Face Authentication using Euclidean Distance Model with PSO Algorithm

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ABSTRACT
In recent technological world lot of devices are invented. Moreover the focused topic is on security system. Even with lot of security system like finger print based, eye-retina based, pin-code based systems are available, face recognition based security system has vital role of advanced technology. Feature based Face authentication requires feature extraction, feature selection and classification. Face recognition process performance is mainly depended on the selection of such extractor and classifier. Feature extraction process gives the feature points of the face in the image. From that important fiducial points are extracted using feature selection process. One have to reduce the feature points, in order to obtain the fast response of recognition. In this work we proposed the feature extraction process with Gabor filter where it is convenient as a biometric filter. Before going to verification process face localization is important one, then only we can reduce the unnecessary feature points. This is done by Neural network classifier. After the face image is obtained, we go for the authentication process with modified Euclidean distance of each fiducial points that made coefficient model for each person. Best optimized Euclidean distance coefficient of images are obtrained through PSO algorithm. Thus the coefficient of test and trained images are given to the classifier and the minimum mean difference profile made as the matching profile. By this work, we reduced the perception time at significant level compared to previous work and we made the recognition rate of the work as 91.81 percent with PIE database.

General Terms
Pattern recognition and Authentication

Keywords
Feature Extractor, PSO-particle swarm Optimization, fiducial points, neural network classifiers..

1. INTRODUCTION
Face recognition has become a very active research area in recent years, mainly attracted by its broad applications such as in public security, human-computer interaction. There are two processes we have to consider. One is face identification, where the test image is identified with the known people in the data base[6]. The second one is whether to accept the identification of the test person. Previous research has shown that face recognition under well-controlled acquisition conditions is relatively mature and provides high recognition rates [8]. But when consider the uncontrolled conditions like face physical changes, illumination variance will affect the recognition rate of previous work [12].

Due to the large size of galleries, not only the accuracy but also the scalability of a face identification system needs to be considered. The number of database in the gallery can be quite large; hence, common search techniques such as brute force nearest neighbour, k-means nearest neighbour take more time [7]. And also in previous work for authentication, in-order to normalize the face from the image is not considered. They are only taking the face images only [11]. From the face images only they are analyzing the authentication process. Here we are introducing with automatic face detection and authentication process. In the recognition process, the feature points for verifications are the important factor.

2. FACE LOCALIZATION
2.1. Gabor filter
Gabor filter represents the band-pass linear filter whose impulse response is defined by a harmonic function multiplied by a Gaussian Envelope. Thus a bi-dimensional Gabor filter constitutes a complex sinusoidal plane of particular frequency and orientation modulated by a Gaussian envelope. It achieves an optimal resolution in both spatial and frequency domains. The 2D odd-symmetric Gabor filter for the image has the given form:

$$G_{\theta_k, f_i, \sigma_{x,\sigma_y}}(x,y) = exp\left(-\left[\left(\frac{x_{\theta_k}^2}{\sigma_x^2} + \frac{y_{\theta_k}^2}{\sigma_y^2}\right]\right).\cos\left(2\pi f_i \; x_{\theta_k} + \varphi\right)\right)$$

Where $x_{\theta_i} = x\cos\theta_k + y\sin\theta_k$, it defines the spatial orientations $y_{\theta_i} = y\cos\theta_k - x\sin\theta_k$, f provides the central frequency of the sinusoidal plane wave at an angle θ_k with the x-axis and σ_x and σ_y represent the standard deviations of the Gaussian envelope along the two axes x and y. We set the phase $\varphi = \pi/2$ and compute each orientation as $\theta_k = \frac{k\pi}{n}$ where k= {1,…..n}.The 2D filters represent a group of wavelets which optimally captures both local orientation and frequency information from a digital image. Each face image is filtered with various orientation, frequencies and standard deviations [13].

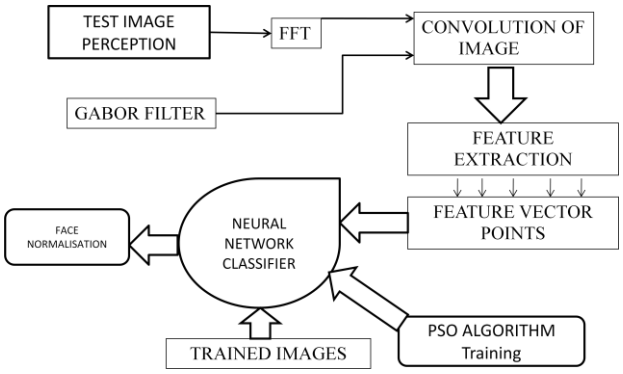


Fig 1: Overall view of this work for Face Normalization

The parameter design of Gabor filters are $\sigma_x = 2, \sigma_y = 1, f_i \in \{0.75,1.5\}$ and n=5. Where it means 8 orientations and 5 scales give 40 Gabor filters. The result of Gabor filter images is shown below in fig.2.

Fig 2:a) Gabor filtered image
b) Normal gray scale image

2.2. Neural Network

It is an information processing paradigm that is inspired by the way biological nervous system. It is configured for a specific application through a specific learning process. The most commonly used family of neural networks for pattern classification tasks is the feed-forward network, which observes multilayer perceptron and Radial basis networks. The general idea is to use gradient descent to update the weights to minimize the squared error between the network output values and the target output values. The update rules are declared and defined by taking the partial derivative to the error. Then, each weight is adjusted. The Multi-layer perception is used to classify the faces and non-faces region in the images [11]. It has feed forward architecture within input layer, a hidden layer and an output layer. We can get a pictured view in figure 2.2. Here feed forward neural network is designed with one hundred neurons in the hidden layer and one neuron in the output layer. For training, all data of face and non-faces regions are used from the database where the training is optimized using PSO for the assignment of weights. Before going to the normalization process, we made the adjustment on the histogram on the image in order to obtain better contrast. Then the image is converted to FFT and it convolved with Gabor filters in frequency domain. The high intensity feature vectors are to be extracted. To do that all the feature vector points are given to the neural network where it analyze the face region and non-face regions by the threshold range. When the threshold level is made as continuous one, then network recognized the face region and made the prescribed boundary on the face region. For the localization process the boundary regions are cropped and made for the verification process.

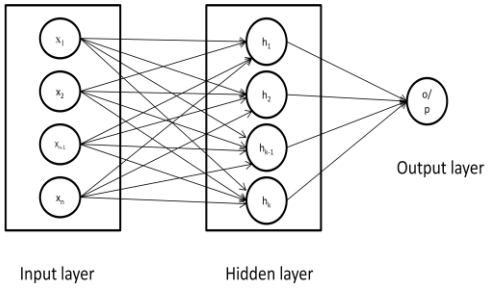


Fig 3: Neural network architecture

The localization of face and its cropped face is shown in the fig 4. This level of process taken as the face localization process and the further process is authentication process where we should need the reduced points of face image instead of all points on the image.

Fig 4: a) Face recognized from the image
b) Cropped face image

3. MODIFIED EUCLIDEAN DISTANCE WITH PSO ALGORITHM

In previous work, the Euclidean distance are used for the analysis of inter classification of images. Here the Euclidean distances are taken as the fiducial points for the image and it is given to the neural network classifier. Before going to feed, the best optimized value of the fiducial points has to be taken. For that we use edge detection, in order to get the reduced fiducial points. For that we can use various techniques, here in fig.5. shows the edge detection using various algorithms.

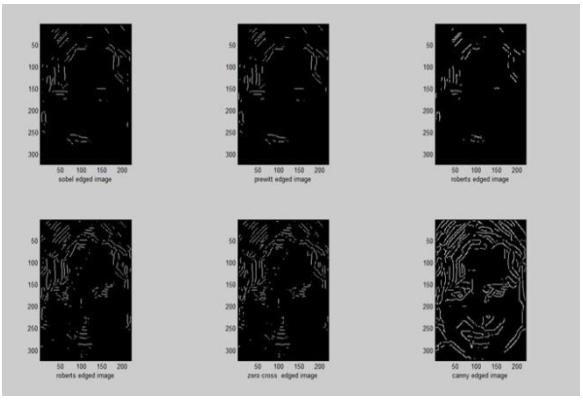


Fig 5: Edge Detection a) Sobel b) Perwitt c) Roberts d) Log based e) Zero cross f)canny

In that *canny* algorithm give much needed edge points of the image. Then each fiducial point is feed for the Euclidean distance of intra points. In order to get the optimized distance of fiducial points we used PSO algorithm distance of fiducial points we used PSO algorithm. The overall view of the classification is shown in fig.6.

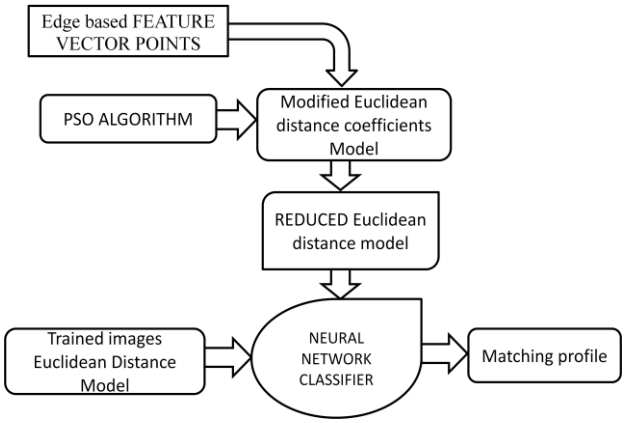


Fig 6:.Block diagram of Face Authentication

Particle swarm optimization algorithm is a recent powerful method for optimization purpose where it is based on the bird feed search method. Using this PSO each fiducial points have its personal best value of Euclidean distance. The process is shown in fig 7. For the authentication process, the trained person databases are given to the neural network as targets and the test person vectors are given as inputs. When reduced error is attained with the satisfaction of threshold level then the profile is made as matched profile.

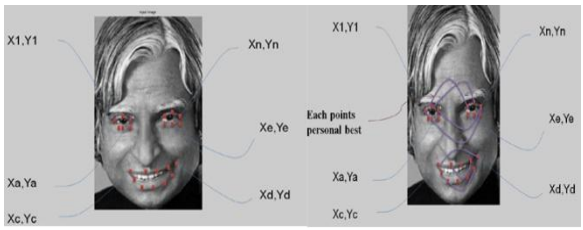


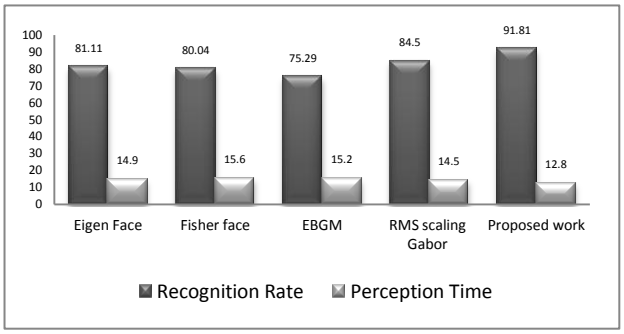
Fig 7: Personal best values of fiducial points using PSO algorithm

4. EXPERIMENTAL RESULTS WITH PIE DATA BASE

The PIE database contains images with major variations, including changes in illumination, subjects wearing classes and different facial expressions. The database involves 300 frontal face images with 10 images of 100 individuals. The size of each image is 250x250 with 256 gray levels. To decrease perception time and simultaneously guarantee better sophisticated resolution, each image is scaled to an image size of 60x80. We take the first ten images of each person as the training samples and remaining part as the test samples. The PIE database training and test samples are taken as70 and 230. A comparison is made based on the classification performance with recognition rate and perception time of all the methods is provided in table 1.

Our approach obtains the highest recognition rate. The best improvements in the recognition rate of our approach with reduced perception time over those of Eigen-face, Fisher-face and EBGM. The recognition rates of these methods are 81.11%, 80.08% and 75.29%. When we introduce our approach in this database we obtained reduced training time with highest recognition rate of 91.81%.

Table.1. Comparison of classification performance using the PIE database



5. CONCLUSION

The experimental results show that our approach made a high recognition rate with reduced perception time. Further process of reduced database for authentication is to be used with modified coefficient model with large feature extracted points. But at the same time we have to increase the recognition rate with reduced perception time. Then the best optimized system is to be implemented in virtexpro processor for analysis the performance in real world environment.

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