Iris Segmentation & Recognition in Unconstrained Environment

Sonia* and Arpit Bansal**

Punjabi University, YCOE (Talwandi Sabo), Punjab (INDIA)
Singlasonia90@gmail.com

Punjabi university, YCOE (Talwandi Sabo), Punjab (INDIA)

Arpitbansal22@gmail.com

ABSTRACT

Recently, Iris recognition systems have gained increased attention especially in non-cooperative environments. One of the crucial steps in the iris recognition system is the iris segmentation because it significantly affects the accuracy of the feature extraction and iris matching steps. In this paper, a new algorithm is being proposed to segment the iris images captured in visible wavelength under unconstrained environment. The proposed algorithm uses the various types of filters to smooth the iris image. The proposed algorithm reduces the error percentage even in the presence of noise include iris obstruction and specular reflection. The proposed algorithm starts with the acquired iris image and determining the expected region of the iris using the Fuzzy C-means clustering technique. The Canny Edge detection is used to detect the edges of the iris or eye. The Hough Transform is employed to estimate the iris radius and center. After detecting the edges and Hough Transform, a new efficient algorithm is developed to detect the upper or lower eyelid. Finally, the non-iris regions are removed and the results of the proposed algorithm on our iris image database demonstrate that it improves the segmentation accuracy and time.

I. INTRODUCTION

Iris recognition is a biometric recognition technology that utilizes pattern recognition techniques on the basis of iris high qualityimages. Since in comparison with other features utilized in biometric systems, iris patterns are more stable and reliable, iris recognition is known as one of the most outstanding biometric technologies [3]. Iris images could be taken from humans eyes free from such limitations as frontal image acquisition and special illuminationcircumstances [3]. Human iris patterns are very stable throughout a person's life. Further- more, each iris is unique and even irises of identical twins are also different. This is because the human iris is a complex pattern and contains many distinctive features such as arching ligaments, furrows, ridges, crypts, rings, freckles and a zigzag collarette thus iris patterns possess a high degree of randomness [2].
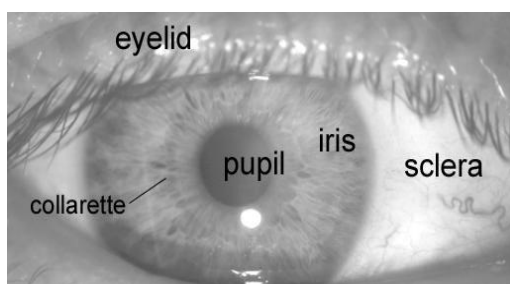

Figure 1:A front-on view of the human eye

The concept of automatic iris recognition was proposed in 1987, many researchers have proposed a lot of powerful algorithms in this field [1]. One of the crucial steps in the iris recognition system is the iris segmentation because it significantly affects the accuracy of the feature extraction and iris matching steps. When a person is to be identified by an iris recognition system, their eye is first photographed, and then a template is created for their iris region. Then this template is compared with the other templates stored in a database until either a matching template is found and the person is identified, or no match is found and the person remains unidentified. Furthermore, a number of new methods are propose to enhance the performance of the segmentation in noisy images such as a method to localize the upper eyelid through detecting it in the sclera region as that will enable the algorithm to deal more effectively with noisy iris images. The proposed algorithm segments the noisy iris images and reduces the execution time, enabling it to be used in real-time applications [2].

II. RELATED WORK

1. Daugman's Approach- The first practical automatic iris pattern encoding and recognition method was proposed by Daugman in 1993. Since then, the basic idea of Daugman's original approach inspired many of the new research developments as well as commercial products.Daugman makes use of an integro-differential operator for locating the

circular iris and pupil regions, and also the arcs of the upper and lower eyelids. The integro-differential can be seen as a variation of the Hough transform, since it too makes use of first derivatives of the image and performs a search to find geometric parameters. Since it works with raw derivative information, it does not suffer from the thresholding problems of the Hough transform. However, the algorithm can fail where there is noise in the eye image, such as from reflections, since it works only on a local scale [4].

2. Wilde's Approach- The wilde's approach is also very prominent in the field of iris recognition. It uses different image acquisition and iris segmentation processes which gives it some advantages over Daugman's system in some aspects. In the iris segmentation step, the circular Hough transform is used to detect the pupil and limbic boundaries. The Hough transform is known to be tolerant to gaps in edge descriptions and is relatively unaffected by image noise. It is claimed that Wildes' approach achieved 0 false accept rate and 0 false reject rate, based on a database of 600 iris images from 60 different persons[5].

III. METHODS OF IRIS RECOGNITION SYSTEM

1. In preprocessing step , used Gaussian and median filters in order to smooth the image. The purpose of doing this is that the edges will be more clear by doing this step and the noisy variations in the image. Some morphological operations also have been applied in order to highlight iris and eye-lid regions.
2. Later on an iris window is cropped by finding a circle using Hough transform.
3. After this fuzzy-c-means clustering has been applied on the cropped window. It divides the whole image into a number of clusters results in better segmentation of whole iris region.
4. Then canny edge detector has been applied in order to get edges around iris boundaries and noisy regions. It provides better results even for less sharp edges in the image.
5. After doing some morphological operations, Hough transform has been applied on cropped window, which gives valid extraction of iris circle. Circle co-ordinates have been stored and pupil circle has been found by Hough transform using pupil radius input range.
6. Then upper eyelid are marked by a line using sclera region around iris because the intensity contrast between the sclera and the upper eyelid is higher than that between the iris and the upper eyelid.
7. To localize the lower eyelid of the iris, the canny edge detection is applied to the lowest half of the iris and then the best line is found using same technique as above.
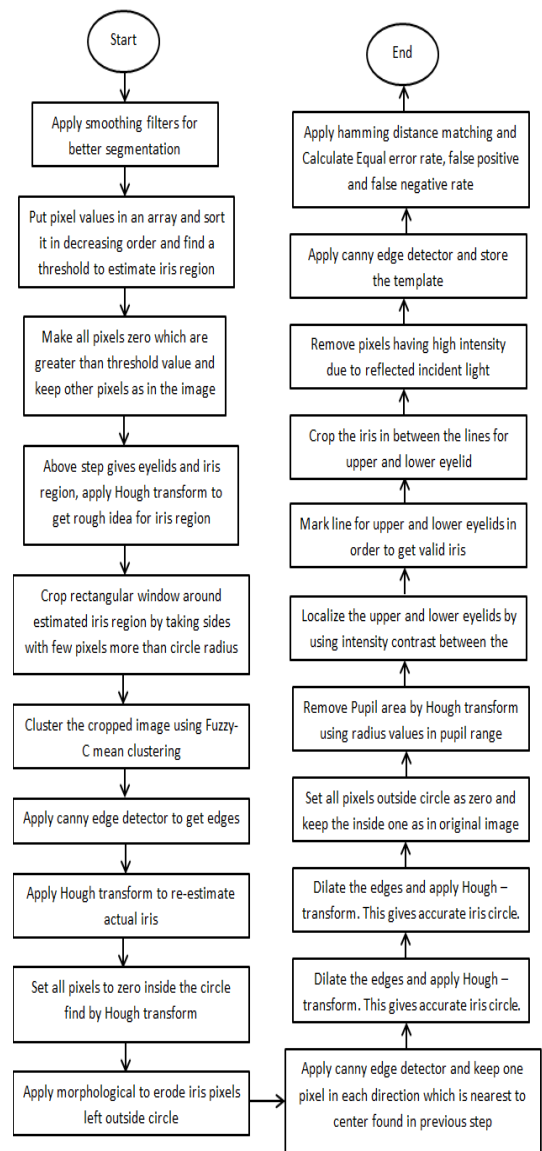

Figure 2: Flowchart for the algorithm used for iris recognition.

8. Pupil area has been removed using median filter then canny edge detector for edge detection and then apply circular hough transform.
9. Templates for all images have been stored in the folder and matching has been done using hamming distance technique.

IV. Experimental Results

In this section, experiments are carried out on the iris image databases taken from internet to evaluate the effectiveness of the proposed methods.5 different sets have used for evaluate the algorithm for iris detection. Below are some results after applying the algorithm in the image.

Figure 3: Original test image
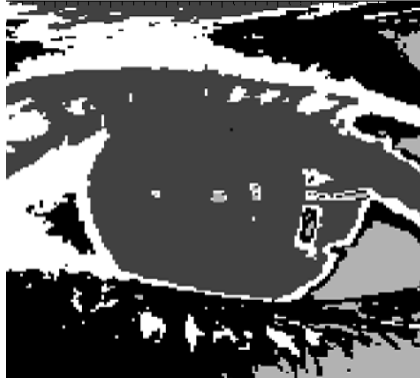
Segmentation

Figure 4: Results after applying fuzzy clustering method on eye window

Fuzzy method of clustering works well then other methods. It segments the entire region according to intensity oriented proximity function and put each pixel in the cluster having higher weightage.
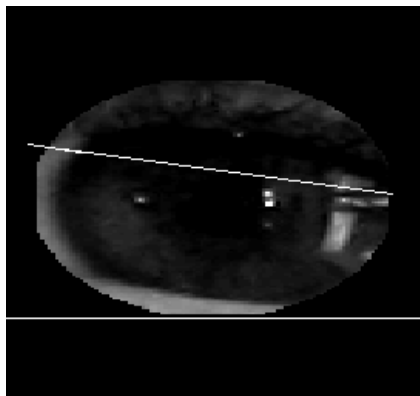
Finding iris and locating upper and lower eyelids

Figure 5: Iris area has been generated
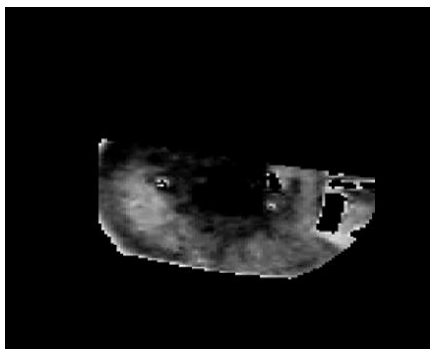
lower and upper eyelids are marked.

Figure 6: Valid iris region extracted from

whole image.

Finally template has been stored in the folder in binary forma as one dimensional array. Matching has been done using binary hamming distance of the template.

Figure 7: Template matching with hamming

distance.

Results

Experimental results for a database of 16 images taken from internet is shown below:

Data	Image1	Image2	Image3	Image4
Data1	True Positive	False Positive	True Positive	True Positive
Data2	True Positive	True Positive	No template	True Positive
Data3	True Positive	True Positive	True Positive	True Positive
Data4	True Positive	No Template	True Positive	True Positive

Table 1 :Shows True Positive and false positive for the database images

Below is the Table and plot graph for the results where +1 treated as True positive and -1 treated as false positive and 0 as no template generated.

Data	Image1	Image2	Image3	Image4
Data1	1	1	1	1
Data2	1	1	0	1
Data3	1	1	-1	1
Data4	1	-1	1	1

Table 2: 1 treated as True positive and -1 treated as false positive and 0 as no template generated.

In the table, if the two samples match well enough, the identity claim is verified, and if the two samples do not match well enough, the claim is rejected. Thus there are four possible outcomes. A true accept occurs when the system accepts, or verifies, an identity claim, and the claim is true. A false accept occurs when the system accepts an identity claim, but the claim is not true. A true reject occurs when the system rejects an identity claim and the claim is false. A false reject occurs when the system rejects an identity claim, but the claim is true. The two types of errors that can be made are a false accept and a false reject. In table 5.2, plot

graphs for the results1 treated as True positive and -1 treated as false positive and 0 as no template generated.

Results for data 1

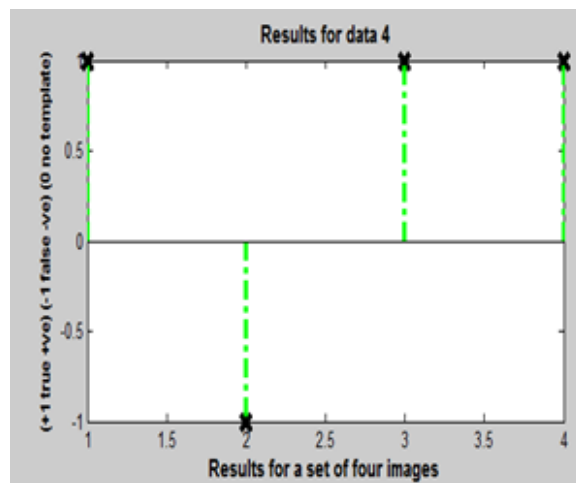Results for data 2

Results for data 3
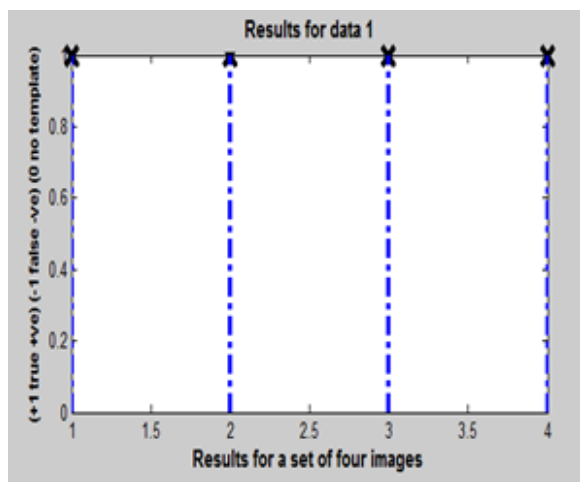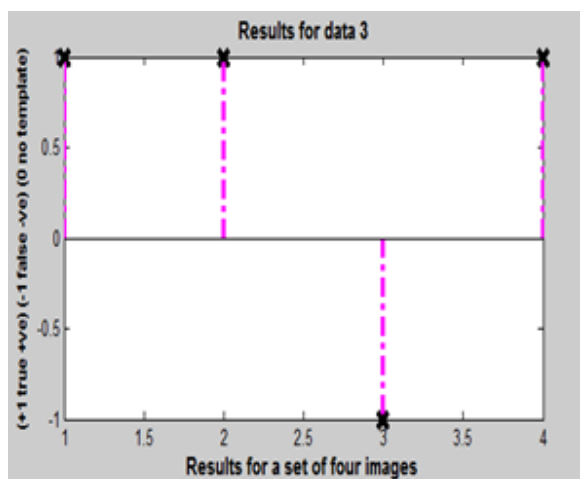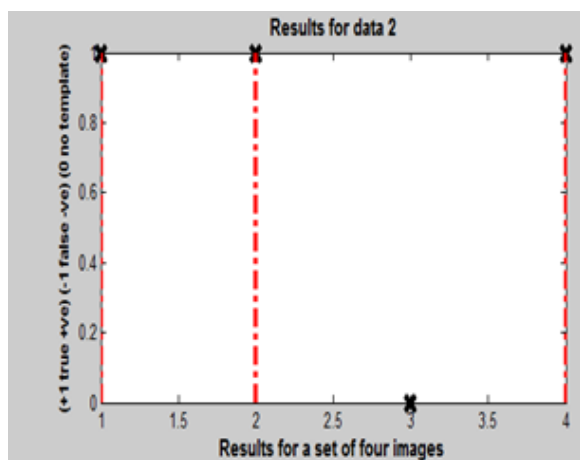

Results for data 4

Figure 8: Stem plots showing results as output from template matching.

V. CONCLUSION

We have presented an efficient algorithm for noisy iris image segmentation in the context of non-cooperative and less-cooperative iris recognition. Firstly, fuzzy method applied to cluster the whole iris image into different parts. The genuine iris region is then extracted with the assistance of several semantic priors, and the non-iris regions (e.g. eyelashes, eyebrow, glass frame, hair, etc.) are identified and excluded as well, which greatly reduces the possibility of mis-localizations on non-iris regions. Secondly, Hough transform is applied to extract the valid iris region and for removal of pupil.. Thirdly, upper and lower eyelids are located and removed which results in required iris region. Finally, binary template has been generated and matching has been performed for existed templates. Experimental results have been noted for image as true and false positive rates.

REFERENCES

[1] S.Sanderson, J. Erbetta. Authentication for secure env based on iris scanning technology. *IEEE Colloquium on Visual Biometrics*, 2000.

[2] L. Ma, Y. Wang, T. Tan. Iris recognition using circular symmetric filters.National Laboratory of Pattern Recognition, Institute of Automation, Chinese Academy of Sciences, 2002.

[3] E. Wolff. *Anatomy of the Eye and Orbit*.7th edition. H. K. Lewis & Co. LTD, 1976.

[4] R. Wildes. Iris recognition: an emerging biometric technology. *Proceedings of the IEEE*, Vol. 85, No. 9, 1997.

[5] N. Ritter. Location of the pupil-iris border in slit-lamp images of the cornea.*Proceedings of the*

International Conference on Image Analysis and Processing, 1999.

[6] D. Field. Relations between the statistics of natural images and the response properties of cortical cells.*Journal of the Optical Society of America*, 1987.

[7] R. Wildes, J. Asmuth, G. Green, S. Hsu, R. Kolczynski, J. Matey, S. McBride. A system for automated iris recognition.*Proceedings IEEE Workshop on Applications of Computer Vision*, Sarasota, FL, pp. 121-128, 1994.

[8] W. Boles, B. Boashash. A human identification technique using images of the iris and wavelet transform.*IEEE Transactions on Signal Processing*, Vol. 46, No. 4, 1998.

[9] S. Lim, K. Lee, O. Byeon, T. Kim. Efficient iris recognition through improvement of feature vector and classifier.*ETRI Journal*, Vol. 23, No. 2, Korea, 2001.

[10] A. Oppenheim, J. Lim. The importance of phase in signals.*Proceedings of the IEEE 69*, 529-541, 1981.

[11] http://en.wikipedia.org/wiki/Hough_transform
[12] S. A. Sahmoud, I.S. Abuhiba, Efficient iris segmentation method in unconstrained environment,Elsevier,2013.