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Human Identification by Segmentation and Enhancement of Sclera using Matlab

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Abstract

Sclera is the white and opaque covering of the eye. The vein structure in sclera is unique and distinct to each person. This paper proposes a recognition method for human identification (ID) using sclera as a biometric. The challenge faced is that the vein structure moves with the movement of the eye and vessel structures are often defocused and or saturated. The sclera has been consider multilayered pattern. The contributions of the paper are:

- *This paper proposes a new approach for human sclera identification.*
- *This paper proposes a new method for sclera segmentation which works for color as well as grayscale images.*
- *This paper designs a Gabor wavelet based sclera pattern enhancement method to emphasize and binarize the sclera vessel pattern.*
- *This paper proposes a line descriptor based feature extraction, registration, and matching method.*

Keywords: *Biometrics, sclera vein recognisation, sclera segmentation, sclera feature matching, enhancement, gabor filter.*

I. Introduction

Biometrics defines a standard measurement related to human characteristics. It is used as a form of identification and access control used for human identity. Biometrics can be classified into two categories. They are:

- Physiological biometrics: That identity from individual biological traits likes face, Iris, Fingerprint, etc.
- Behavioral Biometrics: That identity from individual behavioral traits like gait, typing, etc.

Biometrics is mainly used in security systems and can reduce or eliminate the need to retain a key or to eliminate a password and can speed up user throughput being less intrusive. First, it detects the person's original identity with certainty while still honoring their civil and personal rights. Sclera recognition has many advantages compare to other methods. Face recognition is the natural way to identify a person, but human faces can change over time and age which can affect recognition accuracy. Moreover, in some cultures acquiring facial images can make some users uncomfortable. Though fingerprint recognition is very stable and high accuracy, it cannot be used for identification at a distance and may cause some hygienic issues since it is a contact based biometric. Iris recognition needs to be performed in the near-infrared (NIR) spectrum and requires extra NIR illuminators. Overall, no biometric can be perfect or applied universally. Sclera recognition can be used for identification capability in a distance and scalability to a large population. The blood vessels structure is visible and stable over time and can be obtained non-intrusively via visible wavelength illumination.

II. SCLERA PROPOSED SYSTEM

II. 1: Project description

The sclera completely surrounds the eye and has a tissue of four layers namely the episclera, stroma, lamina fusca, and endothelium. With increasing age, Collagen and elastic fibers depreciate glycosaminoglycan loss and sclera dehydration occurs. In addition lipids and calcium salts accumulate, but the blood vessels do not deteriorate. The blood vessel patterns are unique and by both genetic and developmental components formatting their structure. The paper itself proposes a deformation- invariant line descriptor based sclera recognition. It consists of four steps-

- Sclera segmentation
- sclera vessel feature extraction
- sclera vessel feature matching
- matching decision

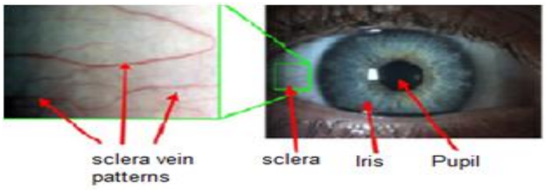

Fig 1: structure of eye and sclera

II. 2: Proposed system

The original image selected is to be segmented first to obtain only the white part of the eye. Next, the features must be extracted and matched. Later the matching decision is done through the available database and output is obtained. The following diagram shows step by step process.

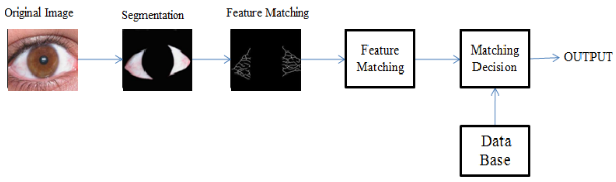

Fig 2: Flowchart

III. SCLERA SEGMENTATION

Sclera segmentation is the first step in sclera recognition. On segmenting the sclera, the blood vessels are clearly exhibited. Even if the light is directed to pupil area to avoid specular reflections, the curled nature of the eyeball has a wide number of intensity values. Brighter skin regions as a result of illumination and occasionally the presence of mascara challenges the sclera segmentation. This can be done by dividing the images into a number of regions called pixels. It is carried out in four steps.

- Estimation of glare area
- Iris boundary detection
- Sclera area detection and
- Refine eyelid and iris

III. 1: Estimation of a glare area.

The glare area refers to a small bright area of the Iris image. Glare inside the pupil or nearby the pupil area can be generalized as a bright object on a much darker background with sharp edges. In some cases, there would be many bright areas with very bright illumination. So a Sobel filter is first applied to highlight desired glare areas. The glare detection method is useful for grayscale images. The conversion of original RGB color image to Grayscale image is employed and then applied to the Sobel filter for convolution output.

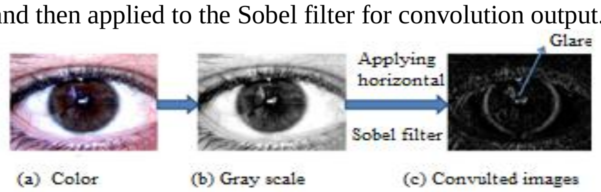

Fig 3: Glare detection approach

III. 2: Iris boundary Detection

This greedy angular search method is used to segment the pupil and iris and also to obtain the regions. The algorithm searches along the radial direction at a predefined set of angles to estimate the pupil boundaries and then iteratively maps the highest edge value along the angular direction for the highest edge value within some radial length range. The final result will be an image with each pixel's value equal to the number of individual radial searches that include the particular pixel.

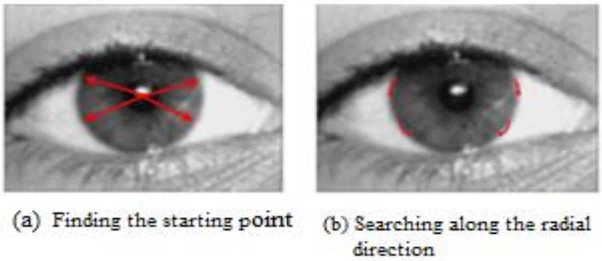

Fig 4: Iris boundary detection

III.3: Sclera area detection.

In grayscale images, the paper uses an Otsu's based method for sclera segmentation. Otsu's method is a linear discriminate analysis- based threshold method. The process of sclera area detection has the following steps: The region of interest (ROI) selection step, Otsu's method based threshold step and the sclera area detection step. Finally it eliminates non-sclera areas. The same approach is applied to detect the right sclera area.

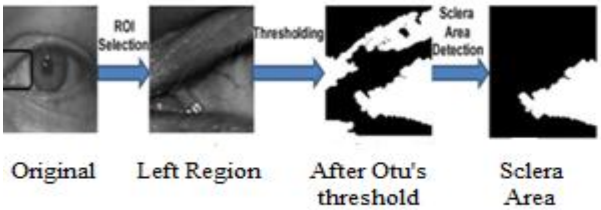

Fig 5: Sclera area detection

III.4: Refine eyelid and Iris.

The top and bottom boundaries used as initial estimates of the sclera boundaries, and a polynomial is fit to every single boundary. Using the upper and lower portions of the estimated sclera region used as guidelines and the upper lid, lower lid and the iris boundaries are then obtained using the Fourier active contour method.

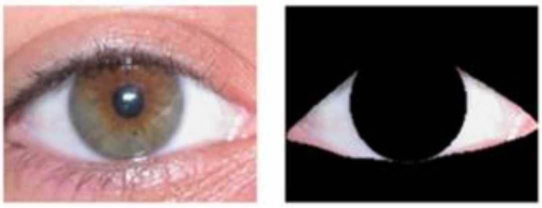

Fig. 6: segmented sclera color image.

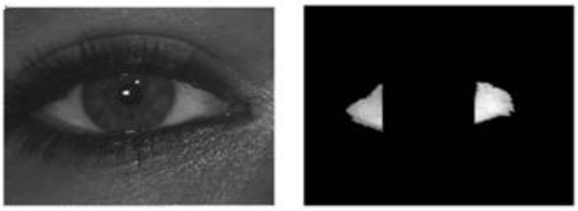

Fig .6.1: Segmented sclera gray scale image.

IV.SCLERA ENHANCEMENT

The sclera vascular patterns are often blurry and have low contrast as the segmented sclera region is highly reflective. It is important to enhance the vein patterns to mitigate the illumination effect to draw an illumination-invariant process. To estimate the vision process of primary visual cortex, a family of Gabor filters is used. A bank of even and odd Gabor filters is used because the vascular patterns could have multiple orientations. Since the even filter is symmetric and the filter is used to determine and identify the location of vessels.

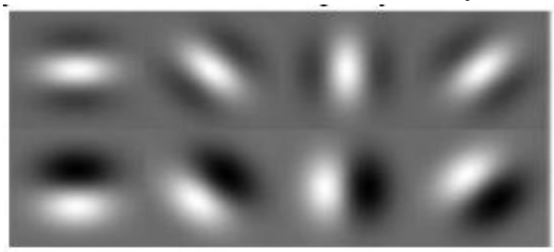

Fig.7: Example image of Gabor filters bank with four directions. The top image is an even filter bank and the bottom image is odd filter bank.

$$IF(x,y,v,s)= I(x,y)*G(x,y,v,s) \text{------ (1)}$$

Where IF(x,y,v,s) is the filtered image with different orientation 'θ'' and scale 's'.
I(x,y) is original intensity image and
G(x, y, v, s) is the Gabor filter
All the filtered images in the database are fused together to get the vessel boosted image.

$$F(x,y) = \sqrt{\sum v \in \theta \sum s \in S(I_F(x,y,v,s))^2} \quad \text{------(2)}$$

V. FEATURE EXTRACTION

In order to reduce the dimension of an image, this paper proposes feature extraction in image processing. To thin the detected vessel structure to a single-pixel-wide skeleton and to remove branch points, the binary morphological operations are used and the result is a set of single-pixel wide lines that represent the vein structure. The process is repeated until the line segments are closely linear with line's maximum size. For every segment, the least square line is fitted. The segments are described by three quantities:

- The segment angle to some sort of reference angle at the iris center.
- The segment distance to the iris center.
- The dominant angular orientation of the line segment.

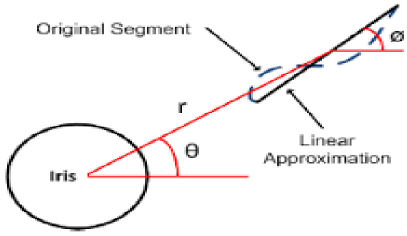

Fig 8: Sketch of parameters of segment descriptor

The template for the sclera vessel structure is the set of all individual segment descriptors which are of fixed length. The line descriptor can extract pattern in different orientations, which makes it possible to achieve orientation-invariant matching.

VI. SCLERA MATCHING

Sclera matching is an important and final step in the recognition process. The matching decision is made whether the person's sclera is matched with the sclera of our database. The sclera matching is of two modules.

- Sclera Template registration
- Sclera Template matching

VI. 1: Sclera Template Registration

Firstly, the camera-to-object distance and the zoom should not vary. The challenges faced are while acquiring the images, the eyelids can have different shapes and may be tilted with respect to the camera and also the iris location and pupil size may vary. Taking these variances into account, It is necessary to perform Sclera ROI registration to achieve global translation, orientation and scaling invariance. It must be robust and exhaustive but does not unduly introduce false accepts. The segments of vascular patterns could move individually and this change must be considered while registration. This paper introduces a new method based on a random sample consensus (RANSAC)-type algorithm to estimate the best fit parameters for registration between the two sclera vascular patterns. RANSAC is an iterative model-fitting method that can robustly fit a model, even given noise. To limit potential false accepts due to over-fitting, the patterns are registered as a set of points- the centers of the line segments that make up the template. As it does not register the patterns using the same parameters for matching, the artificially introduced false accepts are reduced. The algorithm uses two points for registration. One from test template and other from target template. It also randomly chooses a scaling factor and a ration value, based on a priori knowledge of the database.

VI. 2: Sclera Template matching

For accuracy, it is important to design an algorithm that can tolerate segmentation errors. The weighting image is created from the sclera mask by fixing interior pixels in the sclera mask to 1. Pixels with some distance of the boundary of the mask to 0.5 and pixels outside the sclera mask to 0. Thus, the matching value always ranges from 0 to 1 and allows for weighing the matching results based on the segments that are near the mask's boundaries.

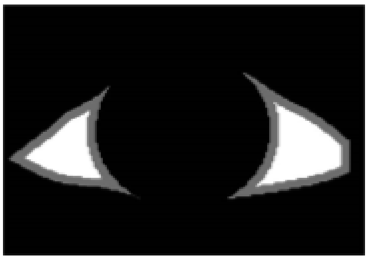

Fig.9: Weighting image

After the templates are registered, each line segment of the test template is compared with the line segments in then target template for matches.

VII. RESULTS

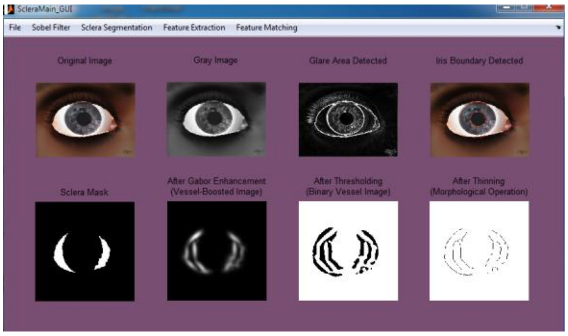

Fig 10: Outputs of segmentation and Enhancement

The input eye image to be tested is selected from test images. The input eye image is applied to the Sobel filter thereby converting it to Gray scale image and Glare area are detected. The next step is to segment the sclera. The steps include Iris boundary detection and Sclera mask. By this the iris and eye lids are refined and Sclera part is segmented. Now to extract desired features from sclera, Gabor filter is used. The image is then applied to adaptive thresholding, the boundaries of eye images at regional level is detected.

For enhancing the eye images a family of gabor filters are used. A bank of even and odd filters is used. There are shown in fig 11, fig 12 below.

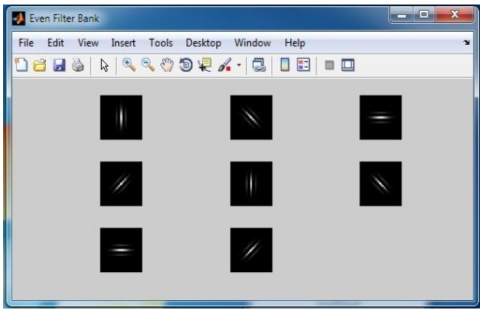

Fig 11: Even Gabor filter bank

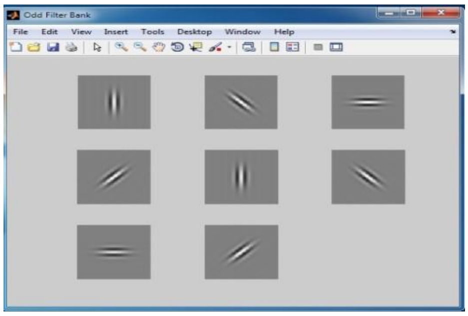

Fig 12: Odd Gabor filter bank

To detect a person the test image is to be matched with the database. If it is matched with the database, the result is as shown in fig :13. If the input image does not match with the database, the result is as shown in fig :14

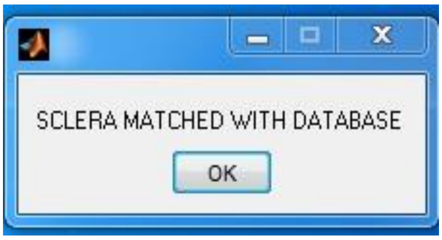

Fig 13: Output of matched image

Fig 14: Output of unmatched image

VII. CONCLUSION

This paper emphasizes on various biometric systems and Sclera recognition method. Sclera recognition is a physiological biometric that ensures identification at far distances and also provide good results in low-resolution images all at visible wavelengths. In this paper the results are shown for different types of eye sclera images .If input image features are matched with the database images then it shows that the sclera is matched with database images. If sclera features are not matched with database images then it shows sclera is not matched with the database images. The recognition is possible when there is just a minor portion of sclera available.

REFERENCES

[1] G. Medioni, J. Choi, C.-H. Kuo, and D. Fidaleo, "Identifying noncooperative subjects at a distance using face images and inferred threedimensional face models," IEEE Trans. Syst., Man, Cybern. A, Syst., Humans, vol. 39, no. 1, pp. 12–24, Jan. 2009.

[2] Dr. P.V. Rama Raju,R.DivyaSree, P.Lakshmi, Y.L.Prannethaand Mr. CH. Ganesh, "IRIS Signal Dispensation and Cataloging by Means of Compound Gabor Filter" International Conference on Navigational Systems and Signal Processing Applications (NSSP-2013) in technical co-operation with IEEE, 13th&14th December 2013, ANU College of Engineering & Technology, AcharyaNagarjuna University, A.P., India.

[3] A. K. Jain, A. Ross, and S. Prabhakar, "An introduction to biometric recognition," IEEE Trans. Circuits Syst. Video Technol., vol. 14, no. 1, pp. 4–20, Jan. 2004.

[4] M. Choras, "Emerging methods of biometrics human identification," in Proc. 2nd Int. Conf. ICICIC, Sep. 5–7, 2007, p. 365.

[5] Y. Du, "Biometrics," in Handbook of Digital Human Modeling. Mahwah, NJ: Lawrence Erlbaurm, 2008.

[6] M. De Marsico, M. Nappi, and D. Riccio, "FARO: Face recognition against occlusions and expression variations," IEEE Trans. Syst., Man, Cybern. A, Syst., Humans, vol. 40, no. 1, pp. 121–132, Jan. 2010.

[7] Z. Zhou, Y. Du, and C. Belcher, "Transforming traditional iris recognition systems to work in nonideal situations," IEEE Trans. Ind. Electron., vol. 56, no. 8, pp. 3203–3213, Aug. 2009.

[8] S. Ribaric and I. Fratric, "A biometric identification system based on eigenpalm and eigenfinger features," IEEE Trans. Pattern Anal. Mach. Intell., vol. 27, no. 11, pp. 1698–1709, Nov. 2005.

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