Personal Identification and Verification using Palm print Biometric

Hlaing Htake Khaung Tin
University of Computer Studies, Yangon, Myanmar
hlainghtakekhaungtin@gmail.com

Abstract- **Biometric technology is an efficient personal authentication and identification technique. The biometric identification system using human palm has been developed and presented in this paper. In this paper, a new approach for personal authentication using palm print images is discussed. The proposed methodology is divided into four steps: image acquisition by a regular webcam, image preprocessing for image normalization, segmentation for biometric extraction and human interpretation. Gray –Scale palm images are captured using a digital camera at a resolution of 640*480. The proposed system has been tested with different images. Experimental tests have proved that the proposed approach is not only robust but also quite efficient.**

Keywords: Personal Identification, Verification, Biometrics, Palm print.

I. INTRODUCTION

Biometrics helps to provide the identity of the user based on his/her physiological or behavioral characteristics. The physiological characteristics signifies using human body parts for authentication like fingerprint, iris, ear, palm print, face etc. The behavioral characteristics include action done using body parts like voice, signature and gait etc. for authentication. Authentication based on a token and password etc. can be stolen or forgotten. Person's friends or relatives can easily access token and can guess the password. It is necessary to add some features that can almost eliminate the limitation of token-based and knowledge based methods [1]

Palm print is one of the relatively new physiological biometrics due to its stable and unique characteristics. The rich texture information of palm print offers one of the powerful means in personal identification and verification. Biometric palm print recognizes a person based on the principal lines, wrinkles and ridges on the surface of the palm. These line structures are stable and remain unchanged throughout the life of an individual.

The inner surface of the normally contains three flexion creases, secondary creases and ridges. The flexion creases are also called principal lines and secondary creases are called wrinkles. The flexion and the major secondary creases are formed between the 3rd and 5th months of pregnancy [2] and superficial lines appear after we born. Although the three major flexions are genetically dependent, most of other creases are not [3]. Even identical twins have different palm prints. These non-genetically deterministic and complex patterns are very useful in personal identification.

Human beings were interested in palm lines for fortune telling long time ago. Scientists know that palm lines are associated with some genetic diseases including Down syndrome, Aarskog syndrome, Cohen syndrome and fetal alcohol syndrome [4]. Scientists and fortunetellers name the lines and regions in palm differently shown in Fig. 1 [5].

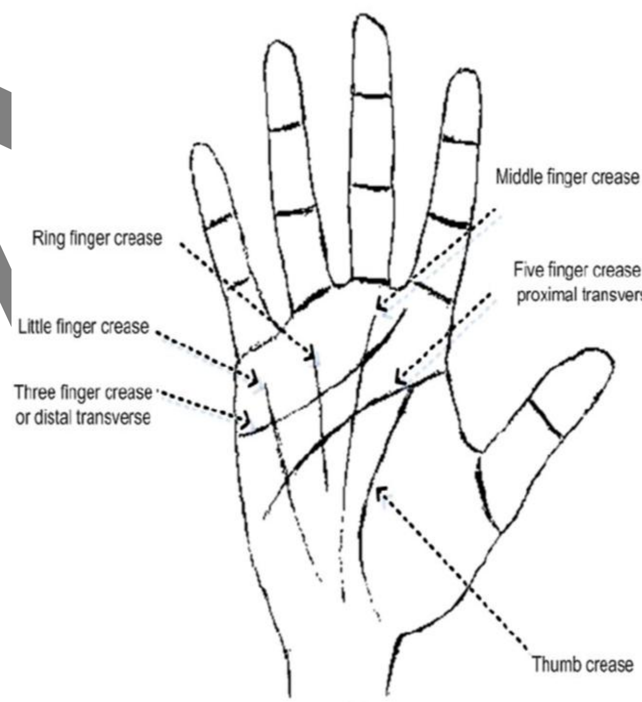


Fig. 1. Definitions of palm lines and regions from scientists

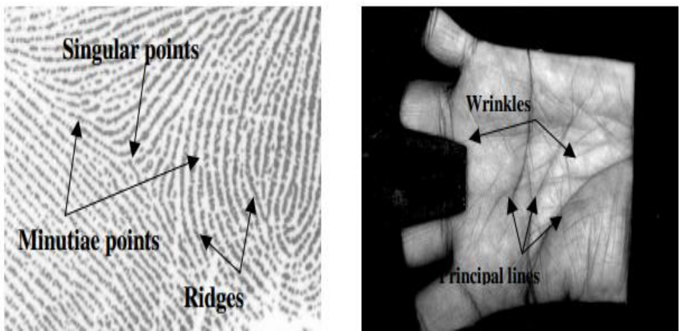
The rest of the paper is organized as follows: Section II reviews palm print and the proposed system is shown in Section III, Section VI lists identification and verification system of the palm print. Finally, the conclusions are presented in Section V.

II. PALM PRINT

There are two types of palm print recognition research, high resolution and low resolution approaches. High resolution approach employs high resolution images while low resolution approach employs low resolution images. High resolution approach is suitable for forensic applications such as criminal detection [6].

Low resolution images are more suitable for civil and commercial applications such as access control. Generally speaking, high resolution refers to 400 dpi or more and low resolution refers to 150 dip or less.

Fig. 2. illustrates a part of a high resolution palm print image and a low resolution palm print image.



(a) (b)

Fig. 2. Palm print features in (a) a high resolution image and (b) a low resolution image

In high resolution images, researchers can extract ridges, singular points and minutia points as features while in low resolution images, they generally use principal lines, wrinkles and texture. At the beginning of palm print research, the high-resolution approach was the focus [7-8] but almost all current research is focused on the low resolution approach because of the potential applications. In this paper, we concentrate only on the low resolution approach since it is the current focus.

For civil and commercial applications, low-resolution palm print images are more suitable than high-resolution images because of their smaller file sizes, which results in shorter computation times during preprocessing and feature extraction. Therefore, they are useful for many real-time palm print applications [9].

There are three key issues to be considered in developing palm print identification system.

1) Palm print Acquisition: How do we obtain a good quality palm print image in a short time interval, such as I second? What kind of device is suitable for data acquisition?
2) Palm print Feature Representation: Which types of palm print features are suitable for identification? How to represent different palm print features?
3) Palm print Identification: How do we search for a queried palm print in a given database and obtain a response within a limited time?

So far, several companies have developed special scanners to capture high-resolution palm print images [10, 11]. These devices can extract many detailed features, including minutiae points and singular points, for special applications. Although these platform scanners can meet the requirements of on-line systems, they are difficult to use in real-time applications because a few seconds are needed to scan a palm. To achieve on-line palm print identification in real-time, a special device is required for fast palm print sampling [9].

III. PROPOSED SYSTEM

In this proposed system, generally consists of four parts: palm print scanner, preprocessing, feature extraction and matcher. Palm print scanner is to collect palm print images. Pre-processing is to setup a coordinate system to align palm print images and to segment a part of palm print image for feature extraction.

Palm images are enhanced and pre-processed to get the region of interest (ROI). Feature extraction is to obtain effective features from the pre-processed palm print. Finally a matcher compares two palm print features.

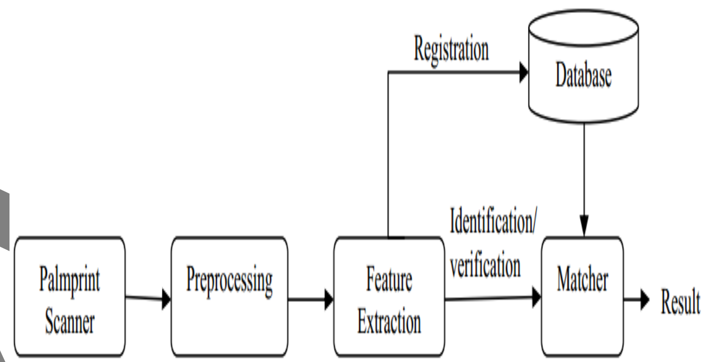


Fig. 3. Stages in palm print identification and verification

A. Pre-processing extraction of Palm print Images

Image is pre-processed to get the region of interest. Pre-processing includes image enhancement, image binarization, boundary extraction, cropping of palm print/ ROI. The ROI size is 64*64 pixels. Sample of ROI is shown in Fig. 4.

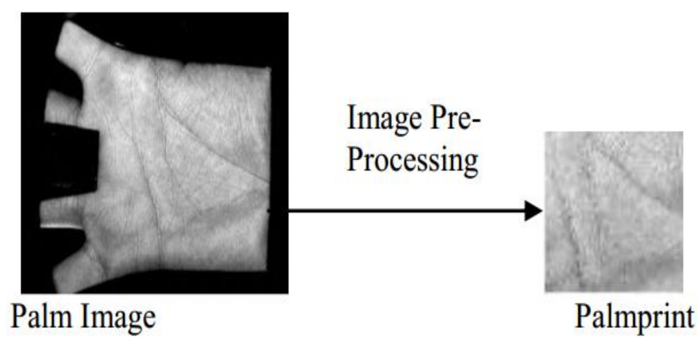


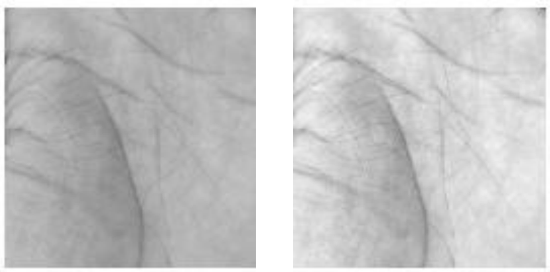
Fig. 4.Sample of ROI

B. Normalization of Palm print Images

The extracted palm print images are normalized to have pre-specified mean and variance. The normalization is used to reduce the possible imperfections in the image due to sensor noise and non-uniform illumination. Let the gray level at (x,y), in a palm print image be represented by $I(x,y)$. The mean and variance of image, $\emptyset$ and ρ, respectively, can be computed from the gray levels of the pixels. The normalized image $I'(x,y)$ is computed using the pixel-wise operations as follows:

$$I'(x,y)=\begin{cases}\phi_d+\lambda & \text{if } I(x,y)>\phi\\ \phi_d-\lambda & \text{otherwise}\end{cases}\qquad \text{where } \lambda=\sqrt{\frac{\rho_d\{I(x,y)-\phi\}^2}{\rho}}$$

Where $\emptyset_d$ and ρ_d are the desired values for mean and variance, respectively. These values are pre-tuned according to the image characteristics, i.e., $I(x,y)$. In all our experiments, the values of $\emptyset_d$ and ρ_d were fixed to 100. Fig. 4. Show a typical palm print image before and after the normalization.



(a) (b)

Fig. 4.Palm print feature extraction; (a) segmented image, (b) image after normalization

IV. PALM PRINT IDENTIFICATION AND VERIFICATION SYSTEM

Palm print identification and verification system using biometrics is one of the emerging technologies, which recognizes a person based on the principle lines, wrinkles and ridges on the surface of the palm. These line structures are stable and remain unchanged throughout the life of an individual. More important, no two palm prints from different individuals are the same, and normally people do not feel uneasy to have their palm print images taken for testing. Therefore palm print recognition offers a promising future for medium-security access control system.

The palm print database is divided into two groups, first group (G_1) consists of 50 persons with each person having 4 palm sample images to train the system, and second group (G_2) contains 50 persons with each person having one palm image different from the first group images to test the system. The hand image size is 284*384 pixels. The palm print image used is 64*64 pixels.

G_1 group

$P_1 = [I_1,I_2,I_3,I_4]$, $P_2 =[I_1,I_2,I_3,I_4]$, …………..

$P_{50} = [I_1,I_2,I_3,I_4]$

In G_1 group each hand P_i contains 4 sample image I_1-$_5$.

G_2 group

$P_1 = [5]$, $P_2 = [I_5]$,…………$P_{50} = [I_5]$

In G_2 group each hand P_i contains only sample image I_6.

Identification and verification is a process of comparing one image against N images. In the following tests, we setup registration databases for the number of persons N=50 in four templates. Similarly for N=50, the registration databases have 200 templates. We also setup a testing database with 200 templates from 50 different palms. None of palm print images in the testing database are contained in any of the registration databases. Each of the palm print images in the testing database is matched with all of the palm print images in the registration databases to generate incorrect and correct identification and verification system.

V. CONCLUSIONS

In this paper, we have explored automated palm print identification and verification. In principle, some features have been extracted to test the effectiveness of this approach, and the preliminary results suggest that palm prints can be effectively applied to identity verification. The technique works well in the presence of noise in the palm print, because the features adopted can be obtained from a low-resolution image. It is believed that this approach can have practical application to personal identification and verification as a new biometric technology.

In summary, we conclude that our palm print identification and verification system can achieve good performance in terms of speed and accuracy. For further improvement of the system, we will focus on three issues: 1) to combine the proposed palm print identification and verification system with other biometric such as face, finger print for identification to achieve higher performance, and 2) some noisy images with cuts and bruises on the hand have to be collected to test the system.

ACKNOWLEDGMENT

The author is grateful to her family who specifically offered strong moral and physical support, care and kindness.

REFERENCES

[1] Jain A.K., Ross A., Prabhakar S, "An introduction to biometric recognition", IEEE Trans. Circuits Syst. Video Tehnology, 14, (1), pp. 4-20, 2004.

[2] M. Cannon, M. byrne, D. Cotter, P.Sham, C. Larkin, E. O'Callaghan, "Futher evidence for anomalies in the hand-prints of patients with schizophrenia : a study of secondary creases". Schizophrenia Research, vol.13, pp. 179-184, 1994.

[3] A. Kong, d. Zhang and G. Lu, "A study of identical twins palm print for personal verification", Pattern Recognition, vol. 39, no. 11, pp. 2149-2156, 2006.

[4] The National Fragile X Foundation http://www.nfxf.org/html/checklist.htm

[5] L.S. Penrose, "Fingerprints and palmistry", The Lancet, vol. 301, no 7814, pp.1239-1242, 1973.

[6] NEC Automated Palmprint Identification System http://www.necmalaysia.com.my/Solutions/PID/products/ppi.html

[7] N. Duta, A.K. Jain and K.V. Mardia, "Matching of palm prints", Pattern Recognition Letters, vol. 23, no. 4, pp. 477-486, 2002.

[8] W. Shu and D. Zhang, "Automated personal identification by palmprint", Optical Engineering, vol. 38, no.8, pp. 2359-2362, 1998.

[9]David Zhang, Wai-Kin Kong and Jane You, "On-Line Palmprint Identification".
[10]http://www.nectech.com/afis/download/PalmprintDtsht.q.pdf - NEC automatic palm print identification system.
[11]http://www.printrakinternational.com/omnitrak.htm - Printrak automatic palm print identification system.