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Face Recognition using Appearance-Based Statistical Technique on Color Images Database

Satonkar Suhas S.
Arts, Commerce and Science College,
Gangakhed, (M.S.), India
Email: suhassatonkar@gmail.com

Kurhe Ajay B.
Shri Guru Buddhiswami College,
Purna, (M.S)
Email: ajay.kurhe@rediffmail.com

Dr. Khanale Prakash B.
Dnyanopasak College,
Parbhani, (M.S.)
Email: prakashkhanale@gmail.com

Abstract **– Face Recognition is one of the most popular problems in the field of image processing. Face recognition is a technology which recognize the human by his/her face image. Identifying a person from an unknown face is usually done by comparing the unknown face with the known faces from a face database. Face Recognition system should be able to automatically detect a face in images or face database. Principal component analysis (PCA) is appearance-based statistical technique used for dimension reduction and recognition, and widely used for facial feature extraction and recognition. In this paper we have attempted a comparative study of appearance based statistical method that is principal component analysis. The experiment is used standard face 96 database, local database and pose variation database. The performance of principal component analysis face 96 database is 100%.The experiment is also tested for locally created poor image quality database and pose variation database and its PCA performance is 100%.**

Keywords **– Biometrics, Color Image, Eigenfaces, Face Recognition, Image Processing, Pattern Recognition, Principal Component Analysis.**

I. INTRODUCTION

After 9/11 tragedy, governments have alert to safety matters. Recent technologies in identification, recognition and tracking of suspects, clamed high portion of national budgets. The demand growth on these applications helped researchers fund their research projects. One of most common biometric recognition techniques is face recognition. Face recognition is not as accurate as the other recognition methods such as fingerprints, it still grabs huge attention of many researchers in the field of computer vision because in efficiencies of the methods used to represent faces have caused many researchers delink their research. The face representation was performed by using two categories. The first category is global approach or appearance-based, which uses holistic texture features and is applied to the face or specific region of it. The second category is feature-based or component-based, which uses the geometric relationship among the facial features like mouth, nose, and eyes [1] implemented feature-based approach by a geometrical model of a face by 2-D elastic graph. Another example of feature-based was done by independently matching templates of three facial regions (eyes, mouth and nose) and the configuration of the features was unconstrained since the system didn't include geometrical model [2],[14].In this paper[6] the success of eigenspace techniques for object search and recognition in a large image database. This papers [8] Using the original FERET testing protocol, a standard PCA classifier did better when using Mahalanobis distance rather than L1, L2 or Angle. This Paper [12] an efficient and simple face recognition system can be built for recognition of faces by using PCA and neural network. The system performs very well for standard database and local images. In this paper [13] we have used Test sets i.e. eigenfaces and then Euclidean, Chessboard and City block distance is calculated between the mean adjusted input image and the projection onto face space. The result of detection using different distance measures techniques is 100% but city block distance measure technique is efficient in terms of CPU execution time. Principal components analysis (PCA) method [3],[4] which is also called eigenfaces [5],[6] is appearance-based technique used widely for the dimensionality reduction and recorded a great performance in face recognition.

II. PRINCIPAL COMPONENT ANALYSIS

Principal Component Analysis (PCA) is a dimensionality reduction technique which is used for compression and recognition problems. It is known as Eigenspace Projection or Karhunen-Loeve Transfromation [5], [7]. PCA projects images into subspace such that the first orthogonal dimension of this subspace captures the greatest amount of variance among the images and the last dimension of this subspace captures the least amount of variance among the images[8]. The main goal of PCA is the dimensionality reduction, therefore the eigenvectors of the covariance matrix should be found in order to reach the solution. PCA is a useful statistical technique that has found application in fields such as face recognition and image compression, and is a common technique for finding patterns in data of high dimension. It is one of the more successful techniques of face recognition [5].

2.1 The steps in finding the principal component analysis [9] as follows:

1. Get the data: Suppose X1, X2 ……,X_M is N x 1

$$X = \frac{1}{M}\sum_{i=1}^{M} X_i$$

2. Subtract the mean:

$$\Phi_i = \bar{X}_i - X$$

3. Calculating the covariance matrix:

Form of matrix A = [Φ1, Φ2….Φ_M] (N x M matrix) then compute

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

4. Calculating the eigenvector and eigenvalue of the covariance matrix: An N x N matrix A is said to have an eigenvector X, and corresponding eigenvalue λ if

$CX = \lambda X$

Where X is the set of eigenvectors associated with its eigenvalue λ.

det | C - λ I | = 0

5. Choosing components and forming a feature vector:

Once eigenvectors are found from the covariance matrix, the next step is to order them by eigenvalue, highest to lowest. This gives you the components in order of significance. The eigenvector with the highest eigenvalue is the principle component of the data set. Choose the highest eigenvalue and forming a feature vector.

6. Deriving the new datasets: Once chosen the components (eigenvectors) that wish to keep in our data and formed a feature vector, imply take the transpose of the vector and multiply it on the left of the original data set, transposed.

Final Data = Row feature vector * Row Data Adjust

The above formula getting the features of images. The Euclidean distance is calculated between the mean adjusted input image and the projection onto face space. The low values indicate that there is a face and display the face.

7. Calculating the Euclidean distance [11] using equation 1

2.2 Euclidean distance

In Euclidean distance transform, the value at a pixel is linearly proportional to the Euclidean distance between that pixel and the object pixel closest to it. Since the method uses the value at a single object pixel to determine the value at pixel of interest, the process is sensitive to noise. The straight-line distance between two pixels is given by using the formula

$D_E[(i,j),(k,l)] = [(i-k)^2 + (j-l)^2]^{1/2}$ (1)

The (i,j) and (k,l) are the two different point coordinates and D_E is the distance.

Suppose the point A(x1,y1) and point B(x2,y2) are given. Then the distance between A and B can be calculated as

$D_E = [(x1-x2)^2 + (y1-y2)^2]^{1/2}$

Here D_E is the Euclidean distance.

Suppose the points are A(6,7) and B(3,4). The Euclidean distance between the given points is as

$D_E = [(6-3)^2 + (7-4)^2]^{1/2}$

$D_E = [(3)^2 + (3)^2]^{1/2}$

$D_E = [(9)^2 + (9)^2]^{1/2} = [18]^{1/2} = 4.2426$

The Euclidean distance is always greater than or equal to zero. The measurement would be zero for identical points and high for points that show little similarity.

III. EXPERIMENT AND RESULTS

The experiments were done using principal component analysis for facial images. The images were obtained from Libor Spacek Collection of facial images [10]. This database includes 7900 colored images of faces of 395 individuals. Each individual has 20 image samples in the database. The database consisits of male and female images of various racial origins. The images are mainly of first year undergraduate students, so the majority of individuals are between 18-20 years old but some under individuals are alsopresent. Some of the individuals has glasses and some of the male individualshave beards. The image format is 24-bit color jpeg in other words 200 x 180 array of pixels and each pixel isrepresented by 24 bits of RGB color values. The image were recorded with an S-VHS camcorder camera and the lighting is artificial, mixture of tungsten and fluorescent overhead.

Experiment were conducted standard face 96 database and local, pose variation database. The face 96 database contains number of individuals 152. The background is complex (glossy poster). Large headscale and some expression variation. The position of face in image issome translation. All images have same size and the extension of these images jpeg. The local and pose variation database is created by digital camera. These databases is available on website http://dsmcsresearch.info.

The 151, 10 and 5 face images in the database were tested using PCA. The threshold value of all database is change.

The first training set 1 include 43 face images figure 4 and is used to compute the face recogniton based on eigenfaces with Euclidean distance measures technique. The figure 1 shows the sample images of face 96 database. The figure 2 shows the mean images of sample images. The figure 3 shows the mean face of all images and the figure 5 gives the tested input and output image.

The second training set 2 include 6 face images figure 9 and is used to compute the face recognition based on eigenfaces with Euclidean distance measures technique. The figure 6 shows the sample images of local database. The figure 7 shows the mean images of sample images. The figure 8 shows the mean face of all images and the figure 10 gives the tested input and output image.

The third training set 3 include 3 face images figure 14 and is used to compute the face recognition based on eigenfaces with Euclidean distance measures technique. The figure 11 shows the sample images of pose variation database. The figure 12 shows the mean images of sample images. The figure 13 shows the mean face of all images and the figure 15 gives the tested input and output image.The success rate of recognition using PCA is 100%. The Table 1 shows the PCA performace.

Table 1: PCA Performance

Database	Method	Tested Image	Threshold Value	Recognition Accuracy (Percentage)
FACE 96	PCA	151	5.1597e+007	100
Local Database		10	2.4198e+007	100
Pose Variation Database		5	3.4307e+007	100

Fig.1. Sample Images of face 96 database

Fig.2. Mean Images of face 96 database

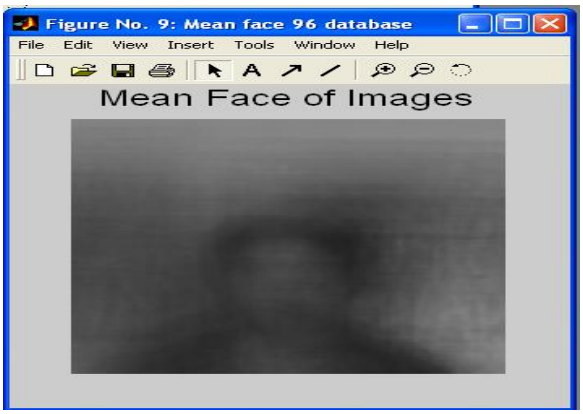

Fig.3. Mean face sample images

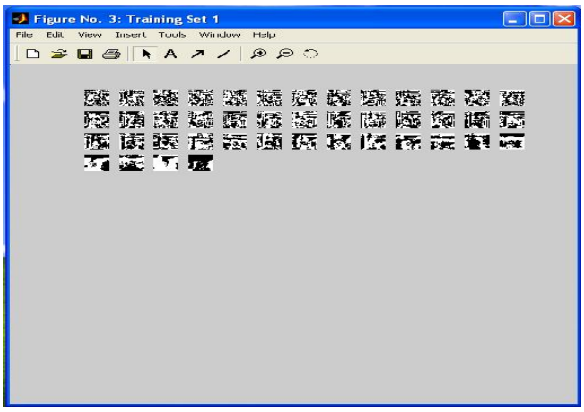

Fig.4. Training set 1

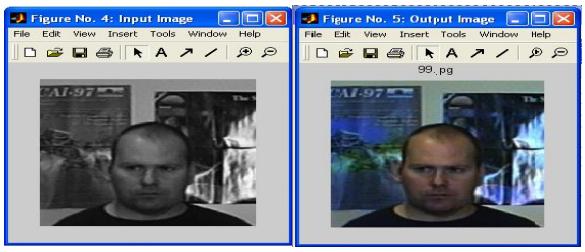

Fig.5. Input and Output Image face 96

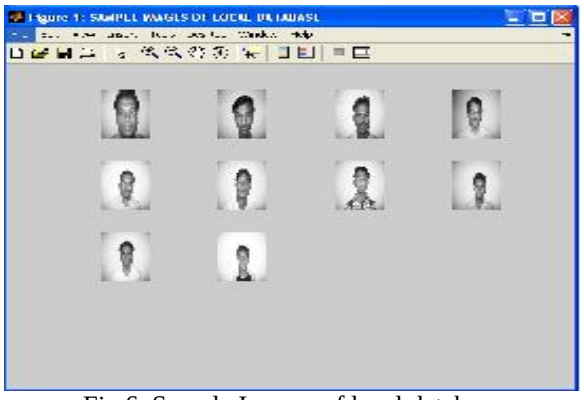

Fig.6. Sample Images of local database

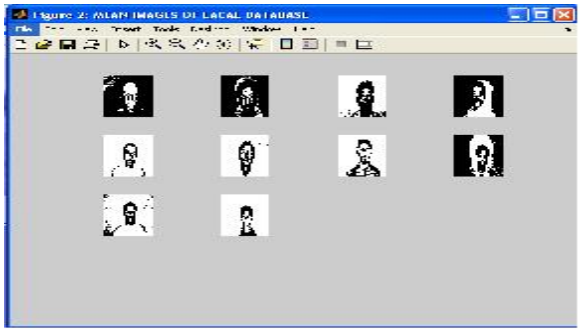

Fig.7. Mean images of local database

Fig.8. Mean face of local database

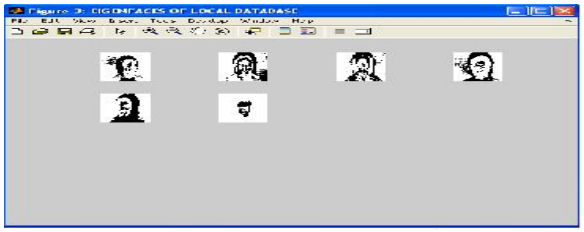

Fig.9. Training set 2

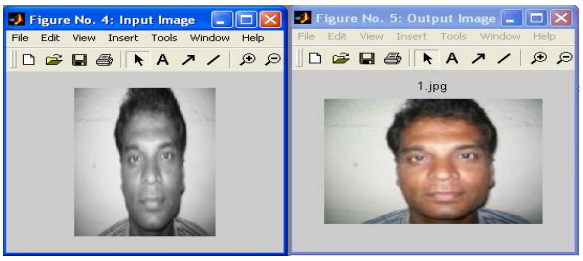

Fig.10. Input and Output Image Local database

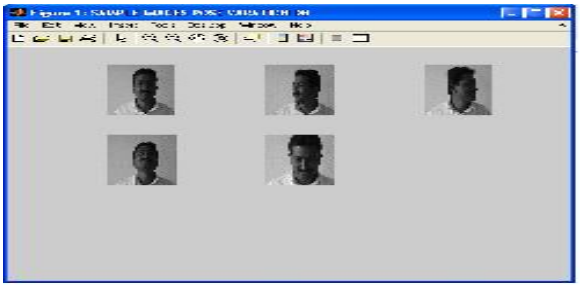

Fig.11. Sample images of Pose Variation database

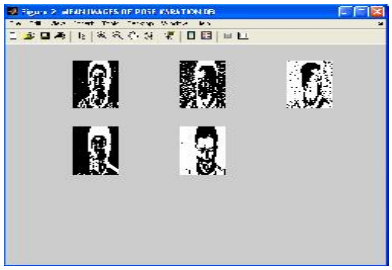

Fig.12. Mean images of Pose Variation database

Fig.13 Mean face of Pose Variation database

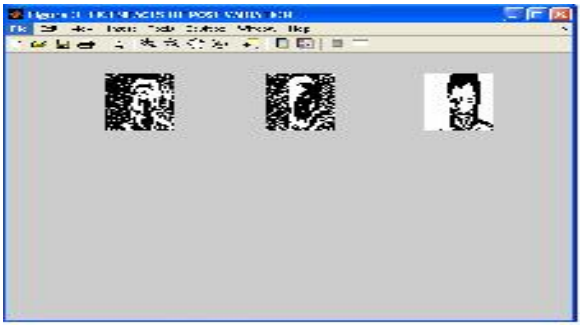

Figure 14 Training set 3

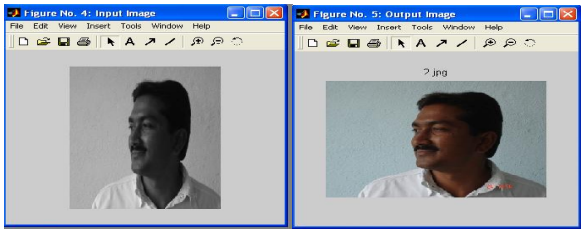

Fig.15. Input and Output Image Pose Variation database

IV. Conclusion

Face recognition Using Appearance Based Statistical Technique on Color Images Database is implemented in MATLAB. Face Recognition system should be able to detect an automatically face in images or face database. In this paper we have attempted a comparative study of appearance based statistical method that is principal component analysis. The experiment is used standard face 96 database, local database and pose variation database. The performance of principal component analysis face 96 database is 100%.The experiment is also tested for locally created poor image quality database and pose variation database and its PCA performance is 100%.

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References

[1] Wiskott, L.; Fellous, J. Kruger, N. And Malsburg, V., “Face Recognition by Elastic Brunch Graph Matching”. IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 19 No. 7, July 1997, 775-779,

[2] Brunelli, R. and Poggio, T. , “Face recognition: Features versus Templates”. IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 15 No. 10, October 1993, 1042-1052,

[3] Sirovich, L. & Kirby, M., “Low-Dimensional Procedure for the Characterization of Human Faces”, Journal of the Optical Society of America A, Vol. 4(3), March 1987

[4] Kirby, M.& Sirovich, L., “Application of the Karhunen-Loeve Procedure for the Characterization of Human Faces”, IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol.12 No.1,January 1990, 103-108, 0162-8828

[5] Turk, M. And Pentland, A. , “Eigenfaces for Recognition”, Journal of Cognitive Neuroscience,Vol. 3, 1991

[6] Pentland, A., Moghaddam, B. and Starner, T. (1994), “View based and modular eigenspaces for face recognition”, In Proceedings of Computer Vision and Pattern Recognition, pp. 84–91, USA, June 1994. IEEE Computer Society, Seattle

[7] Belhumeur,P.;Hespanha,J.& Kriegman,D.(1997). “Eigenfaces vs. Fisherfaces:Recognition Using Class Specific Linear Projection”. IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol.19,No.7,(July 1997) 711-720,0162-8828

[8] Wendy S.Yambor, “Analysis of PCA-Based and Fisher Discriminant-Based Image Recognition Algorithms”, July 1, 2000.

[9] L.I.Smith, “A tutorial on Principal Components Analysis”, Feburary,2002.

[10] Libor Spacek., Description of Libor Spacek collection of Facial Images, 1996, online http://cswww.essex.ac.uk/mv/allfaces/index.html

[11] S.Jayaraman, S.Esakkirajan, T Veerakumar, "Digital Image Processing". Tata McGraw Hill, ISBN(13):978-0-07-014479-8,ISBN(10):0-07-014479-6

[12] P.B.Khanale, "Face Recognition Against Variation in Pose and Background", IEEE INTERNATINAL CONFERENCE ON ELECTRO/INFORMATION TECHNOLOGY (EIT 2011), Minnesota State University Mankato, Min, USA, 2011.

[13] Satonkar S.S., Kurhe A.B., Dr.Khanale P.B., "Face Recognition Using Different Distance Measures Techniques", International Journal of Image Processing and Applications (IJIPA), ISSN: 0975-8178, January-June 2012, Vol.3 No.1, Page 29-36.

[14] Alaa Eleyan and Hasan Demirel, "PCA and LDA based Neural Networks for Human Face Recognition", Eastern mediterraneam University, Northern Cyprus.

AUTHOR'S PROFILE

Suhas S. Satonkar

He is M.Sc. in Computer Science, currently working as Assistant Professor and Head, Department of Computer Science, Shri Sant Janabai Education Society's Arts, Commerce and Science College, Gangakhed District Parbhani, Maharashtra, India, from last 15 years. He has 6 Research papers published in Journals and 4 Research papers published in conferences. He is Ph.D. Scholar Student.

Ajay B. Kurhe

He is M.Sc. in Computer Science, currently working as Assistant Professor and Head, Department of Computer Science, S.G.B.College, Purna district Parbhani, Maharashtra, India, from last 14 years. He has 7 Research papers published in Journals and 4 Research papers published in conferences. He is Ph.D. Scholar student.

Prakash Khanale

Dr. Prakash Khanale has an experience of 13+ years of research work in areas of computer applications in education, Fuzzy Logic and Statistical tools. He has Ph.D. degree in Electronics and is Gold Medalist and is author of several computer books. He holds fifty five international publications to his credit. His current areas of research are face recognition, visual perception and content based image retrieval. He has awarded "Best Teacher" now by SRTMU, Nanded, India.