

A Survey on Face Recognition based security system and its applications

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Abstract - Face is our primary focus of attention and it plays an important role in conveying identity and emotions. We meet numbers of faces throughout our lifetime but it is quite robust to identify despite of variation in visual stimulus due to changing condition such as aging, beard, glasses or changes in hairstyle. Therefore Face Recognition system is a technology which is capable of identifying or verifying a person from a digital image or a video frame from a video source. Face recognition presents a challenging problem in the process of image analysis and computer vision. This paper describes FR, its definition, a brief history about it, Challenges in FR, Face Recognition methods and the various applications that are now in used in the modern trends.

Key Words: Face Recognition, Eigenfaces, Image processing, Face Detection, Principal Component Analysis.

1. INTRODUCTION

Face Recognition has becoming one of the most biometrics authentication techniques from the last few years. Mainly the Face Recognition system has two tasks: one is verification and the other is identification. Face verification means 1:1 match that is verification authenticates an individual by comparing one specific biometric stored in the database, while identification means comparing all the biometrics stored in the database. Therefore face identification means 1: N match. Machine Recognition of faces is very important now-a-days because of the commercial and law enforcement applications such as forensic identification, access control, and border control. The human face plays an important role in our social interaction, conveying people's identity. Using the human face as a key to security, biometric face recognition technology has received significant attention in the past several years due to its potential for a wide variety of applications in both law enforcement and non-law enforcement.

1.1 Definitions

Face Recognition is the process of capable of uniquely identifying or verifying a person by comparing and analyzing patterns based on the person's facial contours. Now-a-days Face Recognition is mostly used for security purposes, though there is increasing interest in other areas of use. In fact, face recognition technology has received significant to law enforcement as well as other

enterprises. Human face plays a very important role in our social interactions and in conveying people's identity. Using the human face as a key to security, face recognition technology has received a significant attention in the past several years due to its potential for a wide variety of applications in the research fields' attention as it has potential for a wide range of application related. A face recognition system can be divided into three major steps:

- a) **Face Detection:** Face detection is the necessary first step in a face recognition system. The main aim of this step is to determine whether a human face appears in a given image.
- b) **Features Extraction:** The main aim of this step is to extract face component features like eyes, nose, mouth, etc from human face image. Feature extraction is very much important for the initialization of processing techniques like face tracking, facial expression recognition or face recognition
- c) **Face Recognition:** The main aim of face recognition is to identify a face from the images in the database.

1.2 History

Face detection and recognition had a huge number of researches because of its important applications in all fields of society as well human's life. So it is impossible to review all the literatures related to it. So in this chapter we will focus on the main research methodologies which are mostly related to my proposed work.

In 1966, the first attempt to construct a semi-automated face recognition human computer system was made [1], [2]. The system was based on the extraction of the coordinates of a set of features from the photographs, which were then used by the computer for recognition. Later, feature extraction and pattern classification techniques [3] were employed for face recognition purposes. In [4] and [5], a template matching approach was developed and improved, using automatic feature measurements and deformable templates which are parameterized models of face.

1970s, Goldstein, Harmon, and Lesk used 21 specific subjective markers such as hair color and lip thickness to automate the recognition. The problem with both of these

early was that the measurements and locations were manually computed.

In 1988, Kirby and Sirovich applied principle component analysis, a standard linear algebra technique, to the face recognition problem. This was considered somewhat of a milestone as it showed that less than one hundred values were required to accurately code a suitably aligned and normalized face image.

Early 1990s have witnessed the beginning of a new wave of developments for face recognition, with considerable research endeavors made for enhancing recognition performance. These include principal component analysis (PCA) [6].

Abdullah, et al, in their research [7] tried to minimize the participated eigenvectors which consequently decreases the computational time. They conduct a study to optimize the time complexity of PCA (eigenfaces) that does not affects the recognition performance.

Arora in (2012) implemented eigenfaces recognition algorithm for real time face recognition in [9] using laptop computer and web camera, Arora considered video frames as still picture, his experiment examined changing or variation in illumination and head size, he considered the experiment quite successful. Results of Arora's experiment where registered as following:

Table -1: Results for eigenfaces algorithm for real time face recognition (Arora, 2012, 196)

Face Condition	Recognition Accuracy	Recognition Error
Normal	83%	17%
Light Variation	61%	39%
Size of Face variation	55%	45%

2. APPLICATIONS OF FACE RECOGNITION SYSTEM

a) Face Identification: Face recognition systems identify people by their face images. Face recognition systems establish the presence of an authorized person rather than just checking whether a valid identification (ID) or key is being used or whether the user knows the secret personal identification numbers (Pins) or passwords. For example to eliminate duplicates in a nationwide voter registration system because there are cases where the same person was assigned more than one identification number. The face recognition system directly compares the face images of the voters and does not use ID numbers to differentiate one from the others. When the top two matched faces are highly

similar to the query face image, manual review is required to make sure they are indeed different persons so as to eliminate duplicates.

- b) Access Control:** Access control is a way of limiting access to a system or to physical or virtual resources. In computing, access control is a process by which users are granted access and certain privileges to system, resources or information.
- c) Security:** Today more than ever, security is a primary concern at airports and for airline staff office and passengers. Airport protection systems that use face recognition technology have been implemented at many airports around the world. The following are the two examples
- d) Image database investigations:** Searching image databases of licensed drivers benefit recipients, missing children, immigrants and police bookings.

3. FACE RECOGNITION METHODS

In beginning Face Recognition was treated as 2D pattern recognition. The distance between important points where used to recognize known faces example: measuring the distance between the eyes or other important points or measuring different angles of facial comparison, the following methods are used for face recognition:

- a) Holistic Matching Method:** In this method the complete face region is taken into account as input data into face catching system. One of the best example of holistic method are Eigen faces, principal component analysis (PCA), linear discriminant analysis (LDA), independent component analysis (IDA) etc.
- b) Feature based Matching:** In this method local feature such as eyes, nose & mouth are first of all extracted and their location and local statistics are fed into structural classifier. Big challenge is face restoration. Feature based distinguishes between three different extraction methods
 - i.** Generic methods based on edges, lines & curves.
 - ii.** Feature template based method.
 - iii.** Structural matching methods that take into consideration geometrical constraints on the features
- c) Hybrid Method:** It uses a combination of both Holistic and Feature based method. Generally 3D images are used.

3. CONCLUSIONS

Face recognition is a challenging problem in the field of image processing. Because of lots of application in different fields the face recognition has received great attention. In today's networked world, the necessity of maintaining information safety as well as preserving the physical property is gradually becoming significant and tedious. As the requirement of high level of security arises, face recognition technology is bound to cope with the upcoming needs. Also, face recognition has caught the eye of researchers in the areas ranging from image processing and security to computer vision. Since it maintain our privacy and protect our assets without dropping our identity. Therefore, face recognition deals with people as its centre of attention and thereby increasing the user-friendliness in human-computer interaction.

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