Face Recognition Techniques

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----------**ABSTRACT**----------
Face detection and recognition is challenging due to the Wide variety of faces and the complexity of noises and image backgrounds. In this paper, we propose a neural network based novel method for face recognition in cluttered and noisy images. We use a Modified radial basis function network (RBFN) to distinguish between face patterns and non face patterns. The complexity RBFN is reduced by RobustPCA as it gives good results even in different illumination environments and highly un-susceptible to occlusion when compared with Classical PCA (Principal component analysis). RobustPCA is applied on Images to get the eigen-vectors. These eigen-vectors are given as input to RBFN network as the inputs for training and recognition. The proposed method has good performance good recognition rate.

Keywords - **Face recognition Techniques**, **Recognition Algorithm, Automated Facial System, Neural Network, Linear SVM, Grid Search SVM**

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I. INTRODUCTION

The Humans have recognition capabilities that are unparalleled in the modern computing era. Humans have always had the ability to recognize and distinguish between faces features. Recently the computers have shown the same ability. In the mid of 1960s, scientists began work on using a computer to recognize human faces. Since that time the facial recognition software has come a long way, the governments and private companies started to use the face recognition system. A lot of changes are being made to enhance scientist's capabilities in this field (Zhang al et., 2009). Many researchers believe that face recognition need to be about face detection, the prior step to face recognition, the accurate detection of human faces in arbitrary scenes, is the most important process involved. Human faces are remarkably similar in global properties, including size, aspect ratio, and location of main features, but can vary considerably in details across individuals, gender, race, or due to facial expression, most traditional face recognition systems attempt to achieve a low recognition error rate, implicitly assuming that the losses of all misclassifications are the same (Shlizerman, 2011). Facial recognition software in any given episode, the security department at the fictional. Montecito Hotel and Casino uses its video surveillance system to pull an image of a card counter, thief or blacklisted individual, then runs that image through the database to find a match and identify the person. In 2001, the Tampa Police Department installed police cameras equipped with facial recognition technology in their City nightlife district in an attempt to cut down on crime in the area, the system failed to do the job, and it was scrapped in 2003 due to ineffectiveness (Patra and Das. 2008). The remainder of this paper is organized as follows; the first Section was to introduce framework and discuss -phase of this framework reviewing the previous studies. The Second Section is about the methodology and the final section is about the researcher results and then the conclusion.

Research Framework

The paper describes the conceptual framework of face recognition systems through scope on the algorithms, usages, benefits, challenges and problems in this figure, Figure (1)

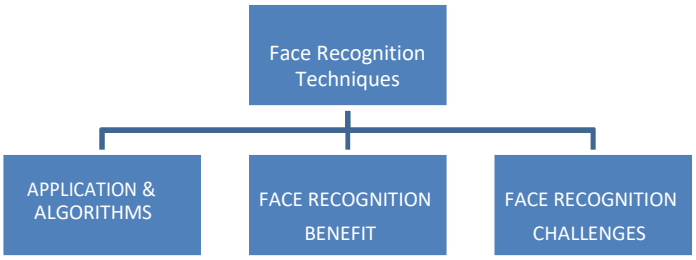

Figure (1) Face Recognition Framework

Literature review

D. Wilkes et. Al., (1992) started with a study related face recognition system and exploited the mobility of the camera by using low-level image data to drive the camera to a standard viewpoint with respect to an unknown object. From such a viewpoint, the object recognition task is reduced to a two-dimensional pattern recognition problem, the system was used an efficient tree-based, probabilistic indexing scheme to find the model object that is likely to have generated the observed data. Line

tracking uses a modification of the token-based tracking scheme of the system that has been successfully tested on a set of origami objects. Given sufficiently accurate low-level data (CHEN AL ET. 2005) (Jianke, 2009). Recognition time is expected to grow only logarithmically with the number of objects stored. (Xiong, 2010).

Thus, Dyar. C.R (1994) argued that there are two basic behaviors that allow reconstruction of a patch around any point in a reconstruction surface region. These behaviors rely only on information extracted directly from face images, and are simple enough to be executed in real time. Global surface reconstruction can be provably achieved by integrating these behaviors to iteratively "grow" the reconstructed regions (Dyar. C.R.,1994) (PIter, alet, 2008).

On the other hand Jianke Zhu, (2009) presented a fusion approach to solve the nonrigid shape recovery problem, which takes advantage of both the appearance information and the local features, they have two major contributions. First, they propose a novel progressive finite Newton optimization scheme for the feature-based nonrigid surface detection problem, which is reduced to only solving a set of linear equations. The key is to formulate the non-rigid surface detection as an unconstrained quadratic optimization problem that has a closed-form solution for a given set of observations. Second, they proposed a deformable Lucas-Kanade algorithm that triangulates the template image into small patches and constrains the algorithm for both efficient and effective issues.

However, YUN FU (2010) introduced paper about Age estimation from facial images has promising applications in human-computer interaction, biometrics, visual surveillance, and electronic customer relationship management, etc. Most existing techniques and systems can only handle frontal or near frontal view age estimation due to the difficulties of (1) differentiating diverse variations from uncontrollable and personalized aging patterns on faces and (2) collecting a fairly large database covering the chronometrical image series for each individual in different views, the researcher proposed a robust framework to deal with multi view age estimation problem, also a large face database, with significant age, pose, gender, and identity variations, which should be followed by classification or regression algorithms (YIN., 2010).

Also, Zheng (2009) wrote on the same topic and focused on the human action recognition problem and proposed a new Curve-Distance approach based on the geometry modeling of video appearance manifold and the human action time series statistics on the geometry information. He presented experimental results on the KTH database and demonstrated the solution to be effective and promising (Zhang, 2009).

Finally, Gao., et al., (2008) proposed a novel high- order local pattern descriptor, local derivative pattern (LDP), for face recognition. LDP is a general framework to encode directional pattern features based on local derivative variations. The *nth*-order LDP is proposed to encode the (*n*-1)*th* -order local derivative direction variations, which can capture more detailed information. They discovered that the high-order LDP consistently performs much better than LBP for both face identification and face verification under various conditions. Next section will be on face recognition applications

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Applications of Face Recognition

Several application designs are available to help in face recognition and some of the applications are:

1- Application number one is related to finding a face within a large database of faces. In this approach the system returns a possible list of faces from the database. The most useful applications contain crowd surveillance, video content indexing, and personal identification: driver's license, mug shots matching are examples of this type of application (Wang. 2009) (Whaite et al., 1991).

2- Application number two is about the real time face recognition. Here, face recognition is used to identify a person on the spot and grant access to a building or a compound, thus avoiding security hassles. In this case the face that is to be compared will be against multiple samples of a person (Bartoli, 2006) (Wright, 2009) .

Existing Algorithms

Face Recognition Based on Principal Component Analysis.

Principal Component Analysis (PCA) is known as algorithm that used in face recognition. The basic idea in PCA is to determine a vector of much lower dimension that best approximates in some sense a given data vector, thus, in face recognition, it takes a s-dimensional vector representation of each face in a training set of images as input, and determines a t-dimensional subspace whose basis vector is maximum corresponding to the original image, the dimension of this new subspace is lower than the original one (t <<s). If the original image elements are considered as random variables, then the principal components are along the eigenvectors corresponding to the larger eigen values of the correlation matrix, and error minimization is done in a least-squares sense(Qing Chen, Xiaoli Yang, Jiying Zhao, 2006).

Face Recognition Based on Independent Component Analysis

Like the PCA based technique, this is also a technique to extract the statistics of the random variables. However, in this case, the second-order and higher-order dependencies of the input data are minimized by the technique and the basis along which the data is statically independent are found (Xu.,et al 2007).

Evolutionary Pursuit

This is an eigenspace-based approach that searches for the best set of projection axes in order to maximize a fitness function, measuring at the same time the classification accuracy and generalization ability of the system

Because the dimension of the solution space is too big, it is solved using a specific kind of genetic algorithm called; Evolutionary Pursuit (Yong, et al., 2010)

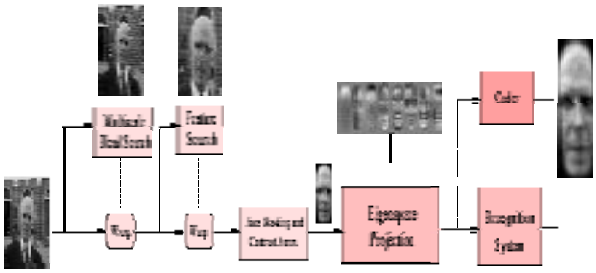

Figure (2) Face Recognition- eigenspace-based Recourse: Moghaddam et. al., 1998

Elastic Bunch Graph Matching

All human faces share a similar topological structure; faces are represented as graphs, with nodes positioned at fiducially points (eyes, nose, etc.) and edges labeled with 2-D distance vectors. Each node contains a set of 40 complex Gabor wavelet coefficients at different scales and orientations (phase, amplitude), they are called "jets". Recognition is based on labeled graphs, a labeled graph is a set of nodes connected by edges; each node is labeled as jets, edges are labeled as distances (Zhao et al, 2006).

Kernel Methods

The face manifold in subspace need not be linear. Kernel methods are a generalization of linear methods. Direct non-linear manifold schemes are explored to learn this non-linear manifold (Wiskott, al et, 1995).

Trace Transform

The Trace transform, a generalization of the Radon transform, is a new tool for image processing which can be used for recognizing objects under transformations, e.g. rotation, translation and scaling; to produce the Trace transform one computes a functional along tracing lines of an image. Different Trace transforms can be produced from an image using different trace functional (Hu L and Wei Z, 2009).

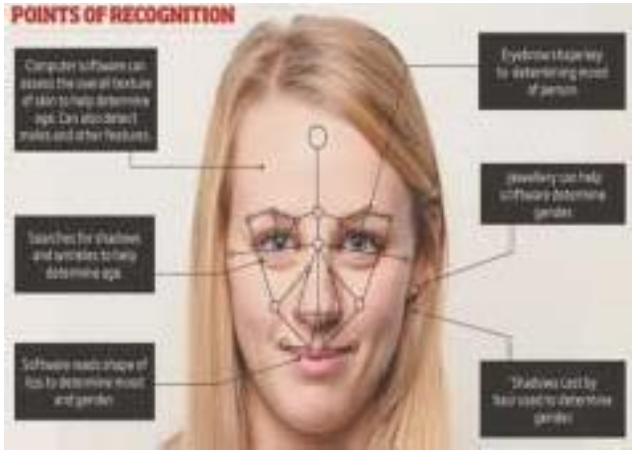

Figure (3) Tesco's facial recognition

Research Methodology

The researchers used descriptive study to propose a framework which formulates the face recognition problem as a multiclass cost-sensitive learning task, and related algorithms were proposed to face recognition.

Benefits of face recognition systems

Understanding of face scanning biometrics security is an important tool for works controlling and monitoring. The biometric clocks can benefit companies in monitoring employees.

Benefit 1 - No More Time Fraud:

The biggest benefit of using facial recognition system in companies is that they did not have to worry about time fraud, it will be impossible for buddy punching to occur, since everyone has to have to clock (Yun. Al., et 2010)

Benefit 2 - Better Security:

The companies also enjoy better security with a face recognition system, not only can track their employees thru biometrics time attendance tracking, but any visitors can be added to the system and tracked throughout the area too, anyone that is not in the system will not be given access (Gao , B. Cao , S. Shan , X. Chen , D. Zhou , X. Zhang and D. Zhao.,2008).

Benefit 3 - Automated Facial System:

Many companies like the fact that biometric imaging systems are automated, they weren't have to worry about having someone there to monitor the system 24 hours a day (Xuet al,. 2007).

Benefit 4 - Easy Integration:
Integrated Biometric facial systems are also easy to program into the companies computer system, usually they will work with existing software that they have in place (Wiskott, ,al et, 1995).

Benefit 5 - High Success Rate:
Facial biometrics technology today has a high success rate, especially with the emergence of 3d face recognition technologies, it is extremely difficult to fool the system, and so you can feel secure knowing that your biometrics computer security system will be successful at tracking time and attendance while providing better security (Jianke Zhu, 2009). Companies with a biometric security device today can purchase a variety of security devices, including safes, locks, time clocks, and more (Wilkes et al., 1992).

Challenge of Face recognition techniques
One of the most important challenge of face recognition is the fact that capturing technology requires cooperation from a subject, for example lens or laser based scanners require the subject to be at a certain distance from the sensor, furthermore, a laser scanner requires a few seconds of complete immobility. In addition, there are currently very few high-quality face databases available for testing and evaluation purposes, those databases that are available should compare to databases used for (Yun et al., 2010).
Furthermore, the comparison of the different face recognition techniques is challenging for a number of reasons:
Firstly; there are a few standardized face databases which are used for benchmarking purposes, thus, the size and type of 3D face datasets varies significantly across different publications.
Secondly; there are differences in the experimental setup and in the metrics which are used to evaluate the performance of face recognition techniques, in terms of the data and algorithms used and the reported recognition performance. (Yong., et al. 2010).
Even though 3D face recognition is still a new emerging area, there is a need to compare the strength of each technique in a controlled setting where they would be subjected to the same evaluation protocol on a large dataset; this need for objective evaluation prompted the design of the evaluation studies as well as the upcoming. (Moghaddam, & Pentland., 1998) (Bartoli, 2006)

The principles of biometric evaluation laid down in the evaluation strategy, so far, these evaluation studies are limited to 2D face recognition techniques but will hopefully include 3D face recognition techniques in the near future.

II. CONCLUSION

Face images are the inputs of the face recognition system, there are different algorithms and methods used for face recognition, even though, the fields still have challenges and limitations; it still needs more accurate techniques, especially for the 3D, furthermore the extension of current face recognition has a bigger problem of face detection, the network need parameters leading to reduced poor generalization capabilities, and face detection tasks are needed for given images detection. Finally researchers find that the change of recognition rate is not appreciable when the number of hidden neurons is more than 40, the researchers recommend that there is a need for evaluation studies, and especially on face recognition field and 3D, in order to reduce problems and challenges.

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