International Journal of Information Processing, 6(1), 60-66, 2012
ISSN : 0973-8215
IK International Publishing House Pvt. Ltd., New Delhi, India

KDE Technique with ECA for Accurate Face Image Classification

M Sharmila Kumari[a] and B H Shekar[b]

[a]Department of Computer Science and Engineering, P.A. College of Engineering, Mangalore, Karnataka, India. Contact: sharmilabp@gmail.com

[b]Department of Computer Science,Mangalore University, Mangalore, Karnataka, India. Contact:bhshekar@gmail.com

In this paper, we have reported a new face image classification algorithm based on Renyi entropy component analysis. In the proposed model, kernel discriminant analysis is integrated with entropy analysis to choose the best principal component vectors which are subsequently used for pattern projection to a lower dimensional space. Extensive experimentation on Yale and UMIST face database has been conducted to reveal the performance of the entropy based Kernel Discriminative Embedding (KDE) technique and Comparative Analysis (CA) is made with conventional kernel linear discriminant method to signify the importance of selection of principal component vectors based on entropy information rather based only on magnitude of eigen values.

Keywords: Linear Discriminant Analysis, Entropy Component Analysis, Fisherface, Face Image Classification.

1. INTRODUCTION

In the last two decades, we have witnessed the significant growth of research in the field of biometrics; in particular on face image classification because of its wide acceptability in several applications ranging from crime detection, identity authentication, access control, face based video indexing/retrieval to human computer interaction/ communication. Several models have been proposed for face image classification ranging from appearance based models to 3D techniques.

Among the many techniques, appearance based models gain much popularity because of their robustness against noise, occlusion and simplicity in terms of feature representation. In these approaches, data transformation is a fundamental step and the goal is to obtain highly discriminative lower-dimensional data from high-dimensional data. Principal Component Analysis (PCA) and Linear Discriminate Analysis (LDA) are the widely used tools in face recognition domain that encodes high-dimensional face images as lower-dimensional eigenfaces [1] and fisherfaces [2] respectively. Although PCA ensures least reconstruction error, it may not be optimal from a discrimination stand point.

Belhumeur et al., [2] have proposed the linear discriminative analysis technique (FLD) that extracts features which possess the best discrimination capability. The PCA based system is better for the databases of a smaller number of classes and the FLD is better for the databases of larger number of classes. Additionally, the effect of non-uniform illumination conditions on the face image classification performance is studied and the superiority of the FLD method over the PCA method has been shown in [2]. However, PCA/FLD are linear methods which ensures that the data transformed are uncorrelated and preserve maximally the second order statistics of the original data and hence is insensitive to the dependencies of multiple features in the patterns. To

Table 3
Classification accuracy of **proposed model** model for YALE face database

Polynomial kernel of degree	Classification accuracy for varying dimensions of feature vectors									
	Dimension of feature vector	3		5		7		9		11	
	No. of testing samples	105	120	105	120	105	120	105	120	105	120
2		75.15	81.21	81.21	93.33	86.06	98.79	87.88	99.39	90.90	99.39
3		63.33	75.76	80.00	83.64	85.45	93.34	87.88	98.78	89.09	99.39
4		73.33	75.16	82.21	87.88	81.81	96.97	86.67	92.73	89.09	98.78

Table 4
Classification accuracy of **kernel FLD** model for YALE face database

Polynomial kernel of degree	Classification accuracy for varying dimensions of feature vectors									
	Dimension of feature vector	3		5		7		9		11	
	No. of testing samples	105	120	105	120	105	120	105	120	105	120
2		68.48	80.60	83.03	87.25	88.48	98.79	90.91	99.39	92.12	99.39
3		69.89	75.15	80.00	90.30	81.21	90.30	89.09	94.55	88.48	96.97
4		73.33	75.15	81.21	86.07	81.81	89.09	81.81	92.73	81.81	98.78

ysis to choose the best principal component vectors which are subsequently used for pattern projection to a lower-dimensional space. Extensive experimentation on the standard face databases reveals that the entropy based principal component vectors selection is more appropriate rather than selecting principal component vectors based only on magnitude of eigenvalues.

Acknowledgements: The authors would like to thank the support provided by DST-RFBR, Govt. of India vide Ref. No. INT/RFBR/P-48 dated 19.06.2009.

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M Sharmila Kumari obtained her B.E., degree from University of Mysore in the year 2000 and M.Tech., degree in Computer Science and Technology from Visweswaraya Technological University in the year 2004. She is currently working as an Associate Professor in the Department of Computer Science and Engineering, PA College of Engineering, Mangalore, India. She has authored about twenty peer-reviewed papers in International Journals and Conferences.

B H Shekar obtained his B.Sc., M.Sc., and Ph.D., degrees in Computer Science and Technology from the University of Mysore, Mysore, India, respectively in the years 1992, 1994, and 2007. He is currently working as a Reader in the Department of Studies in Computer Science, Mangalore University, Mangalore. He authored about 15 journal papers and 60 peer reviewed conference papers. His areas of research cover Video Image Processing, Biometrics, Object Recognition and Shape Analysis.