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Textural Features of Palm Print

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***Abstract*– Image processing is widely used in many applications like medical imaging, industrial manufacturing, entertainment and security system. The size of image is very large. Biometrics which use of human physiological characteristics for identifying an individual, now a widespread method of identification and authentication, uses several image processing techniques. Biometric computing offers an effective approach to identify personal identity by using individual's unique, reliable and stable behavioral characteristics. Biometric identification is a technology which describes the general procedure for identification and verification using feature extraction, storage and matching from the digitized image of biometric characters such as Finger Print, Face, Iris or Palm Print. In this paper we present a comparative study and analysis of some palm print feature extraction and identification methods.**

***Index Terms*– Biometric Computing, Palm Print Classification, Invariant Feature Extraction, Palm Print Alignment, Point Matching and Identify Verification**

I. Introduction

AUTOMATIC human identification has become an important issue in today's information and networked based society. The techniques for automatically identifying an individual based on his physical or behavioral characteristics are called biometrics. Biometrics, which is concerned with the unique, reliable and stable personal physiological characteristics such as fingerprints, facial features, iris pattern, retina and hand geometry, or some aspects of behavior, such as speech and handwriting, is emerging as the most fool proof means of automated personal identification [1]–[4]. Research in fingerprint identification [5] and speech recognition [6] has drawn considerable attention over the last 25 years.

Hand geometry measurements are easily collectible from both the hands. Palm is the inner surface of a hand between the wrist and the fingers. Palm print has been used as a powerful means in law enforcement for identification because of its stability and uniqueness. A key issue is palm print identification involves the search for the best matching of the test sample input to the templates stored in the palm print database.

Palm print can be characterized by the geometry of few principal lines (Heart, Head and Life Lines) and the presence of several wrinkles and ridges in the palm. Principal lines and Datum points (end points of principal lines) have been regarded as useful palm print features for identification purpose [7], [8].

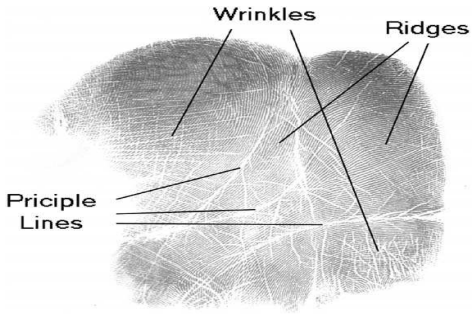

Fig. 1: Layout of palm-print image with principle lines, wrinkles and ridges

Line feature matching method is reported to be powerful for easy computation, tolerance to noise and high accuracy in palm print verification [7]. A palm print is defined as the prints on a palm, which are mainly composed of the palm lines and ridges. A palm print, as a relatively new biometric feature, has several advantages compared with other currently available features [9]. Image alignment (also known as registration or positioning) refers to establishing a common frame of reference for a set of images: it has been widely investigated in various contexts [10].

In the first part of this review article, we present an overview on some of the major research areas in palm print analysis. To set the scene, we first give a brief description of the biometrics background required for a proper understanding of the material. Next, we describe a very important area in palm print analysis, namely, develops a key point detection technique and how principal lines are extracted, identity of a person can be verified based on feature points extracted from palm prints, the basic concepts and disciplines of palm print identification and illustrates the importance of palm print alignment in the whole process. In the second part of this review article, we present an overview

of the biometric technology and palm print technique analysis and comparison.

II. PALM PRINT BIOMETRIC SYSTEM

The three major steps in the palm print biometric system are:

- Acquisition of Palm Prints of all users in a image database.
- Feature extraction for each class of palm prints and update of the database.
- Feature extraction of scanned input image.
- Matching with the stored features for the highest matching score to obtain the identification / verification output of the system.

The verification system can be depicted as a block diagram as shown in Fig. 2. Hand images of every user can be used to extract the palm print. Alternately accurate palm print image is captured by a palm print scanner and then the AC signal is converted into a digital signal, which is transmitted to a computer for further processing.

Some pre-processing may be necessary to bring the palm print images to a common coordinate system based on some hand geometry. Also, several well-known pre-processing techniques can be used to improve the quality of the images.

After extracting features from the palm print images they need to be classified and indexed as several images may belong to the same person. In matching process a distance measure is used to measure the similarity of two palm prints, the input image and the classified images in the database.

Verification in a Palm print biometric system thus refers to the comparison of a claimant's palm print biometrics feature against a person's sample that has been stored in the Biometric system. This is regarded as a one-one matching. Identification on the other hand is concerned with the search for the best match between the input sample and the templates in the database, which is also termed as one-many matching.

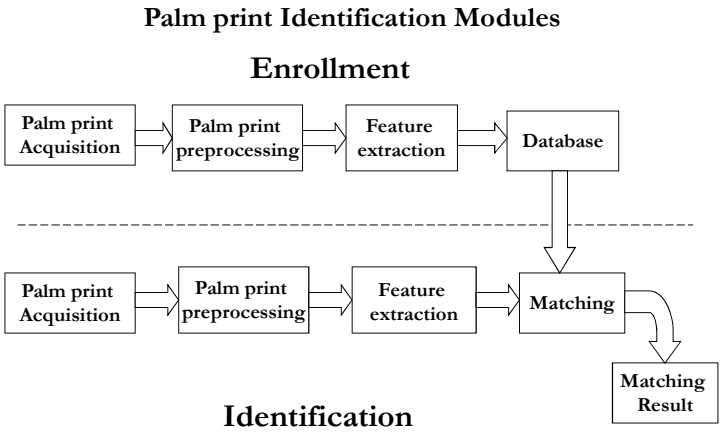

Fig. 2: Block-diagram of the Biometric system

III. FEATURE EXTRACTION

A. Palm Print Classification Using Principal Lines

Xiangqian Wu and David Zhang Kuanquan Wang (2004) have define the principal lines into heart lines, life lines and life lines based on some conditions. First they detect a set of points before they extract principal lines. They extract smooth the original image and convert it into binary image and then trace the boundary of the palm. Next detect the points A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q.

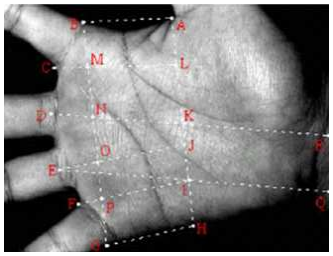

Fig. 3: The process of key points detection

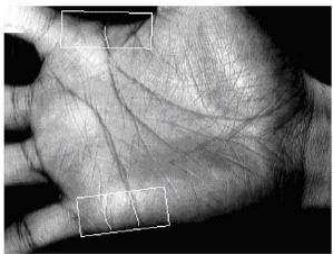

Fig. 4: Extracting line initials, heart line life line and head line

A verification function defined as- they devise a horizontal line detector to detect the lines. The horizontal lines can be obtained by looking for the zero cross points of 'I' in the vertical direction and their strengths are the values of the corresponding points in 'I' and extracting potential line initials of principal line. They extract the beginnings of the principal lines from these regions and use these line initials as the basis to extract the principal lines to their entirety.

They classify the palm print by the number of the principal lines and the intersections of these principle lines. Two principal lines are said to intersect only if some of their points overlap or some points of one line are the neighbors of some points of another line. Palm print can be classified into six categories as:

Category1: Palm prints composed of no more than one principal line.

Category2: Palm prints composed of two principal lines and no intersection.

Category3: Palm prints composed of two principal lines and one intersection.

Category4: Palm prints composed of three principal lines and no intersections.

Category5: Palm prints composed of three principal lines and one intersection.

Category6: Palm prints composed of three principal lines and more than one intersection.

Table 1: Six palm print classification rules

Number of principal lines	⩽ 1	2		3		
Number of the intersections of principal Lines	0	0	1	0	1	⩾ 2
Category no.	1	2	3	4	5	6

In their experiment they have inked the palm-print on the papers and then scanned them to obtain 320×240 images with 8 bits per pixel. Palm print database containing 13,800 palm prints captured from 1,380 different palms with 10 images per palm. Out of those distinct palm print images, 96.03% have been found to be in excellent agreement with the manual estimate.

Table 2: Principle line test results of 13,800 images

Total samples	Correctly classified samples	Misclassified samples	Classification accuracy
13,800	13,252	548	96.03%

B. Invariant Feature of Palm Image Alignment

Wenxin Li , David Zhang , Zhuoqun Xu (2003) proposed a new automatic invariant feature based palmprint alignment method which is able to deal with various image distortions such as image totation and shift [8].

They define a coordinate system, determine Y-axis, determine origin and rotate and shift the original image. Y-axis is the outer boundary of the palm which is the intersection between the heart line and outer boundary. The Y-axis is denoted as y=ax+b . In line segment matching find Slope, intercept and Angle of inclination of all images and find Euclidean distance between the two line segments in two palm images. In verification they defined R = 2N/(N1+N2).

Where N is the number of the corresponding pairs and N1, N2 are the numbers of the line segments determined from the palm print images.

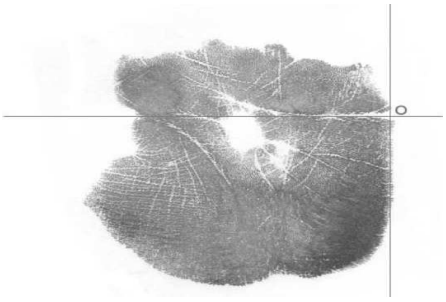

Fig. 5: Two - dimensional right angle palm print coordinate system using two invariant features (outer boundary detection and end point of principal line)

In their experiment palm prints not only have different qualities, but also different contour shapes. So a palm print coordinate system should be defined and an effective algorithm should be developed. They have taken 200 images of 125 dpi (432 x 432 pixels and 256 grey levels) from 100 different individuals are stored in image database. Based on 100 pairs of palm print images in our database, the experiments show that 81 to 94 pairs can be correctly identified before and after using the alignment method respectively.

Table 3: Comparison of 200 images between palm prints before and after alignment

	Origin deviation (pixel)	Direction deviation (deg.)
Before alignment	27.87	7.87
After alignment	3.17	2.07

C. Matching of Palm

Nicolae Duta, Anil K. Jain, Kanti V. Mardia (2002) have extract the feature points along the palm lines [11].

They estimate of the matching score distributions for the genuine and imposter sets of palm pairs showed that palm prints have a good discrimination power which classified can treated as constructing a decision boundary in 2D feature space. They estimate between two feature set matching score is computed as a tuple (P,D) where P is the percentage of points and D is the average distance (in pixels) between the corresponding points. They represent the features of a palm print set of points in the Euclidean plane along with the palm line. If D is a "distance" function between two sets of points A and B, then the point set B is aligned to the point set A to a transformation group G (which rigid, similarity, linear, affine) if D(A,B) cannot be decreased by applying to B a transformation from G. They use least-squares type distance

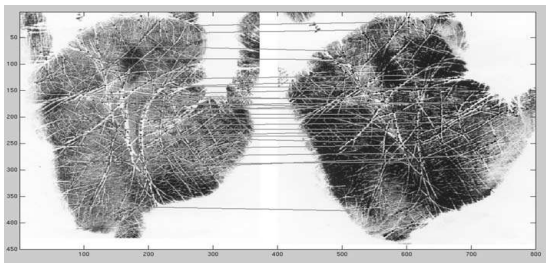

Fig. 6: Feature point matching and pair wise distance computation

In their experiment the genuine distribution resembles a 2D Gaussian centered at about 55% point correspondences and about 4 pixel distance between the corresponding points. The overlap between the genuine and the imposter distributions are primarily due to poor quality images in which the percentage of noise is about 40%. They have collected a small data set of 30 (15 of each of the two hands) palm print images of three persons, the resolution is of 200 dpi (image size 400 x 300

with 256 gray levels). From each palm print a set of approximately 300 feature points was extracted.

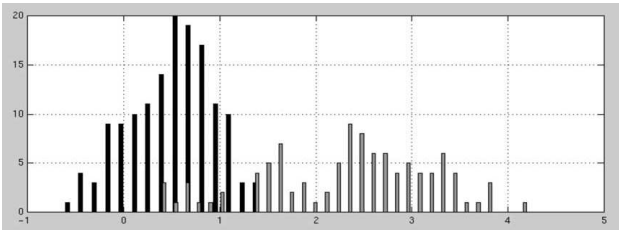

Fig. 7: Palm matching lines test results of 30 images

IV. ANALYSIS AND CONCLUSION

This article presents a review of applications of image processing to the emerging field of biometrics.
In this paper we have presented some of the early work on palm print as a biometric identifier which has set milestones in this area. The Table 5 summarizes these methods.

The results achieved 95 percent correct recognition. Some of the issues in using these methods are:

- The principal lines of some persons may be identical. Some of the persons may have strong wrinkles and some of them have little or no wrinkles.
- The lighting condition is a major issue for geometrical features and texture features.
- The orientation of the hand while acquiring the palm print could pose a problem in feature matching
- The computational overhead is high in most of the methods [8] have suggested an image registration method and defined a coordinate system which will take care of alignment for rotation and translation (Fig. 5). They have used geometrical features of line segment matching and their verification function is similar to the Datum point method [7]. Though each method has some success not much work has been done on the impact of noise, incompleteness, difference in brightness etc. It may be required to use multiple feature extraction techniques to create a more robust and flexible authentication system based on palm prints.

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Table 5: Comparison of different palm print recognition methods

Feature Extraction	Feature type	Database size	Image Size	Result
Principle line Tracking by Xiangqian Wu, et al, Pattern Recognition 37 (2004) 1987-1998	Textural features in intersections	13,800 images (from 1,380 palms)	320 x 240	96.03% accuracy, 4% false detection
Image Alignment by Wenxin Li et al, Signal processing: Image communication 18 (2003) 373-379	Invariant features in palm print alignment representation	200 images (from 100 people)	432 x 432	81-94% accuracy, 6% false detection
Matching of palmprint by Nicolae Duta et al, Pattern Recognition 23(2002)477-485	Textural feature Using 2D feature space	30 images (from 15 individuals)	400 x 300	94 % accuracy, 6% false detection

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