National College of Ireland

Attendance System in Third -Level Irish Institutions and Colleges Using Face Recognition Approach

MSc Research Project
Data Analytics

Rajalakshmi Rangarajan
Student ID: x21168211

School of Computing
National College of Ireland

Supervisor: Dr. Catherine Mulwa

National College of Ireland

MSc Project Submission Sheet

School of Computing

Student Name: ……. ……Rajalakshmi Rangarajan……

Student ID: X21168211

Programme: ……Data Analytics…… **Year:** ……2022……..

Module: ……MSc Research Project……

Lecturer: …… Dr. Catherine Mulwa

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Project Title: ……Attendance System in Third-Level Irish Institutions and Colleges Using Face Recognition Approach……

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Attendance System in Third -Level Irish Institutions and Colleges Using Face Recognition Approach

Rajalakshmi Rangarajan
X21168211

1 Introduction

In this Configuration Manual all the perquisites required to reproduce the research and its outcomes on individual environment are mentioned. The software and the hardware requirement along with a snapshot of code for Data Import and Exploratory Data Analysis, Image augmentation, all the models-built and Evaluation are included. The structure of the report is as follows, Section 2, gives the information about environment configuration.
Section 3, provides detail about data collection. Section 4 is data exportation consists of Data Pre-processing and Exploratory Data Analysis. Facial Recognition is explained in section 5. Section 6 provides the details about Evaluate test images.

2 System Specifications

This section provides the details of Software and Hardware requirements to implement the research done.

2.1 Hardware Requirements

Below Figure 1, provides the hardware specifications required. Intel i5-1135G7 is the 11th Generation Intel Core CPU @ 2.42 GHz, 16 GB installed DDR4 RAM Memory at speed of 3200 MHz, 64 Bit Windows 10 operating System, 512 GB SSD.

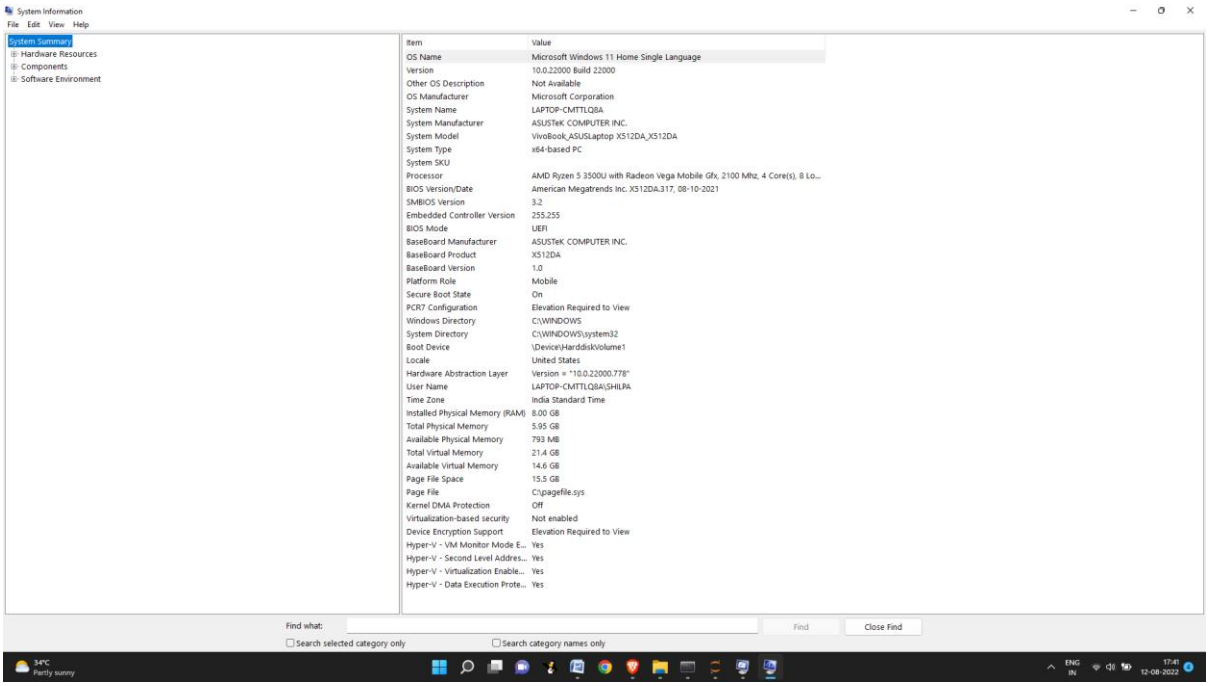

Figure 1: Hardware Requirements2

2.2 Software Requirements

- Google Collab
- Jupyter Notebook
- Python

3 Data Collection

The dataset is taken from Labelled Faces in the Wild public repository. http://vis-www.cs.umass.edu/lfw/is the link for the dataset. The dataset has 13233 images organized of over 5749 celebrities and around 160 people who has two or more images.

4 Data Exploration

All the Python libraries required to implement the entire project are listed in Figure 2.

```
!pip install -v --install-option="--no" --install-option="DLIB_USE_CUDA" dlib
!pip install face_recognition
```

```
/usr/local/lib/python3.8/dist-packages/pip/_internal/commands/install.py:232: UserW
option.
  cmdoptions.check_install_build_global(options)
Using pip 21.1.3 from /usr/local/lib/python3.8/dist-packages/pip (python 3.8)
Value for scheme.platlib does not match. Please report this to <https://github.com/
distutils: /usr/local/lib/python3.8/dist-packages
sysconfig: /usr/lib/python3.8/site-packages
Value for scheme.purelib does not match. Please report this to <https://github.com/
distutils: /usr/local/lib/python3.8/dist-packages
sysconfig: /usr/lib/python3.8/site-packages
Value for scheme.headers does not match. Please report this to <https://github.com/
distutils: /usr/local/include/python3.8/UNKNOWN
sysconfig: /usr/include/python3.8/UNKNOWN
Value for scheme.scripts does not match. Please report this to <https://github.com/
```

Figure 2: Installing required Python Libraries

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

Figure 3: Mounting goggle drive

```
import glob
import face_recognition as fr
import cv2
import numpy as np
import os
from google.colab.patches import cv2_imshow
import re
```

Figure 3: Required Python Libraries

5 Facial Recognition

This section explains the steps taken in facial recognition implementation.

```
gpu_info = !nvidia-smi
gpu_info = '\n'.join(gpu_info)
if gpu_info.find('failed') >= 0:
  print('Not connected to a GPU')
else:
  print(gpu_info)
```

```
Tue Dec 13 17:33:48 2022
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.32.03    Driver Version: 460.32.03    CUDA Version: 11.2     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  A100-SXM4-40GB      Off  | 00000000:00:04.0 Off |                    0 |
| N/A   26C    P0    53W / 400W |      0MiB / 40536MiB |      0%      Default |
|                               |                      |             Disabled |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

Figure 5: Setting up GPU for faster processing

```
path = "/content/drive/MyDrive/FacialRecognition/lfw/"
known_names = []
known_name_encodings = []
images = glob.glob('/content/drive/MyDrive/FacialRecognition/lfw/*/*')
```

Figure 6: Setting up directory path and reading the path for all the images

The code block of Figure 7 shows the implementation for the facial recognition of the training images. This function will read all the training images and generate facial encoding for each person adding the known name or the name of the person as a class to the facial encoding.

```
for i in range((len(images)-1)):
    try:
      image = fr.load_image_file(images[i])
      encoding = fr.face_encodings(image)[0]
      known_name_encodings.append(encoding)
      name = os.path.splitext(os.path.basename(images[i]))[0]
      known_names.append((re.sub("[^A-Za-z]"," ",name).strip()).capitalize())
    except:
        continue
```

```
known_names[0:20]
```

```
['Chuck hagel',
 'Chuck woolery',
 'Chung mong hun',
 'Chung mong hun',
 'Chyung dai chul',
 'Chuck yeager',
 'Chuck yeager',
 'Chuck finley',
 'Chung mong joon',
 'Chung mong joon',
 'Chuck amato',
 'Chuck amato'.
```

Figure 7: Facial Recognition for Training data

6 Test Evaluation

In figure 8 below, the testing function for the test image sis shown. The code takes the facial encoding and facial location of the test image. The encoding is then compared with the train data encodings for the closest match. If the face comparison distance is less the known name for that face is identified and it will display in a rectangular box for the person.

```
def EvaluateTestImage(face_locations, face_encodings):
  for (top, right, bottom, left), face_encoding in zip(face_locations, face_encodings):
      matches = fr.compare_faces(known_name_encodings, face_encoding)
      name = ""

      face_distances = fr.face_distance(known_name_encodings, face_encoding)
      best_match = np.argmin(face_distances)

      if matches[best_match]:
          name = known_names[best_match]

      face_match_percentage = (face_distances.max()-0.25)*100
      print("Performance analysis for ",name, "has score of", np.round(face_match_percentage,4))
      cv2.rectangle(image, (left, top), (right, bottom), (0, 0, 255), 2)
      cv2.rectangle(image, (left, bottom - 15), (right, bottom), (0, 0, 255), cv2.FILLED)
      font = cv2.FONT_HERSHEY_DUPLEX
      cv2.putText(image, name, (left + 6, bottom - 6), font, 1.0, (255, 255, 255), 1)

  cv2_imshow(image)
```

Figure 8: Test Evaluation function

6.1 For test Image 1

```
test_image = "/content/drive/MyDrive/FacialRecognition/test/test.jpg"
```

Figure 9: Initializing test image path

6.1.1 Hog Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='hog')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Courtney cox has score of 86.0935
Performance analysis for  Jennifer aniston has score of 84.4227
Performance analysis for  Matt leblanc has score of 84.7549
Performance analysis for  Matthew perry has score of 81.8127
Performance analysis for  Tatjana gsell has score of 83.5797
Performance analysis for  Rob morrow has score of 83.7428
```

Figure 10: Implementing Hog Model for the image

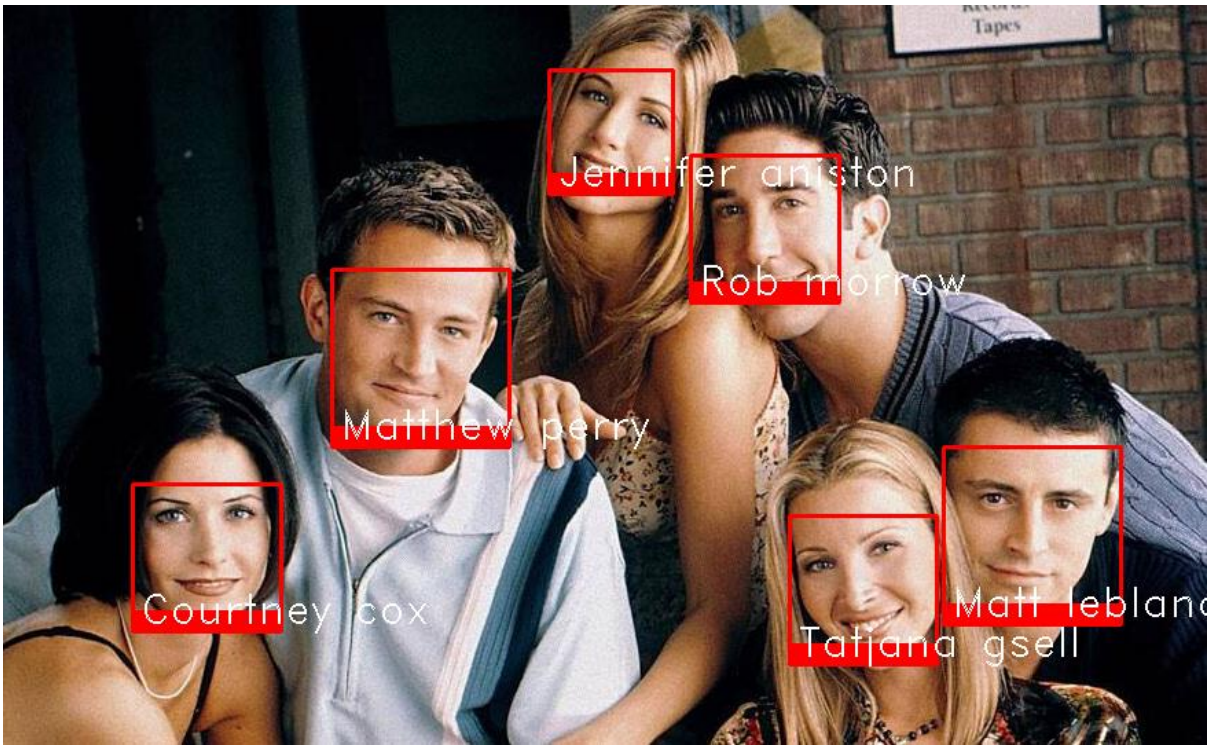

Figure 11: Faces Recognised by Hog Model

6.1.2 CNN Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='cnn')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Steve avery has score of 83.5216
Performance analysis for  Jennifer lopez has score of 83.7667
Performance analysis for  Courtney cox has score of 86.3282
Performance analysis for  Jennifer aniston has score of 84.5927
Performance analysis for  Matthew perry has score of 82.1357
Performance analysis for  Matt leblanc has score of 84.7549
```

Figure 12: Implementing CNN Model for the image

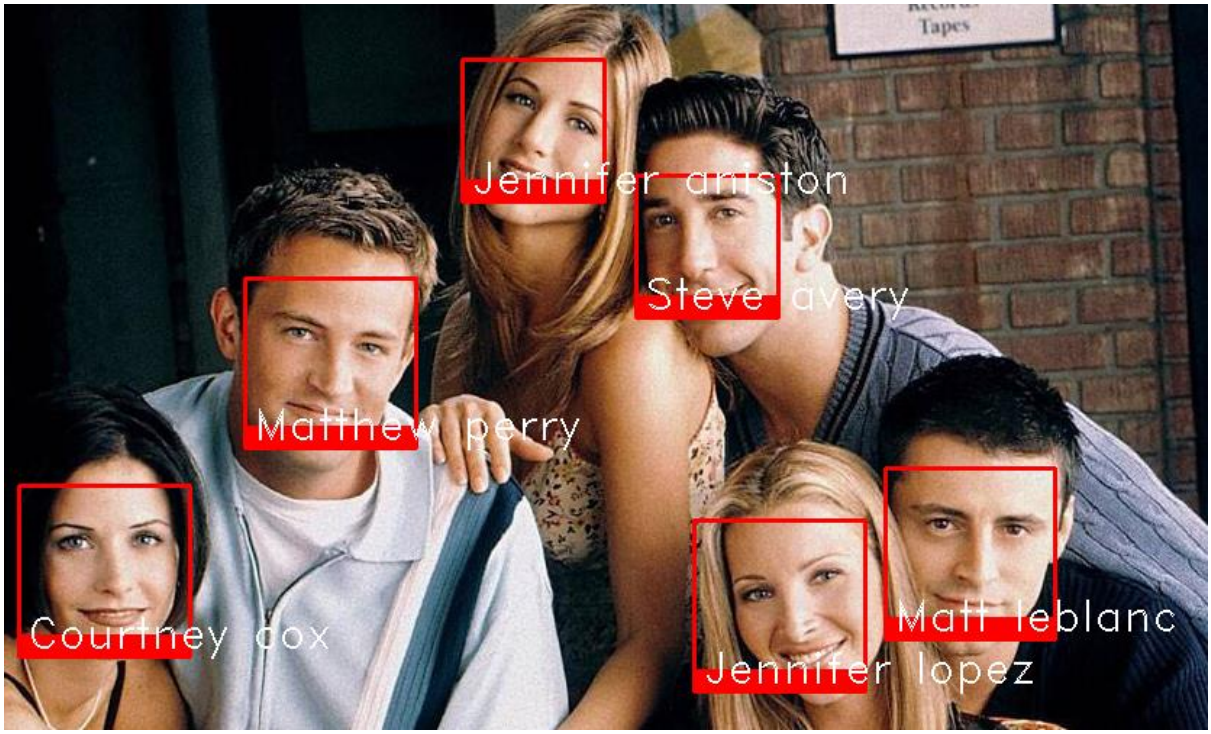

Figure 13: Faces Recognised by CNN Model

6.2 For test Image 2

```
test_image = "/content/drive/MyDrive/FacialRecognition/test/test1.jpg"
```

Figure 14: Initializing test image path

6.2.1 Hog Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='hog')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Kate winslet has score of 85.2815
Performance analysis for  Debra messing has score of 91.7409
Performance analysis for  Sadie frost has score of 87.1781
Performance analysis for  Sadie frost has score of 87.7028
Performance analysis for  Patty schnyder has score of 86.5931
Performance analysis for  Madonna has score of 88.0488
Performance analysis for  Sila calderon has score of 89.7493
Performance analysis for  Desiree lemosi has score of 88.7253
Performance analysis for  Emma watson has score of 93.2129
Performance analysis for  Svetlana koroleva has score of 96.2899
```

Figure 15: Implementing Hog Model for the image

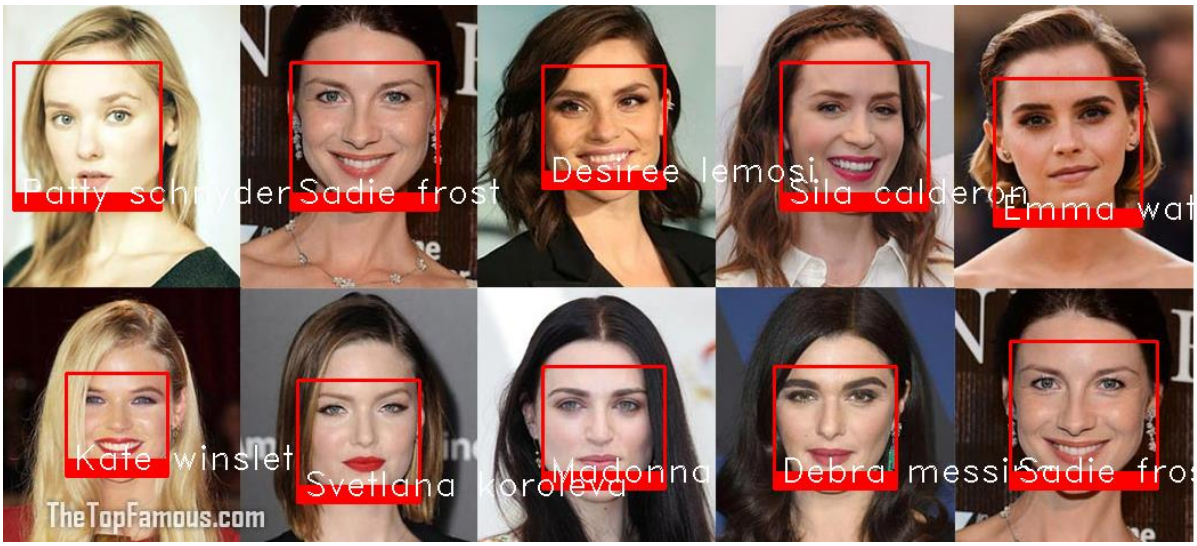

Figure 16: Faces Recognised by Hog Model

6.2.2 CNN Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='cnn')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Madonna has score of 88.3248
Performance analysis for  Sila calderon has score of 89.3289
Performance analysis for  Desiree lemosi has score of 89.0354
Performance analysis for  Emma watson has score of 93.4782
Performance analysis for  Kate winslet has score of 85.5923
Performance analysis for  Naomi watts has score of 86.6674
Performance analysis for  Nastassia kinski has score of 91.5025
Performance analysis for  Sadie frost has score of 87.2496
Performance analysis for  Svetlana koroleva has score of 95.7945
Performance analysis for  Sadie frost has score of 86.6739
```

Figure 17: Implementing CNN Model for the image

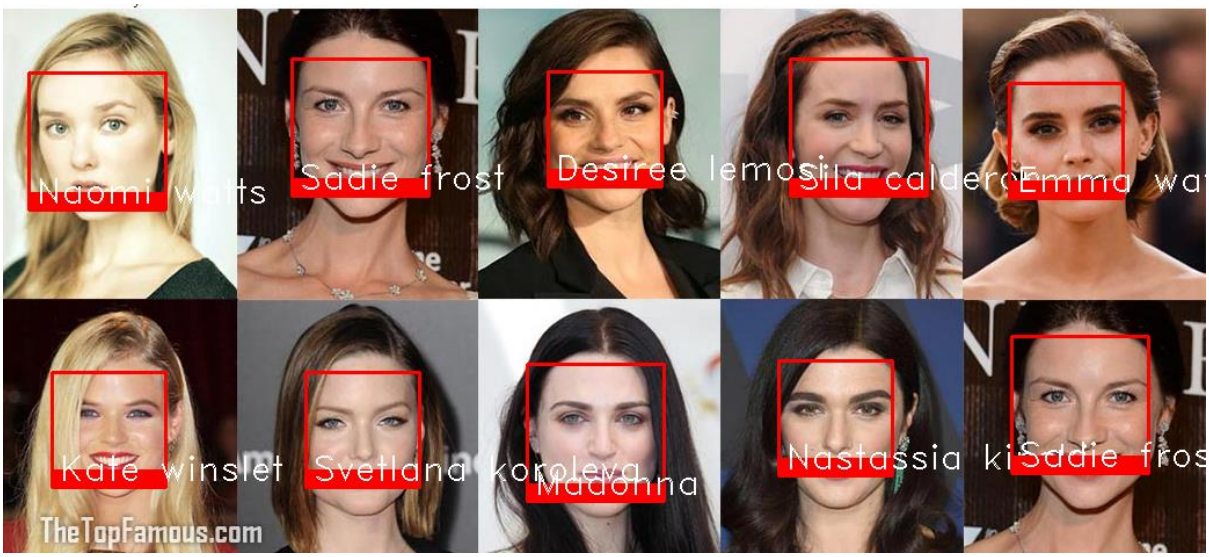

Figure 18: Faces Recognised by CNN Model

6.3 For test Image 3

```
test_image = "/content/drive/MyDrive/FacialRecognition/test/test2.jpg"
```
Figure 19: Intializing test image path

6.3.1 Hog Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='hog')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Christian lirette has score of 83.5136
Performance analysis for  Victoria beckham has score of 83.3682
Performance analysis for  Rick dinse has score of 82.4194
Performance analysis for  Amanda bynes has score of 86.7693
Performance analysis for  Franco dragone has score of 81.1014
Performance analysis for  Tony blair has score of 79.5665
Performance analysis for  Walter mondale has score of 85.897
Performance analysis for  Maggie smith has score of 83.1819
Performance analysis for  Hank azaria has score of 80.8071
Performance analysis for  Rupert grint has score of 83.1714
Performance analysis for  Daniel radcliffe has score of 85.5605
Performance analysis for  Robbie coltrane has score of 83.5461
Performance analysis for  Michael schumacher has score of 75.3467
```
Figure 20: Implementing Hog Model for the image

Figure 21: Faces Recognised by Hog Model

6.3.2 CNN Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='cnn')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Jack valenti has score of 85.876
Performance analysis for  Bill clinton has score of 82.5611
Performance analysis for  Robbie coltrane has score of 83.9808
Performance analysis for  Franco dragone has score of 81.1014
Performance analysis for  Matt doherty has score of 79.6024
Performance analysis for  Amanda bynes has score of 86.7693
Performance analysis for  Maggie smith has score of 83.7579
Performance analysis for  Daniel radcliffe has score of 85.2608
Performance analysis for  Christian lirette has score of 82.8183
Performance analysis for  Lance bass has score of 81.1127
Performance analysis for  Tony blair has score of 79.2456
Performance analysis for  Abdullah nasseef has score of 82.585
Performance analysis for  Victoria beckham has score of 83.5886
Performance analysis for  Rupert grint has score of 81.9163
```

Figure 22: Implementing CNN Model for the image

Figure 23: Faces Recognised by CNN Model

6.4 For test Image 4

```
test_image = "/content/drive/MyDrive/FacialRecognition/test/test3.jpg"
```

Figure 24: Initializing test image path

6.4.1 Hog Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='hog')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Felix mantilla has score of 82.3267
Performance analysis for  Edward kennedy has score of 82.026
Performance analysis for  Leandro andrade has score of 79.8362
Performance analysis for  George plimpton has score of 84.5456
Performance analysis for  Daniel day lewis has score of 85.1712
Performance analysis for  Bela karolyi has score of 82.2448
Performance analysis for  Mitchell mclaughlin has score of 77.0055
```

Figure 25: Implementing Hog Model for the image

Figure 26: Faces Recognised by Hog Model

6.4.2 CNN Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='cnn')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Felix mantilla has score of 81.9934
Performance analysis for  Leandro andrade has score of 80.5445
Performance analysis for  George plimpton has score of 85.3546
Performance analysis for  Mitchell mclaughlin has score of 77.0055
Performance analysis for  George karl has score of 83.7033
Performance analysis for  Edward kennedy has score of 81.6197
Performance analysis for  Bela karolyi has score of 81.7378
```

Figure 27: Implementing CNN Model for the image

Figure 28: Faces Recognised by CNN Model

6.5 For test Image 5

```
test_image = "/content/drive/MyDrive/FacialRecognition/test/test4.jpg"
```

Figure 29: Initializing test image path

6.5.1 Hog Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='hog')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Victoria beckham has score of 90.8172
Performance analysis for  Marquier montano contreras has score of 87.6609
Performance analysis for  Robert downey jr has score of 74.8379
Performance analysis for  Akiko morigami has score of 86.1133
Performance analysis for  Naomi watts has score of 86.3134
Performance analysis for  Nadia petrova has score of 84.4452
Performance analysis for  Jennifer furminger has score of 82.4608
Performance analysis for  Leonardo fernandez has score of 84.4441
Performance analysis for  Antwun echols has score of 88.0157
Performance analysis for  Ta mclendon has score of 87.1666
Performance analysis for  Xavier malisse has score of 85.5377
Performance analysis for  Mohammaed ahmad al jarallah has score of 81.0246
Performance analysis for  David beckham has score of 77.4865
Performance analysis for  Katherine harris has score of 83.3562
Performance analysis for  Alek wek has score of 87.808
Performance analysis for  Ashley postell has score of 95.3963
Performance analysis for  Jeffery hendren has score of 87.2591
Performance analysis for  Guillaume depardieu has score of 81.9314
Performance analysis for  Nadia petrova has score of 90.7252
Performance analysis for  Gwyneth paltrow has score of 83.2074
Performance analysis for  Bill mcbride has score of 81.3776
Performance analysis for  Ren qingjin has score of 87.5481
Performance analysis for  Craig morgan has score of 81.9735
Performance analysis for  Ralf schumacher has score of 92.0729
Performance analysis for  Hugo colace has score of 86.5527
Performance analysis for  Vojislav kostunica has score of 88.2723
Performance analysis for  Julian battle has score of 84.7353
Performance analysis for  Robert ehrlich has score of 82.6915
Performance analysis for  Marcus garrettson has score of 81.347
Performance analysis for  Catherine zeta jones has score of 82.744
Performance analysis for  Jean chretien has score of 78.2103
Performance analysis for  Quincy jones has score of 84.4999
Performance analysis for  Nick turner has score of 90.5464
Performance analysis for  Pele has score of 89.9125
```

Figure 30: Implementing Hog Model for the image

Figure 31: Faces Recognised by Hog Model

6.5.2 CNN Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='cnn')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Guillaume depardieu has score of 81.281
Performance analysis for  Ta mclendon has score of 87.5205
Performance analysis for  Xavier malisse has score of 85.4423
Performance analysis for  Julian battle has score of 83.9016
Performance analysis for  Serena williams has score of 90.0015
Performance analysis for  Mohammaed ahmad al jarallah has score of 81.0246
Performance analysis for  Marquier montano contreras has score of 87.6609
Performance analysis for  Erick barkley has score of 82.6922
Performance analysis for  Pele has score of 89.7139
Performance analysis for  David beckham has score of 77.7174
Performance analysis for  Marcus garrettson has score of 82.3537
Performance analysis for  Carlos moya has score of 81.5807
Performance analysis for  Ren qingjin has score of 88.1548
Performance analysis for  Jeffery hendren has score of 87.8747
Performance analysis for  Daniel zelman has score of 78.0444
Performance analysis for  Nadia petrova has score of 90.9743
Performance analysis for  Craig morgan has score of 82.0232
Performance analysis for  Victoria beckham has score of 86.0644
Performance analysis for  Marcus garrettson has score of 95.6243
Performance analysis for  Catherine zeta jones has score of 83.7125
Performance analysis for  Jose luis chilavert has score of 82.0135
Performance analysis for  Akiko morigami has score of 84.6999
Performance analysis for  Hugo colace has score of 86.8105
Performance analysis for  Vojislav kostunica has score of 87.6873
Performance analysis for  Leonardo fernandez has score of 84.2806
Performance analysis for  Laura bush has score of 83.072
Performance analysis for  Ralf schumacher has score of 91.0927
Performance analysis for  Gwyneth paltrow has score of 84.3433
Performance analysis for  Robert ehrlich has score of 82.5339
Performance analysis for  Jennifer furminger has score of 82.4608
Performance analysis for  Victoria beckham has score of 90.6083
Performance analysis for  Katherine harris has score of 83.3562
Performance analysis for  Robert downey jr has score of 75.0385
Performance analysis for  Chuck bednarik has score of 87.5254
```

Figure 32: Implementing CNN Model for the image

Figure 33: Faces Recognised by CNN Model

6.6 For test Image 6

```
test_image = "/content/drive/MyDrive/FacialRecognition/test/test5.jpg"
```

Figure 34: Initializing test image path

6.6.1 Hog Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='hog')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Monique ferreira has score of 82.7623
Performance analysis for  Andrew bernard has score of 90.4204
Performance analysis for  Julio cesar chavez has score of 87.612
Performance analysis for  Sebastien grosjean has score of 76.7071
Performance analysis for  Jennifer garner has score of 85.9189
Performance analysis for  Roger machado has score of 81.5859
Performance analysis for  Richard rodriguez has score of 86.3281
Performance analysis for  Ben affleck has score of 82.8726
Performance analysis for  Ken watanabe has score of 78.251
Performance analysis for  Jose maria aznar has score of 83.6168
Performance analysis for  Sharon stone has score of 82.0842
Performance analysis for  Ben affleck has score of 81.2924
Performance analysis for  Jennifer garner has score of 86.4318
Performance analysis for  Jennifer garner has score of 89.5364
Performance analysis for  Caroline dhavernas has score of 85.5062
Performance analysis for  Alvaro uribe has score of 90.76
Performance analysis for  Holly hunter has score of 83.4831
```

Figure 35: Implementing Hog Model for the image

Figure 36: Faces Recognised by Hog Model

6.6.2 CNN Model

```
image = cv2.imread(test_image)
face_locations = fr.face_locations(image, model='cnn')
face_encodings = fr.face_encodings(image, face_locations)
EvaluateTestImage(face_locations, face_encodings)
```

```
Performance analysis for  Ken watanabe has score of 78.251
Performance analysis for  Michael jasny has score of 89.9974
Performance analysis for  Ben affleck has score of 82.8726
Performance analysis for  Jose maria aznar has score of 83.6168
Performance analysis for  Richard rodriguez has score of 86.3281
Performance analysis for  Monique ferreira has score of 82.7623
Performance analysis for  Sharon stone has score of 82.0842
Performance analysis for  Roger machado has score of 81.5859
Performance analysis for  Julio cesar chavez has score of 87.612
Performance analysis for  Sebastien grosjean has score of 76.7071
Performance analysis for  Jennifer garner has score of 85.9189
Performance analysis for  Jennifer garner has score of 89.8684
Performance analysis for  Ben affleck has score of 83.1017
Performance analysis for  Salma hayek has score of 84.9028
Performance analysis for  Jennifer garner has score of 86.4318
Performance analysis for  Alvaro uribe has score of 90.76
Performance analysis for  Fidel castro has score of 79.2763
```

Figure 37: Implementing CNN Model for the image

Figure 38: Faces Recognised by CNN Model

References

https://pypi.org/project/face-recognition/

https://www.analyticsvidhya.com/blog/2022/04/face-recognition-system-using-python/

https://face-recognition.readthedocs.io/en/latest/face_recognition.html

https://github.com/ageitgey/face_recognition