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An Efficient Iris Recognition System using DCT Transform based on Feed Forward Neural Networks

Author: Amrata Gupta[1], Mr. Sachin Mahajan[2]

PG Scholar, CSE Department, Jawaharlal Institute of Technology, Borawan (M.P.)[1],

HOD of IT Department, Jawaharlal Institute of Technology, Borawan (M.P.)[2]

E-mail: 03amrata@gmail.com[1], er_sachin1980@yahoo.com[2]

ABSTRACT

Iris recognition has been done by many researchers in last decade. Iris recognition plays an important role to improve efficiency in biometric identification due to its reliability in highly secured areas. In this paper, we describe the techniques we developed to create an Iris Recognition System, in addition to an analysis of our results. . We used Circular Hough Transform, to detect the iris boundaries in the eye's digital image. We then applied the DCT technique in order to extract the deterministic patterns, feed forward Neural Network (NN) is used for the classification of iris patterns, we determine finally whether two irises are similar. Our results show that our system is quite effective.

Keywords

Iris recognition, feed forward Neural Network, ANN, DCT.

1. INTRODUCTION

Biometrics refers to the automatic identification of a person based on his or her physiological or behavioral characteristics[1].

Now days, security is one of the important factor in the field of information technology, business, e-commerce, military and etc. For this reason Personal identification has become very important some methods of identification are used such as PIN, Password, ID card, Signatures that are widely used and have some draw backs. ID card or PIN can be stolen or forgotten and signatures can be limited. Most of the Companies started to use biometric authentication to protect high confidential assets. Iris detection is one of the most accurate and secure means of biometric identification[2].

Iris has many properties which make it ideal biometric recognition. The iris is a thin circular structure in the eye. Iris region is the part between the pupil and the white sclera. The human iris is not changeable and is stable. From one year of age until death, the patterns of the iris are relatively constant over a person's lifetime. Its high uniqueness and stability makes it a good biometrics that can be used for identifying individuals. Iris not only differs between identical twins but also from left to right eye. Iris begins to form in the third month of gestation and the structures creating its pattern are largely complete by the eight month. Compare iris biometric from Other biometric technologies, such as face, speech and finger recognition, iris recognition can easily be considered as the most reliable form of biometric technology. We can classify the Biometric techniques into classes:

1.Physiological based techniques

2. Behavior based techniques

Some common physical characteristics that may be used for identification include fingerprints, palm prints, hand geometry, retinal scan, vascular patterns, DNA and iris patterns. Behavioral characteristics includes signature, voice pattern, walking style & keystroke dynamics. These biometric systems are universal, unique[3].

Biometric system can be either an 'identification' system or a 'verification' (authentication) system, which are defined below.

Identification - One to Many: Biometrics can be used to determine a person's identity even without his knowledge or consent. For example, scanning a crowd with a camera and using face recognition technology, one can determine matches against a known database.

Verification - One to One: Biometrics can also be used to verify a person's identity. For example, one can grant physical access to a secure area in a building by using finger scans or can grant access to a bank account at an ATM by using retinal scan[2].The various application using biometrics are passports, driving licenses, banking, Premises access control (home, office, laboratory), Secure Financial Transactions (electronic commerce, banking),Internet Security etc.

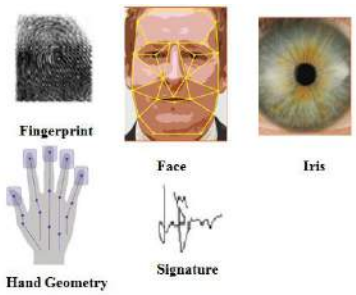


Figure 1:Biometric Example

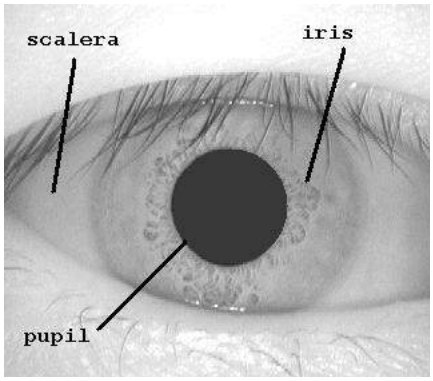


Figure 2: A front view of the Human Iris

2. Literature Review

The major investigation on iris recognition has been started in the last decade. Iris recognition is becoming an active area of research in biometrics due to its high reliability for personal identification. A variety of techniques have been developed for iris localization. According to C. H. Daouk et. al. used a Canny Edge Detection scheme and a Circular Hough Transform to detect the iris boundaries in the eye's digital image. We then applied the Haar wavelet in order to extract the deterministic patterns in a person's iris in the form of a feature vector. By comparing the quantized vectors using the Hamming Distance operator[7]

According to Rahib H.Abiyev et. al. proposed a new Iris Recognition system based on Neural Network. Neural Network (NN) is used for the classification of iris patterns. Advantage of these method iris segmentation is performed in short time[8].

According to R.Meenakshi Sundaram et. al. The first step consists of iris localization using Circular Hough transform (CHT) . In the subsequent step, image is normalized into a fixed dimension by Daugman's Rubber Sheet model. Then normalized image is decomposed by 2-D Haar wavelet and textural features are extracted. Finally, for the matching purposes probabilistic neural network (PNN) is used[9].

3.Steps Involve In Iris Recognition

The proposed iris recognition system is obtained from three major steps as follows:

a)Preprocessing includes image Acquisition, image iris localization, iris normalization, iris de-noising and enhancement.
b) Iris feature extraction.
c) Iris feature classification

3.1 Image Acquisition

Iris recognition system works by first capturing a digital color image of the eye. It deals with capturing a high quality image of the iris. Images with sufficient resolution and sharpness are obtained. Usually the camera is placed in a distance of not more than 3 feet from the eye.

Figure 3: Image Acquisition

3.2 Iris Localization

It is the detection of the iris area between pupil and sclera. So we need to detect the upper and lower boundaries of the iris and determine its inner and outer circles. Iris localization is used to separate out the iris part from the eye image. This step is to detect the inner (iris/pupil) boundary and the outer (iris/sclera) boundary in the original image**.** The first stage of iris recognition is to isolate the actual iris region in a digital eye image. The iris region is approximated by two circles, one by the iris-sclera boundary and another, interior to the first, by the iris-pupil boundary. In Iris Localization step we calculate the centre coordinates and radius of the pupil and the iris[4].

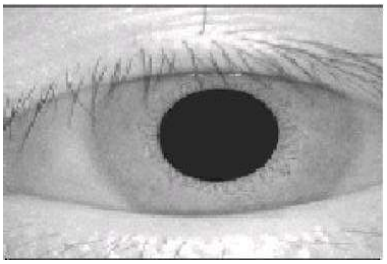


Figure 4: Iris Image

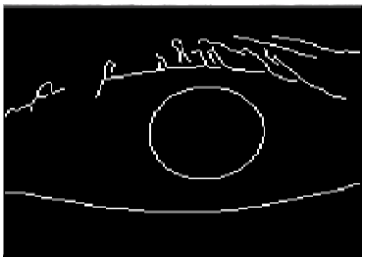


Figure5: Edges using Canny Method

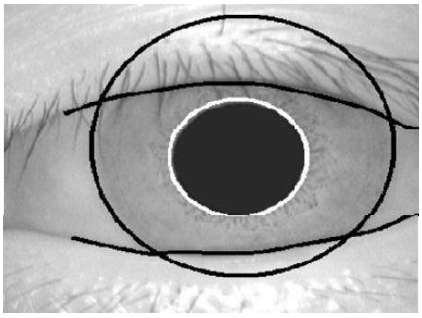


Figure 6: Original image after inner and Outer edges of iris determined

3.3 Iris Normalization

The irises captured from the different people have different sizes. The size of the irises from the same eye may change due to illumination variations, distance from the camera, or other factors. At the same time, the iris and the pupil are non concentric. These factors may affect the result of iris matching. In order to avoid these factors and achieve more accurate recognition, the normalization of iris images is implemented. In normalization, the iris circular region is transformed to a rectangular region with a fixed size[5].

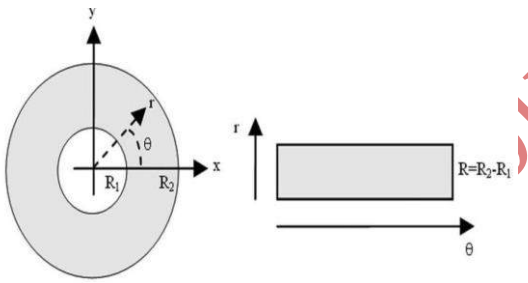


Fig.7 Daugman's Rubber Sheet Model

3.4 Iris De-Noising And Enhancement

Due to the effect of imaging conditions and situations of light sources, the normalized iris image does not have an appropriate quality. These disturbances may affect the performance of feature extraction and matching processes.The noise results while normalization process and while capturing the image some light illusion results were removed during enhancement. To extract the iris pattern it is necessary one to enhance the image[6].

4.Proposed System

The aim of work is to develop an Iris Recognition System that uses the concept of Neural network to minimize the computation time, False Reject Rate and False Accept Rate.

Experimental results on the WVU iris databases indicate the efficacy of the proposed technique.

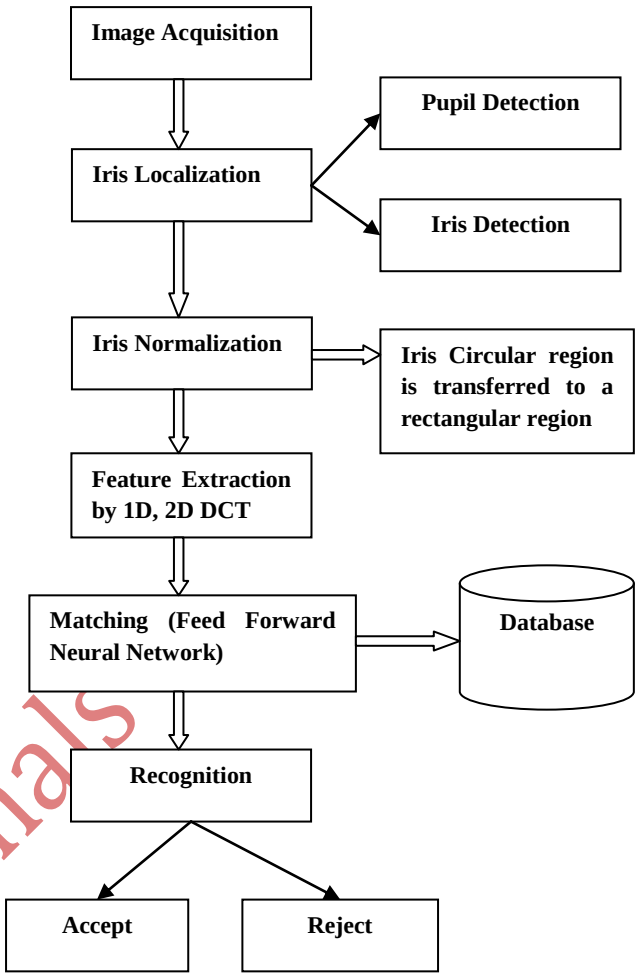


Figure 8: Proposed Model of Iris Recognition System

4.1Iris Image Dataset

There are many iris image database. such as BATH Database, UBIRIS Database, CASIA Database(Chinese Academy of Sciences), ICE Database(Iris Challenge Evaluation), MMU Database (Multimedia University) etc. We used WVU (West Virginia University) Database in our project.

After studying the various types of iris databases, we concluded that none of them was suitable for the evaluation of robust iris recognition methods, those where noise identification and handling assumes higher relevance. Based on this, we decided to build a new public and freely available iris images database - WVU [10] Images of the WVU database were captured with less constraining imaging conditions and, due to this, incorporate several types of noise, such as iris obstructions, poor focused and off-angle iris images..WVU database is comprised of 60 images.

4.2 Iris Localization

It is the detection of the iris area between pupil and sclera. So we need to detect the upper and lower boundaries of the iris and determine its inner and

outer circles. In our project we use circular Hough transform with canny edge detector method for Localization .

4.3 Iris Normalization

In normalization, the iris circular region is transformed to a rectangular region with a fixed size. In our project we use Daugman's Rubber Sheet Model for Normalization.

5.DCT For Feature Extraction

Feature extraction is a special form of dimensionality reduction and contains more information about the original image. Features are extracted, using the normalized iris image. The most discriminating information in an iris pattern must be extracted. Only the significant features of the iris must be encoded so that comparisons between templates can be made conveniently and correctly. The DCT is a real valued transform, which calculates a truncated Chebyshev series possessing well-known minimax properties and can be implemented using the Discrete Fourier Transform (DFT). The DCT is widely used for data compression[11].

The One-Dimensional DCT

The most common DCT definition of a 1-D sequence of length N is

$$C(u)=\alpha(u)\sum_{x=0}^{N-1} f(x)\cos\left[\frac{\pi(2x+1)u}{2N}\right]$$

The Two-Dimensional DCT

The 2-D DCT is a direct extension of the 1-D case and is given by

$$C(u,v)=\alpha(u)\alpha(v)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} f(x,y)\cos\left[\frac{\pi(2x+1)u}{2N}\right]\cos\left[\frac{\pi(2y+1)v}{2N}\right]$$

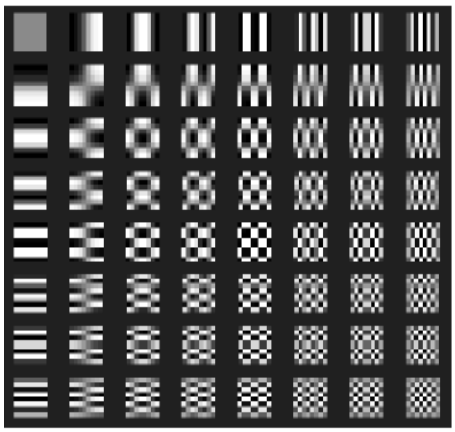


Figure 9: Two dimensional DCT basis functions (N = 8). Neutral gray represents zero, white represents positive amplitudes, and black represents negative amplitude

6.Classification Method

The last module of an iris recognition system is used for matching two iris templates. Its purpose is to measure how similar or different templates are and to decide whether or not they belong to the same individual or not. The test of matching is implemented by the feed forward neural network applied to the encode feature vector of any two iris patterns.

Feed forward neural network has been used for for iris feature classification. Feed-forward neural networks (FNN) are one of the popular structures among artificial neural networks. In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes. There are 3 layers in feed Forward Neural Network.

1.Input Layers
2.Hidden layers
3.Output Layers

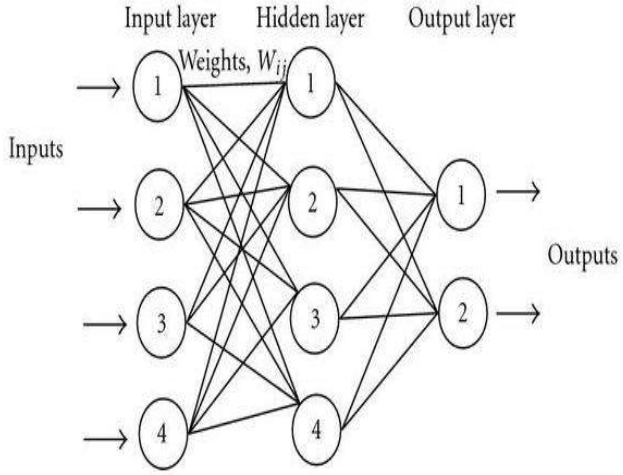
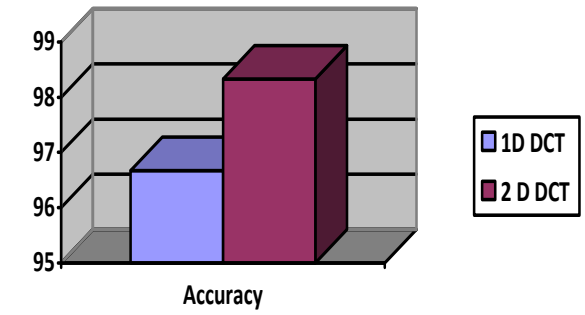


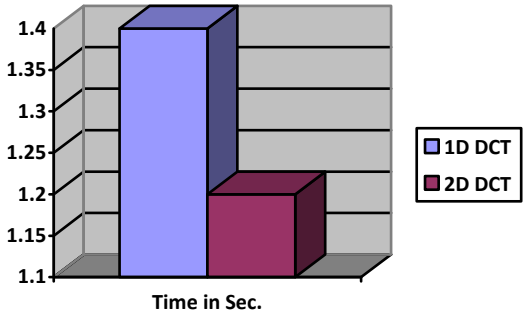
Figure 10: Multi Layer Feed Forward Neural Network Classifier performs its function in two phases; Training and Testing. After pre-processing and Feature Extraction process, Training is performed by considering the feature vectors which are stored in the form of matrices. Result of training is used for testing the numerals.

7.Experiment Result

The matching performance of our segmentation algorithm was evaluated on the WVU non-ideal iris image datasets.

Methodology	Accuracy Rate	Average time
1D DCT with NN	96.67%	1.4s
2D DCT with NN	98.33%	1.2s





8.Conclusion And Future Work

The most robust way was considered iris identification to identify different human. The iris recognition system that was developed proved to be a highly accurate and efficient system that can be used for biometric identification. A biometric system based on Iris using Neural Network was presented. The Iris localization method proposed uses circular Hough transform only for pupil circle detection. Iris Normalization uses Daugman's Rubber Sheet Model and feature extracted by Discrete Cosine Transform. The application of iris recognition system has been seen in various areas of life such as Airport, crime detection, Business application, Banks and Industries.

In future, two or more classifiers can be combined to achieve better results New challenges to the recognition that must be overcome, and predictably demand the adjustment of some of our methods to these new constraints. Reducing the feature dimension. Reducing the noise of images in Iris. Reducing the time complexity.

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