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A Survey on Various Feature Extraction Techniques and Face Recognition Methodologies using Neural Networks

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Abstract- Face is a complex multidimensional visual model and developing a computational model for face recognition. The Proposed methodology is consist of two stages – Feature extraction and recognition various Neural Network. Face recognition has become a valuable tool used by criminal investigators. Face recognition is more demanding because it must be able to handle facial images captured under non-ideal conditions and it has high liability for following legal procedures. This paper discusses recent developments in automated face recognition . Improvements in face recognition through research in facial aging, facial marks, forensic sketch recognition, face recognition in video, near infrared face recognition will be discussed. Previous work related to face recognition will also be discussed in this paper.

Keywords– *Face* Recognition, Pattern Recognition, Artificial Neural Network (ANN), Feature extraction

I. INTRODUCTION

The face is the primary focus of attention in the society, playing a major role in conveying identity and emotion. Although the ability to infer intelligence or character from facial appearance is suspect, the human ability to recognize faces is remarkable. A human can recognize thousands of faces learned throughout the lifetime and identify familiar faces at a glance even after years of separation. This skill is quite robust, despite of large changes in the visual stimulus due to viewing conditions, expression, aging, and distractions such as glasses, beards or changes in hair style. Face recognition has become an important issue in many applications such as security systems, credit card verification, criminal identification etc. Even the ability to merely detect faces, as opposed to recognizing them, can be important. Although it is clear that people are good at face recognition, it is not at all obvious how faces are encoded or decoded by a human brain. Human face recognition has been studied for more than twenty years. Developing a computational model of face

Recognition is quite difficult, because faces are complex, multi-dimensional visual stimuli. Therefore, face recognition is a very high level computer vision task, in which many early vision techniques can be involved. Face recognition is the ability to establish a subject's identity based on his facial characteristics .face recognition has been extensively studied over the past two decades due to its important role in a number of application domains, including access control, visual surveillance, and de duplication of government issued identity documents (e.g., passport and driver license), to name a few. Face recognition systems generally operate under one of two scenarios: verification or identification [1]. In a verification scenario, the similarity between two face images is measured and a determination of either match or non-match is made. In an identification scenario, the similarity between a given face image and all the face images in a large database is computed; the top match is returned as the hypothesized identity of the subject. The techniques used in the best face recognition systems may depend on the application of the system. There are at least two broad categories of face recognition systems:

a. The goal is to find a person within a large database of faces (e.g. in a police database). These systems typically return a list of the most likely people in the database (Pentland, Starner, Etcoff, Masoiu, Oliyide and Turk, 1993)[2]. Often only one image is available per person. It is usually not necessary for recognition to be done in real-time.
b. The goal is to identify particular people in real-time (e.g. in a security monitoring system, location tracking system, etc.), or to allow access to a group of people and deny access to all others (e.g. access to a building, computer, etc.) (Chellappa et al., 1995)[3] Multiple images per person are often available for training and real-time recognition is required.

The performance of automatic face recognition techniques .For face identification the starting step involves extraction of the relevant features from facial images. Investigations by numerous researchers over the past several years indicate that certain facial characteristics are used by human beings to identify faces.

The remaining part of our paper is organized as follows: In section II we will discuss the literature review done in field of face recognition and in section III we will discuss the performance issues and research challenges. The comparative analysis of various face recognition techniques will be discussed in section IV and finally in section v we will conclude the paper and give the future scope of this paper.

II. LITERATURE REVIEW

This section summarizes related work on face recognition – geometrical feature based approaches, template matching, neural network approaches, and the popular eigenfaces, PCA with Neural networks technique.Several approaches for Face recognition in images and videos have been proposed in the past. Most of these methods aim to extract the Features based on general properties of images. Many researchers working on feature extraction with various approaches have achieved good performance based on some constraints. Face recognition by humans has a long history. Face recognition is one of the few biometric methods that possess the merits of both high accuracy and low intrusiveness. It has the accuracy of a physiological approach without being intrusive. For this reason, since the early 70's (Kelly,1970), face recognition has drawn the attention of researchers in fields from security, psychology, and image processing, to computer vision. Numerous algorithms have been proposed for face recognition; as the technology has matured, commercial products (such as Miros' TrueFace (1999) and Visionics' FaceIt (1999)) have appeared on the market. The first attempt to identify a subject by comparing a pair of facial photographs was reported in a British court in 1871 [4], and the first known systematic method for face recognition was developed by the French criminologist Alphonse Bertillon in 1882 [5].

The first paper on automatic face recognition appeared in 1966 by Bledsoe et al. [6]. The project was called "manmachine because a set of facial features were extracted from the photographs by a human. These features were then fed to a computer to conduct automated matching. From the set of feature points (such as the center of pupils, inside and outside corners of eyes, point of widows peak, etc) a list of 20 distances were computed and used to measure the similarity between face images. The man-machine system was able to consistently outperform humans based on a database of over 2,000 photographs. Goldstein and Harmon [7] also used 22 descriptive features (morphological descriptions of the face, hair, eyebrows, etc.) to identify people based on face images. These features were provided to a set of trained jurors as well as computers to conduct identification tasks. Goldstein and Harmon concluded that six different features are required to identify a person in a database of 255 subjects, and predicted that 14 features are required to identify a person in a gallery of 4×106 faces.

The first fully automatic face identification system was developed by Kanade [8] using a set of facial parameters based on local histograms of gray scale pixel values. and reported a recognition rate of between 45-75% with a database of 20 people. Brunelli and Poggio (1993)[2] compute a set of geometrical features such as nose width and length 20 people which report a 90% recognition rate on a database of 47 people. Cox,Ghosn and Yianilos (1995) have recently introduced a *mixture-distance* technique which achieves a recognition rate of 95% using 95 test images and 685 training images (one image per person in each case). Each face is represented by 30 *manually* extracted distances. Systems which employ precisely measured distances between features may be most useful for finding possible It was not until much later that many other automated face recognition systems were introduced.

The Principal Component Analysis (PCA) method was first applied on face images by Sirovich [9] for image compression, then by Turk and Pentland [10] for identification. The ordered set of eigenvectors corresponds to a set of basis images that characterizes the variation between face images Turk and Pentland (1991)[10] present results on a database of 16 subjects with various head orientation, scaling, and lighting. Their images appear identical otherwise with little variation in facial expression, facial details, pose, etc. For lighting, orientation, and scale variation their system achieves 96%, 85% and 64% correct classification respectively. Scale is renormalized to the eigenface size based on an estimate of the head size .In Pentland et al. (1993; 1994)[10] good results are reported on a large database (95% recognition of 200 people from a database of 3,000). It is difficult to draw broad conclusions as many of the images of the same people look very similar (in the sense that there is little difference in expression, hairstyle, etc.), and the database has accurate registration and alignment (Moghaddam and Pentland, 1994).

In Moghaddam and Pentland (1994[10], very good results are reported with the US Army FERET database database – only one mistake .In summary, it appears that eigenfaces is a fast, simple, and practical algorithm. Template matching methods such as (Brunelli and Poggio, 1993)[2] operate by performing direct correlation of image segments (e.g. by computing the Euclidean distance). Template matching is only effective when the query images have the same scale, orientation, and illumination as the training images (Cox et al., 1995). However. PCA based approaches greatly reduced the computational burden and inspired more active research in face recognition. Another popular face recognition method is Linear Discriminant Analysis (LDA) [11], which is based on the Fisher's Liner Discriminant Analysis. The use of separate class labels for each subject in LDA provided better identification accuracy over PCA. Some other well known methods include Elastic Bunch Graph Matching (EBGM) [12] and Local Binary Pattern (LBP) [13] based feature representation.

III. PERFORMANCE ISSUES AND RESEARCH CHALLENGES

A. Performance Issues:

The two standard biometric measures to indicate the identifying powers are False Rejection Rate (FRR) and False Acceptance Rate (FAR). FRR (Type I Error) and FAR (Type II Error) are inversely proportional measurements; For example, if an ID system tunes its threshold value to reject all imposters (minimizing FAR), it may also improperly reject some authorized users (maximizing FRR). Therefore, ID system designers often provide a variable threshold setting for the customers to strike a balance. If a site requires near 100% rejection. An ID system with *both* low FAR and FRR is considered having good discriminating power. The performance of face recognition techniques has been evaluated in a series of tests conducted by the National Institute of Standards and Technology (NIST) using the FERET evaluation methodology [17].

The Face Recognition Vendor Test (FRVT) and Face Recognition Grand Challenge (FRGC) have continued these benchmarks with participants from both industry and academia. In the FRVT 2002 [13], an identification accuracy of ~70% was achieved for facial images with near frontal pose and normal lighting conditions on a large gallery (121,589 face images of 37,437 subjects). The most recent test, FRVT 2006 [14], involved a verification scenario; the best performing system showed a False Reject Rate (FRR) of 0.01 at a False Accept Rate (FAR) of 0.001 for high resolution (400 pixels between eyes) or 3D images. Despite the impressive performance of automatic face recognition systems in a controlled setting, the benchmarked error rates in FRVT do not reflect the accuracy of face recognition systems when used in certain operational and forensic scenarios where it is not possible to make restrictive assumptions about ambient illumination, subject pose, sensor resolution, and compression. Contrary to the CSIeffect [14], which gives the illusory impression to citizens about the capabilities of state of the art face recognition technology, a number of prototype deployments (e.g., theSuper Bowl game in Tampa in 2001 [15] and the Meinz railway station test in Germany in 2006 [16]) did not meet the required levels of matching accuracy. On the other hand, there are a few face biometric applications successfully deployed such as Smartgate in Australia [17] and the border control system between Hong Kong and China [18]), where user's cooperation is expected under a constrained environment. In addition to the effects of these extrinsic variables on face recognition accuracy, real-world forensic scenarios exhibit large intrinsic variations (e.g., due to facial aging, expression and cosmetic makeup) which further degrade the recognition performance and are generally not replicated in controlled studies.

B. Research Challenges:

The various challenges faced during the face recognition can be categorized as follows:

- Camera distortion and noise
- Complex background
- Illumination
- Translation, rotation, scaling, and occlusion
- Facial expression
- Makeup and hair style

Camera distortion and noise are standard variations in image recognition problems. Previous researchers have developed numerous tools to increase the signal-to-noise ratio. To deal with complex image background, the recognizer requires a good face detector to isolate the real faces from other parts of the image. Illumination is often a major factor in the obstruction of the recognition process. To alleviate the influence of the illumination effect, people may take conventional image enhancement techniques (dynamic thresholding, histogram equalization), or train a neural network for feature extraction (Brunelli, 1993)(Lin, 1997).

IV. COMPARATIVE ANALYSIS

The comparison between various techniques used for face recognition is described in the following table.

Table: 1

Method	**Approach**	**Database**	**Identification accuracy**
Bledsoe et al. [29]	20 features such as width of mouth, width of eyes, etc. (first semiautomatic method.)	N/A*	N/A*
Goldstein and Harmon [37]	22 features including simple morphological description about face, hair, eyebrows, etc. (semi-automatic)	255 images of 7 subjects	53%
Kanade [38]	Local histogram (first fully automatic method)	20 images of 20 subjects	75%
Turk and Pentland [41]	Principal component analysis (PCA or Eigenface)	21,500 images of16 subjects	100%
Belhumeur et al. [26]	Linear Discriminant Analysis (LDA)	160 images of 16 subjects (Yale DB)	99.4%
Ahonen et al. [43]	Local Binary Patterns (LBP)	1,196 Subjects (FERET DB)	97%

V. CONCLUSION

This paper highlights what is face recognition ang basically it focus on the face recognition using neural networks. we have also discussed the literature review in face recognition and we have also analyze the various performance issues and research challenges as well as we have also examine the comparative analysis of the methods on the basis of the features and we have identified various recognition accuracy. So we can say face recognition is a challenging task now a days in artificial neural network and become the important area of research and a number of work has been done in this field and various work has to be done in this field and we can propose various algorithms to reduce the challenges met so that system performance increases.

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