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Development of Iris Biometric System Using Gaussian Filter and Gabor Wavelet Feature Extraction Technique

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Abstract: Current scenario of Iris recognition technology is being used in banks and financial organizations, replacing the time taking, pin based, and password based systems. The use of iris recognition is expected to improve standards of financial services as the bankers will become free from time consuming document processing for identity proofs.The iris biometric system overcome the problem like Iris are different for even identical twins, Iris has more than 266 degrees of freedom and damage or scratches is there in case of other biometric traits such as fingerprints but iris is well protected behind the eyelid, cornea and aqueous humor which make it very less susceptible to damage. This paper present the work on iris recognition system.MMU Standard Iris database used for experimental purpose.Two feature extraction technique we have tested like Gaussian filter and Gabor wavelet but for matching process use Gabor wavelet feature, Hamming Distance and the system find out recognition accuracy is 96.04%.The FAR is 0.3% and the FRR is 0.1%.All experiment carried out in MATLAB.

Keywords: Iris, Feature, Gaussian filter, Gabor wavelet, Database, Hamming distance

I. INTRODUCTION

Biometrics technology verifies or identified a person based on physical or behavioral characteristics a Biometric system uses hardware to compute the Biometric information and software maintain and manage it. In the real of computer security, biometrics refers to authentication techniques that rely on measurable physiological and individual characteristics that can be automatically verified. In other words, we all have unique personal attributes that can be used for distinctive identification purposes, although the field of Biometrics is still in its infancy, security [1]. Iris recognition is the process of recognizing a person by analyzing the random pattern of Iris.

1.1.Human Iris

Iris is the colored ring that surrounds the pupil .It is a protected internal organ of the eye behind the cornea. The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. The function of the iris is to control the amount of light entering through the pupil, and this is done by the sphincter and the dilator muscles, which adjust the size of the pupil. The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter [2].The iris consists of a number of layers; the lowest is the epithelium layer, which contains dense pigmentation cells. The stromal layer lies above the epithelium layer, and contains blood vessels, pigment cells and the two iris muscles. The density of stromal pigmentation determines the color of the iris. The externally visible surface of the multi-layered iris contains two zones, which often differ in color. An outer cilliary zone and an inner pupilary zone, and these two zones are divided by the collarette–which appears as a zigzag pattern. Formation of the iris begins during the third month of embryonic life.The unique pattern on the surface of the iris is formed during the first year of life, and pigmentation of the stoma takes place for the first few years. Formation of the unique patterns of the iris is random and not related to any genetic factors [3]. The only characteristic that is dependent on genetics is the pigmentation of the iris, which determines its color. Due to the epigenetic nature of iris patterns, the two eyes of an individual contain completely independent iris patterns, and identical twins possess uncorrelated iris patterns.

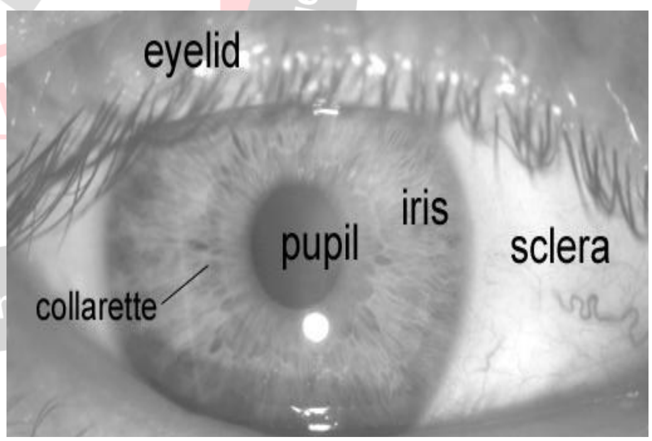


Fig.1 Human Iris & Iris Recognition Model

II. METHODOLOGY

2.1. Algorithm:

Preprocessing and localization process Dousman's Integro-differential Operator use the sequence of the Algorithm procedure is shown in flowing diagram.

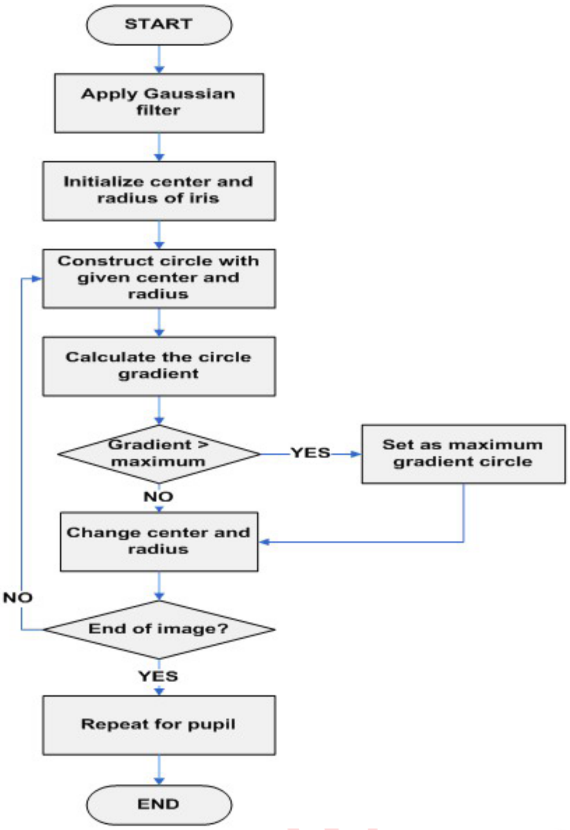


Fig.2. Optimized Daugman's localization algorithm operation.

III. EXPERIMENT

All experiment carried out in MATLAB the main Graphical User Interface shown in following Diagram.

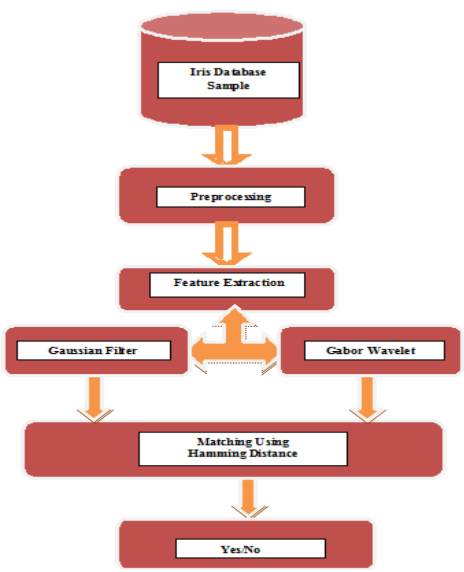


Fig.3. Proposed Model of Iris Recognition System

This work focus on Iris recognition experiment and model use for experimental purpose.

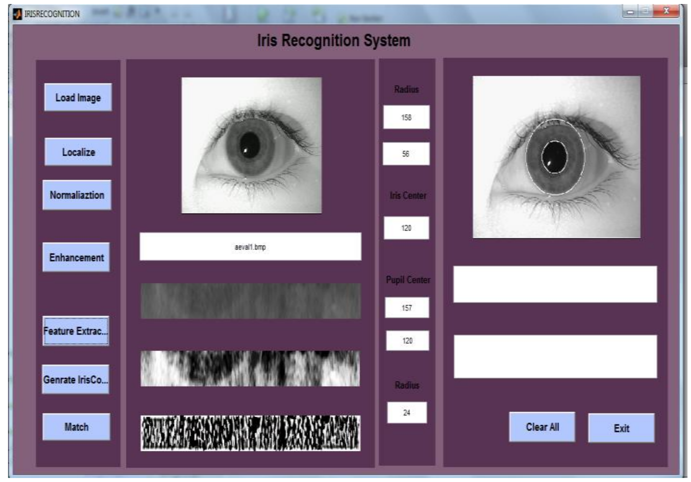


Fig.4. GUI Iris Recognition System

3.1. Database

For experimental work use MMU (Multimedia University) Database. MMU iris database contributes a total number of 450 iris images which were taken using LG IrisAccess®2200.The camera is semi-automated and it operates at the range of 7-25 cm. On the other hand, MMU1 iris database consists of 995 iris images. The iris images are collected using Panasonic BM-ET100US Authentication and its operating range is even farther with a distance of 47-53 cm away from the user. These iris images are contributed by 100 volunteers with different age and nationality. They come from Asia, Middle East, Africa and Europe. Each of them contributes 5 iris images for each eye. There are 5 left eye iris images which are excluded from the database due to cataract disease.

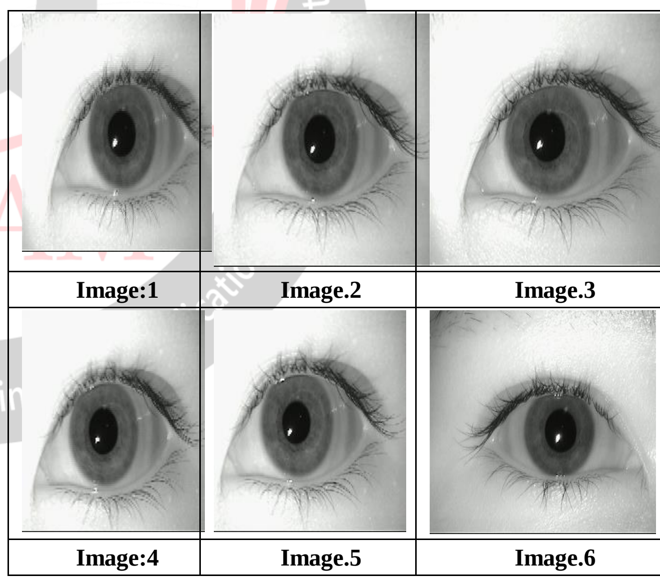


Fig5.MMU Database Sample Images.

IV. FEATURE EXTRACTION

4.1. Gaussian filter:

In electronics and signal processing, a Gaussian filter is a filter whose impulse response is a Gaussian function. Gaussian filters are designed to give no overshoot to a step function input while minimizing the rise and fall time. This behavior is closely connected to the fact that the Gaussian filter has the minimum possible group delay[4]. Mathematically, Gaussian filter modifies the input signal by convolution with a Gaussian function; this transformation is also known as the Weirestrass transform.

4.2. Laplacian filter:

The Laplacian filter is used for detection of edges in an image. It high lights areas in which intensity changes rapidly producing a picture of all he edges in an image. The Laplacian filter is a standard Laplacian of Gaussian convolution. This is a second derivative function designed to measure changes in intensity without being overly sensitive to noise [5]. The function produces a peak at the start of the change in intensity and then at the end of the change. Because the Laplacian of Gaussian produces a fairly wide convolution for a small radius this filter can become quite computationally expensive as radius is increased.

Fig.6. Laplacian Filter

Fig.7.Image Feature extraction

4.3. Gabor wavelet

The following figure shows iris localization by using Hough man transform and normalization by using rubber sheet model and Feature Extraction by using Gabor wavelet.

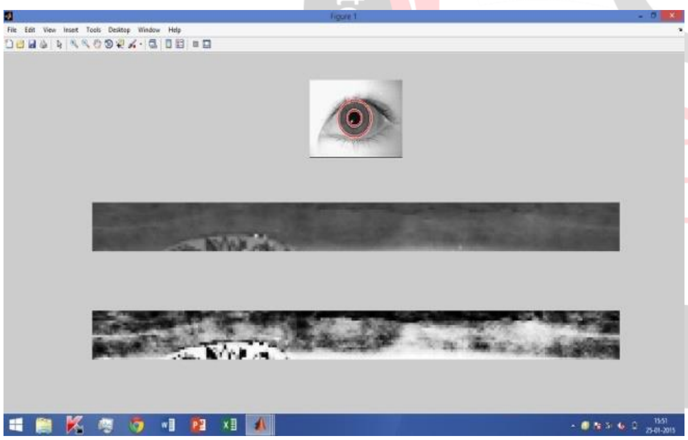


Fig.8.Gabor wavelet Feature Extraction

V. MATCHING

5.1. Euclidean Distance

Euclidean distance is the distance between two points in Euclidean space. 300 B.C.E. to study the relationships between angles and distances. This system of geometry is still in use today and is the one that high school students study most often. Euclidean geometry specifically applies to spaces of two and three dimensions [6]. However, it can easily be generalized to higher order dimensions. Compute the Euclidean distance for one dimension. The distance between two points in one dimension is simply the absolute value of the difference between their coordinates. Mathematically, this is shown as |p1 - q1| where p1 is the first coordinate of the first point and q1 is the first coordinate of the second point. We use the absolute value of this difference since distance is normally considered to have only a non-negative value[7]. The Euclidean distance is one way of defining the closeness of match between two iris feature templates. It is calculated by measuring the norm between two vectors.

$$D = Sqrt\{ (X2-X1)^2 + (Y2-Y1)^2\}$$

5.2..Hamming Distance

Hamming distance was originally conceived for detection and correction of errors in digital communication It is simply defined as the number of bits that are different between two bit vectors. In the context of prioritized model checking, the minimum Hamming distance between the state being explored and the set of error states is used as an evaluation function to guide the search [8].The intuition is that those states that have a lower Hamming distance to the largest Enlarged target are explored first. Hopefully, the states with very few bits differing from the enlarged target will require very few cycles to reach that target [9]. While the distance in the state graph between a state and the largest enlarged error target is not necessarily correlated to their Hamming distance, when the state has reached an enlarged target, the Hamming distance is zero. Consequently, Hamming distance can be valuable although crude evaluation function.

5.3. Calculation for FAR, FRR and Total Success Rate.

The FAR stands for False Acceptance Rate (FAR)[10].The FAR is the frequency that a non authorized person is accepted as authorized Because a false acceptance can often lead to damages, FAR is generally a security relevant measure.

$$FAR = \frac{\text{Number of Rejected Client Claims}}{\text{Total Number of Client Accesses}} X100\%$$

FAR is a non-stationary statistical quantity which does not only show a personal correlation.[11] it can even be determined for each individual biometric characteristic.

VI. RESULTS

Person	FAR	FRR
1	0	0.01
2	0	0.1
3	0	0.1
4	0.05	0.1
5	0.2	0.14
6	0.14	0.01
7	0.2	0.5
8	0.3	0.2
9	0	0.01
10	0.1	0.4
11	0.1	0.3
12	0.2	0.2
13	0.3	0.2

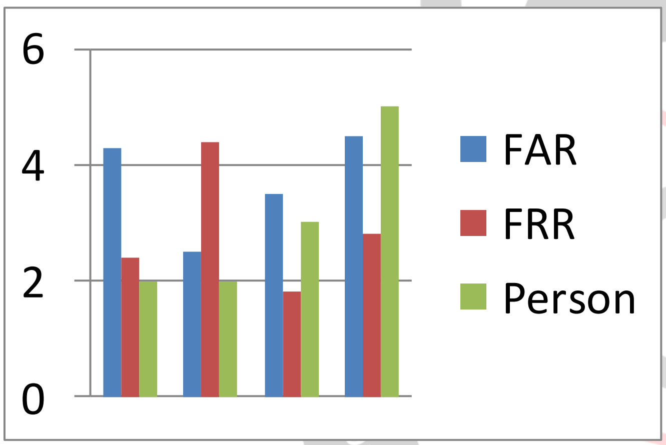
14	0.3	0.1
15	0.1	0.1
16	0.2	0.4
17	0.4	0.3
18	0.18	0.11
19	0.1	0.1
20	0.11	0.21

Table.1. FAR, FRR Result

Table.2.Feature Mean for quality Measurement

Sr.No.	Database	Method	FAR (%)	FRR (%)	Accuracy (%)
1	MMU Database	Gabor Wavelet and matching Hamming distance	0.3	0.1	96.04%

Table.3. Performance Analysis of Results



Graph.1. Performance Analysis of Results

VII. CONCLUSION

The main objective of our work is to develop an iris biometric system for person Identification. This is unimodel biometric system. As per experimental analysis of this work we have find the accuracy is 96.04% ,The FAR is 0.3% and the FRR is 0.1% the proposed work will develop a Multimodal Biometric System for high security application.

Image	Mean	Mode	Median	Std.Dev.	Variance
Image1	129..4900	101	130	73.6914	5.4304e
Image2	127.4928	56	134	75.2517	5.6628e
Image3	135.2671	85	141	73.3688	5.3830e
Image4	128.7444	93	133	73.8059	5.4473e

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