International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 01, January-2016

Iris Recognition as a Biometric Tool in Unconstrained Environments

Gurmail Kaur
M.Tech Student,
BGIET Sangrur, Punjab, India

Mr. Deepinder Singh
Assistant Professor,
BGIET Sangrur, Punjab, India

Abstract **- Iris recognition has been one of the most reliable techniques for biometric authentication due to the inherent stability, randomness and high degree of freedom of iris pattern. In this work, a number of algorithms has been used for final segmentation of iris region.We perform contrast adjustment to make iris region more distinguishable. For this we used imadjust function which has variable gamma parameter to adjust the image. After that we applied Gaussian filter for smoothing the image. After that gray level threshold has been applied to divide the image into low and high intensity area. By doing this, eye and surrounding region like eyelashes and eyelids falls into low intensity segmentation. After that fuzzy-c-means has been applied to cluster the image into fixed number of clusters and canny edge has been applied followed by CHT as preprocessing step for locating the iris region. After that upper and lower eyelid has been removed with the help of sclera region as sclera region has high intensity and eyelids and eyelashes has lower intensity. After that a template has been generated which contains the texture information of resulted iris. Results have been evaluated by sensitivity and specificity parameters. In future work, this algorithm can be modified for eyes having glasses on it.**

Keywords: Iris Segmentation, Circular Hough Transforms, Canny Edge, Contrast Adjustment

1.INTRODUCTION

Iris recognition has been one of the most reliable techniques for biometric authentication due to the inherent stability, randomness and high degree of freedom of iris pattern. As a fundamental step of iris recognition, iris segmentation is an important prerequisite for iris recognition systems. The pioneering work by Daugman [1] shows the effectiveness of an integro-differential operator for near-infrared (NIR) iris images captured in controlled environment. Following Daugman, a number of iris segmentation algorithms have been proposed. Despite excellent performance, the aforementioned algorithms are difficult to be deployed on mobile devices, such as smart phones, tablets and pads. The reason is that these algorithms are less effective for colour iris images captured by mobile devices. Compared with NIR images, colour iris images are much noisier due to specular re- flection. Additionally, mobile devices usually work in less constraint environment, which leads to more noise factors such as illumination variance, eyelids occlusion and motion blur. Therefore, it is necessary to investigate an effective colour iris segmentation method. Over the last few years, significant research has been focusing on colour iris segmentation. Many color iris segmentation methods have been proposed. For example, intergro-differential constellationalgorithm ,intergro-differential operator in YIQ colour space knowledge-based algorithm , improved Hough transform, grow cut based algorithm, classifier based methods. These algorithms report excellent performance. However, the test datasets used to evaluate these algorithms are captured by static cameras.

For using iris as a widely available system for various security reasons and other access systems, it should work well in non-ideal conditions also. By non-ideal conditions we mean that no fixed lightening conditions are there when eye images are being captured. And thus iris recognition in unconstrained environment plays a very crucial rule in day to day life for security and identification purposes. Various countries have also adopted iris as a unique human identification system for their citizens as iris scan cannot be forged by anyone. Human identification based on iris scan is almost foolproof and the most accurate than any other identification system. Iris recognition for unconstrained environment has wide applications in real time environment. As user cooperation is not required thus the person will not get to know where the image capturing device is located. So it is very difficult to forge with such a system. Various applications of such a system are given below:

• Security at borders and airports in various countries.

• Attendance system at various institutes and industries.

• Access to specified areas of any company to check unauthentic access.

• Access to premises like houses and research laboratories.

Iris recognition system works by acquiring the eye image of an individual and is stored in the iris image database for further identification. This iris image is processed by application of various procedures. Various types of existing noise like eyelashes, eyelids and specular reflections are removed. Iris template is created and then stored in the database for recognition. Various methods have been used by the people working in the field of iris recognition.
To extract iris pattern, circular iris is segmented first by localizing boundaries of inner (pupil-iris) and outer (irissclera) iris as shown in Fig. 1. The segmented iris is unwrapped into polar form in normalization process. Then, features are extracted and analyzed.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 01, January-2016

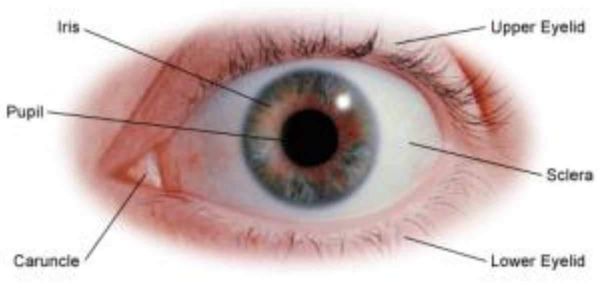

Fig. 1: The anatomy of eye

Of these processes, localization is a crucial process. Miss localization of inner and outer boundaries of iris causes inaccurate iris segmentation and then failure in further analysis. The most common algorithm used in iris localization is Circular Hough Transform (CHT). It has been proven as the best algorithm in localizing iris .

Q. C. Tian et al. [2] employed modified Hough transform to localize the iris. The modified algorithm has been proven successful to localize iris with short computation time. A. E. Yahya and M. J. Nordin[3] proposed a new technique for iris localization. To detect the inner boundaries of iris, they employed direct least square fitting of ellipse and Hough transform for outer boundaries of iris. The correct rate of the proposed method is 96.7%.

A new technique for iris localization also has been proposed by [4]. The researchers localized pupil and iris using combination of thresholding and CHT. The experimental results obtained accuracy of 98.62%.

J. Cui et al. [5] proposed an iris localization algorithm based on texture segmentation. The researchers used information of low frequency of wavelet transform of the iris image and modified Hough transform to segment pupil and iris. They achieved accuracy of 99.54%. Initially, CHT generates edge image using Canny edge detection, then detects the radius from the values in accumulator array and finally detects circles of inner and outer iris. To generate edge image, most of the researchers employed gray scale image instead of colour image. Normally, pupil area is darker than iris. After colour image is transform to gray scale, high intensity is obtained in the pupil area. With the large difference of intensity between pupil and iris area, Canny edge detector can simply generates edge map. In this work, we have used CHT as key algorithm for detecting circular iris and pupil.

1.Proposed Scheme
The proposed scheme is divided into four stages:

- Preprocessing and locating eye from base image
- detecting inner and outer iris-borders,
- detecting eyelids, and detecting eyelashes.
- Template making and matching

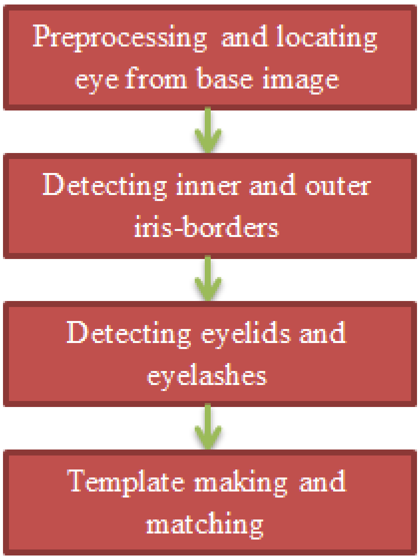

Figure 2:The flow chart of the proposed scheme

Stage 1: Preprocessing and locating eye from base image
As a pre-processing step, we perform contrast adjustment to make iris region more distinguishable. For this we used imadjust function which has variable gamma parameter to adjust the image. After that we applied Gaussian filter for smoothing the image. After that gray level threshold has been applied to divide the image into low and high intensity area. By doing this, eye and surrounding region like eyelashes and eyelids falls into low intensity segmentation. After that fuzzy-c-means has been applied to cluster the image into fixed number of clusters and canny edge has been applied followed by CHT as preprocessing step for locating the iris region. Resulted output dominant circle produced by CHT is used as pre-process step to locate the eye window, which is then used for further processing.We are using Fuzzy Cmean clustering technique for making different clusters of the eye image. These clusters are formed based on the varying intensity values of the various eye parts. The part having higher intensity values belong to the one cluster and the one having lower values of intensity form a different cluster and the other one having the values of intensity in between these two intensity values. These clusters are formed by using Fuzzy methods and based on the membership function we define the exact cluster to which the part of the eye image belongs. Membership function defines the exact belongingness of the given eye part to a particular cluster. The use of Fuzzy-C mean clustering technique is better then the previous K-mean clustering technique because k-mean clustering technique forms the clusters based on intensity values having full belongingness to the cluster or not. But using Fuzzy-C mean clustering, the part of the image is assigned with the degree of belongingness to the cluster which means that the up to what extent the part of the image belong to that particular cluster or to some other cluster. So based on this belongingness or membership function, Fuzzy-C mean clustering technique is better in performance and efficiency then the previously used K-mean clustering technique.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 01, January-2016

The results at this step has been shown below

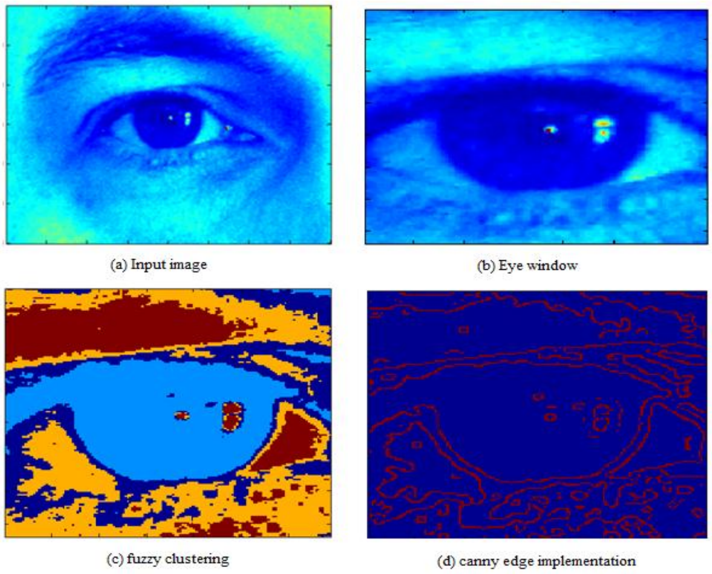

Figure3 : Resulted outputs at stage one

Stage 2: Inner and Outer Iris-Border Detection using CHT and canny edge detector

The iris in an eye-image is an annulus bounded by an inner boundary and an outer boundary. Both the inner and outer boundaries should be located before the iris extraction. Since the inner iris-boundary is the boundary between iris and pupil, to locate the inner boundary is to detect the pupil. The detailed steps for inner and outer iris-border detection are illustrated in the following subsections.

Circular Hough Transform (CHT)

CHT has been recognized as robust technique for curve detection whereby it can detect object even in noisy image [6]. It is also good at extracting geometrical components from any given object [7]. The CHT mainly consists of a voting process, where every point in the image votes for a point in an accumulation array according to a specific voting scheme. Image points belonging to a circularshaped object vote for the same point in the accumulation array, leading to local maxima. The detection of circles is then reduced to the task of detecting peaks in the accumulation array. The CHT requires a user-defined radius range for the search of circular objects and a different range has been provided for both iris and pupil circles.

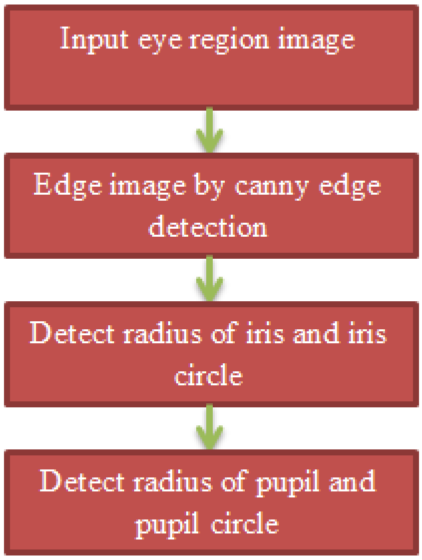

Figure 4: shows the process of CHT in localizing the iris.

The steps involved in this process are generating edge image, detecting radius of pupil and iris and lastly, detecting circle of pupil and iris. The results of this step has been shown in figure below

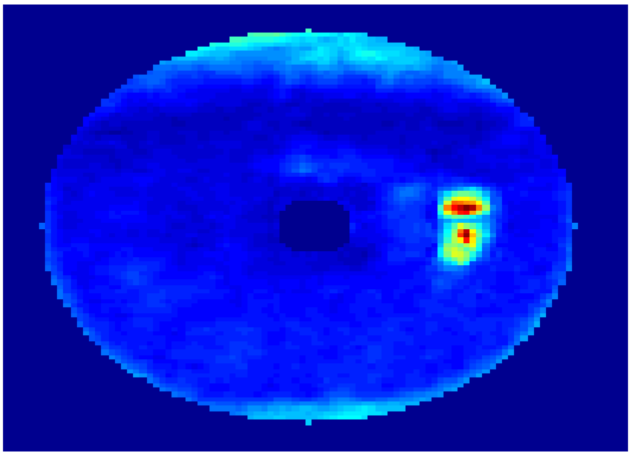

Figure 5: Extracted iris and pupil region from the image

Canny Edge Detector

Canny Edge detector[8] is a very efficient edge detector. It was used to detect iris edges and it established three main performance related criteria i. Good detection: The algorithm should mark all real edges in the image which are possible. ii. Good Segmentation: Edges in the real image should be as close as possible to the marked edges. iii. Low multiplicity response to single edge and image should not create false edges.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 01, January-2016

Canny Edge Detection Process:

a. Smooth the image and eliminate noise.

b. Find the edge strength and define edge direction.

c. Non-Maximum Suppression.

d. Double thresholding and edge tracking the image using hysteresis.

It uses probability for finding errors. It has complex computations and false zero crossing. In our paper it is used to detect the boundaries of the iris. These iris edges are then treated with circular Hough transform to get iris boundaries exactly. Morphological operations are then applied on the eye image to detect noise like eyelids and eyelashes with a particular structuring element.

Stage 3: Detecting eyelids and eyelashes
In this step, threshold method has been applied to segment the sclera region from iris. As eyelids and eyelashes have lower intensity a threshold value is applied to localize these features in the sclera region as sclera region has high intensity value. From this segmentation, upper and lower eyelids are marked by two straight lines.

Stage 4: Template making and matching
In this step final segmented part of iris has been used for feature extraction. This region excludes pupil area, upper eyelid and lower eyelid areas along with eyelashes. Then hamming function is applied to extract and save the features in a folder for matching process. Finally matching has been done from pre-trained templates of all the database and best matched results has been visualized.Below is the actual representation of the result at this stage

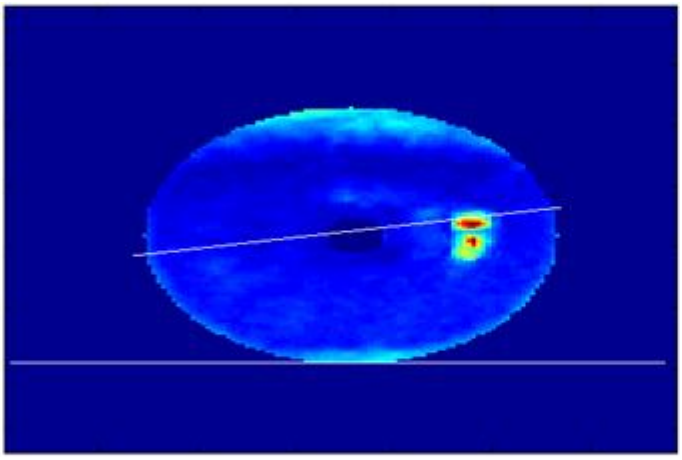

Figure 6: Lines for marking upper and lower eyelids

3 EXPERIMENTAL RESULTS

Various datasets containing eye images taken in unconstrained environment are available. These datasets contain thousands of eye images of various persons taken in varying imaging conditions. In this work, UBIRIS v2 [9] dataset has been used which consists of eye images of various persons from different countries. These persons belong to different age group. Also various eye images of the same person taken with varying camera to eye angle and varying imaging conditions.
We used sensitivity and specificity parameters for evaluating the results. Sensitivity and specificity are statistical measures of the performance of a binary classification test, also known in statistics as classification function:
Thus sensitivity quantifies the avoiding of false negatives, as specificity does for false positives.
The formulas for sensitivity and specificity has been shown below

$$Sensitivity = \frac{TP}{TP + FP}$$
$$Specificity = \frac{TP}{TP + FN} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Below is the Table and plot graph for the results for sensitivity and specificity values

Table 5.2: Table shows results for sensitivity and specificity values for tested datasets

Data	TP	FP	FN	Sensitivity (%)	Specificity (%)
Dataset1	4	0	0	100	100
Dataset2	3	0	1	100	100
Dataset3	4	0	0	100	100
Dataset4	4	0	0	100	100
Dataset5	4	0	0	100	100
Dataset6	4	0	0	100	100
Dataset7	4	0	0	100	100
Dataset8	4	0	0	100	100

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 01, January-2016

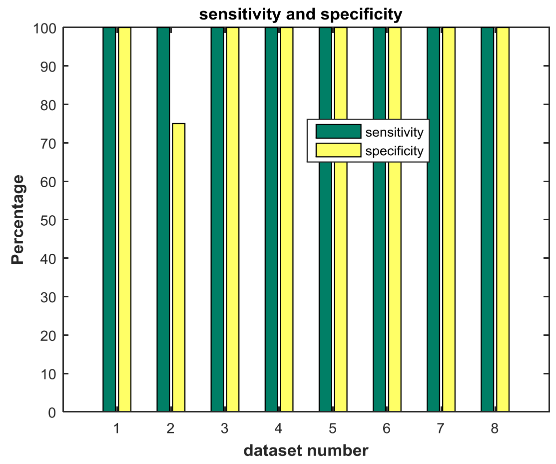

Figure 7: Sensitivity and specificity bar graphs for the matching output

5.1 CONCLUSION

We propose a new iris recognition method for the iris images degraded by noisy factors. The iris has been detected by color information of iris. And the iris authentication is completed by comparing the iris binary code based on "texture information" of iris region. In this work, a number of algorithms has been used for final segmentation of iris region.we perform contrast adjustment to make iris region more distinguishable. For this we used imadjust function which has variable gamma parameter to adjust the image. After that we applied Gaussian filter for smoothing the image. After that gray level threshold has been applied to divide the image into low and high intensity area. By doing this, eye and surrounding region like eyelashes and eyelids falls into low intensity segmentation. After that fuzzy-c-means has been applied to cluster the image into fixed number of clusters and canny edge has been applied followed by CHT as preprocessing step for locating the iris region. After that upper and lower eyelid has been removed with the help of sclera region as sclera region has high intensity and eyelids and eyelashes has lower intensity. After that a template has been generated which contains the texture information of resulted iris. results have been evaluated by sensitivity and specificity parameters. In future work, this algorithm can be modified for eyes having glasses on it.

REFERENCES

[1] J. Daugman, High confidence visual recognition of persons by a test of statistical independence, IEEE Trans. Pattern Anal. Mach. Intell. 15(11) (1993) 1148 – 1161.

[2] Q. C. Tian, Q. Pan, Y. M. Cheng, Q. X. Gao, "Fast Algorithm and Application of Hough Transform in Iris Segmentation", Machine Learning and Cybernetics, 2004. Proceedings of 2004 International Conference on , 26-29 Aug. 2004.vol.7, no., pp. 3977- 3980.

[3] A. E. Yahya, M. J. Nordin, "A New Technique for Iris Localization", International Scientific Conference Computer Science'2008, Information Technology Journal,7(6):924-929, 2008

[4] Y. R. F. Ng, Y. H. Tay, K. M. Mok, "An effective segmentation method for iris recognition system", Visual Information Engineering, 2008. VIE 2008. 5th International Conference on , vol., no., pp.548-553, July 29 2008-Aug. 1 2008.

[5] J. Cui, Y. Wang, T. Tan, L. Ma, Z. Sun, "A Fast and Robust Iris Localization Method Based on Texture Segmentation", Proceedings of the 3rd Iberian conference on Pattern Recognition and Image Analysis, Part II, Pages 162 - 169.

[6] M. Rizon et al., "Object Detection Using Circular Hough Transform", American Journal of Applied Sciences 2(12), pp 1606-1609, 2005.

[7] S. S. Shylalaja et al., "Feed Forward Neural Network Based Eye localizaation and Recognition using Hough Transform", International Journal of Advanced Computer Science and Applications, Vol. 2, No.3,

[8] J.Canny, "A computational approach to edge detection," IEEE Trans. Pattern Analysis and Machine Intelligence, vol.8, no.6, pp.679-698, 1986. http://dx.doi.org/10.1109/TPAMI.1986.4767851

[9] Hugo Proença, Sílvio Filipe, Ricardo Santos, João Oliveira and Luís A. Alexandre; The UBIRIS.v2: A Database of Visible Wavelength Iris Images Captured On-The-Move and At-ADistance, IEEE Transactions on Pattern Analysis and Machine Intelligence, 2009, Digital Object Identifier 10.1016/j.imavis.2009.03.003 March 2011.