Iris Segmentation Along with Noise Detection using Hough Transform

Ms. Sunanda Singh, Mrs. Shikha Singh

***Abstract*— this paper presents the iris localization using Hough transformation. The performance of iris recognition systems highly depends on the segmentation process. Segmentation is used for the localization of the correct iris region in an eye and it should be done accurately and correctly to remove the eyelids, eyelashes noises present in iris region.**

In this paper we are using Hough Transform segmentation method for Iris Recognition. Generally eyelids and eyelashes are noise factors in the iris image. To increase the accuracy of the system we must have to remove these factors from the iris image. Linear Hough transformation can be used to detect the eyelids. Before applying Hough transformation on the images for identify the circles and lines we have used the canny edge detection to improve the performance of the iris recognition system.

Index Terms—**Segmentation, Localization, Recognition and Hough Transform, Eyelids and eyelashes**

I. INTRODUCTION

The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. Localization of iris has many applications especially in biometric such as Iris recognition. Iris recognition is a method of biometric authentication that uses pattern recognition techniques based on high resolution images of the iris that able to distinguish from one person to another. Among all biometric methods, iris is currently considered as one of the most reliable biometrics because of its unique texture‘s random variation. Iris recognition systems are divided into four blocks, iris segmentation, iris normalization, and feature extraction and matching. Iris segmentation separates an iris region from the entire captured eye image. Iris normalization fixes the dimensions of segmented iris region to allow for accurate comparisons. Feature extraction draws out the biometric templates from normalized image and matches this template with reference templates. The performance of an iris system closely depends on the precision of the iris segmentation.The purpose of ‘Iris Recognition’, a biometrical based technology for personal identification and verification, is to recognize a person from his/her iris prints. In fact, iris patterns are characterized by high level of stability and distinctiveness. Each individual has a unique iris , the difference even exists between identical twins. currently iris recognition systems performs with very high accuracy .

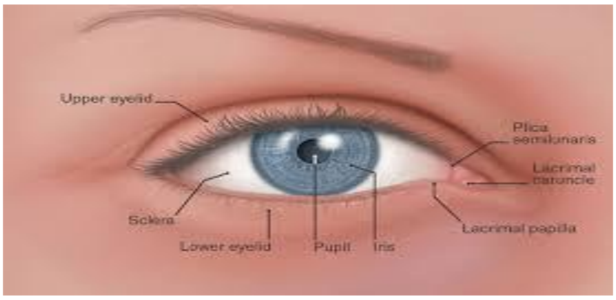

Fig1. Human Eye

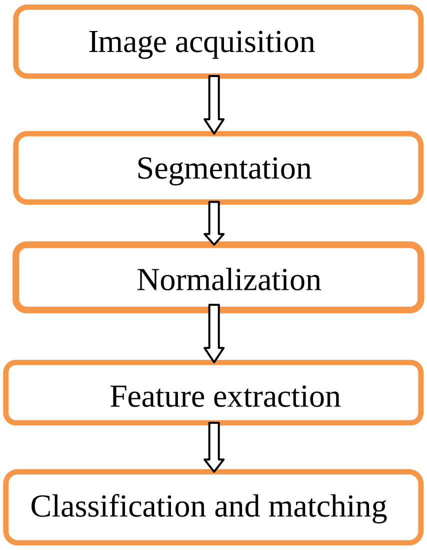

Fig -2.Stages of iris recognition.

II. RELATED WORK

Wildes **[1]** processed iris segmentation through simple filtering and histogram operations. Eyelid edges were detected when edge detectors were processed with horizontal and then modeled as parabolas. No direction preference leaded to the pupil boundary. Eyelash and pupil noises were not considered in his method.

Tisse et al. **[3]** proposed a segmentation method based on integro-differential operators with a Hough Transform. This reduced the computation time and excluded potential centers outside of the eye image. Eyelash and pupil noises were also not considered in his method. Viral Doshi, Abhinav Jain and Sreeram Iyer **[5]** .This paper presented the complete iris recognition system consists of an automatic segmentation system. The system presented in this paper is able to perform

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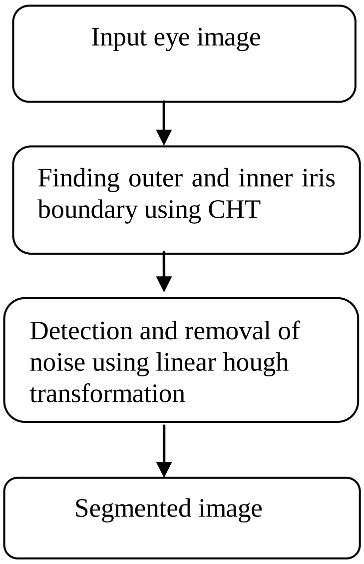
accurately, however there are still a number of issues which need to be addressed. First of all, the automatic segmentation was not perfect, since it could not successfully segment the iris regions for all of the eye images in the two databases. In order to improve the automatic segmentation algorithm, a more elaborate eyelid and eyelash detection system are implemented. PrateekVerma, Maheedhar Dubey, Somak Basu, Praveen Verma **[6] ,**This paper has presented an iris recognition system, in which Hough Transform segmentation stage is based on accuracy and higher efficiency rate. An automatic segmentation algorithm was presented, which would localize the iris region from an eye imag and isolate eyelid, eyelash and reflection areas. Threshold was also employed for isolating eyelashes and reflections of the image.
J.G Daugman **[7]** proposed an integro-differential operator for localizing iris regions along with removing the possible eyelid noises. From the publications, we cannot judge whether pupil and eyelash noises are considered in his method. P.Gupta et al **[17]** proposed a metod in which Circular Hough Transform was used for detection of outer iris and inner iris boundaries. The procedure first finds the intensity image gradient at all the locations in the given image by convolving with the sobel filters. The absolute value of the gradient images along the vertical and horizontal direction is obtained to form an absolute gradient image. The absolute gradient image is used to find edges.
sunil Chawla and Ashish Oberoi [**20**], proposed a segmentation method using Hough transform,they mainly focused on the segmentation and normalization stage of iris recognisation process.

III. PROPOSED WORK

This section discusses in detail the proposed iris segmentation method.This includes iris inner and outer boundaries localization,Upper and lower eyelids detection and eyelashes.



3.1. HOUGH TRANSFORMATION

The Hough transformation is a standard computer vision algorithm that can be used to determine the parameters of simple geometric objects such as lines and circles present in an image. In this paper we introduce a detection strategy based on circular Hough transform and linear Hough transform methods.
Circular Hough transform is used for detecting the iris and pupil boundaries, this involves generating an edge map using canny edge detection.

Canny edge detection algorithm is very well known and popular edge detection algorithm it runs on following stages.

3.1.1. Smoothing - The main aim of smoothing is to remove the noise from the blur images. Before the image is edge detect, Gaussian filter is used to smoothen the image that will reduce the noise that cause false edge detection. The smoothed image produced depends on the standard deviation of the Gaussian filter.

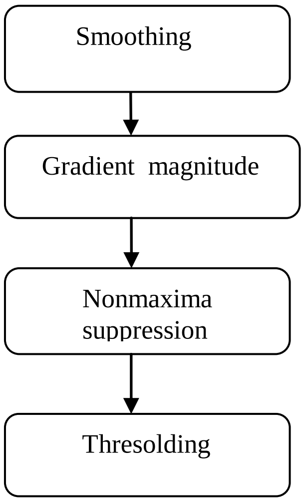


Fig- 3 stages of canny edge detection

3.1.2. Finding Gradient - When the grayscale intensity of the image is changed to find the edges basically canny algorithm is used. Those areas are found by determining gradients of that image. From the smoothed images the gradient points are determines each pixel by applying Sobel-operator. First step is to approximate the gradient in the x- and y-direction respectively by applying the kernels.
The gradient magnitudes (also known as the edge strengths) can then be determined as an Euclidean distance measured by applying the law of Pythagoras as shown in Equation (1). It is sometimes simplified by applying Manhattan distance measure as shown in Equation (2) to reduce the computational complexity. The Euclidean distance measure has been applied to the test image.

$$|M|=(M_x^2+M_y^2)^{1/2} \quad (1)$$

$$|M|=|M_x|+|M_y| \quad (2)$$

Where: Mx and My are the gradients in the x- and y-directions respectively.
An image of the gradient magnitudes indicates the edges quite clearly. However, the edges are typically broad and do not indicate exactly where the edges are. To make it possible to determine this , the direction of the edges must be determined and stored as shown in Equation (3).

$$\theta=\arctan M_y/M_x \quad (3)$$

3.1.3. Non-maximum suppression - It is to convert the blurred edges in the image of the gradient magnitudes to make

sharp edges. Basically this is done by preserving all local maxima in the gradient image, and deleting everything else. The algorithm is for each pixel in the gradient image:
1. Round the gradient direction θ to nearest coordinate, corresponding to the use of an 8-connected neighborhood.
2. Compare the edge strength of the current pixel with the edge strength of the pixel in the positive and negative gradient direction.
3. If the edge strength of the current pixel is largest; preserve the value of the edge strength. If not, suppress (i.e. remove) the value.

3.1.4. Double thresholding - The edge-pixels remaining after the non-maximum suppression step are marked with their strength pixel-by-pixel. Some of these will probably be true edges in the image, but some may cause noise or color variations for instance due to rough surfaces. The simplest way to distinguish between these would be to use a threshold, and then only strongest edge value would be preserved. Edge pixels stronger than the high threshold are marked as strong, edge pixels weaker than the low threshold are concealed and edge pixels between the two thresholds are marked as weak.

3.1.5. Edge tracking by hysteresis - In this step, strong edges can be selected as certain edges and these edges are included as final edges. Here, If any weak edge is connected to strong edge then only it is included Strong edges are interpreted as “certain edges”, and can immediately be included in the final edge image. Weak edges are included if and only if they are connected to strong edges. The logic is of course that noise and other small variations are unlikely to result in a strong edge. Thus strong edges will only be due to true edges in the original image. The latter type will probably be distributed independently of edges on the entire image, and thus only a small amount will be located adjacent to strong edges. Weak edges due to true edges are much more likely to be connected directly to strong edges.

Functions used-
segmentiris - peforms automatic segmentation of the iris region from an eye image. Also isolates noise areas such as occluding eyelids and eyelashes.
Findcircle - returns the coordinates of a circle in an image using the Hough transform and Canny edge detection to create the edge map.
Canny- function to perform canny edge detection.
Houghcircle - takes an edge map image, and performs the Hough transform for finding circles in the image.
Addcircle- A circle generator for adding (drawing) weights into a Hough accumulator array.
Findline - returns the coordinates of a line in an image using the linear Hough transform and Canny edge detection to create the edge map.
Linecoords - returns the x y coordinates of positions along a line

3.2. Applying Hough Transform

We can find geometric shapes, such as circles, or lines within an image with the help of Hough transform technique .This technique works on the basis of parametric equations . After applying canny edge detection technique, we can get canny edge detected image. Then, the Hough algorithm can be applied to the canny edge detected image. This method is very efficient for the task of finding the iris from an image . Because it works even when noise is present in the image and performs well even when a large amount of the circle is hidden .
In this paper, we introduce a detection strategy based on circular Hough transform and linear Hough transform methods. We firstly detect the inner and outer boundaries of the pupil in iris image . Then we have applied linear Hough transform to detect noise factor i.e. eyelids and eyelashes in the iris image . The parameter space.
The equation of the circle is :

$$(x-a)^2 + (y-b)^2 = r^2 \text{-------- (4)}$$

As it can be seen the circle to get three parameter r, a & b, where a & b are the center of the circle in the direction x & y respectively and r is the radius.
The parametric representation of the circle is :

$$x = a + r\cos\theta \text{ -------- (5)}$$
$$y = b + r\sin\theta \text{ -------- (6)}$$

The equation of the line is :

$$r = x\cos\theta + y\sin\theta \text{ -------- (7)}$$

Where, r = distance between line and the origin
Θ = angle of the vector
Then we can get an n dimensional parameter space (three dimensional spaces for a circle and line) . Figure 5 shows Result after applying Hough Transform to iris image.

3.3. EYELIDES AND EYELASH DETECTION

Eyelids and Eyelashes are the main noise factor in the iris image. These noise factors can affect the accuracy of the iris recognition system. After applying circular Hough transform to iris, we are applying linear Hough transform and we get line detected noise region in the iris image. We have to remove these detected eyelids and eyelashes from the iris image Thresolding is used for the removal of eyelashes. Then, the noise free iris image can be available for future use.

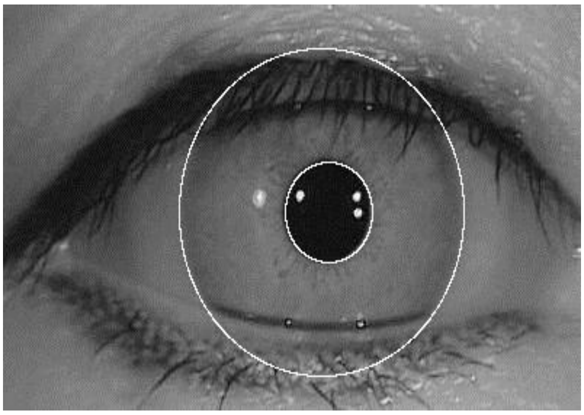


Fig- 4 Iris Inner and Outer Boundary localization using circular hough transform**.**

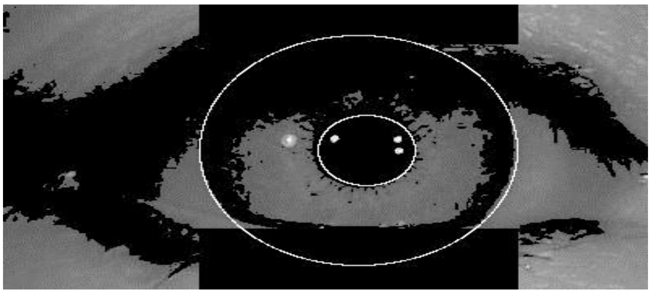
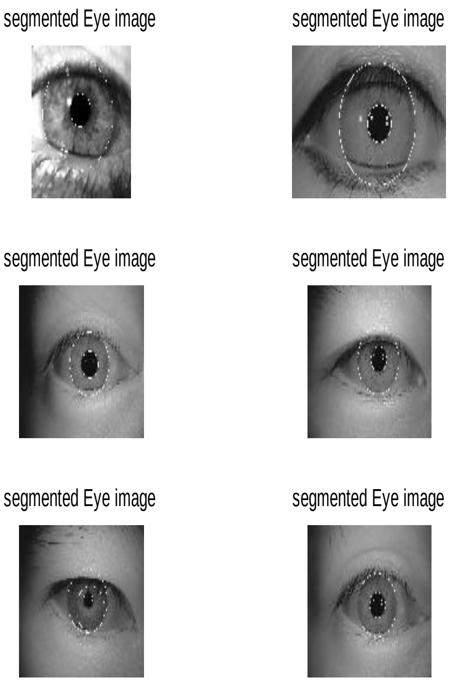


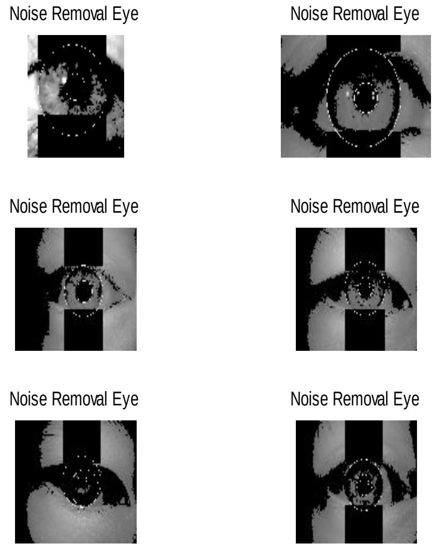
Fig -5 Noise detection and removal using linear hough transform

IV. RESULTS AND FUTURE SCOPE

The result of the system is shown below in fig. The database of the eye images for this project has been taken from the Casia database. The fig-5 shows the Segmentation stage after CHT, and the figure Noise removal eye shows the result after linear Hough transformation. The system which has been used in this project is a quick way of identifying an individual with no room for human error. It is more secure and simple. In our work as we have used Hough transformation for segmentation so it is easy to detect many identification marks for identifying a person and is also detects the eyelids, eyelashes, and reflection and pupil noises present in iris region. This helps in increasing the performance of the iris recognition system.

This work can be enhanced to get real time application of iris recognition system.





V. CONCLUSION

In this paper eyelid and eyelashes detection method is discussed with reduced noise. Eyelids and eyelashes detection method is more accurate. This system will reduce the time for detecting the inner and outer edges of the iris with the help of linear Hough transform and circular Hough transform. iris recognition system consists of an automatic segmentation system based on the Hough Transform, and is able to localize the circular iris and pupil region, occluding eyelids and eyelashes, and reflections. Properly detecting the inner and outer boundaries of iris texture is important for all iris recognition systems.

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