IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 17, Issue 4, Ver. IV (July – Aug. 2015), PP 31-36
www.iosrjournals.org

Analysis of Iris Recognition Based On FAR and FRR Using Hough Transform

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Abstract: *Iris recognition is an identification method of biometric that uses pattern-recognition techniques. It is one of the most biometrical techniques used for personal identification. In this paper, we give a brief overview of different methods used in iris recognition system and use houghman transform and rubber sheet method for increasing accuracy by calculating metrics like FAR and FRR.*

Keywords: *Biometrics, Canny edge detection, FAR, FRR, Houghman Transform, Normalization Basic Rubber Sheet Model*

I. Introduction

Biometrics is a system that measure physical and behavioral uniqueness to identify an individual. Instead of requiring personal identification cards, keys or passwords, biometrics can identify fingerprints, face, iris, signature, or retinas of an individual for easy verification. Iris Recognition is a biometrical technology for personal identification and verification which recognize a person from his/her iris prints.

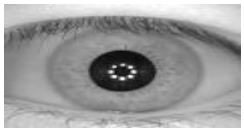

Figure.1 Eye

II. Stages In Iris Recognition System

A. Image Acquisition- It is for capturing a number of iris images using a designed sensor. Image acquisition step is one of the most sensitive and important for the quality of image to be processed, data extracted from raw input determines the performance of the entire system to a large extent.

B. Localization/Segmentation- The iris is acquired as a part of a larger image that contains data derived from the surrounding eye region. The inner and the outer boundaries of the iris are calculated.So it is important to localize that portion of the image that corresponds to iris.

C. Normalization- It is that process in which there is change in the range of pixel intensity values. It produce iris region which have the same constant dimensions, so that two images of the same iris under different conditions will have same features.

D. Feature Extraction- The most important step in iris recognition is the ability of extracting some unique attributes from iris, which help to generate a specific code for each individual. Feature extraction is a special form of dimensionality reduction.

E. Pattern Matching-Pattern Matching phase is the last phase after all phases. The feature which is generated in the feature extraction method is used as the input value for comparing the iris image with the iris codes.

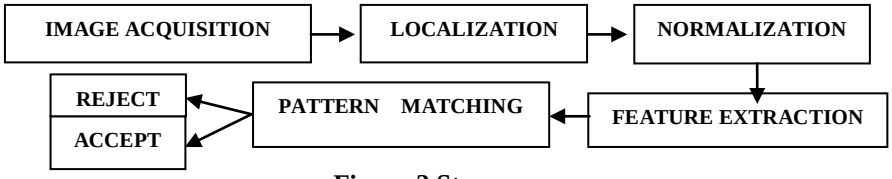

Figure.2 Stages

III. Methods Used In Existing Iris Recognition

A. Localization or Segmentation

a. Canny Edge Detection: It is an edge detection operator that is used to detect a wide range of edges in images. The boundary coordinates are separated from the rest of the image based on the intensity value of the pixel.

b. Hough Transform: It is used for identify lines in the image. It is used to estimate the parameters of a shape from its boundary points in a image.

c. Circular Hough Transform: It is used to deduce the radius and centre coordinates of the pupil and iris regions by biasing the derivatives in horizontal direction during edge mapping detects the eyelids and biasing the derivatives in the vertical direction helps in detecting the circular boundary of the iris [7].

d. Daughman's Intergo-Differertial Operator: It is used for locating the circular iris and pupil region. This operator searches for the circular path. It takes the close up image as input from that where there is maximum change in pixel values by varying the radius and centre(x & y) positions.

B. Normalization

a. Daughman's Rubber Sheet Model: It converts the Cartesian coordinates (e.g. [1, 2]) into polar coordinates (e.g. [radius, angle]).It takes into account pupil dilation and size consistencies to produce normalized representation with constant dimensions [1].

b. Rubber sheet model of lower half of iris: The iris is partially covered with eyelids. This can lead to false recognition result. To avoid the prominent occlusion due to upper eyelid this technique was Implemented [1].

c. Sector Based Normalization: There exists traditional method for iris normalization that transforms the detected annular ring into a rectangular block. The sector based normalization helps to minimize by eyelashes and eyelids. For certain range of angular values the radial dimension along left and right sector are taken completely because no occlusion occurs here. However for the upper and lower region only partial values are taken in the sector.

d. Analysis Band Based Normalization: In this technique of normalization the portion of the iris to be analyzed is mapped and subdivided into eight analysis bands [1].

e. Dimension Reduction Approach: This approach is used to reduce the dimensionality of the problem. It takes the two portions having the size equal to the pupil size from the left and right side of the iris. After performing normalization operation, these two portions are merged [1].

C. Feature Extraction

a. Cumsum Based CPA: This is a algorithm used for extract features by generating iris codes by analyzing changes of grey values of iris pattern by using change point analysis which determine whether a change has take place from darkness to brightness or brightness to darkness.

b. Daubechies Wavelets: It is used to transform huge data in smaller representations by using filters that produce smooth and scaling functions.

c. Ridgelet: It is combination of random transform and wavelet transform. It relates the scales of the line position with wavelet transform and relates it to the scale of the point positions.

D. Pattern Matching

a. Hamming Distance: It is a method that calculates the bit difference by using the XOR operation on the iris patterns. Hamming distance between two strings of equal length is the number of positions at which corresponding symbols are different.

b. Euclidean Distance: Euclidean distance is the matching metric to match the iris with the iris images already present in the data base.

c. K-NN Classifier: It is one of the most important non-parameter algorithms and it is a supervised learning algorithm. The classification rules are generated by the training samples themselves without any additional data. The KNN classification algorithm predicts the test sample's category according to the K training samples which are the nearest neighbors to the test sample, and judge it to that category which has the largest category probability [5].

d. Histogram Matching: It is a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. Pattern matching is performed by this technique.

E. Accept/Reject
Final phase is for accepting the code or rejecting the code. It depends on identification and verification which are important for security of every system. In the verification, the system checks if the user data that was entered is correct or not (e.g., username and password) but in the identification stage, the system tries to find who is without any input information.

IV. Proposed Methodology

In this proposed system we use following steps with Hough transform and rubber sheet techniques.
A. Input Data:-In first step there is capturing of image from cassia database.

B. Define Length:-In second step length is calculated.

C. Edge Detector (canny edge detector):- It is an edge detection operator that uses a multistage algorithm to detect a wide range of edges in images. It is a method of segmentation. The boundary coordinates are separated from the rest of the image based on the intensity value of the pixel and strength of them.

D. Boundary Detector(Hough transform):- It is used for identify lines in the image. It is used to estimate the parameters of a shape from its boundary points in a image. In this there are three types of detection:-1.Pupil region detection.2.Pupil boundary.3.Outer boundary detection.

E. Find Boundary Coordinates:-In this step there is searching of boundary coordinates.

F. Detection of noisy region and noisy circles:-In next steps there is detection of noisy parts like noisy regions and noisy circles.

G. Normalization (Rubber sheet):- It converts the Cartesian coordinates ([1, 2]) into polar coordinates ([radius, angle]).It takes into account pupil dilation and size consistencies to produce normalized representation with constant dimensions [1].

H. Histogram:- Histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. The histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance. Image histograms are present on many modern digital cameras. It evaluates the accuracy of images.

I. Output values:-There are some values used to determine performance.
a. Mean Squared Error MSE is a risk function, corresponding to the expected value of the squared error loss or quadratic loss. MSE measures the average of the squares of the "errors."

b. Root Mean Squared Error:- RMSE is used to measure differences between values predicted by a model or an estimator and the values actually observed. It is the square root of mean squared error.

c. Signal-to-noise ratio:-SNR is a measure that compares the level of desired signal to the level of background noise. It also refers to the ratio of useful information to false data in a exchange.

d. Root Signal-to-noise ratio:- It is a square root of measurement that compares the level of desired signal to the level of background noise. It also refers to the ratio of useful information to false data in a exchange.

e. Peak signal-to-noise ratio:-PSNR is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

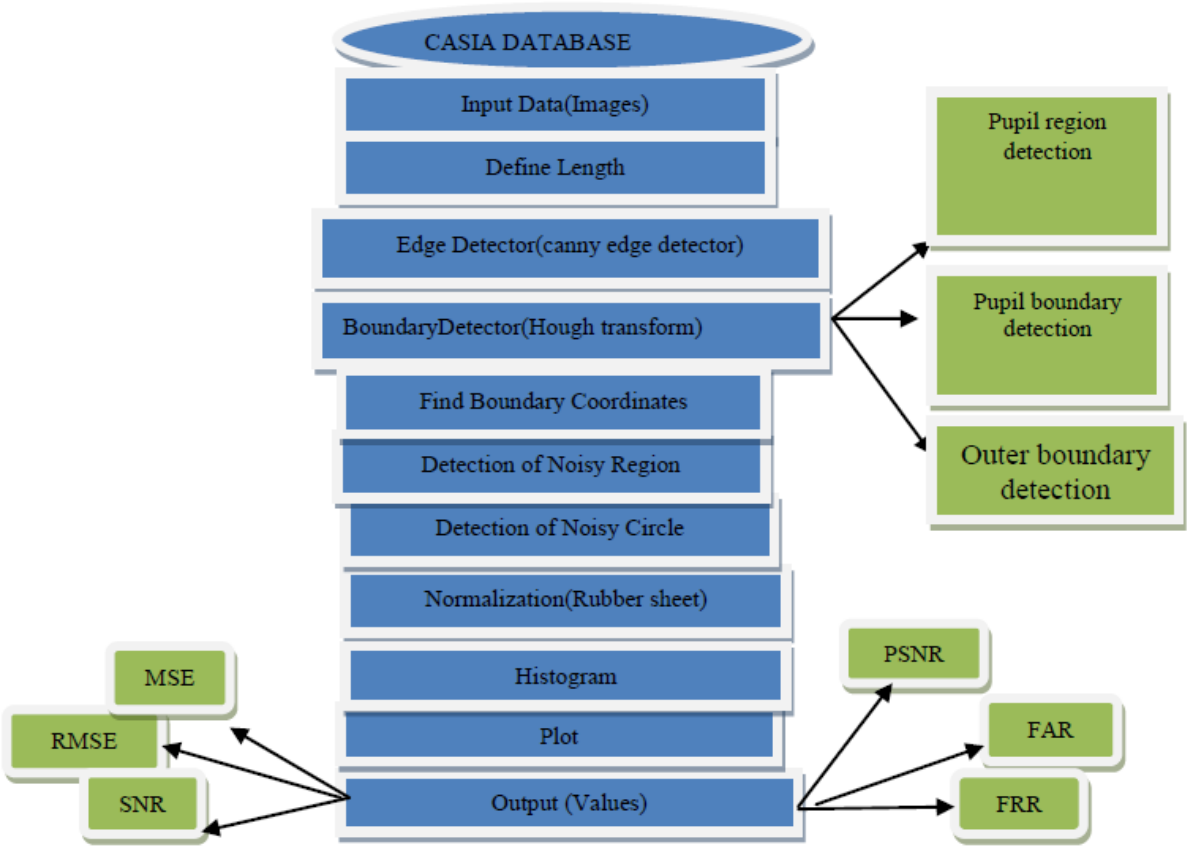

Figure.3Methodology

V. Performance Evaluation

Following metrics are used to evaluate the performance of the system.

1. False Acceptance Rate (FAR): FAR is the measure of the likelihood that the biometric security system will incorrectly accept an access attempt by an unauthorized user. FAR is defined as the ratio of the number of false acceptances divided by the total number of identification attempts.Accuracy increases with decrease in FAR.
2. False Rejection Rate (FRR): FRR is the measure of the likelihood that the biometric security system will incorrectly reject an access attempt by an authorized user. FRR is defined as the ratio of the number of false rejections divided by the total number of identification attempts.Accuracy increases with decrease in FRR.

VI. Result

The proposed technique has been applied to the following database(CASIA):

Images:-

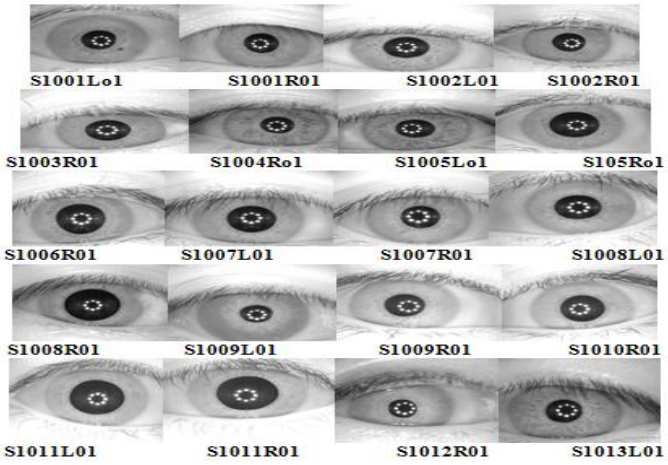

Figure.4 Database Images

Far And Frr:-

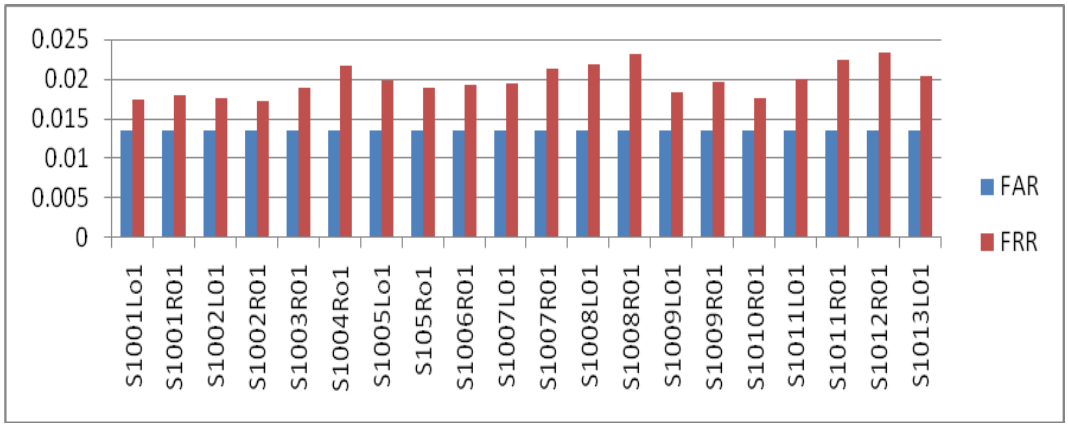

Figure.5 Result of FAR and FRR

Mse,Rmse increases—accuracy decreases,Mse, Rmse decreases—accuracy increases
Psnr,Snr increases—accuracy increases ,Psnr,Snr decreases—accuracy decreases
FAR increases—accuracy decreases, FAR decreases—accuracy increases
FRR increases—accuracy decreases, FRR decreases—accuracy increases

Comparision With Existing Systems:-

System[reference]	FAR	FRR	Overall % Accuracy
Avila	0.03	2.08	82.2%
Li Ma	0.02	1.98	83.4%
Tisse	1.84	8.79	74.5%
Daugman	0.01	0.09	88.1%
Using Circular Hough Transform	0.005	0.238	95.6%
Proposed System CASIA	**0.013**	**0.018**	**99.3%**

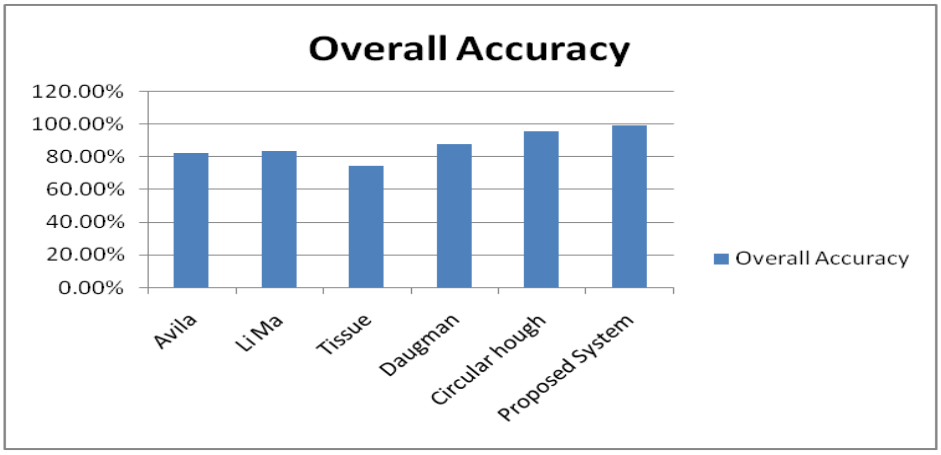

Figure.6 Accuracy

VII. Conclusion And Future Scope

We have study all methods and approaches on some images which are used in iris recognition system and compare them according to their values of FAR AND FRR. The images which have low values of FAR and FRR, they have more accuracy then other images. We have study all methods which are used in iris recognition system and compare them according to their performance. Techniques and methods can be improved which are used under system for increasing the accuracy of iris recognition system. This can be done by decreasing FAR and FRR, so that final outcome can be improved.

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