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Segment Based Hierarchical Palmprint Matching

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Abstract: Biometric Identification system has high efficiency, high recognition rate and comfortable to user's operating characteristics. Palmprint are the most common authentic biometrics for personal identification, especially for forensic security. Palmprint authentication system is considered to be the most reliable biometric recognition due to its merits such as low-cost, user-friendliness, high speed and accuracy. In this paper, a novel hierarchical minutiae matching algorithm for palmprint identification system is proposed. Real time images are captured using a scanner. Each of these gray-scale images are aligned and then used to extract palmprint features. A hierarchical matching system that is used to reduce the computation cost by segmenting the image and matching it with the database, thereby false palmprints are rejected in the subsequent changes by comparing just a portion of the whole palmprint. The hierarchical strategy can reject many palmprint (in the database of the AFIS) which do not belong to the same hand as the input palmprint quickly, thus it can save much time.

Keywords : Palmprint authentication, Segmentation, Binarization, Hierarchical matching.

I. INTRODUCTION

Biometric is the science of establishing the identity of an individual based on the physical, chemical or behavioral attributes of the person. Human have used palmprints for personal identification for many decades. A palmprint is the pattern of ridges and valleys on the surfaces of a palmtip whose formation is determined during the first seven months of fetal development. Automatic palmprint recognition technology has now rapidly grown beyond forensic applications and into civilian applications. Now a days, most civil and criminal AFISs accept live-scan digital images acquired by directly sensing the palm surface with and electronic palmprint scanner. No ink is required in this method, and all that a subject has to do is to press his/her palm against the flat surface of a live-scan scanner.

Reliability in personal authentication is the key to security for any transactional databases and biometric technologies play and important role in various security applications. Biometric-based authentication is a verification approach using the biological features inherent to each individual. Most of the current research in biometric focuses on palmprint, iris and face. However it is difficult to extract palmprintfeatures i.e. minutiae from unclear palmprintand iris output devices are expensive. The reliability of face biometric is low as it continues to problem with pose, lighting, orientation and gesture. Compared with all of these, the palmprint biometric has several advantages: (i) Palmprint contain rich texture information than palmprint; (ii) It can easily be integrated with existing authentication system to provide an enhanced level of authentication; (iii) User acceptability is high; (iv) Even with low resolution device palmprints are easily captured.

A palmprint image consists of various features including principal lines, wrinkles, ridges, minutiae points, singular points and texture. These line structures are stable and remain unchanged throughout the life of an individual. Moreover, no tow palmprints form different individuals are the same and people do not feel uneasy to have their palm images taken for testing. Therefore palmprint recognition offers promising future medium-security access control system.

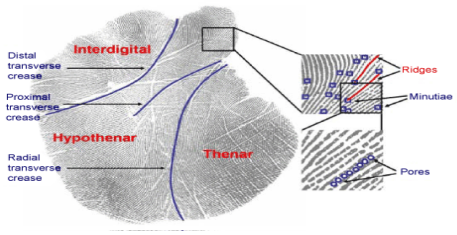

Fig.1. Palmprint Image

Palmprint verification system is a one-to-one matching process. It matches a person's identity to an enrolled pattern. There are two phases in the system – *enrolment and verification*. An illustration of typical palmprint system is given below.

a. At the *enrolment* stage, a set of template images represented by their feature is labeled and stored into a database.
b. At the *verification* stage, features are extracted form an input image and then are matched with the datebase

Both phases comprise the following steps: Pre-processing, Feature Extraction and Matching.

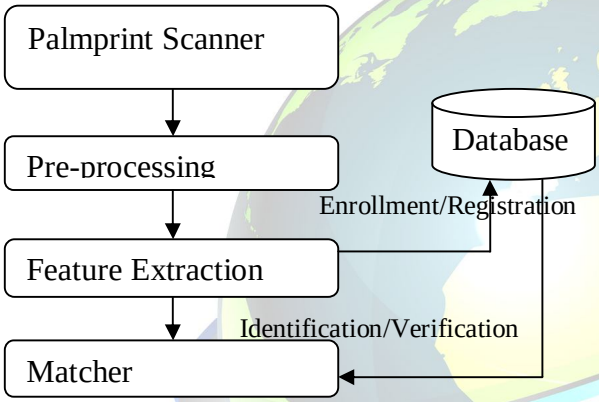

Fig.2. An illustration of a typical palmprint verification system.

The rest of the paper is organized as follows: section 2 describes some related works. In section 3, the proposed framework is introduced, and in section 4, experimental results are evaluated and finally this paper is concluded in section 5.

II. Related Work

Robert Hastings, [1] developed a method for enhancing the ridge pattern by using process of oriented diffusion by adaptation of anisotropic diffusion to smooth the image in the direction parallel to the ridge flow. The image intensity varies smoothly as one traverse along the ridges or valleys by removing most of the small irregularities and breaks but with the identity of the individual ridges and valleys preserved.

David Zang [2] discuss a biometric approach to Online Palmprint Identification using Palmprint Technology. This system process low-resolution image to achieve effective Personal Identification. The system consists of two parts: a novel device for online palmprint image acquisition and an efficient algorithm for palmprint recognition.

Jain [3] discuss Latent Palmprint Matching System for palmprint-based personal authentication in access control type of applications that is needed in forensic applications. This system is dealing with palmprints captured at 500 ppi or higher resolution and uses minutiae as features to be compatible with the methodology used by latent experts.

Chen [4] discuss Hierarchical and Minutiae matching for Palmprint identification system. This method decomposes the matching step into several stages and rejects many false palmprints on different stages, thus it can save much time while preserving a high identification rate. A hierarchical strategy is used in the matching stage. A randomly selected 500 palms is used to form the training set, and the rest are used for testing

III. Proposed Work

A. *Image Acquisition*

Image Acquisition can be done in different ways. The image is obtained from the scanner multi-scan basic SDK 2.6. Different Impressions for the same palm and palm are collected from different persons.

B. *Preprocessing*

In this module palm and palm image is pre-processed and palmprint region is extracted. The palm and palm image is binarised using a global thresholding. Due to regular and controllable uniform background illumination condition during image capturing, and contrasting color of palm and palm image and background, global thresholding can be applied to extract the palm and palm from the background. Image is pre-processed using image enhancement procedures and processed with morphological operations to remove any isolated small blobs or holes. In the pre-processing stage the gray level image is converted to binary image.

C. *Minutiae Extraction*

Enhancement of the image is the extraction of minutiae. The enhanced image is binarised first in this step. The skeleton of the image is then formed. The minutiae points are then extracted by the following method. The binary image is thinned as a result of which a ridge is only one pixel wide. The minutiae points are thus those which have a pixel value of one (ridge ending) as their neighbor or more than two ones (ridge bifurcations) in their neighborhood. This ends the process of extraction of

minutiae points. The similarity of two sets of minutiae are computed as the product of matching quantity score S_{mn} and quality score S_{mq} computed in Equation (1). The matching quantity score is measured by the sum of matched minutiae pairs. The matching quality score is computed as the proportion of matched minutiae in all minutiae within the common area.

$$S_m = S_{mn} \times S_{mq} \quad \text{------} \quad (1)$$

D. Segment based Hierarchical Palmprint Matching

In this work a quantitative statistical study of various characteristics of various palmprints and palmprints to be conducted to guide the design and parameter selection of matching system. A hierarchical strategy is used in the matching stage. A randomly selected 500 palms and palms is used to form the training set, and the rest are used for testing. In order to deal with distortion and varying discrimination power of different palmprint regions, a segment-based palmprint matching and fusion algorithm can be used.

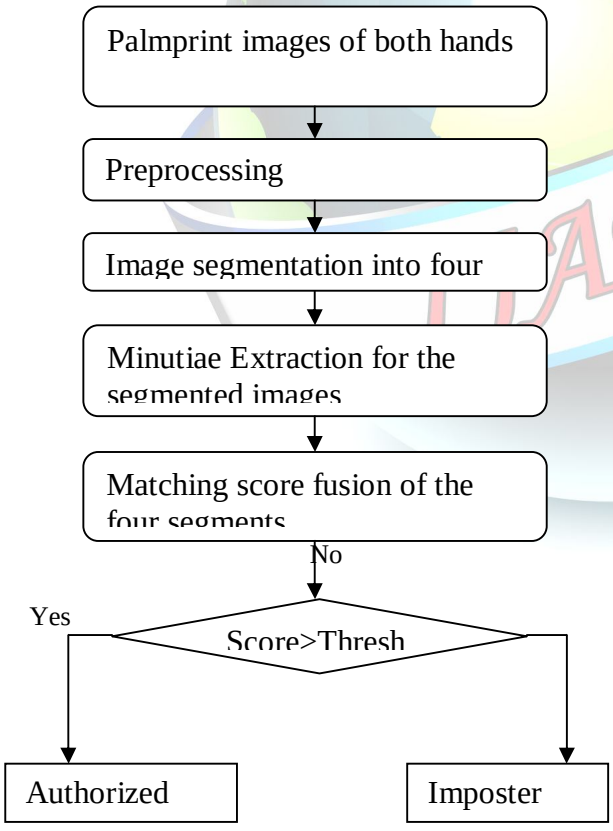

Fig.3. Flow Chart of the proposed Matching System.

The similarity between two palmprints and palmprints is calculated by fusing the similarity scores of different segments using k nearest neighbor algorithm. A filter is built to reject non-matched palmprints in an early stage by comparing just a portion of the whorl palmprint. The palmprints and palmprints are aligned at segment level. The segmented image is matched with the corresponding segment from the database. The hierarchical matching scheme is used to reduce the computation required to match tow images. In order to avoid the blind searching for the best fit between the given patterns, a guided search strategy is used that searches first at the low level, coarse grained images, to the high level, fine grained images. The training set is used to learn the threshold for each step. In each step the threshold is determined to allow the right template in the database. Hence this Hierarchical strategy can reject many false palmprints and palmprints which do not belong to the same palm and palm as the input palmprint quickly, thus it can save searching time compared to the conventional method. The similarity scores of minutiae are combined by k-nearest neighbor, k-means to output a match score. The likelihood ratio of Genuine versus Impostor can be calculated. If the calculated likelihood ratio is greater than the threshold, the match pair is declared as impostor.

IV. Experimentation And Results

Till now there has been no publicly available high resolution palmprint database to our knowledge. To test the algorithm 218 palmprints from 30 subjects have been collected from persons (two palms per person and four impressions per palm). All these palmprints and palmprints are made up of 550x460 pixels and 96ppi. Among all the palmprints and palmprints about 20 percent are poor qualities due to large amount of creases, deformation, smudges, blurs and incompleteness. As for accuracy 14 palmprints and 18 palmprints are not registered in database because of poor quality which is 0.28 percent of all the palmprints and 0.3 percent of all palmprints. All these failure cases are due to improper impression or of bad image quality. The accuracy is effective in this case of minutiae based method than texture based methods.

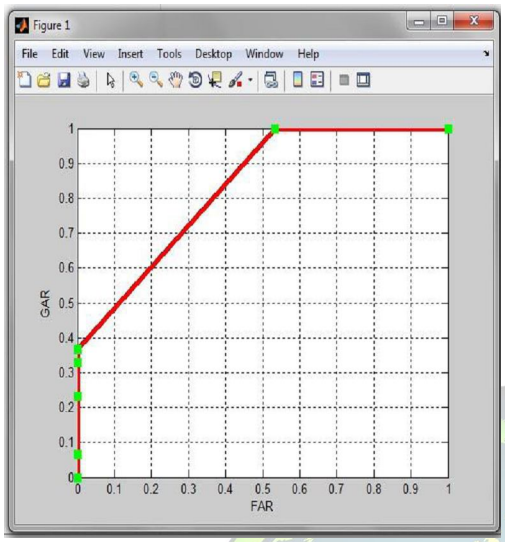

Fig.4. GAR and FAR Graph

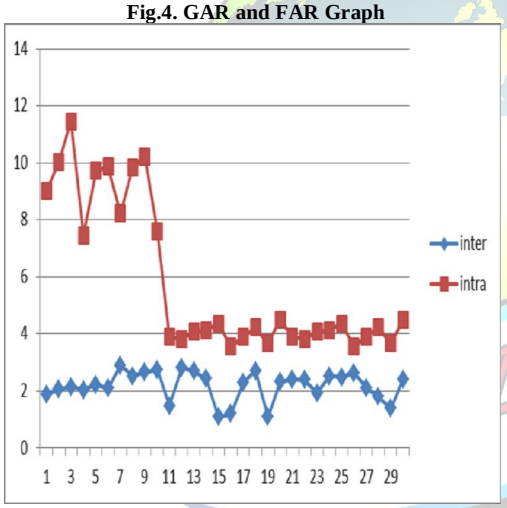

Fig.5. Matching Score of the Proposed System

As for accuracy is concerned the proposed matching system detects with 73 percent inter, intra matching at an absolute error rate of 0.182(calculated based on threshold value).

V. CONCLUSION AND FUTURE WORK

In this paper, a hierarchical strategy is proposed and utilized in the matching stage. The segmentation and hierarchical matching strategy can reject many palmprints and palmprints which do not belong to the same palm and same palm as the input palmprint quickly, thus it can save much time. Experimental results show that the proposed algorithm can produce high accuracy compared to the traditional method and illustrate its effectiveness. Not as the conventional method based on classification and indexing, the proposed method does not use more features than or information than minutiae, and it can be integrated as the conventional identification systems in future.

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