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CS6001 Assignment 4: Face Recognition

REPORT

A. OUTLINE FOR PROGRAM ALGORITHM:

The algorithm for implementing the program is given below in steps:

1. Matlab function files are created for each model separately. The program then executes the corresponding model. Images for 'eigenfaces' as well as pair of test image and its corresponding matched image are plotted to provide some visualization aid.
2. Factors which can be varied to get different results for a model are: selection of K (Number of eigenvectors) & distance metrics used for inference algorithm.
3. The program firstly creates an 'IMAGE_MATRIX' for training face images by looping through each file in the directory (and sub directory) of training images. Inside the loop, the image data is converted into column vector and a matrix consisting column vectors of all images is saved. Another matrix named 'train_subject_number' is created which consists of subject (person) corresponding to image number. This matrix is used later for the calculation of accuracy. The mean is calculated for this matrix, subtracted from the image matrix and then it is averaged. Covariance matrix is computed from the earlier obtained value of mean.
4. In the next part, this image matrix is passed through in-built MATLAB function named 'pca' (Principal Component Analysis). This function return eigen vectors and eigen values for the given training images. Number of eigen vectors to be used for the construction of feature vector ('feature_reference') is selected. Finally, these images are projected into subspace.
5. For the inference algorithm, firstly an 'IMAGE_MATRIX' is created for testing face images using process explained in the above point. Then these images are projected into subspace using eigen vectors of training data to create feature vector ('feature_test'). To match the image, the feature vector of the given test image is compared with the feature vector of each training image. Comparison between feature vectors is done by determining distances between them. (Different methods like Euclid, Manhattan, Cosine are available) The training image with the least distance is matched with the test image.
6. In the last part, accuracy for matched subject is computed. ('Matched_Subject_Accuracy') Also, a matrix named 'matched_matrix' is saved for further analysis.

B. RESULTS:

This is the table for all the models implemented using the program for **Euclid distance metrics**:

	MODEL	MATCHED SUBJECT ACCURACY (%)	NUMBER OF EIGEN VECTORS (K)
1	RGB	29.31	10
2	RGB	35.77	50
3	RGB	38.79	183
4	RGB	37.06	56
5	HSV	34.91	56
6	YCbCr	35.77	56
7	GRAY	34.91	56
8	RGB + HSV	37.5	56
9	RGB + YCbCr	33.18	56

Table for RGB model using the program for **different distance metrics**:

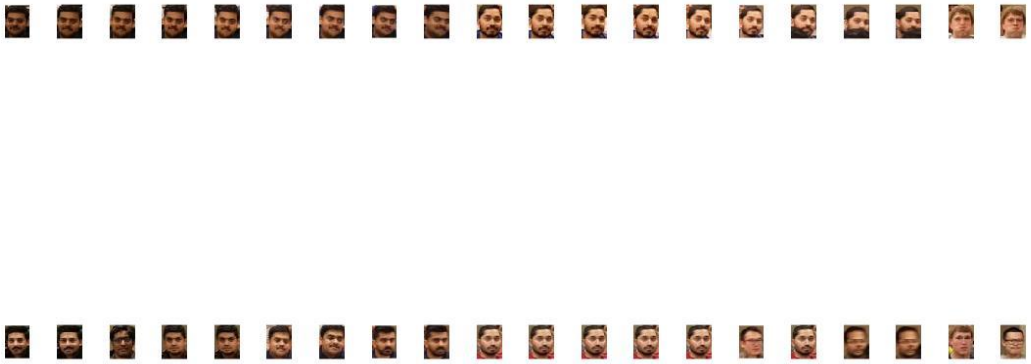
	DISTANCE METRICS	MATCHED SUBJECT ACCURACY (%)	NUMBER OF EIGEN VECTORS (K)
1	Euclidean	35.77	50
2	City Block (Manhattan)	35.15	50
3	Cosine	38.36	50
4	Minkowski	35.78	50
5	Chebychev	26.72	50

Results for each model are given below separately. It should be noted that the eigen faces can also be viewed.

1. RGB Model:

This model uses values of red, green and blue to describe the image.

Few pair of matched images and their test images:

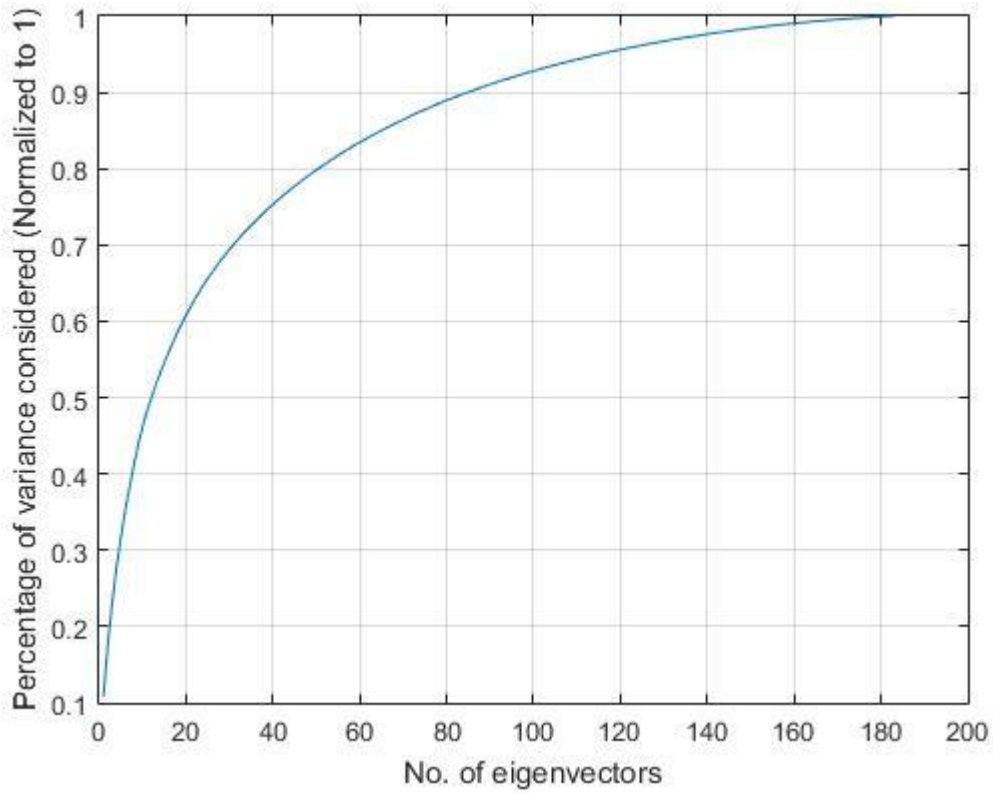


(Upper row is the test image row and lower row is the corresponding matched images row)

2. HSV model:

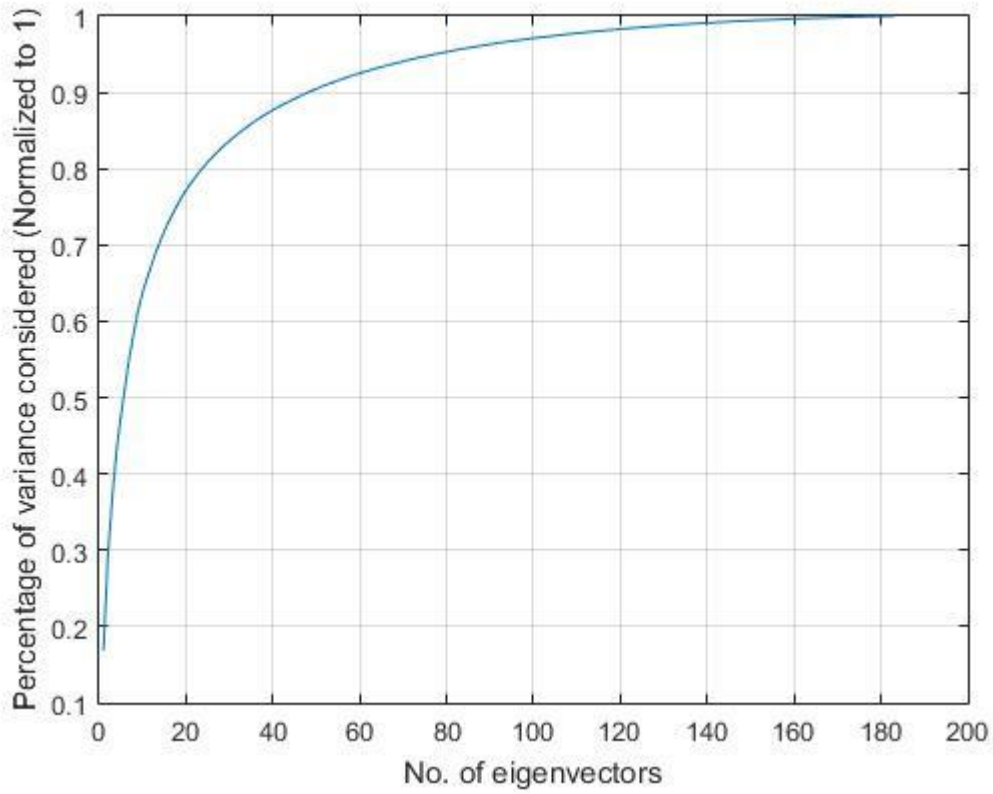
This model converts RGB values into Hue, Saturation & Value to describe image.

Few pair of matched images and their test images:



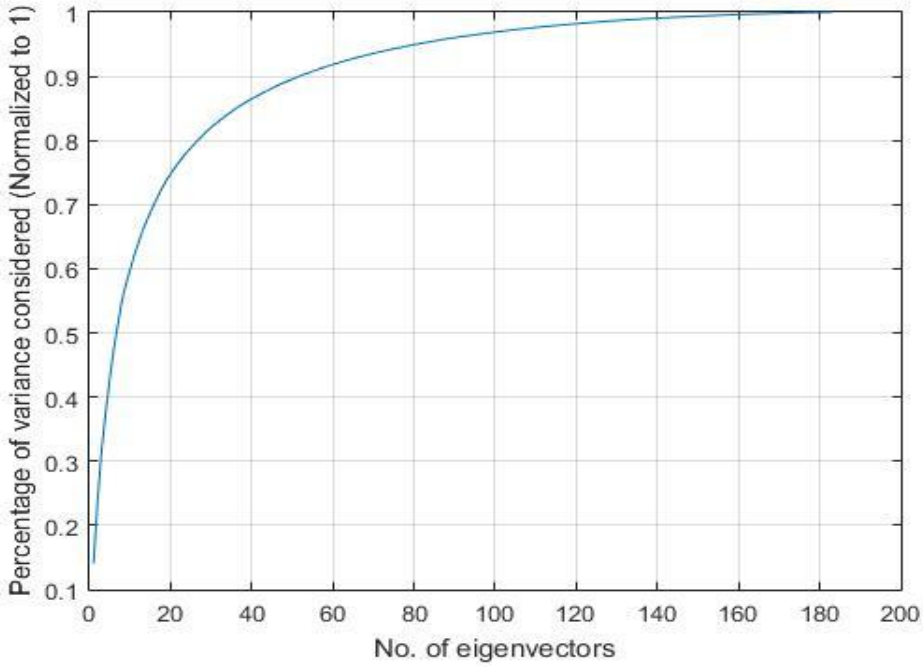
3. YCbCr model:

This model converts RGB values into Y, Cb and Cr values to describe the image.



4. GRAY Model:

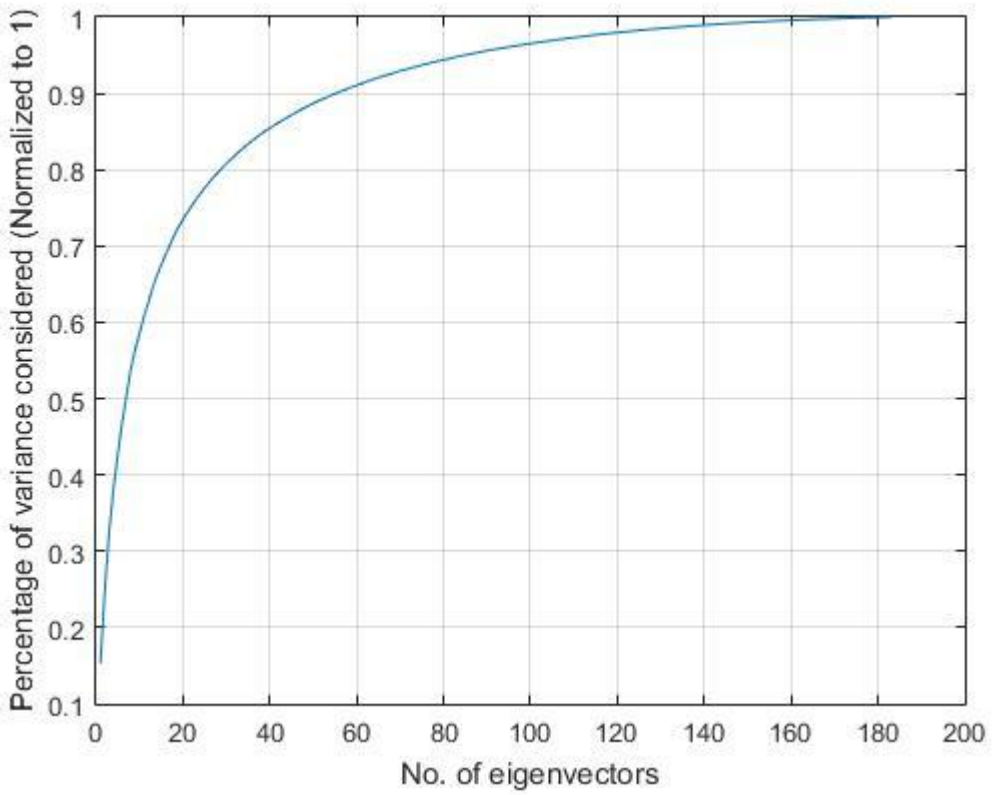
In this model, image is converted to grayscale. These values in single channel are taken to estimate mean and covariance.



C. General Observation & Comments:

1. Computation of eigen vectors and eigen values is much faster using in-built MATLAB function ‘pca’ than using the function ‘eig’. Also, calculation of mean shifted image matrix and covariance matrix is not necessary in the case of former function.

2. From the first few values of table 1, it is clear that determination of number of eigen vectors (K) is an important factor. Below is the graph showing normalized value of variance covered by number of eigen vectors to determine the image (For RGB model).



3. From table 2 it can be deduced that the distance metric used for inference algorithm is also important for accuracy. The distance metric ‘cosine’ gave maximum value for accuracy.

D. Summary and Concluding Comments:

1. The aim of this assignment was to recognize face of the subject in the image. From the results, it is evident that the algorithm is moderately efficient in recognition.
2. It could be possible to increase the accuracy of the algorithm by considering different algorithms like Fisherface or Linear Space.
3. Another approach would be to increase the number of training images, as they are used to compute eigen vectors. Certain image filters reducing illumination effect might also help.