International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8, Issue-1S5, June 2019

Correct Personal Iris Recognition at Long Distance by using Dougman's Rubber Sheet Model

Swati D. Shirke, C. Rajabhushnam

Abstract—Now a days, the personal identification of iris recognition acts as a powerful tool. This is because of iris has good stability, cannot change throughout the life and every person has different iris biometric characteristics. But in real instance it is very complicated to get a good quality of iris image. Therefore to make this iris recognition system more convenient, here this article presents an efficient iris recognition scheme which can capture iris image about 4 to 8 meter long distance accurately. While designing this system there are many key issued are occurred such as blur, image processing, human machine interference, iris image acquisition, etc. The different methods in this paper can resolve all of above problems. To develop this system this successfully different algorithm are used. The algorithm used are Hough Transform for detection of iris circle and edge, scaT T loop for feature extraction, Dougman's rubber sheet model for normalization and segmentation, median filter and Trained neural network, etc. This iris recognition was tested on Casia V4 database. This system is developed on MATLAB for performing the Hough transform operations and for reading the iris images. The simulation results shows that this system successfully recognize the iris at a distance 4 to 8 meter.

Keywords— Matlab, Iris recognition, Hough Transform, Image Normalization, Image Segmentation, Feature Extraction, Dougman's Rubber Sheet Model, Trained Neural Network, etc.

I. INTRODUCTION

In most of the practical based applications like as congregation entrance, airport boarding, custom clearance and so on requires high security. For this high security purpose most of the companies uses iris recognition system. The government of India uses this system to identify the citizen in many applications like as Aadhar project, in rashan shops, while filling different government exam forms, registration department, etc.

Revised Manuscript Received on May 30, 2019.

Ms. Swati Dattatraya Shirke, PhD Scholar, CSE Department, Bharath Institute of Higher Education and research. Bharath University, Chennai
shirke.swati14@gmail.com.

.**Dr. C.Rajabhushnam**, Professor, CSE Department, Bharath Institute of Higher Education and research. Bharath University, Chennai.
rajabhushanamc.cse@bharathuniv.ac.in

. In UAE it is used for border crossing application. Most of the manufacturing companies developed iris products, some of the companies are Iris King's IKEMB-100, Iris guard's IG-H100, Panasonic's BM-ET300, OKI's Iris Pass-WG, LG's Iris Access, etc. But all of these manufacturing companies face one problem that is iris at a distance and getting an iris image, also the motion of camera and person. The presented business systems are based on NIR imaging technique and in most of the application it is used. But most of the methods cannot shows the accurate detection of iris recognition and this can be happen due to imposing the person to stand in front of camera at a fixed distance, iris image quality which is captured by the sensors, other factures like as textural richness controls, illumination, contrast, image quality, etc. Due to the above reasons the image quality captured by the camera may be degraded. The images may be degraded due to the lack of texture, blur or low resolution. Therefore it is necessary to design a proper machine which actively cooperate and take less time to get a better image for iris recognition. It can extracts the features of iris image correctly under uncontrolled environment. The annular portion between the white sclera and dark pupil is called iris and it contains large amount of texture information which is help for the iris recognition system.

The main goal of this proposed system is to design a system responsible for classifying different iris images. A super resolution algorithm builds the greater resolution image from the less resolution iris image. In this article we designed an effective system to resolve the above problems like as human machine interface, image acquisition and image processing problems, etc. And for this purpose we developed the different algorithms.

It is very difficult to develop the optical path for iris imaging at a distance because of the human iris is so small and it requires very high resolution to capture. This problem is resolved in this system by carefully calculating parameters of illumination intensity, lens, cameras and distance. The human machine interface problem can be solved in this system by standing the user at right position and by designing self adaptive machine.

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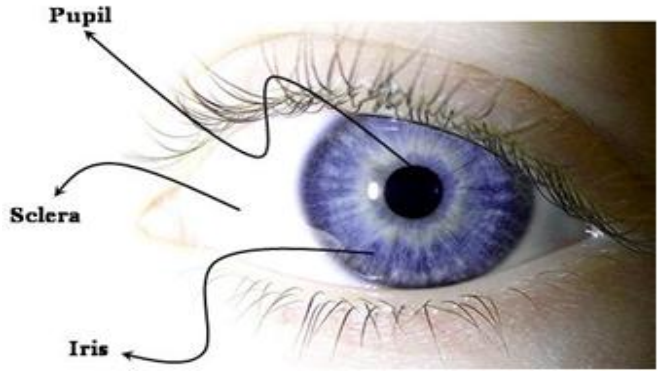

Fig. 1. Introduction to Eye Sample.

This error can be happen due to users are of different height and it is difficult for a one camera to cover so large range. The iris recognition and image processing problems can be solved by using Hough transform the localization of pupil and iris region is achieved with the help of normalization and automatic segmentation. For iris image normalization the Daugman's Rubber Sheet Model is designed.

The different sections of this paper are organized in the following way where section II reports the detailed study of different methods which are used design this system. The block diagram and sequence flow of this system is explained in the section III. The results and performance of the proposed system is presents in the section IV and finally the section V reports the conclusion of the system.

II. Related Work

By taking the review of different papers some of the papers are explained here. In the paper written by G. Fahmy [8] presents super resolution algorithm that improves recognition performance of low quality in iris videos fusing images.

The super resolution technique presents in this paper on an auto-regressive signature model. This auto-regressive signature model converts the low resolution pixel images into the high resolution images which is capture from long distance. In this way the blur is removed from the image.

In the paper written by L. Zhang, Q. Li, J. You, D. Zhang [3] presents the model modified matched filter. This filter is used for removing the false response of an image. This improved similar filter uses two surface thresholding.

In the paper designed by K.A. Goatman, A.D. Fleming, S. Philip, G.J. Williams, J.A.Olson, P.F. Sharp [4] uses the gradient method to detect the new vessel. The main disadvantage of the segmentation technique is this technique does not perform vessel segmentation properly because new vessels are avoided in this method. The different amplitude modulation frequency modulation (AM-FM) techniques shown in the paper by C. Agurto, V. Murray, E. Barriga, S. Murillo, M. Pattichis, H.Davis [5] is used to define the different retinal structures of iris image by using spectral texture analysis. In this method, the new vessels are generated. On the other hand, the work by C. Agurto, Y. Honggang, V. Murray, M.S. Pattichis, S. Barriga, and W. Bauman [6] presents AM-FM along with granulometry and the vessel segmentation to detect the new vessels on the optic disc. The other researcher also developed many techniques on these topics. C.N. Doukas, I. Maglogiannis, A.A. Chatziioannou [7] presents the method an automatic technique for the quantity of small-vessel mass inside an internal outside of the eggshells. It incorporated textural information, branching points, and vessel length. The key proposal of a Suggested technique is not only line operator but also straight vessel removal for deduction of false rate. The paper written by Nadia Othman and Bernadette Dorizzi " Impact of Quality-Based Fusion Techniques for Video-Based Iris Recognition at a Distance"[9], presents video based different image acquisition context and the local quality-based fusion scheme for image acquisition.

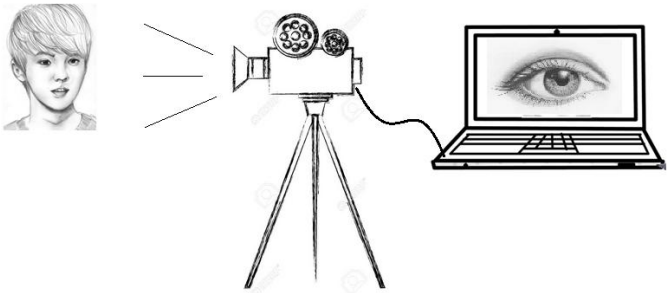

Fig. 2. Iris Image Acquisition.

III. Iris Image Acquisition

This proposed system divided into two section iris image acquisition and classification section. In this section the detection module of an iris is presents. The classification module is presents in the next section IV. In an image acquisition step the persons eye image was taken by 14 megapixels good camera, therefore distribution of images becomes good at different angles and under different lighting conditions. The many challenges was occurred while developing this system. A high-quality image for iris recognition is difficult to capture which contains more number of texture of the iris or features of the iris. But in this system we get the iris images with sufficient sharpness and resolution, Less number of artifacts in infrared light. Also we get proper illumination of interior iris pattern. The distance between the camera and the eye and may vary from 4-8 meter. To extract good feature from iris image the diameter of iris should be between 100-200 pixels. The eye of the person can be track and detected by using state-of-the-art eye detection method. This method has very high robustness and accuracy. Figure 3 shows the iris detection and localization. Now in the detection section the captured images are taken. The extraction of areas and features patterns of iris images and segmentation of input captured iris image is the main work of this module.

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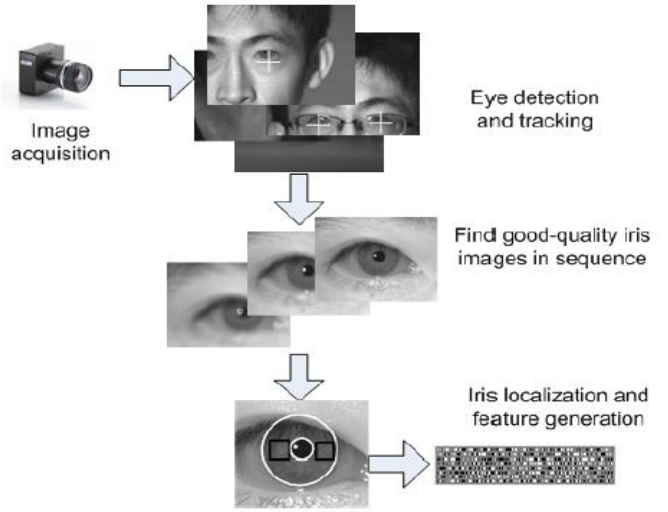

Fig. 3. Iris detection and localization.

IV. CLASSIFICATION MODULE

This section shows the proposed algorithm of the system. The implementation of this work are given in this step. Figure 4 shows the block diagram of recognition using Daugman's rubber sheet model.

A. Input Iris Images

The database used for this purpose is Casia V4. Here there are 20 peoples dataset is to be considered for the experiment. This iris recognition was tested on Casia V4 database.

B. Pre-processing and De-Noising

The intensity range of an iris image is normalized to [0 1]. This range of intensity values shows the maximum intensity value by dividing all intensity values.The diffusion filter process is explained in [17]. In pre-processing, the signal to noise ratio of iris image is improved and for this work anisotropic diffusion filter is given to the iris images as a pre-processing step. The pre-processing of an iris image is used to increse the quality of an image due to undesired distortions. In pre-processing step it enhances the some features of iris image which are required for further processing. it only enhances the quality of image, it does not increases the information content of an image.

To enhance the image this method uses the considerable redundancy presents in images[15]-[16]. This method allocates the average value of neighboring pixels to the distorted pixel. The tool which is used for this purpose is MatLab realize the many brightness transformations. The new pixel brightness can be calculated with the help of this filter. Also to remove the noise presents in the degraded iris images this filter is used. Therefore the iris image de-noising is the fundamental problem in the field of image processing. For the image processing these filters are widely used. There are some advantages of this filter for example the noise can be effectively removed by these filters while edges can be retained. To find the rank-order information and spatial information of an iris image a weighted median (WM) filter is used and this is one of the type of median filter. The noises shot and impulse noise are rejected by the median filter.

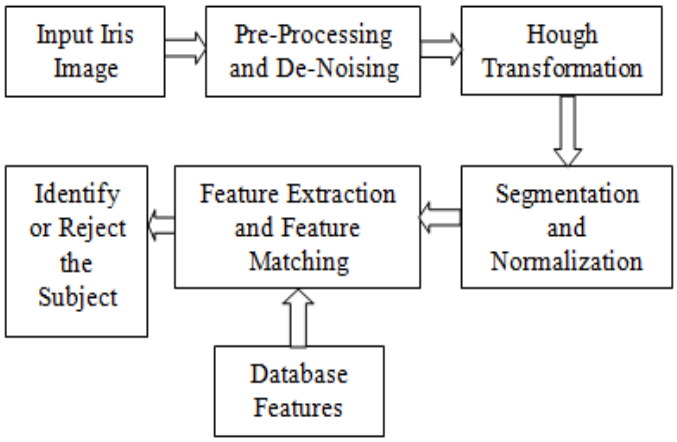

Fig. 4. Iris Recognition Using Dougman's Rubber Sheet Model.

According to brightness or intensity of the pixel, the median filter ranked the neighboring pixels and the median value becomes a new value for the central pixel[13]-[15]. In the median filtering operation, to find the rank-order information and spatial information of an iris image a weighted median (WM) filter is used and this is one of the types of median filter. According to the brightness or intensity of the pixel, the median filter ranked the neighboring pixels also Mean significance. [13]-[15].

C. The Hough Transform

The Hough transform uses the voting procedure to detect the damaged parts of image within a certain class of shapes. For the feature extraction used in image analysis, computer vision and digital image processing are calculated with the help of Hough transform. A two-dimensional array algorithm is used in linear Hough transform to detect the existence of a line and it is also called an accumulator. The line can be detected by the formula

$$r = x \cos \theta + y \sin \theta \quad (1)$$

The r and θ are considering quantized values in the pair (r,θ). The (r,θ) of the line can be calculated by applying Hough transform algorithm to its neighborhood pixel at (x,y). The result obtained from Hough transform is two dimensional matrix with values of quantized distance r and quantized angle θ. The each element of new matrix obtained has a cost equal to the addition of the points or pixels that are located on the line represented by quantized parameters (r, θ). With the help of Hough transform, the lines in the image can find, different shapes like as circles or ellipses and identify the positions of arbitrary shapes. The edges of images are improved by putting an intermediate stage with the help of Hough transform. Different shapes like as circle, ellipse, etc. can also be finds and represents by the set of parameters by using Hough transform. For the circle the Hough transform finds the set of radius and center. The different curves and ellipses can also found using the same method of Hough transform and expressed in set.

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D. Segmentation and Normalization

It is the first step in the Iris recognition system also the backbone of the complete recognition system. This process separates the usable iris pattern and the part of the eye also noisy data. It consists of Iris localization is picky for the staging of an iris identification structure. It aims to detect layout, centers, and radii, of the two iris borderline. Locating the lower as well as upper eyelid also separate eyelashes.The segmentation identifies the region of interest, finds the location of the tumor, lesion and other abnormalities. The measure of tissue volume is used to measure the growth of tumor which also decreases in size of the tumor with treatment. It also helps in treatment planning prior to radiation therapy in the radiation dose calculation. With the help of the Daugman's Rubber Sheet Model the image segmentation, acquisition and feature encoding of an iris image can takes place. This model is also used to define the performance of the system. This technique uses the Canny edge detection techniques and Hough Circles on iris images.

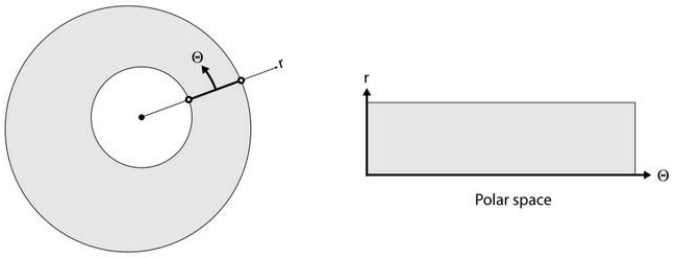

Fig. 5. Daugman's rubber sheet model.

After applying these techniques, this algorithm produces highly accurate algorithm for reliable iris recognition system. Figure 5 shows the Dougman's Rubber Sheet Model. The coefficient of an iris image will not be shifted even if the signal is distorted due to the camera and persons position. In this segmentation step, the iris image is separated into different regions. The division of the regions can takes place by considering similar properties of an iris image. Some of similar properties are color, brightness, contrast, texture, gray level, etc. The segmented iris image is prepared by using normalization algorithm. the segmented iris image is used for future extraction process. Due to the varying position of a person and the camera, the iris image is highly affected by distortion. Therefore normalization is used to compensate this problem.

E. Feature Extraction and Feature Matching

In feature extraction step, the iris image is classified into new vessels image. In this image region contains many vessel segments that are closely spaced with multiple orientations and have a twisted nature. For the measurement of feature characteristics, the new vessel segments are generated from a binary vessel maps. In order to find out local features, a sub window of size 50 x 50 is created. These local features are associated with morphology of vasculature. The iris image are examined through this sub window. And for every sub window the number of vessel pixels and pixel passion can calculated. If the number of vessel pixels is greater than threshold value then it is highlighted as final output image. The features extracted in this step are matched with the database which is presents in the computer. According to this matching the person is identified.

V. PERFORMARION OF SYSTEM

The step by step execution of the proposed algorithm is presents in this section. The performance of proposed system reports this section. Firstly we take the input test iris image. In this paper there are 20 peoples dataset is to be considered for the experiment. The database used for this purpose is Casia V4. Figure 3 shows the key in iris recognition image having the dimension 512 x 512. This image can be selected by using GUI in matlab. Figure 6 shows the input cropped image having the dimension 512 x 512. This image can be selected by using GUI in matlab. This input test image of iris is applied for the pre-processing. In this stage the different features of an iris image are extracted. Figure 7 shows the output of preprocessing the image, which highlights the iris part of the eye (black portion).

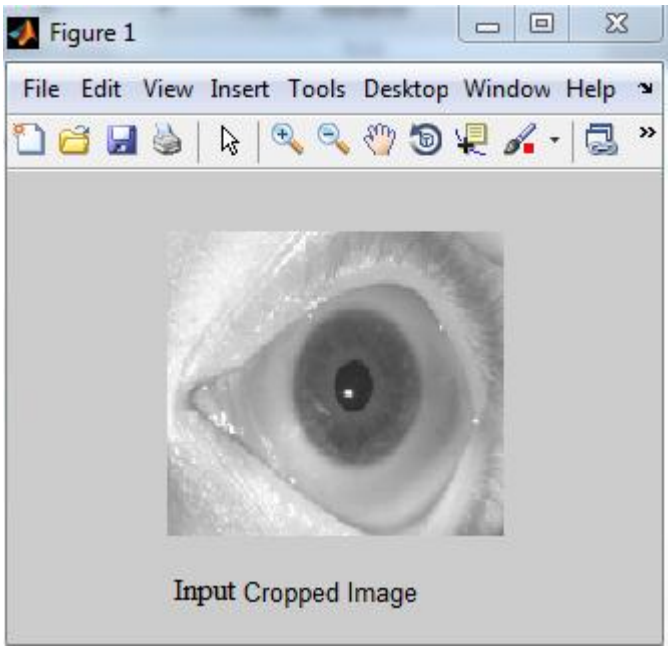

Fig 6. Input Cropped Image.

The Median filter is used to remove the noise presents in the iris image. Figure 5 shows result for de-noised and colour to gray median filter image**.** Out of which a colour image is Original image, Gray image is right to original image, Salt and pepper noise is below the original image, and remaining one is Median Filter image. In the Segmentation and Normalization process detection of Pupil and Iris boundary of original image is takes place. The detection is done with the help of Hough circles. The dataset of different Iris images are shown in figure 8. Figure 9 shows the detected boundaries of an iris image. The white boarder presents in this image is the corresponding boundaries of iris image.

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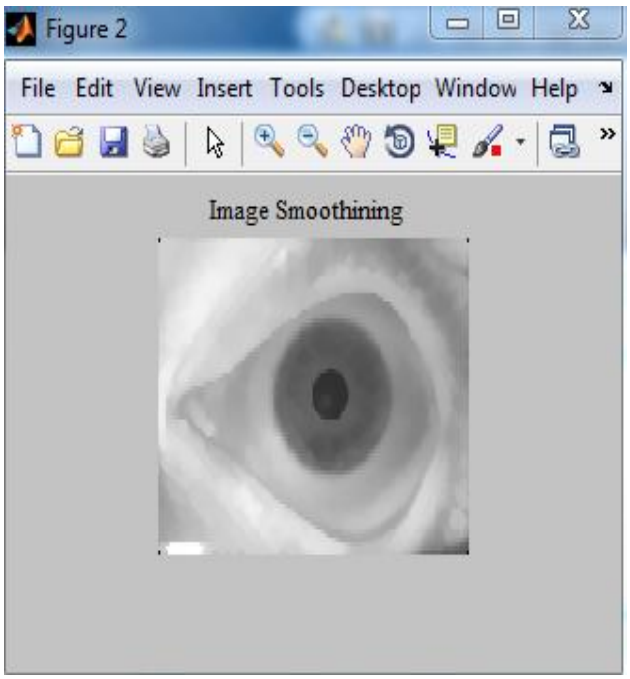

Fig 7. Preprocessing image

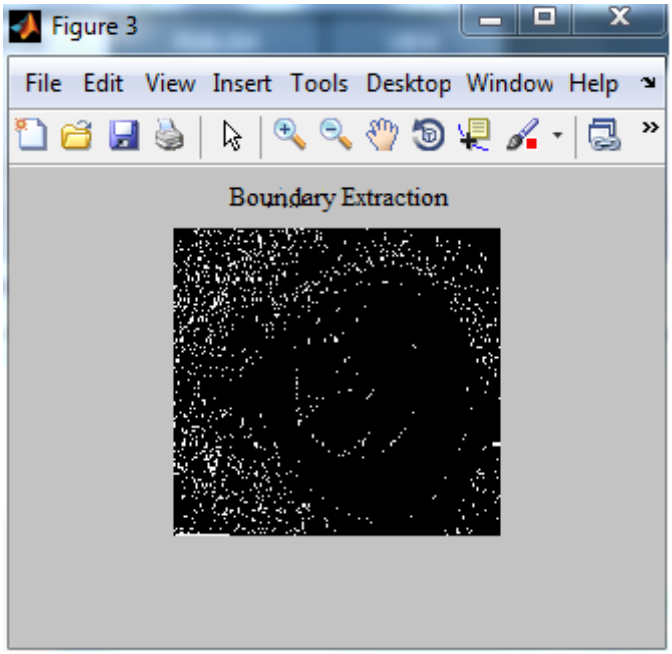

Fig 9. Boundry extraction of Iris Image .

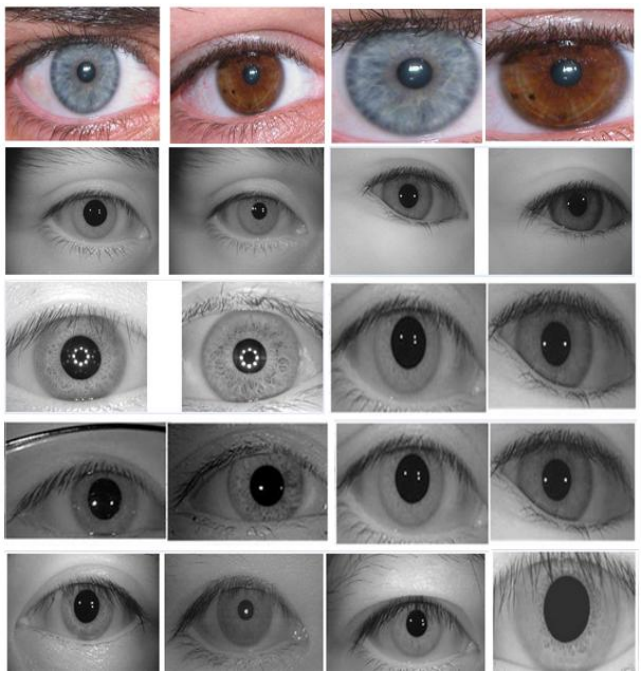

Fig 8. Databse of different Iris Images.

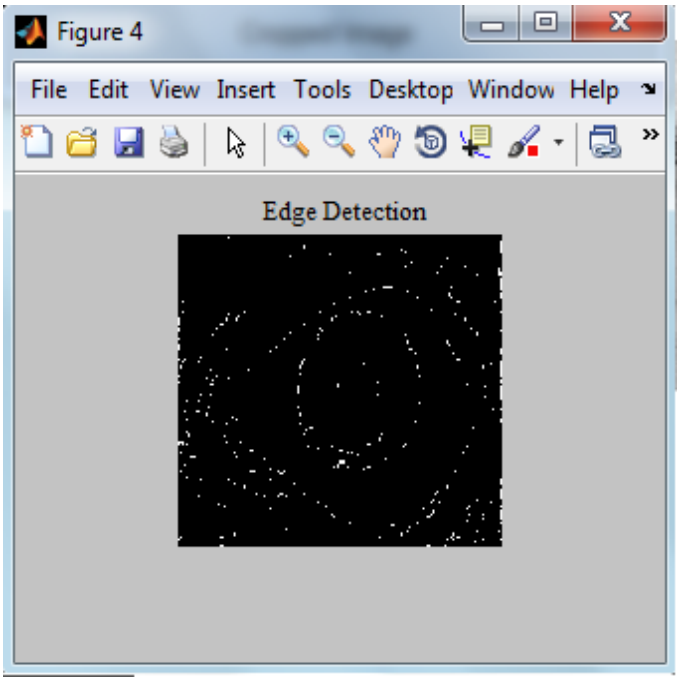

Fig 10. Edge Detection of Iris Image.

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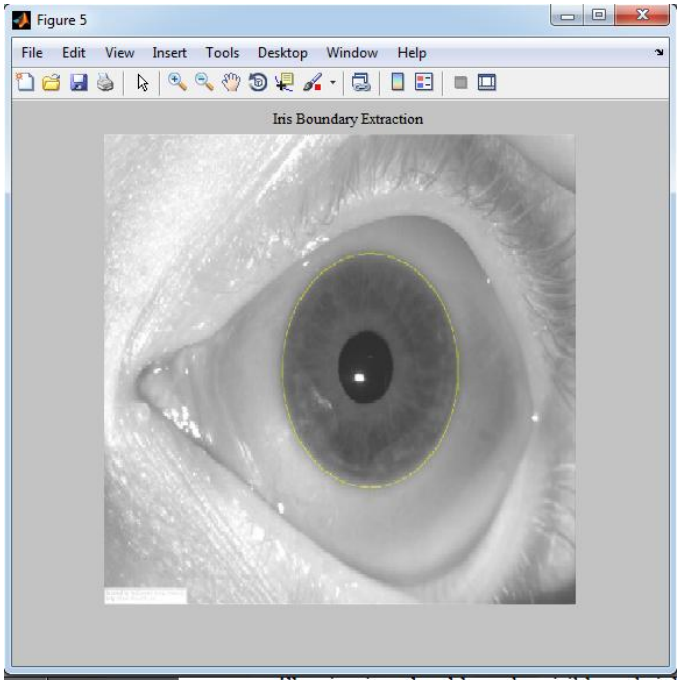

Fig 11.Iris Image Boudary Extraction.

After boundary identification, the edge of an iris image is identified by using Normalization and Segmentation process. Figure 10 shows the corresponding edges of pupil of an iris image. The edges of an iris image can be detected with the help of the canny edge detection process. The iris image boundary extraction if done with the help of Hough transform. The extraction of the circles from iris image is done with the help of Hough transform. The figure 11 shows the extraction of iris boundary using Hough transform. The circle extracted in this step is shown in yellow color in the figure 11.

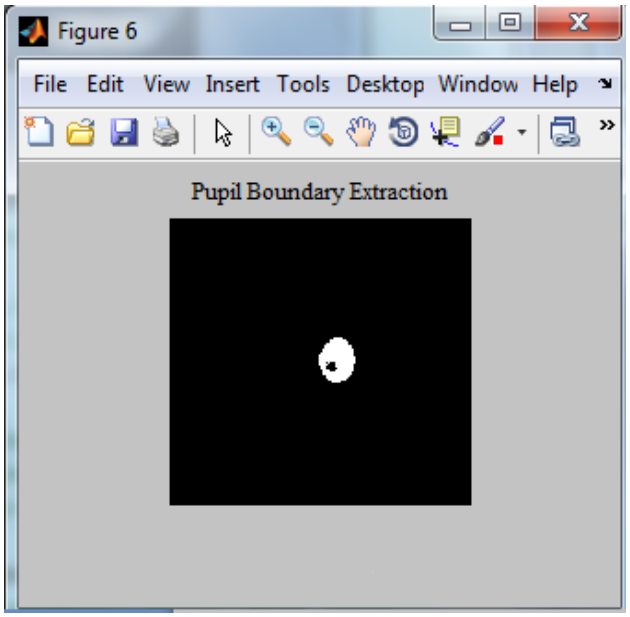

Fig.12. Pupile Boundary Extraction of Iris image.

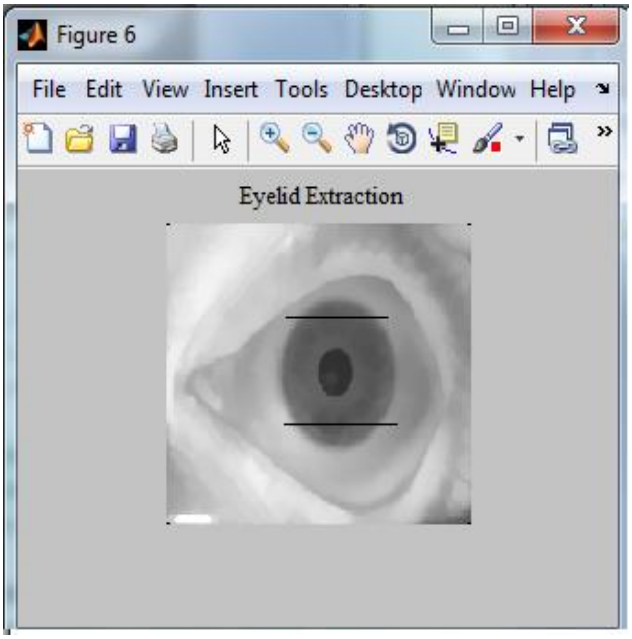

Fig 13.Eyelid Extraction of Iris image.

Figure 12 shows the pupil boundary extraction of iris image and for this purpose the Hough transform is used. Figure 13 shows the eyelid Extraction of Iris image. The lines of eyelid are finds with the help of Hough transform. The Hough transform is used to find the lines of eyelid. Normalization is the processed image polar to rectangle conversion where the improve iris image is not only segmented first to localize circular iris but also pupil region, the abstracted iris region was then normalized into a rectangular block with constant dimensions to account for imaging inconsistencies.

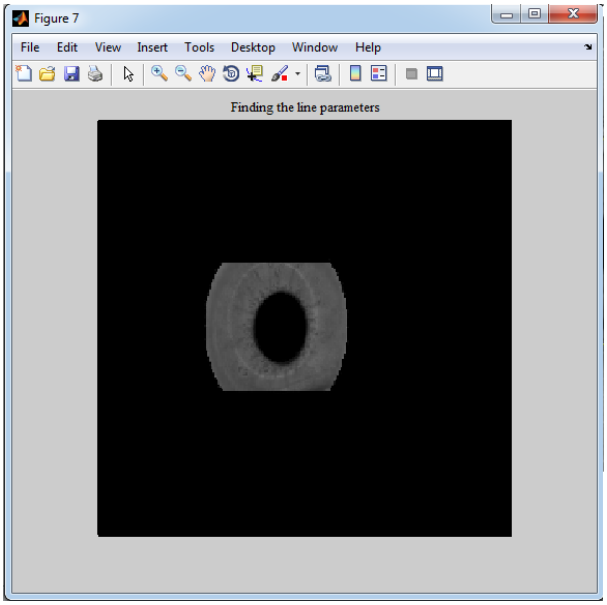

Fig 14. Eyelid of Bottom and Top Segmentation of an Iris Image.

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In iris recognition when an eye is segmented then transformation of iris boundry line is proceeding. Figure 14 shows eyelid of bottom and top segmentation of an Iris Image.

VI. CONCLUSION

An effective iris recognition system for person identification is presents in this article. With the help of the binary iris segmentation false response is reduces. The unnecessary background images are also removed with the help of image segmentation process. Different methods presents in Hough transform are used to for segmentation such as linear, circular and parabolic. With the help of iris image normalization the extraction of fixed number of features is done. The CASIA V4 database is used for testing purpose of this iris recognition system. Also the Daugman's model is used for iris segmentation, normalization, feature encoding and feature matching. An automated system which is capable of recognizing the iris is presents in this paper. This system reduces false responses to bright lesions and other retinal feature of eye. The tool used for this purpose is MatLab digital image processing. This paper presents iris recognition system that removes all previous drawbacks. Also many problems of iris recognition was solved like as human machine interface, image processing and image acquisition problems. The performance analysis show that the iris recognition method is accurate and successfully recognize the iris at a distance 4 to 8 meter long.

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Authors:

Ms. Swati D. Shirke holds an M.E.degree in Computer Science and Engineering from Pune University and is a research fellow in the Department of Computer Science and Engineering, Bharath Institute of Higher Education and Research, Bharath University. Her main area of interest includes pattern recognition, image processing, machine learning, She has published several papers in well known peer-reviewed journals.

Dr. C. Rajabhushnam holds a Ph.D. in Neural Networks, from Louisiana State University, USA And he is a professor in the Department of In the Department of Computer Science and Engineering, Bharath Institute of Higher Education and Research, Bharath University. His main area of interest includes pattern recognition, image processing, machine learning he has published several papers in well known peer-reviewed journals.

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