# A Comparative study of Palmprint Feature Extraction

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***Abstract***— The different kind of characteristics of human beings such as fingerprints, palm print , facial features , iris pattern , retina and hand geometry are the personal identification and verification computing by Biometric. Such type of Biometric verification and authentication approach using the biological features inherent in each individual. This kind of Biometric identification is a technology which describes the general procedure for verification using feature extraction. The palm print features are introduced some interesting points and textural features by Biometrics. It is very suitable in many network based applications. Now it is a widespread method of identification and authentication uses several image processing techniques. In this paper we present a comparative study and analysis of some palm print feature extraction and identification methods.

***Keywords***—Personal authentication, Biometric computing, Interesting points, feature extraction, image matching, palm print features.

## Introduction

Biometric features have been widely used in many personal authentication applications like universality, Distinctiveness, Permanence, Collectability, Performance, Acceptability and Circumvention [1]. Biometric features are the features extracted from human biological organs or behaviour for personal identification by Jain et al in 1999 [2]. There has been a high demand for personal identification and verification for security reasons and different kind of characteristics of human beings such as fingerprints, palm print, facial features, iris pattern, retina and hand geometry are the personal identification and verification computing by Biometric [3]. Some researchers have investigated the problem of logo recognition, by applying algebraic and differential invariants [4] , positive and negative shape feature [5], Zernike moment [6], String-Matching technique [7], template matching [8], combined measure [9], Zhang proposed a texture based feature extraction method to obtain the global attributes of a palm, besides a dynamic selection scheme was also designed to ensure the palm print samples to be correctly and electively classified in a large database [10].

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.

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.

In the second part of this review article, we present an overview of the biometric technology and palm print technique analysis and comparison.

## 2. PALM PRINT BIOMETRIC SYSTEM

In the palm print biometric system there is three major steps are

- Acquisition of Palm Prints of all users in a image as shown in figure 1.
- 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.

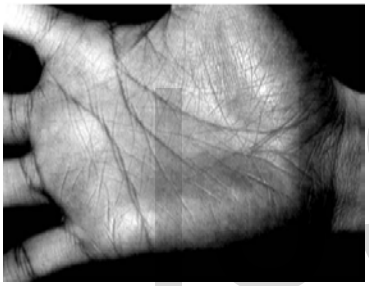


**FIGURE 1: SNAPSHOT OF THE PALM PRINT IMAGE**

The verification system can be depicted as a block diagram as shown in figure 2. Feature extraction plays an important role in image identification and verification. There are many features exhibited in a palm. 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. A distance measure is used to measure the similarity of two palm prints in the palm matching process.
Verification is regarded as a one-one matching. Identification on the other hand is concerned with the search for the best match between the training sample and the test in the database, which is also termed as one-many matching.

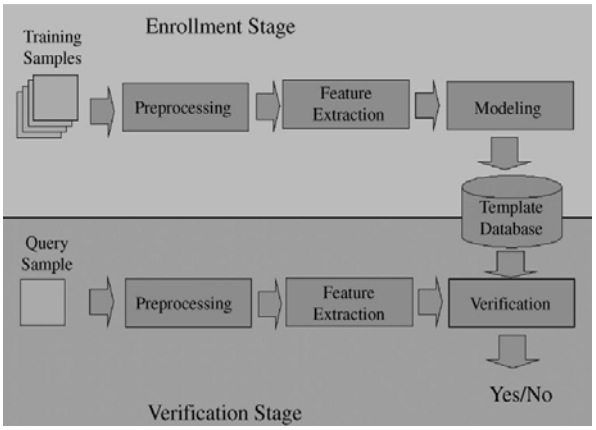



**Figure2. The proposed system of biometrics verification**

## 3. FEATURE EXTRACTION

### 3.1. TEXTURE FEATURE AND INTERESTING POINTS -

Jane You and Wenxin Li have done careful study of new method to authenticate individuals based on palmprint identification and verification. They propose a dynamic selection scheme to facilitate the coarse-to-fine palmprint pattern matching by combining global and local palmprint features in a hierarchical fashion. Here they detect the palmprint features as well as the interesting points. These points are used as a process of registration of the palm print images as in Figure 3. Datum point and Principal lines determination are done using directional projection algorithm.

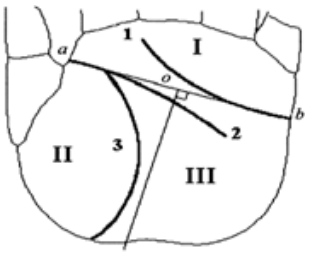



Fig.3. Definitions of a Palm print: Principal lines (1-heart line, 2-head line and 3-life line), Regions (I-finger-root region, II- inside region

and III-outside region) and Datum points (a, b-endpoint, o-their midpoint).

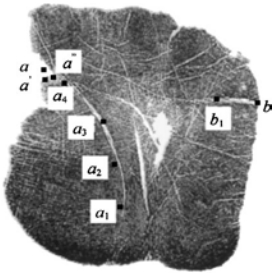



Fig. 4. Track of datum point determination by using the directional projection algorithm
Certain line geometry features such as slope and intercept are also used to match line segments between two palm images.

A verification function defined as-

$$Slope\ (i)=(y_2(i)-y_1))\ /\ x_2(i)-x_1(i)).$$
$$Intercept(i)=y_1(i)-x_1(i)slope(i), a(i)=tan^{-1}(slope(i)).$$

Has been used for the final decision, $(x_1(i), y_1(i)), x_2(i), y_2(i)), i=1, 2,...., N$, where $N$ is the number line segment. Each line segment can be represented by two parameters like slope and intercept.
In their experiment they have inked the palm-print on the papers and then scanned them to obtain 232×232 images. The 232 x 232 gray-scale inked palm-print images were taken with resolution of 125 dpi and digitised to 256 gray scales. Out of 200 distinct palm print images, 91 have been found to be in excellent agreement with the manual estimate as shown in table 1.

**Comparison of different palmprint matching methods**

| Hierarchical matching (proposed approach) | | | | |
|---|---|---|---|---|
| **Database size** | **Feature extraction** | **Matching criteria** | **Search method** | **Accuracy** |
| **200 samples** | **Texture and feature points(multiple features)** | **Energy difference and Hausdorff distance(flexible measurement)** | **Guided search (hierarchical)** | **91% Good** |

Table. 1. Accuracy rate of 200 selected images

**3.2. PERSONAL AUTHENTICATION BY PALMPRINT FEATURE –** Chin-Chuan Han, Hsu-Liang Cheng, Chih-Chih Lin have used the scanner-based personal authentication by using the palm print features. This method is very suitable in many network based applications. They extract the meaningful features from the segmented ROI. They employ the simple Sobel operators to extract the feature points of palm prints. Four directional Sobel operators like $S_0$, $S_{90}$, $S_{45}$ and $S_{135}$. This operation is operated following expression:

$$f * S = max(f * S_0, f * S_{45}, f * S_{90}, f * S_{135})$$

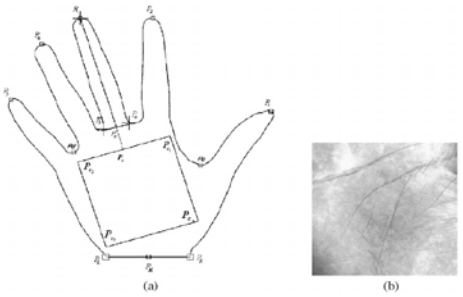



Fig.5. the generation of region of interest (ROI).

Here the symbol * is defined as the convolution operation. They applied Sobel operator and present other complex morphological operators to extract the palm print features.
In their experiment a palm print input device with three kinds of window sizes 32x32, 16x16, 8x8 are adopted to evaluate the performance of the template matching methodology. They have been used to acquire the palm prints of images with 845 x 829 pixels. An image has been collected from 1000 positive samples of individuals x 49 times. A high recognition rate of 98% has been achieved both FAR and FRR values of matching scheme as shown in table 2.

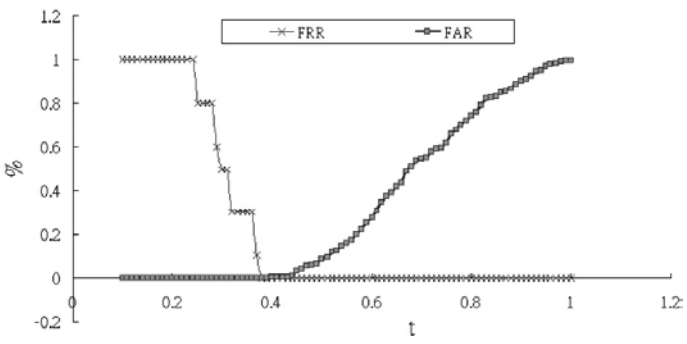


Table.2. Eigen Palm test results of 1000 images

**3.3. LINE SEGMENT HAUSDORFF DISTANCE** – given by Jingying Chen and Maylor K. Leung (2002) considers palm print as a new approach has been advantage to incorporate structural and spatial information to compute dissimilarity between two sets of line segments. They proposed the line segments Hausdroff distance generated from logos with three modules like segmentation, logo representation, and matching results. In this method the two sets of points $M = \{m_1, .... , m_p\}$(representing a model in the database) and $N = \{n_1, .... , n_q\}$(representing a test image), the Hausdorff distance is defined as

$$H(M,N) = max(h(M,N),h(N,M)),$$

The function $h(M,N)$ is called the directed Hausdorff distance from $M$ to $N$. It identifies the point of $M$ that is the farthest from its nearest neighbours in $N$. Thus the Hausdorff distance, H(M,N), measures the degree of mismatch between two sets. Intuitively, if the Hausdorff distance is $d$, then every point of $M$ must be within a distance $d$ of some point of $N$ and vice versa.

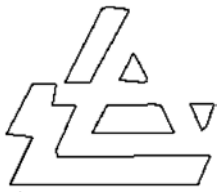
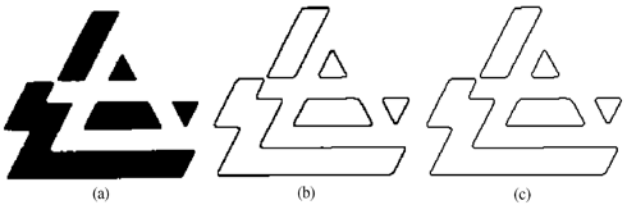


**Fig.6 A sample of line segment representation image**




**An illustration of segmentation: (a) intensity image, (b) edge image, (c) thinned image.**

In their experiment Hausdorff distance is a shape comparison metric based on binary image. It is a distance defined between two sets of points. Here they have taken 105 distinct logo images in the TIFF format. 189 test logos, mostly generated from 20 of the 105 models, were used to test the system performance. The 20 logos were selected evenly according to the number of lines detected on each model logo. The first test set 20 generated logos has been correctly recognized by the proposed system. Most test logos 99% have been classified correctly. They uses rotated and scaled logos from a database of approximately 100 logos.

| Threshold | Correct (%) | FP (%) | FN (%) |
|---|---|---|---|
| (1) MLHD | 99 | 0 | 1 |
| 0.16 | 77 | 22 | 1 |
| 0.17 | 78 | 22 | 0 |
| 0.18 | | | |
| (11) LHD | 57 | 0 | 43 |
| 2 | 73 | 4 | 23 |
| 3 | 83 | 10 | 7 |
| 4 | 80 | 17 | 3 |
| 5 | 68 | 32 | 0 |
| 6 | | | |
| (111) MHD | 75 | 0 | 25 |
| 2 | 78 | 12 | 10 |
| 3 | 71 | 27 | 2 |
| 4 | 40 | 60 | 0 |
| 5 | | | |

Table. 3. The result with different threshold values

## 3. ANALYSIS AND CONCLUSION

A different approach is presented to authenticate individuals by using their image features. 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.

Some of the issues in using these methods are –

(1) Palmprint is one of the most unique, reliable and stable personal characteristics which provide a powerful means to authenticate individuals for many security system.

(2) 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.

(3) The lighting condition is a major issue for geometrical features and texture features.

(4) The orientation of the hand while acquiring the palm print could pose a problem in feature matching

| Feature Extraction | Feature type | Database size | Image Size | Result |
|---|---|---|---|---|
| Texture feature and interesting points by Jane You et al, Pattern Recognition 35 (2002) 847-859 | Textural Features of palmprint features | 200 images (from 100 palms) | 232 x 232 | 91% accuracy, 9% false detection |
| Personal authentication by palmprint features by Chin Chuan Han et al, Pattern Recognition 36 (2003) 371-381 | Biological features in Sobel and Morphological operation | 1000 images (from 50 people) | 845 x 829 | 98% accuracy, 2% false detection |
| Line segment Housdorff Distance by Jingying Chen et al, Pattern Recognition 36 (2003) 943-955 | Structural feature Using Logo recognition | 105 images (from 20 models) | 128 x 128 rotated and scaled logo | 99 % accuracy, 1% false detection |

Table 6. Summarizes these methods.

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