



Face Recognition with its Various Techniques: A Review

Raman Kumar^{1,*}, Satnam Singh¹ and Reyaz Ahmad²

¹Sri Sai College of Engg & Tech Badhani, Pathankot Punjab, India.

²Department of Electronics & Instrumentation Technology, University of Kashmir, Srinagar India.

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ABSTRACT

Face recognition is major challenge and provides significant attention of research in the computer vision. In recent years, reliable automated face recognition has become a realistic target of biometrics research. This biometrics will provide identity and verification of the person. The objective of face recognition involves the extraction of different features of the human face from the face image which makes it different from the other persons. In this, we give a review on face recognition system and the various classifications of recognition methods. This paper will also contain the various techniques, like PCA, LDA etc, which are used in the recognition of the face.

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Introduction

Recognition of faces in the computer vision is most important because a human face plays an important role in our social interaction and for people's identity. Using the human face as a key to security, face recognition technology has received significant attention in the past several years due to its potential for a wide variety of applications. Face recognition is defined as identifying an individual from images of the face. It has the broad inter-disciplinary nature of the interest within computer recognition and pattern recognition; biometrics and security; psychology and neuroscience [1]. Biometric based recognition depends upon physiological and behavior properties of human because these identifiers cannot be easily misplaced, forged, or shared, and are more reliable for person recognition than or knowledge-based methods [2]. As compared with other biometrics systems using fingerprint or palm print and iris, face recognition has distinct advantages because of its non-contact process. Biometric face recognition technology is called as an automatic and semi automated system [1]. The face recognition system mainly divides into two parts according to their uses i.e. verification part and identification part. In verification there is one to one matching process is used and in the identification, there is one too many matching process is used [3]. In Face recognizing process, images can be captured from a distance without touching the person that is being identified, and the identification does not require interacting with the person. The face recognizing process is classified into holistic based, feature based, neural network and appearance based methods [4]. There are different techniques used, like PCA, LDA and DCT etc, in these categories. Recognition of face according to appearance-based pattern is an important challenge because the feature of the face will be changed over the period of time [5]. In addition; face recognition serves the crime deterrent purpose because face images that have been recorded and archived can later help identify a person [6]. Face recognition has been an active area of research in image processing and computer vision, due to its

large range of prospective applications relating to information security, video surveillance, law enforcement, identity authentication, smart cards, and access control systems [7].

Face Recognition System:

The face recognition is a biometric automated system. In this system, an incoming image which is called as a probe image is thus compared to a small number of model images of the person whose identity is claimed and not [8]. It is combination of both hardware and software part. The hardware part takes the image of person and given to the software part. The software part will produce the match. The face recognition system is used for verification and identification. In verification, an individual is already enrolled in the reference database or gallery i.e. it is a one-to-one matching task whereas in identification, a probe image is matched with a biometric reference in the gallery i.e. it represents a one-to-many matching process [5]. Biometric devices will be explained by three step procedure. In first step, a sensor takes an observation. The type of sensor and its observation depend on the type of biometric devices used. In second step, a computer algorithm "normalizes" the biometric characteristics so that it is in the same format (size, resolution, view, etc.) as the characteristics stored in the system's database. In the final step, a matcher compares the normalized characteristics of the incoming input with the set of normalized characteristics on the system's database and provides a "similarity score" that compares the individual's with the stored data base [8]. The face recognition basically involves two stages i.e. face detection and other is face recognition stage [9].

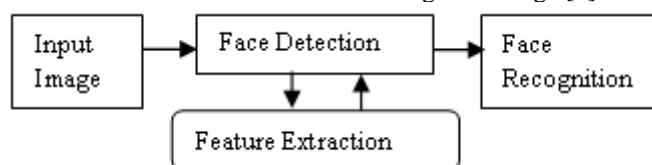


Fig1: Block diagram of face recognition system [9]

The objective of face detection is to determine whether the face is present in the image and if any, then to specify the face location [10]. The face recognition stage further consists of the preprocessing phase, feature extraction phase, enrollment phase and recognition phase [5].

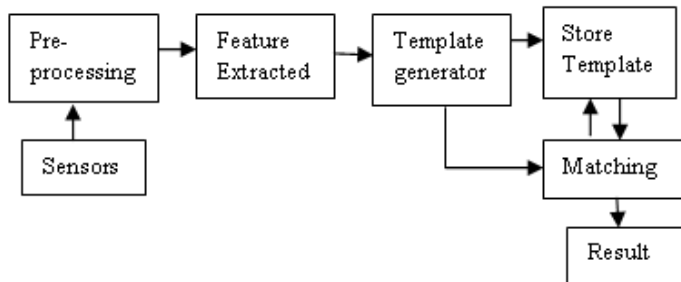


Fig 2: working process of recognition process [9]

The working of recognition phase will be shown in figure 2. The sensor will take the image of the person and give the captured image to the pre processing stage. The necessary action like image size, resolution etc is performed in pre processing stage. Next stage is feature extraction, in this required feature from the image are extracted using various techniques. A template is a synthesis of all the characteristics extracted from the source, in the optimal size to allow for adequate identifiability. In the enrollment process, the generated templates are stored in the memory. After that obtained template is passed to a matcher in the recognition process, that compares it with other existing templates and the result will be generated. There are two outcomes will produced i.e. the person is not recognized or the person is recognized. In the recognition process, false reject and false accept mistakes are occurred. False reject indicates a mistake that occur when the system reject a known person and false accept indicates a mistake in accepting a claim when it is in fact false [5].

Classification of Face recognitions Methods: On the basis of the way to represent face, all available face recognition techniques can be classified into following methods, i.e. holistic, feature and hybrid methods.

Holistic methods: - These methods identify a face by using the whole face images as a single input. Holistic approach identifies the faces by using global representations. The main challenge of this method is that how to address the extremely small size problem [4]. Appearance based technique uses holistic texture features.

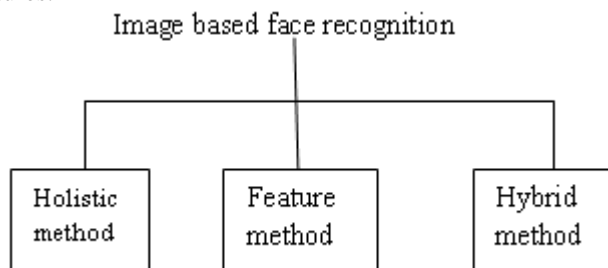


Fig 3: classification of face recognition

Feature based methods: - These methods used the local facial features for recognition like eyes, nose, and mouth. Some care should be taken, when deciding how to incorporate global configurationally information into local face methods [4].

Hybrid methods: - These methods use both feature-based and holistic features to recognize a face. These methods have the potential to offer better performance than individual holistic or feature based method [11].

Techniques of face recognition: Face Recognition System (FRS) is the computer application of recognizing similar faces from the images of face database. Four individual techniques of face recognition systems are: PCA, DCT, LDA and neural network [12].

Principal Component Analysis (PCA): PCA is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. It is a statistical dimensionality reduction method that produces an optimal linear least-square decomposition of a training set [10]. PCA will found application in fields such as face recognition and image compression. In PCA, the input (probe) and stored (gallery) images must have same size and would be normalized to line up the eyes and mouth of the subjects within the images. The PCA approach is then applied to reduce the dimension of the data by means of data compression, and reveals the most effective low dimensional structure of facial patterns. This reduction will remove the information that is not useful and also broken the face structure into orthogonal components known as Eigen faces [13]. Each face image may be represented as a weighted sum (feature vector) of the Eigen faces, which are stored in a 1D array. PCA will use these Eigen faces for recognition [14]. A probe image is compared against a gallery image by measuring the distance between their respective feature vectors. The PCA approach requires the full frontal face to be presented each time; otherwise the image results in poor performance. The primary advantage of this technique is that it can reduce the data needed to identify the individual to 1/1000th of the data presented.

Linear Discriminant Analysis (LDA): LDA is a data separation and supervised learning technique that relies on class labels. This algorithm is used in statistics, pattern recognition and machine learning to find a linear combination of features or directions which well separates two or more classes of objects once projected upon [10]. LDA consists in finding a base of vectors providing the best discrimination among the classes [4]. This technique will maximize difference between the class variance and minimize within class variance. Each of the new dimensions is a linear combination of pixel values, which form a template. The linear combinations obtained using Fisher's linear discriminant are called Fisher faces. Linear discriminant analysis is primarily used to reduce the number of features to a more manageable number before classification. LDA provides better classification performances only when a wide training set is available.

DCT: DCT-based technique of face recognition used for access control applications. One technique of this method is based on computing the DCT spectrum of the face image and then using the entire spectrum as a part of it for classification [15]. The generated classification algorithms can vary from simple distances between DCT coefficients vectors or more complex algorithms employing neural network techniques and making recognition decision based on the distance of the DCT code of the query face from the reference DCT codes in the database [16,17].

Neural Network: Neural Network is a machine learning algorithm that has been used for various pattern classification problems such as gender classification, face recognition, and classification of facial expression [18]. Neural Network classifier has advantages over linear ones such as incredible generalization, good learning ability and reduces

misclassifications among the neighborhood classes [4]. The basic idea is to consider every pixel in the image a net with a neuron. We give some input patterns for training and some target values and the weights of neural networks get adjusted [18]. Basically the neural network is composed of 3 types of layers: first is Input layer, which is responsible for inserting the information to the network. Second is Hidden layer, which may consist of one or more layers as needed to solve difficult problem and responsible for processing the data and training of the network. The output layer is used to give the network's output to a comparator which compares the output with predefined target value neural networks requires training.

Conclusion:

Recognition of face means to identify the particular face from the stored set of faces. Recognizing of faces is something that people usually done effortlessly and it has been remained a difficult problem in the area of computer vision. In recent time, new automated face recognition system will be used that based on biometric characteristics. They will use behavior and physiological characteristics of human being. The importance of utilizing biometrics to establish personal authenticity and to detect impostors is growing in the present scenario of global security concern. Recognition can be used for identification and verification purpose. There are various methods used in the face recognition that depends upon the way they use the image such as appearance based and feature based methods. These methods will use various techniques like PCA, LDA etc. It is used in various applications like information security, identity authentication and access control systems.

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