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A Review on Palmprint Recognition

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Abstract: ***Biometrics is defined as the exceptional or individual physical properties or attributes of human body. These attributes are used to recognize each human. Any details of the person body which differs from another person to the other is used as unique biometrics data which serve to that's person's unique ID. Palmprint recognition being one of the important aspects of biometric technology. These palmprint recognition serves into four stages, palmprint image acquisition, preprocessing, feature extraction and matching. The major approach for palmprint recognition is to extract feature vector from each individual palm and to perform matching based on some distance metrics. This paper present a detailed review on palmprint recognition approaches.***

Keywords: Biometric, Preprocessing, Feature Extraction and Matching

1. Introduction

A biometric system is a technological system that uses information about a person to identify that person. It is automated method of recognizing a person based on physiological or behavioral characteristics. Biometrics technologies are becoming the foundation of an extensive array of highly serve identification and personal verification solution. As a level of security violated and transaction fraud increases, need for highly secure verification technologies is becoming apparent.

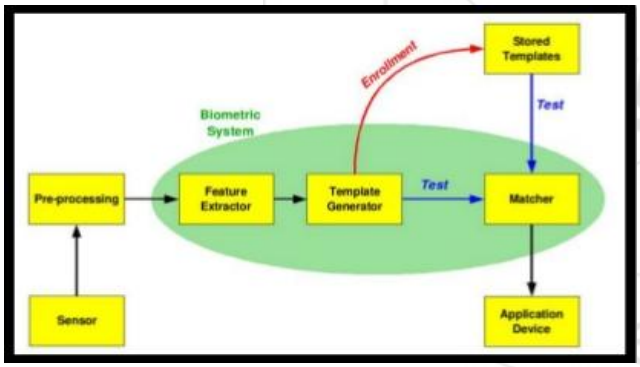

Figure 1: Biometric system

These biometric based technologies are able to provide for confidential financial transaction and personal data privacy. There are different types of modalities available for identification purposes such as iris, fingerprint, palmprint, face etc. [1]. Palmprint is one of the most reliable modality. It possesses more features than other modality such as principal lines, orientation, minutia etc. Palmprint Identification has gained high effect over other biometric modalities due to its reliability and higher user adoption. There are two types of palmprint recognition system: high resolution and low resolution techniques. High resolution techniques imply high resolution images which is appropriate for forensic application such as criminal observation. Low resolution images which is more capable for civil and commercial application such as access control.

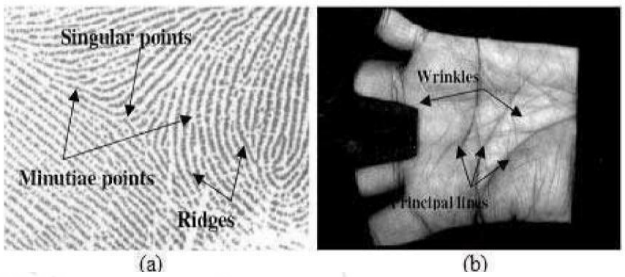

Figure 2: (a) High Resolution palm image and (b) Low Resolution palm image

Rest of the paper is organized as follows: Section II describes palmprint recognition system, Section III explains review of previous work and Section IV summarizes the contribution of the paper

2. Palmprint Recognition System

The palmprint recognition includes preprocessing followed by ROI Extraction. After ROI Extraction, features are extracted using the feature extraction algorithms. Then matching is done on the basic of the extracted features. The palmprint is then accepted or rejected. The palmprint recognition system is represented in figure which is described in flowchart

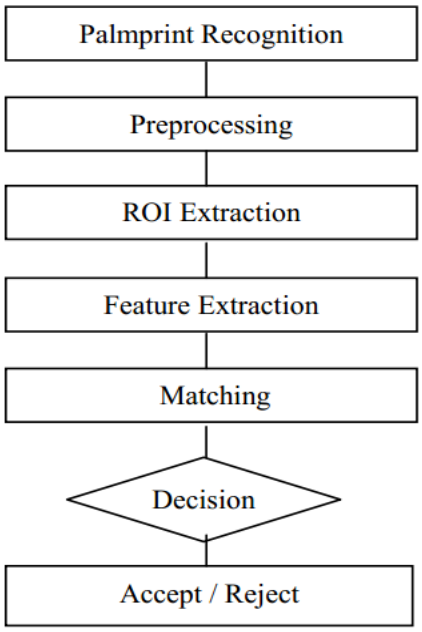

Figure 3: Flowchart of Palmprint Recognition

The palmprint recognition system consists of four stages: Palmprint Image acquisition, Preprocessing, Feature extraction and matching as shown in Figure 3. The palmprint image is acquired using a palmprint scanner. Preprocessing has two parts, image alignment and region of interest selection. Image alignment is done by referring to the key points. Region of interest selection is the cropping of palmprint image from the hand image. Feature extraction obtains features from the preprocessed palmprints. The matching compares the captured image features with the stored templates.

A. Preprocessing

After capturing the data or image of the palmprint, preprocessing is done. To reduce the overhead, instead of directly using the palmprint images, preprocessing needs to be done. Preprocessing is used to remove distortion, align the palmprint and to crop the region of interest. This cropped ROI is used for feature extraction, done in following steps:

1) Binarizing the palm image.
2) Boundary tracking.
3) Key point detection.
4) Establishing a coordinate system.
5) Extracting the central part.

B. Feature Extraction

Feature extraction is followed by pre-processing. The objective of this step is to extract variables that describe, unequivocally, the forms belonging to the same class while differentiating them from the other classes. In other words, it is the process in which phase features of palm are extracted like principal lines, orientation field, minutiae, density map, texture, singular points etc. These features are helpful for identification or verification of individual. Extracted features are stored in database for further process of matching.

Research on feature extraction and matching algorithms are classified as follows: Line based, subspace based, Statistical based and coding based approaches.

Line based approach: This approach develops edge detectors and makes use of the magnitude of the palm lines. The magnitudes of the palm lines are projected in x and y coordinates forming histograms.
After this, the first and second order derivatives of the palm images are calculated. The first order derivative is used to identify the edge points and corresponding directions. The second order derivative is used to identify the magnitude of lines. Then the Euclidian distance is used for matching.

Subspace based approach: This approach makes use of Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Independent Component Analysis (IDA). The spatial coefficients are considered as the features used for matching. This approach does not need any prior knowledge of the palmprints.

Statistical approach: These are of two types, local and global. The local approach transforms the image in another domain. This transformed image is then divided into several regions such as mean and variance of each region.

The global features include moments, center of gravity and density. The global approach is applied on the whole palmprint image. This is the only difference between the local and global approach. The local approach is applied on the segments of the palmprint image whereas the global approach is applied on the whole image.

Coding approaches: This approach uses a single Gabor filter to extract the local phase information of palmprint. This extracted phase information is used by the palmprint recognition systems to reduce the registered data size and to deal with non-linear distortion between palmprint images This approach has very low memory requirement and fast matching speed.

C. Matching

Matching is next to the feature extraction phase. Feature matching determines the degree of similarity of recognition template with master template. Different approaches are used for matching. Input provided by an individual is matched with templates present in the database. Matching is dependent on whether the system performs identification or verification. If it performs identification, then one-to-many matching, which matches input as palmprint of individuals with all templates of database, otherwise one-to-one match is done for verification where input of an individual is matched with only the template he/she claims to be.

3. Literature Survey

Some recent papers are reviewed for palmprint recognition:

Zhang Yaxin et al [2] proposed palmprint identification system based on the global strategy and integration of local feature. Global feature selected as Fourier characteristics. Local feature selected as Gabor feature. Gabor feature for palmprint into blocks, a set of features the same position is a new feature then through local classifiers as the serial integration.

Wafa El-Tarhouni et al [3] proposed a novel fusion approach that combines two feature extraction algorithms. Local Binary Pattern Histogram Fourier Features and Gabor filter techniques for use as one feature extraction. The fused features are applied to improve the performances of palmprint recognition. However, the main problem associated with this approach is the extremely large number of feature, which can result in an overfitting problem for classification. To overcome this difficulty, spectral regression kernel discriminant analysis (SR-KDA) is applied as a reduction technique. The K- nearest neighbor classifier is used for the final decision.

Jayashri P. Patil et al [4] proposed a method using Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT) with Principal Component Analysis (PCA) techniques is simple and effective methodology for palmprint recognition. In this, preprocessing used for palmprint image alignment, to resize the palmprint image and to enhance contrast of palmprint image by using histogram equalization. DCT and DWT used to generate feature and that feature are extracted by using PCA.

Faegheh Shojaiee, Farshid Hajati [5] proposed a new Local Composition Derivative Pattern (LCDP) for palmprint recognition. In this, LCDP firstly extracts first order derivative information of images along radial and directional directions which can capture more information than Local Binary Pattern (LBP). Experimental evaluation is done on Hong Kong Polytechnic University database.

Yali Zhang et al [6] proposed a weighted fusion method of Discrete Multifeature Wavelet Transform (DMWT) and Local Binary Pattern (LBP). This method fuses the global image feature by DMWT and Local image features by LBP, which can overcome limitation of the single feature extraction method. Principal Component Analysis (PCA) is used to solve the dimensional increase problem of this fusion.

Bob Zhang et al [7] proposed three novel global features of 3-D palmprint which describe shape information and can be used for coarse matching and indexing to improve the efficiency of palmprint recognition, particularly in large databases. Three proposed shape features are maximum depth of palm center, horizontal cross-sectional area of different levels, and radial line length. We treat these features as a column vector and use linear discriminant analysis to reduce their dimensionality.

Abdallah Meraoumia et al [8] proposed a method based on Histogram of Oriented Gradient (HOG) descriptors for palmprint identification. Nowadays, identification of persons has a great importance for information protection and access control. Thus, author proposed a method which utilized the fusion, at matching score level, of some classifier (Radial Basis Function (RBF), Random Forest Transform (RFT), and Support Vector Machine (SVM) to improve the performance in identification accuracy.

Mohammed Saigaa et al [9] presented a multi-modal personal identification system using the Histogram of Oriented Gradient (HOG) descriptors as feature extraction. Single biometric system may be inadequate in many application; so, to overcome the limitation of the single biometric, multi representation biometric is used. In this, two classifiers are used (Distance Classifier and Radial Basis Function(RBF)) to design two subsystems. The experimental results showed that designed system achieves an excellent identification rate.

Sang et al [10] proposed a robust, touchless, palmprint recognition system which is based on color palmprint images. This system uses skin-color thresholding and hand valley detection algorithm for extracting palmprint. Then, order to extract the palmprint features. Finally, chi square statistic is used for classification.

Guo et al [11] presented a paper in which five methods of feature extraction are used. They are statistics feature, Fourier transform, DCT transform, Gabor transform and Local Binary Pattern (LBP). The feature vectors of all the sub-images are combined together to form the feature vector of the palmprint image. Finally, the pattern classification can be implemented by the nearest neighbor classifier.

Shashikala et al [12] proposed a palmprint identification system based on DWT, DCT and QPCA (PIDDQ). Histogram equalization is used on palmprint to enhance contrast of an image. The DWT is applied on Histogram equalized image to generate LL, LH, HL and HH bands. The LL band is converted into DCT coefficients using DCT. QPCA is applied on DCT coefficients to generate features. The test and database palmprint features are compared using Euclidean Distance (ED).

4. Conclusion

Biometric identification system has high productivity, high verification rate and comfortable to user's operating characteristics. Palm recognition is considered the most reliable biometric recognition technique with low cost, user friendliness, high speed and accuracy. In this paper, we have reviewed the various existing methods used for palmprint recognition system. The aim of working on the palmprint recognition system is to develop a system with increased speed and accuracy.

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