Sclera Segmentation for Eye Gaze Detection and Sclera Recognition by using Algorithm

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Abstract— *I have proposed in this paper a unique technique which is able to adapt to noisy images for eye gaze detection as the processing of noisy sclera images captured at a distance and on the move has not been extensively investigated. The blood vessels of sclera have previously been investigated as an useful biometric characteristic.Capturing this section of the eye with a normal came ra with pictures of visible distance instead of near infrared images has given rise to attention in research interest This technique involves a sclera template rotational alignment and a distance scaling method to minimize the error rate when audible eye images are taken prisoner at a distance and on the move. The proposed system is being tested and results are generated by extensive simulation in java.*

Keywords— *Biometrics, feature extraction, Gabor filter's, kernel, linear discriminates analysis, pattern recognition, sclera recognition.*

I. INTRODUCTION

This Sclera segmentation has achieved significant importance for the biometry of eye & iris. Moreover, sclera segmentation hasn't been thoroughly researched as a different subject, but it has primarily been illustrated as part of a wider task. The sclera is the white and opaque areas of the blood vessels and the connective tissue inside the eye. This part of the eye surrounds the iris that's the colored tissue around the pupil. The sclera as shown in figure. 1. seems to have a rich pattern of blood vessels with different patterns and layers. Consequently, the discriminatory characteristics of these blood vessels are thought to be a bright factor for the recognition of the eye under visible wavelength illumination. Fig. Fig. 1. Eye structure consisting of pupil, iris and sclera region Sclera recognition has recently received attention due to the distinctive features extracted from blood vessels within the sclera.

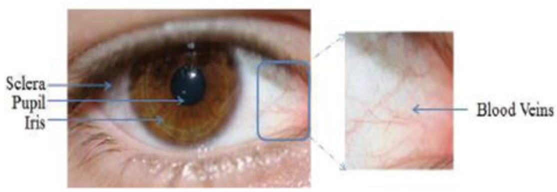


Fig. 1. Eye structure consisting of pupil, iris and sclera region

However, errant human pose, multiple iris viewing directions, a completely different eye view capturing distance and variation in lighting conditions are causing a number of challenges in sclera recognition. Various challenges in sclera recognition company of accurate segmentation of the sclera area, sclera vessel enhancement & extraction of judicial features of the sclera vessel pattern for authentication.

The task becomes harder as often as a complete sclera image is not received but is hindered by portions of the eyelid and eyelashes. In addition, different lighting conditions may alter the appearance of texture patterns by accentuating and attenuating different shades of gray. The authentication system should also work in real-time so that the creation, representation and comparison of texture images should not take place.

After that, the classification system uses a sclera texture mathematical model to compare it with other sclera images in order to identify specific individuals or recognize an object. In this paper, we suggested an eyegaze detection technique that would improve the identification of scelras when they are captured on or on the move. Our contribution includes the fusion method for the segmentation of the sclera which I shall use.

II. LITERATURE SURVEY

One of the first papers discussing sclera segmentation uses a modified Self Organizing Map in a gaze tracking approach. The procedure relies on the first discovery of the iris boundary and the setting of two control positions determined by the use of the iris center and radius. The two control positions are then used in an active contour model algorithm to fine tune the sclera boundary location.

In it is proposed that sclera detection should be performed only on the layer of sclera vein patterns, which are stable over time, rather than including the conjunctiva vasculature. The sclera segmentation method used in assumes that the photos include frontal eyes and the position of the iris center is visible. Two binary maps are generated on the basis of non-skin region observation using RBG Color Space & White Light with HSV Color Space.

In addition, the convex hull of the two masks is determined and mixed for the final sclera area. Derakhshani and Ross[6] explored a new method for representing and matching the structure of blood vessels using wavelet-derived characteristics and neural network classifiers. Semi-automated segmentation of the sclera was used in[7] a semi-automated sclera segmentation system, along with an image enhancement and registration scheme, was used to process information in the blood veins of the sclera. Thomas et al.[8] suggested a new automatic sclera segmentation approach based on a single skin segmentation in the RGB color space.

On the other hand, features describing the blood vessels in the sclera have been derived from local binary patterns (LBPs) in[9]. Derakhshani et al.[10], the sclera area was segmented manually. Their work looked at the possibility of using blood vessels in the sclera as a means of identification. In[11] the authors explored the Sclera vasculature as a biometric modality under different wavelengths.

The sclera was segmented using a sclera index measure that relies on multispectral information, i.e. the difference between near infrared and green pixel intensities is larger for the sclera region. A K-means clustering strategy is used for the section of the sclera in [12]

A survey of sclera recognition works until 2013 was performed in[13] and, with regard to sclera seg-mentation, the survey shows that the few current methods depend on different assumptions, e.g. the location of the iris centre. In 2014, Abhijit et al proposed a sclera segmentation approach based on Fuzzy logic[14]. Zhou et al.[15] used a Gabor filter bank with a line descriptor build a skeleton map of discrete blood vessels.

The discreet Meyer wavelet filter banks and the Local Directional Pattern (LDP) were used in[16] for the enhancement and extraction of blood vessels. Finally, Alkassar et al.[17] proposed a new segmentation of the sclera and occluded eye for sclera validation. A. Sclera Segmentation Segmentation is the first step in most biometric related research.

The main aim here is to classify the area of interest as accurately as possible. Similarly, perfect segmentation is important in the biometric sclera otherwise incorrect segmentation may reduce the pattern available, but it may also introduce other patterns, such as eyelashes and eyelids. In the literature on Sclera Biometrics, therefore, the researchers have given great importance to this process.

Maybe[18] was the first work on automatic sclera seg-mentation. Here, the sclera was segmented by a time-adapting active contour-based approach. The iris was located in the observed eye strip in the binary image by matching the pattern using an adaptive half-circle template. A TASOM (Time Adaptive Self-Organizing Map) active contour system outlined in[19],[20] It was used to get the inner boundary of the sclera.

In[21], the authors have designed enhancement and registration methods for processing and matching conjunctival vasculature obtained under non-ideal conditions. A sclera segmentation of the color image was proposed in[22], which includes image down sampling, conversion to HSV color space, estimation of the sclera region, iris and eyelid detection, eyelid and iris boundary refinement, Creation of masks and mask up-sampling.

A robust multi-angle sclera recognition technique was proposed in[23]. A new robust method of sclera segmentation for color images was proposed in[24]. This survey shows the framework of the Sclera Biometrics literature and summarizes the current state-of - the-art. There are still a number of active research topics within Sclera Biometrics.

Many of these contribute to the desire to make sclera recognition as realistic under less-controlled conditions, as well as a real-time process as possible. Limitations and obstacles still exist. These are: 1) the segmentation of the sclera has not been investigated using high-noise eye images; 2) There is still a lack of eye rotation orientation work that could influence the angles and location of the blood vessel; 3) scanning of the sclera has not been thoroughly studied when eye images are taken on - the-move and at-a-distance.

III. PROPOSED METHODOLOGY

First of all, for the segmentation of iris, we used the integro-differential operator to locate the circular pupil and iris regions. Specular reflex removal is used to remove the brightest spots in the iris image. Instead, for each image, the iris center coordinates of Ciris(x, y) and radius r are stored.

We propose a new fusion approach for the segmentation of sclera regions that is robust to noise factors. This approach generates two binary maps for the image of the eye and fuses them to improve sclera region detection for noisy images. Fig. Fig. 2. Sclera Segment Algorithm. After this, we will refer to the IRADS (Image Rotation Alignment and Distance Scaling) process.

A. Architecure

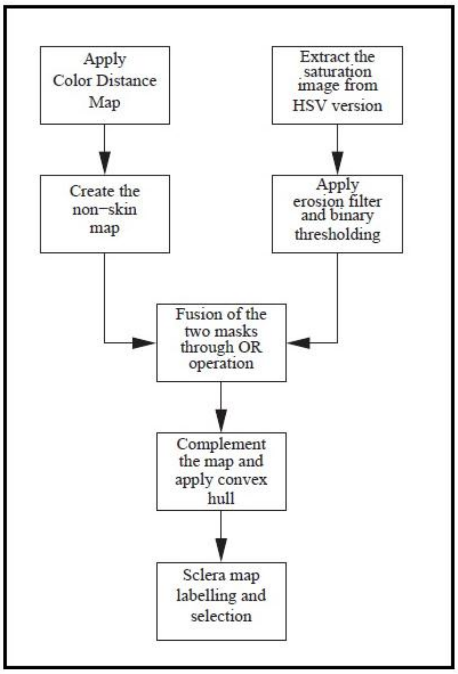
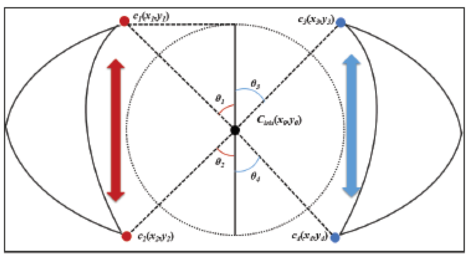


Fig. 2. sclera segmentation algorithm.

Next, the rotation alignment cycle for (F G) as shown in Fig. 4 is accomplished by splitting each individual mask into two parts around the detected iris and extracting the four internal corners c1, c2, c3 and c4 of the sclera binary mask using Harris corner detection Calculate the internal angles of these corners f1, f2, f3 and f4 with respect to the y-axis of the iris center position; change the angles f1, f2, f3 and f4 to be equal to 45 by applying an image rotation function that uses the nearest neighbor interpolation to rotate an image with the defined angle L; Fig. 3. Rotational alignment of the sclera where the internal sclera cor ners c1, c2, c3 and c4 are identified and f1, f2, f3 and f4 are calculated.



Next phase is to strengthen the sclera of the blood vessels. In order to increase the isolation of the sclera blood veins from the back, two steps are used, including the ex-traction of the green channel of the sclera picture and the ap-plying Contrast-Limited Adaptive Histogram Equalization (CLAHE), which increases the local contrast of the blood vessels.

Then we examine the features of the sclera picture using a Gabor filter bank. After this KFDA is used for the extraction of the element. The KFDA approach maps the features provided by nonlinear mapping F to some F-space function and uses linear discriminant fishers with a Mercer kernel strategy. This technique formulates an algorithm using dot products (F(x),F(y)) to resolve the limitation of the inability to solve matrices directly between and within the scatter class if F is very large or has infinite dimensional space. And atlast Mahalanobis cosine distance similarity is used for distance similarity.

B. Mathematical Model

Mathematical Model is a system description that uses mathematical concepts and language. The method of creating a mathematical model is called mathematical modeling. Let the device or the program be S.

S={I,P,O}
where
I=Input
P= Process
O= Output

I ={i1}
i1= image from data set;

P={S1, EF,S2,F,PI,NR}
Where,
S1= segmentation S1 mask;

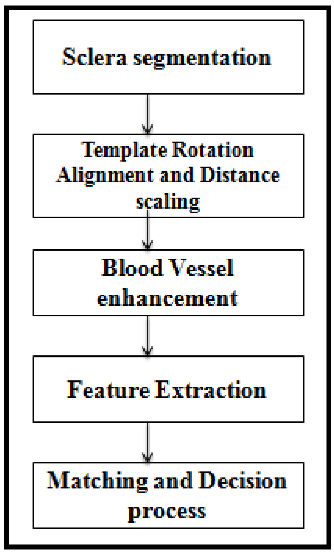


Fig. 4. System Architecture

EF= Eye image in saturation level offer applying erosion filter;
S2= S2 mask;
F= Fusion the image and make it available for processing
PI= Process the image
NR= Remove noise

O={seg S}
Seg S= Segmented Sclera

C. Function dependency graph

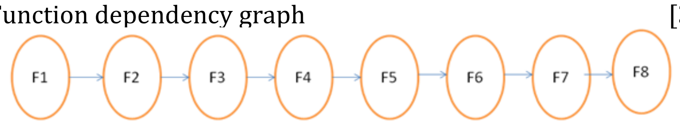


Fig. Function Dependency Graph

F1: Input Image
F2: Skin Segmentation map
F3: Detect ROI (Region of interest) area
F4: Right and Left ROI region
F5: Eyelids Borders Detection
F6: Candidate corners points
F7: Estimate gaze
F8: Generate graphs

Table 1.1: Function Dependency

	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	0	0	0	0	0	0	0
F2	0	1	0	0	0	0	0	0
F3	0	0	1	0	0	0	0	0
F4	0	0	0	1	0	0	0	0
F5	0	0	0	0	1	0	0	0
F6	0	0	0	0	0	1	0	0
F7	0	0	0	0	0	0	1	0
F8	0	0	0	0	0	0	0	1

IV. CONCLUSION

In this paper, we propose a novel approach to gaze detection. Our proposed work adapts to the noisy images as well as to the picture that is taken on the move and at a distance. The proposed architecture includes a robust sclera scaling approach to mitigate the impact of sclera image capture on - the-move and at-a-distance. System output is measured by testing the system on multiple images and the result produced is shown in the result.

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