Unauthorized Access and Key Generation from Face Feature Data

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***Abstract*—Face Recognition is used for security purpose in real time application. This paper represents two modules. In first module, face recognition is done by combining local binary pattern (LBP) and principal component analysis (PCA) in different way. Proposed algorithm is used for better recognition rate. PCA reduce dimension of image and LBP describe the local texture of image data. So proposed method will increase the recognition rate (RR) of face and also decreased false match rate (FMR) but there is no difference in verification time and also fastest key generation algorithm from face feature vectors. So it is most suitable for real time application. We compared proposed method with both PCA and LBP to figure out changes. In case of execution time, there is no difference between of existing and proposed method. In Second module, key generation from feature vectors of proposed algorithm for the purpose of the security. According to the result proposed algorithm generate fastest key compared to the existing key.**

Index Terms—: Face Recognition¸ principal component analysis, Unauthorized Access, Key Generation

INTRODUCTION

Facial features are done by global features and local features of face. Global features focus on whole entire facial image so it has less accuracy. Local features focus only on local area of the face. So it is most accurate method. The local binary pattern (LBP) is design for local texture description and shape of an image. It is done by dividing an image into small parts from which local features are extracted. These local features consist of binary patterns which describe the location of pixels in those areas.

The gained features from the regions are combined into a single feature histogram, which is represents the image. Images can be compared by distance measurement.

It is based on local feature extraction and dimension reduction. In proposed method face recognition done by combining the LBP and PCA in different way which provides very good results. It increased the performance of recognition. It can work against face images with different facial conditions.

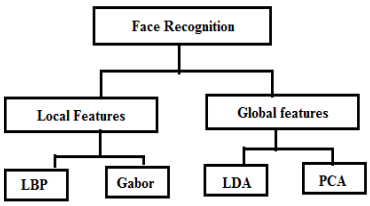

Fig.1 Face recognition methods

face recognition problem using PCA Algorithms

Illumination Problem

Illumination problem happens when same image with condition. So person have to keep with fix lighting condition, fixed distance, same facial expression and also same view point. It can emerge extensively different when lighting condition is different. [8]

Pose Problem

Face recognition with different facial poses that is called pose problem. If face rotation made very large changes in face appearance it reduce recognition rate. If person try to match same image with different facial pose, it show the different result.[8]

face recognition problem using LBP Operator

Limitation of the basic LBP operator is that its small 3 * 3 neighborhood cannot capture dominant features with large-scale structures. It cannot deal with the texture at different scales and the operator was later generalized to use neighborhoods of different size so LBP cannot work well on large scale images.[5]

database

The FEI face database is a Brazilian face database that holds 14 images for each of 200 individuals, a total of 2800 images. All images are colorful and standing frontal position with profile rotation up to about 180 degrees. Age of persons between 19 to 40 years old with distinct appearance, hairstyle, and adorns.[47]

object of proposed method and local binary pattern

Increased recognition rate

Decreased false mate rate

Biometric template security using cryptography

Fastest key generation from facial feature

Local Binary Pattern (LBP) operator describes the local texture of gray scale image. LBP is a binary code for an image-pixel which describe local neighborhood of that pixel. This operator works with the eight neighbors of a pixel, using the value of this center pixel as a threshold. If a neighbor pixel has a higher gray value than the center pixel (or the same gray value) than a one is assigned to that pixel, else it gets a zero. The LBP code for the center pixel is then produced by concatenating the eight ones or zeros to a binary code.[43]

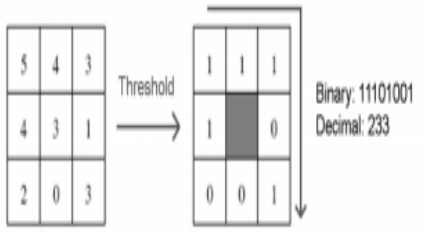

Fig. 2 The original LBP operator

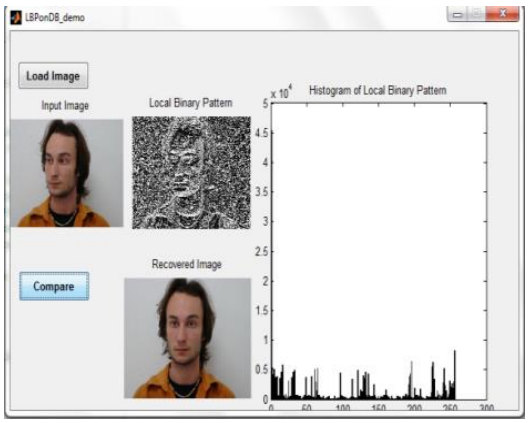

Fig. 3 LBP on FEI Database

PCA ALGORITHM

Principal Component Analysis (PCA) is well-organized method for face recognition. It is most popular methods for a face image. It is used to reduce the dimension of the image and also holds variations in the image data. It projecting face image into a feature space that covers the variations significantly. Those features are called as "Eigen faces", because they are the eigenvectors or Principal Component of faces.

PCA has several steps [8][20][19]

Stage 1: Subtract the Mean of the data from each variable (our adjusted data) subtraction of the overall mean from each of our values as for covariance we need at least two dimensions of data. It is in fact the subtraction of the mean of each row from each element in that row.

Stage 2: Calculate and form a covariance Matrix

$$cov(x,y) = \frac{\sum_{i-1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{(n-1)}$$

Stage 3: Calculate Eigenvectors and Eigen values from the covariance Matrix Eigen values are a product of multiplying matrices however they are as special case. Eigen values are found by

multiples of the covariance matrix by a vector in two dimensional space (i.e. a Eigenvector). This makes the covariance matrix the equivalent of a transformation matrix.

Stage 4: Chose a Feature Vector (a fancy name for a matrix of vectors) Once Eigenvectors are found from the covariance matrix, the next step is to order them by Eigen value, highest to lowest. This gives you the components in order of significance. Here the data can be compressed and the weaker vectors are removed producing a lossy compression method, the data lost is deemed to be insignificant.

Stage 5: Multiply the transposed Feature Vectors by the transposed adjusted data. The final stage in PCA is to take the transpose of the feature vector matrix and multiply it with the transposed adjusted data set (the adjusted data set is from Stage 1 where the mean was subtracted from the data).

The technique proposed in this paper was tested, verified and implemented with C# framework for number of systems. The software purchased cannot be installed on client system without the verification and validation of the watermarked information. If anybody wants to pirate the copy of software of the client on its system, the proposed technique does not allow him/her to do so, if implemented. This has given an opportunity to client to purchase the software and use it without the risk of redeployment of software to others. By doing so, intellectual property of the developer and value for money of the client, both are protected. This technique can be implemented over different mobile platforms.

PCA on FEI Database

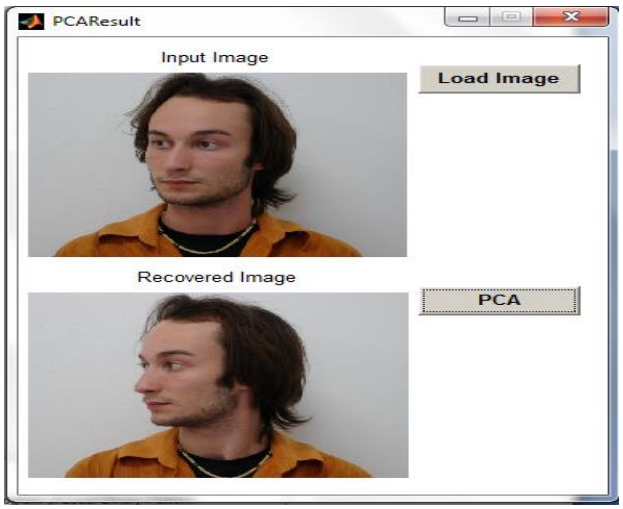

Fig. 4 PCA on FEI Database

PROPOSED ALGORITHM

Step 1: Find the mean image.
Step 2: Reallocate the array for the local binary pattern.
Step 3: LBP feature extraction using Feature Vectors.
Step 4: Calculate the eigenvectors and eigenvalues
Step 5: Combine LBP local feature vectors with PCA global feature vectors.
Step 6: Key generation using these face features and encrypt image data using Euclidean and Euclidean Squared Distance Metrics method.
Step 7: Encrypted image data stored in database.
Step 8: Apply Step 1 to 6 if it is Inputted Image.
Step 9: Decrypt Database all image data using same key.
Step 10: Verification of Database images and inputted image using Ecudian distance measurement method.
Step 11: Retrieved image from database which have minimum distance between input image and Database images.

IMOLIMENTATION

Implementation of proposed algorithm

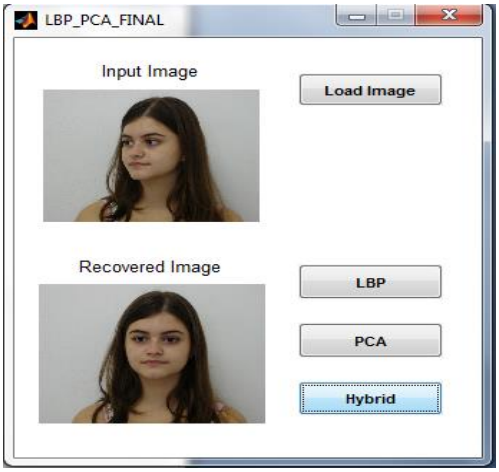

Fig.5 Implementation of proposed algorithm

Key Generation and Implementation of image cryptography

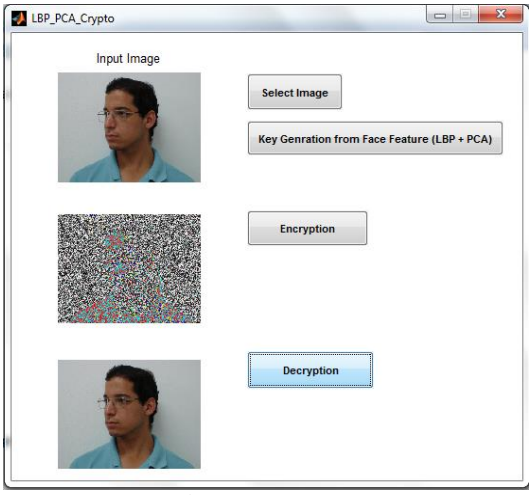

Fig. 6 Implementation of proposed algorithm on real time database

RESULT AND ANALYSIS OF PCA AND LBP ALGORITHM

PCA & LBP on FEI Face Database

Subject	DB Images	Trainee Images	RR%		FMR%		Avg.Verification Time (In Seconds)	
			PCA	LBP	PCA	LBP	PCA	LBP
05	14	14	98.50	62.85	1.5	37.15	0.37	0.05
10	14	14	95.71	70.00	4.29	30.00	0.25	0.05
15	14	14	92.85	79.52	7.15	20.48	0.29	0.05
20	14	14	89.64	64.64	10.36	35.36	0.32	0.05

Table 1. PCA & LBP on FEI Face Database

PCA& LBP on Real time Database (6 trainee images)

Subject	DB Images	Input Images	RR%		FMR%		Avg.Verification Time (In Seconds)	
			PCA	LBP	PCA	LBP	PCA	LBP
05	5	6	76.66	52.22	23.34	47.78	0.22	0.04
10	5	6	63.33	48.66	36.67	51.34	0.25	0.05
15	5	6	58.88	46.66	41.12	53.34	0.27	0.05
20	5	6	56.66	46.55	43.34	53.45	0.30	0.06

Table 2. PCA& LBP on Real time Database (6 trainee images)

PCA& LBP on Real time Database (14 trainee images)

Subject	DB Images	Input Images	RR%		FMR%		Avg.Verification Time (In Seconds)	
			PCA	LBP	PCA	LBP	PCA	LBP
05	5	14	82.85	68.00	17.15	32.00	0.04	0.04
10	5	14	75.71	65.00	24.29	35.00	0.05	0.05
15	5	14	76.66	70.47	23.34	29.53	0.05	0.06
20	5	14	75.71	69.64	24.29	30.36	0.06	0.06

Table 3. PCA& LBP on Real time Database (14 trainee images)

proposed system on real time database (14 trainee images)

Subject	Database Images	Input Images	Recognition Rate (RR in %)	False Match Rate (FMR in %)	Avg.Verification Time (In Seconds)
05	5	14	92.85	7.15	0.04
10	5	14	90.71	9.29	0.06
15	5	14	84.28	15.72	0.04
20	5	14	84.64	15.36	0.07

Table 4 proposed system on real time database (14 trainee images)

proposed system on real time database (3 DB images)

Subject	Database Images	Input Images	Recognition Rate (RR in %)	False Match Rate (FMR in	Avg.Verification Time (In Seconds)

				%)	
05	3	14	88.57	11.43	0.03
10	3	14	79.28	20.71	0.04
15	3	14	71.90	28.10	0.05
20	3	14	72.85	27.15	0.05

Table 5 proposed system on real time database (3 DB images)

Comparison (Difference) of proposed algorithm with PCA and LBP

Subject	DB Images	Input Images	Increased RR%		Decreased FMR%		Diff. AVG.Veri.Time (In Seconds)	
			PCA	LBP	PCA	LBP	PCA	LBP
05	5	14	10.00	24.85	10.00	24.85	00.00	00.00
10	5	14	15.00	25.71	15.00	25.71	00.01	00.01
15	5	14	07.62	13.81	07.62	13.81	00.01	00.02
20	5	14	08.93	15.00	08.93	15.00	00.01	00.01

Table 6 Comparison (Difference) of proposed algorithm with PCA and LBP

Key Generation, Encryption, and Decryption of existing algorithm

Subject	DB Images	Input Images	Key Generation	Encryption	Decryption
			(In seconds)		
05	14	14	0.05	0.15	0.14
10	14	14	0.05	0.14	0.14
15	14	14	0.06	0.14	0.14
20	14	14	0.08	0.22	0.15

Table 7 Key Generation, Encryption, and Decryption of existing algorithm

Key Generation, Encryption, and Decryption of proposed algorithm

Subject	DB Images	Input Images	Key Generation	Encryption	Decryption
			(In seconds)		
05	14	14	0.00	0.12	0.12
10	14	14	0.00	0.12	0.12
15	14	14	0.00	0.13	0.11
20	14	14	0.00	0.13	0.11

Table 8 Key Generation, Encryption, and Decryption of proposed algorithm

Difference between Key Generation, Encryption, and Decryption of existing algorithm and proposed algorithm

Subject	DB Images	Input Images	Key Generation	Encryption	Decryption
			(Decreased In seconds)		
05	14	14	0.05	0.03	0.02
10	14	14	0.05	0.02	0.02
15	14	14	0.06	0.01	0.03
20	14	14	0.08	0.09	0.04

Table 9 Difference between Key Generation, Encryption, and Decryption of existing algorithm and proposed algorithm

CONCLUSION

LBP is fastest execution operator so it is most suitable for real time application and remove illumination problem but it works only on local regional of image. So it cannot detain main features of large-scale structures. PCA has high accuracy rate but it has illumination problem and pose problem. If LBP feature vector combine with PCA Eigen vector according to this way, it remove the illumination and pose problem and also increased recognition rate and decreased false match rate as well as not much more difference between verification time. For the security purpose, image data is encrypted with the proposed feature vectors so it is used for the security of database template.

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