ANALYZING VARIOUS FACE RECOGNITION TECHNIQUES USING NEURAL NETWORKS

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Abstract: Face recognition is a form of biometric identification and off late it has become the most important method to recognize various people in a real time system. Recognition is a method to identify a person in a still image or in video. It became important due to its applications in many safety and security related areas such as at airports, banks for authentication. New research studies of recognition in this area in recent years is focused towards using neural network methods. Going forward in research in this area is application of Fuzzy system. In this comparative study the focus will be on neural networks, fuzzy system and neuro-Fuzzy system**.**

Index Terms **- Neural networks, face recognition, fuzzy system, Neuro-fuzzy.**

I. Introduction

Face is a physical characteristic that a person posses to identify him/her self automatically. Face recognition is a process of identifying an image by matching with the images in the database. Face Detection is the process of claiming a person as an authorized user. It's a type of one – to –one matching. Facial images may be represented as a 2D or 3D. The 3D facial images are able to identify pose variations, has no effect due lightening. The main challenges one has to encounter in face recognizing are due to facial expressions, rotation effects, noise and distortion. Sometimes recognition is complex due to ***interclass*** and ***intra class*** similarities. In the first type two persons may appear to be similar such as twins where as in the second case same person but change in poses. Face recognition can be done in four different ways. Using

Knowledge Based Approach **[1], [2], [3], [4]** encodes faces based on rules. In ***Feature Invariant*** method identifies the facial feature that doesn't change due to expressions, pose, illumination etc. Hand coded templates are stored and then used for face detection in ***Template Matching*** which is the simplest of all methods. The images are trained using different learning methods of neural networks, PCA, SVM in

Appearance Based Method. Most of the research in face recognition in the recent years is based on the last method. From [2] the steps in face recognition are acquiring the face image, pre-processing is done to remove any noise in the image. Later two sets of data are selected, one for training and one for testing the new Image. The performance of any face recognition system is determined by the parameters False Acceptance Rate(FAR) – number of times a unauthorized users are accepted, False Rejection Rate (FRR) – number of times an authorized user has been rejected, Equal Error rate(EER)- FAR and FRR equals, Time to verify, Time taken to capture.

In this study Section II consists of Face recognition methods using Neural Networks, Section III focuses on Fuzzy System. Section IV describes a combination of both approaches Neuro-Fuzzy for face detection. In section V a comparative analysis is made on the two approaches that are neural networks and fuzzy system based on parameters. Section VI concludes on the Neuro-Fuzzy system.

II. Face Recognition Using Neural Networks

2.1Back Propagation (BP)

From [4] a general back propagation network is used for face recognition. The author has proposed two algorithms for feature extraction i) View Based ii) Biometric based. Using a component based detector (CBD) the features of the face are extracted by selecting the sub images and calculating the biometric distance. The components that are selected in the face image are eyes, nose and mouth. From the sub image seven distance biometrics are calculated and normalized in terms of gray levels raging between the values 0 to 1. The resulting value is used as input to the classifier. BP uses both forward and reverse evaluation [5] to train the network and adjusting weights. The resulting training set is named as primary and secondary classifiers. During recognition if the face image doesn't matches with the primary then it matches with the secondary classifier.

2.2Self Organizing Maps (SOM)

SOM is a unsupervised learning method in neural networks which is mostly used a clustering algorithm. Maps the input space from higher dimension to low dimension. This algorithms follows the competitive learning method where the neurons compete with one another and the winning neuron is termed as the "Best Matching Unit(BMU) " which is very close to the input vector. At the end of the training phase the neurons are clustered based on the input space forming a Lattice. From [6] SOM is used to classify the face images even when there is change in facial expression. Here the author has proposed four SOM classifiers. The first SOM classifier (C1) applies to all neurons prior to testing phase. In this method there is no weight updating hence the neurons can be a winner or may be rejected or labeled a s unknown. In the second SOM classifier (C2) the class centroids are chosen for labeling as they are known before training. In this method neuron belongs to only one class. In the third SOM Classifier (C3) which is a form of supervised SOM the input vectors are classified as pattern vector and class vector. The class vectors are of unit length whose value is to "1' the others are set to "0". In the last method SOM Classifier (C4) for each class assigned one SOM.

In the testing phase winning neuron is one among all of the SOM. In [7] the author presents a form of SOM that is used for facial skin segmentation recognition after plastic surgery. The different color spaces in Image processing are RGB, CMY, HIS, YIQ, IHLS. In this method [7] the given input face image which is normally based on RGB values are converted to IHLS. This color space method is used to improve color saturation and brightness of an image. The resulting images are processed by SOM in two stages. After conversion to IHLS the SOM starts with some random initial values for weight adjustments. The 256 neurons (16*16 colors) in the input space are reduced to 5 neurons after the second stage of the SOM. Then the resulting images is post processed to obtained facial segmentation.

III. Face Recognition Using Fuzzy Method

Any image is converted into a set of integer values called "pixels". Face detection using fuzzy method can be done using two steps [8]. They are skin detection and edge detection. In the first step the given image values which are in the form of RGB values are converted to YCbCr values. Since RGB has different brightness values for Red, Green and Blue to overcome this YCbCr method is adopted. The Y component is the sum of R,G and B values, CB is obtained using B-Y, Cr is obtained using R-Y. The Cb, Cr values are used to identify if a pixel belongs to skin part or not. In the second step Fuzzy rules are applied to detect the edges of the face. A set of four pixels are chosen from a 2x2 widow size and sixteen inference rules are proposed to detect edges of the face[8]. An edge is present when there is a large difference between intensities of adjacent pixels.

In [9] fuzzy Retinex method was proposed for face image normalization. Initially the face and eye regions are detected using Adaboost algorithm. In the next step the image is normalized using Fuzzy Logic. Input to the fuzzy based normalization is the mean and standard deviation grey values of the facial image. Using the fuzzy Retinex method the global and local variations are overcome. Fuzzy membership function is derived for the input image. After normalization the face is recognized.

IV. Face Recognition Using Neuro - Fuzzy (NF) System

4.1BP and Fuzzy System

In [10] this method the input Facial image considered as image matrix. The rows that are identical are fed as input to the neural network. The number of input neurons are equal to the number of columns in data set matrix. The entire system is designed in two phases. First is the training phase and second is the recognition phase. In the first phase Back Propagation Neural Network is used for training the data sets. During training if there is any error it is feed back to adjust the weights. Once the network is converged the number of epoch and gradient is calculated. These two values are treated as input for Fuzzy Inference System (FIS). Based on the accuracy of the fuzzy membership values face recognition is done.

4.2 EigenFace and Neuro-Fuzzy System

In [11] this method Face features are extracted using Principal component Analysis (PCA) using Eigen faces. The PCA components are taken as input for the Neuro- Fuzzy System. Prior to this Fuzzification of PCA values are done. For each input and output values two membership values High and Low are derived. These values are fed as input to the BP Neural Network for Training Purpose. The hidden layer of BP takes the High and Low values as input. In the next step Genetic algorithms are used for recognition purpose.

4.3 Wavelet Gabor and Neuro-Fuzzy System

In [12] the author proposed a method of face detection using Wavelet Gabor for feature Extraction and NF system for face recognition. The features of the face are extracted by applying the Wavelet Gabor filter. NF is used to classify the input image. In this system BP is used for training purpose. The input layer is same as to that of the General BP but the hidden layer is fuzzification and rule antecedent layer. The output is rule inference layer. In the backward phase error is determined and minimized.

V. Comparison of Neural Networks and Fuzzy System

Table 1: Comparison of Neural Networks and Fuzzy System

Parameters	**Neural Networks**	**Fuzzy System**
Knowledge Representation	Implicit	Explicit
Trainability	Trains itself by learning from data sets.	No Self Training. Training must be defined Explicitly.
Computational Algorithms	Low level	Structured Frame work
Initial Parameters	Fixed well	Randomly Chosen

VI. Conclusion

This study compares three different approaches for face recognition. Using only neural networks approach sometimes the network get trapped in local minima as to that of a back propagation Network. When we adopt only Fuzzy system for face recognition biometrics learning becomes an explicit function. In order to achieve a face recognition system that is fast and self adaptive based on the inputs extracted from the face image we can combine the two systems as Neuro-Fuzzy system. From the above analysis we can say the output performance of face recognition is much better in Neuro-Fuzzy system when compared to the individual system.

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