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Recognition of Veins in Sclera for Human Identification

Authors

Ridhika Chopra[1], Prof Minal Puranik[2], Prof Vidya Gogate[3]

[1,2,3]Electronics Department, Mumbai University

[1]ridhikachopra@gmaiil.com, [2]minalpuranik@gmail.com, [3]Vidya.gogate@gmail.com

Abstract

The vein structure in the sclera, the white and opaque outer protective covering of the eye, is anecdotally stable over time and unique to each person. As a result, it is well suited for use as a biometric for human identification. Sclera recognition poses several challenges: the vein structure moves and deforms with the movement of the eye and its surrounding tissues; images of sclera patterns are often defocused and/or saturated; and, most importantly, the vein structure in the sclera is multi-layered and has complex non-linear deformation. Here proposed a new method for sclera recognition, a line descriptor along with feature extraction, registration, and matching method that is scale, orientation, and deformation invariant, and can mitigate the multi-layered deformation effects and tolerate segmentation error.

Keywords:-*sclera recognition, sclera veins, sclera matching.*

I. INTRODUCTION

In the present scenario it is very important to authenticate a person's identity to prevent the fraudulent activity such as accessing sensitive information, creating false identities etc. The most widely used method for this is passwords or other personal information. According to statistics, it states the Interpol has data on 40M of travel documents are stolen/lost. And the stolen documents are further misused by terrorists or fraudsters. Same happens for credit cards also, 88% of credit cards are misused within minutes. There is an increasing need to find a way to solve user identification issues and cut costs for password administration. A more sophisticated method of authentication is to have a unique system that must be capable of identify a person and these identities cannot be stolen and used by other individuals. Biometrics technology is a promising technology that is being touted as a solution to these problems. At present, biometrics technology holds a biometrics is the identification of humans using intrinsic great deal of promise for doing just that, but is not without its limitations and certainly not without its critics. Physiological, biological, or behavioural characteristics, traits or habits. Biometrics has a potential to provide this desired ability to unambiguously and discretely identify a person's identity more accurately and conveniently than other options. Different parameters of an individual can be used for identification. Ocular biometrics comes under one of the classification among biometrics. Out of which sclera vein recognition has got its unique features so as to use as a biometric trait.

This work is a review on one of the biometric method which is sclera vein recognition. Sclera is the white region of the eye. And the vein pattern in the sclera is unique to each person. There are several methods to extract the sclera vein pattern. This paper compares methods and extracts the vein patterns from sclera area for true human identification.

Sclera Recognition

Sclera recognition is identification of a human using the sclera, the 'white of the eye'. It offers several benefits over other eye-based biometrics that makes it well-suited for non-compliant recognition situation.

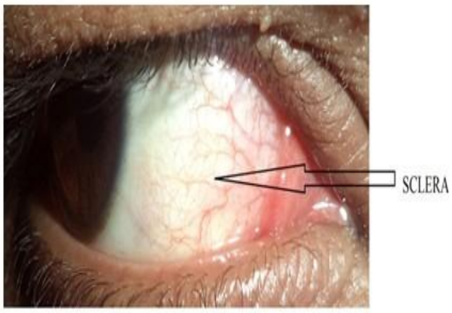


Figure 1:- Sclera

The sclera is the white and opaque outer protective covering of the eye. The sclera completely surrounds the eye, and is made up of four layers of tissue- the episclera, stroma, lumina fusca, and endothelium. The conjunctiva is a clear mucous membrane, made up of epithelial tissue, and consists of cells and underlying basement membrane that covers the sclera and lines the inside of the eyelids. Figure shows an image of an eye under visible wavelength illumination with identification of the sclera vein patterns. In general, the conjunctival vascular is hard to see with naked eye at a distance. For young children, the blood vessels are red in colour. The structure of the blood vessels in the sclera are well suited to be used as a biometric- they are an internal organ that is visible without undue difficulty and they are anecdotally stable over time and unique for each person. Therefore, the vein patterns in the sclera could be used for positive human identification.

In comparison to iris recognition, sclera recognition offers several benefits especially for non-complaint or non-cooperative situations. First, sclera recognition does not require imaging the eye in the near infrared wavelengths. This allows less constrained imaging requirements, including imaging at very long stand-off distances, may not require additional illumination, and perhaps, enable the use of existing imaging systems to acquire and match individuals (such as using existing surveillance systems to acquire the images). Second, sclera recognition does not require frontal gaze images of the eye. For sclera recognition, assuming that the entire sclera region was enrolled for matching, off- angle eye reveal more of the sclera vein pattern for matching. Thus, even an individual who was actively attempting to avoid detection or recognition by looking away from the matching system would be unable to avoid presenting a valid biometric pattern for identification.

II. PREVIOUS WORK

Previous works on recognition of sclera

Many researches were conducted for the identification of human beings based on some unique biometric feature. Many studies are based on the pattern recognition techniques. But there are some problems in the identification of the previous recognition techniques. To solve these problems different solutions have been introduced for accurate recognition.

In 2012, Zhi Zhou, Eliza Yingzi Du, N. Luke Thomas, and Edward J. Delp presented a paper named `A new human identification method: sclera recognition. In this paper identification is possible with the line descriptor based feature extraction, registration and matching method. In this work the segmentation errors and multilayered deformation effects are mitigated. Also, this method is useful for illumination, orientation and deformation invariant photos of the eye. It consists of four modules sclera segmentation, sclera vessel feature extraction, sclera vessel feature matching and matching decision. Segmentation is the beginning measure in the sclera recognition. They proposed fully automatic sclera segmentation method for both color and grayscale images .The experimental result shows that sclera recognition is a promising biometric for positive human identification. The system can recognize the frontal looking images of human, off angle segmentation and recognition is a challenging task for this system. This is one of the main drawbacks of the system.

In 2008, Mohammad Hossein Khosravi and Reza Safabakhsh presented a paper named `

Human eye sclera detection and tracking using a modified time adaptive self organizing map'. In this paper a new method of sclera detection and tracking and its movements is done in a sequence of image based on modified time adaptive self-organizing map (TASOM) based on active contour models (ACMs). The method starts with skin-color segmentation followed by eye strip localization via a novel morphological method. TASOM-based ACM is used to draw out the interior boundary of the eye. This paper presented a fresh method for determining the neuron used, a new definition for unused neurons, and a novel method of feature selection and application to the network. Experimental results demonstrate a very dependable execution of the proposed method in general.

R. Derakhshani, A. Boss and S. Crihalmeanu in 2006 presented a paper named ` A new biometric modality based on the conjunctival vasculature'. In this paper author introduced a conjunctival vasculature feature for the identification. Conjunctival vessels are seen in the visible part of the sclera. These vessels are well seen in the visible light. In this paper, the author discusses about the conjunctiva imaging, pre-processing and feature extraction to derive a suitable conjunctival vascular feature for biometric authentication. An experimental result shows that the conjunctiva vasculature is a good biometric measure of human recognition.

A typical sclera recognition consists of four steps which include sclera segmentation, vein pattern enhancement, feature extraction, feature matching. The registration of feature is a task. Here the comparison is concentrated on feature registration.

III. PROPOSED APPROACH

In this section, it is proposed that a sclera segmentation procedure, vein pattern enhancement method, feature extraction method and finally the feature matching and matching decision. A typical sclera biometric technique is explained in Figure shown below

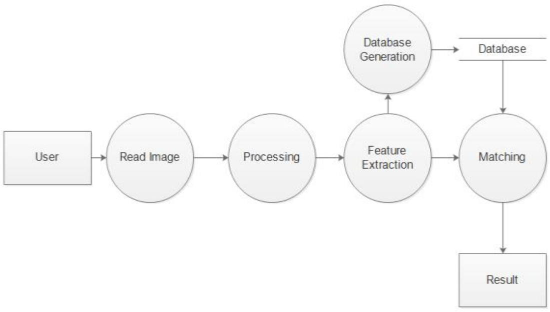


Figure 3:- A typical sclera biometric system with different steps involve

A. Sclera Segmentation

Sclera segmentation is initial phase in the sclera recognition. Itletsinthreestages:1) glare area detection 2) scleraareaestimationand3) iris and eye lid detection & refinement. Figure 3 demonstrates the steps of segmentation.

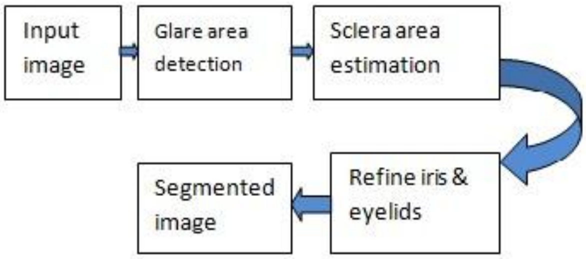


Figure 4:- steps of sclera segmentation process

Glare Area Detection: Glare area means a small bright area near pupil or iris. This is the undesirable portion on the eye picture. For segmentation division 3*3 Sobel filter was applied to high light the needed glare area located in the iris or pupil. Basically it process only for the grayscale picture. If the picture is color, then it needs a transformation to grayscale picture & after that apply it to the Sobel filter to identify the glare area.

Sclera area estimation: As the intensity of sclera a area is different from the background, for which Otsu's thresholding strategy was applied to recognize the region of interest. The stairs of the sclera area detection are: determination of the area of interest (ROI), Otsu's thresholding, sclera region recognition. Left and right sclera range is chosen in view of the iris center and limits. When the region of interest is chosen, then apply Otsu's thresholding for getting the potential sclera ranges.

The right left sclera zone ought to be put in the right and center positions and rectify right sclera area should be placed in the left and center. In this way non sclera areas are wiped out. In the segmentation system all images are not perfectly segmented. Consequently, feature extraction and matching are expected to reduce the segmentation fault. The vein designs in the sclera area are not noticeable in the division system. To get vein designs more noticeable vein design enhancement is to be performed.

B. Vein Pattern Enhancement

The segmented sclera area is highly reflective so vessel structure seen in sclera local is hard to see. To reduce these problems and establish it as an illumination framework, it is important to raise the vein patterns. Gabor filters are used to improve the vein patterns in sclera. Referable to the multiple orientations in the vein design, a bank of Gabor filter is utilized for vein designed improvement.

A Gabor filters built by modulating a sine/cosine wave with a Gaussian. This has the capacity give the ideal conjoint limitation in both space and frequency, since a sine wave is perfectly localized in frequency yet not localized in space Modulation of the sine with a Gaussian provides localization in space, however with loss of localization in frequency. Decomposition of a signal is accomplished utilizing a quadrature pair of Gabor filters, with a actual part determined by a cosine modulated by a Gaussian, and an imaginary part indicated by a sine modulated by a Gaussian. The actual and imaginary filters are otherwise called the even symmetric and odd symmetric components respectively. The image of the distinguishing sclera region is filtered with the Gabor filters with different orientations.

IF(X,Y, Y,S)=I(X, Y)*G(X, Y, Y, S)

H here I(x,y) is original intensity image, G(x,y,υ,s)is that the Gabor filter and IF(x,y,υ,s) is that the filtered picture with completely different orientation `θ' and scale`s'. All the filtered images with in the data base are fused together to get the vessel boosted image. Vein pattern have distinctive thickness at diverse times, this can be owing to dilation and constriction of vessels. So as to avoid this impact morphological operations are utilized. Morphological operations can thin the identified vessel structure and take away the branch points.

C. Feature Extraction

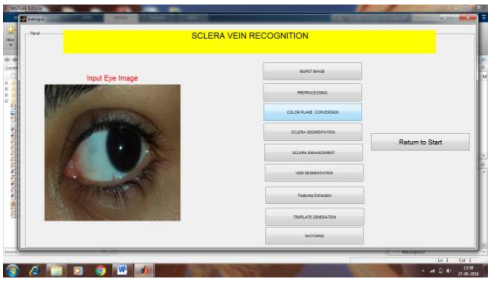
Feature extraction is mainly applied in pattern identification in picture processing to diminish the dimension of an picture. At the point when a picture is specifically used for transforming, it is difficult to treat the huge datain formation of a image. And afterward that input information are transformed to its reduced kind of features which is experienced as the feature vector. At the point when in put information is transformed into set of features is known as the feature extraction. Depending on the physiological status of a person (for example, tiredness or weariness or non-exhaustion), the vessels patterns could have different thicknesses at different times, because of the enlargement and choking of the vessels. In this way, vessel thickness is not a stable pattern for recognition. Likewise, some thin vessels patterns may not be visible at all times. In this paper binary morphological operations are utilized to thin the identified vessel structure down to a single-pixel wide skeleton and to remove the branch points.

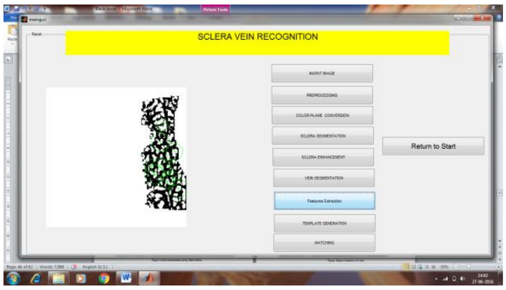
This leaves aarrangement of single-pixel wide lines that represents the vessel structure. These lines are then recursively parsed into smaller segments. The methodology is repeated until the line segments are linear with the line's maximum size. For each segment, a minimums quares line is fit to every segment. These line segments are then used to generate a template for the vascular structure. The segments are described by three quantities—the segment angle to some reference angle at there is focus, the segment distance to the iris focus, and the dominant angular orientation of the line segment. The template for the sclera vascular structure is the set of all individual segments' descriptors. This suggests that, while each segment descriptor is of a fixed length, the overall template size for a sclera vessel structure fluctuates with the number of individual segments.

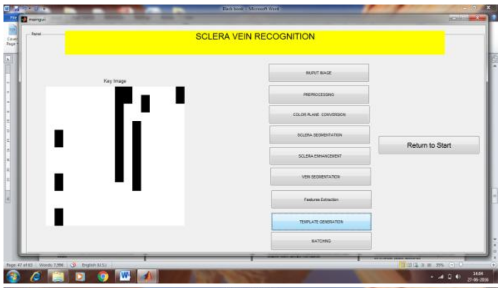
D. Feature Matching

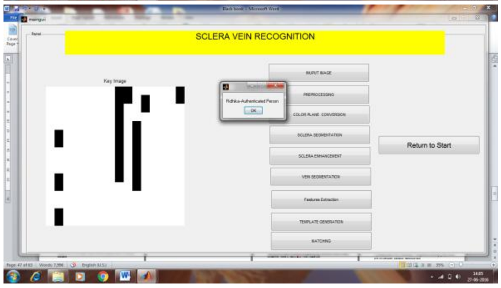
Feature matching is an vital and final step in the recognition process. The decision making is finished with the result of feature matching. In the proposed strategy the two types of features are utilized to get the desired result, to see whether the outcome says that the person is correctly recognized or not. This is finished with the assistance of features extracted from the vein pattern examples seen in the sclera region. The proposed sclera coordinating is done in two stages: training the set of images in the database and check with the query image and see whether the image is comparable or not.

IV. EXPERIMENTAL RESULTS









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