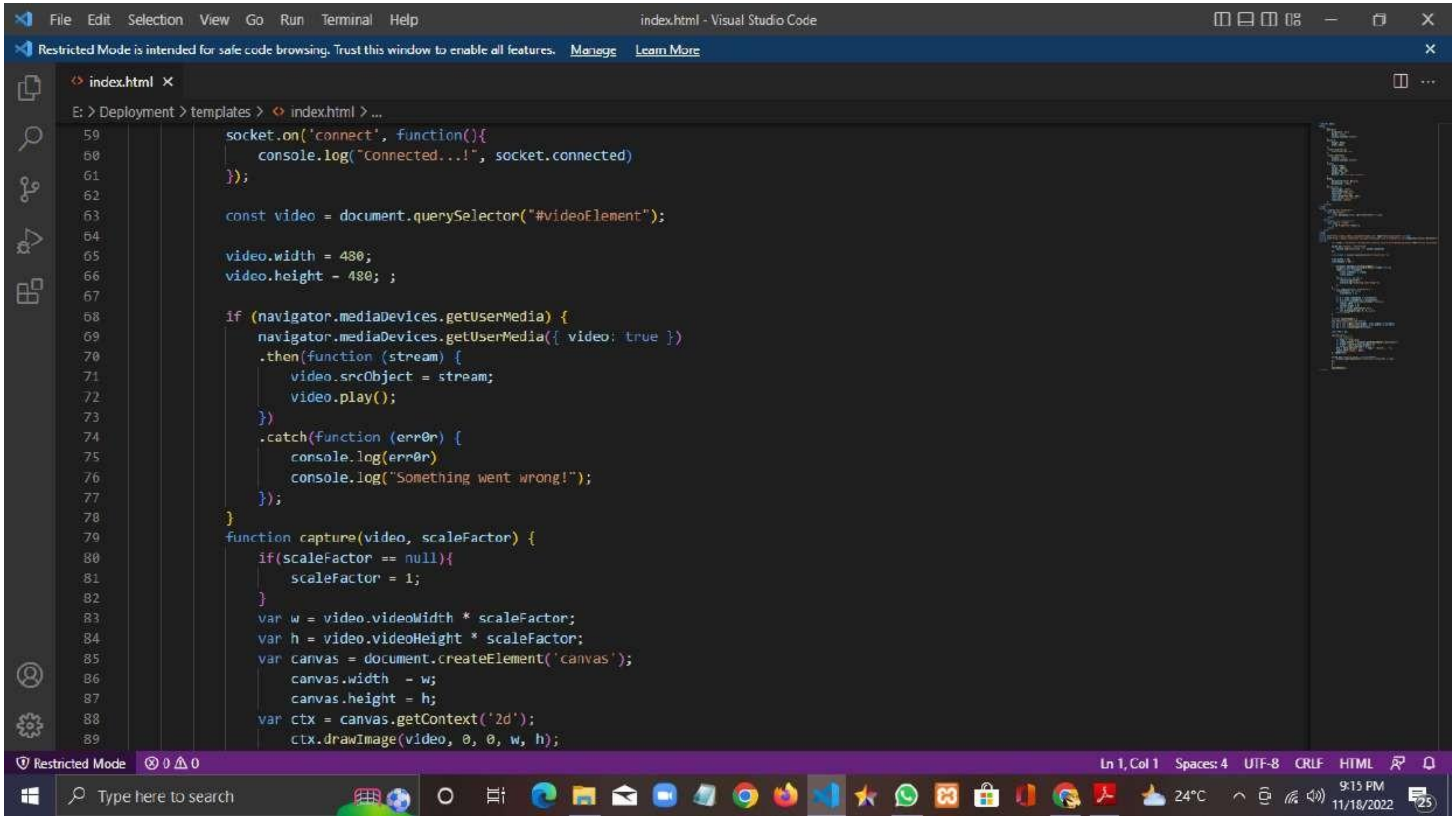
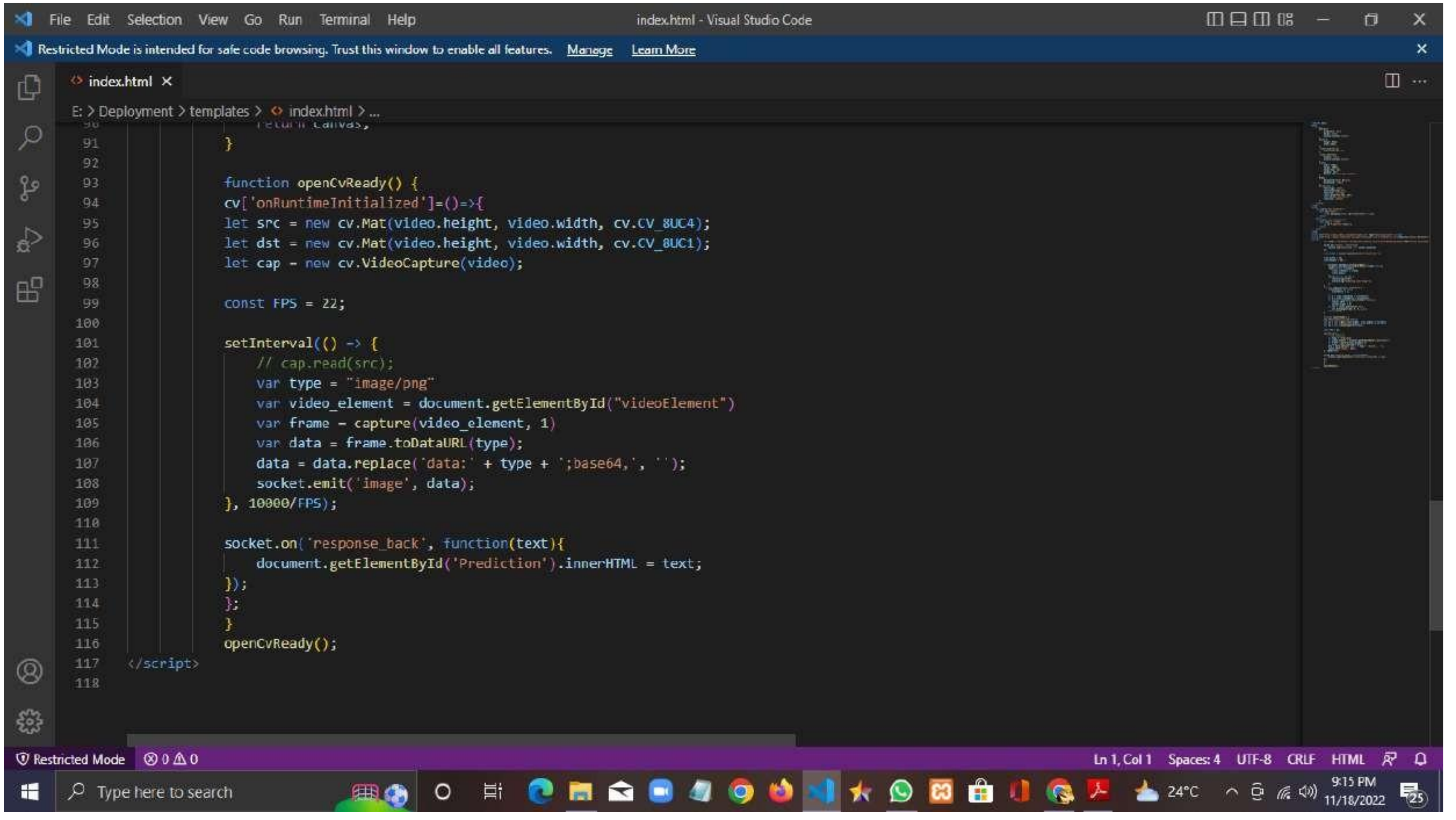
9:15 PM
11/18/2022



File Edit Selection View Go Run Terminal Help
index.html - Visual Studio Code
Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More
index.html
E: > Deployment > templates > index.html > ...
socket.on('connect', function(){
console.log("Connected...!", socket.connected)
});
const video = document.querySelector("#videoElement");
video.width = 480;
video.height = 480; ;
if (navigator.mediaDevices.getUserMedia) {
navigator.mediaDevices.getUserMedia({ video: true })
.then(function (stream) {
video.srcObject = stream;
video.play();
})
.catch(function (err0r) {
console.log(err0r)
console.log("Something went wrong!");
});
}
function capture(video, scaleFactor) {
if(scaleFactor == null){
scaleFactor = 1;
}
var w = video.videoWidth * scaleFactor;
var h = video.videoHeight * scaleFactor;
var canvas = document.createElement('canvas');
canvas.width = w;
canvas.height = h;
var ctx = canvas.getContext('2d');
ctx.drawImage(video, 0, 0, w, h);
Restricted Mode
Ln 1, Col 1 Spaces: 4 UTF-8 CRLF HTML
Type here to search
24°C
9:15 PM
11/18/2022




```
        }

        function openCvReady() {
        cv['onRuntimeInitialized']=()=>{
        let src = new cv.Mat(video.height, video.width, cv.CV_8UC4);
        let dst = new cv.Mat(video.height, video.width, cv.CV_8UC1);
        let cap = new cv.VideoCapture(video);

        const FPS = 22;

        setInterval(() => {
            // cap.read(src);
            var type = "image/png"
            var video_element = document.getElementById("videoElement")
            var frame = capture(video_element, 1)
            var data = frame.toDataURL(type);
            data = data.replace('data:' + type + ';base64,', '');
            socket.emit('image', data);
        }, 10000/FPS);

        socket.on('response_back', function(text){
            document.getElementById('Prediction').innerHTML = text;
        });
        };
        }
        openCvReady();
</script>
```

8 TESTING

8.1 TEST CASE

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC	Functional	Home	Verify user is able to see the	flask backend	1.Enter URL and click go	localhost5000:/home	Login/Signup popup should	Working as	Pass				
LoginPage_TC	UI	Home	Verify the UI elements in	Bootstrap Backend	1.Enter URL and click go	localhost5000:/home	Application should show below UI	Working as	Pass				
LoginPage_TC	Functional	Home	Verify user is able to log into	Sqlite database & Flask	1.Enter URL() and click go	Username:	User should navigate to user	Working as	Pass				
LoginPage_TC	Functional	Login	Verify user is able to log into	Sqlite database & Flask	1.Enter URL() and click go	Username:	Application should show	Working as	Pass				
LoginPage_TC	Functional	Login	Verify user is able to log into	Sqlite database & Flask	1.Enter URL() and click go	Username: chalam	Application should show	Working as	Pass				
DashboardPage	Functional	Dashboar	Verify user is able to view the	Tensorflow Backend &	1.Enter URL() and click go	https://www.google.com/u	Application should display the	Working as	Pass				
DashboardPage	Functional	Dashboar	Verify user is able to view the	Tensorflow Backend &	1.Enter URL() and click go	https://www.google.com/u	Application should display the	Working as	Pass				
LogoutPage_TC	Functional	Logout	Verify user is able to logout	flask backend	1.Enter URL() and click go	localhost5000:/logout	Application should display the	working as	Pass				
LogoutPage_TC	Functional	Logout	Verify user is able to go from	flask backend	1.Enter URL() and click go	localhost5000:/home	Application should display the	working as	Pass				

8.2 User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Emerging Methods for early detection of forest fire project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and howthey were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	5	5	5	20
Duplicate	0	0	0	0	0
External	5	5	0	1	11
Fixed	10	10	5	6	31
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	0	0	0	0
Totals	20	20	12	13	64

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Client Application	5	0	0	5
Security	5	0	0	5
Video Capture	2	0	0	2
Image Classifier	2	0	0	2

9. Result

9.1 Performance Metrics

Model Summary:

Model: "model"

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	[(None, 224, 224, 3)]	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590080
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590080
block3_conv4 (Conv2D)	(None, 56, 56, 256)	590080
block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1180160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2359808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2359808
block4_conv4 (Conv2D)	(None, 28, 28, 512)	2359808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv2 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv4 (Conv2D)	(None, 14, 14, 512)	2359808

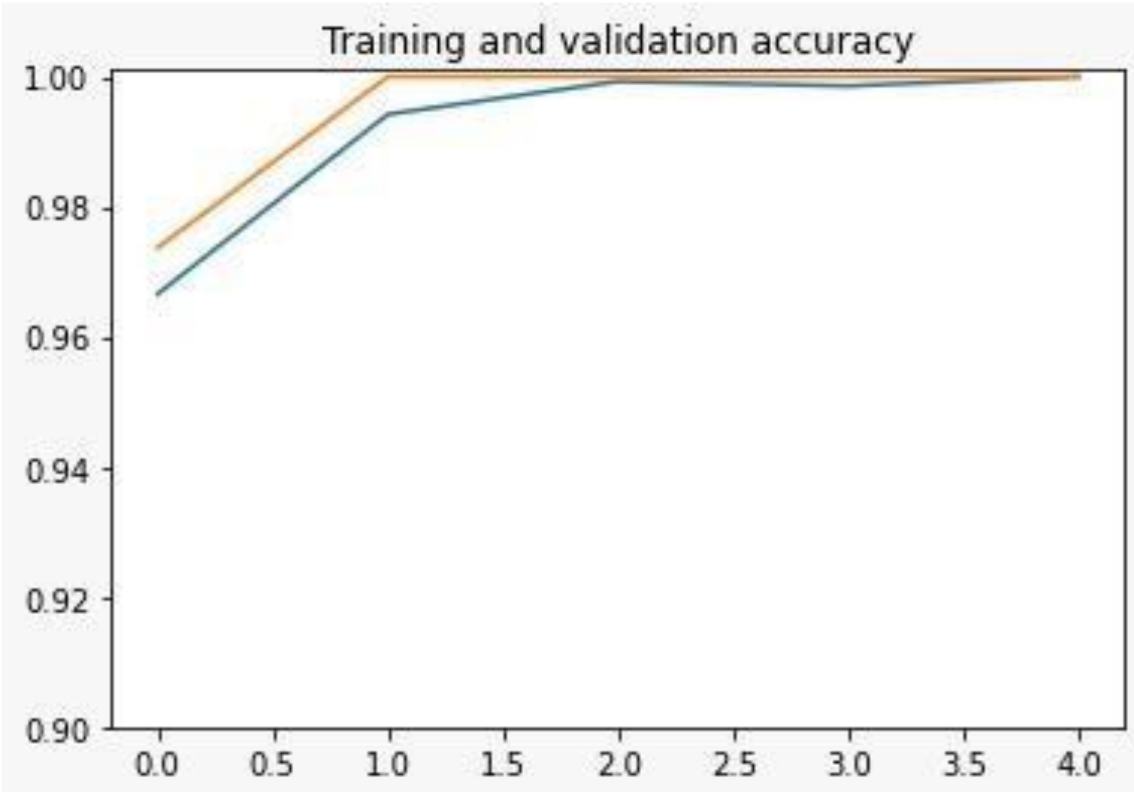
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
flatten (Flatten)	(None, 25088)	0
dense (Dense)	(None, 100)	2508900
dense_1 (Dense)	(None, 100)	10100
dense_2 (Dense)	(None, 100)	10100
dense_3 (Dense)	(None, 2)	202

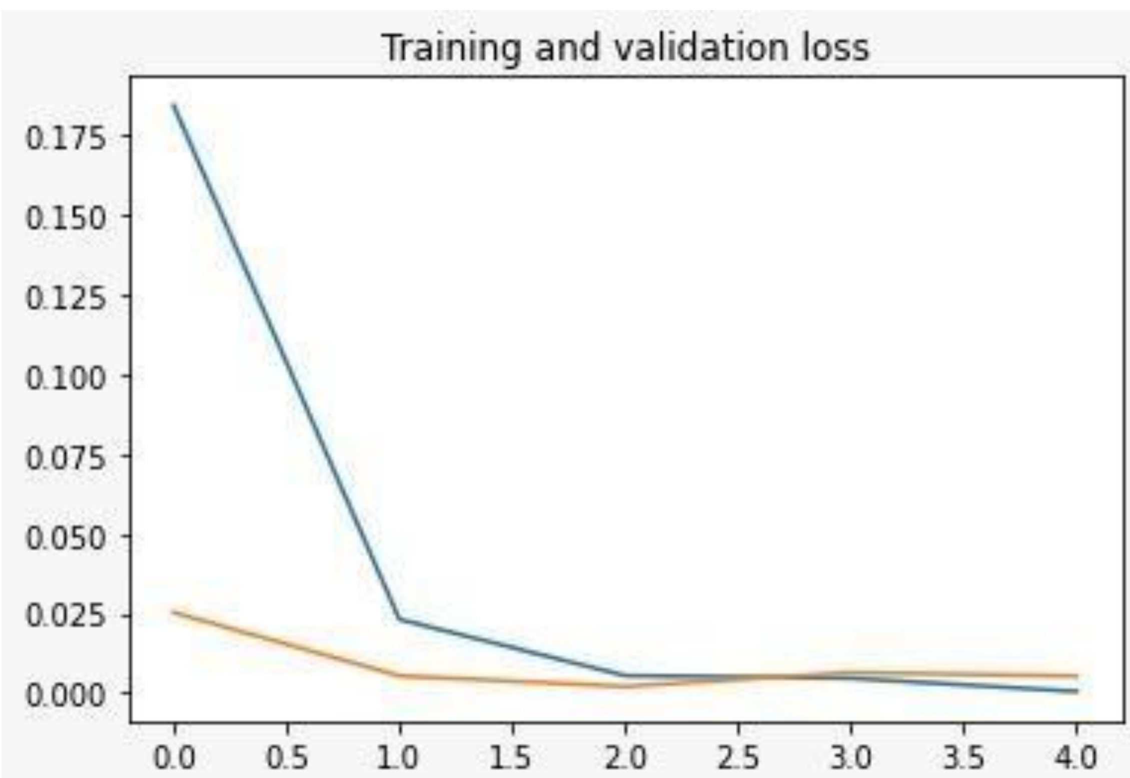
===

Total params: 22,553,686

Trainable params: 2,529,302

Non-trainable params: 20,024,384


Training and validation accuracy
1.00
0.98
0.96
0.94
0.92
0.90
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0


Training and validation loss
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

10. Advantages and Disadvantages of Forest fire

Advantages:

- More dynamic and wider detection as compared tofixed sensors.
- Reduction in cost.
- Unreachable areas can now be controlled
- To detect poaching, and monitor comprehensiveanimal deaths.
- Proposed methods are very convenient and caneasily detect.

Disadvantages:

- Neither easy to capture suitable animals from theenvironment nor equip them with cameras.
- Possibility of lack of appropriate animals for specialforests.
- Determining climate conditions, daily temp differences, seasonal normal temp values, etc. areproblematic.

11 CONCLUSION

New wireless technologies and new satellite tracking systems can be adapted to increase the efficiency of thesystem

Cameras can be produced or existing cameras can be improved to increase robustness of the proposed system.

A number of investigations can be made regardinganimal behavior in case of fire to improve system reliability.

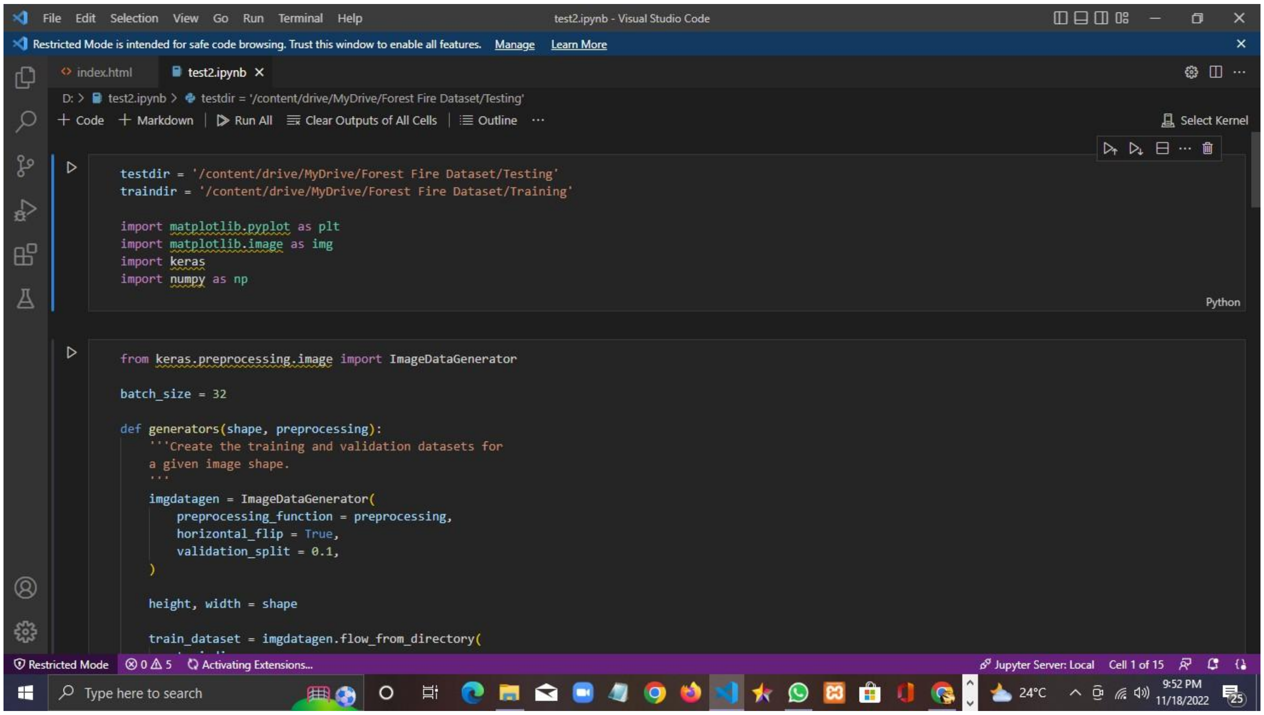
12 Future Scope:

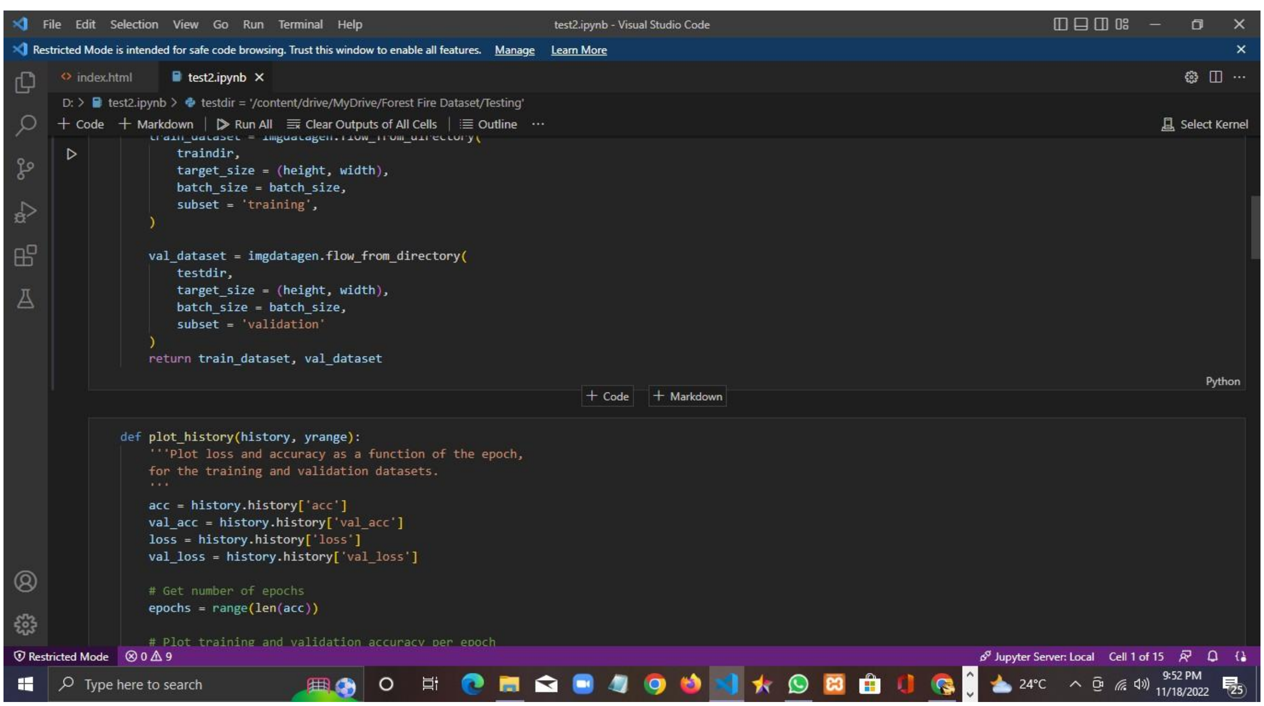
- Integrate live video data and process real timeprocessing of the fires.
- Enhance the time complexity of the detection offires to improve the speed.

13 APPENDIX

Source Code

MODEL BUILDING





```python
    # Plot training and validation accuracy per epoch
    plt.plot(epochs, acc)
    plt.plot(epochs, val_acc)
    plt.title('Training and validation accuracy')
    plt.ylim(yrange)

    # Plot training and validation loss per epoch
    plt.figure()

    plt.plot(epochs, loss)
    plt.plot(epochs, val_loss)
    plt.title('Training and validation loss')

    plt.show()
```

```python
from keras.applications import VGG19
conv_model = VGG19(weights='imagenet', include_top=False, input_shape=(224,224,3))
for layer in conv_model.layers:
    layer.trainable = False
x = keras.layers.Flatten()(conv_model.output)
x = keras.layers.Dense(100, activation='relu')(x)
x = keras.layers.Dense(100, activation='relu')(x)
x = keras.layers.Dense(100, activation='relu')(x)
predictions = keras.layers.Dense(2, activation='softmax')(x)
full_model = keras.models.Model(inputs=conv_model.input, outputs=predictions)
full_model.summary()
```

```python
from keras.applications.vgg19 import preprocess_input
train_dataset, val_dataset = generators((224,224), preprocessing=preprocess_input)
```

```
Found 1377 images belonging to 2 classes.
Found 38 images belonging to 2 classes.
```

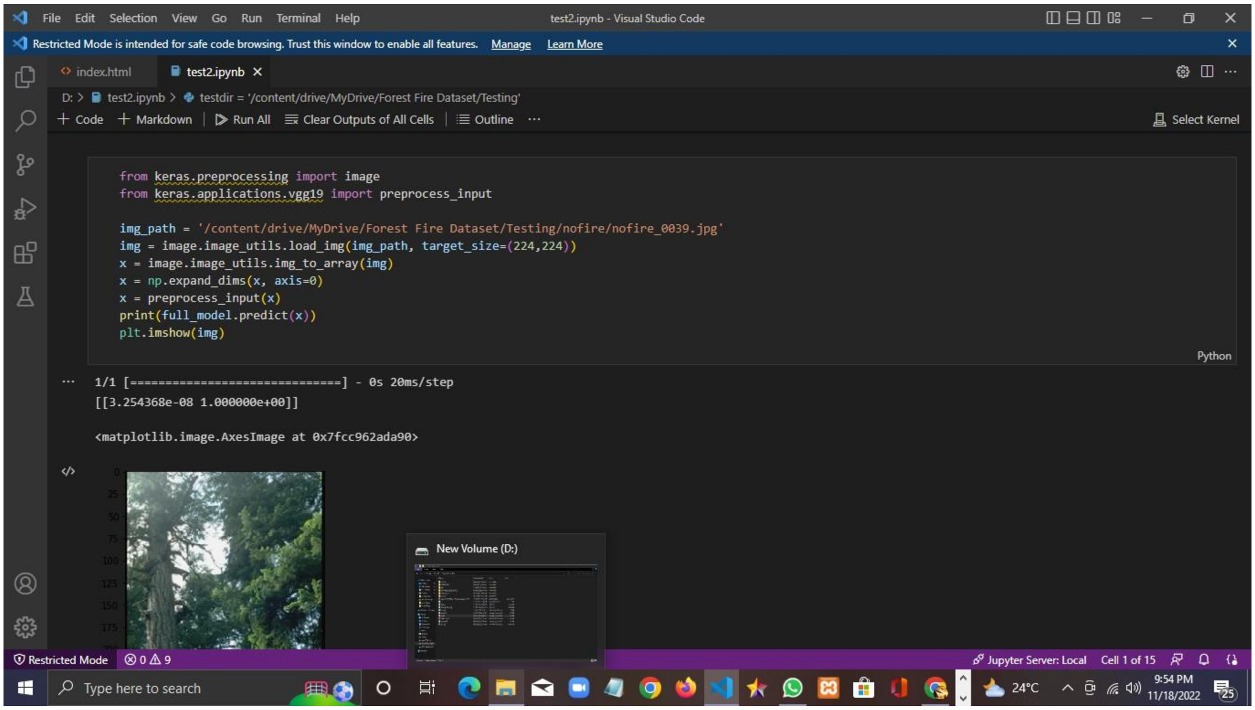
```python
train_dataset.class_indices
```

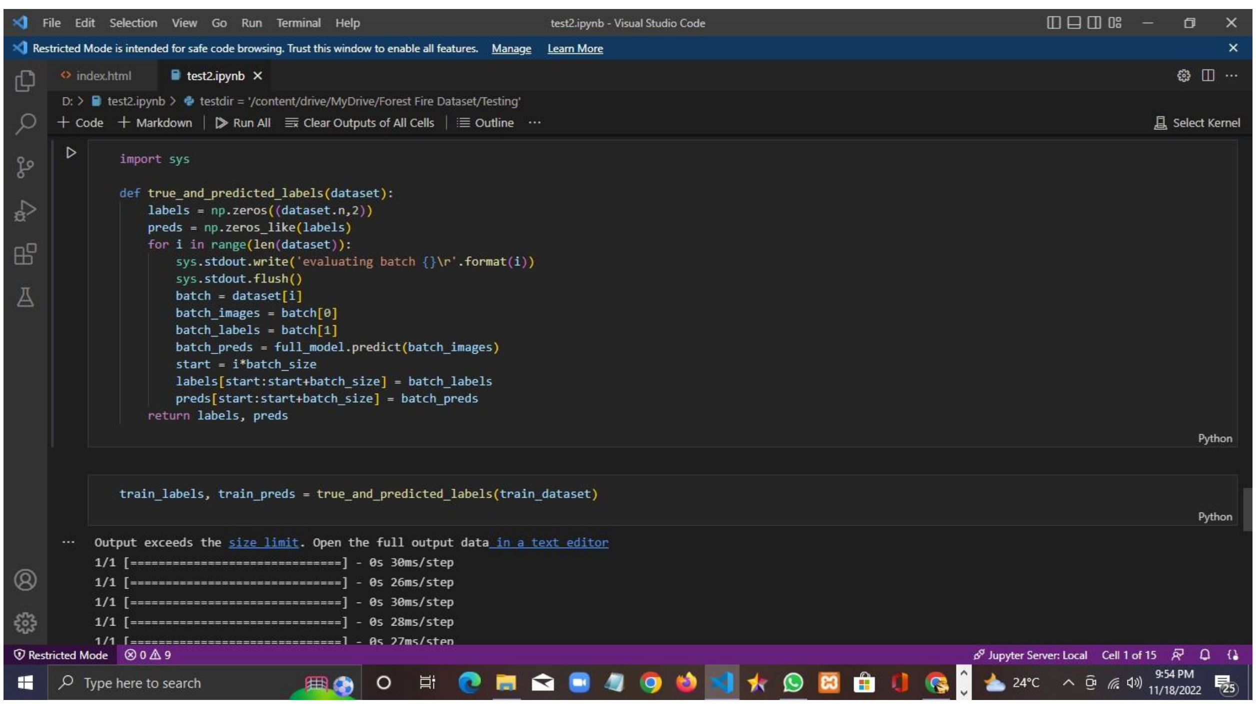
```
{'fire': 0, 'nofire': 1}
```

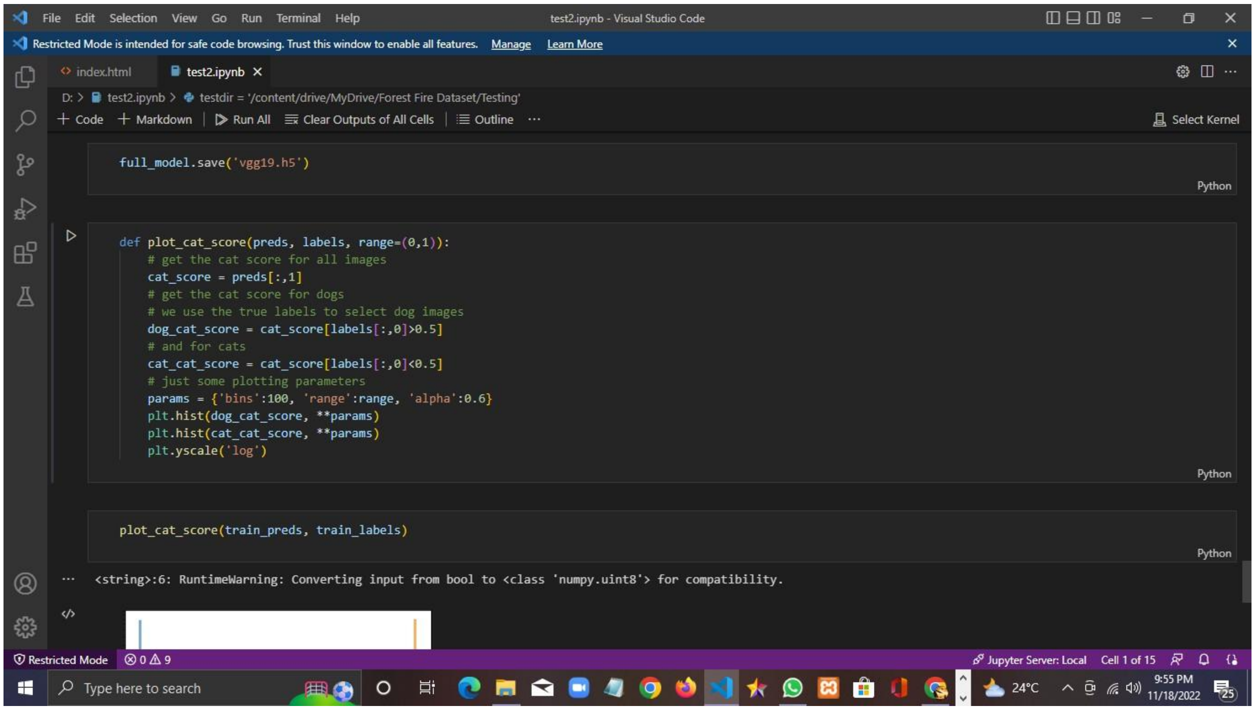
```python
val_dataset.class_indices
```

```
{'fire': 0, 'nofire': 1}
```

```python
full_model.compile(loss='binary_crossentropy',
                  optimizer=keras.optimizers.Adamax(lr=0.001),
                  metrics=['acc'])
history = full_model.fit_generator(
    train_dataset,
```


File Edit Selection View Go Run Terminal Help
test2.ipynb - Visual Studio Code
Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More
index.html
test2.ipynb
D: > test2.ipynb > testdir = '/content/drive/MyDrive/Forest Fire Dataset/Testing/'
+ Code + Markdown Run All Clear Outputs of All Cells Outline
Select Kernel
from keras.preprocessing import image
from keras.applications.vgg19 import preprocess_input
img_path = '/content/drive/MyDrive/Forest Fire Dataset/Testing/nofire/nofire_0039.jpg'
img = image.image_utils.load_img(img_path, target_size=(224,224))
x = image.image_utils.img_to_array(img)
x = np.expand_dims(x, axis=0)
x = preprocess_input(x)
print(full_model.predict(x))
plt.imshow(img)
Python
1/1 [==============================] - 0s 20ms/step
[[3.254368e-08 1.000000e+00]]
<matplotlib.image.AxesImage at 0x7fcc962ada90>
New Volume (D:)
Restricted Mode
Jupyter Server: Local
Cell 1 of 15
Type here to search
24°C
9:54 PM
11/18/2022


File Edit Selection View Go Run Terminal Help
test2.ipynb - Visual Studio Code
Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More
index.html
test2.ipynb
D: > test2.ipynb > testdir = '/content/drive/MyDrive/Forest Fire Dataset/Testing/'
+ Code + Markdown Run All Clear Outputs of All Cells Outline
Select Kernel
import sys
def true_and_predicted_labels(dataset):
labels = np.zeros((dataset.n,2))
preds = np.zeros_like(labels)
for i in range(len(dataset)):
sys.stdout.write('evaluating batch {}\r'.format(i))
sys.stdout.flush()
batch = dataset[i]
batch_images = batch[0]
batch_labels = batch[1]
batch_preds = full_model.predict(batch_images)
start = i*batch_size
labels[start:start+batch_size] = batch_labels
preds[start:start+batch_size] = batch_preds
return labels, preds
Python
train_labels, train_preds = true_and_predicted_labels(train_dataset)
Python
Output exceeds the size limit. Open the full output data in a text editor
1/1 [==============================] - 0s 30ms/step
1/1 [==============================] - 0s 26ms/step
1/1 [==============================] - 0s 30ms/step
1/1 [==============================] - 0s 28ms/step
Restricted Mode
Jupyter Server: Local
Cell 1 of 15
Type here to search
24°C
9:54 PM
11/18/2022



GitHub link :
https://github.com/IBM-EPBL/IBM-Project-549-1658306556
Demo Link:

https://youtu.be/xBzGp13OmtI