A Literature Review on Face Recognition System

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Abstract— Face recognition is a biometric system used to identify or verify a person from a digital image. Face recognition is undoubtedly an interesting research area, growing in importance in recent years, due to its applicability as a biometric system in commercial and security applications. These systems could be used to prevent unauthorized access or fraudulent use of ATMs, cellular phones, smart cards, desktop PCs, workstations, and computer networks. The appealing characteristic of a face recognition system is that, differently from fingerprint or iris biometric systems, it represents a not invasive control tool. In this paper we provide literature review of various face recognition system.

Keywords— Face Recognition, Feature extraction, Access Control

I. INTRODUCTION

Biometric-based techniques have emerged as the most promising option for recognizing individuals in recent years since, instead of certifying people and allowing them access to physical and virtual domains based on passwords, PINs, smart cards, plastic cards, tokens, keys and so, these methods examine an individual's physiological and/or behavioral characteristics in order to determine and/or ascertain his/her identity. Passwords and PINs are difficult to remember and can be stolen or guessed; cards, tokens, keys and the like can be misplaced, forgotten, or duplicated; magnetic cards can become corrupted and unclear. However, an individual's biological traits cannot be misplaced, forgotten, stolen or forged [1].

Face recognition is a biometric system used to identify or verify a person from a digital image. Face Recognition system is used in security. Face recognition system should be able to automatically detect a face in an image. This involves extracts its features and then recognize it, regardless of lighting, expression, illumination, ageing, transformations (translate, rotate and scale image) and pose, which is a difficult task.

Face recognition presents a challenging problem in the field of image analysis and computer vision. The security of information is becoming very significant and difficult. Security cameras are presently common in airports, Offices, University, ATM, Bank and in any locations with a security system.
In order to develop a useful and applicable face recognition system several factors need to be take in hand.
• The overall speed of the system from detection to recognition should be acceptable.
• The accuracy should be high
• The system should be easily updated and enlarged, that is easy to increase the number of subjects that can be recognized.

In this paper we provide literature review of various face recognition system.

II. FACE RECOGNITION METHODS

In the beginning of the 1970's, face recognition was treated as a 2D pattern recognition problem [2]. The distances between important points where used to recognize known faces, e.g. measuring the distance between the eyes or other important points or measuring different angles of facial components. But it is necessary that the face recognition systems to be fully automatic. Face recognition is such a challenging yet interesting problem that it has attracted researchers who have different backgrounds: psychology, pattern recognition, neural networks, computer vision, and computer graphics. The following methods are used to face recognition.

1. Holistic Matching Methods
2. Feature-based (structural) Methods

3. Hybrid Methods

1. Holistic Matching Methods: In holistic approach, the complete face region is taken into account as input data into face catching system. One of the best example of holistic methods are Eigenfaces [8] (most widely used method for face recognition), Principal Component Analysis, Linear Discriminant Analysis [7] and independent component analysis etc.

2. Feature-based (structural) Methods: In this methods local features such as eyes, nose and mouth are first of all extracted and their locations and local statistics (geometric and/or appearance) are fed into a structural classifier. A big challenge for feature extraction methods is feature "restoration", this is when the system tries to retrieve features that are invisible due to large variations, e.g. head Pose when we are matching' a frontal image with a profile image.

3. Hybrid Methods: Hybrid face recognition systems use a combination of both holistic and feature extraction methods. Generally 3D Images are used in hybrid methods. The image of a person's face is caught in 3D, allowing the system to note the curves of the eye sockets, for example, or the shapes of the chin or forehead. Even a face in profile would serve because the system uses depth, and an axis of measurement, which gives it enough information to construct a full face. The 3D system usually proceeds as: Detection, Position, Measurement, Representation and Matching.

Detection - Capturing a face either a scanning a photograph or photographing a person's face in real time.

Position - Determining the location, size and angle of the head.

Measurement - Assigning measurements to each curve of the face to make a template with specific focus on the outside of the eye, the inside of the eye and the angle of the nose.

Representation - Converting the template into a code - a numerical representation of the face and

Matching - Comparing the received data with faces in the existing database.

III. LITERATURE REVIEW

Much of the work in computer recognition of faces has focused on detecting individual features such as the eyes, nose, mouth, and head outline, and defining a face model by the position, size, and relationships among these features. Such approaches have proven difficult to extend to multiple views and have often been quite fragile, requiring a good initial guess to guide them. Different research works performed in face recognition in recent time are explained below.

M. Bicego et. al. [8] wrote a paper "Using Hidden Markov Models and Wavelets for face recognition". In this paper, a new system for face recognition was proposed, based on Hidden Markov Models (HMMs) and wavelet coding. A sequence of overlapping sub-images is extracted from each face image, computing the wavelet coefficients for each of them. The whole sequence is then modelled by using Hidden Markov Models. The proposed method is compared with a DCT coefficients-based approach, showing comparable results.

Liton Chandra Paul et. al. [9] wrote a paper "Face Recognition Using Principal Component Analysis Method". This paper mainly addressed the building of face recognition system by using Principal Component Analysis (PCA). PCA is a statistical approach used for reducing the number of variables in face recognition. In PCA, every image in the training set is represented as a linear combination of weighted eigenvectors called eigenfaces. These eigenvectors are obtained from covariance matrix of a training image set. The weights are found out after selecting a set of most relevant Eigenfaces. Recognition is performed by projecting a test image onto the subspace spanned by the eigenfaces and then classification is done by measuring minimum Euclidean distance.

Divyarajsinh N. Parmar et. al. [10] wrote a paper "Face Recognition Methods & Applications". They described that Face Recognition system is used in security. Face recognition system should be able to automatically detect a face in an image. This involves extracts its features and then recognize it, regardless of lighting, expression, illumination, ageing, transformations (translate, rotate and scale image) and pose, which is a difficult task. This paper contains three sections. The first section describes the common methods like holistic matching method, feature extraction method and hybrid methods. The second section describes applications with examples and finally third section describes the future research directions of face recognition.

Issam Dagher et. al. [11] wrote a paper "Face Recognition using the most Representative Sift Images". In this paper, face recognition using the most representative SIFT images was presented. It is based on obtaining the SIFT (SCALE INVARIANT FEATURE TRANSFORM) features in different regions of each training image. Those regions were obtained using the K-means clustering algorithm applied on the key-points obtained from the SIFT

algorithm. Based on these features, an algorithm which will get the most representative images of each face is presented. In the test phase, an unknown face image is recognized according to those representative images. In order to show its effectiveness this algorithm is compared to other SIFT algorithms and to the LDP algorithm for different databases.

G.Hemalatha et. al. [12] wrote a paper "A Study of Techniques for Facial Detection and Expression Classification". In this paper they described the various approaches for facial recognition are categorized into two namely holistic based facial recognition and feature based facial recognition. Holistic based treat the image data as one entity without isolating different region in the face where as feature based methods identify certain points on the face such as eyes, nose and mouth etc. In this paper, facial expression recognition is analyzed with various methods of facial detection, facial feature extraction and classification.

Sarabjit Singh et. al. [13] wrote a paper "A Face Recognition Technique using Local Binary Pattern Method". In this paper they described that LBP is really a very powerful method to explain the texture and model of a digital image. Therefore it was ideal for feature extraction in face recognition systems. A face image is first split into small regions that LBP histograms are extracted and then concatenated in to a single feature vector. This vector forms an efficient representation of the face area and can be used to measure similarities between images. Automatic facial expression analysis is a fascinating and challenging problem, and impacts important applications in several areas such as human–computer interaction and data-driven animation.

IV. APPLICATIONS OF FACE RECOGNITION SYSTEM

Face recognition is also useful in human computer interaction, virtual reality, database recovery, multimedia, computer entertainment, information security e.g. operating system, medical records, online banking., Biometric e.g. Personal Identification - Passports, driver licenses , Automated identity verification - border controls , Law enforcement e.g. video surveillances , investigation , Personal Security - driver monitoring system, home video surveillance system.

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. The following are 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.

Access Control: In many of the access control applications, such as office access or computer logon, the size of the group of people that need to be recognized is relatively small. The face pictures are also caught under natural conditions, such as frontal faces and indoor illumination. The face recognition system of this application can achieve high accuracy without much co-operation from user. The following are the example.

Face recognition technology is used to monitor continuously who is in front of a computer terminal. It allows the user to leave the terminal without closing files and logging out. When the user leaves for a predetermined time, a screen saver covers up the work and disables the mouse & keyboard. When the user comes back and is recognized, the screen saver clears and the previous session appears as it was left. Any other user who tries to logon without authorization is denied.

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.

In October, 2001, Fresno Yosemite International (FYI) airport in California deployed Viisage's face recognition technology for airport security purposes. The system is designed to alert FYl's airport public safety officers whenever an individual matching the appearance of a known terrorist suspect enters the airport's security checkpoint. Anyone recognized by the system would have further investigative processes by public safety officers. Computer security has also seen the application of face recognition technology. To prevent someone else from changing files or transacting with others when the authorized individual leaves the computer terminal for a short time, users are continuously authenticated, checking that the

individual in front of the computer screen or at a user is the same authorized person who logged in.

Image database investigations: Searching image databases of licensed drivers, benefit recipients, missing children, immigrants and police bookings.

General identity verification: Electoral registration, banking, electronic commerce, identifying newborns, national IDs, passports, employee IDs.

Surveillance: Like security applications in public places, surveillance by face recognition systems has a low user satisfaction level, if not lower. Free lighting conditions, face orientations and other divisors all make the deployment of face recognition systems for large scale surveillance a challenging task. The following are some example of face-based surveillance.

To enhance town center surveillance in Newham Borough of London, this has 300 cameras linked to the closed circuit TV (CCTV) controller room. The city council claims that the technology has helped to achieve a 34% drop in crime since its facility. Similar systems are in place in Birmingham, England. In 1999 Visionics was awarded a contract from National Institute of Justice to develop smart CCTV technology.

IV. CONCLUSION

Face recognition is a biometric system used to identify or verify a person from a digital image. Face Recognition system is used in security. Face recognition system should be able to automatically detect a face in an image. This involves extracts its features and then recognize it, regardless of lighting, expression, illumination, ageing, transformations (translate, rotate and scale image) and pose, which is a difficult task. In this paper we have studied literature review of various face recognition system along with their application areas.

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