



An Efficient Method for Feature Extraction of Face Recognition Using PCA

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Abstract: *The process of identification of a person by their facial image is the face recognition. For criminal identification, for passport verification. Face recognition approached for still image can be broadly categorized into holistic methods. This technique makes it possible to use the facial images of a person to authenticate him into a secure system. He entire raw face image as an input. Holistic methods use whereas extract local facial features and use their geometric and appearance properties feature based methods.*

How to build a simple yet a complete face recognition system using principal component Analysis, a holistic approach this paper describes. Linear projection to the original image space to achieve dimensionality reduction this method apply. By projective face images onto a feature space that spans the significant variations among known face images the system function. As eigenfaces do not necessarily correspond to feature such as ears, eyes and noses the significant features known. For the ability to learn and later recognize new faces in an unsupervised manner it provides. Found to be fast, relatively simple, and works well in an constrained environment this method.

Keywords: *Biometrics, Principal Component Analysis, Eigen Values, Eigen Vector.*

I. INTRODUCTION

An attractive biometric for use in security applications is the face recognition in the world today, without the subject knowing face recognition can be performed because of non-intrusive nature of processing. In modern times because demand for enhanced security in public interest this has become particularly important in today's history.

Many algorithms are there which are capable of performing face recognition, such as following

1. Discrete cosine transform.
2. 3D recognition method.
3. Gabor wavelets method.
4. Hidden Markov models.
5. Principal components analysis.
6. etc

In both still image and video which has its origin in still image face recognition following recognition of face can be done.

1. A holistic approach.
2. A feature based approach.
3. A hybrid approach.

II. BIOMETRICS

By use of physical or behavioral traits, the study of automated identification is called Biometrics.

Physical Vs. Behavioral process.

Physical Process

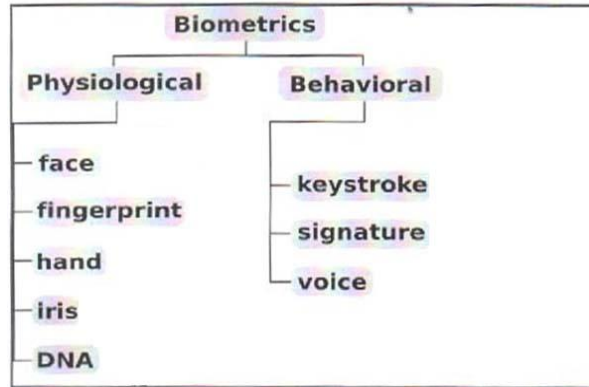
- Face
- Finger Print
- Ear
- Retina
- Hands
- Iris

Behavioral Process

- Functioning of walking gait.
- Patterns of typing.
- Signature operation.

Both Process

- Voice Function



III. ADVANTAGES OF BIOMETRICS

There are no risks in biometric

- Its losing process
- Its getting copied process
- Its forgetting process
- Its being getting stolen
- No risk of being used by anyone else

Biometric Essential Properties

Universality, distinctiveness, collect ability, permanence, performance, acceptability, circumvention used in various applications, each biometric has its strength and weakness and the choice depends on the applications of characteristics of biometric functions.

Biometric Applications

The Forensic Application

Criminal investigation, terrorist identification, corpse identification, missing children, parenthood determination using biometric systems can be carried out.

The Government Applications

correctional facility, border control, passport control, social security, driver's license etc. can be carried out as a biometric applications.

The Commercial Applications

ATM, credit card, physical access control, cellular phone, medical records, management, distance learning etc can be carried out as biometric applications.

IV. PROCESS AND TECHNIQUES OF FACE RECOGNITION

Four steps are there in face recognition process of functioning :-

Sample is Acquired :-

A sensor takes an observation in a complete full implemented biometric system of the process. The observation is the snap shot picture and the sensor might be a camera in the functioning process. A sensor will be ignored and a 2D face picture observation will be supplied manually in our system of functioning process.

Features Extracting Process

The relevant data is extracted from the predefined captured sample for this step of functioning. By the use of software where many algorithms are available this can be done completely.

Templates Comparison Process

On the application at hand this process is dependent. This step will be a comparison between a given picture for the subject and all the biometric templates stored on a database for identification purposes of functioning. The biometric template of the claimed identity will be retrieved and this will be compared to a given picture for verification of the process.

A Match Declaring Process :-

Potential matches the face recognition system will return a candidate match list of functioning. The intervention of a human operation will be required in order to select the best fit from the candidates list in this case of happening. If a

persons causes the detector to beep, a human operation steps in and checks the person manually or with a hand held detection of an illustrative analogy of that of a walk through meta detector of functioning.

V. TECHNIQUES OF FACE RECOGNITION

Based on Appearance

- | | | |
|---------------|---|------------------------------------|
| 1- Linear | - | PCA
PDA
LDA
ICA
Others |
| 2- Non Linear | - | KPCA
ISOMAP.LLE |

Neural Networks

Matching of Templates

Based on Models - 2D and 3D

FACE RECOGNITION APPLICATIONS

A large number of commercial security and forensic applications requiring the use of face recognition technology there are functioning :-

- 1) For small scale verification applications it is a very good biometric identifier functioning process.
- 2) For screening of unwanted individuals in a crowd in real time face recognition can at least in theory be used for process of functioning
- 3) With old or no long used photographs data bases, videotape or other image sources the biometric works or at least works in theory of process of functioning.
- 4) Tending to intrude from a biometric sampling point of view requiring no contact nor even the awareness of subject are the functioning of face recognition systems.
- 5) Automated crowds surveillance access control, face recognition design of human computer interface, multimedia communication and content based image database management includes these application of process.
- 6) Verifying identity, criminal, investigation, eliminating, duplicates, IDS, face recognitions system can be used.
- 7) Cost-effective, accurate, non-invasive, uses legacy data, built in human back up mechanism are the benefits of face recognition system.

VI. PRINCIPLE COMPONENT ANALYSIS

A standard technique for visualizing high dimensional data and for data pre-processing is a PCA. By maintaining as much variance as possible PCA reduces the dimensionality of a data set.

Steps for recognition using PCA

- 1) Data preparation process
- 2) Mean obtaining process
- 3) Subtraction of mean from original image
- 4) Calculation of the covariance matrix
- 5) Calculation of eigen value and eigen vector of the covariance matrix and select the principal components.

Why PCA used?

Many issues to consider when choosing a face recognition method are there the key one of them are following :

- Its availability function
- Its accuracy function
- Its time limitations function
- Its function process speed function

You will implement a face recognition system using the principal component analysis in this project of functioning.

Try to find the identity of a given face image according to their memory automatic face recognition system is used by a training set the memory of a face recognize is generally simulated in the system our training set consists of the features extracted from known face images of different persons in this function projects.

To find the most similar feature vector among the training set to the feature vector f a given test image is the task of the face recognition. The identity of a person where an image of that person is given to the system we want to recognize here. In this project as a feature extraction algorithm you will use PCA for functioning.

VII. EIGENVECTORS AND EIGEN VALUES

A vector such that if multiplied with the matrix, the result is always in integer multiple of that vector is an eigenvector of a matrix. The corresponding of eigenvalue of the eigenvector is this integer value by the equation $M \times u = \lambda \times u$. This relationship can be describe.

Following properties possess eigenvectors: 0

- Only for square matrices they can be determined.
- N eigenvectors are there in a n x n matrix.
- Perpendicular are all eigenvectors.

Eigenface Calculation

Step 1 : The data preparation

Should be prepared for processing in this step the faces constituting the training set (Γ_i)

Step 2 : The mean Subtraction

Then Subtracted from the original faces (Γ_i) and the result stored in the variable Φ_i :

$$\Psi = \frac{1}{M} \sum_{n=1}^M \Gamma_n$$

$$\Phi_i = \Gamma_i - \Psi$$

Step 3 : The covariance matrix calculation

The covariance matrix C is calculated according to in the next step

$$C = \frac{1}{M} \sum_{n=1}^M \Phi_n \Phi_n^T$$

Step 4 : The eigenvectors and eigenvalues of the covariance matrix calculation

The eigenvectors (eigenfaces) u and the corresponding eigenvalues λ_i should be calculated in this Step. So that they are unit vectors, i.e. of length 1 the eigenvectors (eigenfaces) must be normalized. As it belongs to the standard arsenal of most math programming libraries the description of the exact algorithm for determination of eigenvectors and eigenvalues is omitted here.

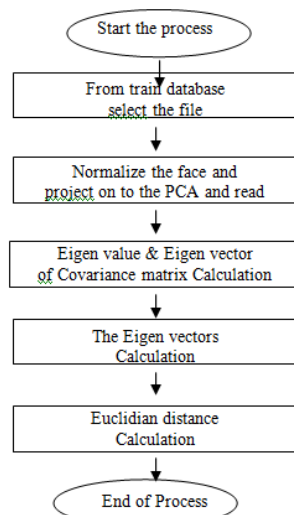
Step 5 : The Principal components selection

Which have the highest eigenvalues. From M eigenvectors (eigenfaces) u_i only M' should be chosen. The more characteristic feature of a face does the particular eigenvectors describe the higher the eigenvalues. The 'training' phase of the algorithm is finished after M' eigenfaces u_i are determined. As they explain only a small part of characteristic feature of a face's eigenfaces with low eigenvalues can be omitted.

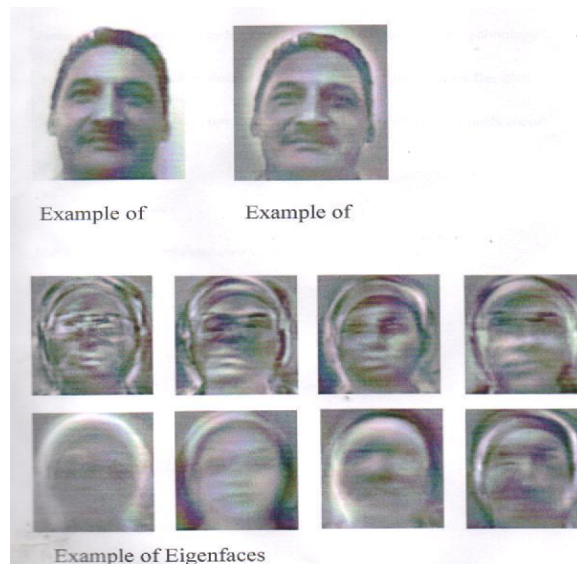
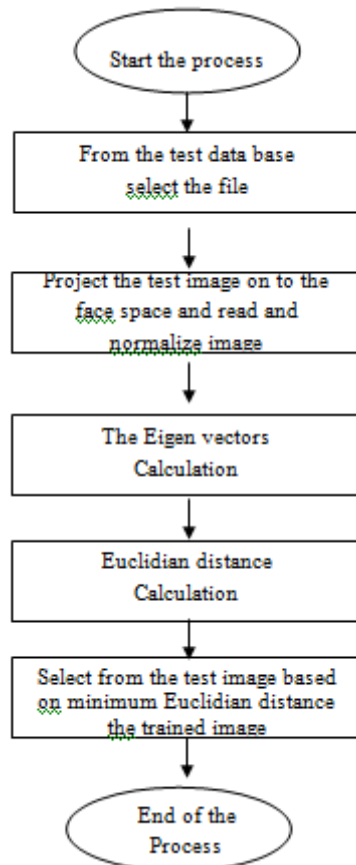
1.13 Implementation Process

- Face recognition using PCA can be broadly classified as consisting of following 3 steps :
 - Preparation of data base
 - Training
 - Testing
- 1. The steps are shown below :
 - Data input
 - Preparation of data base
 - DB prepared
 - Training
 - DB Scan
 - Testing
 - Input Data Recognized

VIII. TRAINING CONDITIONS



TESTING CONDITIONS



PROBLEM DEFINITION

Finding the expression of an image and recognize the with expression it is such as happy, said, angry, disgust, neutral mean facial expression detection or recognition. Principal component analysis is the technique used for facial expression detection or recognition. One of the most successful technique that have been used to recognize faces in image is the principal component analysis.

IX. RESULT

LIMITATIONS OF THE PROPOSED ALGORITHM

The data variations by capturing the facial image subjected to the reasonably constraint environment we tried to minimize.

1. Lighting controlled
2. View of frontal geometry

Depends on its robustness gains the inadvertent and the inevitable data variations success of a practical face recognition system with image grabbed.

The important issue involved are specifically –

1. Occlusion facial (Hat, Scarf, Sunglasses etc)
2. Normalization of facial size
3. To lighting conditions invariance (Including outdoor / indoor)
4. To aging invariance
5. Face of the Non-frontal view (head movement, 3D pose)

X. CONCLUSION

The system worked better in different conditions of face orientation and successfully recognized the human faces. We implemented the face recognition system using principal component analysis and eigen face approach in this thesis.

XI. FUTURE SCOPE

On database the whole software is dependent and the resolution of camera is dependent on the database. The result could be considerably improved if good resolution digital camera or good resolution analog camera it used.

On Eigen face approach that gives an accuracy maximum percentage this project is based. To obtain an optimum threshold value adaptive algorithms may be used. For future betterment of the algorithm by using neural network technique that can give better results as compared to Eigen face approach there is a scope. Accuracy can be improved with the help of neural network techniques.

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