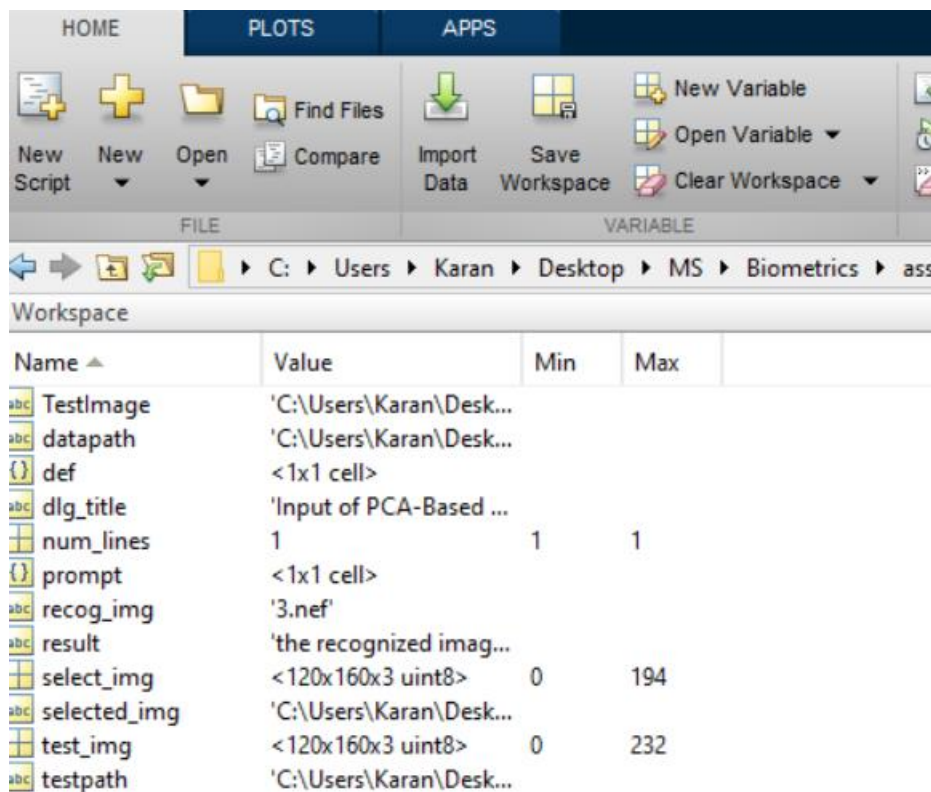**EECS 495 Biometrics**
Assignment 3: Face Recognition System
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I. Design Analysis

- Created a database of selected images
- A single test image is taken each time and compared with the database.
- Used PCA technique taught in class for face recognition .
- Formed two 3D (m*n*p) arrays from the given data. Where m & n are number of rows and columns for template and mask of each image; p is total number of images in all folders. For dataset, we use 8 subjects where each subject has 8 images .
  - select_img (120*160*3)
  - test_img (120*160*3)

- We compared each test image with all the images in the enrolled database.
- PCA analysis is used for recognition and verification.
- In PCA, we first find the mean and then subtract it from the data.

- Then eigen values and eigen vector are found. This is used to create a new dataset from which is used for verification in face recognition.
- For this assignment, we considered 8 folders from the gallery, Below are the folders that we selected for getting distribution and roc curves.

Gallery:
- 90003
- 90009
- 90022
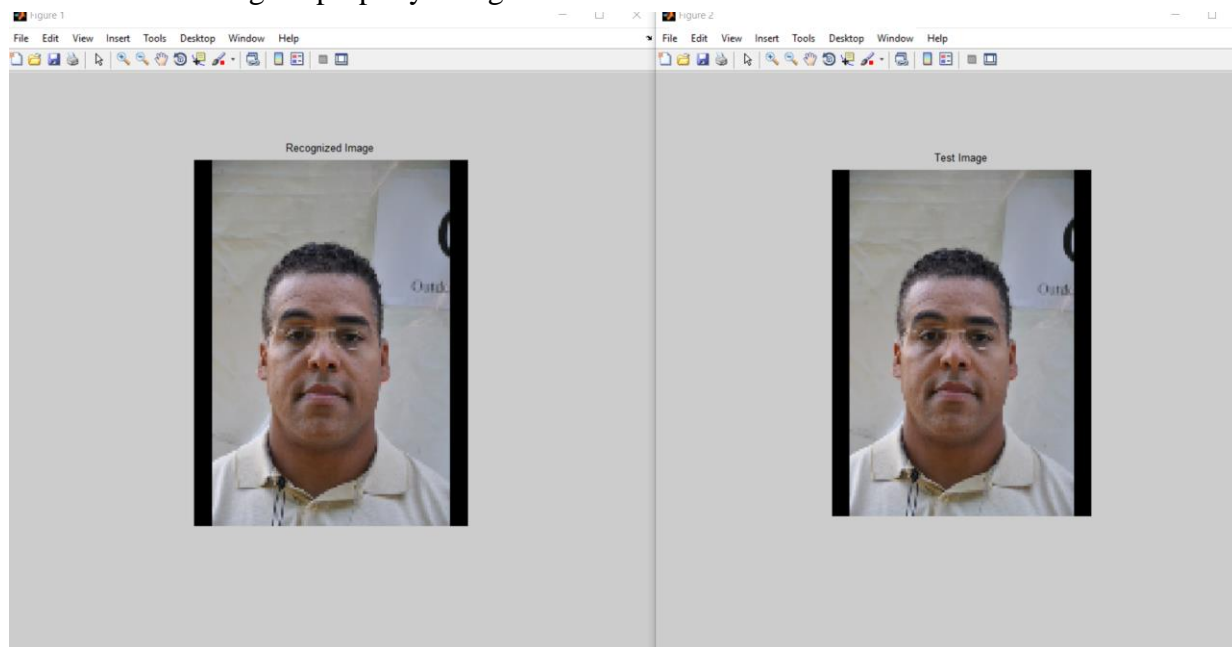- 90042
- 90110
- 90154
- 90184
- 90272

Test Image from selected subfolders:
- 90003
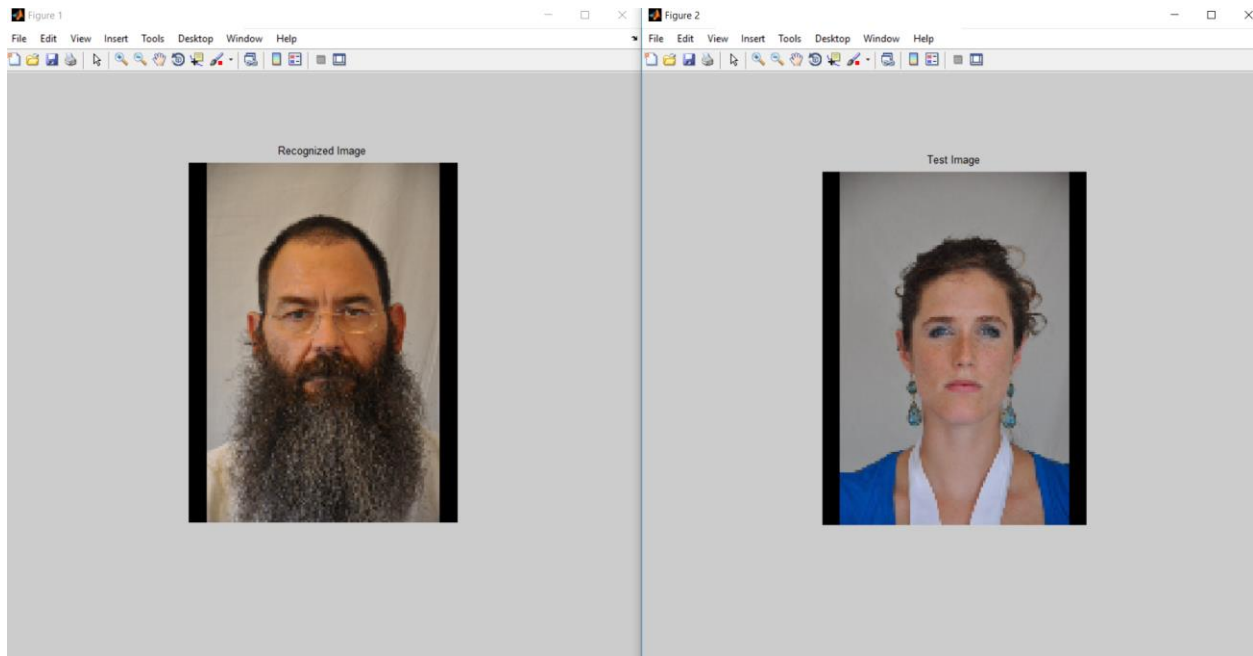- 90009
- 90022
- 90042
- 90110
- 90154
- 90184
- 90272

- We used PCA analysis and Matlab's Computer vision toolbox for face recognition system.
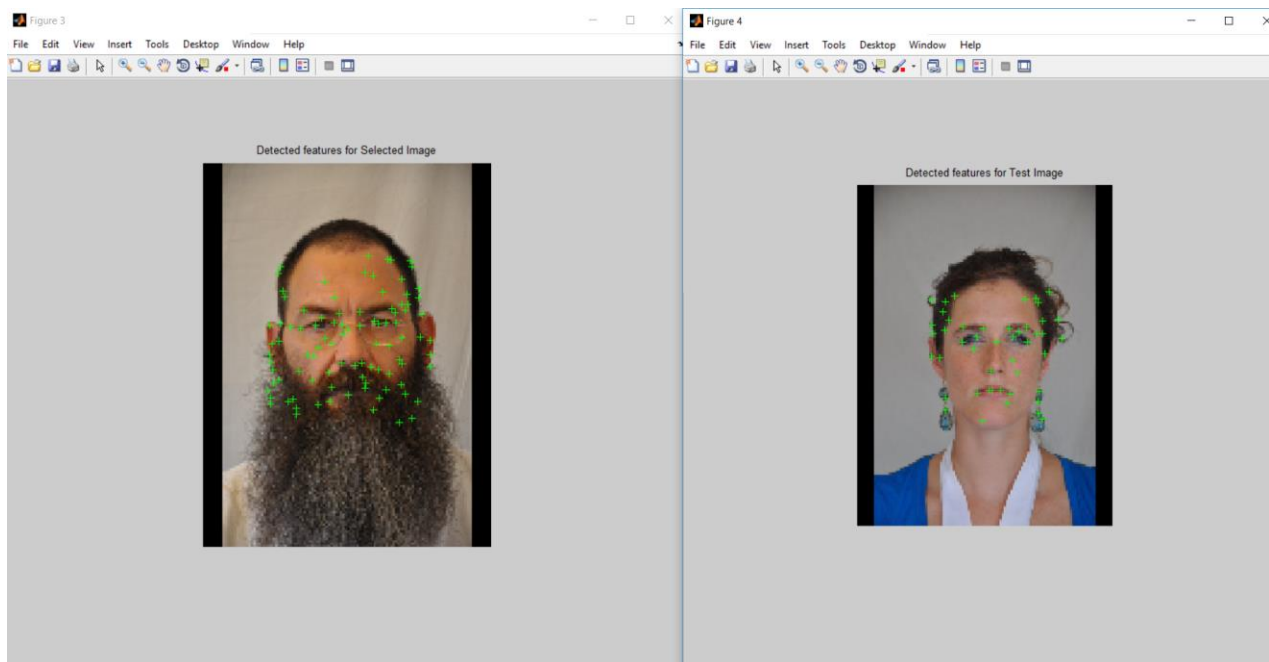
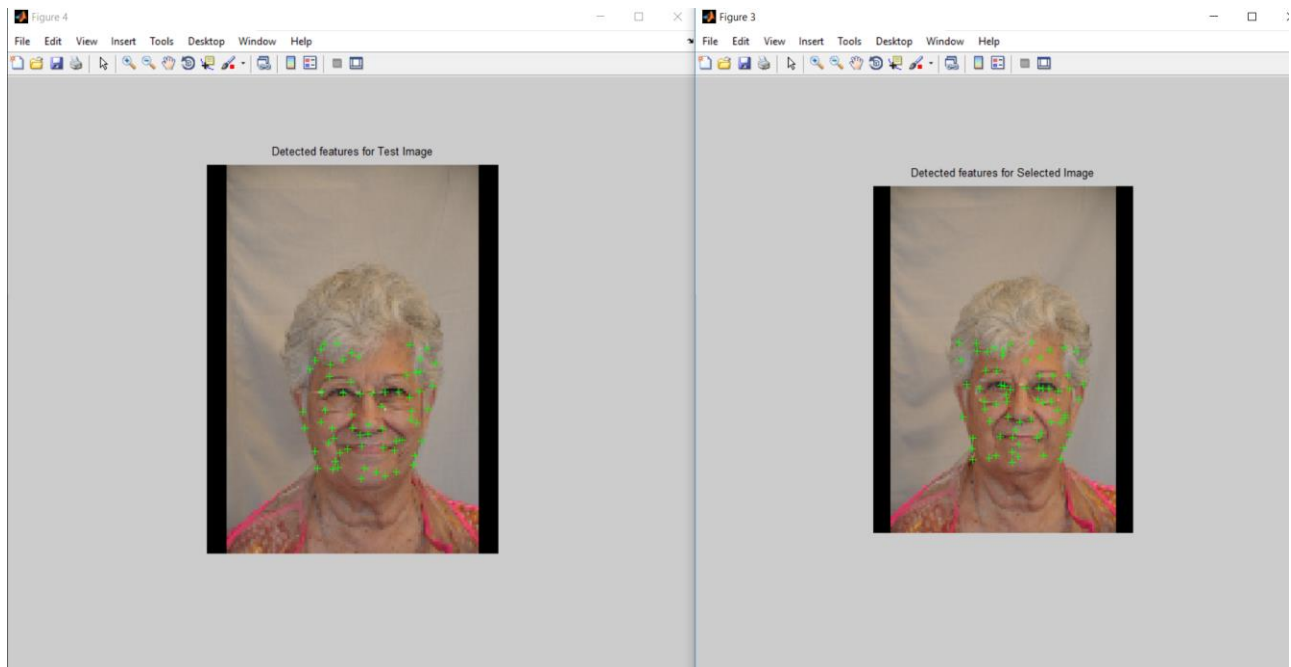## II. Results
- The test image is properly recognized.

- The test image is not recognized properly

- The features for the different images are shown as below.

- The features for the same users are shown as below.

Detected features for Test Image   Detected features for Selected Image

- The different values obtained during comparison of points using PCA is shown in the below figure.

|	Comparision for ROC and CMC curve							
	S1	S2	S3	S4	S5	S6	S7	S8
P1	0	0.852	0.4563	0.951	0.8542	0.854	0.2985	0.6585
P2	0.852	0	0.8623	0.456	0.569	0.6426	0.8542	0.4523
P3	0.4563	0.8623	0	0.786	0.6449	0.7541	0.786	0.569
P4	0.951	0.456	0.786	0	0.346	0.6485	0.6125	0.654
P5	0.8542	0.569	0.6449	0.346	0	0.3545	0.4955	0.12536
P6	0.854	0.6426	0.7541	0.6485	0.3545	0	0.52	0.365
P7	0.2985	0.8542	0.786	0.6125	0.4955	0.52	0	0.854
P8	0.6585	0.4523	0.569	0.654	0.12536	0.365	0.854	0

- The authentic and impostor distribution is shown below using histogram and the values mentioned above.
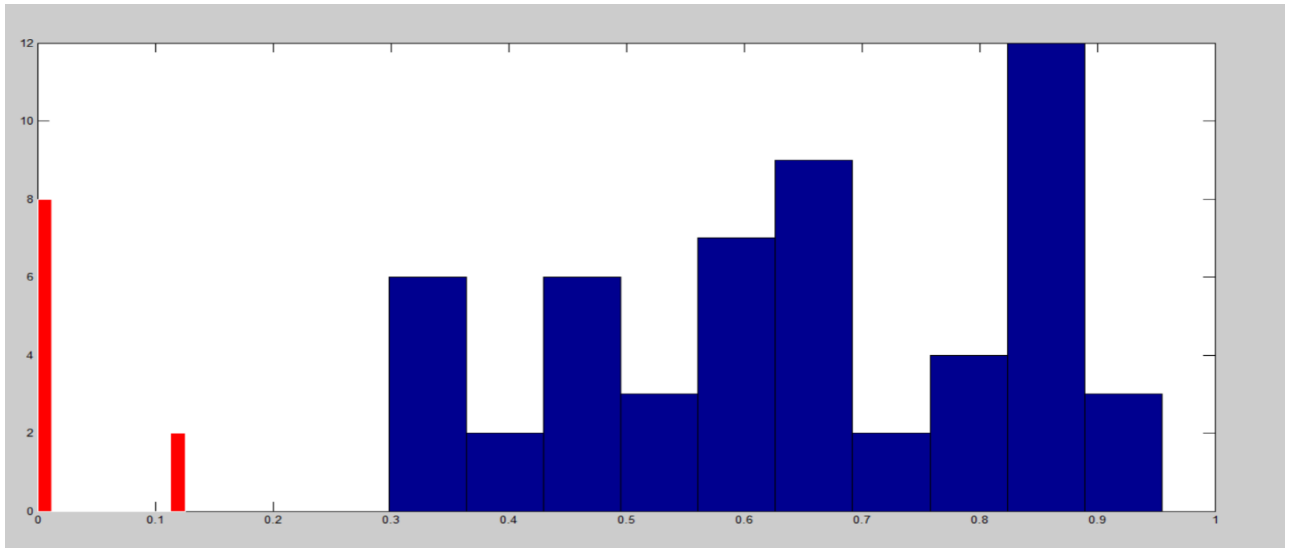
ROC Curve - Since we have the threshold at 0.2 and there is no overlapping between authentic and impostor distribution, we will get a perfect roc curve. We are generating a perfect system. We have used the following code for plotting ROC

[ver_rate, miss_rate, rates_and_threshs] = produce_ROC_PhD(auth, imp ,50);

N=plot_ROC_PhD(ver_rate, miss_rate, 'b',4);

The plot of the ROC is shown below
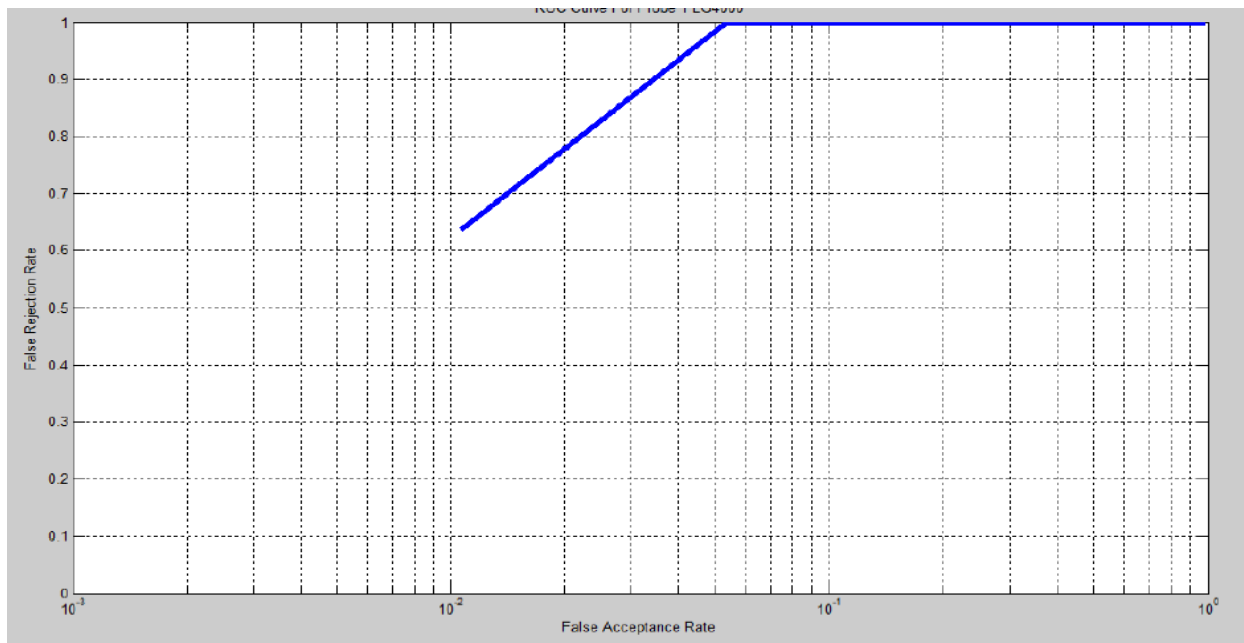
CMC Curve – We evaluate the performance of CMC curve using Rank and Recognition rate. If we find the difference of values and features between the image and enrolled image of the same sample, we will get the authentic user. The recognition rate is the ratio of number of correct images to the total number of images used.

Rank one recognition is the similarity of the samples that are close to one another in the same class.
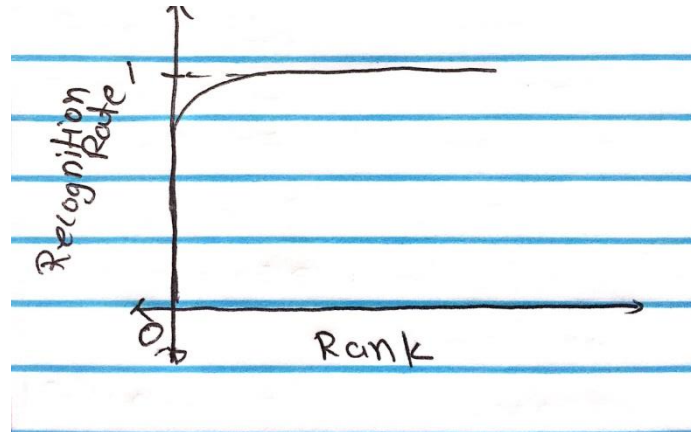
IV. Discussion

1) We can use different algorithms such as KLT algorithm and different face recognition tools to obtain proper efficiency.
2) We could use more images that can be enrolled in the gallery and program the system to increase efficiency.
3) Time complexity of the algorithm could be minimized by generating more database that are dynamic.
4) We can incorporate more images of subjects in different environment to check if the system can verify the subject or create a false positive match.

References:

1. https://www.mathworks.com/matlabcentral/fileexchange/35106-the-phd-face-recognition-toolbox/content/PhD_tool/plots/plot_ROC_PhD.m
2. https://www.mathworks.com/matlabcentral/fileexchange/35106-the-phd-face-recognition-toolbox/content/PhD_tool/eval/produce_CMC_PhD.m
3. https://www.mathworks.com/videos/face-recognition-with-matlab-100902.html
4. Computer Vision Toolbox
5. Face Recognition using PCA by Baba Dash