TABLE OF CONTENTS

A Gesture-Based Tool For Sterile Browsing Of Radiology Images

1.<u>INTRODUCTION</u>

1.1 Project overview

Gestures as a basic form of non-verbal communication made with the hands. 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 . Inorder 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, User interacts with the UI (User Interface) to upload the image as input. Depending on the different gesture inputs different operations are applied to the input image. Once model analyses the gesture, the prediction with operation applied on image is showcased on the UI. 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 by data collection and then image is processed by ImageDataGenerator library. The proposed project is done using open cv and IBM cloud. By CNN model is initialized and input,hidden,output layers are created and then is proposed for testing and training. 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 predicted is 1 then images is blurred;2, image is resized;3, image is rotated etc. Application layout is done by HTML for better outlook.

1.2 Purpose

Computer information technology is increasingly penetrating into the hospital domain. A major challenge involved in this process is to provide doctors with efficient, intuitive, accurate and safe means of interaction without affecting the quality of their work. Keyboards and pointing devices, such as a mouse, are today's principal method of human—computer interaction. However, the use of computer keyboards and mice by doctors and nurses in intensive care units (ICUs) is a common method for spreading infections.we suggest the use of hand gestures as an alternative to existing interface techniques, offering the major advantage of sterility In this work we refer to gestures as a basic form of non-verbal communication made with the hands. Psychological studies showed that young children use gestures to communicate before they learn to talk. Manipulation, as a form of gesticulation, is often used when people speak to each other about some object. Naturalness of expression, non-encumbered interaction, intuitiveness and high sterility are all good reasons to replace the current interface technology (e.g., keyboard, mouse, and joystick) with more natural interfaces.

2. LITERATURE SURVEY

2.1 Existing problem

The use of doctor-computer interaction devices in the operation room (OR) requires new modalities that support medical imaging manipulation while allowing doctors' hands to remain sterile, supporting their focus of attention, and providing fast response times

Keyboards and pointing devices, suchas a mouse, are today’s principal method of human—computer interaction. However, the use of computer key-boards and mice by doctors and nurses in intensive care units (ICUs) is a common method for spreading infections. In this paper, we suggest the use of hand gestures as an alternative to existing interface techniques, offering themajor advantage of sterility. Even though voice control alsoprovides sterility, the noise level in the operating room (OR)deems it problematic.

2.2 References

*1.***Hand gesture recognition with depth images**

(*J. Suarez and R. R. Murphy 2012)*

The papers that use the Kinect and the OpenNI libraries for hand tracking tend to focus more on applications than on localization and classification methods, and show that the OpenNI hand tracking method is good enough for the applications tested. Kinect and other depth sensors for gesture recognition have yet to be tested in challenging applications and environments.

2. Gesture-Based Affective Computing on Motion Capture Data

(Kapur, A.,Kapur, A.,Virji-Babul,N.,Tzanetakis,G., Driessen,P.F. (2005).Gesture Based Affective Computing on Motion Capture Data.In: Tao, J.,Tan, T.,Picard, R.W.(eds) Affective Computing and Intelligent Interaction.ACII 2005.Lecture Notes in Computer Science, vol3784.)

Body skeletal movements captured using video-based sensor technology developed by Vicon Motion Systems, to train machine to identify different human emotions. automatic classification results into perspective a user study onthe human perception of the same data was conducted with average classification accuracy of 93%.Accuracy is not 100%

3. A gesture based interaction technique for a planning tool for construction and design

M.Rauterberg, M. Bichsel, M. Meier and M. Fjeld, "A gesture based interaction technique for a planning tool for construction and design," Proceedings 6th IEEEInternational Workshop on Robot and Human Communicatio n. RO-MAN'97 SENDAI, 1997, pp. 212-217, doi: 10.1109/ROM AN.1997.6469 84

The AR design strategy enables humans to behave in a nearly natural way. Natural interaction means human actions in the real world with other humans and/or with real world objects. Guided by the basic constraints of natural interaction, we derive a set of recommendations for the next generation of user interfaces: the natural user interface (NUI). Our approach to NUIs is discussed in the form of a general framework followed by a prototype.

4. Gesture-based interaction and communication: automated classification of hand gesture contours

L. Gupta and Suwei Ma, "Gesture- based interaction and communicatio n: automated classification of hand gesture contours," in IEEE Transactions on Systems, Man, and Cybernetics

The accurate classification of hand gestures is crucial in the development of novel hand gesture-based systems designed for human-computer interaction (HCI) and for human alternative and augmentative communication (HAAC). A complete vision-based system, consisting of hand gesture acquisition, segmentaion, filtering, representation and classification, is developed to robustly classify hand gestures.

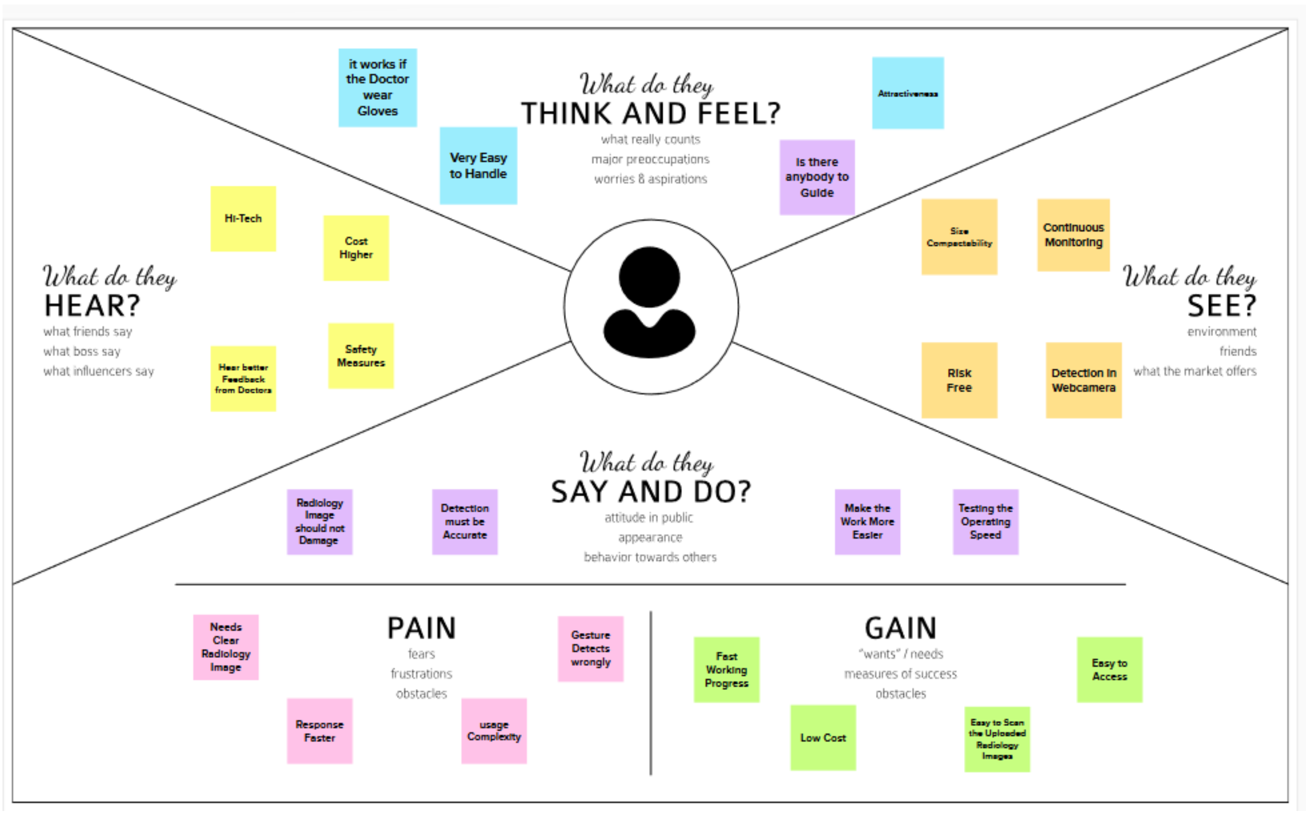
2.3 Problem Statement Definition

The use of doctor-computer interaction devices in the operation room (OR) requires new modalities that support medical imaging manipulation while allowing doctors' hands to remain sterile, supporting their focus of attention, and providing fast response times

Keyboards and pointing devices, such as a mouse, are today's principal method of human—computer interaction. However, the use of computer key-boards and mice by doctors and nurses in intensive care units (ICUs) is a common method for spreading infections.we suggest the use of hand gestures as an alternative to existing interface techniques, offering the major advantage of sterility provides sterility, the noise level in the operating room (OR) deems it problematic.In this project Gesture based Desktop automation, User interacts with the UI (User Interface) to upload the image as input. Depending on the different gesture inputs different operations are applied to the input image. Once model analyses the gesture, the prediction with operation applied on image is showcased on the UI. 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 by data collection and then image is processed by ImageDataGenerator library . The proposed project is done using open cv and IBM cloud.By CNN model is initialized and input,hidden,output layers are created and then is proposed for testing and training. 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 predicted is 1 then images is blurred;2, image is resized;3,image is rotated etc. Application layout is done by HTML for better outlook.

3. IDEATION AND PROPOSED SOLUTION

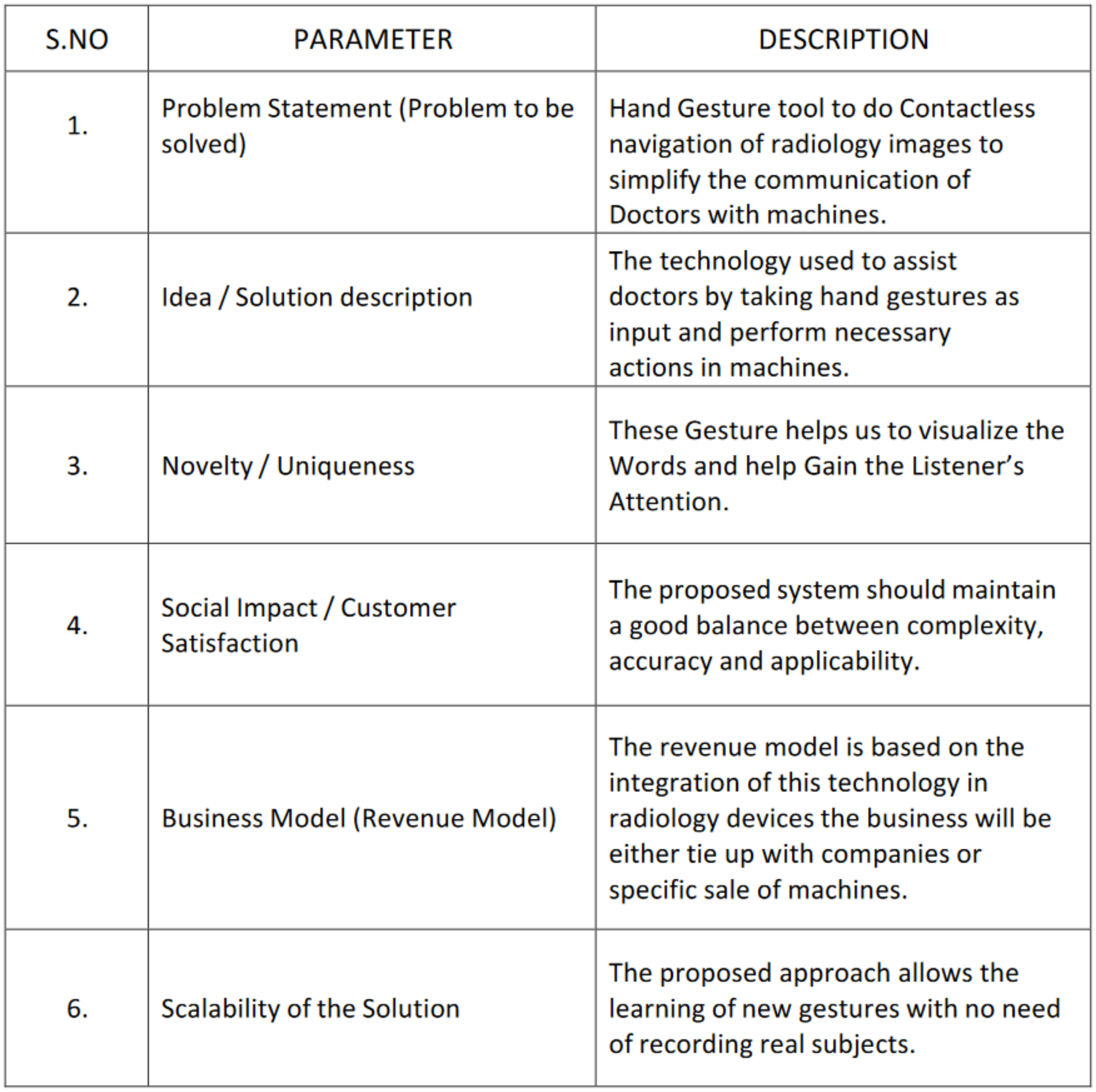
3.1 Empathy Map canvas



3.2 Ideation and brainstorming

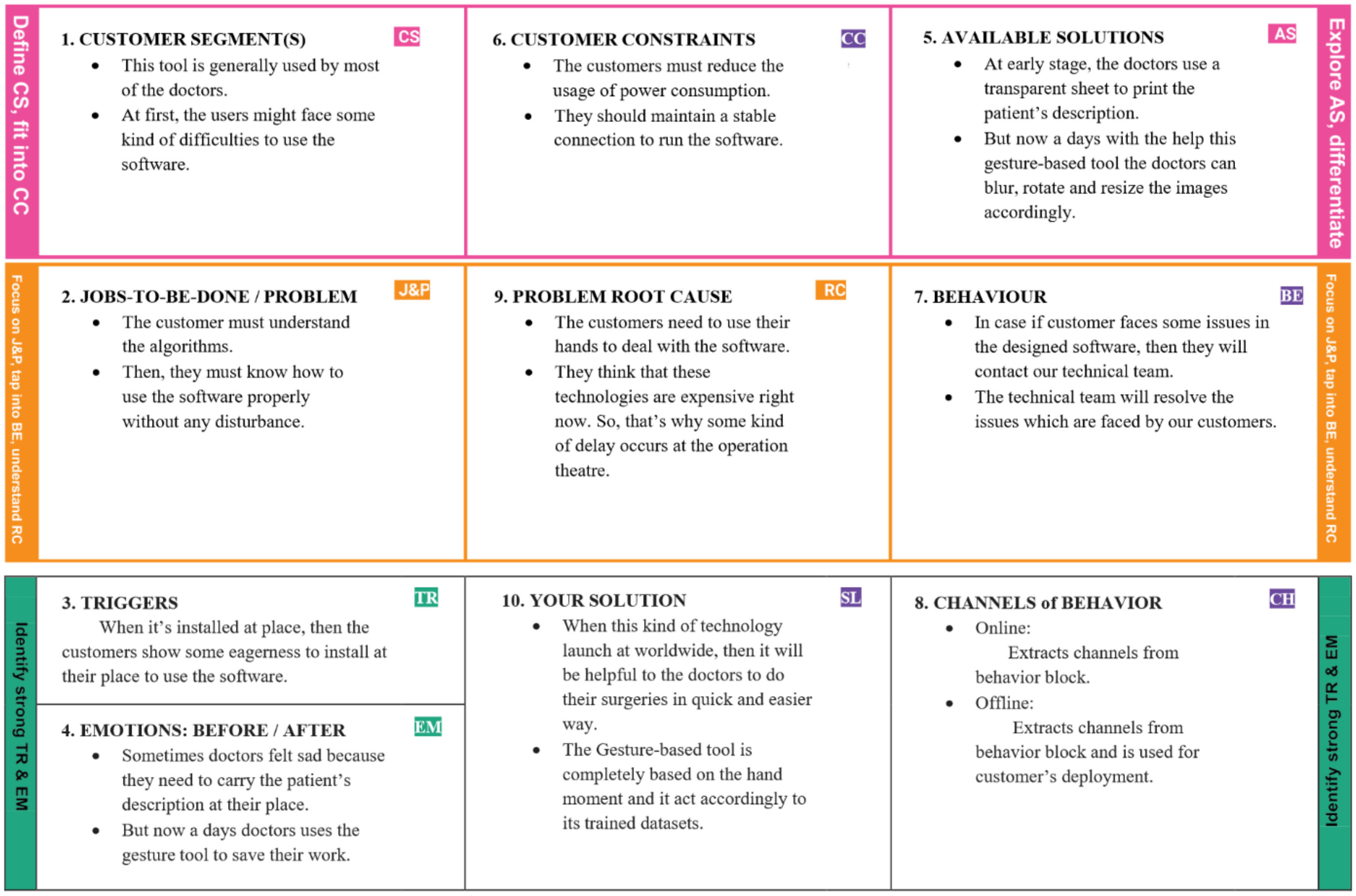
Gestures as a basic form of non-verbal communication made with the hands. Humans are able to recognize body and sign language easily. This is possible due to the combination of vision and synaptic interactions that were formed along brain development . Inorder to replicate this skill in computers, some 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, User interacts with the UI (User Interface) to upload the image as input. Depending on the different gesture inputs different operations are applied to the input image. Once model analyses the gesture, the prediction with operation applied on image is showcased on the UI. 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 by data collection and then image is processed by ImageDataGenerator library. The proposed project is done using open cv and IBM cloud. By CNN model is initialized and input,hidden,output layers are created and then is proposed for testing and training. 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 predicted is 1 then images is blurred;2, image is resized;3, image is rotated etc. Application layout is done by HTML for better outlook.

3.3 Proposed Solution



S.NO	PARAMETER	DESCRIPTION
1.	Problem Statement (Problem to be solved)	Hand Gesture tool to do Contactless navigation of radiology images to simplify the communication of Doctors with machines.
2.	Idea / Solution description	The technology used to assist doctors by taking hand gestures as input and perform necessary actions in machines.
3.	Novelty / Uniqueness	These Gesture helps us to visualize the Words and help Gain the Listener's Attention.
4.	Social Impact / Customer Satisfaction	The proposed system should maintain a good balance between complexity, accuracy and applicability.
5.	Business Model (Revenue Model)	The revenue model is based on the integration of this technology in radiology devices the business will be either tie up with companies or specific sale of machines.
6.	Scalability of the Solution	The proposed approach allows the learning of new gestures with no need of recording real subjects.

3.4 Problem solution fit



Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

- This tool is generally used by most of the doctors.
- At first, the users might face some kind of difficulties to use the software.

6. CUSTOMER CONSTRAINTS CC

- The customers must reduce the usage of power consumption.
- They should maintain a stable connection to run the software.

5. AVAILABLE SOLUTIONS AS

- At early stage, the doctors use a transparent sheet to print the patient's description.
- But now a days with the help this gesture-based tool the doctors can blur, rotate and resize the images accordingly.

Explore AS, differentiate

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

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

- The customer must understand the algorithms.
- Then, they must know how to use the software properly without any disturbance.

9. PROBLEM ROOT CAUSE RC

- The customers need to use their hands to deal with the software.
- They think that these technologies are expensive right now. So, that's why some kind of delay occurs at the operation theatre.

7. BEHAVIOUR BE

- In case if customer faces some issues in the designed software, then they will contact our technical team.
- The technical team will resolve the issues which are faced by our customers.

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

Identify strong TR & EM

3. TRIGGERS TR

When it's installed at place, then the customers show some eagerness to install at their place to use the software.

4. EMOTIONS: BEFORE / AFTER EM

- Sometimes doctors felt sad because they need to carry the patient's description at their place.
- But now a days doctors uses the gesture tool to save their work.

10. YOUR SOLUTION SL

- When this kind of technology launch at worldwide, then it will be helpful to the doctors to do their surgeries in quick and easier way.
- The Gesture-based tool is completely based on the hand moment and it act accordingly to its trained datasets.

8. CHANNELS of BEHAVIOR CH

- Online:
  Extracts channels from behavior block.
- Offline:
  Extracts channels from behavior block and is used for customer's deployment.

Identify strong TR & EM

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Launching the model	Launch the trained CNN model from the cloud
FR-2	Capturing the images	After capturing the images in camera we have to upload the images in the system
FR-3	Performing gestures	After classifying, identify the correct image by the gesture and it should perform the operation
FR-4	Model rendering	After capturing the image the algorithm will start its processing task
FR-5	Sterile browsing	The sterile browsing can be performed after identifying the gestures
FR-6	Visibility of images	After completing all the processes,a user can be able to see the images

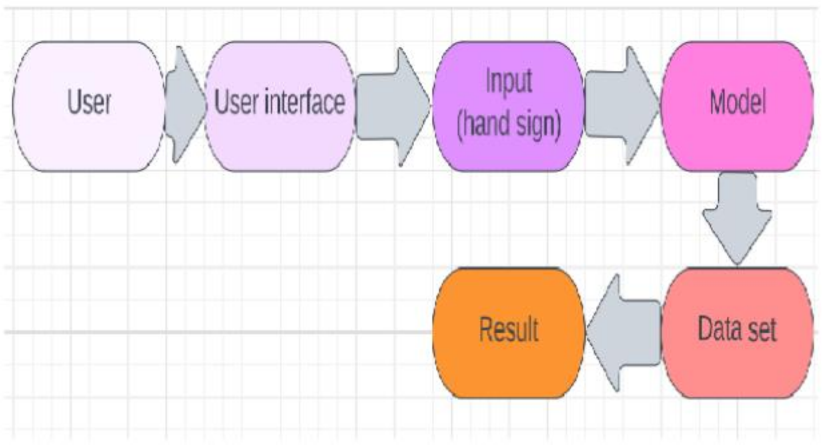
4.2 Non-Functional requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	This system helps to have the control over images without having direct contact with system which avoids the harmful rays and is ease of use
NFR-2	**Security**	This system is protected and only authorized users can access it
NFR-3	**Reliability**	After installing the application,the system will predict the gesture and performs sterile browsing
NFR-4	**Performance**	The system responds to a user in seconds and the hardware and software works well
NFR-5	**Availability**	It is accessible by authorised user from anywhere at any time whenever there is an emergency
NFR-6	**Scalability**	This system allows more number of users at a time and there is no loss can be identified

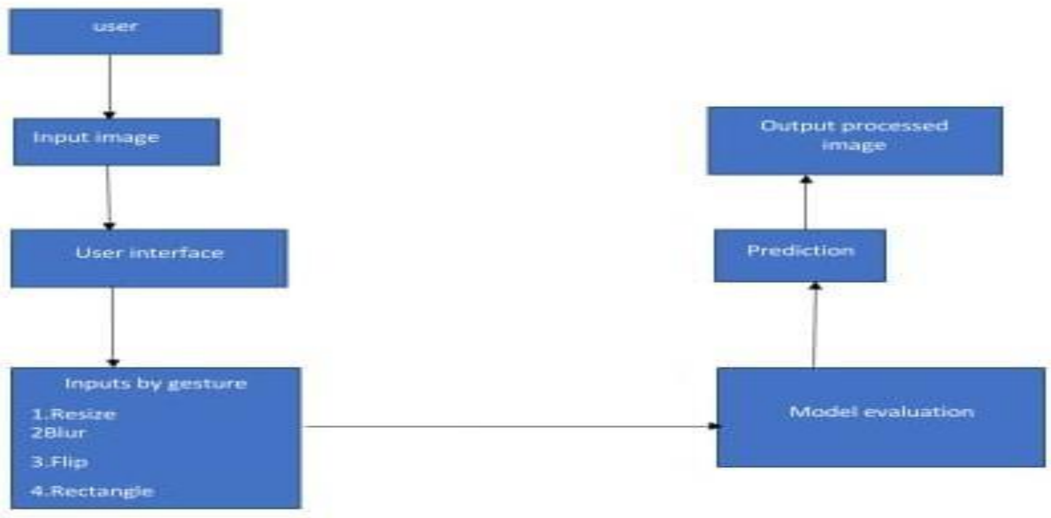
5. PROJECT DESIGN

5.1 Data Flow Diagrams

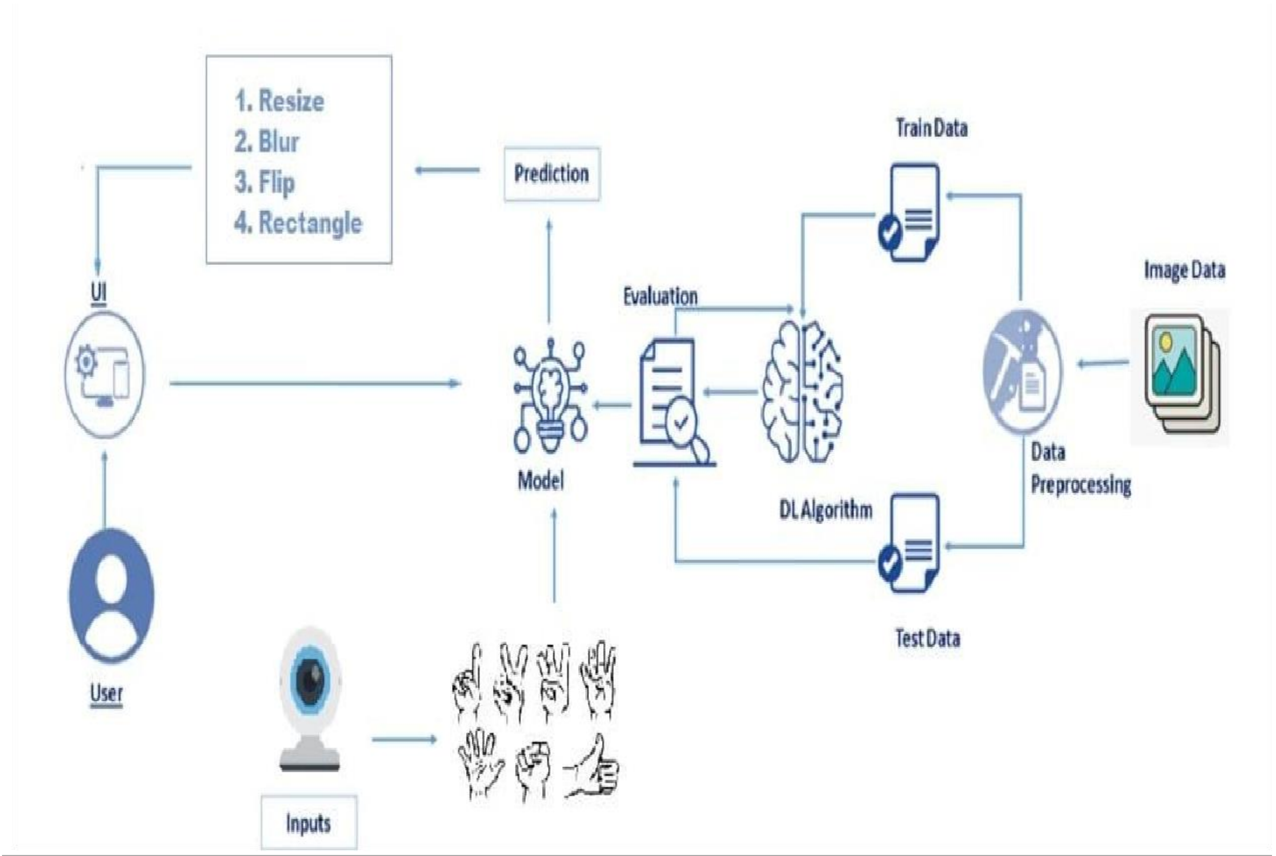
Simplified form



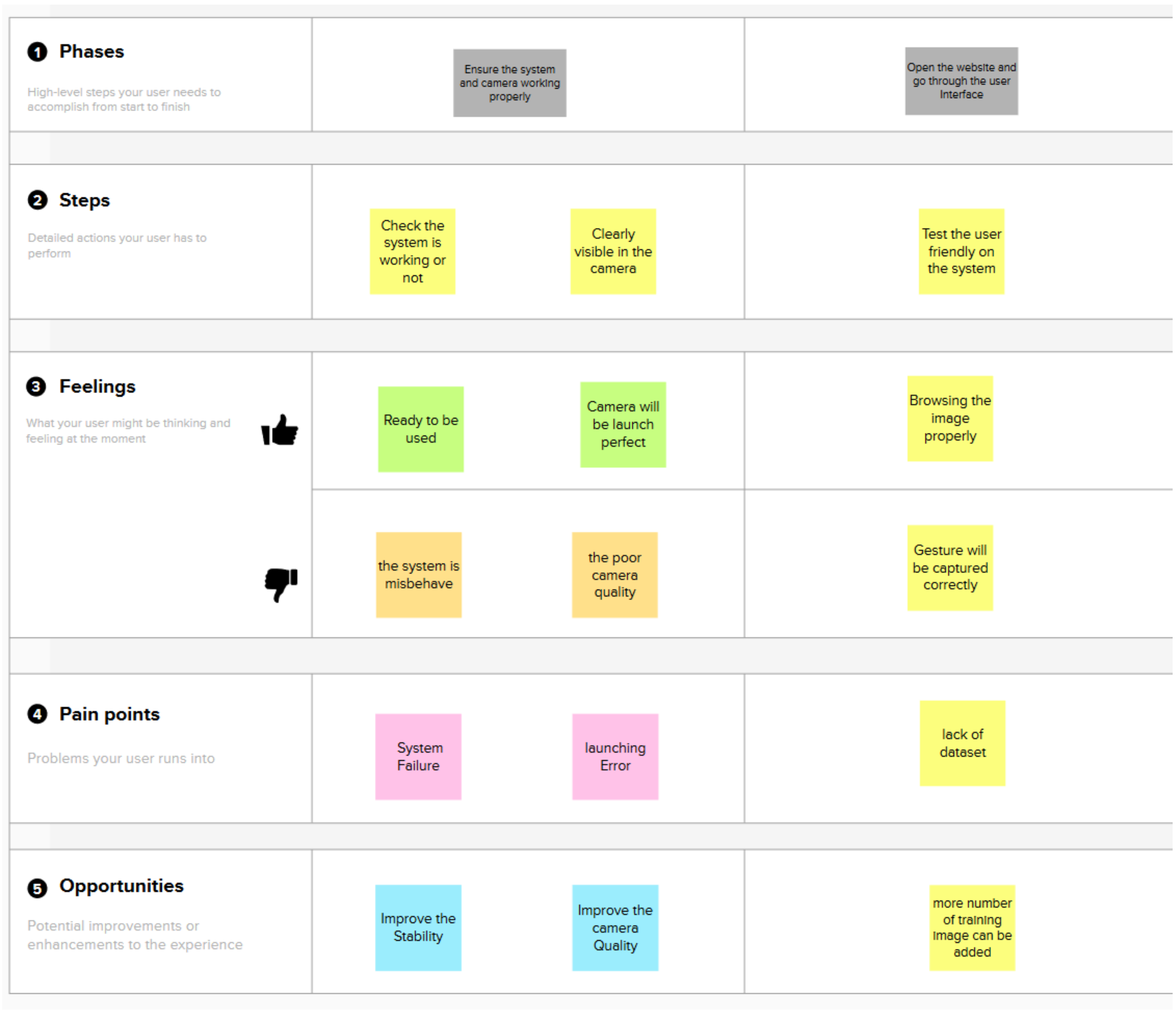
Flow diagram



5.2 Solution & Technical Architecture



5.3 User stories



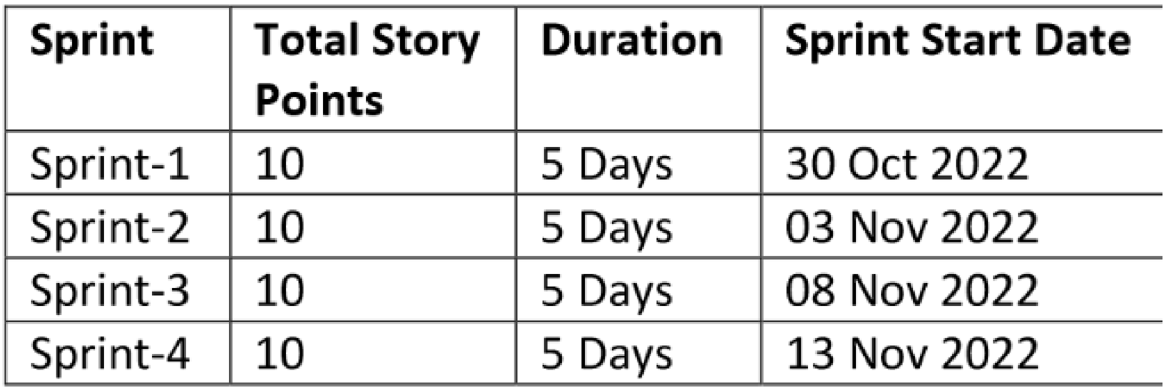
1 Phases High-level steps your user needs to accomplish from start to finish	Ensure the system and camera working properly		Open the website and go through the user Interface
2 Steps Detailed actions your user has to perform	Check the system is working or not	Clearly visible in the camera	Test the user friendly on the system
3 Feelings What your user might be thinking and feeling at the moment 👍	Ready to be used	Camera will be launch perfect	Browsing the image properly
👎	the system is misbehave	the poor camera quality	Gesture will be captured correctly
4 Pain points Problems your user runs into	System Failure	launching Error	lack of dataset
5 Opportunities Potential improvements or enhancements to the experience	Improve the Stability	Improve the camera Quality	more number of training image can be added

6. PROJECT PLANNING & SCHEDULING

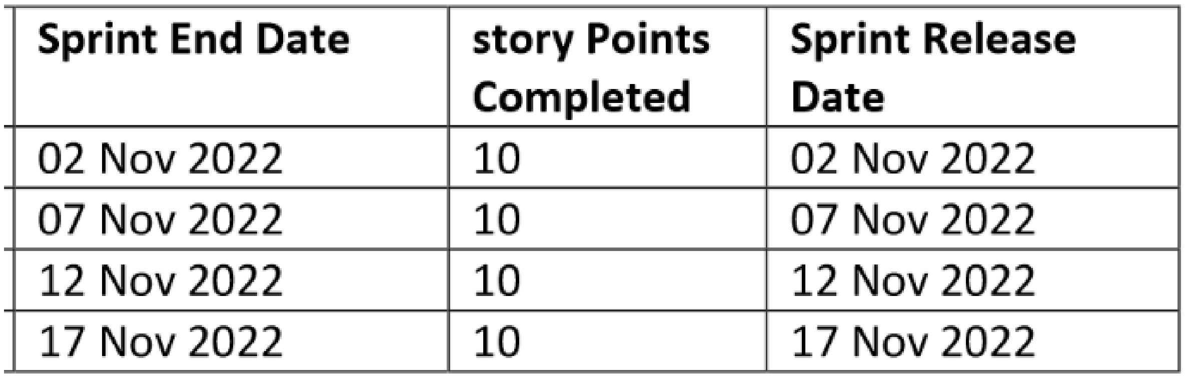
6.1 Sprint Planning and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Point	Priority	Team Members
Sprint-1	**Data Collection**	USN-1	Download the Dataset	10	High	B.Raghul Krishna
Sprint-1		USN-2	Image Pre-processing	10	High	B.Raghul Krishna
Sprint-1		USN-3	Import and Configure the Image Data Generator Library and Class	10	High	B.Raghul Krishna S.Muthamil Selvam S.Vishva
Sprint-1		USN-4	Apply Image Data Generator Functionality to Train-Set and Test-Set	10	High	B.Raghul Krishna R.Vignesh
Sprint-2	**Model Building**	USN-5	Import the Model Building Libraries and Initializing the Model	10	High	B .Raghul Krishna S.Muthamil Selvam S.Vishva
Sprint-2		USN-6	Adding CNN Layers and Dense Layers	10	High	B.Raghul Krishna R.Vignesh S.Muthamil Selvam
Sprint-2		USN-7	Configure the Learning Process	10	High	B.Raghul Krishna S.Vishva
Sprint-2		USN-8	Train the Model, Save the Model and Test the Model	10	High	B.Raghul Krishna R.Vignesh
Sprint-3	**Application Building**	USN-9	Create Web Application using HTML, CSS, JavaScript	10	High	B.Raghul Krishna
Sprint-3		USN-10	Build Python code	10	High	S.Vishva
Sprint-4	**Train The Model on IBM**	USN-11	Register for IBM Cloud	10	High	R.Vignesh
Sprint-4		USN-12	Train the Model and Test the Model and its Overall Performance	10	High	S.Muthamil Selvam

6.2 Sprint Delivery schedule



Sprint	Total Story Points	Duration	Sprint Start Date
Sprint-1	10	5 Days	30 Oct 2022
Sprint-2	10	5 Days	03 Nov 2022
Sprint-3	10	5 Days	08 Nov 2022
Sprint-4	10	5 Days	13 Nov 2022



Sprint End Date	story Points Completed	Sprint Release Date
02 Nov 2022	10	02 Nov 2022
07 Nov 2022	10	07 Nov 2022
12 Nov 2022	10	12 Nov 2022
17 Nov 2022	10	17 Nov 2022

7. CODING & SOLUTIONING

Project structure

● Dataset folder contains the training and testing images for training our model.

● We are building a Flask Application which needs HTML pages stored in the templates folder and a python script app.py for server side scripting

● we need the model which is saved and the saved model in this content is gesture.h5

● The static folder will contain js and cssfiles

● Whenever we upload a image to predict, that images is saved in uploads folder.

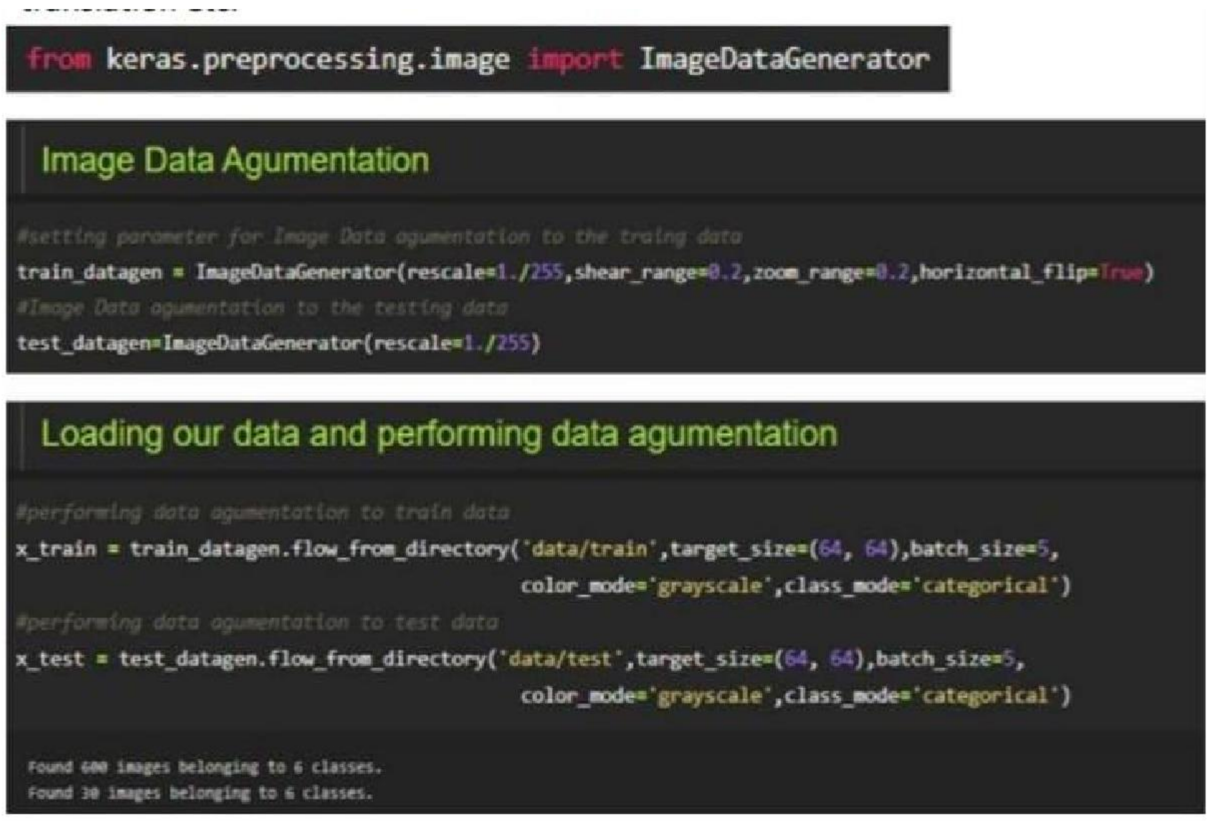
Data collection

ML depends heavily on data, without data, it is impossible for a machine to learn. It is the most crucial aspect that makes algorithm training possible. In

Machine Learning projects, we need a training data set. It is the actual data set used to train the model for performing various actions.

Image processing

In this step we improve the image data that suppresses unwilling distortions or enhances some image features important for further processing, although perform some geometric transformations of images like rotation, scaling, translation etc.



```
from keras.preprocessing.image import ImageDataGenerator
```

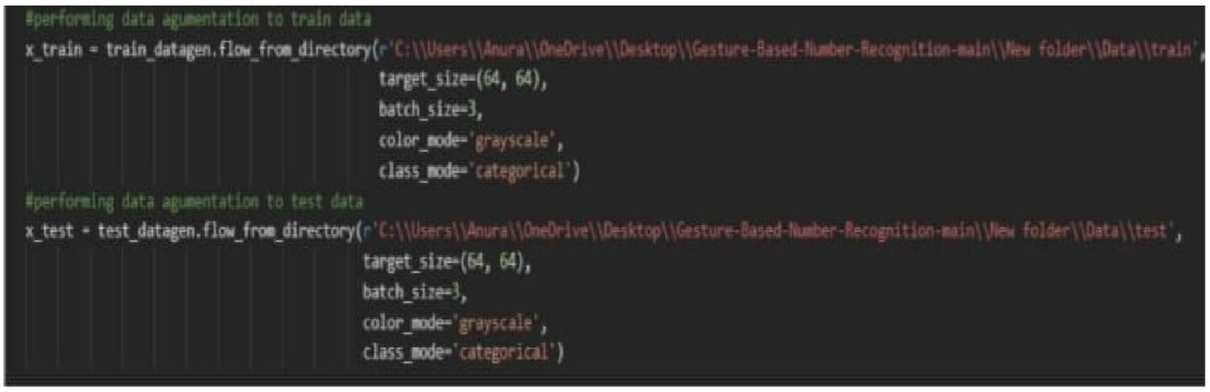
Image Data Agumentation

```
#setting parameter for Image Data agumentation to the traing data
train_datagen = ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_flip=True)
#Image Data agumentation to the testing data
test_datagen=ImageDataGenerator(rescale=1./255)
```

Loading our data and performing data agumentation

```
#performing data agumentation to train data
x_train = train_datagen.flow_from_directory('data/train',target_size=(64, 64),batch_size=5,
                                            color_mode='grayscale',class_mode='categorical')
#performing data agumentation to test data
x_test = test_datagen.flow_from_directory('data/test',target_size=(64, 64),batch_size=5,
                                            color_mode='grayscale',class_mode='categorical')
```

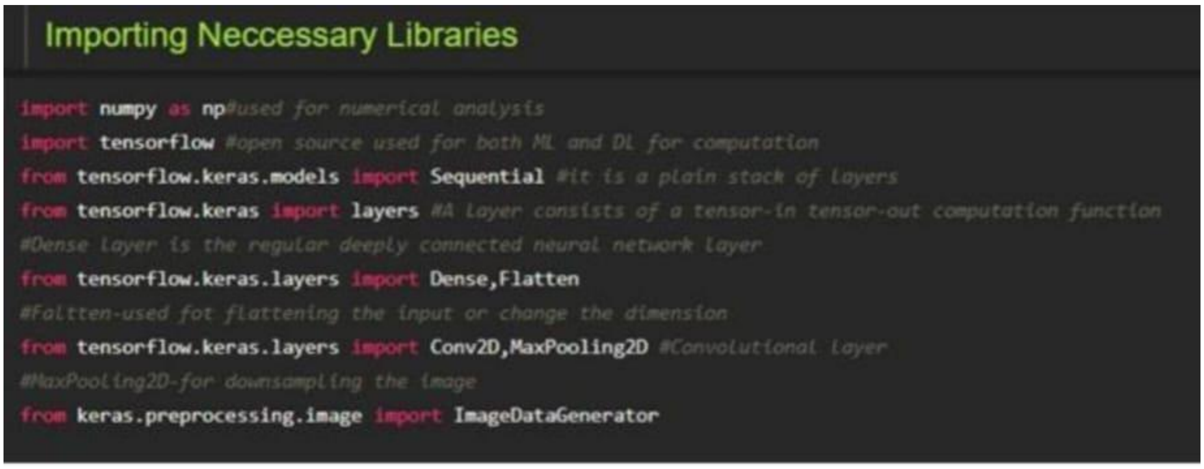
```
Found 600 images belonging to 6 classes.
Found 30 images belonging to 6 classes.
```



```
#performing data agumentation to train data
x_train = train_datagen.flow_from_directory(r'C:\\Users\\Anura\\OneDrive\\Desktop\\Gesture-Based-Number-Recognition-main\\New folder\\Data\\train',
                                            target_size=(64, 64),
                                            batch_size=3,
                                            color_mode='grayscale',
                                            class_mode='categorical')
#performing data agumentation to test data
x_test = test_datagen.flow_from_directory(r'C:\\Users\\Anura\\OneDrive\\Desktop\\Gesture-Based-Number-Recognition-main\\New folder\\Data\\test',
                                          target_size=(64, 64),
                                          batch_size=3,
                                          color_mode='grayscale',
                                          class_mode='categorical')
```

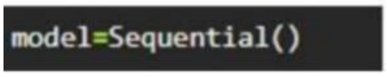
<u>Model building</u>

Importing the libraries



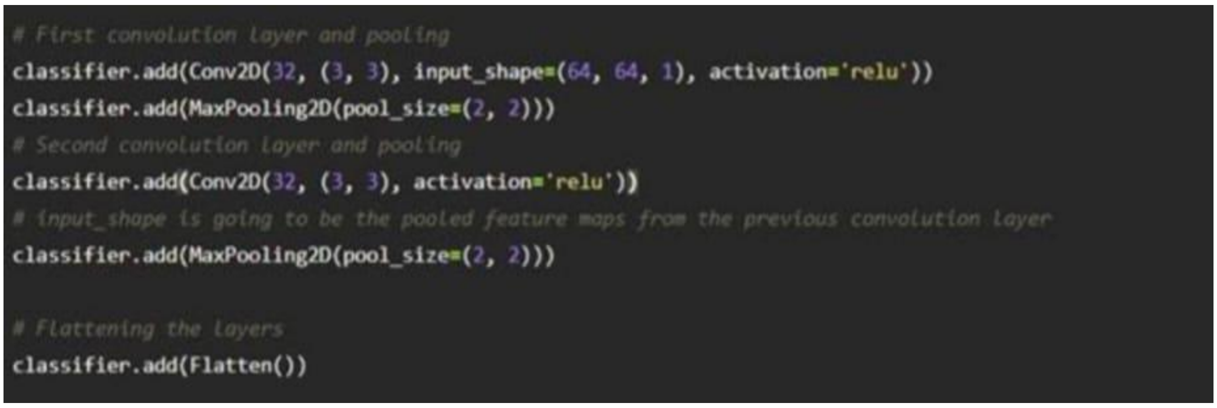
Importing Neccessary Libraries

```python
import numpy as np#used for numerical analysis
import tensorflow #open source used for both ML and DL for computation
from tensorflow.keras.models import Sequential #it is a plain stack of layers
from tensorflow.keras import layers #A layer consists of a tensor-in tensor-out computation function
#Dense layer is the regular deeply connected neural network layer
from tensorflow.keras.layers import Dense,Flatten
#Faltten-used fot flattening the input or change the dimension
from tensorflow.keras.layers import Conv2D,MaxPooling2D #Convolutional layer
#MaxPooling2D-for downsampling the image
from keras.preprocessing.image import ImageDataGenerator
```



```python
model=Sequential()
```

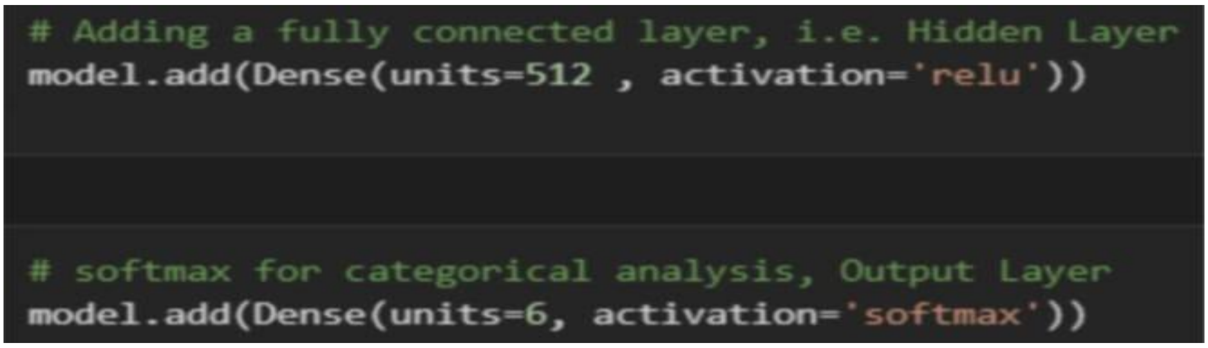
Adding cnn layers



```python
# First convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 1), activation='relu'))
classifier.add(MaxPooling2D(pool_size=(2, 2)))
# Second convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), activation='relu'))
# input_shape is going to be the pooled feature maps from the previous convolution layer
classifier.add(MaxPooling2D(pool_size=(2, 2)))

# Flattening the layers
classifier.add(Flatten())
```

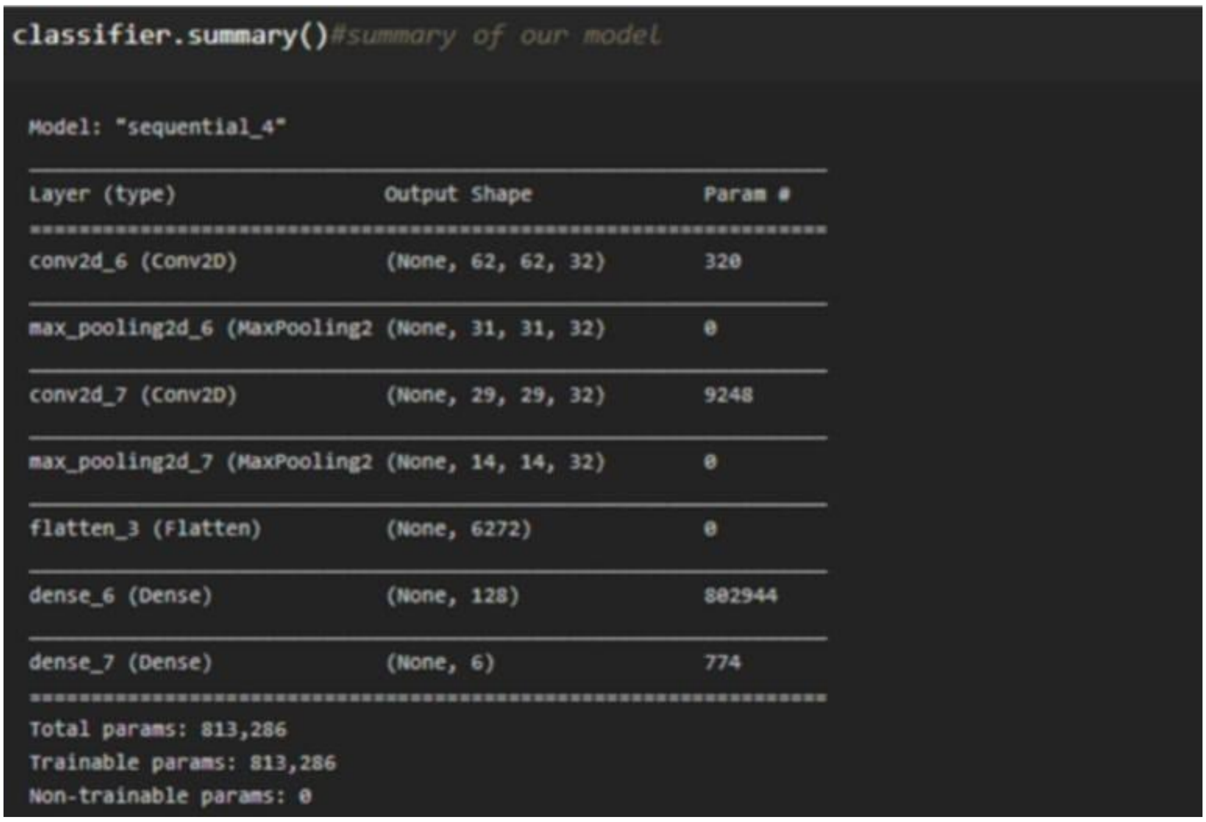
Adding dense layers

Dense layer is deeply connected neural network layer. It is most common and frequently used layer.



```python
# Adding a fully connected layer, i.e. Hidden Layer
model.add(Dense(units=512 , activation='relu'))


# softmax for categorical analysis, Output Layer
model.add(Dense(units=6, activation='softmax'))
```

Understanding the model is very important phase to properly use it for training and prediction purposes. Keras provides a simple method, summary to get the full information about the model and its layers.

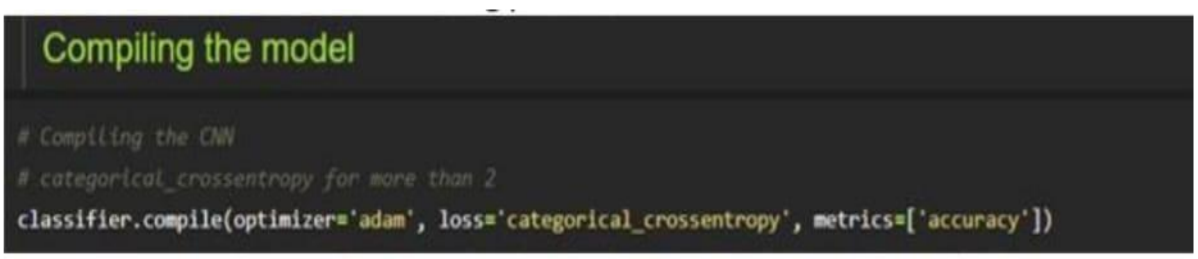


```
classifier.summary()#summary of our model

Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_6 (Conv2D)            (None, 62, 62, 32)        320
_________________________________________________________________
max_pooling2d_6 (MaxPooling2 (None, 31, 31, 32)        0
_________________________________________________________________
conv2d_7 (Conv2D)            (None, 29, 29, 32)        9248
_________________________________________________________________
max_pooling2d_7 (MaxPooling2 (None, 14, 14, 32)        0
_________________________________________________________________
flatten_3 (Flatten)          (None, 6272)              0
_________________________________________________________________
dense_6 (Dense)              (None, 128)               802944
_________________________________________________________________
dense_7 (Dense)              (None, 6)                 774
=================================================================
Total params: 813,286
Trainable params: 813,286
Non-trainable params: 0
```

Configure the learning process

● The compilation is the final step in creating a model. Once the compilation is done, we can move on to training phase. Loss function is used to find error or deviation in the learning process. Keras requires loss function during model compilation process.

● Optimization is an important process which optimize the input weights by comparing the prediction and the loss function. Here we are using Adam optimizer Metrics is used to evaluate the performance of your model. It is similar to loss function, but not used in training process.


Compiling the model

```
# Compiling the CNN
# categorical_crossentropy for more than 2
classifier.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])
```

Train the model

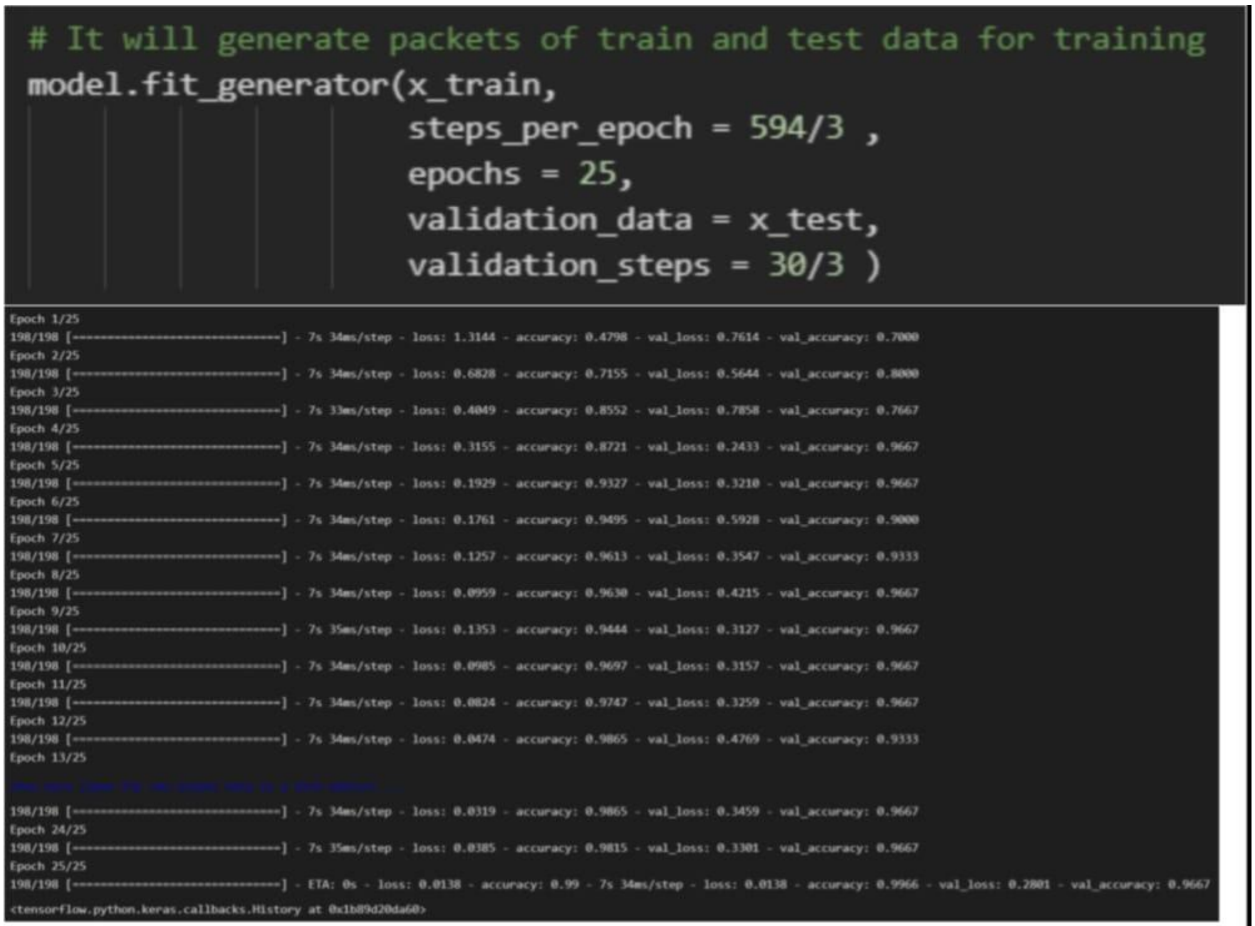
Train the model with our image dataset. fit_generator functions used to train a deep learning neural network Arguments:

● steps_per_epoch : it specifies the total number of steps taken from the generator as soon as one epoch is finished and next epoch has started. We can calculate the value of steps_per_epoch as the total number of samples in your dataset divided by the batch size.

● Epochs : an integer and number of epochs we want to train our model for.

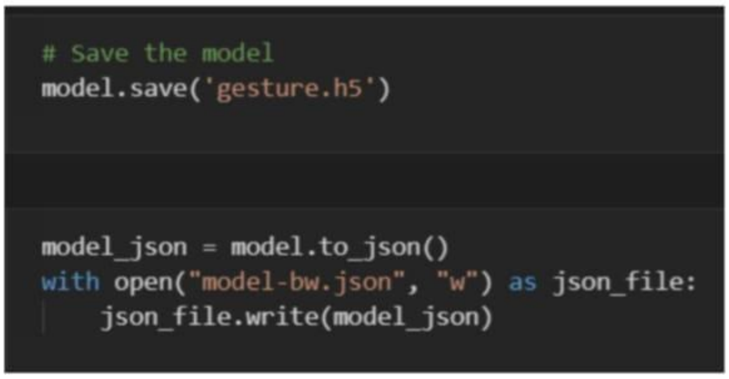
● validation_data can be either: 1. an inputs and targets list 2. a generator 3. an inputs, targets, and sample_weights list which can be used to evaluate the loss and metrics for any model after any epoch has ended.

● validation_steps :only if the validation_data is a generator then only this argument can be used. It specifies the total number of steps taken from the generator before it is stopped at every epoch and its value is calculated as the total number of validation data points in your dataset divided by the validation batch size.



```
# It will generate packets of train and test data for training
model.fit_generator(x_train,
                    steps_per_epoch = 594/3 ,
                    epochs = 25,
                    validation_data = x_test,
                    validation_steps = 30/3 )
```

```
Epoch 1/25
198/198 [==============================] - 7s 34ms/step - loss: 1.3144 - accuracy: 0.4798 - val_loss: 0.7614 - val_accuracy: 0.7000
Epoch 2/25
198/198 [==============================] - 7s 34ms/step - loss: 0.6828 - accuracy: 0.7155 - val_loss: 0.5644 - val_accuracy: 0.8000
Epoch 3/25
198/198 [==============================] - 7s 33ms/step - loss: 0.4049 - accuracy: 0.8552 - val_loss: 0.7858 - val_accuracy: 0.7667
Epoch 4/25
198/198 [==============================] - 7s 34ms/step - loss: 0.3155 - accuracy: 0.8721 - val_loss: 0.2433 - val_accuracy: 0.9667
Epoch 5/25
198/198 [==============================] - 7s 34ms/step - loss: 0.1929 - accuracy: 0.9327 - val_loss: 0.3210 - val_accuracy: 0.9667
Epoch 6/25
198/198 [==============================] - 7s 34ms/step - loss: 0.1761 - accuracy: 0.9495 - val_loss: 0.5928 - val_accuracy: 0.9000
Epoch 7/25
198/198 [==============================] - 7s 34ms/step - loss: 0.1257 - accuracy: 0.9613 - val_loss: 0.3547 - val_accuracy: 0.9333
Epoch 8/25
198/198 [==============================] - 7s 34ms/step - loss: 0.0959 - accuracy: 0.9630 - val_loss: 0.4215 - val_accuracy: 0.9667
Epoch 9/25
198/198 [==============================] - 7s 35ms/step - loss: 0.1353 - accuracy: 0.9444 - val_loss: 0.3127 - val_accuracy: 0.9667
Epoch 10/25
198/198 [==============================] - 7s 34ms/step - loss: 0.0985 - accuracy: 0.9697 - val_loss: 0.3157 - val_accuracy: 0.9667
Epoch 11/25
198/198 [==============================] - 7s 34ms/step - loss: 0.0824 - accuracy: 0.9747 - val_loss: 0.3259 - val_accuracy: 0.9667
Epoch 12/25
198/198 [==============================] - 7s 34ms/step - loss: 0.0474 - accuracy: 0.9865 - val_loss: 0.4769 - val_accuracy: 0.9333
Epoch 13/25

[illegible]

198/198 [==============================] - 7s 34ms/step - loss: 0.0319 - accuracy: 0.9865 - val_loss: 0.3459 - val_accuracy: 0.9667
Epoch 24/25
198/198 [==============================] - 7s 35ms/step - loss: 0.0385 - accuracy: 0.9815 - val_loss: 0.3301 - val_accuracy: 0.9667
Epoch 25/25
198/198 [==============================] - ETA: 0s - loss: 0.0138 - accuracy: 0.99 - 7s 34ms/step - loss: 0.0138 - accuracy: 0.9966 - val_loss: 0.2801 - val_accuracy: 0.9667
<tensorflow.python.keras.callbacks.History at 0x1b89d20da60>
```

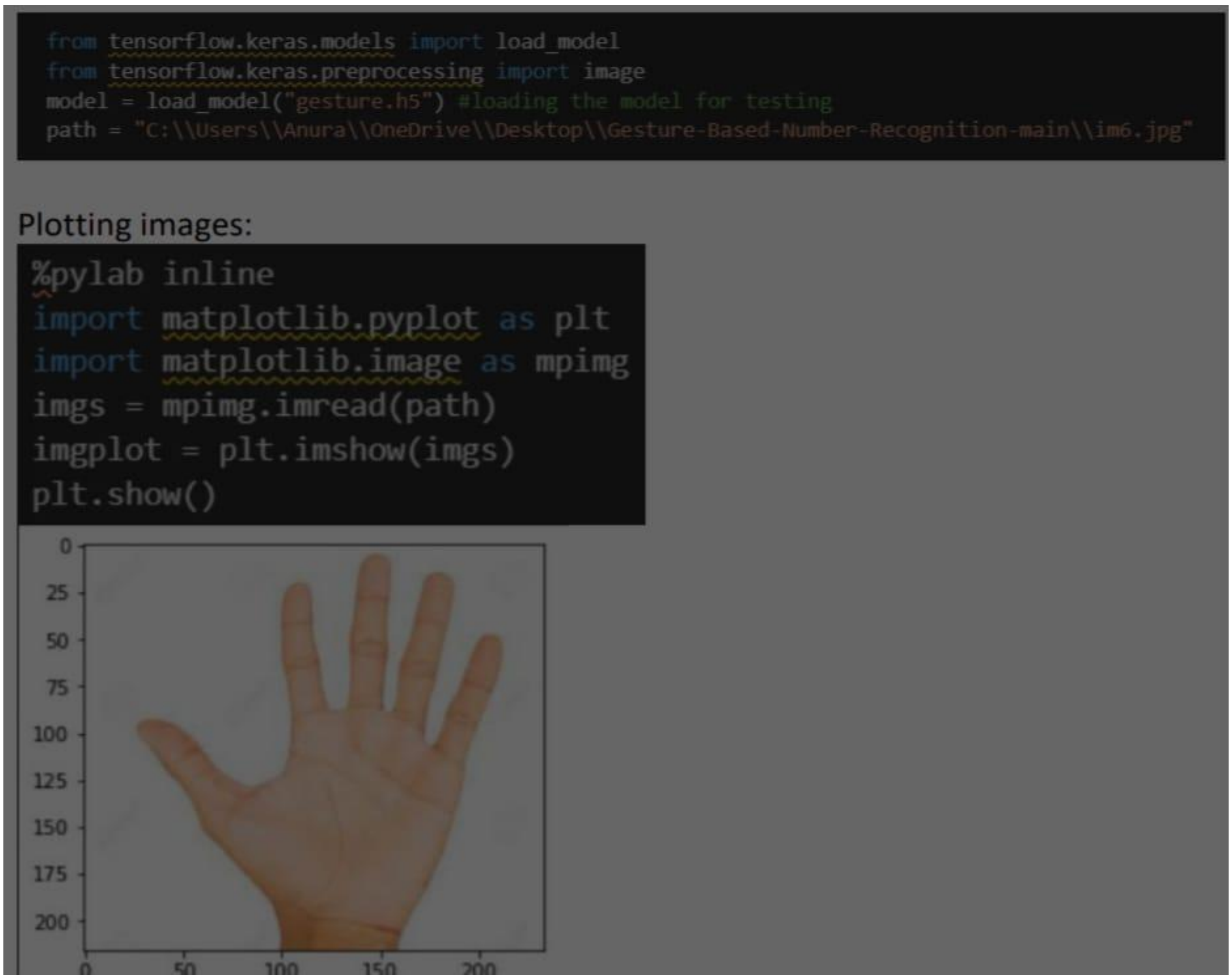


```
# Save the model
model.save('gesture.h5')
```

```
model_json = model.to_json()
with open("model-bw.json", "w") as json_file:
    json_file.write(model_json)
```

Testing the model

Evaluation is a process during development of the model to check whether the model is best fit for the given problem and corresponding data. Load the saved model using load_model

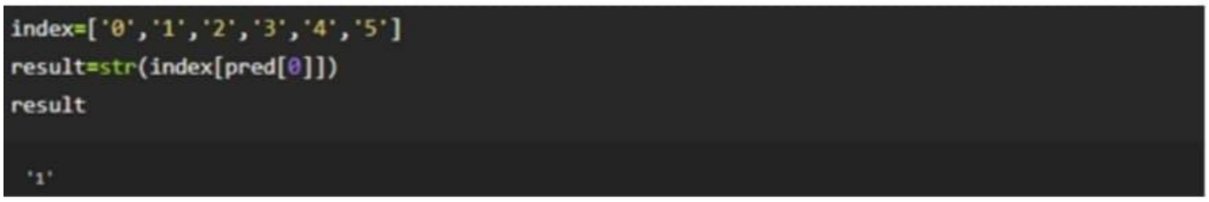


```
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
model = load_model("gesture.h5") #loading the model for testing
path = "C:\\Users\\Anura\\OneDrive\\Desktop\\Gesture-Based-Number-Recognition-main\\im6.jpg"
```

Plotting images:

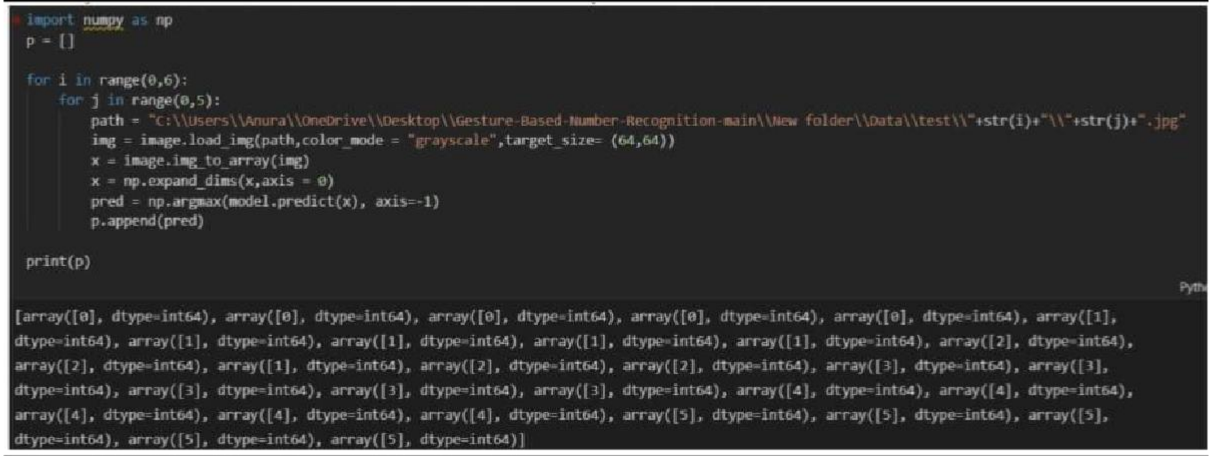
```
%pylab inline
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
imgs = mpimg.imread(path)
imgplot = plt.imshow(imgs)
plt.show()
```

Taking an image as input and checking the results



```
index=['0','1','2','3','4','5']
result=str(index[pred[0]])
result
```

```
'1'
```



```
import numpy as np
p = []

for i in range(0,6):
    for j in range(0,5):
        path = "C:\\Users\\Anura\\OneDrive\\Desktop\\Gesture-Based-Number-Recognition-main\\New folder\\Data\\test\\"+str(i)+"\\"+str(j)+".jpg"
        img = image.load_img(path,color_mode = "grayscale",target_size= (64,64))
        x = image.img_to_array(img)
        x = np.expand_dims(x,axis = 0)
        pred = np.argmax(model.predict(x), axis=-1)
        p.append(pred)

print(p)
```

```
[array([0], dtype=int64), array([0], dtype=int64), array([0], dtype=int64), array([0], dtype=int64), array([0], dtype=int64), array([1],
dtype=int64), array([1], dtype=int64), array([1], dtype=int64), array([1], dtype=int64), array([1], dtype=int64), array([2], dtype=int64),
array([2], dtype=int64), array([1], dtype=int64), array([2], dtype=int64), array([2], dtype=int64), array([3], dtype=int64), array([3],
dtype=int64), array([3], dtype=int64), array([3], dtype=int64), array([3], dtype=int64), array([4], dtype=int64), array([4], dtype=int64),
array([4], dtype=int64), array([4], dtype=int64), array([4], dtype=int64), array([5], dtype=int64), array([5], dtype=int64), array([5],
dtype=int64), array([5], dtype=int64), array([5], dtype=int64)]
```

Application building

After the model is trained in this particular step, we will be building our flask application which will be running in our local browser with a user interface.

Create HTML Pages

● We use HTML to create the front end part of the web page.

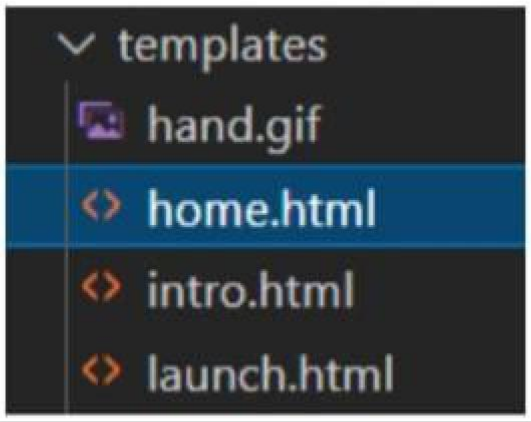
● Here, we created 3 html pages- home.html, intro.html and index6.html

● home.html displays home page.

● Intro.html displays introduction about the hand gesture recognition

● index6.html accepts input from the user and predicts the values.

● We also use JavaScript-main.js and CSS-main.css to enhance our functionality and view of HTML pages.



Build Python Code

● Build flask file ‘app.py’ which is a web framework written in python for server-side scripting.

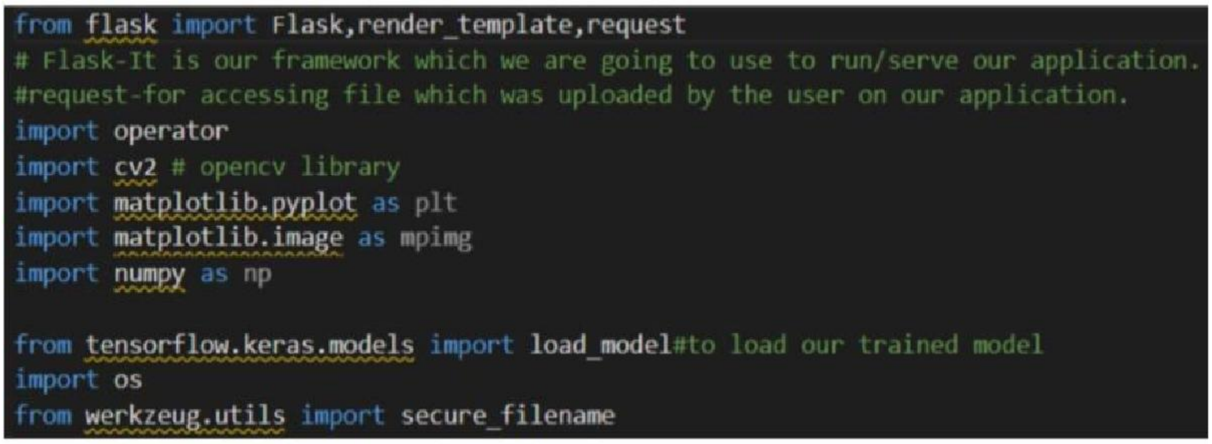
● App starts running when “ name ” constructor is called in main.

● render_template is used to return html file.

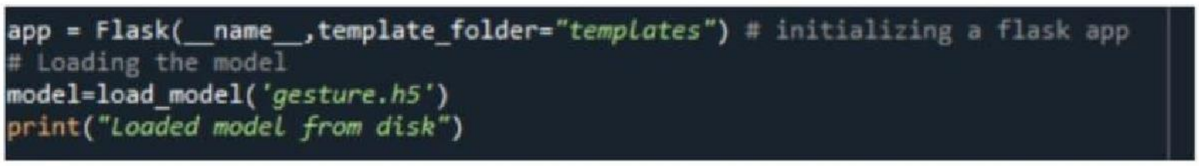
● “GET” method is used to take input from the user.

● “POST” method is used to display the output to the user.

● Importing Libraries

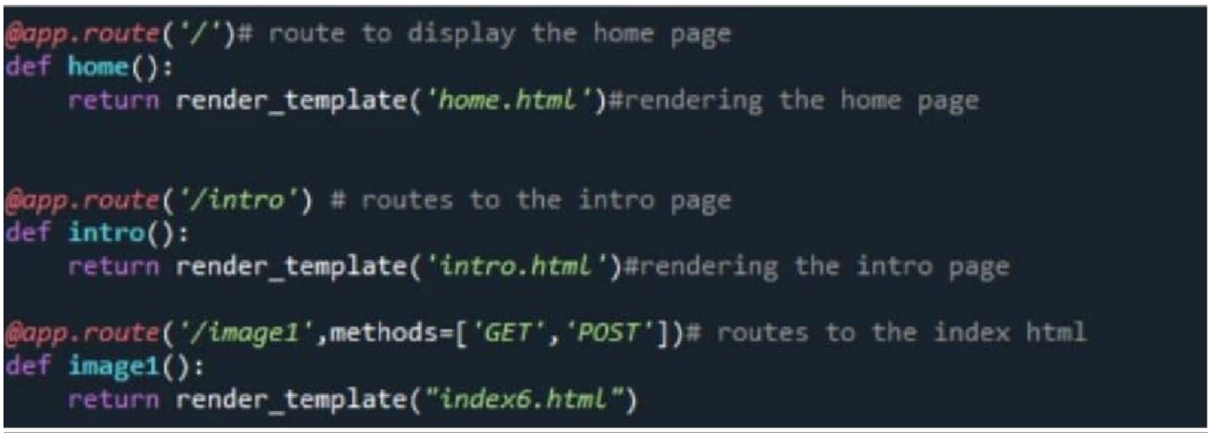


```
from flask import Flask,render_template,request
# Flask-It is our framework which we are going to use to run/serve our application.
#request-for accessing file which was uploaded by the user on our application.
import operator
import cv2 # opencv library
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
import numpy as np

from tensorflow.keras.models import load_model#to load our trained model
import os
from werkzeug.utils import secure_filename
```

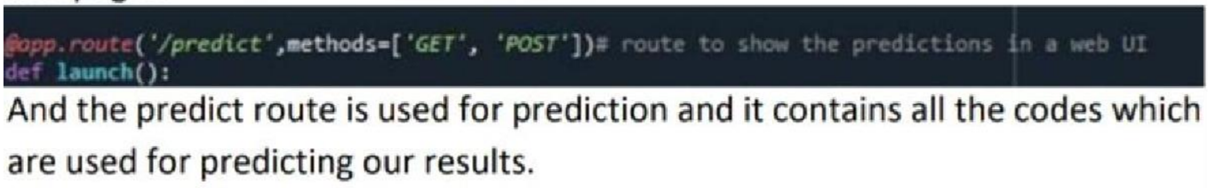


```
app = Flask(__name__,template_folder="templates") # initializing a flask app
# Loading the model
model=load_model('gesture.h5')
print("Loaded model from disk")
```

Routing to html page



```
@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("index6.html")
```



```
@app.route('/predict',methods=['GET', 'POST'])# route to show the predictions in a web UI
def launch():
```

And the predict route is used for prediction and it contains all the codes which are used for predicting our results.

And the predict route is used for prediction and it contains all the codes which are used for predicting our results. Firstly, inside launch function we are having the following things:

● Getting our input and storing it

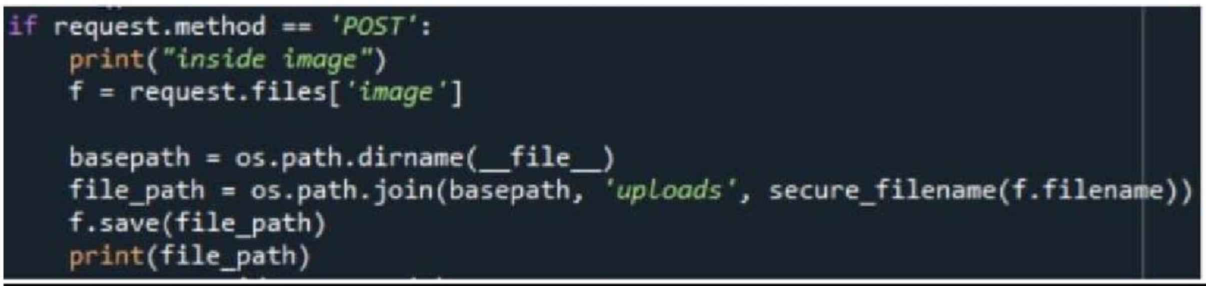
● Grab the frames from the web cam.

● Creating ROI

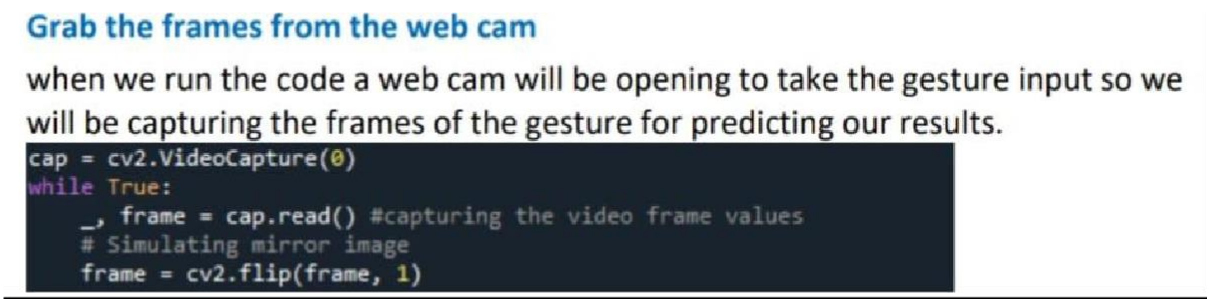
● Predicting our results

● Showcase the results with the help of opencv

● Finally run the application Getting our input and storing it Once the predict route is called, we will check whether the method is POST or not if is POST then we will request the image files and with the help of os function we will be storing the image in the uploads folder in our local system.



```
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)
```



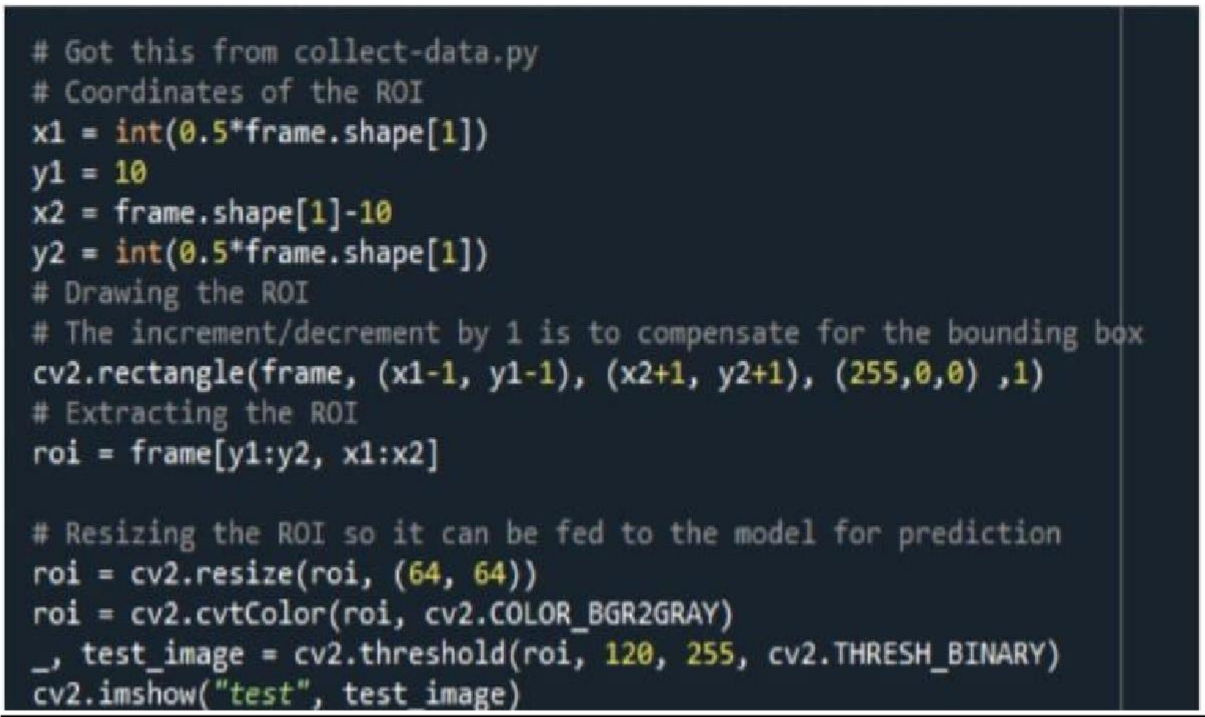
Grab the frames from the web cam

when we run the code a web cam will be opening to take the gesture input so we will be capturing the frames of the gesture for predicting our results.

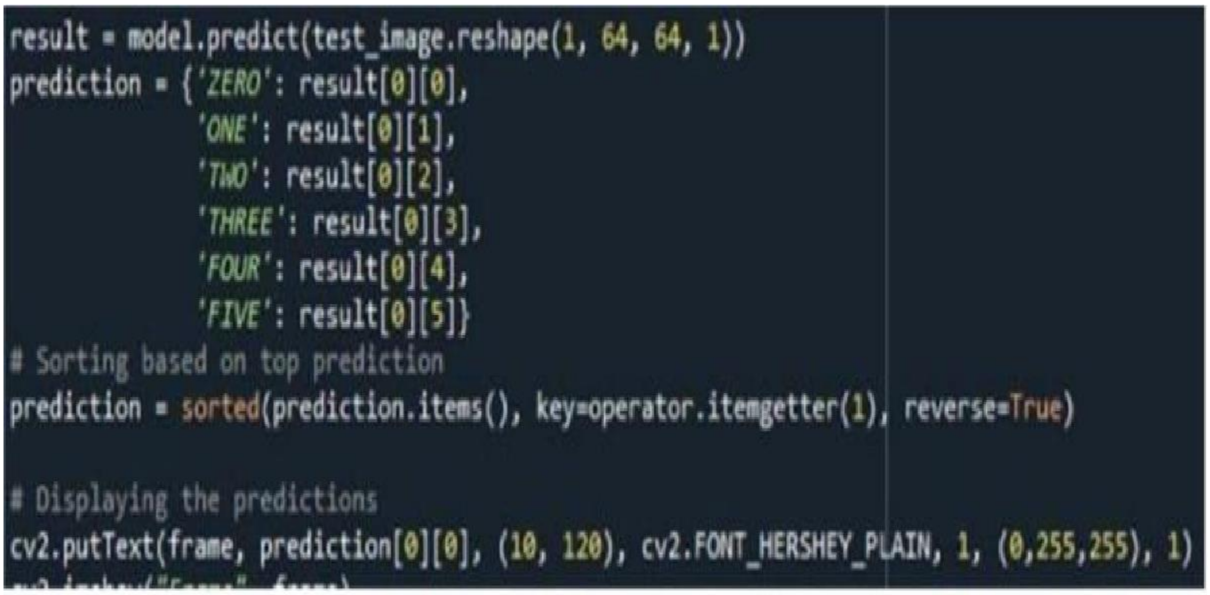
```
cap = cv2.VideoCapture(0)
while True:
    _, frame = cap.read() #capturing the video frame values
    # Simulating mirror image
    frame = cv2.flip(frame, 1)
```

Creating ROI

A region of interest (ROI) is a portion of an image that you want to filter or operate on in some way. The toolbox supports a set of ROI objects that you can use to create ROIs of many shapes, such circles, ellipses, polygons, rectangles, and hand-drawn shapes. A common use of an ROI is to create a binary mask image.

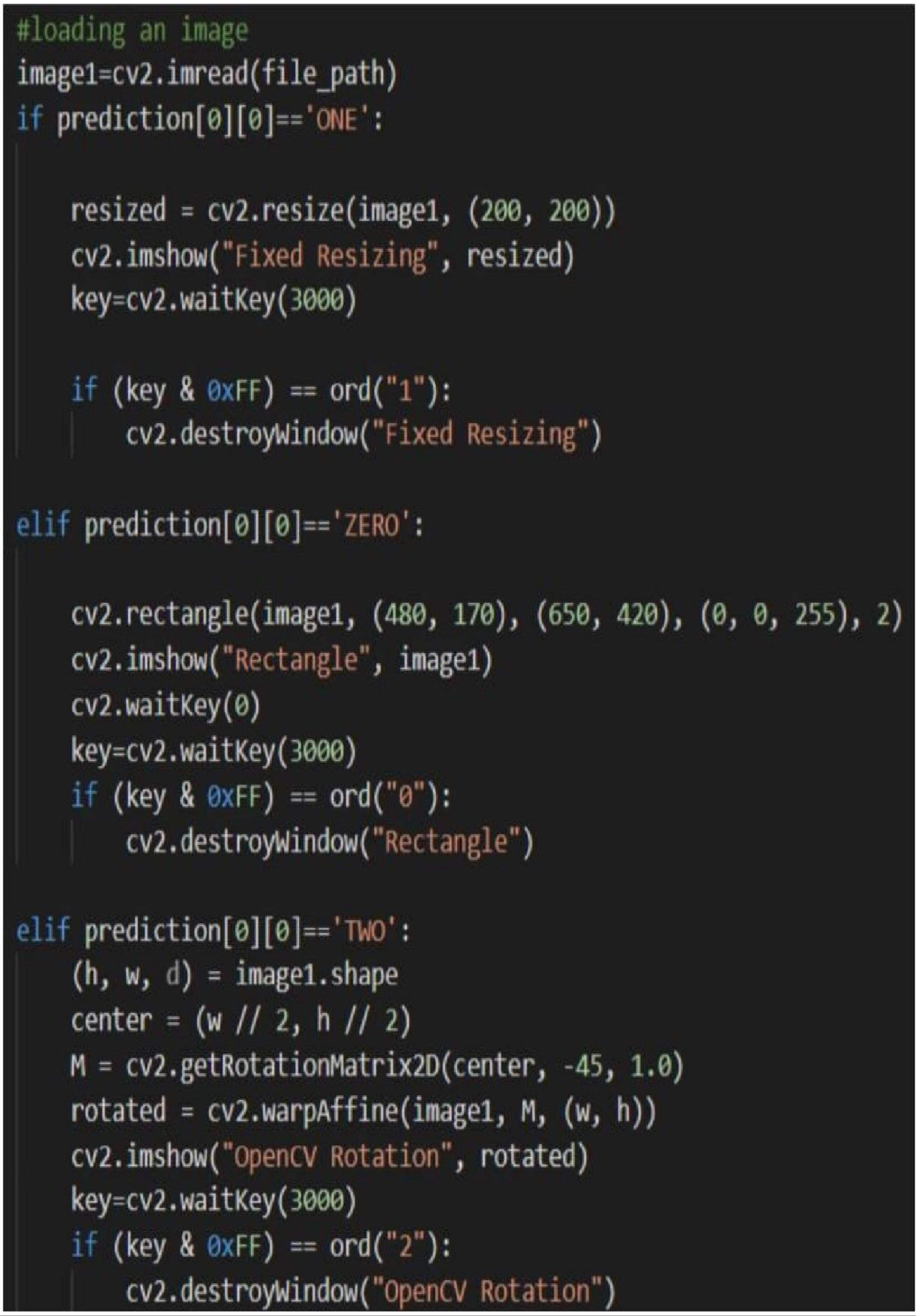


```
# Got this from collect-data.py
# Coordinates of the ROI
x1 = int(0.5*frame.shape[1])
y1 = 10
x2 = frame.shape[1]-10
y2 = int(0.5*frame.shape[1])
# Drawing the ROI
# The increment/decrement by 1 is to compensate for the bounding box
cv2.rectangle(frame, (x1-1, y1-1), (x2+1, y2+1), (255,0,0) ,1)
# Extracting the ROI
roi = frame[y1:y2, x1:x2]

# Resizing the ROI so it can be fed to the model for prediction
roi = cv2.resize(roi, (64, 64))
roi = cv2.cvtColor(roi, cv2.COLOR_BGR2GRAY)
_, test_image = cv2.threshold(roi, 120, 255, cv2.THRESH_BINARY)
cv2.imshow(“test”, test_image)
```

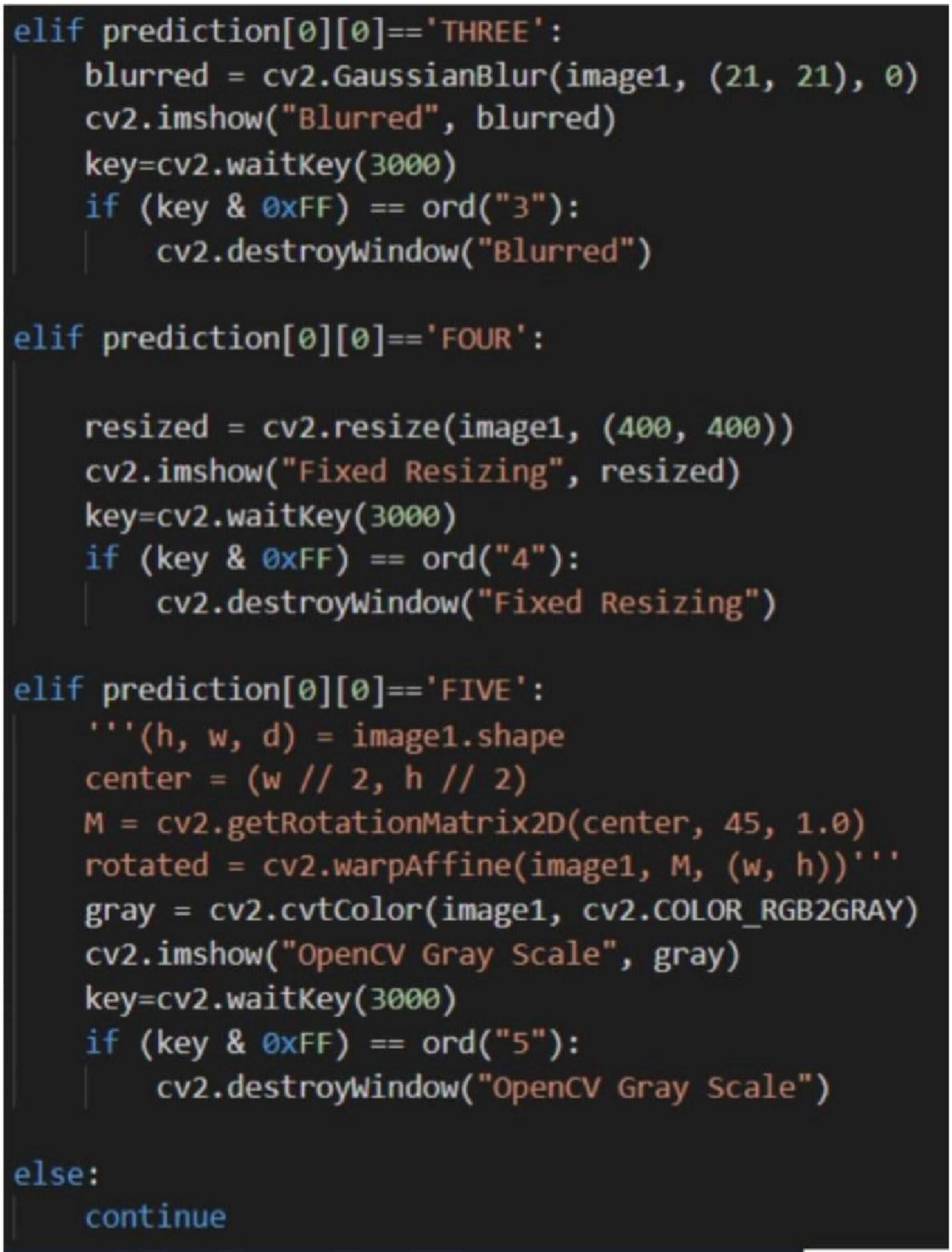


```
result = model.predict(test_image.reshape(1, 64, 64, 1))
prediction = {'ZERO': result[0][0],
              'ONE': result[0][1],
              'TWO': result[0][2],
              'THREE': result[0][3],
              'FOUR': result[0][4],
              'FIVE': result[0][5]}
# Sorting based on top prediction
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)
[illegible]
```

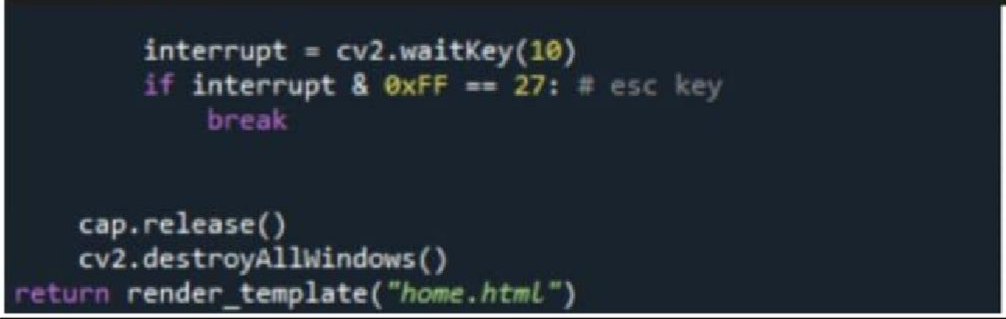
Finally according to the result predicted with our model we will be performing certain operations like resize, blur , rotate etc.



```
#loading an image
image1=cv2.imread(file_path)
if prediction[0][0]=='ONE':

    resized = cv2.resize(image1, (200, 200))
    cv2.imshow("Fixed Resizing", resized)
    key=cv2.waitKey(3000)

    if (key & 0xFF) == ord("1"):
        cv2.destroyWindow("Fixed Resizing")

elif prediction[0][0]=='ZERO':

    cv2.rectangle(image1, (480, 170), (650, 420), (0, 0, 255), 2)
    cv2.imshow("Rectangle", image1)
    cv2.waitKey(0)
    key=cv2.waitKey(3000)
    if (key & 0xFF) == ord("0"):
        cv2.destroyWindow("Rectangle")

elif prediction[0][0]=='TWO':
    (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("OpenCV Rotation", rotated)
    key=cv2.waitKey(3000)
    if (key & 0xFF) == ord("2"):
        cv2.destroyWindow("OpenCV Rotation")
```

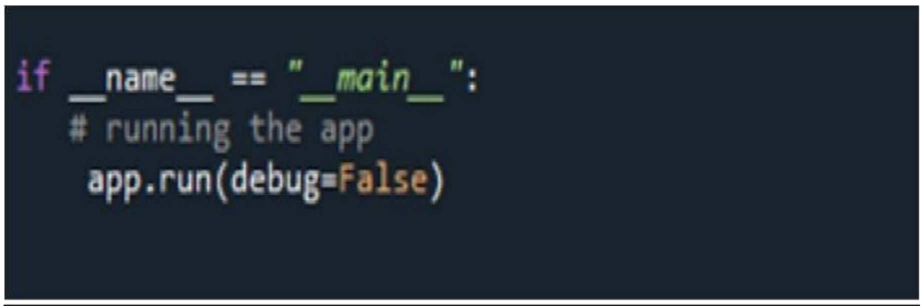


```python
elif prediction[0][0]=='THREE':
    blurred = cv2.GaussianBlur(image1, (21, 21), 0)
    cv2.imshow("Blurred", blurred)
    key=cv2.waitKey(3000)
    if (key & 0xFF) == ord("3"):
        cv2.destroyWindow("Blurred")

elif prediction[0][0]=='FOUR':

    resized = cv2.resize(image1, (400, 400))
    cv2.imshow("Fixed Resizing", resized)
    key=cv2.waitKey(3000)
    if (key & 0xFF) == ord("4"):
        cv2.destroyWindow("Fixed Resizing")

elif prediction[0][0]=='FIVE':
    '''(h, w, d) = image1.shape
    center = (w // 2, h // 2)
    M = cv2.getRotationMatrix2D(center, 45, 1.0)
    rotated = cv2.warpAffine(image1, M, (w, h))'''
    gray = cv2.cvtColor(image1, cv2.COLOR_RGB2GRAY)
    cv2.imshow("OpenCV Gray Scale", gray)
    key=cv2.waitKey(3000)
    if (key & 0xFF) == ord("5"):
        cv2.destroyWindow("OpenCV Gray Scale")

else:
    continue
```



```python
        interrupt = cv2.waitKey(10)
        if interrupt & 0xFF == 27: # esc key
            break


    cap.release()
    cv2.destroyAllWindows()
return render_template("home.html")
```

Run the application



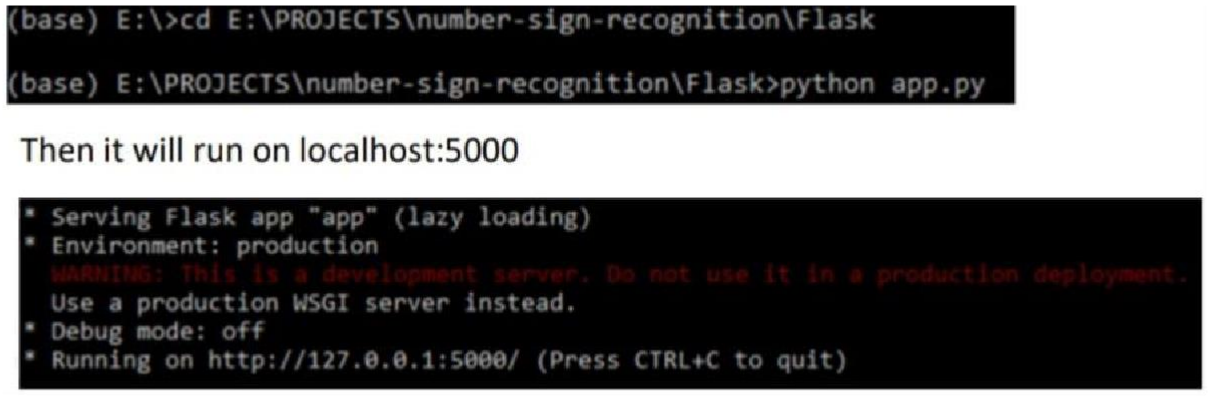
```
if __name__ == "__main__":
    # running the app
     app.run(debug=False)
```

Run The app in local browser

● Open anaconda prompt from the start menu

● Navigate to the folder where your python script is.

● Now type “python app.py” command Navigate to the localhost where you can view your web page



```
(base) E:\>cd E:\PROJECTS\number-sign-recognition\Flask

(base) E:\PROJECTS\number-sign-recognition\Flask>python app.py
```

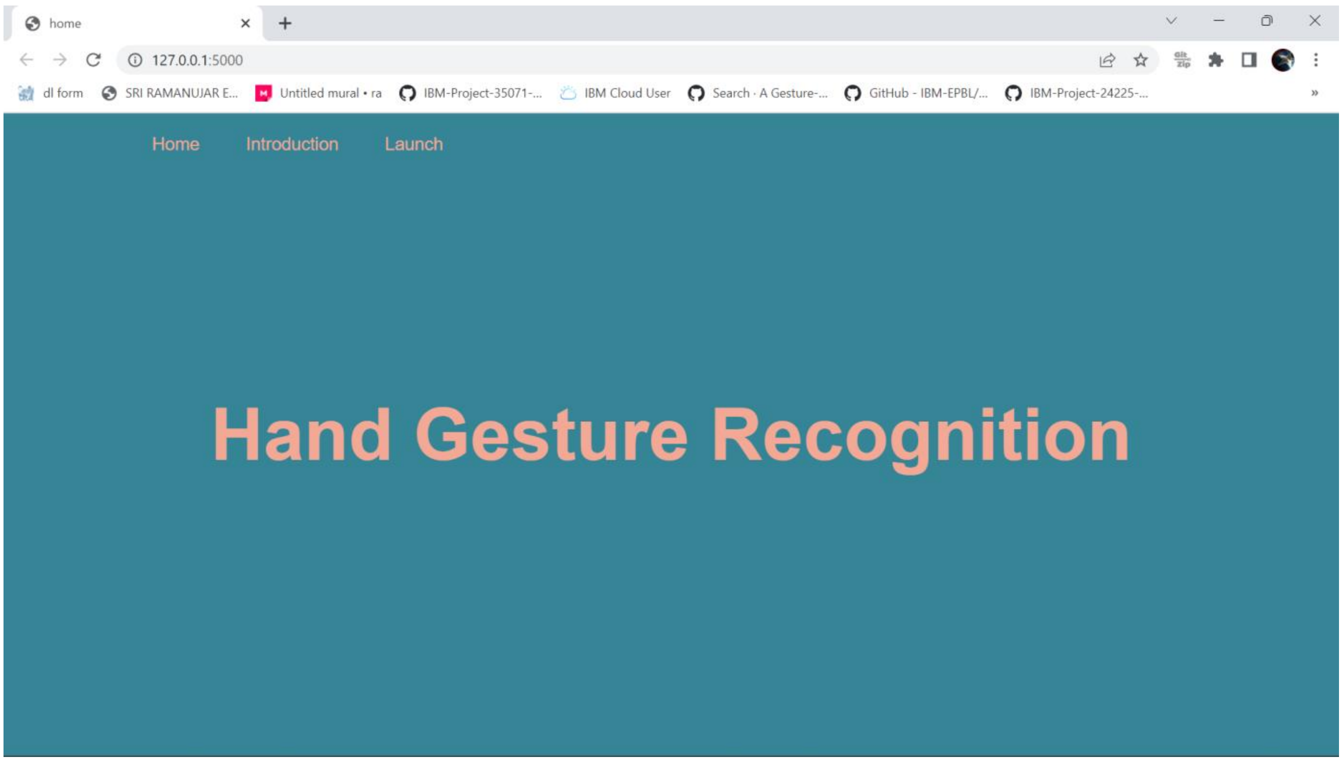
Then it will run on localhost:5000

```
* Serving Flask app "app" (lazy loading)
* Environment: production
  WARNING: This is a development server. Do not use it in a production deployment.
  Use a production WSGI server instead.
* Debug mode: off
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

Navigate to the localhost (http://127.0.0.1:5000/)where you can view your web page.

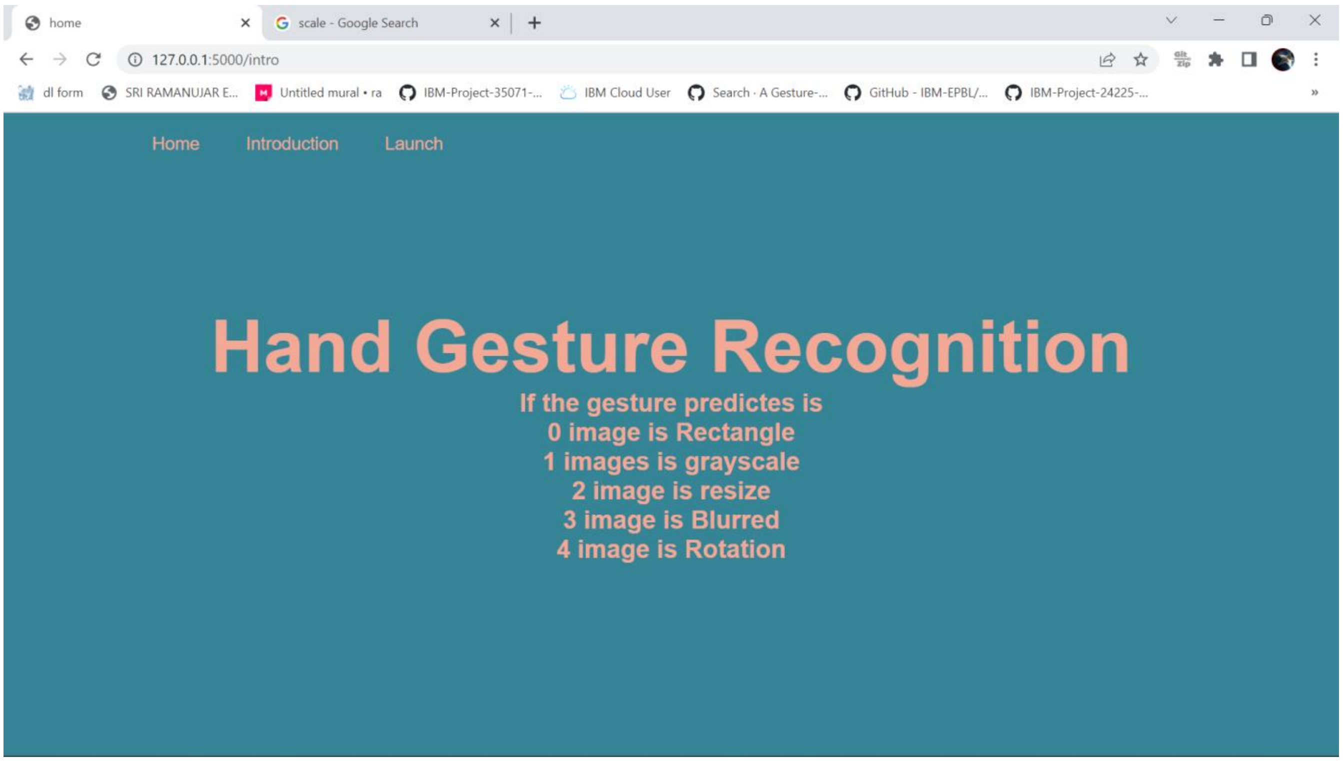
8. TESTING

Home page:



Hand Gesture Recognition

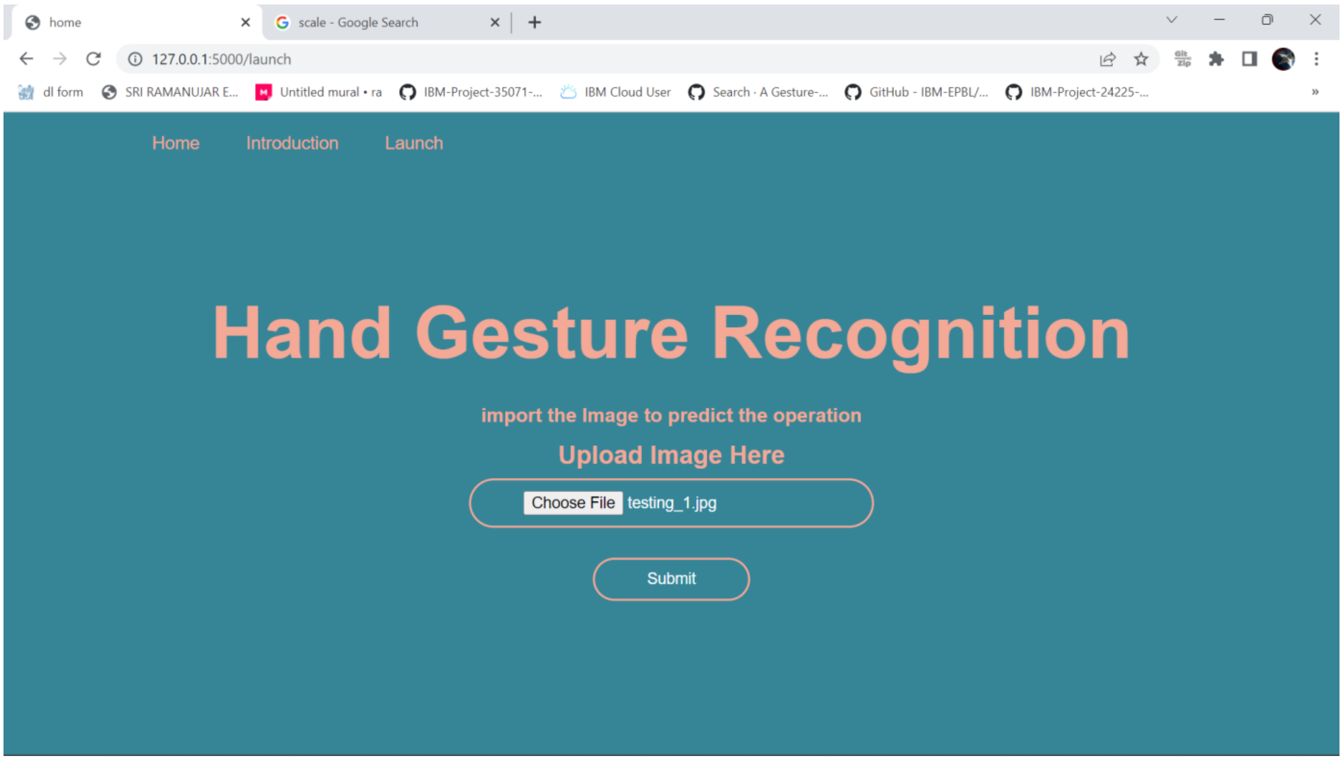
Introduction page:



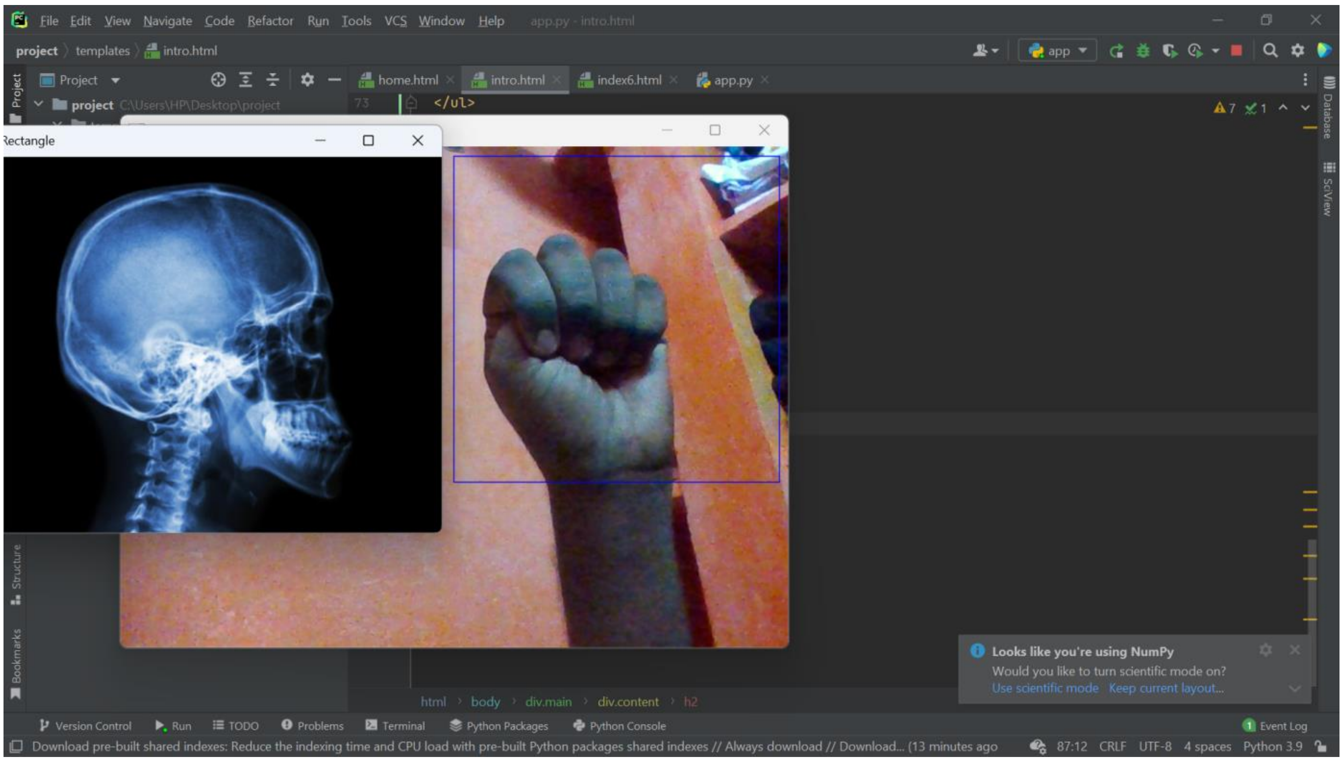
Hand Gesture Recognition

If the gesture predictes is
0 image is Rectangle
1 images is grayscale
2 image is resize
3 image is Blurred
4 image is Rotation

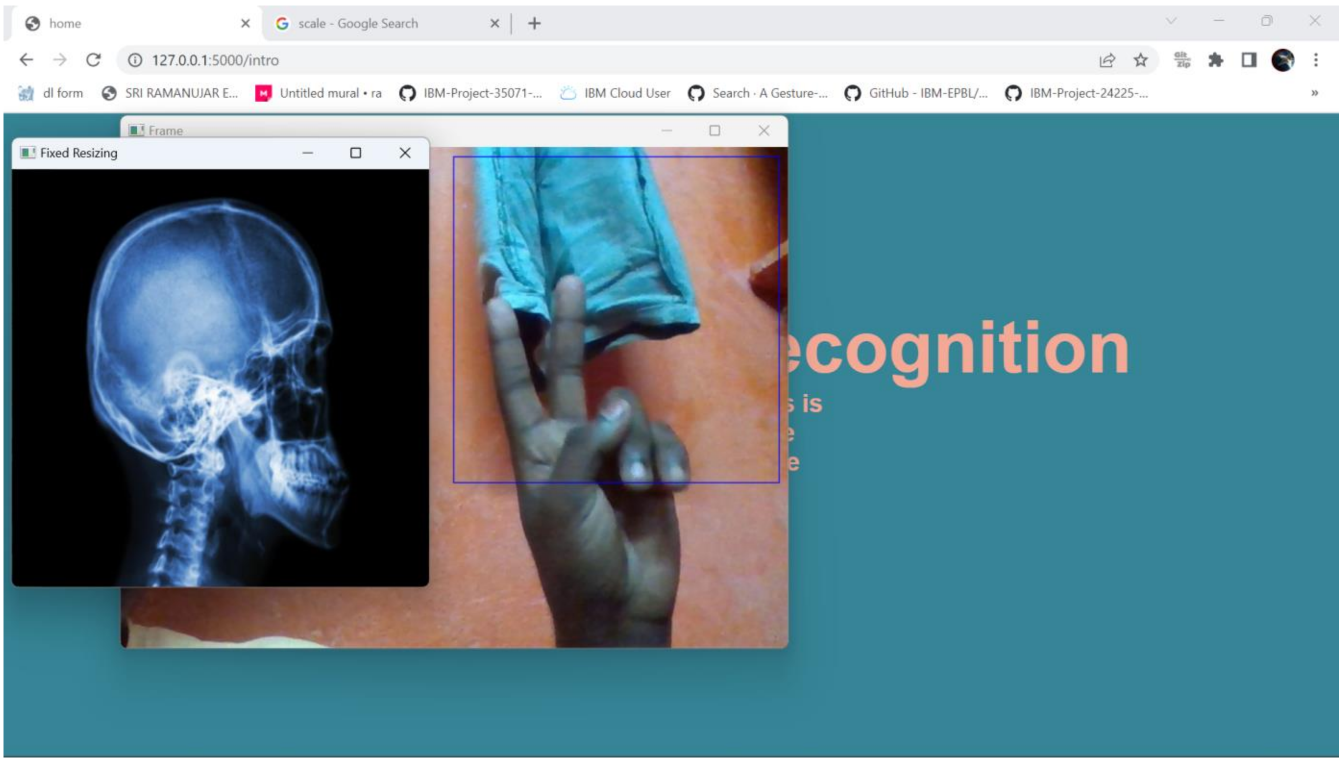
Launch page:



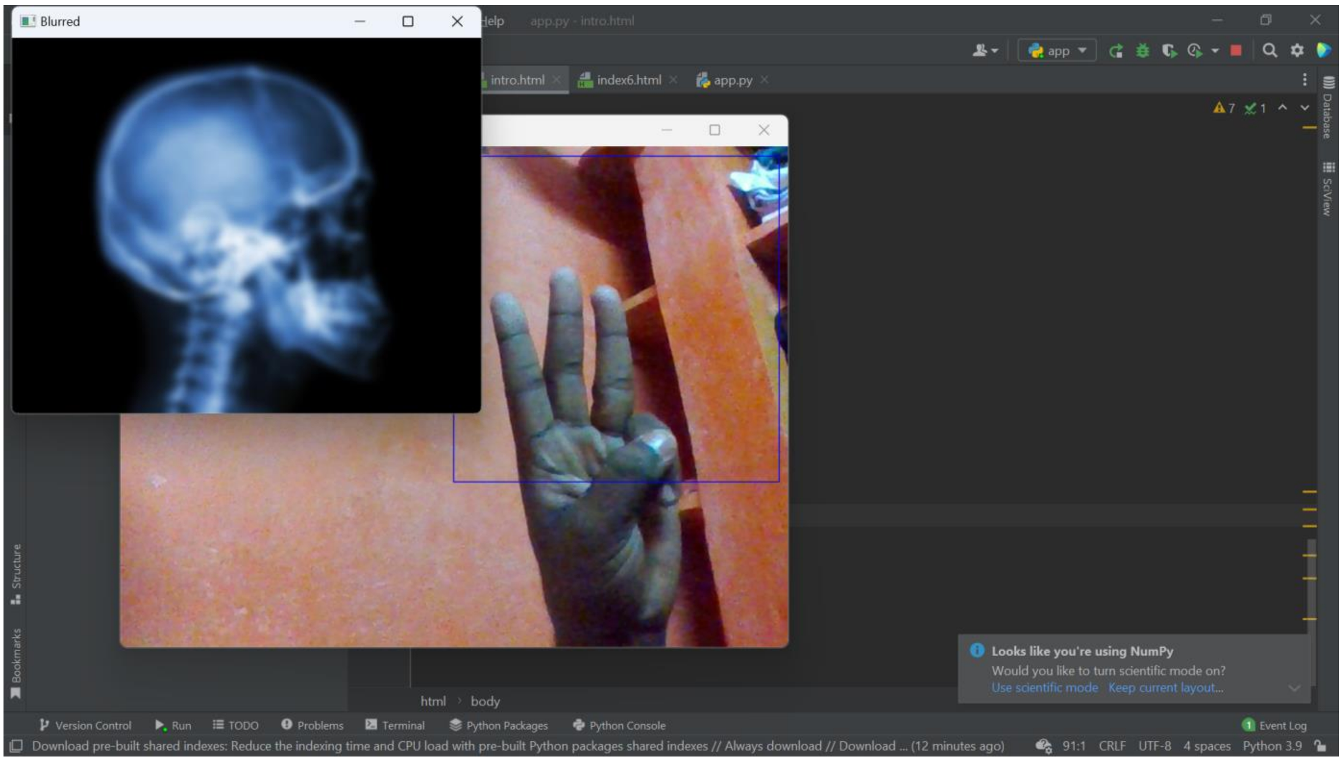
In this the input is given as 0 the imag is Rectangle


File Edit View Navigate Code Refactor Run Tools VCS Window Help
project templates intro.html
home.html intro.html index6.html app.py
Rectangle
Looks like you're using NumPy
Would you like to turn scientific mode on?
Use scientific mode Keep current layout...
Version Control Run TODO Problems Terminal Python Packages Python Console
Event Log
Python 3.9

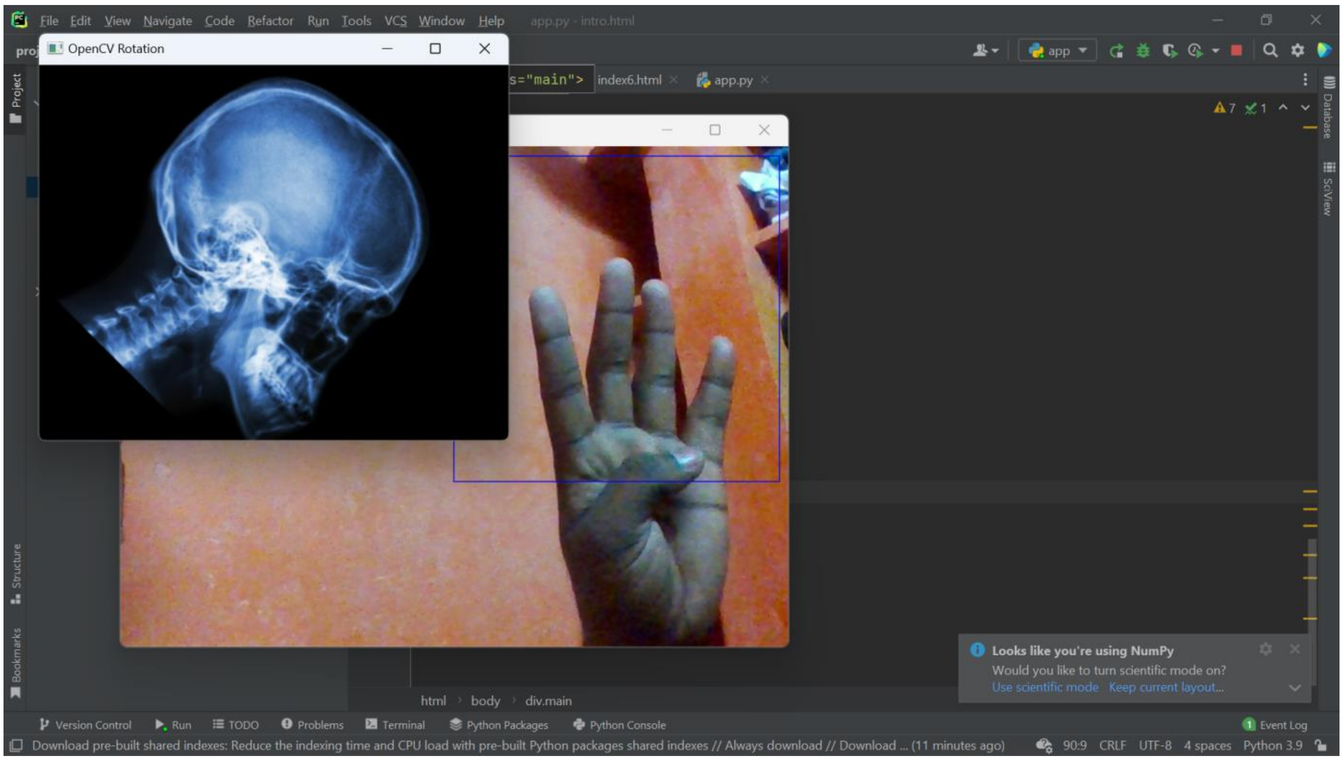
In this the input is given as 2 the image is resize



In this the input is given as 3,the image is blurred.

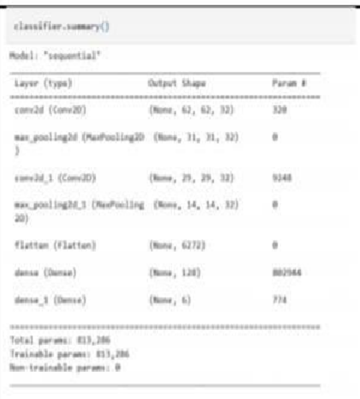

Blurred
Help
app.py - intro.html
app
intro.html
index6.html
app.py
Looks like you're using NumPy
Would you like to turn scientific mode on?
Use scientific mode   Keep current layout...
html › body
Version Control
Run
TODO
Problems
Terminal
Python Packages
Python Console
Event Log
Download pre-built shared indexes: Reduce the indexing time and CPU load with pre-built Python packages shared indexes // Always download // Download ... (12 minutes ago)
91:1 CRLF UTF-8 4 spaces Python 3.9

In this the input is given as 4,the image is rotated.


File Edit View Navigate Code Refactor Run Tools VCS Window Help
app.py - intro.html
OpenCV Rotation
s="main">
index6.html
app.py
Looks like you're using NumPy
Would you like to turn scientific mode on?
Use scientific mode Keep current layout...
html body div.main
Version Control Run TODO Problems Terminal Python Packages Python Console
Event Log
Download pre-built shared indexes: Reduce the indexing time and CPU load with pre-built Python packages shared indexes // Always download // Download ... (11 minutes ago)
90:9 CRLF UTF-8 4 spaces Python 3.9

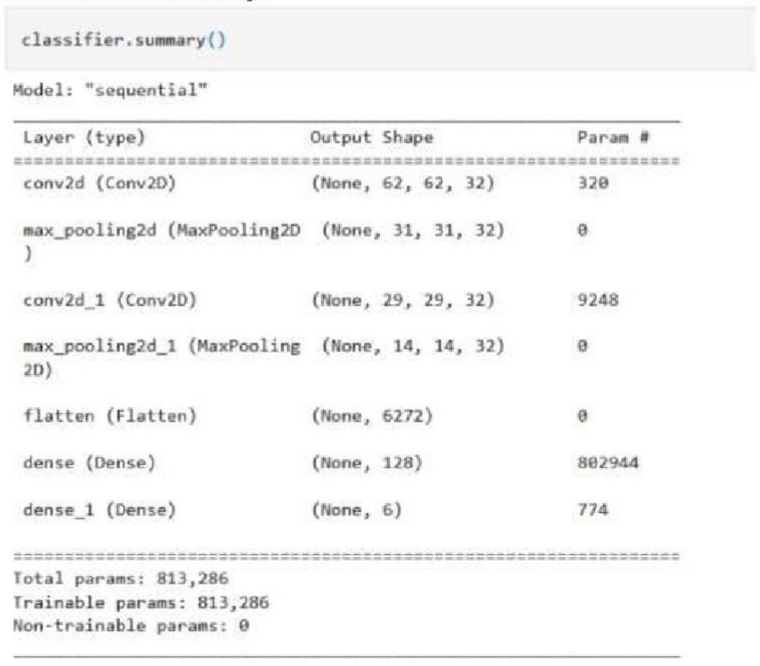
9. RESULTS

9.1 PERFORMANCE METRICS

S.No.	Parameter	Values	Screenshot
1.	Model Summary	conv2d (Conv2D) - 320 max_pooling2d (MaxPooling2D) - 0 conv2d_1 (Conv2D) - 9248 max_pooling2d_1 (MaxPooling2D) - 0 flatten (Flatten) - 0 dense (Dense) - 802944 dense_1 (Dense) - 774 ================================ Total params: 813,286 Trainable params: 813,286 Non-trainable params: 0	 classifier.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 (MaxPooling2D) (None, 14, 14, 32) 0 flatten (Flatten) (None, 6272) 0 dense (Dense) (None, 128) 802944 dense_1 (Dense) (None, 6) 774 Total params: 813,286 Trainable params: 813,286 Non-trainable params: 0
2.	Accuracy	Training Accuracy - 99.16% Validation Accuracy – 96.67%	[illegible]
3.	Confidence Score (Only Yolo Projects)	Class Detected - Confidence Score -	NA

Screenshots:

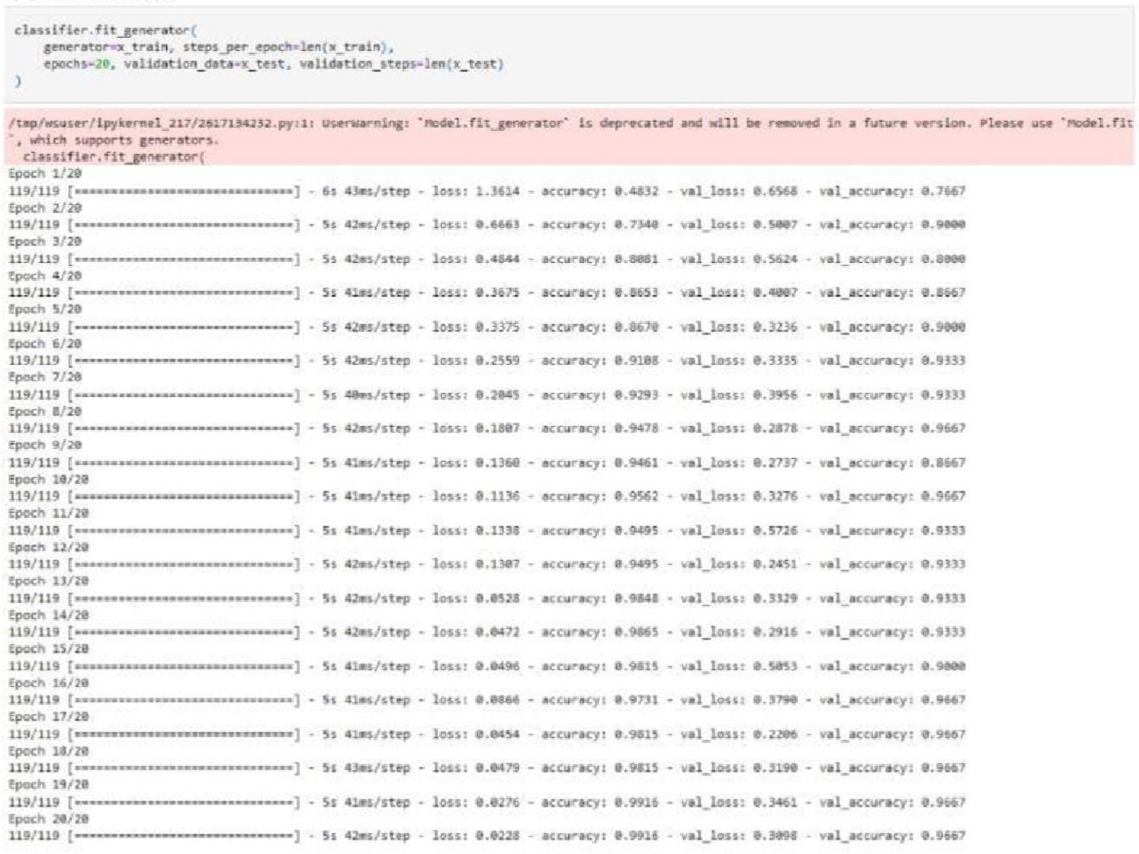
1. Model Summary:



```
classifier.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, 128)               802944

 dense_1 (Dense)             (None, 6)                 774

=================================================================
Total params: 813,286
Trainable params: 813,286
Non-trainable params: 0
_________________________________________________________________
```

2. Accuracy:



```
classifier.fit_generator(
    generator=x_train, steps_per_epoch=len(x_train),
    epochs=20, validation_data=x_test, validation_steps=len(x_test)
)
```

```
/tmp/wsuser/ipykernel_217/2617134232.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit
`, which supports generators.
  classifier.fit_generator(
Epoch 1/20
119/119 [==============================] - 6s 43ms/step - loss: 1.3614 - accuracy: 0.4832 - val_loss: 0.6568 - val_accuracy: 0.7667
Epoch 2/20
119/119 [==============================] - 5s 42ms/step - loss: 0.6663 - accuracy: 0.7340 - val_loss: 0.5007 - val_accuracy: 0.9000
Epoch 3/20
119/119 [==============================] - 5s 42ms/step - loss: 0.4844 - accuracy: 0.8081 - val_loss: 0.5624 - val_accuracy: 0.8000
Epoch 4/20
119/119 [==============================] - 5s 41ms/step - loss: 0.3675 - accuracy: 0.8653 - val_loss: 0.4007 - val_accuracy: 0.8667
Epoch 5/20
119/119 [==============================] - 5s 42ms/step - loss: 0.3375 - accuracy: 0.8670 - val_loss: 0.3236 - val_accuracy: 0.9000
Epoch 6/20
119/119 [==============================] - 5s 42ms/step - loss: 0.2559 - accuracy: 0.9108 - val_loss: 0.3335 - val_accuracy: 0.9333
Epoch 7/20
119/119 [==============================] - 5s 40ms/step - loss: 0.2045 - accuracy: 0.9293 - val_loss: 0.3956 - val_accuracy: 0.9333
Epoch 8/20
119/119 [==============================] - 5s 42ms/step - loss: 0.1807 - accuracy: 0.9478 - val_loss: 0.2878 - val_accuracy: 0.9667
Epoch 9/20
119/119 [==============================] - 5s 41ms/step - loss: 0.1360 - accuracy: 0.9461 - val_loss: 0.2737 - val_accuracy: 0.8667
Epoch 10/20
119/119 [==============================] - 5s 41ms/step - loss: 0.1136 - accuracy: 0.9562 - val_loss: 0.3276 - val_accuracy: 0.9667
Epoch 11/20
119/119 [==============================] - 5s 41ms/step - loss: 0.1338 - accuracy: 0.9495 - val_loss: 0.5726 - val_accuracy: 0.9333
Epoch 12/20
119/119 [==============================] - 5s 42ms/step - loss: 0.1307 - accuracy: 0.9495 - val_loss: 0.2451 - val_accuracy: 0.9333
Epoch 13/20
119/119 [==============================] - 5s 42ms/step - loss: 0.0528 - accuracy: 0.9848 - val_loss: 0.3329 - val_accuracy: 0.9333
Epoch 14/20
119/119 [==============================] - 5s 42ms/step - loss: 0.0472 - accuracy: 0.9865 - val_loss: 0.2916 - val_accuracy: 0.9333
Epoch 15/20
119/119 [==============================] - 5s 41ms/step - loss: 0.0496 - accuracy: 0.9815 - val_loss: 0.5053 - val_accuracy: 0.9000
Epoch 16/20
119/119 [==============================] - 5s 41ms/step - loss: 0.0866 - accuracy: 0.9731 - val_loss: 0.3790 - val_accuracy: 0.9667
Epoch 17/20
119/119 [==============================] - 5s 41ms/step - loss: 0.0454 - accuracy: 0.9815 - val_loss: 0.2206 - val_accuracy: 0.9667
Epoch 18/20
119/119 [==============================] - 5s 43ms/step - loss: 0.0479 - accuracy: 0.9815 - val_loss: 0.3190 - val_accuracy: 0.9667
Epoch 19/20
119/119 [==============================] - 5s 41ms/step - loss: 0.0276 - accuracy: 0.9916 - val_loss: 0.3461 - val_accuracy: 0.9667
Epoch 20/20
119/119 [==============================] - 5s 42ms/step - loss: 0.0228 - accuracy: 0.9916 - val_loss: 0.3098 - val_accuracy: 0.9667
```

10. ADVANTAGES & DISADVANTAGES

Advantages

(i) ease of use—the system allows the surgeon to use his/her hands, their natural work tool;

(ii) rapid reaction—nonverbal instructions by hand gesture commands are intuitive and fast

(iii) an unencumbered interface—the proposed system does not require the surgeon to attach a microphone, use head-mounted (body-contact) sensing devices or to use foot pedals

(iv) distance control—the hand gestures can be performed up to 5 meters from the camera and still be recognized accurately.

Disadvantages

Such systems are difficult to devolope because of the complexity and the cost of implementation .

As each gesture is assigned a specific control command this system is not a platform independent since certain commands vary as the operating system varies.

11. CONCLUSION

In this project we developed a tool which recognises hand gestures and enables doctors to browse through radiology images using these gestures. This enables doctors and surgeons to maintain the sterility as they would not have to touch any mouse or keyboard to go through the images. This tool is also easy to use and is quicker than the regular method of using mouse/keyboard. It can be used regardless of the users location since they don’t have to be in contact with any device. It also does not require the user to have any device on them to use it.

Further this technology can be extended to other industries like it can be used by presenters, by teachers for show images in the classroom, etc.

12. FUTURE SCOPE

• The tool can be made quicker by increasing the recognition speed.

• More number of gestures can be added thereby increasing this tool's functionality and useability for different purposes.

• Tracking of both hands can be added to increase the set of commands. Voice commands can also be added to further increase the functionality.

13. APPENDIX

13.1 SOURCE CODE

https://github.com/IBM-EPBL/IBM-Project-52795-1661157279/tree/main/A%20Gesture-based%20Tool%20for%20Sterile%20Browsing%20of%20Radiology%20Images/Final%20Deliverables/Flask

13.2 GIT HUB AND PROJECT DEMO LINK

Git repo link

IBM-EPBL / **IBM-Project-52795-1661157279**

Project Demolink

https://youtu.be/IpVg733zHdk