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A COMPARATIVE ANALYSIS OF LINEAR DISCRIMINANT, PRINCIPAL COMPONENT AND EVOLUTIONARY PURSUIT FOR RECOGNITION OF HUMAN FACES

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Abstract— Face Recognition system is a computer based security system that can automatically detect and identify human faces. It is used to provide government facilities, in access control systems and detecting criminals. It is also used for video surveillance system in both on-line and off-line. Early face recognition algorithm uses simple geometric models and now the recognition process has matured into mathematical representation and matching process. The algorithms of face recognition system are Principal component analysis (PCA), Linear discriminant analysis (LDA), and Evolutionary pursuit (EP). In Principal component analysis, input image is compared with the face images which is divided into small sets of character feature through distance measuring methods. Linear discriminant analysis is used for recognizing human subject. This allows objective evaluation of the significance of visual information in different parts. Evolutionary pursuit implements strategies characteristics of genetic algorithm for searching the space of possible solutions to determine the optimal basis. The original data is projected into lower dimension whitened PCA space. In this paper a comparative study of different human faces is analyzed and implemented using the above three face recognition algorithm.

Keywords— Face recognition, security system, video surveillance, PCA, LDA, EP.

I. INTRODUCTION

Face recognition is one of the researches in pattern recognition and computer vision due to its numerous practices in the area of biometrics, in the field of Information security, access control, law enforcement, smart cards and surveillance system. To develop a face recognition system several factors, need to be considered.

1. The overall speed of the system should be considerable.
2. The accuracy should be high as possible.
3. The system should be easily updated, and to increases the number of subjects that are recognized [1].

The most significant security system is the face recognition system. Face recognition operate by extracting a feature set from the face and comparing this feature against the trained set in the database. The most successful approaches used in face recognition is Eigen space based methods. This comparative study considers the three different projection methods such as PCA, LDA and EP. PCA treats face recognition as a two dimensional problem. The applications of PCA are face recognition, handprint recognition, human-made object recognition, industrial robotics and mobile robotics [5]

It will compute a vector that has the largest variance associated with it. LDA takes into account the guessers of the face. LDA has also been proposed for generic object recognition. It will compute the best discriminates between the two classes. The faces with different poses and angles are recognized by EP. EP is the Eigen space based adaptive approach which searches for the best set of projection axes. The face recognition involves modules such as data acquisition (capturing the image), feature extraction, classifier, face gallery and decision making.

II. LITERATURE SURVEY

This section deals with the human face recognition techniques that apply mostly to frontal faces. In early 1970's, face recognition was treated as 2D pattern recognition problem [2]. To recognize the faces, the distance between the eyes or other important points is measured. Now it is necessary that the face recognition systems should operate automatically. The methods used are Eigen faces, feature matching and template matching [7].

A. EIGEN FACES:

Eigen face is one of the best approach used for face recognition. It is also known as Karhunen- Loeve expansion, Eigen picture and Eigen vector. In principal component analysis, to efficiently represent pictures of faces. They are the principal components of the faces of the covariance matrix of the set of face images. Each faces can be represented by a linear combination of the Eigen faces. It can also be approximated using the eigenvectors with the "best" eigenvalues. The M Eigen faces construct an M dimensional space.

B. FEATURE MATCHING:

Feature matching techniques were based on the computation of a set of geometrical features from the picture of a face. The face recognition is possible even at coarse resolution as low as 8x6 pixels. When the single facial features are hardly revealed in detail then it implies that the overall geometrical configuration of the face features is sufficient for recognition. The overall configuration was described by a vector representing the position and size of the main facial features, such as eyes, nose, mouth, and the shape of face outline.

C.TEMPLATE MATCHING:

Template matching is a test image represented as a two-dimensional array of intensity values that is compared with the Euclidean distance and a single template representing the whole face. There are numerous sophisticated versions of template matching on face recognition. It uses more number of face templates from different viewpoints to represent an individual's face.

III. SYSTEM ARCHITECTURE

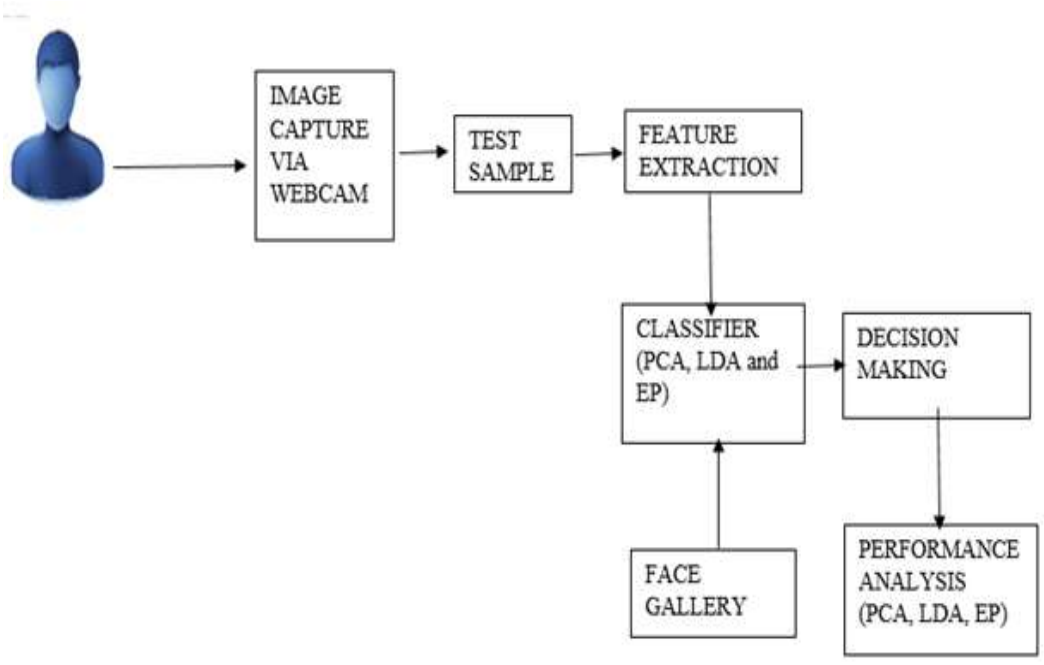

Figure 1: Face Recognition system

IV. IMPLEMENTATION

The implementation involves five modules. They are as follows

a. Data Acquisition
b. Feature Extraction
c. Face Gallery
d. Classifier
e. Decision Making

A. DATA ACQUISITION: Face Recognition System can acquire faces from web camera that generates images of sufficient quality and resolution. The images are captured within 3 or 5 seconds.

B. FEATURE EXTRACTION: Images are cropped such that the facial image remains, and color images are normally converted into black and white in order to perform comparisons based on grayscale. The presence of face in a scene must be detected. Once the face is detected it must be localized and normalized to bring the dimensions in alignment with one on the trained set. The features extracted are upper ridges of the eye socket, areas around the cheek bones, distance between the eyes and nose shape.

C. CLASSIFIER: This is the module where all the three algorithms are executed. They are PCA, LDA, and EP.

PCA: PCA allows us to compute a linear transformation that maps data from a high dimensional space to a lower dimensional sub-space.

LDA: LDA will compute a vector which best discriminates between the two classes. It takes into account the expression of the face.

EP: A Eigen space-based adaptive approach that searches for the best set of projection axes to maximize a fitness function, measuring the classification accuracy and generalization ability of the system. The dimension of the solution space is too big, it is solved using a specific kind of gene**tic** algorithm called Evolutionary Pursuit.

D. FACE GALLERY: This module contains the trained set image, which is created from a multiplicity of processed facial images.

E. DECISION MAKING: It compares the test set of the user and the trained set in the face gallery and gives the best match of images among them. All the three algorithm gives the best match image and the three outputs are compared and efficient algorithm is found among the three.

V. ALGORITHM

A. PCA ALGORITHM:

STEP1: convert the training set into image vector
STEP 2: Normalize the face vector
    2a) calculate the average face vectors
    2b) subtract the average face vector with each face vector
STEP 3: calculate the Eigen vectors from reduced covariance matrix
STEP 4: Select K best Eigen faces such that K<=M and can represent the whole training set
STEP 5: Convert lower dimension K eigenvectors to original face dimensionality.

B. LDA ALGORITHM:

STEP 1: In first step, we need to compute the dimensional mean vector.
STEP 2: Then compute the scatter matrices that is compute both the matrices.

- Within-class
- Between-class

STEP 3: In third step, matrix $S_W^{-1}S_B$ is solved to generalize the eigenvalues.
STEP 4: After that, we have to select the linear discriminants for the new feature subspace which means we need to sort the eigenvectors by decreasing eigenvalues and choose the "k" eigenvectors with the largest eigenvalues.
STEP 5: In the final step, transform all the samples onto the new subspace.

EP ALGORITHM:
STEP 1: compute the Eigen vector and Eigen matrices.
STEP 2: choose the leading Eigen vector (m) as basis vector.
STEP 3: Project the original image set into those vector to form a feature set z.
STEP 4: Whiten the feature set z and form new feature set v in the whitened pica space.
STEP 5: Set [e1, e1…em] as m*m unit matrix (i.e.) [e1, e1…em] =I'm.
STEP 6: Begin the evolution loop unit the stopping criteria is met (i.e.) fitness value does not change or maximum trial is met.

6a) sweep m (m-1)/2 pairs of axes coordinates to get the rotation angle.

6b) compute the fitness value.

6c) Find the set of angles and the subsets of projection axes that maximize the fitness value, and keep those chromosomes as the best solutions so far.

6d) Change the values of rotation angles and the subsets of the projection axes according to GA's genetic operators, and repeat the evolution loop.

STEP 7: Calculate the recognized face using the face basis T.

VI. RESULTS AND DISCUSSION

A. SNAPSHOT OF PCA:

Figure 2: Browsing the image

Figure 3: Feature Extraction

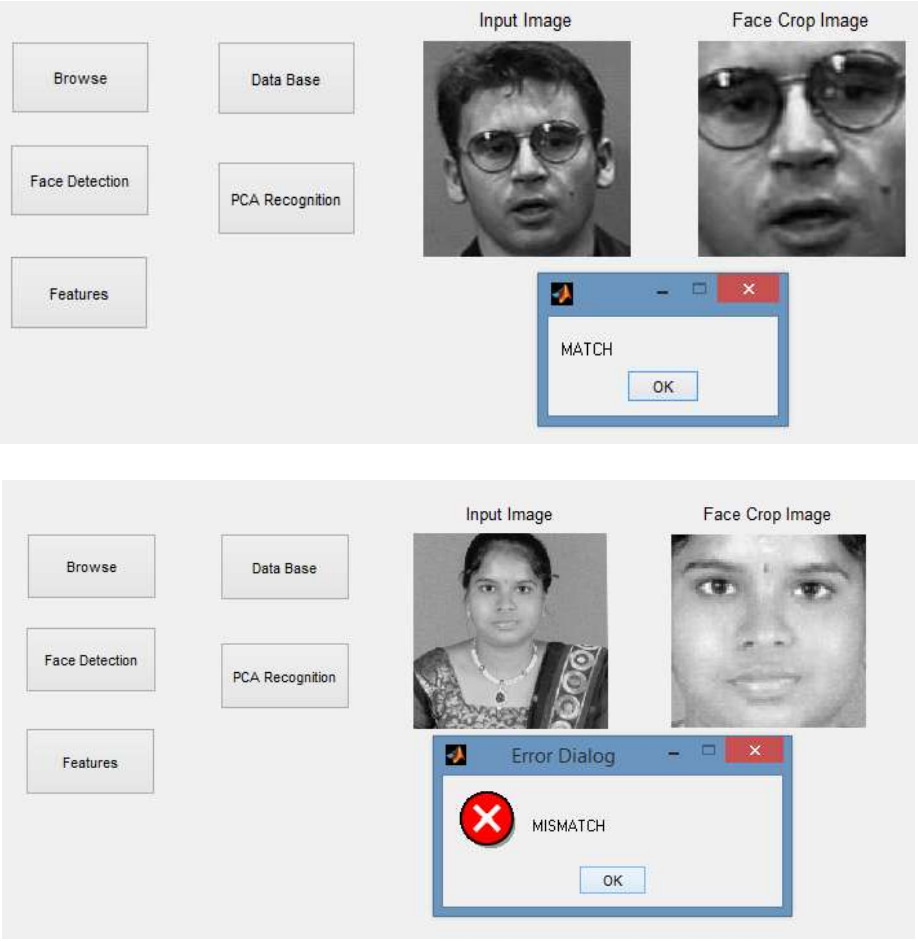

Figure 4: Decision Making of PCA

First the test image is browsed from the dataset as mentioned in fig 2. In fig 3, the features are extracted from the test image. Then entropy, mean and variance are calculated for the extracted features. These values are compared with the database values and the decision is taken in fig 4.

B.SNAPSHOT OF LDA:

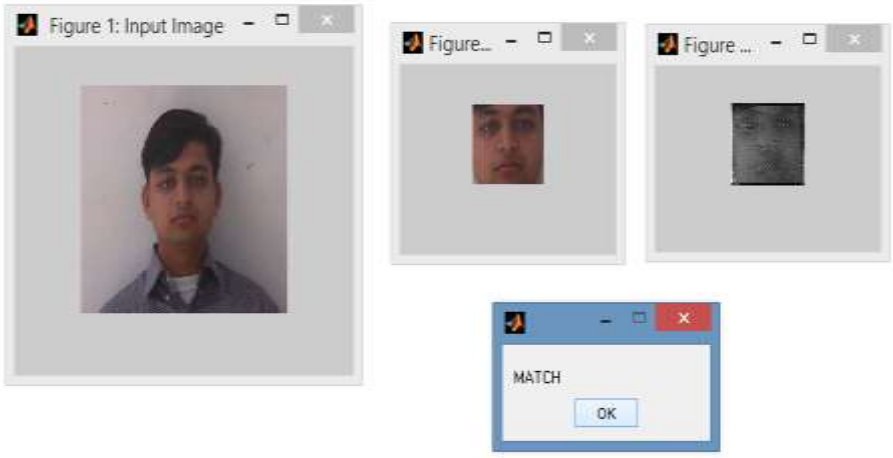

Figure 5: Decision Making of LDA

In LDA, the test image is selected from the dataset. Then the features are extracted from that image. Here only the entropy values are calucated and compared. Then the decision is made.

VII.CONCLUSION

We discussed the implementation of face recognition algorithms such as PCA,LDA,EP. PCA is based on appearance method. It outperforms when the number of samples per class is small or when the training dataset nonuniformly sample the underlying distribution. So PCA performs for the images that are linearly projected. LDA is a holistic projection based approach in which the face feature extraction is taken and the most discriminant vectors are derived from LDA of face images in a database.LDA outperforms for the images that are projected with different guesters. EP is a novel adaptive representation which increases the generalization ability. It seeks for face projections suitable for compact and efficient face encoding in terms of present and future reoginition ability.It outperforms for the images that projected in different angles.As a future work we are implementing by considering different kinds of eigenspace based approaches.

REFERENCE

[1] Parmar, Divyarajsinh N., and Brijesh B. Mehta. "Face Recognition Methods & Applications." *arXiv preprintarXiv:1403.0485* (2014).
[2] C. A. Hansen, "Face Recognition", Institute for Computer Science University of Tromso, Norway.
[3] Liu, Chengjun, and Harry Wechsler. "Evolutionary pursuit and its application to face recognition." *Pattern Analysis and Machine Intelligence, IEEE Transactions on* 22.6 (2000): 570-582.
[4] Navarrete, Pablo, and Javier Ruiz-del-Solar. "Analysis and comparison of eigenspace-based face recognition approaches." *International Journal of Pattern Recognition and Artificial Intelligence* 16.07 (2002): 817-830.
[5] Khoukhi, Amar, and Syed Faraz Ahmed. "A genetically modified fuzzy linear discriminant analysis for face recognition." *Journal of the franklin institute*348.10 (2011): 2701-2717.
[6] Al-modwahi, Ashraf Abbas M., et al. "Facial expression recognition intelligent security system for real time surveillance." *Proceedings of the International Conference on Computer Graphics and Virtual Reality (CGVR)*. The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), 2012.
[7] Tolba, A. S., A. H. El-Baz, and A. A. El-Harby. "Face recognition: A literature review." *International Journal of Signal Processing* 2.2 (2006): 88-103.

