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A Comparative Analysis on Face Recognition Techniques

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***Abstract*—Face recognition has remained a competitive and huge area of research in image processing system. This paper discusses major two approaches, first is featured based and second is statistical .Former comprises of Scale Space Filtering, Elastic Bunch Graph and the later one includes PCA and LDA techniques for recognition. This review provides a brief comparative study between the features of face recognition techniques and also discussed the performance under different circumstances.**

***Keywords*— Elastic Bunch Graph Matching (EBGM) Scale Space Filtering (SSF), Principal Component Analysis (PCA), Linear Discriminate Analysis (LDA).**

I. INTRODUCTION

Face recognition is a subfield of pattern recognition. It is the task for detecting and extracting the data from input images, used to make the different patterns and match them to verify and identify with given patterns in database.
It has becomes more popular than other pattern recognition techniques like Thumb recognition, Palm recognition and retina identification. Because it is more secure and superior technique rather than other pattern recognition techniques [1].
It contains wide area of applications. Some of interesting application used in Security (access control to airports, ATM), surveillance (technology used recently in [2]), and "Smart Card" application [3] (image template store in smart card).

II. FEATURE BASED APPROACH

In featured based approach the primary step is to identify the input image and then measure the all distinctive facial points like Eyes, Mouth, and Nose etc. points the all facial feature in to a face vector and generate the geometric relationship over them with the help of these measurements input images are matched with given database. The earliest attempt by Knade [4], who extracts the face into a 16 facial parameters.
The well-known featured-based techniques are Elastic-Bunch Graph Matching [5] and Scale Space approach [6].

A. Elastic Bunch Graph Matching (EBGM)

Elastic bunch graph matching technique based on nonlinear characteristics of face image like changing in lightning conditions, different angels of face and various expressions of face. This method allocates a minor number of sections ("Gabor filters") over small zone of image by multiplying and adding the sections with various pixel values to generate numbers ("jets") at several locations on image.

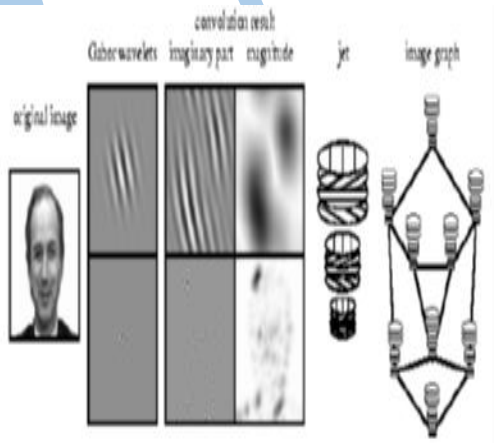

Figure -2) Graph representation of an image producing with the help of Gabor wavelet transform. This method calculates 40 coefficients, those phases vary with wavelet frequencies (imaginary part) and magnitudes varies gently. Graph image contains bunches (set of jets) and illustration of image have on contains bunches (set of jets) and illustration of image have only 3 frequencies and 4 orientation.
The main objective of this technique is to generate "labeled graph". Labeled graph considered with nodes and edges. Nodes contain the wavelet response locally wrapped in jets and edges contain the distance between two jets. Store modeled graph can be matched to new image to produce image graph. Gabor wavelets provide stability against the lightning conditions, minor shifts and distortions. Jets inspect a suitable set of fiducial marks over nose, eyes, mouth, color etc.
Gabor wavelet provides robustness against brightness in image after normalizing the jets with the help of kernels. The main disadvantage of kernel it is very sensitive to background variations. However if an object counter is known then impact of background can be suppressed [7].
We can also compare the jets for finding the displacement

and similarity function, the similarity function Sϕ(J,J') with small displacement b $\vec{}$. Jets and distance also vary due to phase rotation. A set of jets is defined as fiducial Point and one fiducial point is called bunch.

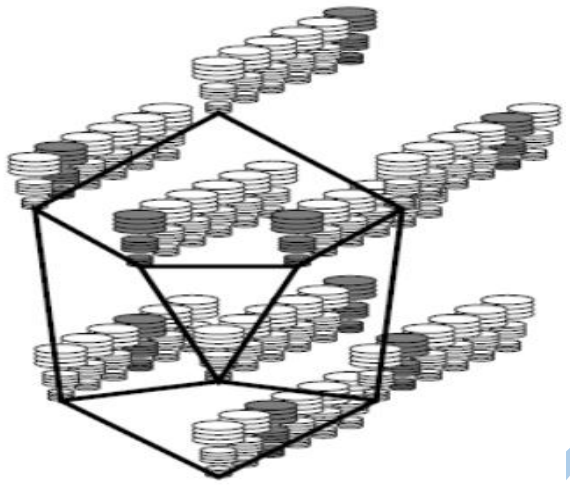

Figure 3.) FBG of an image contains the presence of all possible variations in image and grey jet specify the finest jet when compare to another image.

Elastic bunch graph designed for in-class recognition and it has no way specialized in faces. Performance degrades with large phase rotation and the system cannot inspect robustness against variation as illumination and structured background. This technique can compare to others [8],[9],[10] regard to conceptual and performance aspects.

B. Scale Space Filtering (SSF)

Scale space filtering approach is proposed in [11] is used for face recognition from profile faces. A black and white image is generated from gray-level image where black portion of image represents face region. Outline curve of Front portion of shadow has been extracted before the actual processing start. With the help of this curve we automatically identified the set of twelve fiducial points over the shadow image using scale space filtering with different parameters. Measure the Euclidean distance between two fiducial points after normalizing the feature characteristics. Euclidean distance is used to compute the likeness of feature vector which are generated from outline profiles.

Scale space filtering approach defines signal in a qualitative manner that localized the large scale-events, and expertly managing the ambiguity with different scales without introducing thresholds randomly.

In this filtering the Gaussian convolution is used for smoothing the un-smoothed signal with small and large scale parameters. The Gaussian is effortlessly differentiate or integrate. The term convolution defines as mathematical operation which is basic to many common image processing operator. Convolution provides a method of multiplying of numbers, generally of different size but same dimensionality.

Generally Gaussian method is used blurring the images and remove the detailed noise from the images, generally that it is used to reducing the amount of intensity variations between one pixel and the next.

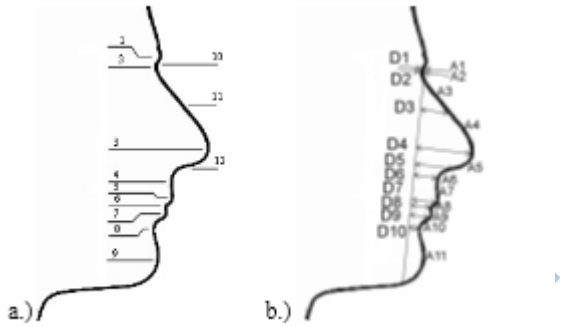

Figure 4 a) set of twenty one feature characters generated with help of fiducial marks. Where D1 to D10 are Euclidean distances and A1 to A11 are the arcs over face.

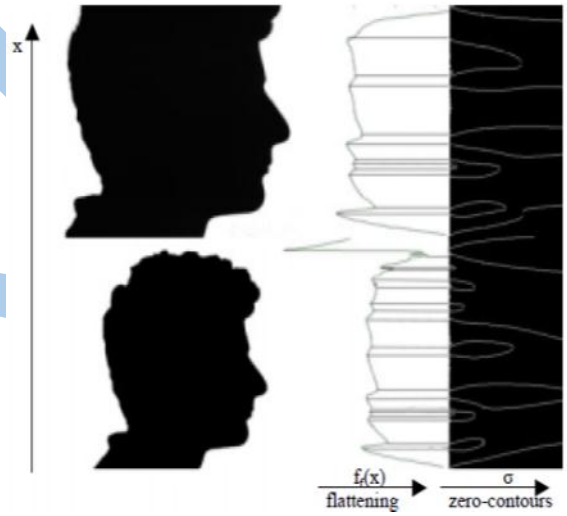

Figure 5.) (Profile face of image from university of Bern profile database)

The performance is increasing with using the additional fudicial points and dimensional characteristics. In [12] author using 17 fudicial points which gives much better performance.

The major advantages of feature-based approach are that, its robustness against position variation [13], orientation and lightning condition [14]. And also provides high speed matching and compactness of represent face images [15]. And this approach has disadvantage of automatic feature detection [16] and lack of discrimination ability.

III. STATISTICAL APPROACH

In statistical approach the co-relational features of input image is compared to other faces which are stored in database. Under limited constraints this approach has shown

in [17]. The main occlusion of this approach is that they require high-dimensional space. Because of this curse of dimensionality, the statistical approach is use.

A. Principal Component Analysis (PCA)

Principal component analysis is mathematical procedure that uses an orthogonal transformation to convert a set of values correlated variables into a set of uncorrelated variable called "Principal components" or "Eigen faces". PCA method is an important method for dimension reduction and feature selection. This method was given by Turk and Pentland [18]. This method reduces the dimensionality of original data space by defining a feature space. And this reduced data space is used for face recognition. After the dimensionality reduction rebuild the human faces was done by Kirby and Sirovich [19]. But this method has two major problems: poor discriminating power and huge computation. These two problems make it incapable of grouping the important features of face and also overhead of large computation. This problem overcomes by LDA (linear discriminate analysis). LDA has power of discrimination of feature but for better feature selection, LDA based system first reduces the dimensionality of image data using PCA and then LDA is used to maximize the discriminating power. Without dimensionality reduction, the data set selected by LDA would have larger sample per class for good discriminating feature extraction. Therefore, PCA & LDA are used correspondence to each other for better performance. And this combination of both approach well given in [20].

IV. BRIEF COMPARISON BETWEEN FACE RECOGNITION TECHNIQUES

A brief comparison between the featured based and statistical approach is comparing the key features of the techniques and defining that which techniques are the best with different situations like pose variations, illuminations and with different expressions. In the process of face recognition EBGM approach provides better performance with low dimension data and also it is very sensitive to lightning conditions because it is local featured based approach like eyes, nose etc. the major drawback is that it's not working with pose variations above 22 degree. In PCA approach the feature extraction step is automatic where in EBGM feature extraction step is taking long time cause of manual feature detection scheme. It's also giving the better performance with different expressions and pose variations and one major drawback is it requires the high dimensional data and PCA has no discrimination ability. Where LDA has high discrimination ability to differentiate between the features but the drawback is that it is a small sample size problem and it is less sensitive than PCA in illumination conditions. In PCA+LDA approach is the best approach above all statistical techniques because it's a hybrid model of both PCA and LDA and its perform better with both (high and low dimensions) data. It is less expensive the all other techniques. In PCA-LDA+ neural network technique performance increases and error decreases but the training time of data is too long. Training time is major disadvantage of neural techniques but it performs better and recognition rate is high than all other techniques. The given (table 1) provides better view about all the techniques of face recognition of frontal face images.

Table 1: table of comparison between different face recognition techniques

FEATURES	**EBGM**	**PCA**	**LDA**	**PCA+LDA**	**EBGM+EIGEN FACES**	**PCA-LDA WITH NEURAL**
LOCAL FEATURED BASE OR GLOBAL	LOCAL FEATURED BASED	GLOBAL FEATURED BASED	GLOBAL FEATURED BASED	GLOBAL FEATURED BASED	LOCAL FEATURED BASED	GLOBAL FEATURED BASED
COMPUTATIONAL COST	EXPENSIVE	EXPENSIVE	MORE EXPENSIVE THAN PCA	LESS EXPENSIVE THAN PCA AND LDA	MUCH LESS THAN EBGM	LESS EXPENSIVE THAN PCA AND LDA

DISCRIMINATION ABILITY	NO DISCRIMINATION ABILITY	NO DISCRIMINATION ABILITY	HIGH DISCRIMNATION ABILITY	HIGH DISCRIMNATION ABILITY	NO DISCRIMINATION ABILITY	HIGH DISCRIMNATION ABILITY
DIMENSION OF DATA REQUIRES	SMALL (Contains local feature like eyes, nose etc.)	DIMENSION OF DATA IS LARGE WITH HIGHLY CORRELATED	IT IS SMALL SAMPLE SZE(SSS) PROBLEM	EFFICIENT FOR BOTH LARGE AND SMALL SAMPLE SIZE DATA	SMALL (Contains local feature like eyes, nose etc.)	EFFICIENT FOR BOTH LARGE AND SMALL SAMPLE SIZE DATA
FEATURE DETECTION (MANUALY OR AUTOMATIC)	MANUAL FEATURE DETECTION SCHEME	AUTOMATIC FEATURE DETECTION SCHEME	AUTOMATIC FEATURE DETECTION SCHEME	AUTOMATIC FEATURE DETECTION SCHEME	MANUAL FEATURE DETECTION SCHEME	AUTOMATIC FEATURE DETECTION SCHEME
ROBUSTNESS AGAINST POSITION VARIATIONS	PERFORMANCE DEGRADES ABOVE 22 DEGREE ROTATIONS	PERFORMANCE DEGRADES WHEN EXTREME CHANGE IN POSITIONS	PERFORMANCE INCREASES BECAUSE EACH POSE RELATE TO SPECIFIC CLASS	PERFORMANCE INCREASES BECAUSE EACH POSE RELATE TO SPECIFIC CLASS	PERFORMANCE INCREASES WITH DIFFERENT TRAINING SET	PERFORMANCE INCREASES BECAUSE EACH POSE RELATE TO SPECIFIC CLASS
SENSITIVITY TO ILLUMINATION	VERY SENSITIVE	LESS SENSITIVE THAN (EBGM)	LESS SENSITIVE THAN PCA	LESS SENSITIVE THAN PCA	LESS SENSITIVE THAN EBGM	LESS SENSITIVE THAN PCA
PERFORMANCE WITH DIFFERENT EXPRESSION	LOW	GOOD	GOOD	GOOD	GOOD	PERFORMANCE INCREASES AND ERROR DECREASES WITH NEURAL CLASSIFICATION but TRAINING

						TIME IS HIGH.

V. CONCLUSION

This review provides the brief knowledge of featured based approach and statistical approach of face recognition. The use of non-linear characteristics is covered in feature based technique and linear characteristics covered statistical approach. Both method are giving better performance under different circumstances and provide the different base to recognition of faces. PCA and LDA enhance the power of recognition with no loss of informative data and with neural network approach the performance is enhanced without any error of information loss.

VI. REFERENCES

[1]. Rabia Jafri* and Hamid R. Arabnia* "a survey of face recognition techniques" Journal of Information Processing Systems, Vol.5, No.2, June 2009.

[2]. CNN, "Education School face scanner to search for sex offenders." Phoenix, Arizona: The Associated Press, 2003.

[3]. 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.

[4]. Kanade, "Picture Processing System by Computer Complex and Recognition of Human Faces," Kyoto University, Japan, PhD. Thesis 1973.

[5]. "Face Recognition by Elastic Bunch Graph Matching" y Laurenz Wiskott1z,Jean-Marc Fellous2x,Norbert Kruger and Christoph von der Malsburg1;21 Institute for Neural Computation , Ruhr-University Bochum D-44780 Bochum, Germany 2 Computer Science Department University of Southern California Los Angeles, CA 90089, USA.

[6]. Z. Liposcak and S. Loncaric, "A scale-space approachto face recognition from profiles," in Proceedings of the 8th International Conference on Computer Analysis of Images and Patterns, Vol. 1689, Lecture Notes In Computer Science. London, UK: Springer- Verlag, 1999, pp.243-250.

[7]. Potzsch, M., Kruger, N., and von der Malsburg, C. (1996). "improving object recognition by transforming Gabor filter responses". Network: Computation in Neural Systems, 7(2):341-347. 4, 20.

[8]. Chellappa, R., Wilson, C. L., and Sirohey, S. (1995). "Human and machine recognition of faces": A survey. Proc. of the IEEE, 83(5):705-740. 14.

[9]. Samal, A. and Iyengar, P. A. (1992). "Automatic recognition and analysis of human faces and facial Expressions": A survey. Pattern Recognition, 25(1):65-77. 14.

[10]. Valentin, D., Abdi, H., O'Toole, A. J., and Cottrell, G. W. (1994). "Connectionist models of face processing": A survey. Pattern Recognition, 27(9):1209-1230. 14

[11]. A. P. Witkin: "Scale-space filtering", Proc. 8th. Int. Joint Conf. AI 1983, pp 1019-1022.

[12]. L. Harmon, M. Khan, R. Lasch, and P. Ramig, "Machine identification of human faces," pattern recognition., vol.13, pp.97-110, 1981.

[13]. T. Jebara, "3D Pose Estimation and Normalization for Face Recognition" Center for Intelligent Machines, McGill University, Undergraduate Thesis May, 1996.

[14]. I. J. Cox, J. Ghosn, and P. N. Yianilos, "Feature based face recognition using mixture-distance," in Proceedings of IEEE Conference on Computer Vision and Pattern Recognition, 1996, pp.209-216.

[15]. R. Brunelli and T. Poggio, "Face Recognition Through Geometrical Features," in Proceedings of the Second European Conference on Computer Vision, Vol.588, Lecture Notes In Computer Science, G. Sandini, Ed. London, UK: Springer-Verlag, 1992, pp.782-800.

[16]. R. Cendrillon and B. C. Lowell, "Real-Time Face Recognition using Eigen faces," in Proceedings of the SPIE International Conference on Visual Communications and Image Processing, Vol.4067, 2000, pp.269-276.

[17]. R. J. Baron, "Mechanisms of Human Facial Recognition, "International Journal of Man-Machine Studies, Vol.15, pp.137-178, 1981.

[18]. M. Turk and A. Pentland, "Eigen faces for recognition," J. Cognitive Neuroscience, vol. 3, 71-86., 1991.

[19]. D. L. Swets and J. J. Weng, "Using discriminant Eigen features for image retrieval", IEEE Trans. PAMI.,vol. 18, No. 8, 831-836, 1996.

[20]. Issam Dagher,"Incremental PCA-LDA algorithm", International Journal of Biometrics and Bioinformatics (IJBB), Volume (4): Issue (2).

