IJARESM
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING, SCIENCE & MANAGEMENT

PCA AND LDA BASED 2D FACE RECOGNITION METHODS: A SURVEY

Marvadi Dhara
Student, Electronics and Communication, Sarvajanik College of Engineering and Technology, Surat, Gujarat, India

Abstract: ***Face recognition domain has always attracted attention of researchers due to applications like criminal ID verification, authentication of person's identity, security, border control and illegal immigration. There is a strong requirement of system to withstand in continuously changing environment to meet challenges of above applications. Face as a biometric has lot of advantages as compared to other commonly used biometrics such as iris and fingerprint. But Face Recognition Vendor Test (FRVT 2005) experiments have shown that most of 2D face recognition approaches reached recognition rate more than 90% in controlled environment, current days face recognition system degrade their performances in case of uncontrolled environment which includes pose variations, illumination variations and expression variation.***

Keywords:PCA, LDA, ICA, 2D-PCA, 2D-LDA.

I. INTRODUCTION

Biometric security system finds its immediate needs in view of activities such as terrorist attacks, illegal immigrations etc. Such un-human illegal incidents have exposed serious flaws and weakness in current security and safety systems. These motivate government agencies to develop efficient mechanism which cannot be easily stolen and de-duplicated with high fault tolerance value. Most of government agencies are investigating a considerable amount of resources for improving security of systems. Knowledge based identification systems which are using password, personal identification number etc. and token based identification systems which include driver's license, passport, etc. are not sufficiently secure [1]. Improvement in security of data system based on physical or behavioural characteristic of person called 'Biometric' is the need of a day. Biometric traits are the unique distinctive measurable characteristics of every individual [1,2]. Biometric traits are mainly classified as behavioural and psychological biometrics. Iris and Fingerprint are widely used biometrics in most of current security and safety mechanisms [1, 2].

Most commercial face recognition technologies suffer from two kinds of problems. The first one concerns inter-class similarity such as twin's classes and fathers-son's classes. Here, people have similar appearances which make their discrimination difficult. The second, and the more important complexity, is due to intra-class variations such as change in lighting conditions, pose variations (i.e. three-dimensional

head orientation), Occlusions, time delay (ageing effect) and facial expressions variation. [2]

Even though the latest 2D face recognition systems have achieved good performance in constrained environments, their performance significantly degrades in uncontrolled environment. The major difference between a real face and photograph is their depth information. As we know, human face is a three dimensional non-rigid object and most of two dimensional approaches consider face as two dimensional rigid object which is major reason for degraded performance of two-dimensional approaches[2,15].

Most of 2D approaches are based on "intensity values" which are insufficient to describe all information available from face. In case of 3D face, it is more robust against lightening condition variation, expression variation, and occlusion because it takes advantage of 3D shape, texture and depth that provide more information about face other than only intensity value information [1,2,3].The rest of paper is organized as follows: Section II includes literature survey of 2D face recognition approaches.

II. LITERATURE REVIEW OF 2D FACE RECOGNITION

Face recognition is basically object recognition task in which recognition needs to be done in a high-dimensional space. Since such high dimensional space possesses large computational complexity and requires more time, therefore some reduction techniques are required to project it in a lower-dimensional space.

Indeed, Kirby and Sirovich et al. [3] developed eignenfaces method which is considered as pioneer method for face recognition. Martinez and Kak et al. [5] reported on PCA (Principal Component Analysis) and provide recognition accuracy 70% on AR-face database [6].

Lu et al., [4] and Martinez and Kak et al. [5] practiced LDA (Linear Discriminant Analysis) with main objective to find the subspace that best discriminates different face classes by maximizing between class scatter matrix,while minimizing the within-class scatter matrix. The eigenvectors chosen by LDA provide the best separation among the class distributions, According to Martinez and Kak et al. [5], LDA based face recognition on AR-face database [6] provide 88% recognition accuracy.

Martinez and Kak et al. [5], discussed that LDA provides better discrimination only when large training database is available. To overcome SSS problem, the above approaches combined and two stage PCA+LDA approach can be applied. [5]

Bartlett et al., [7] investigated ICA (Independent Component Analysis) which proved that first and second order statistics involved in PCA and LDA give information of only the amplitude spectrum of an image by avoiding the phase-spectrum, while some researches bring out that phase ICA can also referred to as a generalization of Implementation of ICA has been provided with recognition accuracy of 89% when tested against FERET database [8].

Yang et al. [9] provided a solution known as two-dimensional PCA (2DPCA) for problem of estimating the covariance matrix under the small sample size condition in case of eigenface approach [3,5]. It claimed to be more computationally cheap and suitable for small sample size problem. It gave recognition accuracy of 84.24% and maximum 96.1% on Yale face database [10] and AR- face database [6].

Ye et al. [12] perform Two-Dimensional Linear Discriminant Analysis (2D-LDA) and it is also an extension of LDA [4, 5] and provides more robust performance over small sample size problem. Optimal projection vectors are chosen when Fisher's criterion is maximized. The verification rate observed on ORL database [13] is 97.50%.

TABLE I. Comparison and analysis of various 2D Face recognition approaches

Sr. No.	Method		Database	Reported Performance
	Author	Method Name		
1	Martinez and Kak [5]	PCA	AR-Face[6]	70%
2	Martinez and Kak [5]	LDA	AR-Face[6]	88%
3	Barlett Marian et al.[7]	ICA	FERET[8]	89%
4	Yang et al.[9]	2D-PCA	Yale[10]	84.24%
			AR Face[6]	96.1%
5	Ye et al.[12]	2D-LDA	ORL[13]	97.50%

III. CONCLUSION

- Face recognition system has large number of applications. From above discussion, we can say that PCA and LDA based 2D face recognition are efficient to deal with various face recognition challenges like intensity variation, expression variations, pose variation and make-up effect. Still there is lot of research scope is available for efficient face recognition system design.

REFERENCES

[01] Jain, Anil K., Patrick Flynn, and Arun A. Ross. “Handbook of biometrics”, Springer, 2007.

[02] Stan, Z. Li, and K. Jain Anil. "Handbook of face recognition", Springer, 2005.

[03] Kirby, Michael, and Lawrence Sirovich. "Application of the Karhunen-Loeve procedure for the characterization of human faces." IEEE Transactions on Pattern Analysis and Machine Intelligence, vol.12, no. 1, pp.103-108, 1990.

[04] Lu, Juwei, Konstantinos N. Plataniotis, and Anastasios N. Venetsanopoulos. "Face recognition using LDA-based algorithms." IEEE Transactions on Neural Networks, vol.14, no. 1, pp.195-200, 2003.

[05] Martínez, Aleix M., and Avinash C. Kak. "Pca versus lda." IEEE Transactions on Pattern Analysis and Machine Intelligence, vol.23, no. 2, pp.228-233, 2001.

[06] Martinez, Aleix M. "The AR face database." CVC Technical Report 24 ,1998.

[07] Bartlett, Marian Stewart, Javier R. Movellan, and Terrence J. Sejnowski. "Face recognition by independent component analysis." IEEE Transactions on Neural Networks, vol.13, no. 6, pp.1450-1464, 2002.

[08] Phillips, P. Jonathon, Harry Wechsler, Jeffery Huang, and Patrick J. Rauss. "The FERET database and evaluation procedure for face-recognition algorithms." Image and vision computing, vol.16, no. 5, pp.295-306, 1998.

[09] Yang, Jian, David Zhang, Alejandro F. Frangi, and Jing-yu Yang. "Two-dimensional PCA: a new approach to appearance-based face representation and recognition.” IEEE

Transactions on Pattern Analysis and Machine Intelligence, vol.26, no.1, pp.131-137, 2004.

[10] Georghiades, A. "Yale face database." Center for computational Vision and Control at Yale University, http://cvc. yale. edu/projects/yalefaces/yalefa, 1997.

[11] Wang, Xiao-ming, Chang Huang, Xiao-ying Fang, and Jin-gao Liu. "2DPCA vs. 2DLDA: face recognition using two-dimensional method." International Conference on Artificial Intelligence and Computational Intelligence, AICI'09., vol. 2, pp. 357-360, 2009.

[12] Ye, Jieping, Ravi Janardan, and Qi Li. "Two-dimensional linear discriminant analysis." In Advances in neural information processing systems, pp. 1569-1576. 2004.

[13] AT & T (ORL) Face Database: http:// www.cl.cam.ac.uk /research /dtg/attarchive/facedatabase.html

[14] Gökberk, Berk, Albert Ali Salah, Lale Akarun, Remy Etheve, Daniel Riccio, and Jean-Luc Dugelay. "3D face recognition." In Guide to Biometric Reference Systems and Performance Evaluation, pp. 263-295. Springer London, 2009.

[15] Bowyer, Kevin W., Kyong Chang, and Patrick Flynn. "A survey of approaches and challenges in 3D and multi-modal 3D+ 2D face recognition." Computer vision and image understanding, vol.101, no. 1, pp.1-15,2006.

