



Face Recognition: An Outlook of Application, Database and Process

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Abstract: In the present investigation an overview of face recognition system is presented. An outlook of related work, commonly used image database, face recognition process and application is presented.

Keywords— Eigen faces, Eigenvectors, Covariance Matrix, Principal Component Analysis.

I. INTRODUCTION

Security, identification, and verification are primary concern in digital age. The requirement of biometrics system increase tremendously day by day. The various biometric features of human like face, fingerprint, palm print, hand geometry, iris and speech can be used for the purpose of human recognition [1]. Face recognition biometrics system is simple and fast process because it does not require active co-operation of a person. So that it could be applied to verity of task including criminal identification, security system, commercial and law enforcement, crowd surveillance to name only a few [2-4].

PCA involves a mathematical procedure that transform a number of possible correlated variable into the uncorrelated variable called principal components. Mathematically, PCA is an orthogonal linear transformation that transforms the data into a new coordinate system. The principal component is also known as eigen faces which represent valuable information about face [5][6]. Eigen face is orthogonal and uncorrelated component can be stored in 1-D array, because PCA reduced the dimension of data. A probe image is compared against a gallery image by measuring the distance between their respective feature vectors. For PCA to work well the probe image must be similar to the gallery image in terms of size, pose, and illumination [7][8][9]. In the forthcoming section a brief review of work related to this study is presented.

II. LITERATURE REVIEW

A brief review of previously conducted studies useful in present investigation for principal component analysis depicted in Table 1.[10-22]

Table 1: Overview of Related Work

Parameter	Researcher
Semi Automated System	Woody Bledsoe [1955]; Helen Chan Wolf [1965]; Charles Bisson[1966]; B.S.Manjunath,Chellappa[1992]; C.Von der Malsburg [1992]; Muhammad Sharif [1993]; I.J Cox, J Ghosn, P.N. Yianios [1996].
Specific Marker Based Technique	A.B Lesk [1970]; A.J Goldstein [1970]; and L.D Harmon [1970]; Carry, S. Diamond [1977]; R.J. Baron [1981]; Muhammad Sharif [1981]; T.J Stonham [1986]; Bellumeur, V. Hespanda, J., Kiregeman [1997].
Principal Component Analysis	Kirby and Sirovich [1987]; Burt P. [1988]; R. Chellappa, P. J. Phillips, A. Rosenfeld[1989]; Ming – Hsuan Yang [1990]; David J. Kriegman and Narendra Ahuja [2002]; L.i X and Areibi S [2004]; K; Fred L. Selvakumar, R.K Nallaperumal [2006]; Ali Javed [2013]; Dinesh Kumar and Rajni [2014].
Eigen Face Techniques	Turk and Pentland [1991]; R. Bruneli and T. Poggio [1993]; M Kosugi [1995]; A Pentland, A. Choudhury [2000]; A. S. Tolba, A.H, El-Baz, A.A. El-Harby,[2006];

III. COMMONLY USED DATABASE

A brief summary of commonly used data base is depicted in Table 2.

Table 2: Commonly Used Database

S. No.	Database	Downloading Link	Description
1.	AT & T	http://www.cl.cam.ac.uk/Research/DTG/attarchive/pub/data/att_faces.tar.Z	It contains face images of 40 persons, with 10 images of each person.
2.	MIT	http://whitehapel.media.mit.edu/pub/images/	Contains 16 subjects. Each subject has 27 images of persons.

3.	XM2VTS	http://www.ee.surrey.ac.uk/Research/VSSP/xm2vtsdb/	It consists of video sequences and speech recordings taken of 295 subjects.
4.	Yale	http://cvc.yale.edu/	Contains frontal grayscale face images of 15 persons, with 11 face images of each person.
5.	Yale B	http://cvc.yale.edu/projects/yalefacesB/yalefacesB.html	It contains frontal grayscale images of 10 subjects with 64 different lighting angles and 9 different poses angles, total of 5760 images.
6.	Extended Yale B	http://vision.ucsd.edu/~leekc/ExtYaleDatabase/ExtYaleB.html	Extended form of Yale B database. It contains 38 subjects with 64 different lighting angles.
7.	UMIST	http://images.ee.umist.ac.uk/danny/database.html	It consists of 564 grayscale images of 20 people Image size is about 220*220.
8.	The FERET	http://www.itl.nist.gov/iad/humanid/feret/	Contains face images of over 1000 people consists of 14051 grayscale images of human heads with views that include frontal views, left and right profile views, and quarter left and right views.

IV. PROCESS OF FACE RECOGNITION SYSTEM

The process of face reorganization [23][24][25][26] is depicted in figure 1.

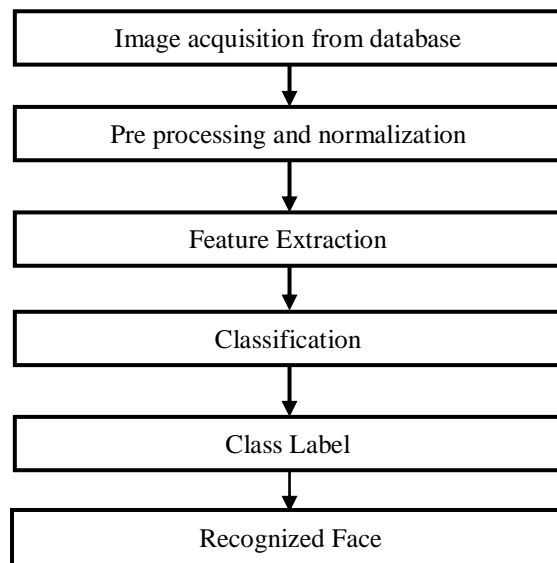


Fig. 1: Process of face recognition system [23]

The Acquisition Module: This is the first step of the face recognition system process acquires the image from camera and online created database.

Normalization: This means that the image must be standardized in terms of size, pose, illumination, etc. To normalize a probe image, the key facial landmarks must be located accurately.

Pre-processing Module: The purpose of the preprocessing module is to reduce or eliminate some of the variations in face due to illumination. It normalized and enhanced the face image to improve the recognition performance of the system.

Feature extraction and recognition: Once the face image has been normalized, the feature extraction and recognition of the face can take place. In feature extraction process the input information change into the group of features whereas the latest condensed depiction has a large amount of the pertinent data from the unique information. In feature extraction, a mathematical representation called a biometric template which is stored in the database.

The Classification Module: The purpose the classification module is to map the feature space of a test data to a discrete set of label data that serves as template. The classification techniques used are neural network, normalized correlation, euclidean distance.

V. APPLICATION OF FACE RECOGNITION

Security concern has increased in today's digital age. The identification and authentication method has been used in many areas such as.[27][28][29]

- **Entertainment:** video game, human robot interaction.
- **Biometrics:** driver licenses, immigration process, ID passport and voter registration.

- **Security Information:** Personal device log on for entry gate, secure trading terminal and security application.
- **Law enforcement and Surveillance:** Video surveillance, CCTV control, Post event analysis.
- **Forensic:** applications such as corpse identification, criminal investigation, terrorist identification, and missing children.

VI. CONCLUSION

In summary, the present study is useful in providing research directions and guidance to the beginners and it provides commonly used database, application, face recognition process and related at a common platform. Moreover, it may help researchers, academicians and practitioners working in this field.

REFERENCES

- [1] M. Turk and A. Pentland, "Eigenfaces for Recognition", *Journal of Cognitive Neuroscience*, vol 3, no. 1, pp. 71-86, 1991.
- [2] D. Zhang and W. Shu, "Two novel characteristic in palmprint verification: Datum point invariance and line feature matching," *Pattern Recognition*, vol. 32, no. 4, pp. 691-702, 1999.
- [3] C. Beumier and M. Acheroy, "Face verification from 3D and grey level clues," *Pattern Recognition Letters*, vol. 22, no. 1 pp.1321-1329, 2001.
- [4] Shang-Hung Lin, "An introduction to face recognition technology", *Informing Science Special Issue on Multimedia Informing Technology-Part-2*, vol. 3, no. 1, pp. 103-105, 2000.
- [5] Ali Javed, "Face recognition based on principal component analysis", *I.J. Image, Graphics & Signal Processing*, vol. 6, no. 3, pp. 238-244, 2013.
- [6] Ashok Samal and Prasana A.Iyengar, "Automatic recognition and analysis of human faces and facial expressions: A survey", *Pattern Recognition*, vol. 25, no. 1, pp. 65-77, 1992.
- [7] Belhumeur P. N., Hespanha J. P., and Kriegman D. J., "Eigenfaces versus fisherfaces: recognition using class specific linear projection", *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 23, no. 7, pp. 711-720, 1997.
- [8] H. Moon, "Biometrics Person Authentication Using Projection-Based Face Recognition System in Verification Scenario," in *International Conference on Bioinformatics and its Applications*. Hong Kong, China, 2004, pp.207-213.
- [9] P. J. Phillips, H. Moon, P. J. Rauss, and S. A. Rizvi, "The FERET Evaluation Methodology for Face Recognition Algorithms," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol.22, pp.1090-1104, 2000.
- [10] W.W Bleadsoe, "The Man Machine Facial Recognition", *Association of Computing Machine*, vol. 103, no. 2, pp. 304-306, 1965.
- [11] R.J. Baron, "Mechanism of human facial recognition," *Int'l J.Man Machine Studies*, vol. 15, pp. 137-178, 1981.
- [12] B.S. Manjunath, R. Chellappa, and C. Von der Malsburg, "A Feature based approach to face recognition," In *Proc. IEEE Conf. Computer Vision and Pattern Recognition*, pp. 373-378, 1992.
- [13] I.J. Cox, J. Ghosn, and P.N. Yianios, "Feature-Based face recognition using mixturedistance," *Computer Vision and Pattern Recognition*, 1996.
- [14] Mohammed sharif, Bhaskar Gupta, "Performance Comparison of Various Face Detection Techniques", *International Journal of Scientific Research Engineering & Technology (IJSRET)* vol. 2, no.1, pp. 019-0027, 2013.
- [15] W. Zhao, R. Chellappa, A. Rosenfeld and P. J. Phillips, "Face Recognition: A Literature Survey", *ACM Computing Surveys*, vol. 35, no. 4, pp. 399-458, 2003.
- [16] Goldstein, A. J., Harmon, L. D., and Lesk, A. B., "Identification of human faces", In *Proceeding IEEE 59*, pp. 748-760, 1971. W.W Bleadsoe, "The Man Machine Facial Recognition", *Association of Computing Machine*, vol. 103, no. 2, pp. 304-306, 1965.
- [17] M. Kirby and L. Sirovich, "Application of the Karhunen-Loève procedure for the characterisation of human faces," *IEEE Trans. Pattern Analysis and Machine Intelligence*, vol. 12, pp. 831-835, 1990.
- [18] M. A. Turk and A. P. Pentland, "Face recognition using eigenfaces", In *IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR 91*, pages 586-591, 1991.
- [19] Carry, S. & Diamond, R., "From Piecemeal to Configuration Processing of Face", *Science*, vol. 95, pp. 312-314, 1977.
- [20] Dinesh Kumar and Rajni, "Face recognition based on face recognition using simulink in Matlab", *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)*, vol. 3, no.7, pp. 2303-2311, 2014.
- [21] Kwang In Kim, Keechul Jung, and Hang Joon Kim, "Face recognition using kernel principal component analysis," *Signal Processing letters IEEE*, vol. 9 Issue. 2 pp. 40-42, 2002.
- [22] Xin Chen, Patrick J. Flynn, Kevin W. Bowyer, "PCA-Based Face Recognition in Infrared Imagery: Baseline and Comparative Studies", *IEEE International Workshop on Analysis and Modeling of Faces and Gestures*, pp.127, 2003.
- [23] Neerja, Ekta Walia, "Face Recognition Using Improved Fast PCA Algorithm", *International Congress on Image and Signal Processing CISP 2008*, in Sanya, Hainan, China, vol. 1, no. 20, pp. 554-558, 2008.

- [24] W. Zhao and R. Chellappa, "SFS based view synthesis for robust face recognition," Proc. Int'l Conf. Automatic Face and Gesture Recognition, pp. 285- 292, 2000.
- [25] K. I. Kim, K. Jung, and J. Kim, "Face recognition using support vector machines with local correlation kernels," International Journal of Pattern Recognition and Artificial Intelligence, vol. 16 no. 1, pp. 97-111, 2002.
- [26] L. Hong and A. Jain, "Integrating faces and fingerprints for personal identification," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 20, no. 12, pp. 1295-1307, Dec. 1998.
- [27] Laurenz Wiskott, Jean-Marc Fellous, Norbert Krüger, and Christoph von der Malsburg, "Face Recognition by Elastic Bunch Graph Matching", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 19, pp. 775-779, no.7, 1997.
- [28] Park, U., Tong, Y., and Jain, A.K. "Age-Invariant Face Recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 32, no. 5, pp. 149-158, 2010.
- [29] Wu C. J., and Huang, J. S., "Human face profile recognition by computer", Pattern Recognition Letters, vol. 23, no. 4, pp. 255-259, 1990.
- [30] Kaufman, G. J., and Breeding, K. J, "The automatic recognition of human faces from profile silhouettes", IEEE Trans. Syst. Man Cybern., vol. 6, pp. 113-120, 1976.