CIE 6004(Fall 2019) Assignment 4

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1 Introduction

This report is about the Assignment 4 of "Image Processing and Computer Vision". We mainly discuss face recognition with eigenface, how to train a visual word vocabulary and comparing the visual word histograms of test images. And my code is based on Matlab.

The report includes the description of the problems, the algorithm to solve them and the results of the resolution.

2 Exercise

2.1 Eigenface for Face Recognition

Perform face recognition using eigenface on ORL dataset. The ORL dataset we used contains 400 face images(32*32) of 40 people. There are 280 and 120 for training and testing respectively.

(a) Computation of eigenfaces of the training set and display the former 100 eigenfaces.

Firstly, load the training set. Then, we calculate the average face and the shifted face(faces minus the average face). Finally, we run pca method and display the former 100 eigenfaces.

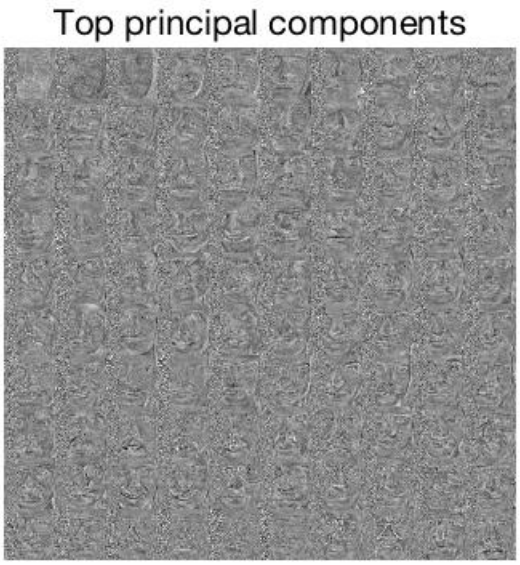

Figure 1: The former 100 eigenfaces

(b) Classification of the test set.

With 100 eigenfaces and 280 faces for training, we achieve a classification rate of 82.5% on test set of 120 faces.

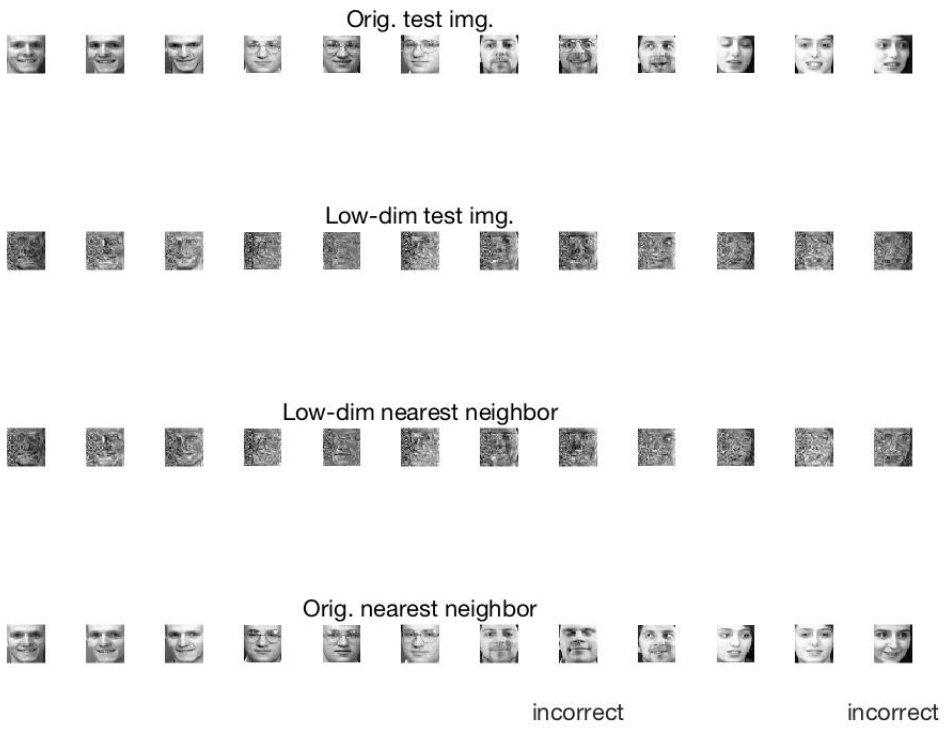

Figure 2: Classification Results

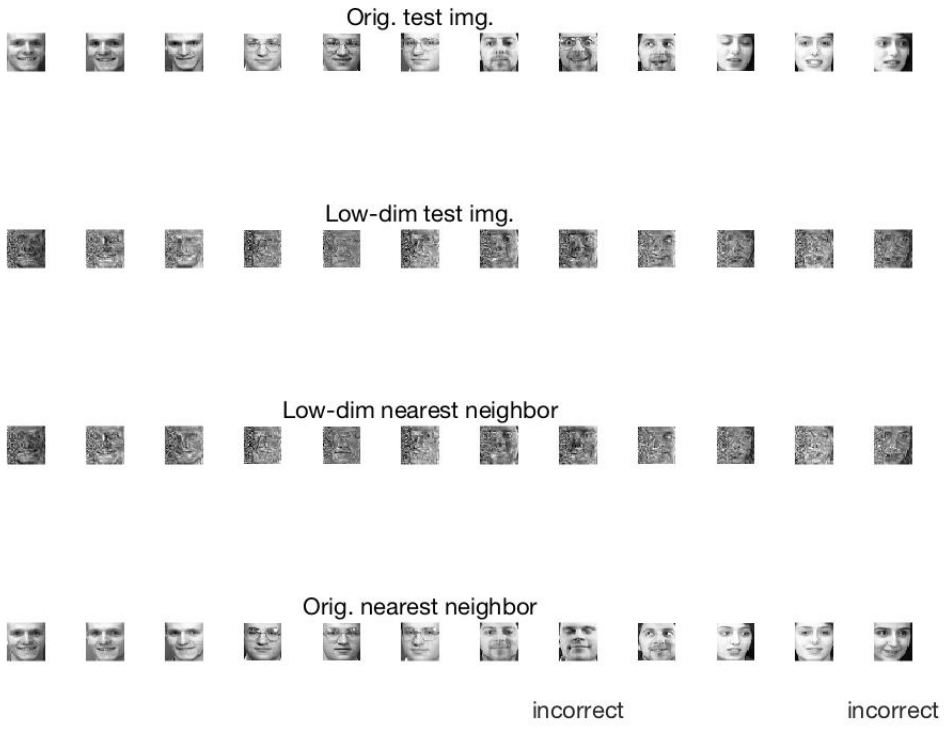

Figure 3: Classification Results

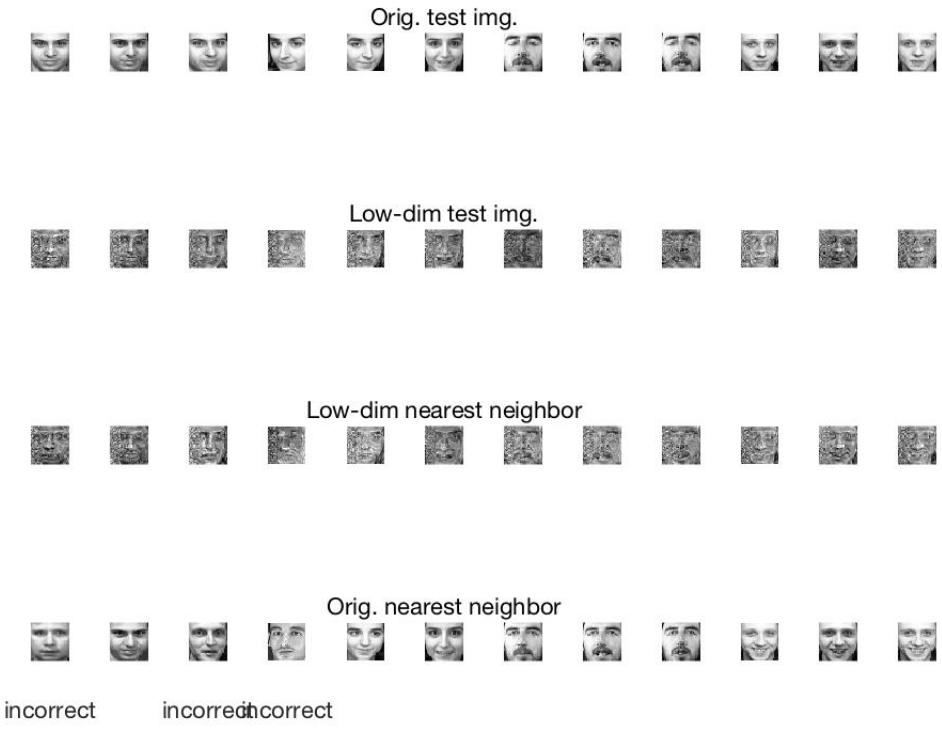

Figure 4: Classification Results

2.2 Visual Word

(a) Learn a visual vocabulary using the Caltech 101 dataset and cluster the descriptors by k-means.

There are actually 102 classes in Caltech 101 dataset, and we use a subset of 15 images for each class to train the vocabulary. The descriptors are created by $\mathrm{vl}_sift method. And we use 50 as the number of centers for means$.

(b) Compute and plot the visual word histograms of three images, two taken from a similar scene (the Dayun Park) and the other taken from a different scene (the Robotics Lab).

From the histograms, we observe that the histograms of two similar scene are close to each other, while the histogram of Lab scene is quite different.

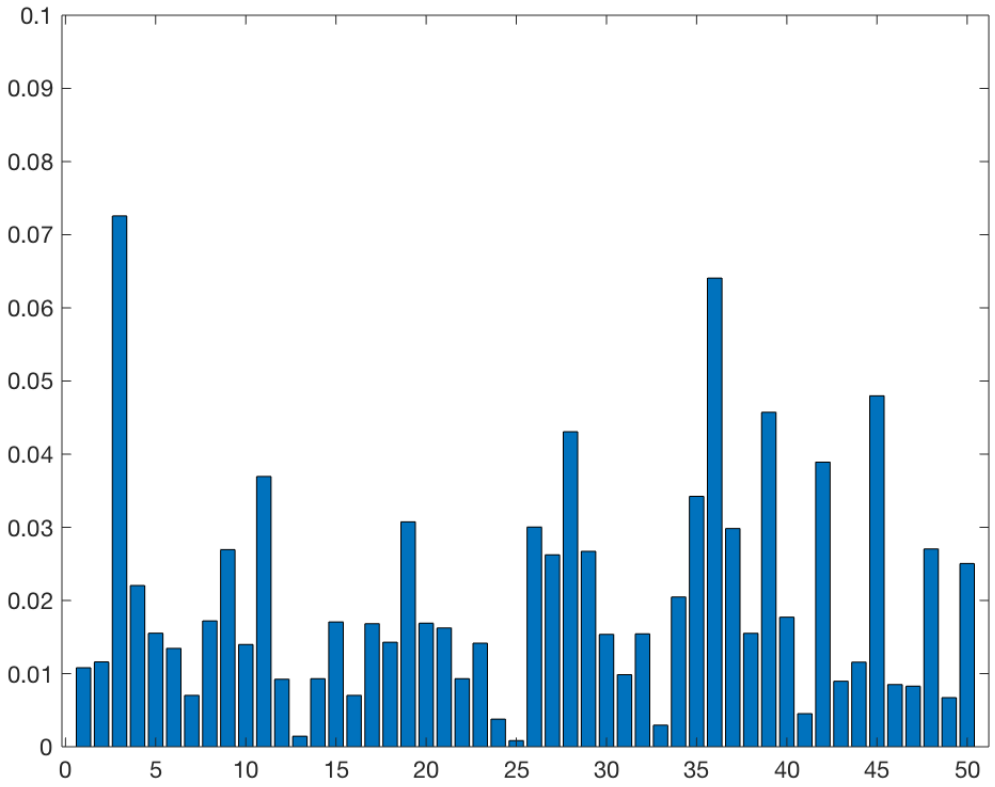

Figure 5: features histogram of Dayun1

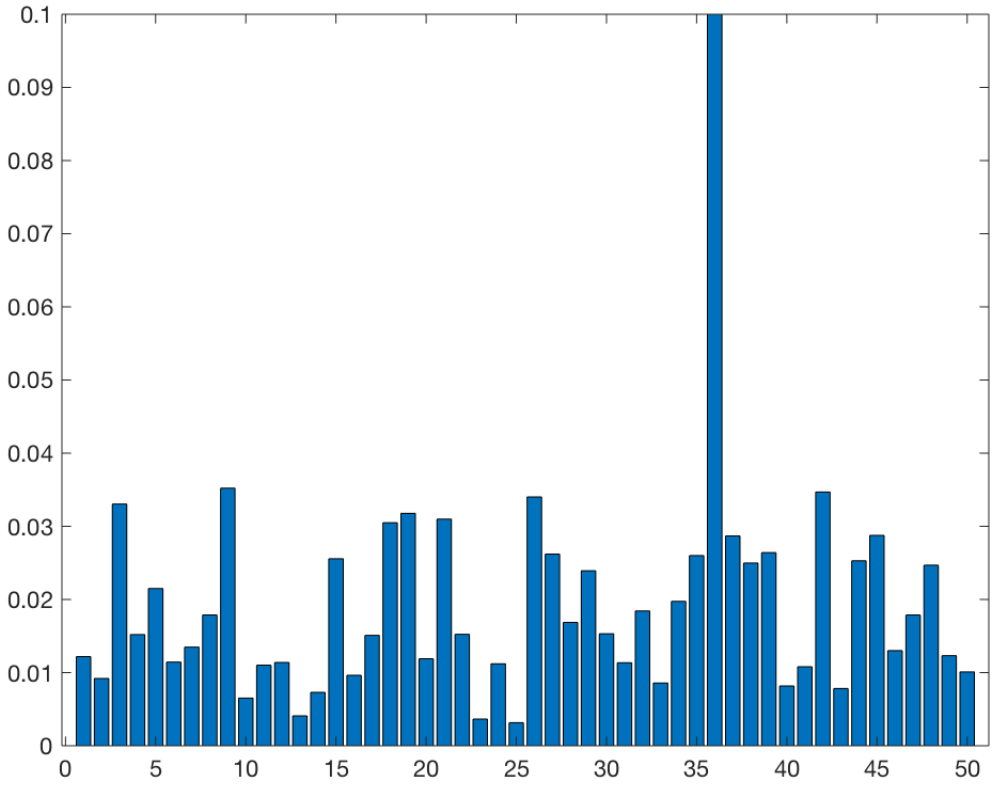

Figure 6: features histogram of Dayun2

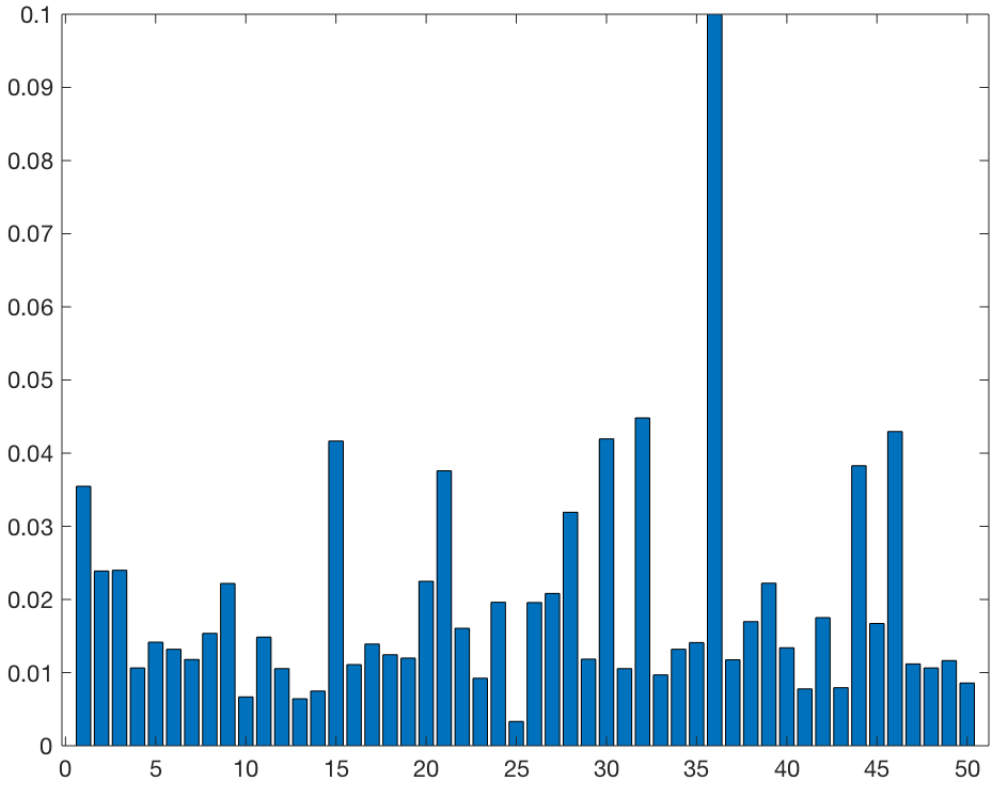

Figure 7: features histogram of Robotics Lab

2.3 How the Intrinsic Matrix Changes

(a) If we scale the image from (w, h) to (aw, bh), how the intrinsic matrix changes?

$$\begin{bmatrix} afx & 0 & cx \\ 0 & bfy & cy \\ 0 & 0 & 1 \end{bmatrix}$$

(b) If we make a center cropping on the image by k pixels, namely, the size of the image will reduce to (w - 2k, h - 2k), how the intrinsic matrix changes?

$$\begin{bmatrix} fx - 2k & 0 & cx \\ 0 & fy - 2k & cy \\ 0 & 0 & 1 \end{bmatrix}$$

(c) If we horizontally flip the image, how the intrinsic matrix changes?

$$\begin{bmatrix} fx & 0 & cx \\ 0 & fy & cy \\ 0 & 0 & 1 \end{bmatrix}$$