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Fast Face Recognition Based on Wavelet Transform on PCA

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ABSTRACT

Today the word is moving towards the globalization in engineering techniques, the capacity and techniques established for an identity of individuals using face as a biometric has become more importance. The face extracted leads the many application like photography, security surveillance, database identification etc. This paper includes the comparison of the rate of face recognition using the Principal Component Analysis (PCA) and the PCA using Discrete Wavelet Transforms (DWT). The proposed algorithm uses the concept of DWT for the image compression and PCA for the feature extraction and identification method. The limitations of the only PCA algorithm are a poor recognition speed and complex mathematical calculating load. To eliminate these limitations we are applying the DWT with different decomposition levels, i.e from level 0 to level 3 to facial image by using Daubechies Transform and applying the PCA for feature extraction process. The Euclidean Distance Measures system is used to find the nearest matching features in the whole database. In this paper the the mentioned algorithms are compared with their total recognisation time and the second parameter is the percentage of recognition of a test image. The results shows that the PCA with DWT applied gives higher recognition rate up to 93% than only PCA ,with very less access time.
Keywords: Principal Components Analysis; Discrete Wavelet Transforms; Euclidean Distance Measures.

I. INTRODUCTION

Recently the identification and authentication of every individual is important task in day today's life. In the massive number of the individuals, we can use the electronic based signal system [1] for the identification methods. For these the biometric based systems have the more importance in present days. The physical characteristics of the human beings like face geometry, fingerprint, iris identity, palm structure can be used as the individual identification for the every individual. The face reorganization based systems have the more advantages than the others. In the other methods like iris and finger detection method we have to go for the primitive actions like physical contact with the system, exact iris position etc., but for face recognition the slide change in face orientation may also be acceptable. In the face recognition system we are taking the set of different oriented images with high pixel camera and used for the feature extraction. The face recognition system has the more advantages over the other biometric system like iris detection, fingerprint recognition.

Initially we are using the PCA algorithm which is based on the creation of the low dimensional representation of the face i.e. Eigenface .In these algorithm we are selecting the Principal Component by using Eigenvectors [2] having the greater value of Eigenvalue. After this the DWT based subband system is going to be applied on the PCA [3] .The DWT will go for the compression of images which altimetly affects the speed of face recognition process. The result of the PCA-DWT is compared with only PCA.

II. METHODS AND MATERIAL

A. Principals Component Analysis (PCA)

Principal Component Analysis is proposed by Turk and Pent land in 1991, which is often used for extracting features of image. Principal Component Analysis is most widely used method considering with the face image extraction in image processing. Basic idea behind the PCA [4] is, the set of images are initially transformed into Eigenfacec i.e. lower data space by using the K-L transform method. This method includes the linear

transformation of the higher data space into the lower data space using linear transformation method. This extracted lower dimensional image preserves the most of the data or information from the original higher dimensional facial image. This mapped lower data space is called as the Eigenface. Then the test Eigenfaces is projected on the trainee Eigenfaces to get the correct match.

For PCA, two-dimensional image matrix must be first transformed to a one-dimensional vector with high order. While the number of training sample is small, it is very difficult to calculate covariance matrix of training sample accurately. Furthermore, structure information will be lost during processing. The Eigen faces are Principal Components of a distribution of faces, or equivalently, the Eigen vectors of the covariance matrix of the set of the face images. Find Principal Components of the distribution of faces, or the Eigen Vectors of the covariance matrix of the set of face images. Each image location Contributes to each Eigen vector, so that we can display the Eigen vector as a sort of face. Each face image can be represented exactly in terms of linear combination of the Eigen faces. The number of possible Eigen faces is equal to the number of face image in the training set. The faces can also be approximated by using best Eigen face, those that have the largest Eigen values, and which therefore account for most variance between the set of face images. The primary reason for using fewer Eigen faces is computational efficiency.

A. Brief Discussion of PCA-

1) First, consider the set of images in the column matrix or the row matrix format, named A

$$A=(I_1,I_2,I_3,I_4,\ldots\ldots\ldots I_M)$$

Where, M is the total number of objects present in total database.

2) Find the average of the defined matrix A

$$\mu = \frac{1}{M}\sum_{n=1}^{M} I_n$$

Hear, n =is the total number of images in single object of Database

μ =Mean of the defined matrix A

3) Then find the differential distance between the trainee images and the mean calculated

$$\alpha = I_i - \mu$$

Hear, we will get the α , scatter matrix for each image.

4) Find the covariance matrix C as follows,

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

5) Find the eigenvector and eigenvalue of the covariance matrix C. These eigenvectors are arranged in descending order and the weighted vector is selected having the highest eigenvalue for the feature extraction.

6) This feature vector is consist of the extracted data of all the images present in database and is compared with the vector of test image.

B. Discrete Wavelet Transform (DWT)

Recently, in the field of image processing the DWT [5], [6] becomes a very powerful tool for practical study of the facial image based applications. The image compression and the multiresolution of the image are the two dependent factors for the image processing. Multiresolution and the compression provide the way to generate the decomposed data. The image compression may leads to increase the storing capacity of the images. The DWT is the highly efficient and flexible method to decompose the image into different sub-bands or decomposed levels. This sub bands or the basis are also called as the wavelets. Hear, the DWT decomposes the image in the wavelet coefficients. These coefficients are useful for the feature extraction of the image. In our study we are going to implementation of 3-wavelet sub bands using the Daubechies Transform. The complete working of system is shown in Fig.1.

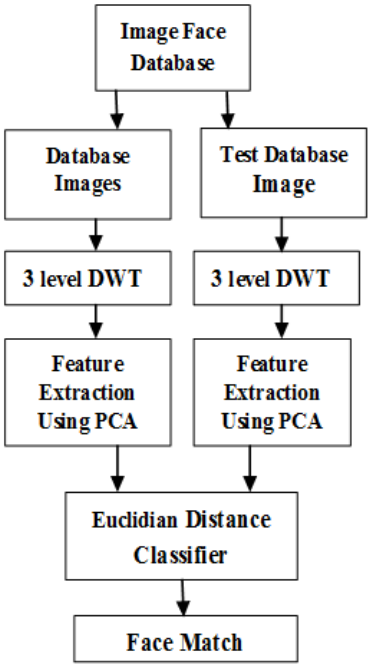

Figure1: Proposal DWT based PCA Algorithm

In this paper, the original facial image is decomposed [7] into three wavelet levels by using Daubechies Transform as shown in Fig .2. The first band that is LL is a coarser to the original facial image. The bands LH and H L record the edges along horizontal and vertical directions respectively. While the HH band records the diagonal edges of the image. This is the first level decomposition. Further decomposition can be conducted on the LL sub-band. In this paper we preferred the Daubechies Transform for the transformation of image in to the 3-level wavelets Fig. 2.The wavelet image has been also shown in Fig. 3.

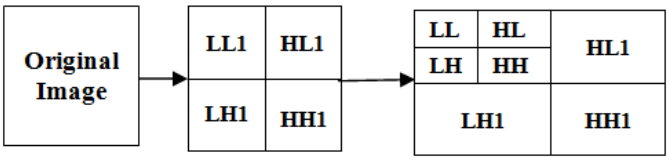

Figure 2: Decomposition at 3-level Wavelet

After extracting the data by using Daubechies wavelet, the PCA is applied to retrieve Principal component for recognition purpose. Hear, then we are applying the Euclidean Distance Measures for retrieving the closest matching face from the facial database. The closest matched face is known as the face as the recognized face.

Figure 3: Decomposed Test Image

i. Daubechies Transform

Daubechies[5] constructed the first wavelet family of scale functions that are orthogonal and have finite vanishing moments. This property insures that the number of non-zero coefficients in the associated filter is finite. This is very useful for local analysis this wavelet type has balanced frequency responses but non-linear phase responses. Daubechies wavelets use overlapping windows, so the high frequency coefficient spectrum reflects all high frequency changes. Therefore Daubechies wavelets are useful in compression and noise removal of audio signal processing [12]. Daubechies wavelets use overlapping windows, so the high frequency coefficient spectrum reflects all high frequency changes. Therefore Daubechies wavelets are useful in compression and noise removal of audio signal processing.

ii. Euclidean Distance Measure

Euclidean distance measure is used simply for the finding and matching the difference between two closest orthogonal points, or simply 'distance', just like a Pythagoras theorem examines the root of square distance between the coordinates of a pair of objects. In this paper Euclidean distance classifier will calculate the distance between the test image and the image from the database image. If the distance is small, we say the images are similar and we can decide which the most similar image in the database. Euclidean distance is one of the simplest and faster classifier as compared to other classifiers. Euclidean distance is defined as the straight-line distance between two points. Minimum Euclidean distance classifier is optimum for normally distributed classes.

III. RESULTS AND DISCUSSION

The test is carried out on the different four dataset that is grouped into the Face94, Face95, Face96 and SELFFACE etc.This groups are consist of the set of 10 objects with, the same 10 images are present into each object. In this individual Face94, Face95, Face96 are used for testing purpose and the SELFFACE is used for calculation of result. The each image in the object has the size of approximate 8kb and with 180x200 pixels.

In the comparison the access speed which depends on time. The time of PCA with DWT at level DB3 has been increased up to 34% than only with PCA .The time of recognisation is always decreases as we increase the levels of decomposition Table I.

Table I. Comparitive Study of Access Time of Different Waveles with Extracted Features

Database Type	PCA Algorithm		PCA+DWT(DB1)		PCA+DWT(DB3)	
	Features Extracted	Time	Features Extracted	Time	Features Extracted	Time
FACE94	36000	0.109	9000	0.013	575	0.007
FACE95	36000	0.167	9000	0.019	576	0.007
FACE96	38416	0.685	9604	0.014	625	0.008
FACE SELF	36000	0.067	9100	0.013	526	0.008

The rate of recognition has been also calculated, which shows the PCA with DWT has the large Recognition rate, which goes up to the 94% as shown in TABLE II and Fig. 4.

Table II : Comparitive Study of Recognition Rate of PCA And Wavelets

Algorithm used	Total Test Images	Recognition Rate (%)
PCA	100	91
PCA+DWT(DB1)	100	94
PCA+DWT(DB2)	100	92

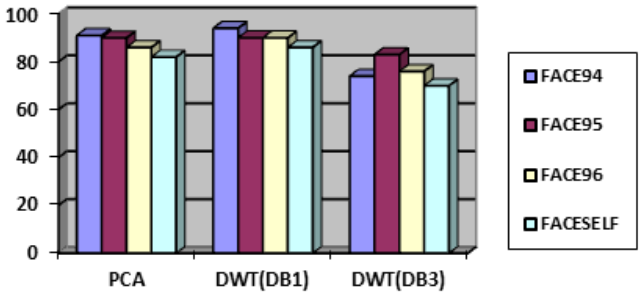

Figure 4: Graphical Representation of Recognition rate

IV. CONCLUSION

In this paper we have compared the access speed and the recognition rate of PCA with the DWT based PCA .The tests are taken using the test images named Face94, Face95, Face96,whereas the result is calculated using the SELFFACE set of images. The result shows that the access speed of the DWT based PCA has 34 % than that of the only PCA. Also, it gives the recognition rate up to 94% which is greater than that of PCA.

V. REFERENCES

[1]. K. Jain, "Fundamentals of digital image processing", pp.163-175, Prentice Hall, 1989. And GSM".

[2]. M. Turk and A. Pentland, "Eigenfaces for recognition", J. Cognitive Neuroscience, Vol. 3, 71-86,1991

[3]. H. Wang, S. Yang and W. Liao, "An Improved PCA Face Recognition Algorithm Based on the Discrete Wavelet Transform and the Support Vector Machines", IEEE International Conference on Computational Intelligence and Security Workshops pp. 309, 2007

[4]. Daubechies, "The wavelet transform time-frequency localization and signal analysis", IEEE Trans. Information Theory, Vol. 36, No. 5, 961- 1005, 1990

[5]. Daubechies, "Ten Lectures on Wavelets", CBMS-NSF series inApplied Mathematics, Vol. 61,SIAM Press, Philadelphia, 1992.

[6]. Eleyan and H. Demirel, "Face Recognition Using Multiresolution PCA", IEEE international Symposium on Signal Processing and Information Technology, pp.52-53.

[7]. M.K. Rao, K.V. Swamy and K.A. Sheela, "Face Recognition Using DWT and Eigenvectors", IEEE 1st International Conference on Emerging Technology Trends in Electronics, Communication and Networking, pp. 1, 2012.