

A Detailed Study on Face Recognition Techniques

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Abstract — *Face recognition has received considerable attention recently, as a promising approach for security and surveillance. Face recognition have the challenges of the light illumination and variations in the poses in various fields. The main aim of this work is to find out the optimum approach which can be used against these challenges and to study various approaches. The problems comes in the various algorithms are also defined and how these problems are resolved by using the new approaches. In this paper the different types of face recognition approaches and the various performance matrices for face recognition on the basis of different parameters have been discussed.*

Keyword - *Face recognition, 2DPCA, PCA, LBP, LDP.*

I. INTRODUCTION

Face recognition is one of the few biometric methods that possess the merits of both high accuracy and low intrusiveness. It has the accuracy of a physiological approach without being intrusive. For this reason, since the early 70's face recognition has drawn the attention of researchers in fields from security, psychology, and image processing, to computer vision. Numerous algorithms have been proposed for face recognition. There are some challenges and issues in the face recognition these are because of illumination, pose the face recognition can be used in the surveillance and security uses. Face recognition can be used for verification and identification of the human being. In verification of the face one to one matching is performed and in the identification the one to many matching is performed [1]. Face recognition is most wide research area in which different approaches are used for the face detection and the recognition.

A. FACE RECOGNITION PROCESS

1) Registration and Normalization-

In this phase of the face recognition process the images of faces are register and normalized. The face images are compressed and only save that data which is useful for the face recognition.

By using the normalization the feature extraction from the facial images become easy.

2) Feature Extraction

In the second phase this process the various features are extracted from the face images. These features are like size, relative position and shape of eyes, nose, cheekbones and jaw. The feature extraction done on the basis of the distance between nose and lips or width of forehead .

3) Image database

Image database has all the images with which the input image has to be tested and the image database has set of various images of an individual with change in poses and illumination. The face recognition algorithm shows the best match with that database

4) Classification

In this phase the input image is tested with the various images stored in the database. The algorithm matches the features of the input image with the features of the images stored in the database and after finding the best match in the features the result is shown as identification of the input image

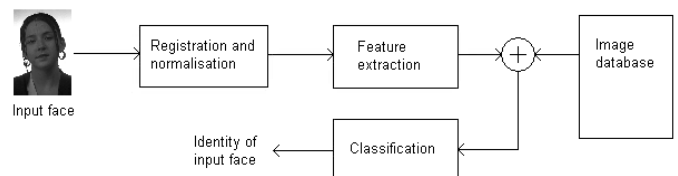


Fig-1 Principle of an identification process with face recognition.

II. RELATED WORK

A number of researcher have proposed the new ideas and approaches which are used for the face

recognition these algorithm are applied on the various databases related to the facial images

- Kyungnam Kim [2] proposed a new algorithm PCA (Principal Component Analysis). In this paper author propose a algorithm which is used for the face recognition.in this algorithm the image matrix first change into 1-d vector then the covariance matrix is calculated by using that 1-d vector and Eigen faces are find out and these Eigen faces are further use for the recognition .
- Jian Yang, Davis Zhang, Alejandro F. Frangi and Jing Ju Yang [3] proposed a new approach for face recognition. In this paper author propose a technique which is slightly different from the previous one. In 2DPCA (Two Dimensional Principal Component Analysis) this author describe the approach why which we can calculate the covariance matrix directly using the original image matrix. There is no need of to change the image into the 1-d vector. Eigenvectors can be derived for the feature extraction. These features can be used further for identification and verification [1].
- Timo Ahonen, Abdenour Hadid, and Matti Pietikainen [4] presented a new approach for feature extraction from the facial images and videos. In this paper author gives an idea how to extract the feature by using the LBP (Local Binary Pattern) approach.
Local descriptors have gained attention due to their robustness to challenges such as pose and illumination changes. LBP is invariance to the monotonic gray-level changes. By using this approach the image is firstly divided into the several regions from which the various LBP feature distributions are extracted and these extracted segments are giving a binary no. and a threshold value is described for each of these no. and these are concatenated to develop a feature vector. That can be used as a face descriptor

Dong-Ju Kim, Sang-Heon Lee and Myoung-Kyu Sohn [5] presented a new idea for face

recognition using the LDP (Local Directional Patterns) method for the feature extraction. This paper describes the approach by which the LDP values are find out. These values are used with the 2DPCA [3] algorithm for the better performance of the method. In the LDP method the edge response values are used for the finding of the LDP codes .these codes are used for face recognition.

III.VARIOUS DATABASE USED IN THE FACE RECOGNITION

- AR Database [6] contains the 4000 color face images of 126 people's faces (70 men and 56 women). Images including the frontal views with various face expressions and lighting conditions. These images are taken in the two sessions differ by two weeks. The people who take part in the both the sessions those images are selected and used in the experiment
- YALE Database [7] 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, w/glasses, happy, left-light, w/no glasses, normal, right-light, sad, sleepy, surprised, and wink
- CMU-PIE database [8] contains more than 40,000 facial images of 68 individuals, 21 illumination conditions, 22 light conditions, 13 poses and four different expressions. Among them, we selected each illumination and light images of 68 individuals with frontal pose. So, the CMU-PIE illumination set consists of 21 images of 68 individuals (21*68 images in total), and the CMU-PIE light set also consists of 22 images of 68 individuals (22*68 images in total). All face images of two databases were converted as gray scale and were cropped and normalized to a resolution of pixels.

IV.VARIOUS FACE RECOGNITION ALGORITHM

The different face recognition algorithms can be used for the face recognition. The main aim of

the recognition algorithm is to achieve the best performance and give the good accuracy. The detailed description of the various algorithms is given below. The performance of the different algorithms is calculated on the various parameters like recognition rate, recognition accuracy, recognition time etc.

a) *Principal Component Analysis (PCA) Algorithm-*

In this algorithm the face image is used for the face recognition in this algorithm the database are used for the face recognition. In this the image is first having the 2-d matrix this cannot be directly stored or change into the covariance matrix, so firstly the image has to be transform from 2-d matrix to the 1-d column vector form. The column vectors of the n images are place to form a data matrix S. the mean vector R is computed from the data matrix S. Then Normalize the data matrix S by subtracting the mean vector R and stored into the variable T. compute the covariance matrix of the column vector. After this compute the Eigen values and corresponding Eigen vectors. Place the image to that Eigen space, Euclidean distance is calculated by using the nearest mean classifier. The minimum Euclidean distance represents the most equivalent image.

b) *2-Dimensional Principal Component Analysis (2DPCA) Algorithm-*

In the 2DPCA algorithm the issues in the PCA are resolved by using the 2-dimensional principal component analysis. In this algorithm the original image is directly converted to the covariance matrix rather than changing the original image to the 1-D column vector. In this approach the image is converted directly to the covariance matrix and the Eigenvalues and the Eigen vector responding to the Eigen values is calculated. Eigen space is also finding and the projected image is implementing on the Eigen space. Euclidean distance is measures as in the previous algorithm are done by using the nearest mean classifier. The minimum

the Euclidean distance most equivalent image is matched.

c) *Local Binary Pattern (LBP) Algorithm-*

LBP is designed for the texture description. The operator is assigned to every pixel of an image by Threshold the 3*3 neighborhood of each pixel with the center pixel value and corresponding result as a binary number.in this algorithm the facial image is divided into the local regions and texture descriptor are extracted from these regions. These descriptors are concatenated to form a global description of the face. By using global description spatially enhanced histogram is formed which encodes both spatial and appearance relations of the facial image. The spatial enhanced histogram is further used for the distance measure. The each element of histogram is related to the small area of the face, based on the psychophysical findings some facial features plays important role for face recognition. Weighted chi square distance is used for measuring the distance.

d) *Local Directional Pattern (LDP) Algorithm-*

In this algorithm the local directional patterns are used for the texture descriptor in this LDP uses the different edge response values and use these values to encode the image descriptor. LDP feature encodes the different local neighborhood property image pixels with a binary bit sequence .code is produced form the collection of the different gradient responses computed over the local region. This algorithm provides the better consistent texture representation in the presence of the random noise and non-monotonic illumination variation. LDP assigns a 8 bit binary no. to each pixel of the input image. This pattern is then calculated by comparing the relative edge response values of a pixel by using Kirsch edge detector. These LDP codes are used for the face recognition.

e) *Bi-2-Dimensional Principal Component Analysis (Bi-2DPCA) Algorithm-*

In this algorithm the working is done same as that of the 2DPCA in this method the coefficients are more than that of the PCA. So this leads the slow classification speed and large storage requirements for large scale database. In this algorithm to overcome this problem the 2dPCA compression is done twice the first one in horizontal direction and second one in the vertical direction. By using this approach classification speed of the algorithm increases and the storage requirements decreases for the large scale databases. In the whole process, the first 2DPCA transform $B = AU$ performs the compression of 2D-data in horizontal direction, making the image energy pack into a small number of columns. While the second 2DPCA transform $C = \text{transpose of } V * B$ performs the compression of 2-D data in vertical direction, eliminating the correlations between columns of image B and making its energy further compact into a small number of rows.

V. FINDINGS BY ANALYSIS

The table 1 reviews the various algorithms are proposed by researcher for face recognition and we analysis that which algorithm is used for which database and which algorithm gives better performance.

Algorithm	Database	Advantages	Disadvantages
PCA	ORL, AR, YALE	Easy to use, use the Eigen faces for recognition	Illumination change, need more time to covariance matrix
2DPCA	AR, YALE, ORL	Create direct CV from original image	need more storage requirement
LBP	FERT, YALE	Monotonic illumination	Not applied to non-monotonic illumination
LDA	CMU-PIE, YALE B	Random noise and non-monotonic illumination	Not easy to find LDP k-th codes

Bi-2DPCA	YALE, AR, ORL	Fast and need less storage	Not use for FERT database
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VI. Conclusion

Various issues of face recognition have encountered due to variance in pose and change in illumination in the discussed literature review. This paper described that the Biometric is used to designs the various algorithm to resolve these issues arises in the biometric by studying and analyzing various algorithms available for face recognition. The LDA algorithm is suitable algorithm for the monotonic and non-monotonic illumination effects images in the YALE database. The second algorithm is 2DPCA the AR, ORL AND YALE database, it gives the better accuracy rate and recognition rate more than the PCA and Bi-2DPCA is the algorithm which gives the good results than that of the 2DPCA algorithm.

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