Image Correction and Feature Extraction for Human Eye

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ABSTRACT
This paper presents sclera-based biometric recognition. The vessel patterns in sclera are different for every individual and this can be used to identify a person uniquely. In this analysis, we are using sobal filter and Otsu's thresholding methodology for sclera segmentation. Second we have designed a Gabor filter for sclera pattern enhancement to high light and binarize the sclera vessel patterns because the segmented sclera area is highly reflective. As a result, the sclera vascular patterns are unclear or/and have very low contrast. To accomplish the illumination impact and to achieve an illumination-invariant method, it is important to enhance the vascular patterns. Finally, we tend to plan a line-descriptor based feature extraction, registration, and matching technique. We have used the UBIRIS version one dataset for the experimentation of our analysis. The experimental results show that sclera recognition could be a trust worthy new biometrics for human identification

Keywords
Sclera recognition**,** sclera segmentation, pattern recognition **.**

1. INTRODUCTION
Biometric system is a pattern recognition scheme consisting of physiological and behavioral features of an individual. Physiological characteristics of a body are fingerprint, palm print, palm veins, hand geometry, facial expression recognition, retina, iris recognition, etc. Behavioral characteristics are less stable than the Physiological characteristics. Biometric identification is unique to each person and they are more stable than the other identification techniques. The eyes are one of the foremost complicated human organs and that we notice several information by analyzing it. There are several analysis work done to differentiate human beings based on eye parts. Sclera is the opaque white part of the eye. It's a tough, protective covering and the muscles that control eye movement are connected to it. The sclera completely surrounds the eye. The vein patterns seen within the sclera region are completely different to every person in visible wavelengths. So it is used for biometric tool for human identification, Fig. 1 shows the sclera region and Fig. 2 shows the vein pattern. The thickness of sclera changes with the increase in the age of a person. By creating this as automated method the features of the vein pattern ought to be extracted. The features extracted from the vein pattern are used for the matching purpose. When sclera recognition is compared with the iris recognition, sclera recognition has many advantages than the iris recognition. Some of the benefits of sclera recognition are: 1) Sclera recognition doesn't need capturing the images in the near infrared wavelength. This enables less imaging necessities like no need of NIR illuminators, images can be acquired from long distances. 2) Sclera recognition doesn't need frontal gaze images of the eye.3) It doesn't need the position of the iris, i.e. off angle segmentation and recognition is also possible

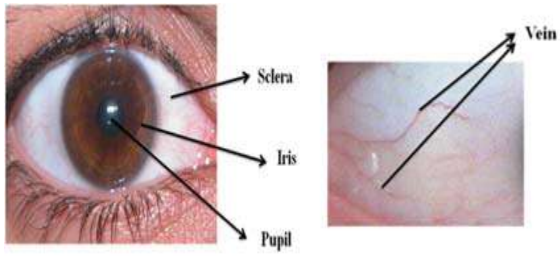

Figure 1 Sclera region and its vein patterns

For sclera recognition the UBIRIS database are used. The UBIRIS database consists of pictures of iris recognition acquired in visible wavelengths. All the images are in color. The main aim of this study is to discover a new biometric technology sclera recognition which gives more accuracy for human identification and prevents plenty of security problem involved nowadays. We apply a sobal filter and Otsu's thresholding algorithm for sclera segmentation. Second we are used Gabor filter for sclera pattern enhancement to high light and binarize the sclera vessel patterns because the segmented sclera area is highly reflective. Third, the sclera vascular patterns are unclear or/and have very low contrast so that it is important to enhance the vascular patterns. finally, line-descriptor based methods are used for feature extraction.In [1], the sclera segmentation is performed by time-adaptive active contour based. A Haar wavelet multi- resolution filter is utilized to upgrade the vessels. Dense Scale Invariant Feature Transform (D-SIFT) is used for feature extraction.In [3], the paper concentrates on conjunctival vasculature enhancement (The anterior part of the sclera is secured by the conjunctival film, a thin layer that aides lubricate the eye for eyelid conclusion), registration and coordinating. In this paper, color image sclera division methodology was proposed which includes Normalized sclera index(NSI),Threshold applied to NSI, Segmented sclera region, Histogram of the NSI. To enhance the segmentation of the blood vessel patterns, the segmented sclera image is pre-processed in two back to back steps 1) Contrast-limited adaptive histogram equalization (clahe),2)Enhancement filter for lines by processing a Gaussian filters and Hessian matrix. In [4], [7], here sclera segmentation was performed by Fuzzy C-means clustering. A preprocessing methodology for vein highlighting is proposed here by the Discrete Meyer wavelet. Feature extraction performed based on the Dense Local Binary Pattern (D-LBP)In [5], Here C-means-based segmentation is used for sclera segmentati Email:on followed by vessel enhancement by the adaptive histogram equalization and Haar filtering. Sclera feature extraction was computed by patch-based Dense-LDP (Linear Directive Pattern).In [6], Multimodal Biometric Recognition Utilizing Sclera and Unique finger impression Based on ANFIS. Multimodal biometric confirmation structure utilize use more than one human modalities, for example, face, iris, retina, sclera and finger impression and so forth to enhance their security of the strategy. In this paper, consolidated the biometric characteristics of sclera and finger impression for tending to confirmation issues, which has not examined and executed prior The combination of multimodal biometric framework serves to reduce the system error rates. The sclera region is the non-skin scope of the eye area. This licenses for fundamental heuristics to be used to request locales in the photo as "skin" or "not-skin", and thereafter, a paired guide of the sclera is thought to be the inverse of the skin. Thusly, the sclera area should have low tint, low concentration, and high power in the HSV shade space. We used the Otsu's edge procedure to segment the sclera parts of eye image. Moreover applying morphological operations to the two parallel maps to evacuate disengaged pixels and little districts of nearby pixels By then finally sclera reach are divided. In feature extraction process we utilize the Gabor channel.In [8], here used a time adaptive active contour-based region growing method for sclera division. Image enhancement procedure done by Haar high pass filter . To get the total orientation of the vessels, we have utilized Orientated Local Binary Pattern (OLBP).

2. PROPOSED APPROACH

In this section, they proposed 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 Fig. 2.

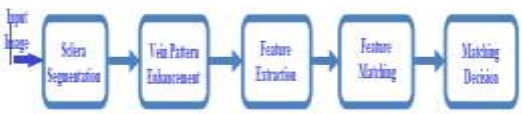

Figure 2 A typical sclera biometric system with different steps involve

2.1 Sclera Segmentation

Sclera segmentation is initial phase in the sclera recognition. It lets in three stages: 1)glare area detection 2) sclera area estimation and 3)iris and eyelid detection & refinement. Fig.3 demonstrates the steps of segmentation. 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 Basically it process only for the grayscale picture.

Figure 3 Steps of sclera segmentation process.

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. Fig. 4 demonstrates the result of the glare area detection

Figure 4 Glare detection approach

Sclera area estimation: As the intensity of sclera 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.Iris and eyelid refinement: The top and bottom boundaries of the sclera locale are utilized as beginning estimates of the sclera boundaries, as well as a polynomial is fit to each boundary. Utilizing the top and bottom portions of the estimated sclera area as rules, the upper eyelid, lower eyelid, and iris boundaries are then refined utilizing the Fourier active contour method Fig.5 shows after the Otsu's thresholding methodology and iris and eyelid refinement to identify right sclera territory . In the same way the left sclera range is distinguished utilizing this technique.

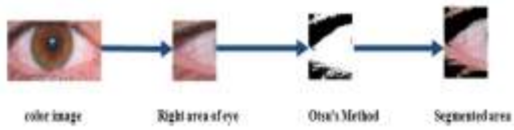

Figure 5 Process of sclera area detection.

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.

2.2 Vein Pattern Enhancement

The segmented sclera area is highly reflective so vessel structure seen in the sclera locale is hard to see. To reduce these enlightenment impacts and establish it as an illumination invariant framework, it is important imperative to raise the vein design. Gabor filters are utilized to the improve vein design in the sclera. Referable to the multiple orientations in the vein design, a bank of Gabor filter is utilized for vein design improvement. Gabor filters have the capacity to give ideal conjoint representation of a sign in space and spatial frequency.A Gabor filter is 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 spaceModulation 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.

$$IF(X, Y, Y, S) = I(X, Y)*G(X, Y, Y, S) \quad (1)$$

where 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 within the database are fused together to get the vessel boosted image. In the Fig. 2 Gabor upgraded picture is shown. 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. Fig.6 shows the image after the morphological operations

Figure 6 Gabor Enhanced Vein Pattern

2.3 Feature Extraction

Feature extraction is mainly applied in pattern identification in picture processing to diminish the dimension of a picture. At the point when a picture is specifically used for transforming, it is difficult to treat the huge data information 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 input information is transformed in to 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 a arrangement of single-pixel wide lines that represents the vessel structure. Fig. 3 shows the vessels skeleton after binary morphology. 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 minimum squares 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 the iris 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 templete size for a sclera vessel structure fluctuates with the number of individual segments.

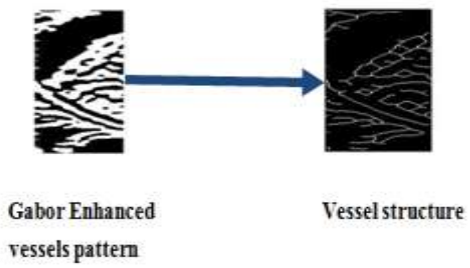

Figure 7: Morphological operations

2.4 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 patterns 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. The attributes of all the images present in the database are trained and put in the new file. At that point, for testing, the feature of the query image is evoked. At that point ,the separation is evaluated to obtain the closeness measure with the norm distance calculation system. This is performed by measuring separation between all the images in the database called the norm distance matching. Norm determines the size of every vector. It is ascertained by measuring the norm between two feature vectors .

$$D = Sqrt\{\{X2-X1\}2 +\{Y2- Y1\}2\} \qquad (2)$$

In a norm based method, the sclera is recognized by the separation from the norm of the database images. The check images are recognized by processing norm vector of the probe to the population norm & coordinating this vector to the database of similarity formed norms

3. EXPERIMENTAL RESULTS

The performance of sclera recognition is evaluated in the feature matching procedure. Check outcomes are obtained for sclera recognition, which it is more exact than alternate techniques of biometric recognizable proof of individuals. These experimental results help to affirm that the sclera vein examples are unique to every person & recognition is more conceivable with this system. Firstly, the images in the database are prepared, that implies extract the features of all images show in the database. Thus, the query picture is tested for matching. From this step whether the individual is correctly matched or not can be recognized. These can be totally corrected in this arrangement, & the person can be recognized when there is simply a minor portion of sclera region visible. . At the point When a person looks ordinarily to the camera, then it brings about ideal identification in the systems. The Fig. 8 shows the matching of normal eye looking in to the camera & its separation measure. Here the technique can identify the low quality images like motion blur & lighting. The images which are not the frontal looking picture they are of also available for testing

Figure 8 matching of normal eye looking in to the camera

Fig. 8 shows a matching result from two sclera images of the same eye (which should match), and the bottom shows the matching result from two sclera images from two different eyes (which should not match).

Figure 9 Matching result from two sclera images of the same eye

4. CONCLUSION

In this paper, we have proposed another biometrics: sclera recognition. Our examination results demonstrate that sclera recognition is extremely encouraging for positive human ID. Sclera gives another alternative to human ID. In this paper, we concentrated on frontal looking sclera picture handling and recognition. Like iris recognition, where off- angle iris picture segmentation and recognition is still a testing exploration theme, off-angle sclera picture segmentation and recognition will be an intriguing and challenging research subject. Likewise, sclera recognition can be joined with different biometrics, for example, iris recognition or face recognition, (for example, 2-D face recognition) to perform multimodal biometrics. Presently, the proposed framework is actualized in Matlab. Additionally, inquire about on sclera biometrics for individuals wearing glasses can be another challenge in this field.

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