ISSN XXXX XXXX © 2017 IJESC

IJESC

Research Article Volume 7 Issue No.6

Multibiometrics by Combining Left and Right Palmprint Images using Modules

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Abstract:
Multibiometric systems use multiple sensors or biometrics to overcome the limitations of single biometric systems. Palm print is preferred compared to other methods such as fingerprint or iris because it is distinctive, easily captured by low resolution devices. The palmprint contains not only principle curves and wrinkles but also rich texture and miniscule points, so the palmprint identification is able to achieve a high accuracy because of available rich information in palmprint. Providing authorized users with secure access to the services are a challenge to the personal identification systems. A real time personal identification system should meet the conflicting dual requirements of accuracy and response time. Multimodal biometric systems perform better than unimodal biometric systems. Recently, palmprint based identification systems have been receiving more attention from researchers because of its good performance. The left and right palmprint images are combined and obtain better results. This is paper propose a novel framework to combine both left and right palmprint images by generating three kinds of scores and performs matching score level fusion. The first two kinds of scores were, respectively generated from the left and right palmprint images and can be obtained by Robust Line Orientation Code (RLOC) method and the third kind of score was obtained using a specialized algorithm. This paper also exploits the similarity of the left and right palmprint of the same subject.

Keywords: Palmprint Recognition, Left and Right Palmprint Images, Multi Biomrtrics, MFRAT And RLOC.

I. INTRODUCTION

A. Need For Palmprint Technology

Palm print images are captured by acquisition module and are fed into recognition module for authentication.

- Compared with face recognition palm print is hardly affected by age and accessories.

- Compared with fingerprint recognition palm print images contain more information and needs only low resolution image capturing devices which reduces the cost of the system.

- Compared with iris recognition the palm print images can be captured without intrusiveness as people might fear of adverse effects on their eyes and cost effective.

Palmprint features are considered promising in identifying people. There are two types of palmprint features with reference to the field at which palmprint systems are used. The first type of features are the principal lines and wrinkles which could be extracted from low resolution images (<100 dpi) and it is used for identification in the commercial applications. The second type of features are the singular point, ridges and minutiae point which could be extracted from high resolution images (>100dpi) and it is used for forensic applications such as law enforcement applications.

A palmprint recognition system normally consists of four parts: image (sensor) level, feature level, matching score level and decision level. In the image (sensor) level fusion, different sensors are usually required to capture the image of the same biometric. Next feature extraction is to acquire effective features from the pre-processed palmprints and feature levels include the combination of and integration of multiple biometric traits. For example, Kumar et al. improved the performance of palmprintbased verification by integrating hand geometry features. Fusion at decision level is too rigid since only abstract identity labels decided by different matchers are available, which contain very limited information about the data to be fused.

The face and palmprint were integrated for personal identification. Various palmprint identification methods, such as coding based methods and principle curve methods , have been proposed in past decades. In addition to these methods, subspace based methods can also perform well for palmprint identification. For example, Eigenpalm and Fisherpalm are two well-known subspace based palmprint identification methods. In recent years, 2D appearance based methods such as 2D Principal Component Analysis (2DPCA) 2D Linear Discriminant Analysis (2DLDA) , and 2D Locality Preserving Projection (2DLPP) have also been used for palmprint recognition. Further, the Representation Based Classification (RBC) method also shows good performance in palmprint identification . Additionally, the Scale Invariant Feature Transform (SIFT), which transforms image data into scale-invariant coordinates, are successfully introduced for the contactless palmprint identification.

B. Multimodel Biometric System

Biometrics has been an emerging field of research in the recent years and is devoted to identification of individuals using physical traits, such as those based on iris or retinal scanning, face recognition, fingerprints, or voices. As unauthorized users are not able to display the same unique physical properties to have a positive authentication, reliability will be ensured. This is much better than the current methods of using passwords, tokens or personal identification number (PINs) at the same time provides a cost effective convenience way of having nothing to carry or remember. Although there are numerous distinguishing traits used for personal identification, this research will focus on using palm prints to more correctly and efficiently identify different personnel through classification at a low cost.

Palm print is preferred compared to other methods such as fingerprint or iris because it is distinctive, easily captured by low resolution devices as well as contains additional features such as principal line. With the help of palm geometry, a highly accurate biometric system can be designed. Iris input devices are expensive and the method is intrusive as people might fear of adverse effects on their eyes.

Fingerprint identification requires high resolution capturing devices and may not be suitable for all as some may be finger deficient. Multimodal biometric systems use multiple sensors or biometrics to overcome the limitations of unimodal biometric systems. For instance iris recognition systems can be compromised by aging irides and finger scanning systems by worn-out or cut fingerprints [1].

While unimodal biometric systems are limited by the integrity of their identifier, it is unlikely that several unimodal systems will suffer from identical limitations. Multimodal biometric systems can obtain sets of information from the same marker (i.e., multiple images of an iris, or scans of the same finger) or information from different biometrics (requiring fingerprint scans and, using voice recognition, a spoken pass-code).

II. THE PROPOSED FRAMEWORK

A.Similarity Between the Left and Right Palmprints

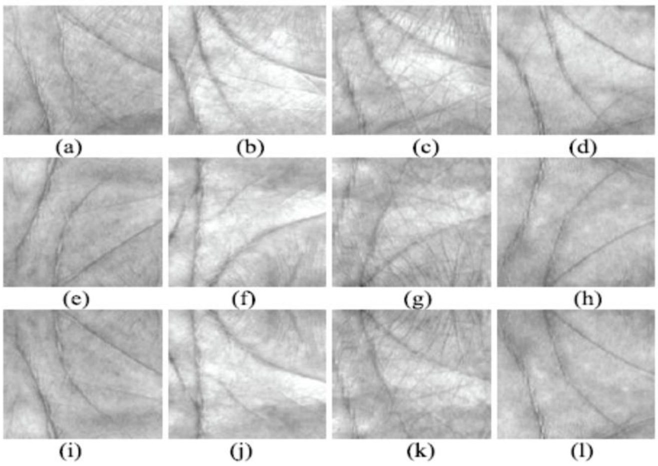

Figure.1. Palmprint images of four subjects. (a)-(d) are four left palmprint images; (e)-(h) are four right palmprint corresponding to (a)-(d); (i)-(l) are the reverse right palmprint images of (e)-(h).

In this subsection the illustration of the correlation between the left and right palmprints. Images in Fig. 1 (i)-(l) are the four reverse palmprint images of those shown in Fig. 1 (e)-(h). It can be seen that the left palmprint image and the reverse right palmprint image of the same subject are somewhat similar.

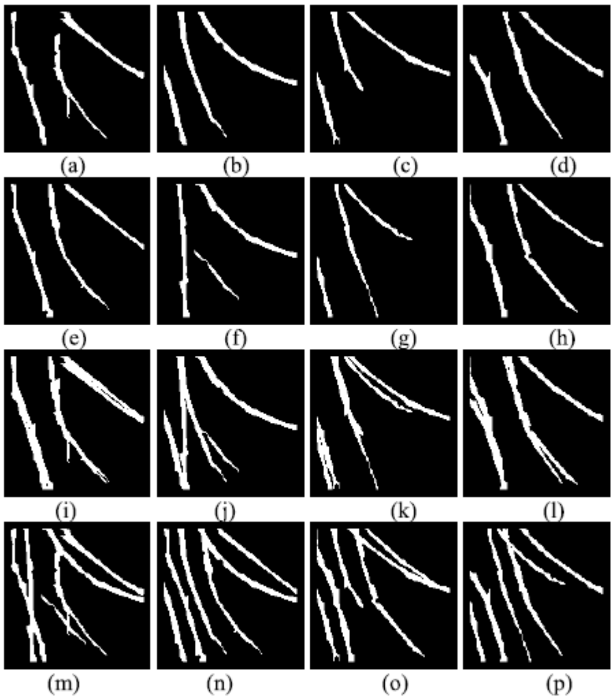

Figure.2. Principal lines images. (a)-(d) are four left palmprint principal lines images, (e)-(h) are four reverse right palmprint principal lines image, (i)-(l) are principal lines matching images of the same people, and (m)-(p) are principal lines matching images from different people.

Fig. 2 (a)-(d) depict the principal lines images of the left palmprint shown in Fig. 1 (a)-(d). Fig. 2 (e)-(h) are the reverse right palmprint principal lines images corresponding to Fig. 1 (i)-(l). Fig. 2 (i)-(l) show the principle lines matching images of Fig. 2 (a)-(d) and Fig. 2(e)-(h), respectively. Fig. 2 (m)-(p) are matching images between the left and reverse right palmprint principal lines images from different subjects. The four matching images of Fig. 2 (m)-(p). are: (a) and (f) principal lines matching image, (b) and (e) principal lines matching image, (c) and (h) principal lines matching image, and (d) and (g) principal lines matching image, respectively. Fig. 2 (i)-(l) clearly show that principal lines of the left and reverse right palmprint from the same subject have very similar shape and position. However, principal lines of the left and right palmprint from different individuals have very different shape and position, as shown in Fig. 2 (m)-(p). This domenstrates that the principal lines of the left palmprint and reverse right palmprint can also be used for palmprint verification/identification.

B.Principle Line Extraction using Modified Finite Radon Transform

In our scheme, the first step is to extract principal lines. We have proposed a modified finite radon transform (MFRAT) to extract principal lines, and in our project the MFRAT will also be adopted to detect some key points of principal lines for fast retrieval. Here, the definition of MFRAT is given as follows: Denoting Zp={0,1,…,p-1}, where p is a positive integer, the MFRAT of real function f[x,y]on the finite grid Z^2_p is defined as:

$$r[L_k] = MFRAT_f(k) = \frac{1}{S}\sum_{(i,j)\in L_k} f[i,j] \qquad (1)$$

where S is a scalar to control the scale of $r[L_k]$, and L_k denotes the set of points that make up a line on the lattice Z^2_p which means:

$$L_k = \{(i,j) : j = k(i-i_0)+j_0, i \in Z_p\} \qquad (2)$$

where (i_0,j_0) denotes the center point of the lattice Z^2_p, and k means the corresponding slope of L_k. In our project, $L_k$has another expression i.e. L(θk), where θkis the angle corresponding to different index k. In the MFRAT, the direction θkand the energy e of center point $f(i_0,j_0)$ of the lattice Z^2_p are calculated by following formula:

$$\theta_{k(i_0,j_0)} = \arg(\min_k(r[L_k])) \quad k = 1,2,\cdots N \qquad (3)$$

$$e_{(i_0,j_0)} = |\min(r[L_k])| \quad k = 1,2,\cdots N \qquad (4)$$

Where $|\cdot|$ means the absolute operation. In this way, the directions and energies of all pixels can be calculated if the center of lattice Z^2_p moves over an image pixel by pixel. And then, two new images i.e. Direction image and Energy image, will be created, which can be used for subsequent extraction of principal lines.

C. Matching Score Calculation

The task of palmprint matching is to calculate the degree of similarity between a test image and a training image. The pixel-to-area matching strategy is adopted for principal lines matching in Robust Line Orientation Code (RLOC) method

$$S(A,B) = \left(\sum_{i=1}^{m}\sum_{j=1}^{n} A(i,j) \,\&\, \overline{B}(i,j)\right) / N_A$$

where *A* and *B* are two palmprint principal lines images, "&" represents the logical "AND" operation, *NA* is the number of pixel points of *A*, and *.B (i, j)* represents a neighbor area of *B(i, j)*. For example, *.B (i, j)* can be defined as a set of five pixel points, *B(i +*1*, j), B(i, j), B(i, j* −1*)*, and *B(i, j* +1*)*. The value of *A(i, j)* & *.B(i, j)* will be 1 if *A(i, j)* and at least one of *.B (i, j)* are simultaneously principal lines points, otherwise, the value of *A(i, j)* & *.B (i, j)* is 0. *S(A, B)* is between 0 and 1, and the larger the matching score is, the more similar *A* and *B* are. Thus, the query palmprint can be classified into the class that produces the maximum matching score.

D. Modules

Four modules are used.

- PalmPrint Identification Across Left Palm
- PalmPrint Identification Across Right Palm
- PalmPrint Identification Across Crossing Palm
- PlamPrint Identification Across Combining Left , Right and Crossing PalmPrint

PalmPrint Identification Across Left Palm:

The framework first works for the left palmprint images and uses a palmprint identification method to calculate the scores of the test sample with respect to each class. Consider m available left palmprint images for training. Let X_i^kdenote the i th left palmprint images of the k th subject ,where i=1….m and k=1…c.Let Z1 stand for left palmprint image [test sample].Then PalmPrint Principal Lines extraction performed by Modified Finite Radon Transform. After the extract of principal lines such as left palmprint principal lines and left training palmprint principal lines ,then matching score is calculated.

PalmPrint Identification Across Right Palm:

The palmprint identification method to the right palmprint images to calculate the score of the test sample with respect to each class. Consider m available right palmprint images for training. LetY_i^kdenote the i th right palmprint images of the k th subject ,where i=1….m and k=1…c.Let Z2 stand for right palmprint image [test sample].Then PalmPrint Principal Lines extraction performed by Modified Finite Radon Transform. After the extract of principal lines such as right palm print principal lines and right training palmprint principal lines ,then matching score is calculated.

PalmPrint Identification Across Crossing Palm:

Crossing matching score of the left palmprint image for testing with respect to the reverse right palmprint images of each class is obtained. Generate the reverse images $\tilde{Y}_i^k$ of the right palmprint images Y_i^k.Both$Y_i^k$and $\tilde{Y}_i^k$ will be used training sample .

$\tilde{Y}_i^k$ is obtained by: $\tilde{Y}_i^k(l,c) = Y_i^k(L_Y - l + 1, c)$, (l= 1….Ly,c=1….Cy), where Ly and Cy are the row number and column number of Y_i^k respectively. Then PalmPrint Principal Lines extraction performed by Modified Finite Radon Transform. After the extract of principal lines such as left palmprint principal lines and reverse right training palmprint principal lines, then matching score is calculated.

PalmPrint Identification Across Left, Right and Crossing PalmPrint:

Finally the framework performs matching score level fusion to integrate these three scores such as left matching score, right matching score and crossing matching score to obtain the identification result. wi(i =1,2,3), which denotes the weight assigned to the ith matcher, can be adjusted and viewed as the importance of the corresponding matchers.

E. Fusion Score Calculation

Since, three score values are obtained a fusion score is to be calculated by using three weights. 帷e weighted fusion scheme is done by

$$f_i = w_1 s_i + w_2 t_i + w_3 g_i \quad \text{Where } 0 \le w_1, w_2 \le 1 \text{ and } w_3 = 1 - w_1 - w_2$$

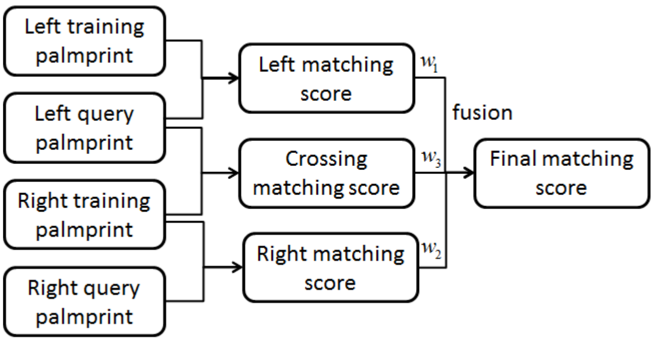

Figure. 3. Architecture of the Proposed Framework.

III. CONCLUSIONS

New personnel identification method is introduced that combine the same biometric trait, the left and right palm. The similarity of left palm and reversed right palm is considered and fusion score is calculated. The paper shows that the left and right palmprint images of the same subject are somewhat similar. The use of this kind of similarity for the performance improvement of palmprint identification has been explored in this paper. The proposed method carefully takes the nature of the left and right palmprint images into account, and designs an algorithm to evaluate the similarity between them. Moreover, by employing this similarity, the proposed weighted fusion scheme uses a method to integrate the three kinds of scores generated from the left and right palmprint images. The system achieved high accuracy.

IV. ACKNOWLEDGMENTS

I would like to express my deep gratitude to my research, Prof. P. P. Kalyankar has a research guide, for their patient guidance, enthusiastic encouragement and useful critiques of this research work. I would also like to extend my thanks to the technicians of the laboratory of the Computer department for their help in offering me the resources in running the program. Finally, I wish to thank my friends and parents for their support and encouragement throughout my project tenure.

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