ISSN : 2494-9150 Vol-02, Issue 02, MAY 2016.

A Review Paper on Face Recognition Techniques

Supriya D. Kakade,

E & TC Dept., TSSM's Bhivarabai Sawant College of Engg. & Research, Pune, Maharashtra, India.
kakdesupriya04@gmail.com

Abstract **With data and information accumulating in abundance, there is a crucial need for high security. Face recognition has been a fast growing, challenging and interesting area in real time applications. A large number of recognition algorithms have been developed in last decades. In this paper an attempt is made to review a wide range of methods used for face recognition comprehensively. This include PCA, LDA, ICA, SVM, Gabor wavelet soft computing tool like ANN for recognition and various hybrid combination of this techniques. This review investigates all these methods with parameters that challenges face recognition like illumination, pose variations, facial expressions.**

Keywords – Face recognition, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Face Recognition, Independent Component Analysis (ICA), Artificial Neural Networks (ANN).

I. INTRODUCTION

Face Recognition becomes one of the most biometrics authentication techniques from the past few years. Face recognition is an interesting and successful application of Pattern recognition and Image analysis.

Face recognition system has two main tasks: verification and identification. Face verification means a 1:1 match that compares a face images against a template face images whose identity being claimed. Face identification means a 1:N problem that compares a query face image against all image templates in a face database. Machine recognition of faces is gradually becoming very important due to its wide range of commercial and law enforcement applications, which include forensic identification, access control, border surveillance and human interactions and availability of low cost recording devices. Various biometric features can be used for the purpose of human recognition like fingerprint, palm print, hand geometry, iris, face, speech, gaits, signature etc. The problem with finger print, iris palm print, speech, gaits are they need active co-operation of person while face recognition is a process does not require active co-operation of a person so without instructing the person can recognize the person. So face recognition is much more advantageous compared to the other biometrics. Face recognition has a high identification or recognition rate of greater than 90% for huge face databases with well-controlled pose and illumination conditions.

II. LITERATURE SURVEY

In [1], author presents a number of typical algorithms being categorized into appearance based & model-based schemes. For appearance-based methods, three linear subspace analysis schemes are presented, and several non-linear manifold analysis approaches for face recognition are briefly described. The model-based approaches are introduced, including Elastic Bunch Graph matching, Active appearance model and 3D Morphable Model Methods.

In [2], author presents the feasibility of these algorithms for human face identification is presented through experimental investigation. It provides user authentication via facial features. These proposed system of face recognition may be applied in identification systems, document control and access control.

In [3], author presents a template matching approach to address the pose problem in face verification, which neither synthesizes the face image, nor builds a model of the face image. Template matching is performed using edginess based representation of face images. The edginess based

representation of face images is computed using one-dimensional (1-D) processing of images. It verifies the identity of a person using score obtained from template matching.

In [4], author presents a review of face recognition new algorithm has to evolve using hybrid methods of soft computing tools such as ANN, SVM, etc. may yields better performance. Attempt is made to review a wide range of methods used for face recognition comprehensively. This include PCA, LDA, ICA, Gabor wavelet soft computing tool like ANN for recognition and various hybrid combination of this techniques. This review investigates all these methods with parameters that challenges face recognition like illumination, pose variation, facial expressions.

In [5], author represents an overview of face recognition & discuss the methodology and its functioning. Thereafter we represent the most recent face recognition techniques listing their advantages and disadvantages. Some techniques specified here also improve the efficiency of face recognition under various illumination and expression condition of face images.

III. BASIC OF FACE RECOGNITION

The block diagram of a typical face recognition system can be shown with the help of Figure. The face detection and face extraction are carried out simultaneously. The complete process of face recognition can be shown in the Figure1.

Fig.1.- Block Dig. of a Face Recognition

The first step in face recognition system is to detect the face in an image. The main objective of face detection is to find whether there are any faces in the image or not. If the face is present, then it returns the location of the image and extent of the each face. Pre-processing is done to remove the noise and reliance on the precise registration. There are various factors that makes the face detection is a challenging task. Pose presence or absence of structural components, Facial expression, Occlusion, Image orientation. The facial feature detection is the process to detect the presence and location of features, like nose, eyebrow, eyes, lip, nostrils, mouth, ears, etc. this is done with the assumptions that there is only a single face in an image. In the face recognition process the input image is compared with the database. The input image is also called as probe and the database is called as gallery. Then it gives a match report and then the classification is done to identify the sub-population to which new observations belong. There are basically three approaches for face recognition:

A. Feature base approach

In feature based approach the local features like nose, eyes are segmented and it can be used as input data in face detection to easier the task of face recognition.

B. Holistic approach

In holistic approach the whole face taken as the input in the face detection system to perform face recognition.

C. Hybrid approach

Hybrid approach is combination of feature based and holistic approach. In this approach both local and whole face is used as the input to face detection system.

IV. DIFFERENT TECHNIQUES FOR FACE RECOGNITION

A. Principal Component Analysis (PCA):-

Derived from Karhunen Loeve's transformation. Given an s dimensional vector representation of each face in a training set of images, Principal Component Analysis (PCA) tends to find a t dimensional subspace whose basis vectors correspond to the maximum variance direction in the original image space. This new subspace is normally lower dimensional (t<<s). If the image elements are considered as random variables, the PCA basis vectors are defined as eigenvectors of the scatter matrix.[6][7][8][9][10].

The Eigenface algorithm uses PCA for dimensionality reduction to find the vectors which best account for the distribution of face images within the entire image space. These vectors define the subspace of face images and the subspace is called face space. All faces in the training set are projected onto the face space to find a set of weights that describes the contribution of each vector in the face space. To identify a test image, it requires the projection of the test image onto the face space to obtain the corresponding set of weights. By comparing the weights of the test image with the set of weights of the faces in the training set, the face in the test image can be identified. The key procedure in PCA is based on Karhumen Loeve

ISSN : 2494-9150 Vol-02, Issue 02, MAY 2016.

transformation. If the image elements are considered to be random variables, the image may be seen as a sample of a stochastic process. The PCA basis vectors are defined as the eigenvectors of the scatter matrix ST,

$$S_T = \Sigma^N{}_{i=1} (x_i - \mu) (x_i - \mu)^T$$

B. Independent Component Analysis (ICA):-

Independent Component Analysis (ICA) is similar to PCA except that the distributions of the components are designed to be non Gaussian. ICA minimizes both second order and higher order dependencies in the input data and attempts to find the basis along which the data (when projected onto them) are statistically independent. Bartlett et al. provided two architectures of ICA for face recognition task:

- Architecture I statistically independent basis images,
- Architecture II factorial code representation.

C. Linear Discriminant Analysis (LDA):-

Both PCA and ICA construct the face space without using the face class (category) information. The whole face training data is taken as a whole. In LDA the goal is to find an efficient or interesting way to represent the face vector space. But exploiting the class information can be helpful to the identification tasks.

Linear Discriminant Analysis (LDA) finds the vectors in the underlying space that best discriminate among classes. For all samples of all classes the between class scatter matrix SB and the within class scatter matrix SW are defined. The goal is to maximize SB while minimizing SW, in other words, maximize the ratio det|SB|/det|SW|. This ratio is maximized when the column vectors of the projection matrix are the eigenvectors of (SW^1 × SB).

D. Support Vector Machine (SVM):-

Given a set of points belonging to two classes, a Support Vector Machine (SVM) finds the hyper plane that separates the largest possible fraction of points of the same class on the same side, while maximizing the distance from either class to the hyper plane. PCA is first used to extract features of face images and then discrimination functions between each pair of images are learned by SVMs.

E. Artificial Neural Network (ANN):-

Multi-Layer Perceptron (MLP) with a feed forward learning algorithms was chosen for the proposed system because of its simplicity and its capability in supervised pattern matching. It has been successfully applied to many pattern classification problems [11]. A new approach to face detection with Gabor wavelets & feed forward neural network was presented in [12]. The method used Gabor wavelet transform and feed forward neural network for both finding feature points and extracting feature vectors. The experimental results, have shown that proposed method achieves better results compared to the graph matching and eigenfaces methods, which are known to be the most successful algorithms. A new class of convolutional neural network was proposed in [13] where the processing cells are shunting inhibitory neurons. Previously shunting inhibitory neurons have been used in a conventional feed forward architecture for classification and non-linear regression and were shown to be more powerful than MLPs [14] [15] i.e. they can approximate complex decision surfaces much more readily than MLPs. A hybrid neural network solution was presented in [16] which combines local image sampling, a self-organizing map neural network, and a convolutional neural network.

V. CONCLUSION

This paper has attempted to review a significant number of papers to cover the recent development in the field of face recognition. Present study reveals that for enhanced face recognition new algorithm has to evolve using hybrid methods of soft computing tools such as ANN, SVM, SOM may yields better performance. You can use any of them as per your requirement and application. You can also work over to improve the efficiency of discussed algorithms and improve the performance. The list of references to provide more detailed understanding of the approaches described is enlisted.

REFERENCES

[1] Xiaoguang Lu" Image Analysis for Face Recognition" published by Dept. of Computer Science & Engineering Michigan State University

[2] S.T.Gandhe, K.T.Talele, A.G.Keskar "Intelligent face recognition techniques: A comparative study" published in IAENG International Journal of Computer Science

[3]Anil Kumar Sao and B. Yegnanaarayana "Template matching Approach for Pose Problem in Face Verification Speech and

Vision Laboratory" Department of Computer Science and Engineering, Indian Institute of Technology Madras

[4] Sujata G. Bhele and V. H. Mankar "A Review Paper on Face Recognition Techniques" published in International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)

[5] Riddhi Patel and Shruti B. Yagnik "A Literature Survey on Face Recognition Techniques" published in International Journal of Computer Trends and Technology (IJCTT)

[6] Sima Taheri,Qiang Qiu, and Rama Chellappa, "Structure-Preserving Sparse Decomposition for Facial Expression Analysis" IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 23, NO. 8, AUGUST 2014

[7] Wang Zhen, Ying Zilu "Facial Expression Recognition Based on Adaptive Local Binary Pattern and Sparse Representation" 978-1-4673-0089-6/12/$26.00 ©2012 IEEE

[8] S. Thakur, J. K. Sing, D. K. Basu, M. Nasipuri,M. Kundu "Face Recognition using Principal Component Analysis and RBF Neural Networks" IJSSST, Vol. 10, No. 5

[9] Sukanya Sagarika Meher , Pallavi Maben " Face Regonition and Facial Expression Identifiation using PCA" 978-1-4799-2572-8/14/$31.00 © 2014 IEEE

[10] Manal Abdullah, Majda Wazzan and Sahar Bo-saeed "OPTIMIZING FACE RECOGNITION USING PCA" International Journal of Artificial Intelligence & Applications (IJAIA), Vol.3, No.2, March 2012

[11] Li X. and Areibi S.,—A Hardware/Software co-design approach for Face Recognition‖, The 16th International Conference on Microelectronics, Tunisia 2004

[12] Avinash Kaushal1, J P S Raina,‖ Face Detection using Neural Network & Gabor Wavelet Transform‖ IJCST Vol. 1, Issue 1, September 2010

[13] F. Tivive and A. Bouzerdoum,‖A new class of convolutional neural network (siconnets) and their application to face detection,‖Proc. Of the International Joint Conference on neural Networks, vol. 3,pp. 2157-2162,2003

[14] A.Bouzerdoum,‖A new class of high order neural networks with non-linear decision boundaries‖,Proc. Of the sixth international conference on neural information processing, vol. 3, pp.1004-1009,1999

[15] A.Bouzerdoum,‖Classification and function approximation using feed-forward shunting inhibitory artificial neural networks,vol. 6,pp.613-618,2000

[16] Steve Lawrence,C.Lee Giles,A.h Chung Tsoi, Andrew D. Back,‖ Face Recognition: A Convolutional Neural Network Approach.

