ASSIGNMENT 6

Face Recognition using Principal Component Analysis(PCA) and Linear Discriminant Analysis(LDA)

In this assignment , PCA and LDA have been used for face recognition

Notes about the dataset :-

1. Train Dataset :- This dataset contains 5 images(different angles) of 5 different people.
2. Test Dataset :- This dataset contains 7 images. 5 images belong to the people in the train dataset while 2 images of random people have been added to check the correctness of the face recognition mechanisms used.

   The images used have a resolution of 720x1280 which on flattening gives 921600 pixels i.e. 921600 dimensions.

Principal Component Analysis

We use the standard PCA method for face recognition here. Some important observations that can be made are :-

1. Let A be out train image matrix with dimensions as :- no. of samples x number of features. We first calculate the eigen vectors for the covariance matrix AA^T and then multiply the

eigen vector with A^T to obtain the eigen vectors of $(AA^T)^T$. This is done so as to make computations easier and quicker.

2. The eigen values in our case are as follows :-

```
[3203.5318848  -682.91348211 -547.36112601 -531.66608517 -492.82482889
 -411.1598164   596.10539555 -337.13887951 -303.29769366  535.953765
  498.96914631  457.29239349 -230.45851     344.61026621  338.02205601
  286.11533635  262.73882273  202.90092191 -135.51972099 -108.96998915
  -59.88839581  -36.60373159   35.99987385   71.21350352  111.34889356]
```

   From these we can see that one eigen value has the value 3203.53188 which is significantly greater than the others. Hence we choose the eigen vector corresponding to this eigen value as our final eigen vector.

3. We use the mahalanobis distance to calculate the distance between the test images and the train images as it gives a better accuracy than the euclidean distance.

The accuracy obtained using the created dataset is 100%. All faces are correctly recognised and the faces that are not present in the training set are correctly separated using a threshold value of 0.005

```
8.749802743251738e-17 2 0
5.599873755681112e-16 6 1
2.239949502272445e-15 11 2
2.799936877840556e-16 18 3
7.349834304331459e-16 23 4
0.1504616397480051 1 5
0.07309746109202128 4 6
1.0
```

The above image shows the minimum distance of test images from the training images. The output displayed is in the format :-

Minimum Distance,Training Image Number,Test Image Number. The images 5 and 6 are not present in the training set and it can be seen that their minimum distance is significantly higher than the other images.

Linear Discriminant Analysis

We first flatten our images. Because the image size is 720x1280 we end up getting 921600 pixel values in a single row which is treated as 921600 features by LDA. LDA can not be used on such a large number of features as it will take a “LOT” of time. To avoid this, we first apply PCA on the training dataset to reduce the number of features to 2 and then apply the standard LDA procedure.

We again use mahalanobis distance to calculate the minimum distance between the test and the train images and use the threshold value of 0.005 as used in PCA. We get an accuracy of 100% on using LDA on the particular dataset used for this assignment.

```
3.814277911459108e-17 2 0
7.628555822918215e-16 6 1
9.15426698750186e-16 11 2
0.0 18 3
1.5257111645836432e-16 23 4
0.031225124484992744 1 5
0.06401627627436443 1 6
1.0
```

The above image shows the minimum distance of test images from the training images. The output displayed is in the format :- Minimum Distance,Training Image Number,Test Image Number. The images 5 and 6 are not present in the training set and it can be seen that their minimum distance is significantly higher than the other images.