PCA Based Improved Algorithm for Face Recognition

Shiwani, Dr. Kamal Sharma, Er. Gurinder Singh

Electronics and Communication Engineering Department, Emax Group of Institutes,

Kurukshetra University, Kurukshetra ,Haryana,

ABSTRACT:- Face Recognition is the process through which a person is identified by his facial image. This technique makes it possible to use the facial images of a person to authenticate him into a secure system, for criminal identification, for passport verification etc. Face is a complex multidimensional structure but here approaches has two-dimensional recognition problem. This scheme build a simple and complete face recognition system using Principal Component Analysis (PCA). This method applies linear projection to the original image space to achieve dimensionality reduction. Face images are projected onto a face space that encodes best variation among known face images. The face space is defined by eigenface which are eigenvectors of the set of faces, which may not correspond to general facial features such as eyes, nose, lips. The eigenface approach uses the PCA for recognition of the images. The system performs by projecting preextracted face image onto a set of face space that represents significant variations among known face images. Face will be categorized as known or unknown face after matching with the present database. If the user is new to the face recognition system then his/her template will be stored in the database else matched against the templates stored in the database. The variable reducing theory of PCA accounts for the smaller face space than the training set of face. The whole experiment is done with the help of the database FACE95. This database contains 1440 images of 72 individuals(each person has 20 different images) under various facial expressions with each image being cropped and resized to 200×180 pixels for the simulation. The results are compared with DCT approach. This method is found to be fast, relatively simple, and works better then the DCT approach.

Keywords: Face recognition, Principal Component Analysis, Eigen faces, Eigenvectors ,DCT

I. 1.INTRODUCTION

Generally Identification systems comprises of three elements: attributed identifiers (name, bank account number, driving license number etc.), biographical identifiers (address, profession, and education), and biometric identifiers (photographs, fingerprint, iris and voice). As populations have grown practical challenges of biometric identification has been difficult to meet. For example, passport photographs are amenable to tampering and hence not reliable; fingerprints, though more reliable than photographs, are amenable to automated processing and efficient dissemination. These concerns has turned attention toward the development of automated biometric systems using face as a biometric parameter.

Over the last ten years, face recognition has become a popular area of research in computer vision and one of the most successful applications of image analysis. One of face recognition main goals is the understanding of the complex human visual system and the knowledge of how humans represent faces in order to discriminate different identities with high accuracy. On the other side, several emerging applications, from law enforcement to commercial tasks, demand the industry to develop new face recognition systems.Mainly face recognition falls into two main categories feature-based approach and holistic approach. Feature-based approach for face recognition basically relies on the detection and characterization of individual facial features and their geometrical relationships. Such features generally include the eyes, nose, and mouth. Holistic or global approaches to face recognition, on the other hand, involve encoding the entire facial image and treating the resulting facial "code" as a point in a high-dimensional space.The human face is a complex, natural object that tends not to have easily identified edges and features. Because of this, it is difficult to develop a mathematical model of the face that can be used as prior knowledge when analyzing a particular image.Computational models of face recognition are interesting because they can contribute not only to theoretical knowledge but also to practical applications. Computers that detect and recognize faces could be applied to a wide variety of tasks including criminal identification, security system, image and film processing, identity verification, tagging purposes and human-computer interaction.

II. PROPOSED METHODOLOGY

2.1METHODOLOGY

This approach of face recognition involves the following initialization operations:

1. Acquire an initial set of face images (the training set).
2. Calculate the eigenfaces from the training set, keeping only the M images that correspond to the highest eigenvalues. These M images define the face space. As new faces are experienced; the eigenfaces can be up-dated or recalculated.
3. Calculate the corresponding distribution in M-dimensional weight space for each known individual, by projecting his or her face images onto the "face space".

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

- Step 1. Calculate a set of weights based on the input image and the M eigenfaces by projecting the input image onto each of the eigenfaces.
- Step 2. Determine if the image is a face by checking to see if the image is sufficiently close to "face space".
- Step 3. If it is a face, classify the weight pattern as either a known person or as unknown.
- Step 4. Update the eigenfaces and/or weight patterns.
- Step5.If the same unknown face is seen several times, calculate its characteristic weight pattern and incorporate into the known faces.

III. GENERATING THE EIGENFACES

We assume that M sample images are being used. Each sample image is referred to as $\mathbf{A_n}$ where n indicates that we are dealing with nth sample image ($1<n<M$). Each $\mathbf{A_n}$ should be a column vector. images are made of pixels, each having (x,y) coordinates with (0,0) being at the upper left corner. The size of the resulting $\mathbf{A_n}$ column vector will depend on the size of the sample images. If the sample images are x pixels across and y pixels tall, the column vector will be of size $(x*y) \times 1$.

The next step is to calculate the average image, **Ø**, as follows:

$$\mathbf{Ø= \sum A_L /M} \qquad \text{where } 1< L<M$$

This average image will be a column vector of the same size as the sample images $((x*y) \times 1)$.

The next step is to calculate the difference faces by subtracting the average face from each sample image.

$$\mathbf{O= A_n - Ø}$$

Each will be a column vector of the same size as our sample image vectors $((x*y) \times 1)$.

After this covariance matrix is formed.The covariance matrix is defined by $\mathbf{AA^T}$ where A is

$$\mathbf{A= [\, O_1\ O_2\ O_3 \ldots O_m]}$$

The matrix **A** will be of size $(x*y) \times M$. The eigenvectors of this matrix can be found through the following formula:

$$\mathbf{u}_k = \frac{\sum_{l=1}^{M} \mathbf{Ö}_l \mathbf{X}_{lk}}{\sqrt{\lambda_k}}$$

$\mathbf{U_k}$ is the kth eigenface of the training data.

2.3 PROJECTING FACES INTO FACE-SPACE

When eigenfaces have been created, then we project a face image into facespace in order to recognize or analyze it, This can be done by following formula.

$$\mathbf{w= U^T(A - Ø)}$$

the vector of weights is found by multiplying the transpose of the matrix $\mathbf{U^T}$by a vector that is found by subtracting the average face image **Ø**, from a sample or test image $\mathbf{A_n}$.

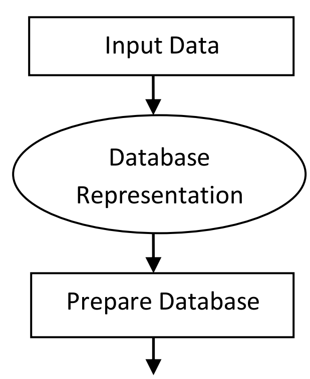
The weights form a vector $\mathbf{W^T = [w1,w2\ldots..wm']}$that describes the contribution of each eigenface in representing the input face image, treating the eigenface as a basis set for face images. This vector is used in a standard pattern recognition algorithm. The simplest method for determining of an input face image is to find the face class k that minimizes the Euclidian distance

$$e^2_k = \|(W - W_k)\|^2$$

Where W_k is a vector describing the kth face class.

The face classes WI are calculated by averaging the results of the eigenface representation over a small number of face images of each individual.

A face is classified as belonging to class k when minimum ek is below some chosen threshold q_e. Otherwise the face is classified as "unknown" and optionally creates a new face class.



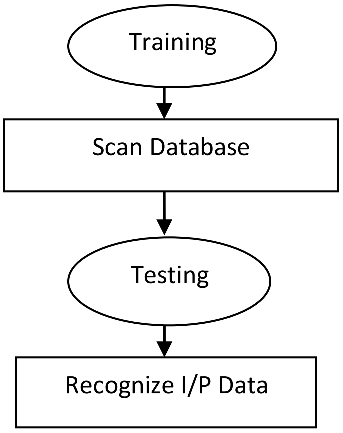


Figure1.Flowchart of Face Recognition

IV. 2.4TRAINING

1. Select any one file from train database using open file dialog box.
2. By using that read all the faces of each person in t train folder.
3. Normalize all the faces.
4. Find significant Eigenvectors of Reduced Covariance Matrix.
5. Hence calculate the Eigenvectors of Covariance Matrix.
6. Calculate Recognizing Pattern Vectors for each image and average RPV for each person.
7. For each person calculate the maximum out of the distances of all his image RPVs from average RPV of that person.

Following formula is used to calculate the eigen vector

$$\mathbf{u}_k = \frac{\sum_{l=1}^{M} \ddot{\mathbf{O}}_l \mathbf{X}_{lk}}{\sqrt{\lambda_k}}$$

.

V. 3. TESTING

Testing is carried out by following steps:

1. Select an image which is to be tested using open file dialog box.
2. Image is Read and normalized.
3. Calculate the RPV of image using Eigenvector of Covariance Matrix.
4. Find the distance of this input image RPV from average RPVs of all the persons.
5. Find the person from which the distance is minimum.
6. If this minimum distance is less than the maximum distance of that person calculated during training than the person is identified as this person.

VI. CONCLUSION

In this paper PCA based algorithm for face recognition is discussed. This is an improved algorithm as compared to DCT because of its simplicity in data compressing and face recognition. PCA operates at a faster rate as it allows us to compute linear transformation that maps data from a a high dimensional space to a lower sub dimensional space using eigenfaces and eigen vectors.

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