Project Report

1. INTRODUCTION

1.1 Project Overview

Humans are able to recognize body and sign language easily. This is possible due to the combination of vision and synaptic interactions that were formed along brain development . In order to replicate this skill in computers, some problems need to be solved: how to separate objects of interest in images and which image capture technology and classification technique are more appropriate, among others.

In this project Gesture based Desktop automation ,First the model is trained pre trained on the images of different hand gestures, such as a showing numbers with fingers as 1 ,2,3,4 . This model uses the integrated webcam to capture the video frame. The image of the gesture captured in the video frame is compared with the Pre-trained model and the gesture is identified. If the gesture predictes is 1 then images is blurred;2, image is resized;3,image is rotated etc.

1. Defining our classification categories
2. Collect training images
3. Train the model
4. Test our model

1.2 Purpose

The main purpose of our project is to create application in which Human can interact with system without any keyboard or mouse to achive a sterile based interaction only by using Camera, So we develop a application which only need user's hand sign to give an input throught the camera to the system.

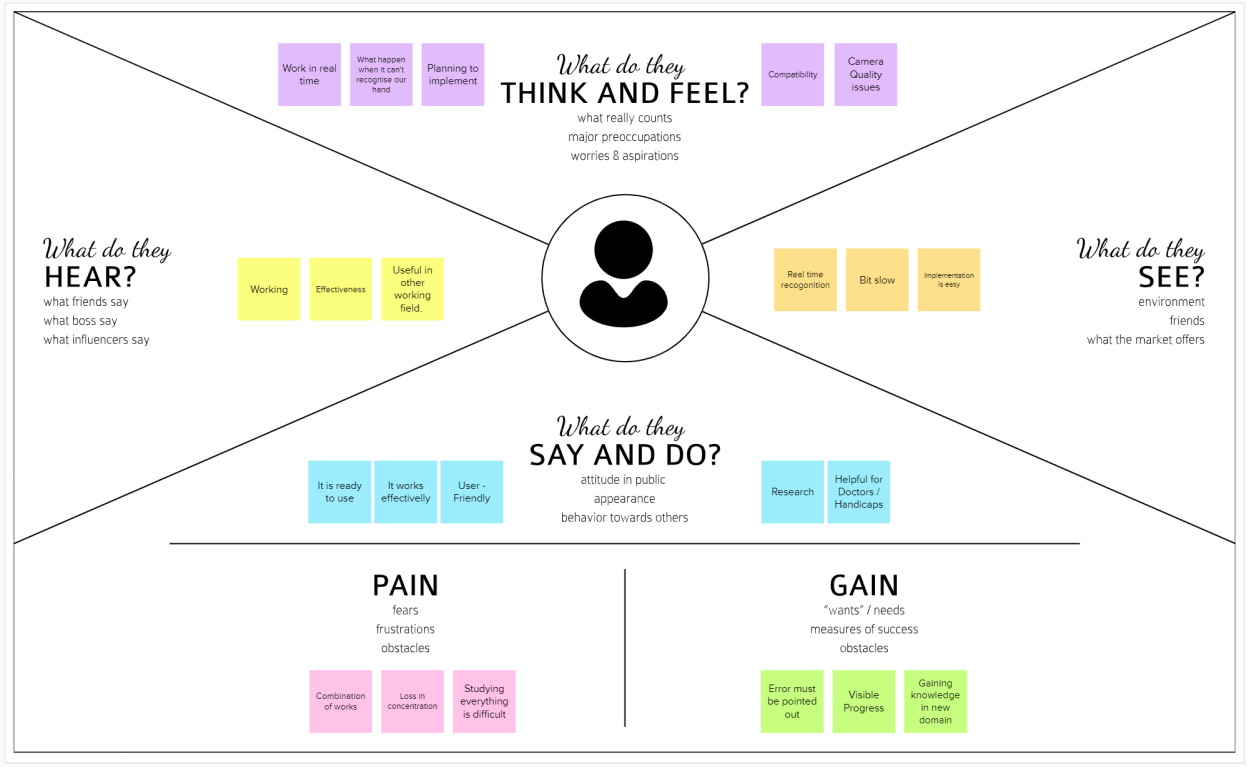
2. LITERATURE SURVEY

S.No	TITLE	AUTHOR(S)	TECHNIQUE(S)	YEAR	ADVANTAGE	DISADVANTAGES
1	Face Detection and recognition using OpenCV	Ramadan TH. Hasan, Amira Bibo Sallow	OpenCV, Face Detection, YOLO, Object Detection, Eigenfaces, Faster R-CNN, Fisherfaces	2021	YOLO is the most recent real-time object detection system that uses a single Neural Network to process the entire image. The SSD method is focused on the feed?forward convolutional network that generates a permanent border-box array and results in the existence of class-based entity instances in these boxes and a non?maximum deletion stage to generate final detection.	The Expected result is not always 100%.
2	Real Time Object Detection and Tracking Using Deep Learning and OpenCV	Chandan G, Ayush Jain, Harsh Jain, Mohana	Region-Based Convolution Neural Networks (RCNN), Single Shot, Detector, You Only Look Once (YOLO)	2018	Objects are detected using SSD algorithm in real time scenarios.SSD have shown results with considerable confidence level.This model showed excellent detection and tracking results on the object trained and can further utilized in specific scenarios to detect, track and respond to the particular targeted objects in the video surveillance	For making this system large amount of data is collected. And for making real time tracking high performanced GPU is required.
3	Air canvas applications using OpenCV and Numpy in python	Prof.S.U.Saoji, Nishtha Dua, Akash Kumar Choudhary, Barat Phoga	Air Writing, Charater Recoginition, Object Detection, Real-Time Gesture Control System, Smart Wearables, CV	2021	The system will be an excellent software for smart wearables using which people could better interact with the digital world.	Using a handwriting recognizer in place of a character recognizer will allow the user to write word by word, making writing faster. Hand-gestures with a pause can be used to control the real-time system as done by instead of using the number of fingertips. Our system sometimes recognizes fingertips in the background and changes their state

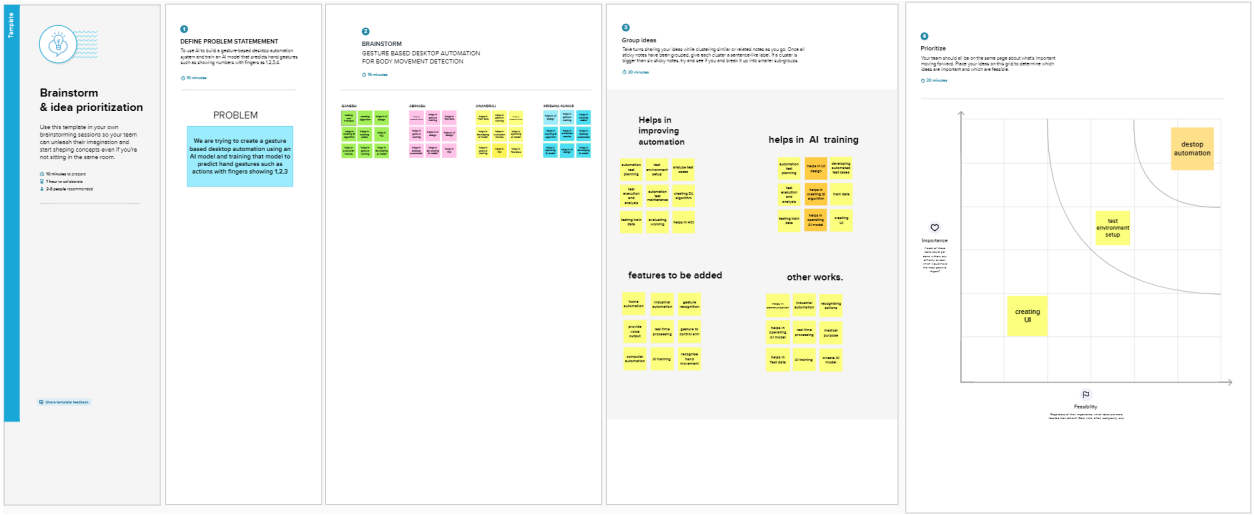
4	Two Naive Algotith m for hand tracking ang gesture recoginit ion.	Hrushikesh, Sri Vasthav Reddy, Shravalika, Sushmitha, Md Shabbeer.	OpenCV, AI, Hand Gesture Recoginition	2022	Human–machine interaction (HMI) refers to the communication and interaction between a human and a machine via a user interface. This can be used to effectively and efficiently recognize and track hands and recognize hand gestures which can then be used to control computers by assigning different simple commands to different gestures.	Detecting and processing the image and also landmark the region of hand difficult to acheive
5	Hand Gesture Recognit ion using OpenCV and Python.	Harini V, Prahelika V, Sneha I, Adline Ebenzer P.	Histogram, Background Cancellation, Contours and Convex Hull.	2020	Histogram based approach is used to separate out the hand from the background image. Background cancellation techniques are used to produce optimum results. The detector hand is then processed and modelled by finding contours and convex hull to recognize finger and palm positions and dimensions	

3. IDEATION & PROPOSED SOLUTION

Empathy Map Canvas



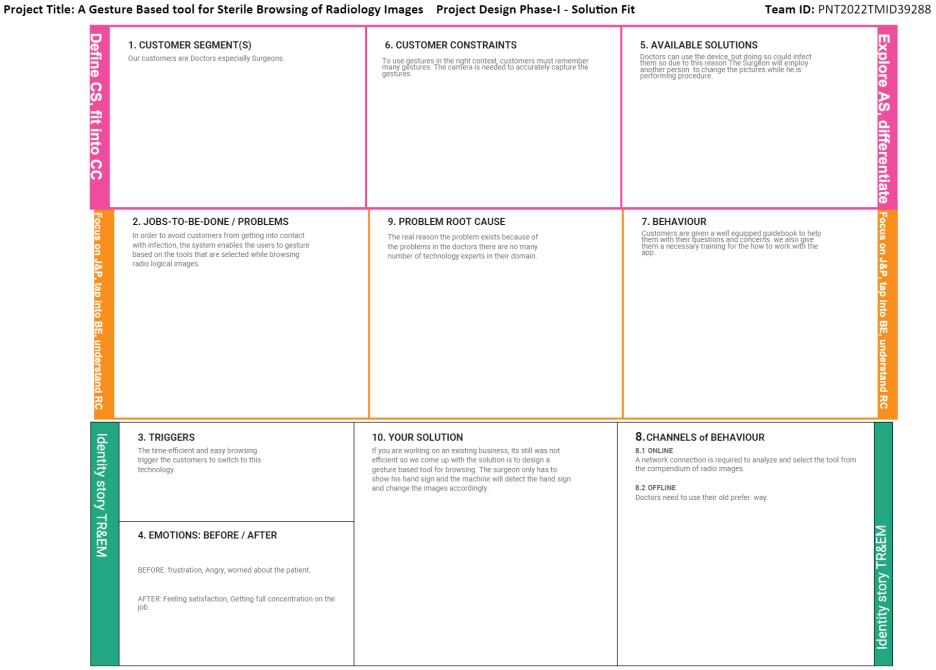
Ideation & Brainstorming



Proposed Solution

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	Using AI, create a gesture-baseddesktop automation and train a model that predicts hand gestures like showing numbers with fingers as 1,2,3
2	Idea / Solution description	To develop a CNN based classifier model, which would be trained on our training data.
3	Novelty / Uniqueness	We train a CNN based model to recognize the hand gesture. The training data include images that captures the hand gestures of 1,2,3,4,5 and 0. The image is resized without much loss of information and used for training a CNN based model. We use Python Flask to provide an UI for our model.
4	Social Impact / Customer Satisfaction	This project would help the doctors in operation theatres where physical contact between persons should be avoided in order to be sterilized and also prevent from any infections.
5	Business Model (Revenue Model)	We can provide our model as a open-source or we can make this project as monthly subscription for little income.
6	Scalability of the Solution	In future, we can include face gesture detection to manipulate the image browsing.

Problem Solution fit



4. REQUIREMENT ANALYSIS

Functional requirements

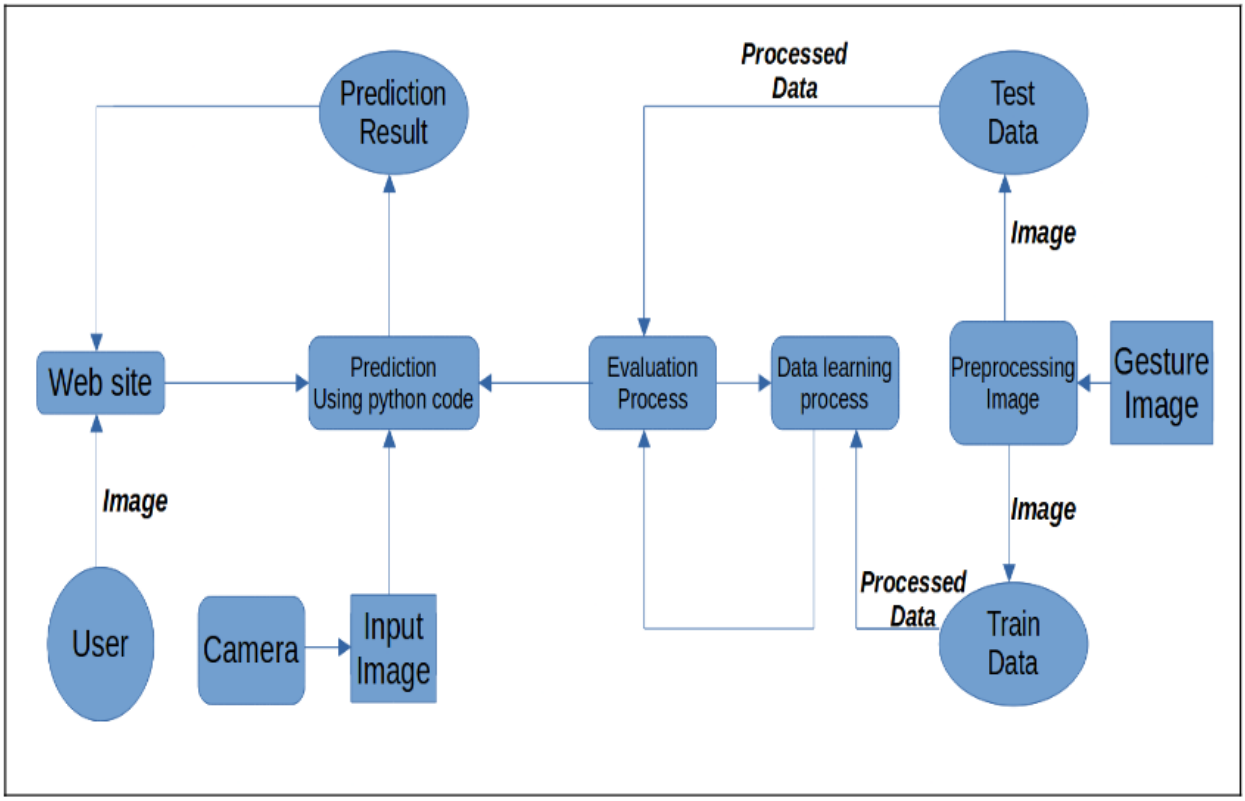
S.no	Parameters	Functional Requirement
1.	User Requirements	pc, camera for input
2.	Hardware requirements	min: i3 4th gen processor, 2Gb RAM
3.	Software requirements	python3, browser
4.	Module requirements	tensorflow, matploit, opencv, os, flask

Non-Functional requirements

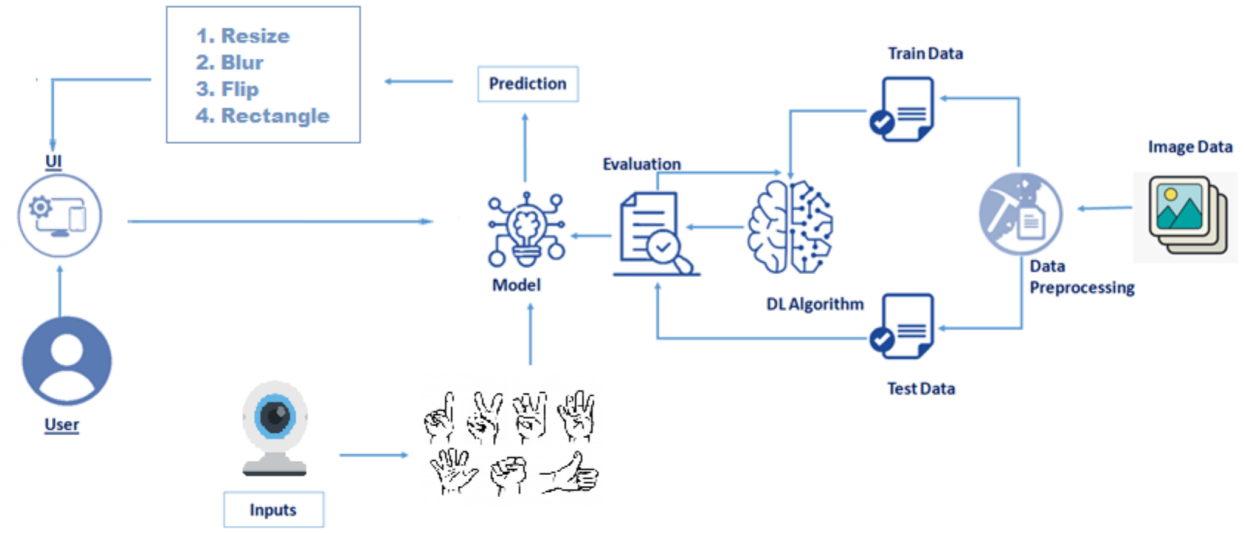
Steps	Non-Functional Requirement
1	Run the python application
2	open the browser
3	go to localhost:5000 to access user interface
4	go to launch page and upload the image
5	click on predict.

5. PROJECT DESIGN

Data Flow Diagrams



Solution & Technical Architecture



User Stories

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Tas	Story Points	Priority	Team Members
Sprint-1	User Interface Building	USN-1	As a user, I can use this website easily	10	Medium	Ganesh J Abinash M Anandaraj E Krishnakumar G
Sprint-3	Additional function	USN-12	As a user, I can use the website to blur the image and its really amazing	10	Low	Ganesh J Abinash M Anandaraj E Krishnakumar G
Sprint-2	Deployment of AI model in the cloud	USN-3	As a user i love to use a web app for human computer interaction	20	High	Ganesh J Abinash M Anandaraj E Krishnakumar G
Sprint-1	User Interface Building	USN-4	I think need better user interface for mobile	10	Low	Ganesh J Abinash M Anandaraj E Krishnakumar G
Sprint-4	Additional function	USN-5	Need some additional function like crop	10	Low	Ganesh J Abinash M Anandaraj E Krishnakumar G
Sprint-3	Deployment of AI model in the cloud	USN-6	As a user, I think the website need to faster in back end processing	20	High	Ganesh J Abinash M Anandaraj E Krishnakumar G
Sprint-4	Prediction	USN-7	As a user, I can get the predicted results from the model deployed in the cloud	20	High	Ganesh J Abinash M Anandaraj E Krishnakumar G

6. PROJECT PLANNING & SCHEDULING

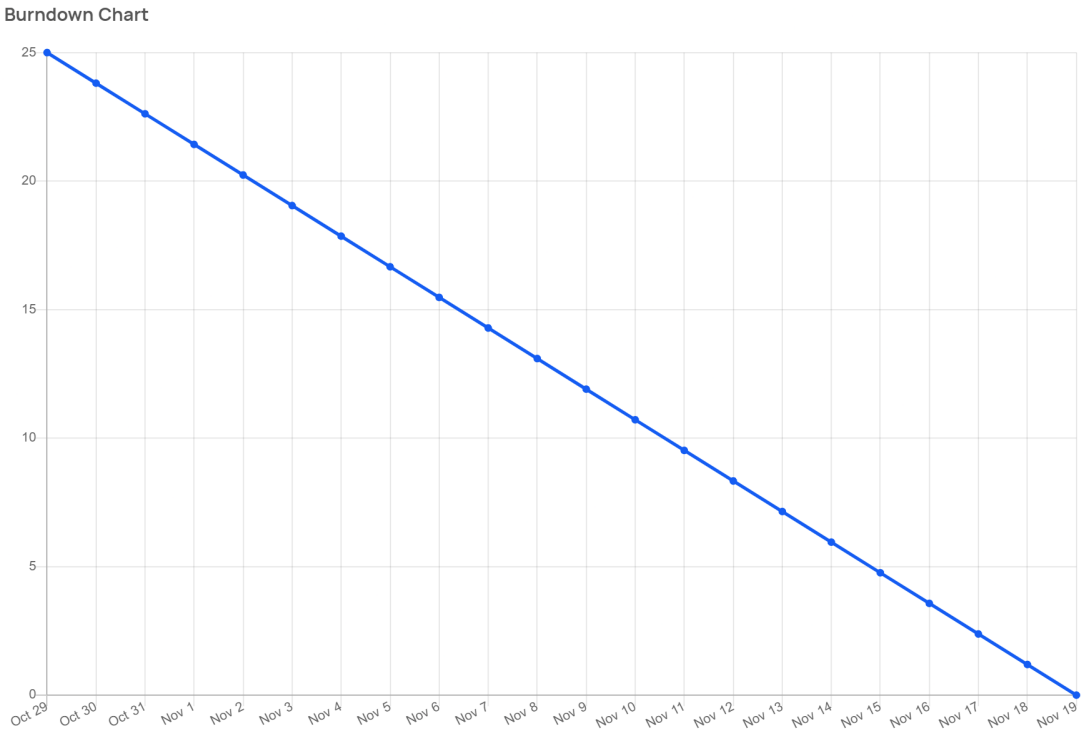
Sprint Planning & Estimation

S.no	Milestone	Activites	Date
1.	Preparation Phase	Pre-requisites	22 Aug 2022 - 27 Aug 2022
		Prior Knowledge	
		Project Structure	
		Project Flow	
		Project Objective	
		Registrations	
		Environment Setup	
2.	Ideation Phase	Literature Survey	29 Aug 2022 - 03 Sep 2022
		Empthy Map	05 Sept 2022 - 10 Sept 2022
		Ideation	12 Sept 2022 - 17 Sept 2022
3.	Project Design Phase - I	Proporsed Solution	19 Sept 2022 - 24 Sept 2022
		Problem Solution Fit	19 Sept 2022
		Solution Architecture	
4.	Project Design Phase - II	Customer Journey	03 Oct 2022 - 08 Oct 2022
		Requirement Analysis	10 Oct 2022 - 15 Oct 2022
		Data Flow Diagrams	
		Technology Architecture	
5.	Project Planning Phase	Milestone & Tasks	17 Oct 2022 - 22 Oct 2022
		Sprint Schedules	
6.	Project Development Phase	Sprint - 1	24 Oct 2022 - 29 Oct 2022
		Sprint - 2	31 Oct 2022 - 05 Nov 2022
		Sprint - 3	07 Nov 2022 - 12 Nov 2022
		Sprint - 4	14 Nov 2022 - 19 Nov 2022

Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint - 1	20	6 Days	24 Oct 2022	29 Oct 2022	20	27 Oct 2022
Sprint - 2	20	6 Days	31 Oct 2022	05 Nov 2022	20	04 Oct 2022
Sprint - 3	30	6 Days	07 Nov 2022	12 Nov 2022	30	09 Oct 2022
Sprint - 4	30	6 Days	14 Oct 2022	19 Nov 2022	30	14 Oct 2022

Reports from JIRA



Burndown Chart

7. CODING & SOLUTIONING

Required Modules :

```
from flask import Flask,render_template,request
import operator
import cv2 # opencv library
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
import numpy as np
from tensorflow.keras.models import load_model
import os
from werkzeug.utils import secure_filename
```

These are the important modules we required to run the application.

```
app = Flask(__name__,template_folder="templates") # initializing a flask app
```

Initialize the Flask :

It will initialize the flask web server frame work for the user interface

```
@app.route('/')# route to display the home page
def home():
    return render_template('home.html')#rendering the home page

@app.route('/intro') # routes to the intro page
def intro():
    return render_template('intro.html')#rendering the intro page

@app.route('/image1',methods=['GET','POST'])# routes to the index html
def image1():
    return render_template("launch.html")
```

Request and Response function :

These are function which helps to receive the request from the browser and send the appropriate response to the browser.

Prediction model :

```
# Loading the model
model=load_model('gesture.h5')
```

This Statement will Include the Trained model.

Camera access :

```
cap = cv2.VideoCapture(0)
while True:
    _, frame = cap.read() #capturing the video frame values
    frame = cv2.flip(frame, 1)# Simulating mirror image
    x1 = int(0.5*frame.shape[1]) # Coordinates of the ROI
    y1 = 10
    x2 = frame.shape[1]-10
    y2 = int(0.5*frame.shape[1])
    cv2.rectangle(frame, (x1-1, y1-1), (x2+1, y2+1), (255,0,0) ,1)# Drawing the ROI
    roi = frame[y1:y2, x1:x2]# Extracting the ROI
```

This code helps to access the camera to get an input for the prediction model.

Upload the image :

```
if request.method == 'POST':
    print("inside image")
    f = request.files['image']
    basepath = os.path.dirname(__file__)
    file_path = os.path.join(basepath, 'uploads', secure_filename(f.filename))
    f.save(file_path)
    print(file_path)
```

Its work is to save the uploaded image for the manipulation.

Prediction function :

```
result = model.predict(test_image.reshape(1, 64, 64, 1))
prediction = {'ZERO': result[0][0],
              'ONE': result[0][1],
              'TWO': result[0][2],
              'THREE': result[0][3],
              'FOUR': result[0][4],
              'FIVE': result[0][5]}
# Sorting based on top prediction
prediction = sorted(prediction.items(), key=operator.itemgetter(1), reverse=True)
# Displaying the predictions
cv2.putText(frame, prediction[0][0], (10, 120), cv2.FONT_HERSHEY_PLAIN, 1, (0,255,255), 1)
cv2.imshow("Frame", frame)
```

It will predict the value of the input from the camera

Manipulation code :

```
if prediction[0][0]=='ZERO':
    cv2.waitKey(0)
```

If the prediction value is zero it stop the process and wait for the key 0 to press.

```
elif prediction[0][0]=='ONE':
    try:
        cv2.destroyWindow("op")
    except:
        print("1")
    finally:
        resized = cv2.resize(image1, (200, 200))
        cv2.imshow("op", resized)
elif prediction[0][0]=='THREE':
    try:
        cv2.destroyWindow("op")
    except:
        print("3")
    finally:
        (h, w, d) = image1.shape
        center = (w // 2, h // 2)
        M = cv2.getRotationMatrix2D(center, -45, 1.0)
        rotated = cv2.warpAffine(image1, M, (w, h))
        cv2.imshow("op", rotated)
```

- If the prediction value is one then the image will be resized to shape 200X200.
- If the prediction value is three then the image will be rotated to angle 45degree.
- If the prediction value is two then the image will be blured.
- If the prediction value is four then the image will be resized to 400X400.

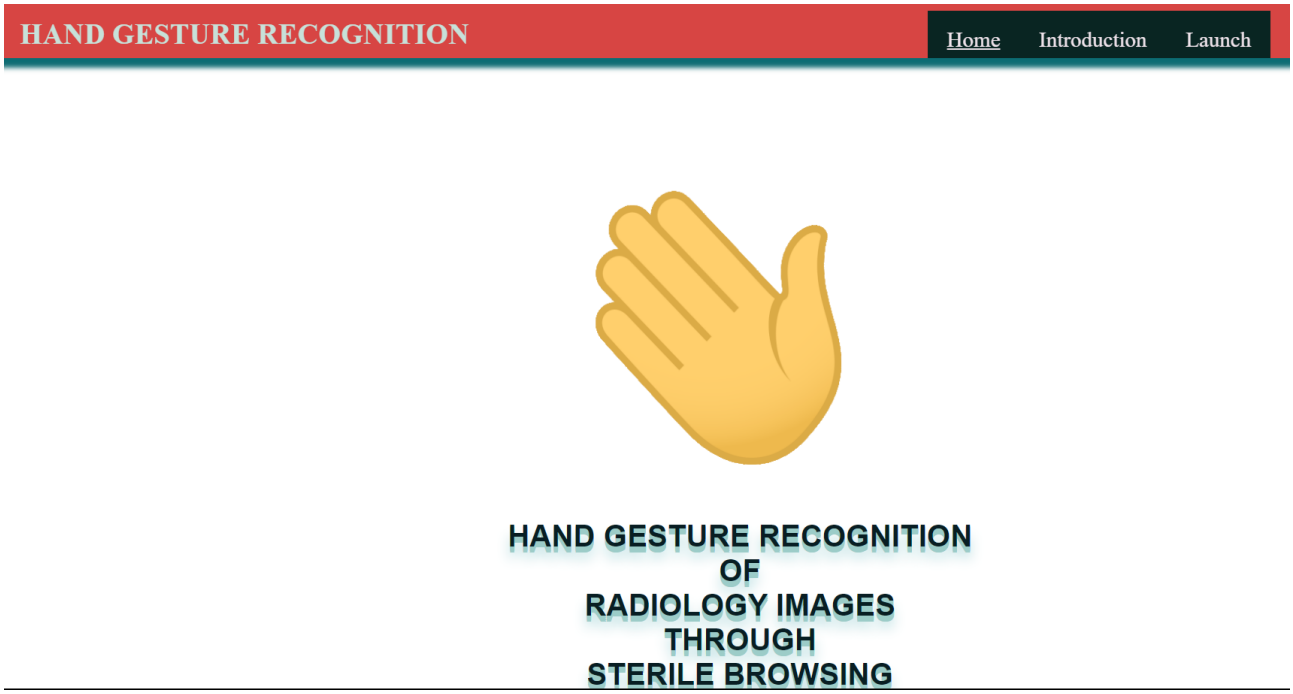
```
elif prediction[0][0]=='FIVE':
    try:
        cv2.destroyWindow("op")
    except:
        print("5")
    finally:
        gray = cv2.cvtColor(image1, cv2.COLOR_RGB2GRAY)
        cv2.imshow("op", gray)

else:
    continue
```

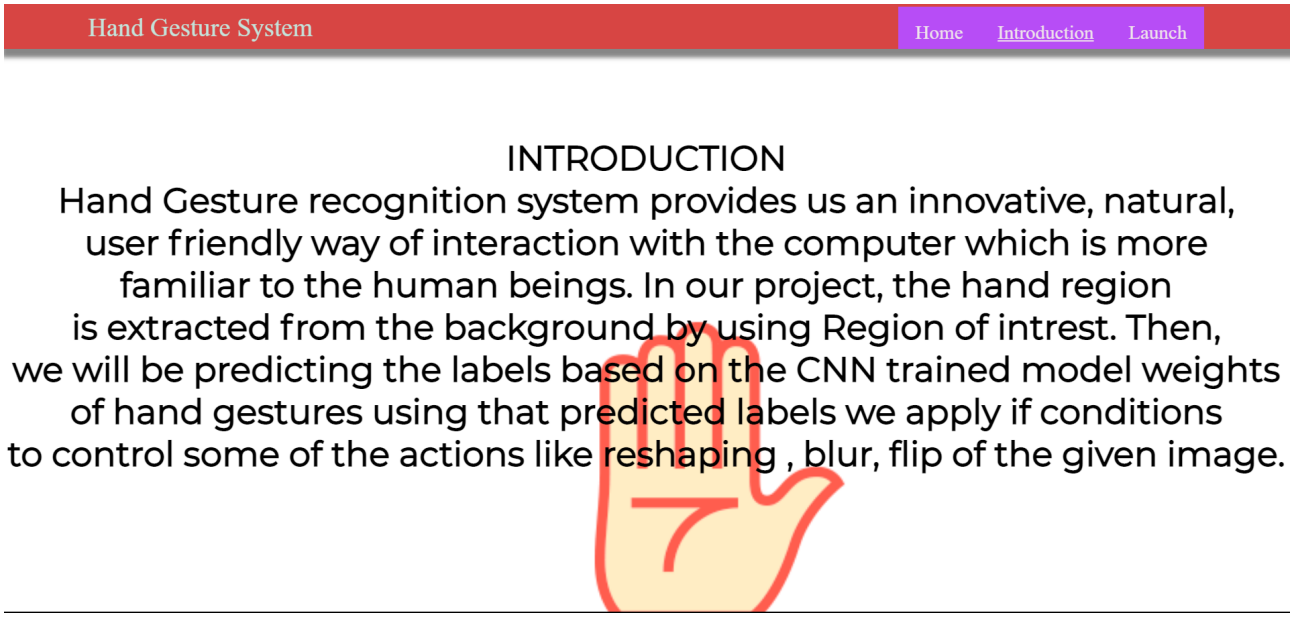
- If the prediction value is five then the image will be converted to rgb to gray.
- If the prediction value is something else it just continue.

User Interface :

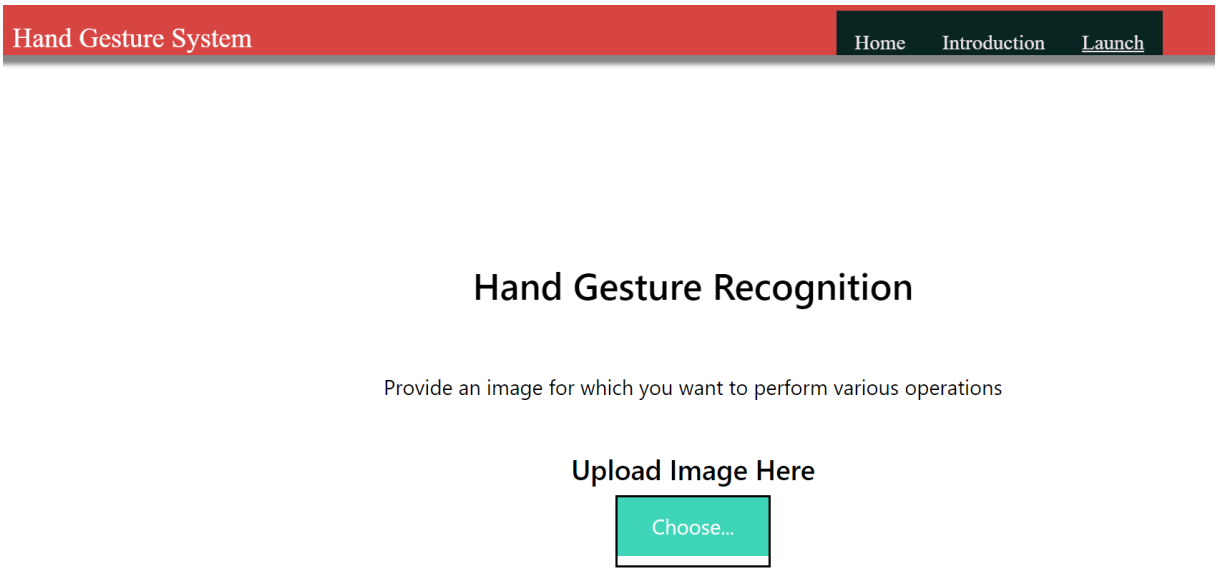
Home Page :

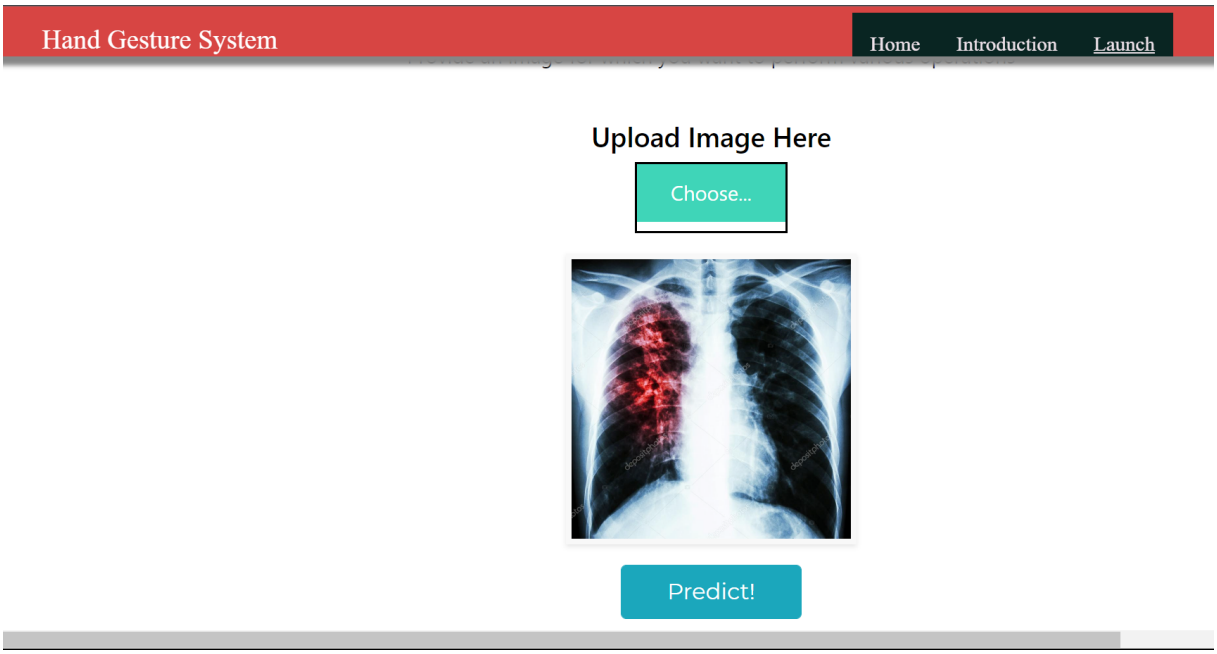


Introduction Page :



Launch Page





In this page you can upload the image to be edited, after upload the image just press predict.

8. TESTING

Test Cases :

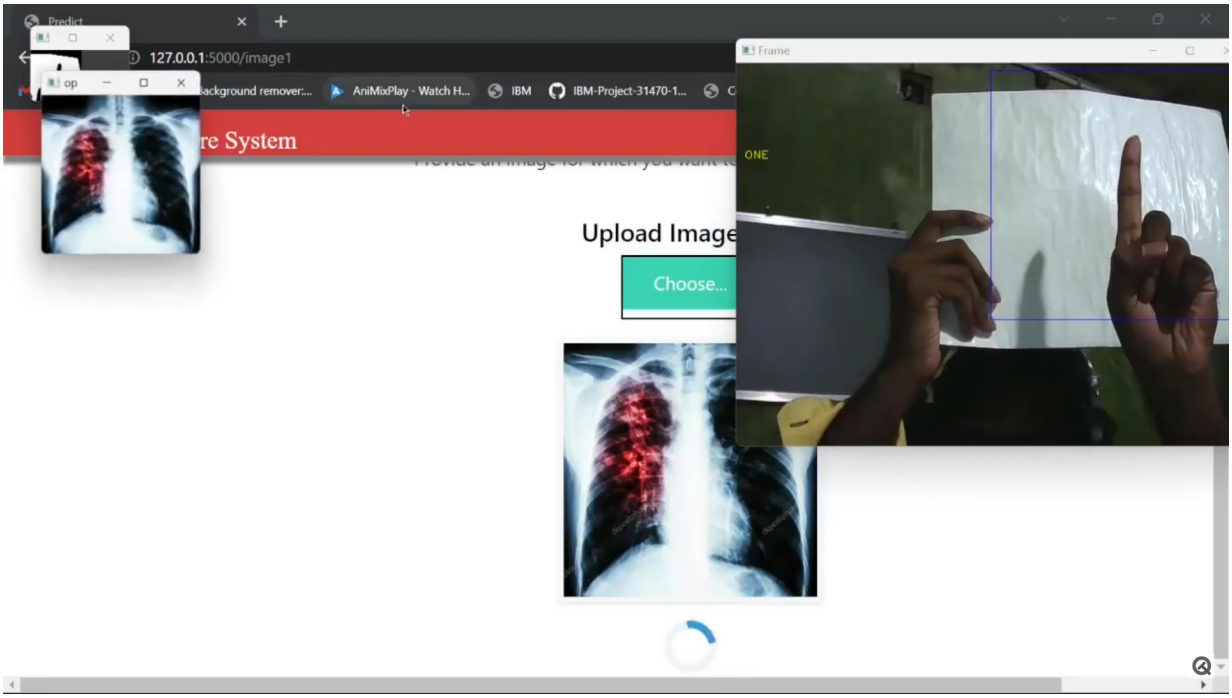
Refer : Testcases Report.xlsx

User Acceptance Testing :

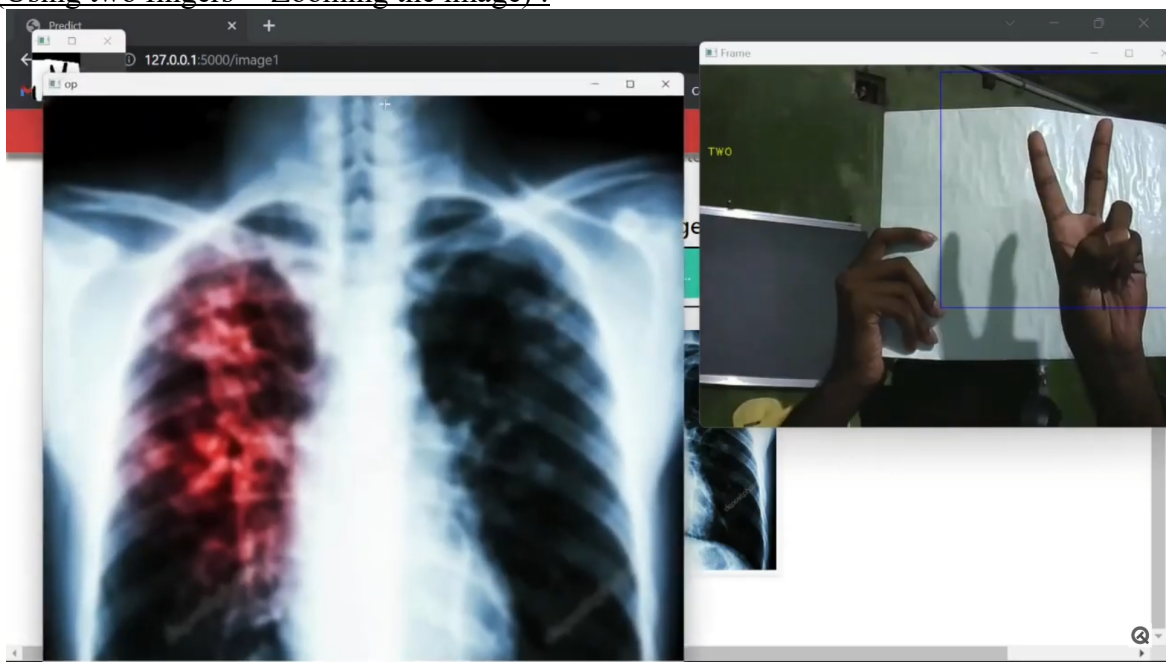
Refer : UAT Report.pdf

9. RESULTS

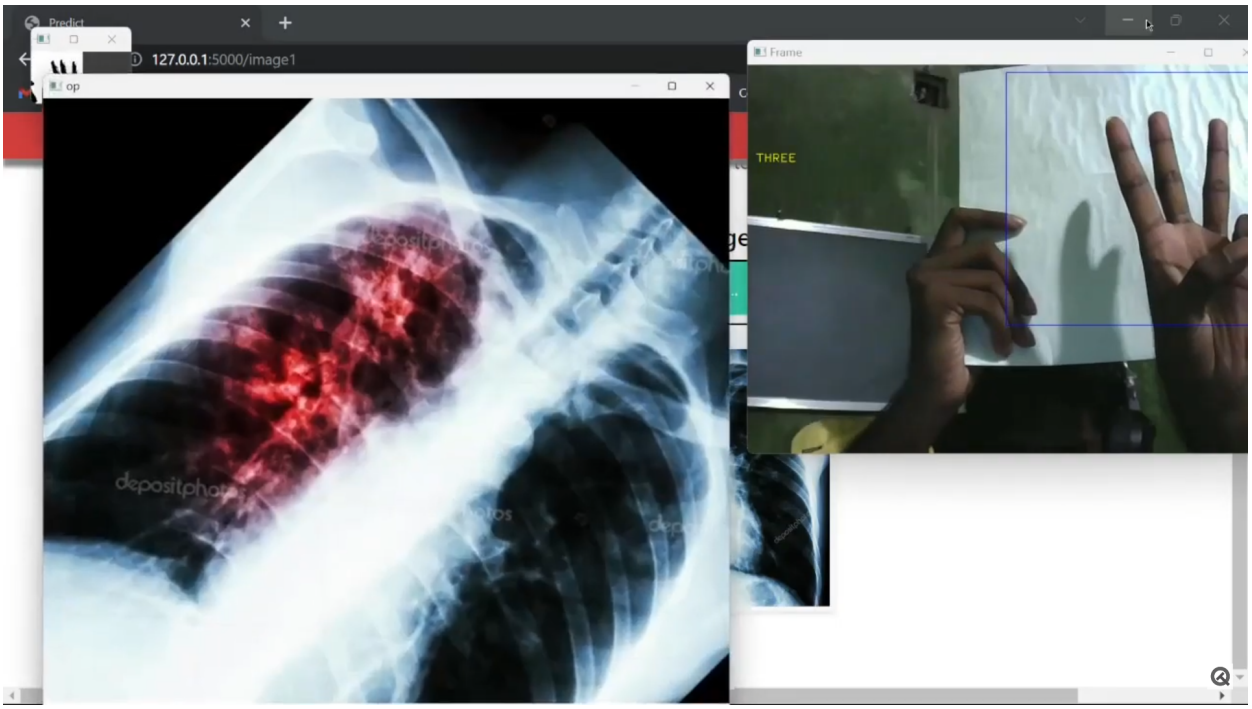
1. (Using One finger -- Opening Image):



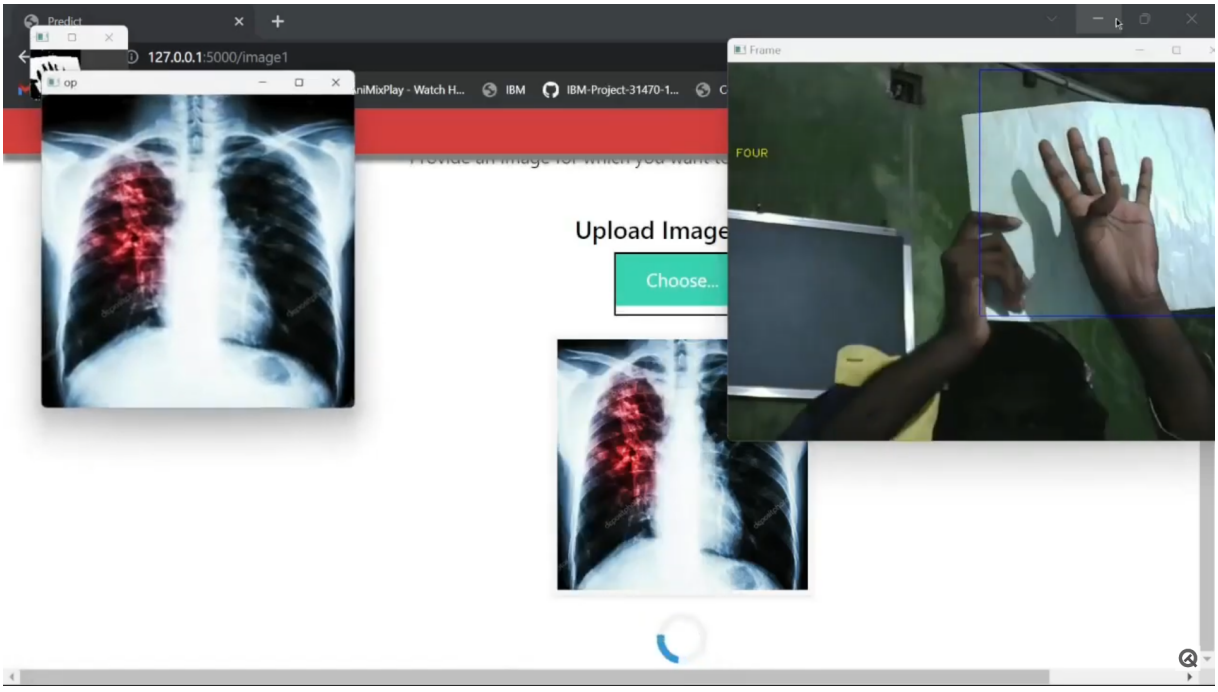
2. (Using two fingers -- Zooming the image) :



3. (Using 3 Fingers -- Rotating The Image) :



4. (Using four Fingers) :



Performance Metrics :

Model Performance Testing :

S.no	Parameter	Values	Screenshots
1.	Model Summary	Total Params : 3,224,422 Trainable Params : 3,224,422	Fig - 9.1
2.	Accuracy	Training Accuracy - 98%	Fig - 9.2 (a)
		Validation Accuracy - 96%	Fig - 9.2 (b)

Summary

```
In [8]: model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 62, 62, 32)        320

 max_pooling2d (MaxPooling2D  (None, 31, 31, 32)       0
 )

 conv2d_1 (Conv2D)           (None, 29, 29, 32)        9248

 max_pooling2d_1 (MaxPooling  (None, 14, 14, 32)       0
 2D)

 flatten (Flatten)           (None, 6272)              0

 dense (Dense)               (None, 512)               3211776

 dense_1 (Dense)             (None, 6)                 3078

=================================================================
Total params: 3,224,422
Trainable params: 3,224,422
Non-trainable params: 0
_________________________________________________________________
```

Fig - 9.1

```
In [10]: train_loss = his.history['loss']
         val_loss   = his.history['val_loss']
         train_acc  = his.history['accuracy']
         val_acc    = his.history['val_accuracy']
         xc         = range(1,26)

         plt.figure()
         plt.plot(xc, train_loss)
         plt.plot(xc, val_loss)

Out[10]: [<matplotlib.lines.Line2D at 0x183c6b614e0>]
```

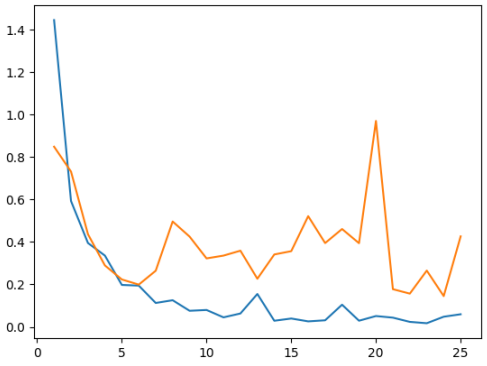


Fig - 9.2 (a)

```
In [11]: plt.plot(xc, train_acc)
         plt.plot(xc, val_acc)

Out[11]: [<matplotlib.lines.Line2D at 0x183c6c08d90>]
```

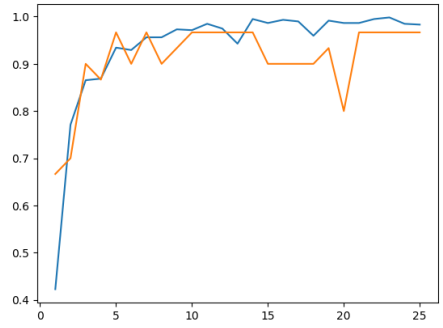


Fig - 9.2 (b)

10. ADVANTAGES & DISADVANTAGES

Advantages :

- As mention in Problem Statement, The Images can be viewed, Zoom, operated Without using Keyboard or Mouse for acheiving Sterile Browsing.
- Not only Radiology Images, But also Other Image Files can be uploaded and Viewed.
- Can be easily implemented on low powered processor.
- Works in Both Linux and Windows.

Disadvantages :

- Light position should be correctly positioned in order to improve accuracy.
- Sometimes it will stop automatically after certain period of time on running, In order is Continue, there should be some Input in command prompt (Terminal, PS).

11. CONCLUSION

So the main objective of our Project is to create a application in which the user uses their hands to give input to the system to browse Images. This is performed in order to acheive Sterile Browsing. Hence The application is built in Industrial method by following Agile methodology to understand the basic concepts of Agile methodolgy, and programming concepts of Python, Tensorflow . And also train and implement the model on IBM Cloud etc.

12. FUTURE SCOPE

- In Future, Certain Disadvantages Can be removed, and acheive full Sterile Browsing.
- Might be implemented not only for sterile browsing but also for other applications.
- Can be implemented on AR/VR 3D Tracking Technologies

13. APPENDIX

Source Code

GitHub Link : https://github.com/IBM-EPBL/IBM-Project-31470-1660200782
Project Demo : https://youtu.be/2syVe3xQYWE