A Comprehensive Approach for Multi Biometric Recognition Using Sclera Vein and Finger Vein Fusion

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Abstract— Sclera and finger print vein fusion is a new biometric approach for uniquely identifying humans. First, Sclera vein is identified and refined using image enhancement techniques. Then Y shape feature extraction algorithm is used to obtain Y shape pattern which are then fused with finger vein pattern. Second, Finger vein pattern is obtained using CCD camera by passing infrared light through the finger. The obtained image is then enhanced. A line shape feature extraction algorithm is used to get line patterns from enhanced finger vein image. Finally Sclera vein image pattern and Finger vein image pattern were combined to get the final fused image. The image thus obtained can be used to uniquely identify a person. The proposed multimodal system will produce accurate results as it combines two main traits of an individual. Therefore, it can be used in human identification and authentication systems.

Index Terms— Sclera vein recognition, finger print vein recognition, vein identification, features fusion, multimodal system.

1 INTRODUCTION

The white part of the eye is called sclera. Sclera veins can be captured and analysed using image processing techniques. The vein pattern of eye does not change with age, eye infection and alcohol intake. So it can be used to verify the identity of a person. In some cases sclera vein pattern may not be reliable and hence multi biometric approach is recommended.

A new method which combines sclera vein recognition and finger vein recognition to provide better authenticity is proposed. Even though many multimodal systems are available, the combination of sclera and finger vein is different which provides positive and satisfying results. The proposed algorithm extracts features from both sclera and finger vein image and combines to form a final image. The fusion is applicable only if the two extracted patterns are compatible.

2 BACKGROUND OF VEIN PATTERN RECOGNITION

2.1 Overview of Sclera Vein Recognition

Sclera vein recognition approach involves sclera image identification, segmentation, enhancement, feature extraction. Sclera image segmentation is the first step in sclera vein recognition. It can be obtained with the help of a high definition digital camera. The next step is sclera segmentation.

After sclera segmentation, it is necessary to enhance and extract the sclera features since the sclera vein patterns often lack contrast, and are hard to detect. Sclera vein appears to be in Y shape pattern. Y shape line descriptor algorithm is used to extract the features from enhanced sclera image. The flow of sclera vein recognition process is shown in fig. 1.

Fig. 1. Simplified Sclera Image extraction process.
2.2 Y-shape Feature Extraction

A novel line-descriptor method is used to describe and store the extracted vein pattern for recognition. The goal is to reliably extract and describe the vein pattern in the sclera for use in identifying the user. As the present set of vessel segments combine to create Y shape branches often belonging to same sclera layer. When the numbers of branches is more than three, the vessels branches may come from different sclera layers and its pattern will deform with movement of eye. Y shape branches are observed to be a stable feature and can be used as sclera feature descriptor.

Fig. 2. Enhanced sclera image with Y shape patterns.

To detect the Y shape branches in the original template, a search for the nearest neighbours set of every line segment in a regular distance should be conducted and the angles among these neighbours should be classified. If there were two types of angle values in the line segment set, this set may be inferred as a Y-shape structure and the line segment angles would be recorded as a new feature of the sclera.

There are two ways to measure both orientation and relationship of every branch of Y shape vessels:

1) One is to use the angles of every branch to x axle,
2) The other is to use the angels between branch and iris radial direction. The first method needs additional rotation operating to align the template.

3 PROPOSED MULTIMODAL SYSTEM

Proposed Multimodal system is a fusion of two individual biometric systems. It combines the benefits of both sclera vein and finger vein authentication systems. Finger vein authentication is a new biometric approach which verifies one’s identity using finger vein pattern.

3.1 Finger Vein Recognition

As the foremost step finger vein pattern should be captured. To do so, a good quality CCD camera and an infrared light emitter can be used. As the infrared lights get absorbed by blood, the vein pattern appears to be a series of dark lines. Then the image is segmented using localized Radon transform (LRT) algorithm.

Fig. 3. A typical way of capturing finger vein pattern.

3.2 Repeated Line Tracking

The repeated line tracking algorithm is used in finger vein identification. The idea is to trace the veins in the image by choosing directions according to predefined probability in the horizontal and vertical orientations. The starting vein point is randomly selected and the whole process is repeated for certain number of times.

Fig. 4. Finger vein image extraction process.

A typical finger vein feature extraction process has four steps as mentioned in fig. 4. The foremost process is capturing the finger vein using a CCD camera and Infrared light Emitter. After that the captured image is segmented and enhanced. Enhancing the image helps us to identify the vein pattern clearly. The final image has the entire necessary feature that is required to identify a person uniquely.
Image fusion is performed by combining the biometric template extracted from every pair of fingerprints and eye representing a user. The matching score is calculated through the Hamming distance calculation between two final fused templates. The template obtained in the encoding process will need a corresponding matching metric that provides a measure of the similarity degree between the two templates. The result of the measure is then compared with an experimental threshold to decide whether or not the two representations belong to the same user.

As this method produces exact matching score results and provides dual security it is preferable in many mission critical applications. It can be successfully implemented in low cost and it is expected to give maximum protection by providing unique human identity.

A simple concatenation process flow is shown in Fig 6. Both sclera and finger vein images are fused together to form a single image. The final template has the unique properties from sclera as well as finger vein pattern. Therefore, it can be used to find the identity of a person and adopted in security systems as well.

4 DISCUSSION AND CONCLUSION

In this paper a new Multimodal biometric authentication method is proposed and analyzed. The new method employs security and special features of both sclera vein pattern and finger vein pattern. Hence, dual security can be achieved. The final image obtained after feature level fusion has the properties of both finger vein and sclera vein. Therefore, it is less prone to forgery. In many Real time environments, multi biometric approach becomes essential and the proposed method better serve the purpose.

REFERENCES


