From Appearance Matching to Feature Invariant Matching Face Recognition: Comparisons between PCA and SIFT

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Introduction

Face recognition is one of the important surveillance application, there are many different method and algorithm related to it, every method have cons and pros, from these method we have principle component analysis (PCA) and scale invariant feature transform (SIFT).

In this paper we compare between PCA and SIFT performance using 3 fold cross validation techniques depend on two parameter accuracy and real time.

Paper Objectives:

To make a good comparison between two commons methods in face recognition field: PCA and SIFT, to show which one more appropriate to face recognition.

Face Recognition Block Diagram:

In this figure show how any face recognition methods working :

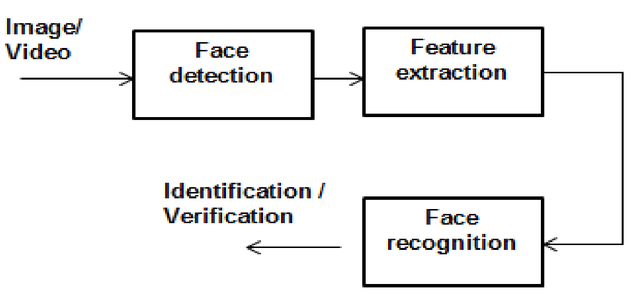

Figure 1: Face Recognition System

Theory:

In this section we explain PCA, SIFT, and matching methods used.

PCA:

It's a statistical method that objected to reduce the dimensionality space of variables without losing of the data.

PCA used in many application and from these applicant it used in face recognition , the scenario of PCA working that we get a database of faces image, build the eigenspace by putting all the image into a one large image, find the mean of every face and subtract it from large image, this step called the normalization stage. Then find the covariance matrix and calculate the eigenvalues and eigenvectors from the matrix, to choose best eigenvalues we should sort them in descending according the eigenvectors. Finally we make projection to eigenspace.

SIFT :

is a well-known method for object recognition devolved by David Lowe extracted as final document in 2004. SIFT discriminate that it invariant to image scaling and rotation, and robustness for illumination and 2D camera view point. It used in many applications mainly for object recognition. Sift has four step to identify the feature in the image which is a vector of 128 dimension, first step search about all scale and location using difference of Gaussian function after make blurring by Gaussian filter in image this step called scale space extrema detection and in it decide if the keypoint is interest or not by search for a minimum or maximum value with 26 neighbor related for any pixel (keypoint). Finally find keypoint descriptor that created from local image gradients and this feature based on orientation histogram.

Matching methods:

PCA and SIFT use nearest neighbor.

Experiments and Result:

Experiments environments

We use Matlab as working environments, SIFT code available in David Lowe website [1], and PCA get from [2].

Database

In this paper we used Yale faces database. The Yale Face database contains 165 gray scale images in GIF format of 15 individuals. There are 11 images per subject, one per different facial expression or configuration: center-light, happy, left-light, w/no glasses, normal, right-light, sad, sleepy, surprised, and wink.

Figure 2: Yale database

Approach

We classify the database based on 3 fold cross validation. For each of 3 fold, we randomly assign the data into 3 fold d0, d1, d2 two of them assigned as training and the rest as test, and then try this process 3 times so can the testing faces changed. Since we use Yale database training fold have 110 faces but test have 55 faces.

Result:

We compare between SIFT and PCA in terms of recognition rate and running times.

- Recognition rate(RR): number of recognized image to number of testing image.
- Running time(RT): is run time for all testing image to the number of testing image.
- The following table showing results:

Parameter	PCA	SIFT
RR	68.83	86.98
RT	1.09	10.9

- We conclude that the SIFT has a higher performance but not in real time than PCA algorithm.

References:

[1] “Sift implementation”: http://www.cs.ubc.ca/~lowe/keypoints/.

[2] “PCA implementation”: http://www.cs.ait.ac.th/~mdailey/matlab/.