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A REVIEW OF FACE RECOGNITION METHODS AND TECHNIQUES

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Abstract: *Face recognition is one of the most important biometrics which seems to be a good compromise between actuality and social reception and balances security and privacy well. A lot of face recognition algorithms have been developed during the past decades, their modifications which can be further evaluated with wavelet using neural network. This paper represents an analytical study of the previous implemented algorithms like PCA, or Radial Basis Function Network. This paper also discusses the pros and cons of the recognition methods.*

Keywords: *AFR, (Automatic Face recognition, PCA (Principal component analysis), RBFN (radial basis function network).*

I. INTRODUCTION

A recognition system is a computer application that is automatically used for identifying or verifying a person from a digital image. One of the best ways to do this is by comparing selected facial features from the image to a facial database. Face recognition is a natural and straight forward biometric method that is used by us to identify one another [1, 2]. The current interest in face recognition can be lead to the use of latest techniques insecurity and surveillances. People want more secure methods to protect their valuable information from unauthorized users. A recognition method involves a procedure which includes the feature extraction, training of the network and then testing of the provided data.

Basic Face recognition model is given below.

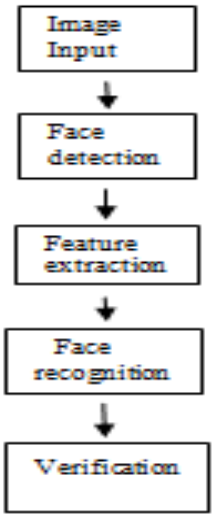

Fig.1.1 Face recognition model.

Face recognition procedure generally consists of main three steps:

Face Detection used is to determine human faces in a given image, and where these faces are located at. The

expected outputs of this step are patches containing each face in the input image.

Feature Extraction: After the face detection step, human-face features are extracted from images. Directly using these features for face recognition have some disadvantages, as each patch usually contains over 1000 pixels that are too large to build a robust recognition system. Also face features may be taken from different camera alignments, with different face expressions, illuminations. To overcome these drawbacks, feature extractions are performed to do information packing, dimension reduction, salience extraction, and noise cleaning. Face features are usually transformed into a vector with fixed dimension.

Face Recognition: Last step is to recognize the identities of these faces. In order to achieve automatic recognition, a face database is required to build. For each person, several images are taken and their features are extracted and stored in the database. Then when an input face image comes in, perform face detection and feature extraction, and compare its feature to each face class stored in the database. There are two general applications of face recognition, one is called identification and another one is called verification.

1. Verification: When a face image is presented for knowing the identity of a person that who, he/she is the person, its identity. Verification is done by one-to-one matching.

2. Identification: From an image of an unknown individual the identity of a person is determined by comparing (possibly after encoding) that image with a database of (possibly encoded) images of known individuals. Identification is done form one-to-many matching. Face verification is a 1:1 match that compares a face images against a template face images, whose identity being claimed .On the contrary, face identification is a 1: N problem that compares a face image against all image templates from a face database in a query [3].

Face recognition Algorithms

Face recognition algorithms can be classified as either geometry based or template based algorithms [4]. The template based methods compare the input image with a set of templates. Many face recognition algorithms include some template matching techniques.

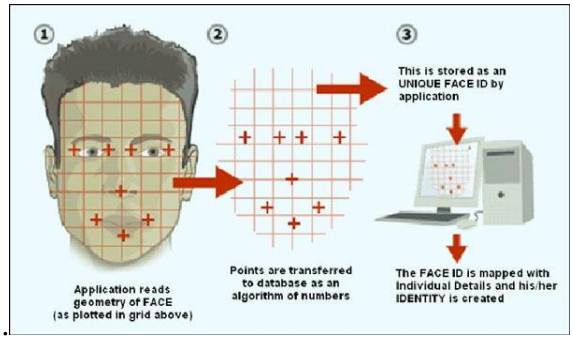

Figure1.2.Face recognition patterns [14]

A template matching process uses pixels, samples, models or textures as pattern as shown in figure.1.2 .The recognition function computes the differences between these features and the stored templates. It uses correlation or distance measures. Although the matching of 2D images was the early trend, nowadays 3D templates are more common.

In Appearances method a face is represent in terms of several raw intensity images. An image is considered as a high-dimensional vector. Then statistical techniques are usually used to derive a feature space from the image distribution. The sample image is compared to the training set.

Appearances methods can be classified as linear or non-linear; while model-based methods can be 2D or 3D [5].Linear appearances-based methods perform a linear dimension reduction. The face vectors are projected to the basis vectors, the projection coefficients are used as the feature representation of each face image. Examples of this approach are PCA, LDA or ICA. Non-linear appearances methods are more complicate. In fact, linear subspace analysis is an approximation of a nonlinear manifold. Kernel PCA (KPCA) is a method widely used [6].

In statistical approach, each image is represented in terms of d features. So, it's viewed as a point (vector) in a d-dimensional space. The dimensionality -number of coordinates needed to specify a data point- of this data is too high. Therefore, the goal is to choose and apply the right statistical tool for extraction and analysis of the underlying manifold. These tools must define the embedded face space in the image space and extract the basis functions from the face space. . Some of them are embedded into bigger systems, or they are just a part of a recognition algorithm. Many of them can be found along classification methods like a DCT embedded in a Bayesian Network or a Gabor Wavelet used with a Fuzzy Multilayer Perceptron [7].

Independent Component Analysis: Independent Component Analysis aims to transform the data as

linear combinations of statistically independent data points. Therefore, it provides independent rather that uncorrelated image representation. ICA is an alternative to PCA which provides a more powerful data representation. The ICA algorithm is performed as follows [15].

Let c_x be the covariance matrix of an image sample X. The ICA of X factorizes the covariance matrix into the following form

$$c_x = F\Delta F^T \quad \ldots.1.1$$

Where Δ is diagonal real positive and F transforms the original data into Z (X = FZ). The components of Z will be the most independent possible. To derive the ICA transformation F,

$$X = \emptyset\, Y^{\frac{1}{2}}\, U \quad \ldots1.2$$

where X and Y are derived solving the following eigen problem:

$$c_x = \emptyset\, Y^{\frac{1}{2}}\, U \quad \ldots1.3$$

Then, there are rotation operations which derive independent components minimizing mutual information. Finally, normalization is carried out.

II. LITERATURE SURVEY

Face recognition is a one of the most both challenging and important recognition technique. In this paper, author has given an introductory survey for the face recognition technology by covering issues such as the generic framework for face recognition, factors that may affect the performance of the recognizer, and several state-of-the-art face recognition algorithms[5].

Neural network based face recognition system is proposed that can recognize even with complex backgrounds, illumination and clutter. To achieve face recognition Robust PCA (Principal component analysis) and Modified RBFN are used. The complexity and dimensionality is reduced by Robust PCA and RBFN (radial basis function network) that gives better speed when compared with native neural methods, so this method gives better result in real time systems [8].

A new framework for face recognition is developed by combining two algorithms: adaptive binning and ada boost. This system is tested with a larger database and the results show better identification of face with better efficiency. The feature i.e. space and execution time of this framework is reduced drastically compared with the other face recognition systems. This new framework is experimentally verified with FERET and found that the recognition rate of the system is improved [9].A new scheme for automatic face recognition (AFR) is proposed. LDA-based feature extraction for face recognition is proposed and tested. Several results on face recognition are presented, in which highly competitive recognition accuracies are achieved with a small number of features. The feature extraction can be applied to WT representation of images to provide a multiscale discriminant framework [10].

Local Binary Patterns (LBPs) is a popular technique for face recognition. Its non-parametric kernel summarizes the local special structure of an image and it is invariant to monotonic gray-scale transformations. Here, we describe the LBP have some limitations that it is not suitable for shadow images and low contrasted images. To overcome those problems new approach is proposed of 2D principles of component analysis (2D-pca) for extracting the facial features of an image .own data bases is used for extracting the facial features [11].

A number of face databases available in the public domain and several published performance evaluation results are digested. Method is proposed for a face recognition system based on local features. Interesting feature points in the face image are located by Gabor filters, by which feature points are located at positions consisting of Gabor coefficients consisting of Gabor coefficients with high facial features [12].

A novel and efficient facial image representation technique is proposed on the bases on local binary pattern (LBP) texture features. In this method the face image is divided into several regions from which the LBP feature distributions are extracted and concatenated into an enhanced feature vector that can be used as a face descriptor [13].

Face recognition has been one of the most interesting and important research fields in the due to its need in automatic recognitions and surveillance systems, and the interest in human visual system on face recognition, and the design of human-computer interface, etc.

These researches involve know-ledge and researchers from disciplines such as neuroscience, psychology, computer vision, pattern recognition, image processing, and machine learning, etc. In this general ideas and structures of recognition are discussed with other, important issues. Results show comparison of factors of human faces, critical techniques and algorithms with conclusion [14].

III. NEURAL NETWORK AS A CLASSFIER

Neural Network is one of the most advance classifier available now these days. A neural network is consisted of three layers namely Input Layer, Hidden Layer and the Output Layer. Each Layer has its significance and work. The input layer is used to provide the input to the architecture of the neural network and the hidden layer is used to process the input architecture of the data provided. The hidden layer works with Neurons and to proceed data with neurons the data must be changed into a format which a neuron can understand. The neurons get the data in form of weights and they combine the weights with the target set and hence in such a manner the neural network is trained. The trained network is then stored in the net object and then the testing is done. The following diagram explains the architecture of the Neural Network.

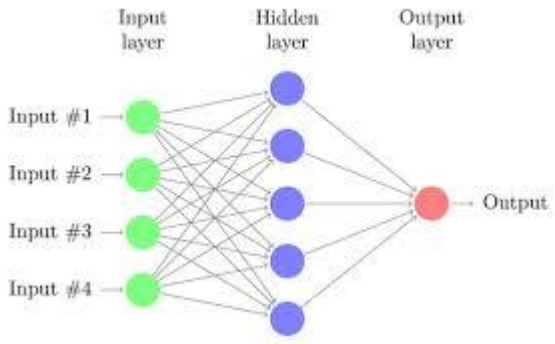

Figure no:1.3 Neural Network

The above diagram [16] refers to the explained Neural Network described as above.

The following table briefs some of the advantages and disadvantages of the techniques discussed above

CLASSIFIER	Iterative	Randomization	Artificial Intelligence	Area Impact
PCA	**1**	**1**	**0**	**1**
ICA	**1**	**1**	**0**	**1**
NEURAL	**1**	**1**	**1**	**0**

Table 1.1 representing Classifiers

The above table represents a general classification comparison based on few parameters which are explained as below.

A) Iterative: Iterative means that the classifier does not conclude the result in one shot, it takes several iterations to compute the best according to the fitness function designed to it.

B) Randomization: Almost every classifier first picks up a random variable to initialize the process of optimization or classification.

C) Artificial Intelligence: It refers to the term of dealing unknown objects or data.

D) Area Impact: Refers to weather the algorithm is bounded to a limited amount of data or not. Or Increase of data puts an impact over the processing or not.

0- FALSE
1- TRUE

The table provided following describes the accuracy of different classifiers with different data sets[17] in which the author D.T.Meva et.al has tried to sum up all the available good classifiers in the same contrast.

DB	NN	PCA	LDA	MRF
YALE	83.07	81.03	100	99.33
ORL	97.90	95.20	93.75	96.75

Table 1.2: Representing accuracies

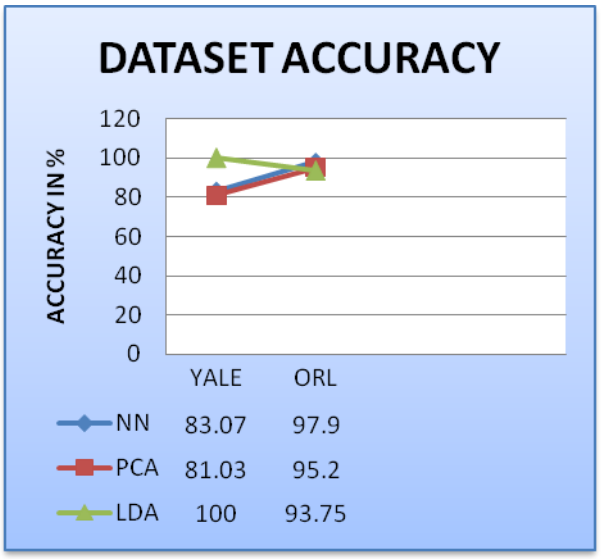

Figure no. 1.4: Dataset Accuracy

The above graph represents the results provided in the [17] attained by Dr. Meva and it proves that the

accuracy of the classifiers is not consistent, it varies from one dataset to another.

CONCULSION

In recent years face recognition has received major attention from both research communities and the market, but it is still remained very challenging in real applications. A lot of face recognition algorithms, using different feature extraction, different classifiers along with their modifications, have been developed during the past decades. This paper describes the general terms of few of the optimization or classification algorithm including ICA, PCA and NEURAL NETWORK and list out the advantages and disadvantages of the algorithms. There are a lot of other methods which could be a part of the research like SIFT algorithm, Support Vector Machines.

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