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DWT-Neural Network based Gender Classification

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Abstract – **Fingerprint recognition plays an important role in the biometric identification of humans. Fingerprint recognition has many applications. It has been used for decades in civilian applications, in criminal investigation, and other applications. In this paper, recognition of male-female fingerprints using neural network (NN) is considered. Using Discrete Wavelet Transform (DWT) the directional images of fingerprints are obtained. The DWT achieves effective low frequency filtering, reducing the noise effects in male-female fingerprint images. Then the feed-forward back-propagation neural network is applied for male-female fingerprint recognition. The fingerprint database is constructed and used to train a neural network. Simulation of the male-female fingerprint recognition system is carried out using MATLAB. The neural network is used to train and identify fingerprints.**

Keywords – **Discrete Wavelet Transform, Feed-Forward Back-Propagation Neural Network.**

I. INTRODUCTION

Biometric identification technique is based on the main physical characteristic that lends itself to biometric identification [1]. Fingerprint biometric performs better as compared to other available traits due to its accuracy, reliability and simplicity. The main reason behind the use of fingerprint biometric is that it is the most proven technique to identify the individual. The fingerprint is basically the combination of ridges and valleys on the surface of the finger [6]. It has a texture that is unique even to genetically identical twins. The gender of the person can be judged using the fingerprint of that concern person based upon the count of the ridges of the fingerprint. The average ridge count is slightly higher in males than in females, with high standard deviation among subjects of both genders [7].

It is believed that fingerprint is unique to individuals. They remain unchanged throughout at least a certain period during the adult life of an individual. Fingerprints possess all of the following properties:

- ***Universality***, which means the characteristic should be present in all individuals.
- ***Uniqueness***, as the characteristic has to be unique to each individual [2].
- ***Permanence:*** its resistance to aging.
- ***Measurability:*** how easy is to acquire image or signal from the individual.
- ***Performance:*** how good it is at recognizing and identifying individuals.
- ***Acceptability:*** the population must be willing to provide the characteristic.
- ***Circumvention:*** how easily can it be forged?

For instance, iris based methods, which are the most reliable, require more expensive acquisition systems than fingerprint recognition systems. Face and voice characteristics are easier to acquire than fingerprints, but they are not so reliable. Overall, fingerprint recognition based systems are well balanced in terms of cost and performance [3].

The main aim of this paper is to develop male-female fingerprint recognition system using 5 level Haar Discrete Wavelet Transform (DWT) and back-propagation neural network. The database for this research work contains fingerprint images of 60 persons with 30 males and 30 females. The fingerprint image goes through the process and the feature vectors are stored in the database and is used for classification.

II. FINGERPRINT RECOGNITION

A smoothly flowing pattern formed by alternating crests (ridges) and troughs (valleys) on the palmar aspect of hand is called a palmprint [10]. Formation of a palmprint depends on the initial conditions of the embryonic mesoderm from which they develop [5]. The pattern on pulp of each terminal phalanx is considered as an individual pattern and is commonly referred to as a fingerprint.

The common architecture of a fingerprint-based automatic identity authentication system is shown in Figure 1. It consists of four components:

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(I) user interface, (II) system database, (III) enrollment module, and (VI) authentication module. The user interface provides mechanisms for a user to indicate his/her identity and input his/her fingerprints into the system. The system database consists of a collection of records, each of which corresponds to an authorized person that has access to the system. Each record contains the following fields which are used for authentication purpose: (I) user name of the person, (II) minutiae templates of the person's fingerprint, and (III) other information (e.g., specific user privileges) [4].

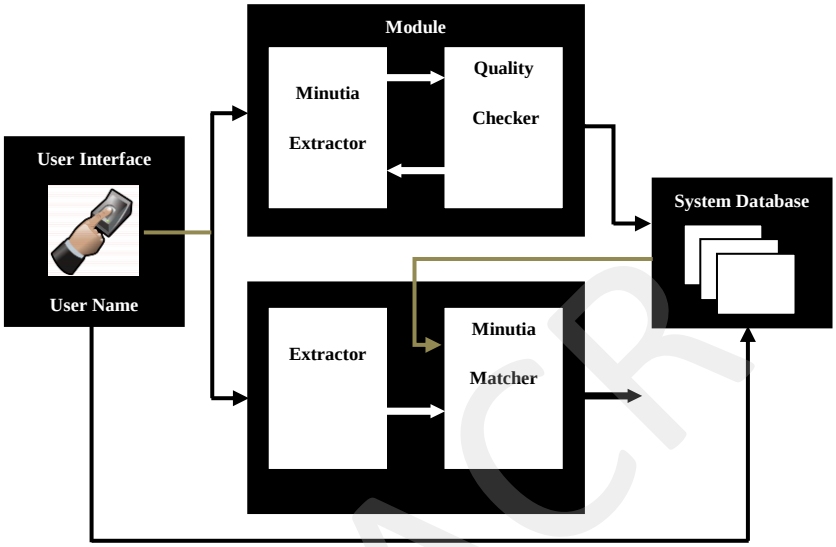

Figure 1: Architecture of an automatic identity authentication system [4]

III. METHODOLOGY

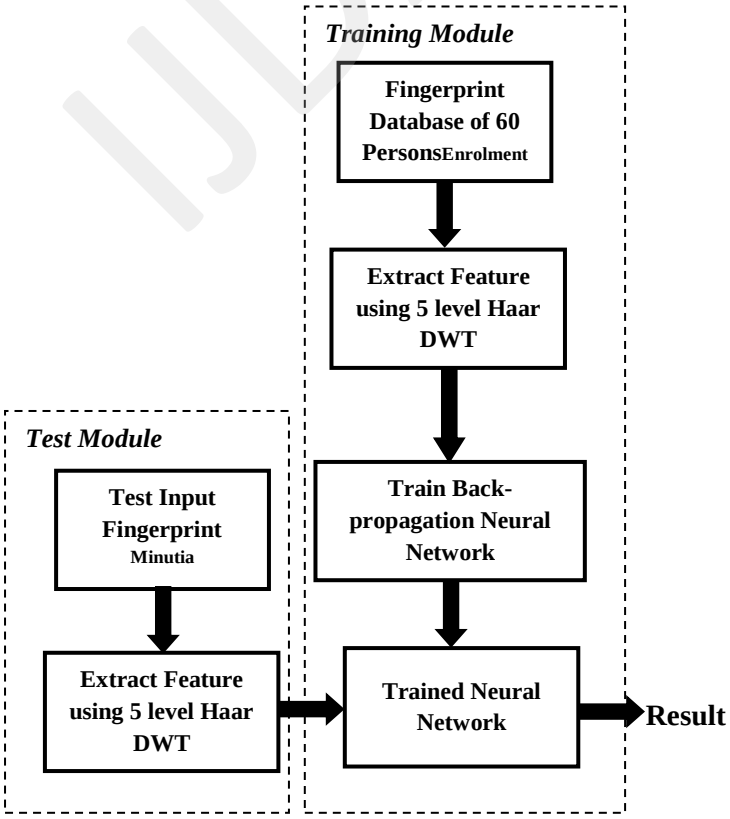

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Figure 2: Block diagram of proposed work

Figure 2 shows the basic block diagram for proposed fingerprint recognition system. It consists of two modules; training and test. A database of 60 persons with 30 males and 30 females is considered for training and experimentation. For every single individual two images are acquired for implementation of 5-level HAAR DWT algorithm. The DWT process at this stage for every individual furnish 4 bands; approximation, horizontal, vertical and diagonal. Approximation band consumes most of the energy. The energy calculated by virtue of individual images constructs an energy vector (16×1) that is introduced as inputs of back propagation neural network. This pseudo code is termed as Training Phase.

The input image assigned for the tests are processed with 5-level HAAR DWT algorithm. Output result is stored for the next step where the band energy is calculated for each image. This band energy is classified in a vector of 16×1 matrix and this is then forwarded to Neural Network. The optimization algorithm based on the iterative process of classification differentiates the individual into a specific category of male and female.

Neural network finds the high energy band according to feature vector of 16×1. Since the ridge count is higher in the fingerprint of male as compared to the fingerprint of female. So, if the band shows high energy then it recognized as a male fingerprint and if the band shows low energy then it will be recognized as a female fingerprint.

IV. SIMULATION AND RESULTS

Simulation is carried out using MATLAB 2010a:

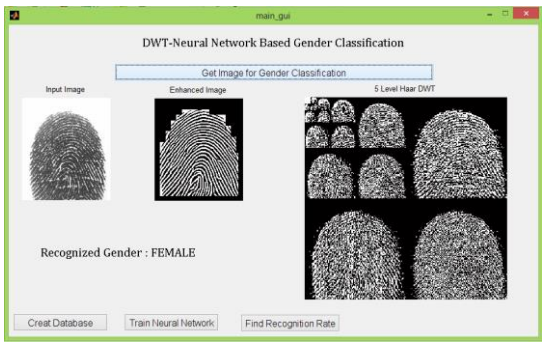

Figure 3: Case 1 - when a female fingerprint given for classification

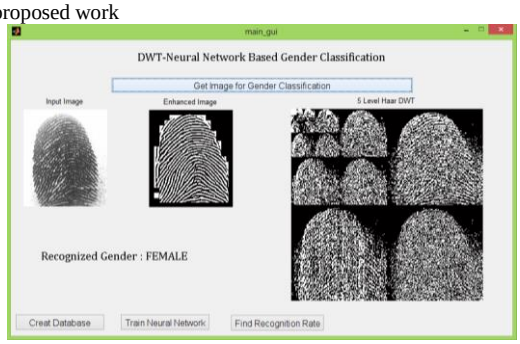

Figure 4: case 2 - when a female fingerprint given for classification

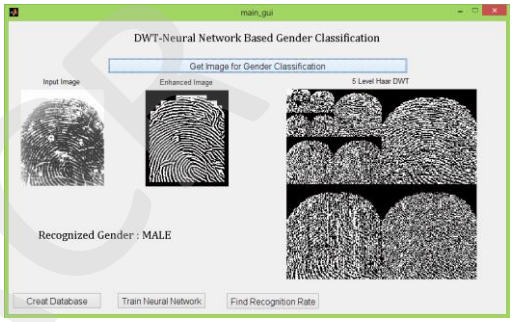

Figure 5: Case 3 - when a male fingerprint given for classification

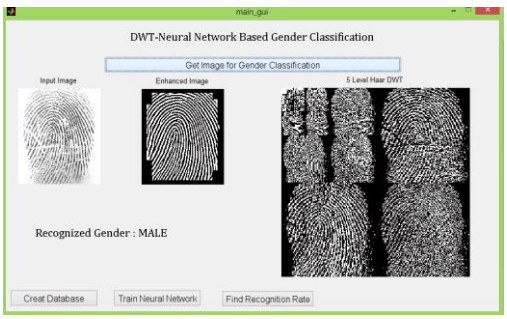

Figure 6: Case 4 - when a male fingerprint given for classification

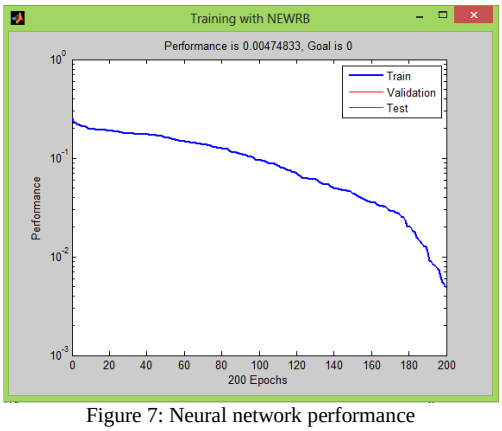

Figure 7: Neural network performance

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V. CONCLUSION

Some of the important characteristics of the biometric recognition system are their speed and accuracy. For improvement these characteristic different methodologies are applied. One of the technologies that can be efficiently used for biometric system recognition is neural networks. This paper shows the gender classification based on the fingerprint recognition using 5-level Haar Discrete Wavelet Transform (DWT) and Neural Networks. The development of gender classification based on fingerprint recognition system has been carried out using MATLAB 2010a. Success rate of classification over 300 images of database was 91.3%.

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