CS663, Assignment 4 **Yash Sanghvi, Pradyot Prakash**
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Question 3: Detection of False and True Negatives

Problem Statement

What will happen if you test your system on images of people which were not part of the training set? (i.e. the last 8 people from the ORL database). What mechanism will you use to report the fact that there is no matching identity? Work this out carefully and explain briefly in your report. Test whatever you propose on all the 32 remaining images (i.e. 8 people times 4 images per person), as also the entire test set containing 6 images each of the first 32 people. How many false positives/negatives did you get? [10 points]

Implementation Details

To deal with the case if the test image doesn't belong to the test set, we make the following changes to the algorithm:

1. For each training image belonging to the same face (lets say Face number i), we find out the mean of the eigencoefficient vector of the training images belonging to the training face, $\overline{x_i}$. In the eigenspace, this represents a center of k dimensional circle. The radius of this circle is equal to the maximum of euclidean distance of the centre, $\overline{x_i}$ from the rest of the training images. Let us call it r_i. Now each face corresponds to a k-dimensional circle in the eigenspace.

2. Now we take the test image, find its coefficient over the eigenspace and find out among the database, the training image whose coefficients are at the minimum euclidean distance from the test image's coefficients. Let us call it y_j and it belongs to the face i.

3. Now, if the distance of the eigencoefficients of the image from the centre of circle corresponding to face i, i.e. $\overline{x_i}$ is less than than ϵ times the radius of the circle corresponding to face (ϵ is a free parameter), i.e ϵr_i , then the test image belongs to face i. Otherwise it is identified as a negative. i.e. doesn't belong to the test image.

Comments:

1. The idea behind the algorithm is to partition the k dimensional eigenspace, where each partition formed by a circle, corresponds to one face. Thus if a test image is not close enough to any of the faces in the dataset, it fails to lie in any of the partition and qualifies as a negative i.e. doesn't belong to the any of the faces in the dataset.

2. The free parameterϵ on trial and error was set 0.45 to achieve the minimum false negatives and maximum true positives without decreasing the recognition rate by too much. If it is kept too low, then the system fails to recognise anything other than the actual training data. However if it is too high, the system may recognise any other face as belonging to data and may defeat its possible purpose as a security system.

Result

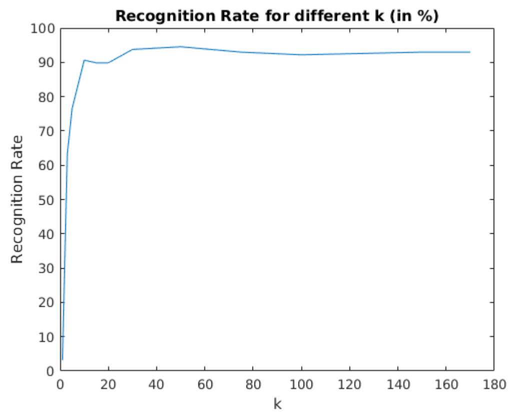

Figure 1. Recognition rate for the given algorithm using $\epsilon = 0.45$

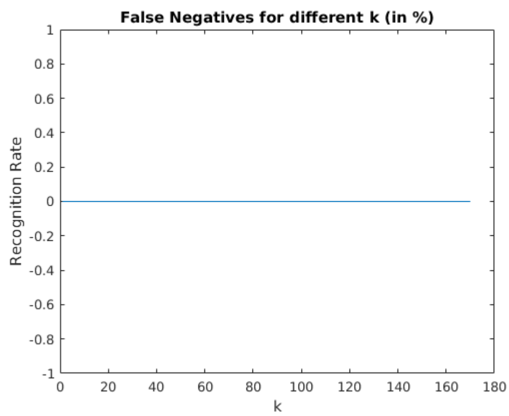

Figure 2. Number of images which were falsely identified as not belonging to the dataset.

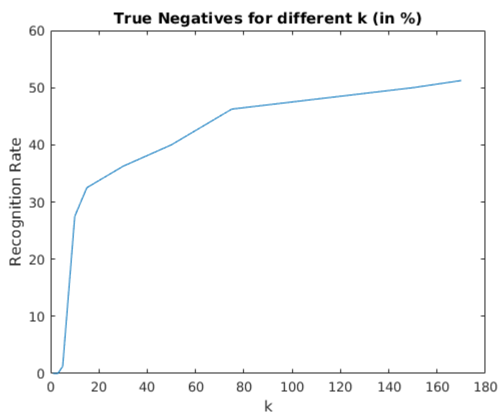

Figure 3. Number of images not belonging to the dataset and correctly identified as 'negatives'.