Design and Development of Lip based Gesture Recognition using PCA and LDA

Aasim Hasan
M. Sc. Student
Govt. Institute of Forensic Science
Aurangabad.
Aurangabad.

Vaishali Shinde
Research Student
Dept of CS & IT,
Dr. B. A. M. University,
Aurangabad.

Santosh Gaikwad
Research Student
Dept. of CS & IT,
Dr. B. A. M. University,
Aurangabad

Sunil Khillare
Assistant Professor
Govt. Institute Of
Forensic Science,
Aurangabad

ABSTRACT
This paper examines the performance of feature extraction techniques which related to facial gesture recognition. The goal of this research is to present independent as well as comparative performances of most popular appearance based feature extraction technique that is Principal Component Analysis (PCA) and Linear Discriminate Analysis (LDA). Actually the primary goal of gestures is to identify human gestures and deploy them to convey information through machine. The automatic recognition of human faces presents a significant challenge to the pattern recognition research community. Human faces are very similar in structure with minor differences from person to person. Most approaches for automatic facial gesture analysis in face image sequences attempt to recognize a set of prototypic emotional facial expressions i.e. Happiness, sadness, fear, surprise, anger, disgust. This paper presents the novel approach that is Emotional Relational Gesture (ERG) for face recognition. The purpose of this study is to identify the gesture and recognize the person using lip element of human face. Using ERG approach we compares PCA and LDA techniques and observed that the LDA has more accurate results than PCA as regard in recognition rate.

General Terms
Facial Gesture Recognition, Biometric.

Keywords
Gesture, Gesture Recognition, PCA, LDA.

1. INTRODUCTION
Gestures play an important role in communication between humans and machines or devices. In the present day framework of interactive, intelligent computing, an efficient human computer interaction is assuming utmost importance in our daily lives. Gesture recognition can be termed as an approach in this direction. Gesture is a movement or position of the hand, arm, body, head or face that is expressive of an idea, opinion; emotion etc. gestures reflect not only emotions, but other mental activities, social interaction and physiological signals [1]. As the technology increases day by day the gesture recognition research has tremendously increased.

Previously several works has done on face recognition, the comparison of face recognition using PCA and ICA on FERET database with different classifiers [2] are discussed and found that the ICA has better recognition rate as compared with PCA. Using Neural Network [3] developed a face detection system which detects a frontal view faces as well as side view faces. Line edge map (LEM) technique has developed using, by using edge map technique and compare LEM with Eigenface approach and they proved that LEM is better than edge map and PCA. When training and trained database has same then using PCA [4] system gives 100% result. As the technology increases research has moves toward the fusion techniques, Fusion of PCA and LDA [5] gives good results than individual use.

Until now various researches has been done on the face recognition, but there is no work has done on the lip part using gesture. So of because of this particular reason we have created our own database which mainly concentrates on lip part which describe in section 2. Section 3 represents the proposed work, section 4 will describe results of our system, and finally conclusion has described.

2. DATABASE CREATION
There are several databases are available at online and offline also, but as our work has mainly focused on lip region, the region restricted database was not available. Because of this particular reason we have create our own database of the lip part. To create the database we have used canon power shot camera and taken 10 utterances per subject. Firstly, we took the Full body picture as shown in figure and then we cropped the face part as shown in figure 2, then automatically we have face database of the happy and sad gesture on which we work for this particular research. Happy and Sad gesture very clearly express the emotions on face.

Figure 1 Full Body Picture

Figure 2 Cropped faces from full body picture

Each for the happy and sad gesture 5 images has been taken. After collection of face database we cropped mouth element of the face and here we work with basic statistical analysis in which we measure lip's shape, size

Figure 3 Lip Database

Finally we have 5 images of each gesture which shown in figure 3. Using some Matlab tools we standardized our database.

3. FEATURE EXTRACTION TECHNIQUE

For this particular study we have reviewed various papers, journals, articles from last twenty years, we selected Eigenface (PCA) approach and LDA approach for the research work.

3.1 Principal Component Analysis

It also called as Eigen face approach. It's a way of identifying patterns in data and expressing the data in a way, as to highlight their similarities and differences [6]. The main advantage of PCA is to find the patterns in the data and reducing the number of dimensions without loss of information. To calculate the PCA mean, standard deviation, mean, variance, covariance matrix, eigenvalue are the basic things.

3.2 Linear Discriminant Analysis

Linear Discriminant Analysis method used in statistics, pattern recognition and machine learning to find a linear combination of features which characterize or separates two or more classes of objective or events. This method maximizes the ratio of between-class variance to the within- class variance in any particular data set thereby guaranteeing maximal separability [7]. In the LDA techniques, we have calculated the values just same as Eigenvalue, Projection matrix, mean value and additionally we also calculated within class scatter matrix and between classes scatter matrix.

False Acceptance Rate (FAR)

$$FAR = \frac{Number\ of\ acceptable\ qualified\ attempts}{Total\ Number\ of\ qualified\ attempts}$$

In biometrics, the instance of a security system incorrectly verifying or identifying an unauthorized person. Also referred to as a type II error, a false acceptance typically is considered the most serious of biometric security errors as it gives unauthorized users access to systems that expressly are trying to keep them out. FAR [3] is often used in biometric access control systems. FAR is a measure of the likelihood that the access system will wrongly accept an access attempt; that is, will allow the access attempt from an unauthorized user. The simple formula for FAR is

False Rejection Rate (FRR)

In biometrics, the instance of a security system failing to verify or identify an authorized person. Also referred to as a type I error, a false rejection does not necessarily indicate a flaw in the biometric system; for example, in a fingerprint - based system, an incorrectly aligned finger on the scanner or dirt on the scanner can result in the scanner misreading the fingerprint, causing a false rejection of the authorized user. The false rejection rate, or FRR, is the measure of the likelihood that the biometric security system will incorrectly reject an access attempt by an authorized user. A system FRR typically is stated as the ratio of the number of false rejections divided by the number of identification attempts.

$$FRR = \frac{Number\ of\ rejected\ qualified\ attempts}{Total\ Number\ of\ qualified\ attempts}$$

We have calculated FAR and FRR of system using both feature extraction technique PCA and LDA. We have made 4 slots of images 10 image, 20 image, 30 image and 40 image slots to take the results and this image selected randomly. In which we have taken 10 images of female and 30 images of male.

4. RESULTS AND DISCUSSIONS

4.1 Experimental Result Using PCA

Table 1 FAR & FRR of System Using PCA

Recognition With PCA				
Sr. No	Image Slots	Accuracy (%)	FAR	FRR
1	10	50	5	05
2	20	65	13	07
3	30	70	21	09
4	40	75	30	10

From the table 1, we observed that at the time of PCA Recognition, accuracy has increased as slots are increased, in 10, 20, 30 and 40 slots system gives the 50%, 65%, 70%, and 75% accuracy respectively

4.2 Experimental Result Using LDA

Table 2 FAR & FRR of System Using LDA

Recognition With LDA				
Sr. No	Image Slots	Accuracy (%)	FAR	FRR
1	10	70	07	03
2	20	75	15	05
3	30	76	23	07
4	40	77.5	31	09

LDA recognition (Table 2) gives more accuracy than PCA. By using LDA, system gives 70%, 75%, 76%, and 77.5 % accuracy in 10, 20, 30 and 40 slots images respectively, i.e. this work can represents that LDA gives better result than PCA technique.

4.3 Confusion Matrix

A confusion matrix [5] contains information about actual and predicted classifications done by a classification system. Performance of such systems is commonly evaluated using the data in the matrix. Each column of the matrix represents the instances in a predicted class, while each row represents the instances in an actual class.

Table 3 Confusion Matrix of LDA

No of Slots	Gesture		No. of Total Images	No. of Rejected Images	Accuracy (%)
	Happy	Sad			
H_10	8	2	10	2	80
H_15	14	1	15	1	93.33
S_10	8	2	10	2	80
S_15	15	0	15	0	100

Table 4 Confusion Matrix of PCA

No of Slots	Gesture		No. of Total Images	No. of Rejected Images	Accuracy (%)
	Happy	Sad			
H_10	9	1	10	1	90
H_15	12	2	15	3	80
S_10	2	8	10	2	60
S_15	2	13	15	2	86.66

Table 5 Accuracy regarding the Confusion Matrix

Gesture Mode	Number of Image	PCA	LDA
Happy	10	90 (%)	80(%)
	15	80 (%)	93.33(%)
Sad	10	80 (%)	80(%)
	15	86.66 (%)	100 (%)

Table 3 and Table 4 show the confusion matrix with using Eigenface and LDA approach. To work on confusion matrix we have created some slots of images in which we have made 10 and 15 randomly selected images for both gestures i.e. happy and sad. Table 4 shows that using Eigenface approach 09 and 12 images matched in 10 and 15 image slot respectively i.e. 01 and 03 images was confused with the same approach. For the sad gesture also we have done this same basic procedure in which we observed that, in both of image slots (10 and 15) 2 images were confused and 08 and 13 images are giving accurate results. For the LDA approach, in table 3 represents, that there were two images was confused with in both of gestures of 10 and 15 image slots i.e. here 10 images are displaying correctly. But in 15 images slot happy gesture gives 14 accurate images where in sad gesture the system gives 100% results. The average FRR of system for happy gesture is 86.66% as regard in LDA approach whether using Eigenface approach system gives 85% for happy gesture. And average FRR is 13.34% and 15% in LDA and PCA approaches respectively. As concern in sad gesture average FAR of LDA and PCA 90% and 83.33% respectively where average FRR is 10% in LDA and 16.66% for PCA approach.

5. ACKNOWLEDGMENTS

The authors would like to thank the university authorities for providing infrastructure to carry out the experiments. This work is supported by UGC under RGNFS Scheme.

6. REFERENCES

[1] Sunil Khillare, B. W. Gawali, " Gesture Recognition Techniques on Face – A Review ", MPGI National Multi Conference 2012 (MPGINMC-2012), 7-8 April, 2012, "Recent Trends in Computing", Proceedings published by International Journal of Computer Applications® (IJCA)ISSN: 0975 - 8887I)

[2] Kailash J. Karande, Sanjay N. Talbar," Independent Component Analysis of Edge Information for Face Recognition", International Journal of Image Processing (IJIP) Volume (3): Issue (3).

[3] Rapahel Feraud, J. Bernier, Jean Emmanuer viallet, "A Fast and Accurate Face Detector Based on Neural Network", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 23, no. 1, January 2001

[4] Rahul Kumar Tyagi, Neha Singh, Piyush Chaudhary, " Analysis of Facial Gesture Recognition using Eigen Communication Volume-II, Number-II

[5] WeiGE, Dawei Wang,Yuqi Cheng,Ming Zhu (2009) Infrared face recognition using linear subspace analysis, Proc. of SPIE Vol. 7496 74961Z-1

[6] V.Radha, Member ,N. Nallammal, "Comparative Analysis of Curvelets Based Face Recognition mthods",Proceedings of the World Congress on Engineering and Computer Science 2011 Vol I, WCECS 2011, October 19-21, 2011, San Francisco, USA.

[7] A comparative study of PCA, ICA and lDA", Kresimir Delac,Mislav Grgic and Sonja Grgic.

[8] http://www.javvin.com/networksecurity/FAR.html, Time 6:17PM, Date: 19June2012.

[9] http://www.webopedia.com/TERM/F/false_rejection.htm