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A PATH FOR HORIZING YOUR INNOVATIVE WORK

FACE RECOGNITION USING EIGEN FACES

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Abstract: Face recognition systems are built on the idea that each person has a particular face structure, computerized face-matching is possible. Face recognition system using the Principal Component Analysis algorithm was implemented. The algorithm is based on an Eigen face approach which represents a PCA method in which a small set of significant features are used to describe the variation between face images. Face recognition presents a challenging problem in the field of image analysis and computer vision, and it received a great deal of attention over the last few years because of its many applications in various domains such as information security, access management, law enforcement etc.

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INTRODUCTION

Face Recognition area is one hot research area in the field of computer vision. There has been plenty of work done in face recognition some of the work has been mentioned here for references. Face Recognition has been used in various applications where personal identification is required. Human face recognition has been studied for many years. Unfortunately developing a computational model of face recognition is quite difficult, because faces are complex. Therefore, the face recognition is a very high level computer vision task, in which many early vision techniques can be involved. Face recognition can be applied for a wide variety of problems like image and film processing, human-computer interaction, criminal identification etc[8]. This has motivated researchers to develop models to identify the faces, which are relatively easy to implement. Some governments started to use computer based face recognition systems for tracing criminals and passport checkouts. For security issues face recognition systems expected to maintain flawless process. In this, nodal points are end points used to measure variables of a person's face, such as the depth of the eye sockets, length or width of the nose. These systems work by capturing data for nodal points on a image of an individual's face and storing the resulting data as a face print. The face print can then be used as a basis for comparison with data captured from faces in an image.

Eigen face technique uses principal component analysis of the images of the faces. This analysis reduces the dimension of the training set, leaving those features that are critical for face recognition. Eigen faces are a set of Eigen vectors used in the computer vision problem of human face recognition. Face recognition has become an important place in many applications such as security systems, credit card verification criminal identification and some other topics. Detecting faces in photographs can be very useful, since the effect of many increasing depends on the image content. Faces pose a particularly difficult problem in this respect because all faces are similar to one another. They contain the same set of features such as eyes, nose, mouth arranged in roughly the same manner.

Much of the work in computer recognition of faces on detecting individual features such as the eyes, mouth, and head outline, and defining a face model by the position, size, and relationships among these features.

2. LITERATURE REVIEW:

Human can use faces to recognize separately and the advancement in computing over the past few decades now enable similar recognition automatically. Early face recognition algorithms use simple models, but the recognition process has now matured into a science of sophisticated matching processes and mathematical representations. Person can enter into in the testing set

and checking to that person face in to the training face .In this paper, it can see the faces of person are present or not in using Eigen faces approach.in the previous technical problem overcome in that paper. Face recognition is such a challenging interesting problem that it has researchers who have different backgrounds: neural networks,pattern recognition, computer vision, and graphics. It is due to this fact that the literature on face recognition is diverse. The single system involves techniques motivated by different principles. The usage of a mixture of techniques makes it difficult to classify these systems based purely on what types of techniques they use for feature representation or classification.

Only one of the obtained subgroups is provided to Principal Component Analysis for recognition. The performance of the algorithm is tested on our database of faces.

3.The Eigen Face Approach:

In the language of information theory, we want to extract the relevant information in a face image, encode it as efficient as possible, and compare one face encoding with a database of models encoded similarly.There are two phases for face recognition using Eigen faces. The first phase is the training phase. In this phase, a large group of individual faces is acted as the training set. These training images should be a good representation of all the faces that one might encounter. The size, orientation and light intensity should be standardized. For example, all images are of size 125 x 125 pixels and all are frontal faces. Each of the images in the training set is represented by a vector of size N by N, with N representing the size of the image. With the training images, a set of Eigen-vectors is found by using Principal Component Analysis.

The basic idea of Principal Component Analysis is to take advantages of the redundancy existing in the training set for representing the set in a more compact way. Using Principal Component Analysis, we can represent an image using M eigenvectors where M is the number of eigenvector used. Eigen faces are a set of eigenvectors used in the computer vision assume ghastly appearance. They refer to an appearance-based approach to face recognition that seeks to capture the variation in a collection of face images and use this information to encode and compare images of individual faces in a holistic manner. Specifically, the Eigen faces are the principal components of a distribution of faces, or equivalently, the eigenvectors of the Covariance problem of human face recognition. Eigen faces matrix of the set of face images, where an image with N x N pixels is considered a point (or vector) in N2-dimensional space.

Extract the relevant facial information, which may or may not be directly related to human intuition of face features such as the eyes and lips. One way to do so is to capture the statistical variation between face images. Represent face images efficiently. To reduce the computation

and space complexity, each face image can be represented using a small number of dimensions[3].

The reasons Eigen face method selecting for face recognition are:

- The simplicity of realization.
- Its independence from the facial geometry.
- Possibility of real-time realization even without specific hardware,
- The ease and speed of recognition with respect to the any other methods,
- The higher success rate in comparison to other methods.

This approach to face recognition involves the following initialization operations:

1. Acquire an initial set of face images (the training set)

2. Calculate the Eigen faces from the training set keeping only the M images corresponding to the highest Eigen values. These M images define the face space.

3. Calculate the corresponding distribution in M dimensional weight space for each known individual, by projecting their face images onto the face space.

Having initialized the system, the following steps are then used to recognize new face images:

1. Calculate a set of weights based on the input image and the M Eigen faces by projecting the input image onto each of the Eigen faces.

2. Determine if the image is a face at all by checking to see if the image is sufficiently close to face to face.

3. (Optional) update the Eigen faces and/or weight patterns.

4. (Optional) if the same unknown face is seen several time, its characteristic weight pattern and incorporate into the known faces.

Fig1.are show that the flowchart of algorithm of Eigen faces in stepwise manner[4].

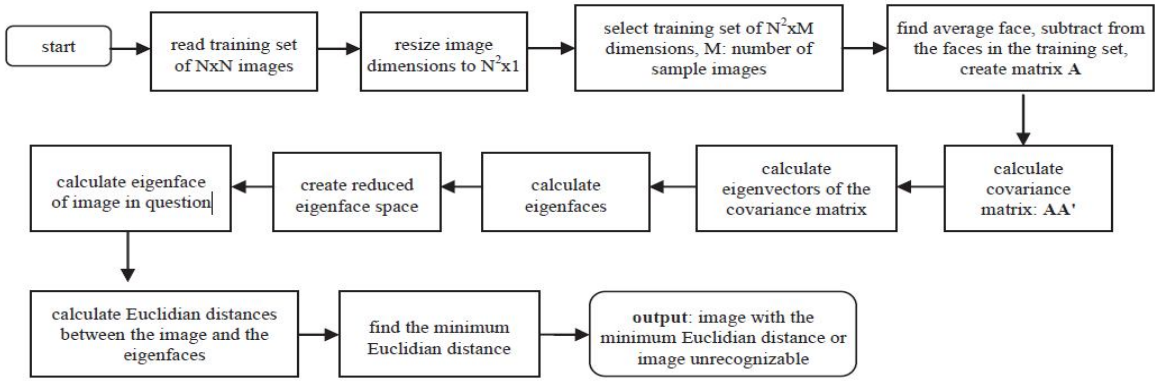

Fig 1.Flowchart of the algorithm of the Eigen faces method

3. Creating the EIGENFACES:

The Prepare a face images in training set. The pictures taken the training set should have been taken under the same light conditions, and must be normalized to have the mouths and eyes aligned across all images. They must also be all resample to the same pixel resolution. Each picture has R rows and C columns.

Step 1: Convert each picture in the training set into a vector of length R x C by concatenating the rows of pixels of the original image.

Step 2: If there are m training set images then create a matrix, G where the number of rows = N and the length of each row = R x C. Each row will be represented by one of the image vectors

Step 3: Calculate the mean image A of the N image vectors. Subtract A from each row of G to obtain the matrix T

Step 4: The covariance matrix, S is given by S=T'.T where T'represents the transposed matrix of T.

Step 5: Calculate the Eigen vectors and Eigen values of S.

R x C no of Eigen vectors has been obtained but the main idea about the principal components is to store only the Eigen vectors with the highest value[2].

These Eigen faces can be used to represent both existing and new faces: A new image has been projected on the Eigen faces and thereby record how that new face differs from the mean face. The Eigen values associated with each Eigen face represent how much the images in the training set vary from the mean image in that direction.

Recognizing a face:

Step 1: Obtain a test image.

Step 2: Subtract the image A from the test image.

Step 3: Find projection on the face space.

Step 4: Find the distances of this projection to the projection of the images already in the face space.

Step 5:Optionally if a face image occurs multiple times but is not found within the training database it may be added to the database and the eigenvectors maybe recomputed so that this face can be recognized from the next trial. This process can be automated.

1. Calculating Eigenfaces

As a starting point, the training images of dimensions N*N are read and they are converted to N^2*1 dimensions.A training set of N^2*M dimensions is thus created, where M is the number of sample images. The average of the image set is calculated as:

$$\varphi = \frac{1}{M}\sum_{i=1}^{M} x_i$$

Where φ: average image, M: number of images, x_i: image vector.

Average face is calculated and subtracted from each face in the training set. A matrix (**A**) is formed using the results of the subtraction operation. The difference between each image and the average image is calculated as

$\emptyset_i = x_i - \varphi$,

i=1,2,...,M

Where $\emptyset_i$ is the difference between the image and the average image.

The matrix obtained by the subtraction operation (**A**) is multiplied by its transpose and thus covariance matrix **C**is formed:

$C=A^TA$

Where **A** is formed by the difference vectors, i.e.,

$A=[\emptyset_1, \emptyset_2, \ldots, \emptyset_M]$

The dimensions of the matrix **C** is N*N. M images are used to form **C**. In practice, the dimensions of **C** is N*M.

The Eigen values of the covariance matrix is calculated .The Eigen faces are created by using the number of training images minus number of classes of eigenvectors.

The selected set of eigenvectors are multiplied by the A matrix to create a reduced Eigen face subspace. The eigenvectors of smaller Eigen values correspond to smaller variations in the covariance matrix. The discriminating features of the face are retained[2]. The number of Eigen vectors depends on the accuracy with which the database is defined and it can be optimized. The group of selected eigenvectors are called the Eigen faces. Once the Eigen faces have been obtained, the images in the database are projected into the Eigen face space and the weights of the image in that space are stored. To determine the identity of an image, the Eigen coefficients are compared with the Eigen coefficients in the database. The Eigen face of the image in question is formed.

The Euclidian distances between the Eigen face of the image and the Eigen faces stored previously are calculated. The person in question is identified as the one whose Euclidian distance is minimum below a threshold value in the Eigen face database[4].

The eigenvectors of smaller Eigen values correspond to smaller variations in the covariance matrix. The discriminating features of the face are retained. The number of eigenvectors depends on the accuracy with which the database is defined and it can be optimized. The group of selected eigenvectors are called the Eigen faces. Once the Eigen faces have been obtained, the images in the database are projected into the Eigen face space and the weights of the image in that space are stored. To determine the identity of an image, the Eigen coefficients are compared with the Eigen coefficients in the database.

Fig2. Testing Set

Fig3. Training Set

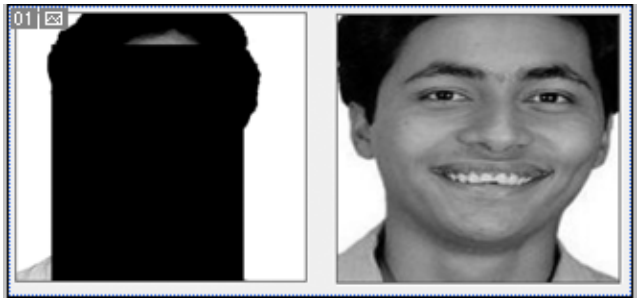

Fig 4. Choose Face

Fig 5. Left Eye

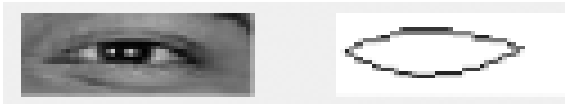

Fig 6. Right Eye

Fig7.Lip Eye

Fig 5.Checking of right, left Eyes, lip.

CONCLUSION

The Eigen faces method is applied to a very large database consisting of 3000 images. The challenging details, such as background, eye-glasses, beard, and moustache are dealt with. Simulation results show that sometimes failure occurs. The success rate is calculated as 97-99%. To increase the success rate, the Eigen faces method can be fortified with the use of additional information.

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