INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 3)
Available online at: www.ijariit.com

Some studies on sclera vascular pattern recognition

Kanchan D. Deshmukh
kanchandeshmukh89@gmail.com
Gokhale Education Society's R. H. Sapat College of Engineering, Management Studies and Research, Nashik, Maharashtra

Hemangi H. Kulkarni
hemangikulkarni@rediffmaill.com
Gokhale Education Society's R. H. Sapat College of Engineering, Management Studies and Research, Nashik, Maharashtra

ABSTRACT

Sclera vein patterns that reside in the human eyes can be one of the biometric for authentication. These vein patterns are stable and unique. Firstly, Segmentation of sclera region along with veins is carried out using otsu Binarization and Contour method. Edge Histogram Descriptor is used for feature extraction of vein patterns. For classification K-nearest Neighbor method is implemented on wide open eye images of the UBIRIS.v1 database.

***Keywords*:** *Sclera, Vein pattern, Authentication*

1. INTRODUCTION

The ocular surface in the human eye consisting of sclera vein patterns is used as biometric for identification of individuals. Every individual has unique sclera vein patterns and they are hard to spoof as they reside inside the eye region [1]. As the vein patterns are randomly oriented thus it is not easy to cheat the system. The vein patterns also do not deteriorate with age, collagen. For extending the population coverage, changing environmental conditions and to get the accurate results sclera vein patterns can be considered as a good biometric [2]. The advantages of using sclera vein pattern are that the system is contact-less and the vein patterns are internally located in the body so difficult to reproduce. Other biometric traits have problems related to recognition and spoofing they can be overcome in case of vein patterns. Vein patterns are not left unintentionally anywhere, not misrepresented by any disease and also they cannot be easily forged. Therefore blood vein patterns are stable over a period of time and unique to every individual [4]. The opaque white region in the eye beside iris and pupil with blood vein patterns makes sclera [2]. Sclera has advantages such as the vein patterns do not deteriorate with the age or alcohol consumption, allergies.

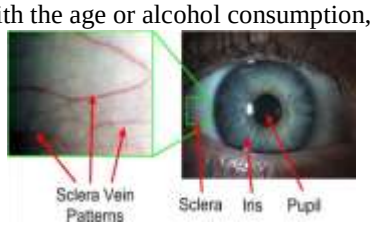

Fig. 1: Parts of eye and sclera region [2].

S. Alkassar *et al.*, [1] proposed segmentation of sclera region with multiple color space skin classifiers to remove the noise and feature extraction is carried out using DT- DWT (Dual-Tree Complex Wavelet Transform). The matching is done using UBIRIS.v1, UBIRIS.v2 and UTIRIS databases which show comparable results between these methods such as KFDA(Kernel Fisher discriminant analysis) and PCA(Principal component analysis), LDA(Local directional pattern), KPCA(Kernel-PCA). Zhi Zhou *et al*. proposed segmentation of sclera for grayscale and color images and line-descriptor method for feature extraction. The human ID identification is done for UBIRIS and IUPUI Multi-wavelength Database through RANSAC method [2]. S. Alkassar *et al*. designed a system where adaptive active contour without edges is used for sclera segmentation. Feature extraction is achieved using Harris corner and edge detection. A two-stage decision method is proposed by using the Euclidean distance and the angle difference for classification on UBIRIS.v1 and UTIRIS databases [3]. Delna K. V. et al. carried segmentation by locating iris with circular Hough transform and feature extraction is done by principal component analysis and Hamming distance based method is used for template matching [5].

From literature, it is clear that to get the high recognition accuracy the separation of ROI, extraction of vein patterns and classification methods need to be carefully selected. The paper is organized in following sections. Section I depicts introduction, Section II explains the Sclera Recognition system, Section III presents experimental results and Conclusion is presented in Section IV.

2. SCLERA RECOGNITION SYSTEM

2.1 Sclera Segmentation

In this section, Pre-processing for removal of unwanted entities and sclera region segmentation is being performed on wide open eye images from the UBIRISv.1 database.

- **Pre-processing**

Pre-processing where conversion of an original RGB image into grayscale and then otsu's binarization is done for a clear representation of iris as the binarized image has white and

black regions. This image provides a precise view of sclera region and iris so as to separate out iris part.

Fig. 2: Pre-processing steps

Figure 3 shows the original RGB image from the database, grayscale image and binarized image with the black and white region.

(a) (b) (c)

Fig. 3: (a) Original image (b) Grayscale image (c) Binarization image

$$G = \sum_{x}^{b}\sum_{y}^{w} \arg\left(I(x,y).R + I(x,y).G + I(x,y).B\right)$$

- **Sclera Segmentation**

Sclera region separation is a very difficult task as it is surrounded by other compact parts such as iris, eyelids, and eyelashes. Segmentation is the first most essential step in any biometric system. In sclera Identification, incorrect segmentation may introduce other non-required patterns such as iris, eyelids, skin part or eyelashes and also reduce the vein patterns for processing [6].

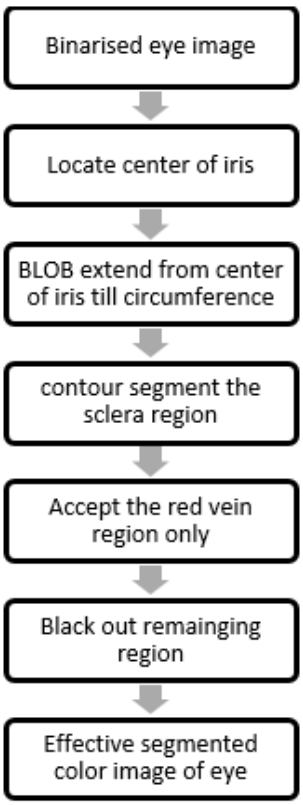

Fig. 4: Flowchart

Figure 4 shows the steps for separation of sclera region from other parts. The center of the iris is detected from the binarized image. BLOB (Binary Large Object) is a group of connected pixels. This group of pixels helps to separate the iris. The BLOB will extend from calculated center point till the circumference of the iris. Then taking contour function segmentation of sclera is carried out.

$$Segment\ Image = \begin{cases} Accept & if\ R>254\ \&\ G<5\ \&\ B<5 \\ Set\ Black & otherwise \end{cases}$$

The contour will accept only the red vascular region and discard other region making it background. Thus masking the image shows the sclera to stand out in its place in fig. 6.

2.2 Feature Extraction

Edge histogram descriptor (EHD) method is used to accurately extract the orientation and edges of vascular patterns in sclera region. The EHD is based on five types of edges in each local area, called a sub-image. When EHD is applied on an image is divided into 4x4 non-overlapping blocks. Therefore, the image is partitioned into 16 sub-images all of the equal size [7]. The five different types of edges are formed like: horizontal, vertical, 45 diagonal, 135 diagonal and non-directional edges. For every sub-image, 5 bins of edge histogram can be generated, corresponding to the above five groups.

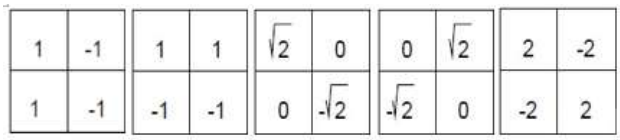

Fig. 5: Five edge filters: (a) horizontal filter, (b) vertical filter,(c) 45 diagonal filter, (d) 135 diagonal filter, and (e) Non-directional filter [7].

For more clear distribution of edges, the image can be further divided into smaller blocks called as image-block. Then mean for the sub-blocks is calculated and convolved with above five filters shown in fig. 5. Thus, we get the five directional edge magnitudes of sclera vein related to five edge type. If the threshold is smaller than maximum magnitude than block is considered to be having that edge type. For each sub-image compute five histogram bins. Dividing each bin with a total number of image-blocks in the sub-image will normalize each histogram. As each sclera image is divided into 4x4 sub-images Thus we get the total 80 bins (4x4x5) for sclera vein orientation histogram.

2.3 Classification

We have implemented classification for scleral vein recognition using:

- **K-nearest neighbors**

For scleral vein template matching K-NN (K-nearest neighbor) method is implemented. A given test image is compared with training templates. The training templates are described by N attributes. Every template stored depicts a point in n-dimensional space. Similarly, in an n-dimensional pattern space, all the training templates are stored. Whenever any unknown template is given, a k-nearest neighbor (k-NN) classifier searches for pattern space for the k training templates and the one closest to the given templates is assigned [8].

The matching and decision process between two sclera templates is the final stage where the St^f of an enrolled user is compared in terms of local orientation and local phase with St^t of any test template.

$$D_p = \begin{cases} 1, & if\ dist(st^f, st^t) \leq th_p \\ 0, & otherwise \end{cases}$$

Euclidean distance is used for classification between training and testing template.

3. RESULTS AND DISCUSSIONS

3.1 Database

The ubiris.v1 database consists of 1877 images of 241 people in two sessions [10]. The first session is for the enrolment has the images with the decreased noise factor. In the second session, images have focus and noise problems. This adds several noise problems with the minimal active participation of subjects [9].

3.2 Results

Figure 3 (a) shows the original image of the eye taken from UBIRIS database. The implementation of the algorithm has been carried out on Microsoft visual studio 2010 using C# programming. Images in UBIRIS database also contains the regions that will give error while matching or may also give the false match or non-match. Figure 6 shows required ROI i.e. sclera region of the proposed segmentation algorithm.

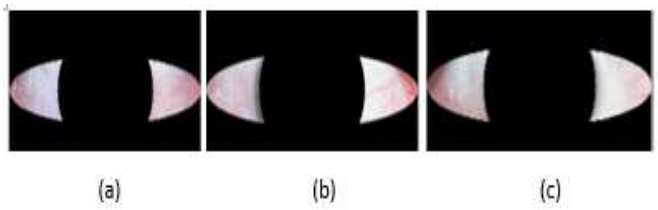

Fig. 6: Results of the Segmented image of sclera veins of three different person

Figure 6 shows that the segmented results of eye image where all other unwanted parts are removed. So all other regions except sclera are turned black. The Otsu binarization and contour methods give better results for segmentation process.

Fig.7: Classification using KNN

Figure 7 shows the GUI for the implemented scleral vein recognition system.

4. CONCLUSION

There should be advanced human authentication system which can be put up against spoofing. Recent studies present the advantages of using sclera vascular patterns for individual recognition as the veins is internally located and unique to everyone. This paper presents effective segmentation for separating sclera from other parts of eye Eyelids, Iris, Eyelashes and the surrounding skin is successfully removed and segmented eye images are usable for the further vascular recognition process. Classification is performed using kNN (k-nearest neighbors). Accurate results are obtained by the proposed system.

5. REFERENCES

[1] S. Alkassar, W. L. Woo, S. S. Dlay and J. A. Chambers, "Enhanced segmentation and complex-sclera features for human recognition with unconstrained visible-wavelength imaging,"*2016 International Conference on Biometrics (ICB)*, Halmstad, pp. 1-8, 2016.

[2] Z. Zhou, E. Y. Du, N. L. Thomas, and E. J. Delp, "A New Human Identification Method: Sclera Recognition," in *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans*, vol. 42, no. 3, pp. 571-583, May 2012.

[3] S. Alkassar, W. L. Woo, S. S. Clay and J. A. Chambers, "Robust Sclera Recognition System With Novel Sclera Segmentation and Validation Techniques," in IEEE Transactions on Systems, Man, and Cybernetics: Systems, vol. 47, no. 3, pp. 474-486, March 2017.

[4] Thomas, N. L., Yingzi Du, Zhi Zhou, and Sabah A.Jassim. "A new approach for sclera vein recognition", Mobile Multimedia/ Image Processing Security and Applications 2010.

[5] K. V. Delna, K. A. Sneha and R. P. Aneesh, "Sclera vein identification in real time using single board computer," 2016 International Conference on Next Generation Intelligent Systems (ICNGIS), Kottayam, 2016, pp. 1-5.

A. Das, U. Pal, M. A. F. Ballester and M. Blumenstein, "Sclera recognition using dense-SIFT,"*2013 13th International Conference on Intelligent Systems Design and Applications*, Bangi, pp. 74-79, 2013.

[6] Won C.S. (2004) "Feature Extraction and Evaluation Using Edge Histogram Descriptor in MPEG-7". In: Aizawa K., Nakamura Y., Satoh S. (eds) Advances in Multimedia Information Processing - PCM 2004. PCM 2004. Lecture Notes in Computer Science, vol 3333. Springer, Berlin, Heidelberg.

A. Das, U. Pal, M. A. Ferrer and M. Blumenstein, "SSRBC 2016: Sclera Segmentation and Recognition Benchmarking Competition," 2016 International Conference on Biometrics (ICB), Halmstad, 2016, pp. 1-6.

[7] S. Alkassar, W. L. Woo, S. Dlay and J. Chambers, "Sclera recognition: on the quality measure and segmentation of degraded images captured under relaxed imaging conditions," in *IET Biometrics*, vol. 6, no. 4, pp. 266-275, 7 2017.

[8] UBIRIS version 1 Database (http://iris.di.ubi.pt/ubiris1.html)

