

A Review of Human Ocular Recognition Based On Sclera

¹Priyanka H.Gadade, ²S.N. Dharwadkar

^{1,2}Department of Electronics and Telecommunication, MESCOE, SPPU
Email: ¹priyanka.h.gadade@gmail.com, ²sndharwadkar@mescoepune.org

Abstract: This paper presents sclera-based biometric recognition. The vessel patterns in sclera are different for every individual and his can be used to identify a person uniquely. The sclera as biometric trait is relatively new exposure in the biometrics literature. In this attention is paid particularly to sclera feature extraction. Support vector machine is used for classification. This paper proposes simple yet novel method which is based on sclera features associated with eye for a biometric verification system. The main difference is the use of moments for feature extraction. Moments are widely used for character ,face, palm , fingerprint, digit recognition but still it is not applied to ocular recognition.

Keywords: Sclera localization ,Zernike moments

I. INTRODUCTION

Biometrics is a the process of identifying a person based on physical trait and/or behavioural characteristics. The physical trait includes face, fingerprint, and iris etc. and behavioural characteristics includes gait, keystroke dynamics and signature. The use of biometric traits has become popular and is considered more convenient, reliable and secure as an individual's biological characteristic cannot be forgotten, lost, easily stolen or copied as compared to other authentication methods such as ID cards and passwords. In the past decade, due to the advancements in computing, automated biometric systems have been proven to be realistic and reliable alternatives to the traditional security systems. The biometric system minimizes and even eliminates the need to preserve a key or memorize a password, also speeding up the process.

The blood vessel structure of the sclera is uncommon to each person, and it can be remotely obtained non intrusively in the visible wavelengths. Therefore, it is suited for human identification (ID). In this paper, we propose a new approach for human ID: sclera recognition. This is a challenging research problem because images of sclera vessel patterns are often deconcentrate and/or saturated and, most importantly, the vessel structure in the sclera is multilayered and has complex nonlinear deformations.

The sclera is the white and opaque outer protective covering of the eye as shown in Fig. 1. The sclera completely envelops the eye and is made up of four layers of tissue—the episclera, stroma, lamina fusca, and endothelium [2], [3]. The structure of the blood vessels is visible and stable over time. It is formed randomly for each person [4], [5]. With increasing age, collagen and

elastic fibers deteriorate, glycosaminoglycan damage and sclera dehydration occur, and lipids and calcium salts accumulate, but the blood vessels do not deteriorate [4]–[7]. As a result, the blood vessel patterns would be unique with both genetic and developmental components conclusive their structure [2]–[7].

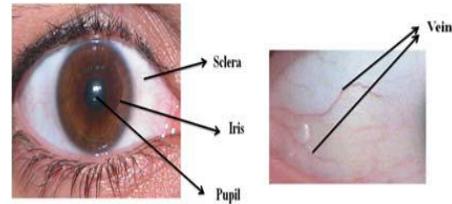


Fig. 1 Sclera region and its vein patterns

Zernike moments is a good enough method for feature extraction that deals with few rotation-independent features and this leads to shorten calculations and increase speed of recognition and stability against rotation [8]. The features extracted from the vein pattern are used for the matching scheme. When sclera recognition is compared with the iris recognition, sclera recognition has many convenience than the iris recognition. Some of the advantages of sclera recognition are: (1) Sclera perception doesn't require capturing the images in the near infrared wavelength. This allows less imaging requirements like no need of NIR illuminators, images can be captured from long distances. (2) Sclera recognition doesn't require frontal gaze images of the eye. (3) The position of the iris doesn't require, i.e. off angle segmentation and recognition is also possible.

II. PREVIOUS WORK

In 2006 R. Derakhshani, A. Boss and S. Crialmeanu presented 'A new biometric modality based on the conjunctival vasculature' [1]. The use of sclera vessels as a biometric identifier was first proposed by Derakhshani et al. [1]. They achieved 100% identification rate in their study. In their work image enhancement was adept in two steps. First, a contrast-limited adaptive histogram equalization scheme was applied to the region of interest i.e. sclera in order to enhance the color image. Then, a second step is to determine the best match from this subset. This is more complex algorithm.

In this author introduced a conjunctival vasculature aspect for the identification. In the visible part of the sclera Conjunctival vessels are seen. These vessels are

well examined in the visible light. In this paper, the author explain about the conjunctiva imaging, preprocessing and detail character i.e. Feature extraction to derive a suitable conjunctival vascular feature for biometric verification. The conjunctiva is a fragile, transparent i.e. clean, and moist tissue that crosses the outer surface of the eye. The part of the conjunctiva that covers the inside lining of the eyelids is called palpebral conjunctiva, and the focal point of this work the character that spreads over the outlying surface of the eye is called ocular conjunctiva. The ocular conjunctiva is very fragile and coherent ; thus the vasculature is well noticeable through it.

In [7] the authors proposed a comprehensive sclera image quality measure. Their method was able to automatically detect poor quality images and predict the identification/verification confidence by considering the image quality, the segmentation accuracy, and valid feature information. The authors used a bank of multiple directional Gabor filters for vascular pattern enhancement. For feature extraction, line segments description and adaptive thresholding was used.

In [8] approach was proposed to improve the recognition rate of sclera biometrics. In this work, pyramidal directional filtering approach (Contourlets) was used for feature extraction. Contourlets are the discrete version of the Curvelets. Only, they add the benefits of multi-resolution and multi-directional functionality. For sclera segmentation, k means clustering along with Euclidean distance metrics was used. The cluster with the largest Euclidean distance from the origin of the coordinate system to its centroid was categorized in the sclera region. The cluster of pixels with the smallest Euclidean distance from the origin of the coordinate system to its centroid was categorized in the iris region.

The paper [9] presents an experimental assessment of the efficiency of various methods based on Invariant Moments for handwritten devanagari vowels recognition. The technique is independent of size, slant, orientation, translation and other variations in handwritten vowels

In [10] this paper a feature extraction method based on moment invariants was applied to handwritten digits recognition. The features are calculated using 15 special Summed-area Tables (SATs), which allows for fast computation at different positions and angles. The feature extraction method uses moments up to the 4th order, it can increase the number of features per set without the usual noise problems related to higher order moments.

Zernike moments-based method [11] has been introduced to extract feature of Farsi and Arabic handwritten characters. Outputs of Zernike moments are put in systematic clustering to decide about characters. The obtained outcome show that feature extraction using Zernike moments is a suitable method

that deals with few rotation-independent features and this leads to reduce calculations and increase speed of recognition and stability against rotation.

III. PROPOSED SYSTEM

Any biometric system has three measure blocks, namely pre-processing, feature extraction and classification. The pre-processing is obtaining the area under observation or in concrete words obtaining the region of interest The next step is feature extraction where valuable information is extracted from segmented image which is processed further. And third step is classification based on extracted information in number classes.

These features are extracted from all the images in the database and compared with the features of the query image whether the person is correctly identified or not. This procedure is done in the classification step.

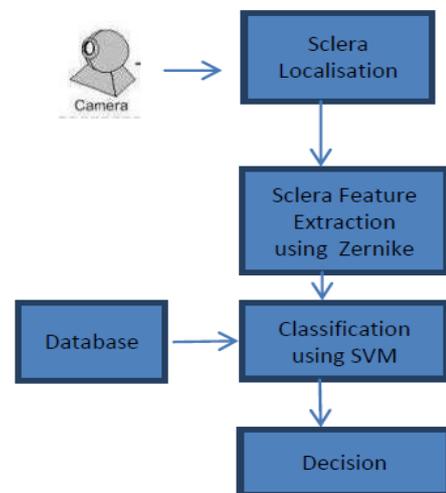


Fig. 2 Block diagram of proposed method

A. Image Preprocessing

The exposed region of sclera is affected by several factors such as head and eyelids movement, rotation of eye-ball, and occlusion by eyelids. The image pre-processing will include regions localization tasks, namely, (1) iris localization and (2) sclera localization Integro- differential operator will be used for iris localization. For sclera localization, binarization process with morphological operation is used.

This step includes accurate segmentation of the sclera region along the eyelid contour and the iris boundary. The entire eye image cannot be used for processing because it is difficult to distinguish the blood vessel patterns from the other facial characteristics like wrinkles, crow feet, eyelashes etc. So segmented image should necessarily retain only vein patterns in sclera. image The process of vessel enhancement is generally computationally expensive. In order to avoid this high computational cost, the sclera localization is limited only to the regions localization tasks, namely, (1) iris localization and (2) sclera localization.

B. Feature extraction

Feature extraction is mainly useful in pattern identification in image processing to reduce the dimension of an image. Feature extraction refers to the extraction of important information from raw data so that they are suitable for the classification process. When an image is directly utilized for processing, it is very hard to treat the large input data of an image. And then that input data are transformed to its decreased form of features which is experienced as the feature vector. When input information is converted into set of features is known as the feature extraction.

Feature extraction methods can be divided into two majors: structural features and statistical features. The first group is based on local structure of image. It means that the structural features deals with local data. Facial change or change in environmental conditions is the major problem of the structural features .

Moments have been used in image processing and classification type problems. The features from all local areas are combined and classified using linear Support Vector Machine (SVM) classifier. The feature extraction stage is characterized by a series of input patterns. The major problem of feature extraction is that it depends on application and the feature extraction methods are not public.

ZM's have been used in a multitude of applications with great success and some with 99% classification accuracy .Now a days, they have been adapted for image processing in shape recognition schemes. The orthogonal properties of ZM's suits them better for such applications because unlike geometric moments their invariants can be calculated independently to arbitrary high orders without having to recalculate low order invariants. These orthogonal properties also allow one to evaluate up to what order to calculate these moments to get a good descriptor for a given database. Zernike moments are used an alternative method to present the image in smaller dimensions. In mathematics, Zernike polynomials are a sequence of polynomials that are orthogonal on unit disc and were established by fritz Zernike and play an important role in image processing.

Zernike moments are defined based on Zernike polynomials and are as equation :

$$A_{nm} = \frac{n+1}{\pi} \int_0^{2\pi} \int_0^1 v_{nm}(r,\theta) f(r,\theta) r dr d\theta$$

That $n-m$, $m \leq n$, $r \leq 1$ is an even number. Zernike polynomials $V_{nm}(r,\theta)$ is defined based on radial functions:

$$V_{nm}(r, \theta) = r_{nm} re^{+jm\theta}$$

C. Classification method Support Vector Machine

Machine Learning is ability to enable the computer to learn. It uses algorithm and techniques which perform different tasks and activities to provide efficient

learning.SVM is a learning machine having a decision surface parameterized by a set of support vectors and a set of corresponding weighting coefficients. An SVM is characterized by a kernel function, the selection of which determines whether the resulting SVM provides classification, regression or other functions. Through application of the kernel function, the SVM maps input vectors into high dimensional feature space, in which a decision surface (a hyperplane) can be constructed to provide classification or other decision functions. An SVM is also characterized by a “decision rule” that is a function of the corresponding kernel function and support vectors.

It gives accuracy equivalent to neural networks with elaborated features in a handwriting recognition task. Support vector machine is used for many applications such as text categorization, pattern recognition, face recognition, handwriting analysis but especially for classification and regression applications. Neural Networks are easier to apply than support vector machine but sometimes it provides insufficient results. Even the perceptron learning algorithms (e.g. gradient descent) are slower than SVM learning. SVM has been found to be unbeaten when used for pattern classification problems. Firstly, the images in the database are trained, that means extract the features of all images present in the database. And so, the query image is tested for matching. From this step whether the person is correctly matched or not can be recognized

Multiclass classification

SVMs were mainly proposed to deal with binary classification but in today’s life, we mostly have huge amount of data which we want to classify. Time series data represent quantities or trace the values taken by a variable over a period such as a month, year etc.

Examples are stock market, price indexing etc. In this there will be more than two classes. So this creates the need of multiclass classification. Multiclass classification means classification with more than two classes. To summarize, it may be said that the choice of a multiclass method depends on the problem in hand. A user should consider the accuracy requirement, the computational time, the resources available and the nature of the problem. For example, the multiclass objective function approach may not be suitable for a problem that contains a large numberof training samples and classes due to the requirement of large memory and extremely long computational time.

IV.CONCLUSION

Here the system can identify the low quality images like off angle. This feature extraction method extracts feature of the converted polar image and this feature brings the system as rotation invariant. Thus, this method gives good result of invariant rotations of input image.

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