FEATURE EXTRACTION: PALM PRINT PRINCIPAL LINE EXTRACTION AND DETECTION

Abstract

The Biometrics refers to the identification of humans by their characteristics or traits. It is the science and technology of measuring and analyzing biological data. This paper proposes a Biometric Palm print principal line extraction using image processing and various morphological operations. Palm-lines, including the principal lines and wrinkles, can describe a palm print clearly. The proposed work discusses the new approach of palm-line extraction for the palm print recognition system. The region of interest (ROI) for each sample is generated to obtain the palm print features by using image filtering technique and morphological operations. Experimental results show that the proposed approach is suitable for palm-line extraction.

Keywords

Biometrics, Morphological operation, image filtering and edge detection techniques, PolyU_Palmprint_Database, Palm print recognition.

1. Introduction

Multimodal biometric systems have recently attracted the attention of researchers and some work has already reported in literature. Most of the reported work has bimodal biometric system such as Finger prints, Face recognition; Iris, Hand and Palm print recognition [1].The biometric use of palm prints uses ridge Patterns to identify an individual. Palms of hands epidermal ridges, thought to provide a friction surface to assist with gripping an object on surface [2]. Palm print identification systems measure and compare ridges, lines and Minutiae found on the palm. Palm print recording and identification for law enforcement purposes has been in existence almost as long as palm prints systems are reported to comprise 30% of all crime scene marks [2]. As much as another 20% are made up of the edge of the hand, fingers between the palm and fingertips and other parts of the hand. A key driver for law enforcement agencies to adopt full-hand scan Technologies are the high incidence of hand related crime scene marks. One of the earliest AFIS systems built to support palm prints is believed to have been developed in Hungary in the early 1990's. In 1997, the technology was bought by a US company. In recent years, most AFIS vendors have added palm print records capabilities to their systems.[4]Joao de Barros, an early explorer and writer, wrote that the Chinese merchants distinguished young children from each other by recording palm prints on paper with ink.

2. Methods for Recognition

There are three groups of marks which are used in palm print identification are as follows:

- Geometric features, such as the width, length and area of the palm. Geometric features are a coarse measurement and are relatively easily duplicated. In themselves they are not sufficiently distinct;[3]
- Line features, principal lines and wrinkles. Line features identify the length, position, depth and size of the various lines and wrinkles on a palm. While wrinkles are highly distinctive and are not easily duplicated, principal lines may not be sufficiently distinctive to be a reliable identifier in themselves;
- Point features or minutiae. Point features or minutiae are similar to fingerprint Minutiae and identify, amongst other features, ridges ridge endings, bifurcation and dots [3].

Palm creases and ridges are often superimposed which makes feature extraction difficult. An important issue in palm print recognition is to extract palm print features that can discriminate an individual from the other. There are two popular approaches to palm print recognition. One of the approaches is to transform palm print images into specific transformation domains [2].Palm print authentication is one of the relatively new physiological biometric technologies which exploit the unique features on the human palm print, namely principle lines, wrinkles, ridges, datum points, etc[3].

3. Palm print Image Database

The Hong Kong Polytechnic University (PolyU) 2D_Palmprint Database. [6]

Palm print has proved to be one of the most unique and stable biometric characteristics. Almost all the curent palm print recognition techniques capture the two dimensional image of the palm surface and use it for feature extraction and matching. Although a palm print recognition can achieve high accuracy [6]. The PolyU Palm print Database contains 7680 samples collected from 384 different palms. Twenty samples from each of these palms were collected in two separated sessions, where 10 samples were captured in each session, respectively. The average time interval between the two sessions

is one month. The all palm print images are of same size and dimension such as 384 X 284 [6]. An each palm print image was recorded in BMP format image file. The palm print images have a name sequence and can be interpreted as follows- e.g. - A palm print image name "PolyU_001_F.bmp" can be interpreted as the initiated word 'PolyU' is the copyright for the Polytechnic University of Hong Kong. Then followed '001' indicate the subject enrollment number as it varies with person to person palm print image. The followed 'F' indicate the session enrollment that whether it is the First or Second. And finally the format 'BMP' of the Image file.

(a) (b) (c)

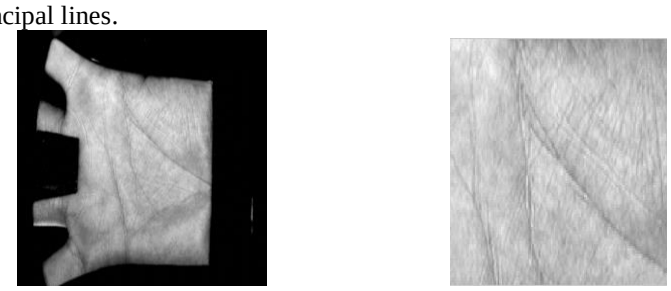
Fig.1. (a) the outlook of image acquisition device; (b) The device is being used to collect palm print image; (c) The "PolyU_001_F_01.bmp" palm print image. [6]

4. Feature Selection

The proposed work discusses the new approach of palm-line extraction for the palm print recognition system. The region of interest (ROI) for each sample is generated to obtain the palm print features by using image filtering techniques and morphological operations. The palm print image is cropped to 101X151 palm print images that is our region of interest (ROI) and is highlighting the Principal line from palm print image. An image enhancement is for highlighting interesting details in an image and removes noise from the image. The proposed work discusses the image enhancement for highlighting the principal lines from palm print image. Before extracting a palm line, the proposed approach smoothes the image along this line's direction, which improve the smoothness and connection of this palm-line. Canny algorithm tries to extract all palm-lines [7].However; the proposed approach extracts palm lines. Another characteristic of the proposed approach is its fine-level extraction stage. At this stage, the missing parts of palm-lines can be further extracted and some broken palm-lines can be linked. Hence the proposed approach outperforms canny algorithm in palm-line extraction.

The image is Image enhancement involves following steps:

1. Input Palm print image from database and crop the palm print image to generate Region of Interest (ROI) consisting three principal lines.



(a) (b)

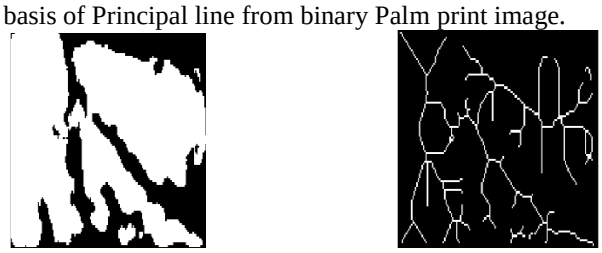
Fig. 2.1 (a) Original Palm print image; (b) ROI from Palm print image.

2. Apply median filter on cropped palm print image and then convert noise free gray scale image into binary image; which will be useful for principal palm line extraction.

(a) (b)

Fig.2.2 (a) Noise free gray scale image; (b) Binary Palm print image.

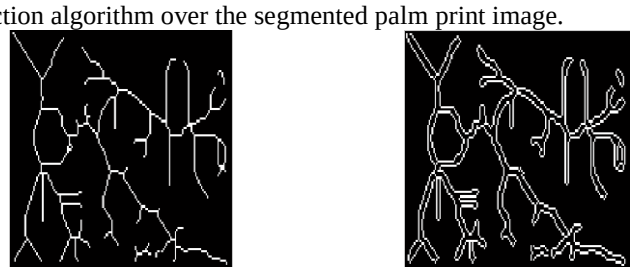
3. Form the segmentation on the basis of Principal line from binary Palm print image.



(a) (b)

Fig.2.3 (a) Binary Palm print image; (b) Principal line palm print image.

4. Apply the canny Edge Detection algorithm over the segmented palm print image.



(a) (b)

Fig.2.4 (a) Principal line palm image; (b) Edge Detected Palm print image

5. Experiment and Result

The Experiment was performed over the palm print image taken from the database developed by the Hong Kong Polytechnic University (PolyU) palm print database. In our experiments, we have applied the proposed Approach to several hundred palm print images. Here no parameter is needed to tune for our approach in the experiments. We employ several samples to compare our approach with another well-known edge detection method, canny algorithm [5].
Figure 3 shows some results obtained by our approach and Canny algorithm. The algorithm runs in 5 separate steps:

1. Smoothing: In this step any image filter such as average filter is to be applied in order to blur an image to remove noise.
2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes as $\mathbf{K_{GX}}$ and $\mathbf{K_{GY}}$. First step is to approximate the gradient in the x- and y-direction respectively by applying the kernels shown in Equation (1)

$$\mathbf{K_{GX}} = \begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix} \qquad \mathbf{K_{GY}} = \begin{matrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{matrix} \tag{1}$$

$$|\mathbf{G}| = \sqrt{\boldsymbol{Gx^2 + Gy^2}} \qquad |\mathbf{G}| = |\mathbf{Gx}| + |\mathbf{Gy}| \tag{2}$$

Where:
In the equation (2) 'Gx and Gy' are the gradients in the x- and y-directions respectively.

3. Non-maximum suppression: Only local maxima should be marked as edges.

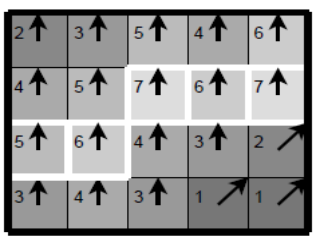


Fig. 3 Illustration of Non-maximum suppression.

In fig 3 the notion about the edge strengths are indicated both as colors and numbers, while the gradient directions are shown as arrows. The resulting edge pixels are marked with white borders.

4. Double thresholding: This step is essential in which potential edges are determined by thresholding.

5. Edge tracking by hysteresis: this step is useful by which final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge. These are the necessary steps are followed in order to carry the experiments related to the Canny edge detection algorithm.

In figure 4, the left, middle and right columns are the original palm print images, the results of the proposed approach and the results of canny algorithm, respectively.

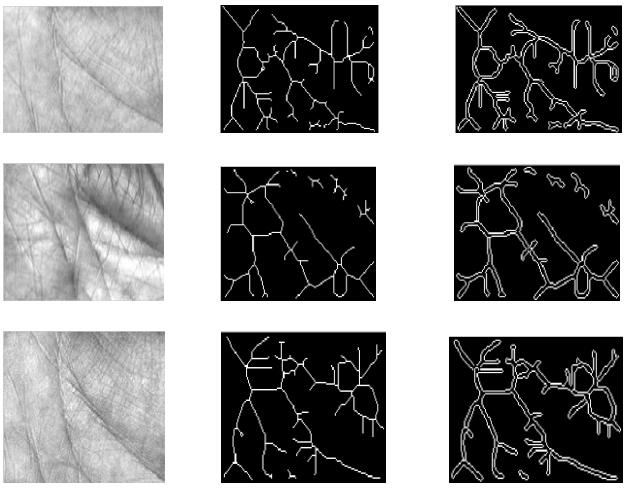


Fig.4 shows experimental results and comparisons. Left column: the ROI of palm prints; Middle column: the principal lines extracted using our approach; Right column: the Principal line edge detection using canny algorithm.

From Figure 4, each principal line of the palm print correspond two parallel edges in canny algorithm. This is because that canny algorithm is based on magnitude maximums of the gradient image. According to Figure 4, though the principal lines in some palm prints are very complex: their shapes, directions are quite different to each other, the proposed approach still can extract them effectively.

6. Conclusion

Principal lines of the palm print image form one of the most important features for palm print recognition. In this paper, a novel approach is devised to extract principal line from palm print images. At the every extraction stage, most of the palm print principal lines are extracted using the morphological operations with directional structuring element. The proposed approach and related experiment smoothes the palm print image along his line's direction. That result to improve the smoothness and line connection in the palm print. Canny algorithm tries to extract all palm print principal lines. This approach can effectively extract the palm print principal lines from palm prints including those containing unclear palm print lines and very complex line structures.

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