Palm Image Recognition Using Image Processing Techniques

Wen-Yuan Chen[1], Yu-Ming Kuo[1], and Chin-Ho Chung[2]

[1] Department of Electronic Engineering,
National Chin-Yi University of Technology, Taichung, Taiwan, R.O.C.
[2] Department of Electronic Engineering,
Ta Hwa University of Science and Technology
cwy@ncut.edu.tw, kuoym1115@gmail.com, chc@tust.edu.tw

Abstract. In this research, we find the palm from the hand image firstly. And then distinguish the fingers using the triangular calculation method. In the palm detection, the color of skin, background subtraction, hand image extraction, edge detection and histogram analysis are used to achieve the goal. In fingers distinguish; we record the tips and valley of the fingers by means of calculating the histogram of the palm image firstly. Next, we find out the original point which is the center of the gravity of the palm using the area that the palm image gets rid of the fingers part. Successively, we draw the original point and center of the cut line of the palm use as the base line, means zero angle line. Meanwhile, we draw another line from tip of finger to the original point called tip line. Finally, we calculate the angle between base line and tip line use as the finger angular. Since the fingers have different angle, so the fingers are easily be distinguished.

Keywords: Palm image, Skin Color, Center-of-gravity, Angle Detection.

1 Introduction

S. C. et al. [1] proposed a contact free system for palm image recognition. Several techniques are used to achieve the goal. They use the Palm images in Red, Green and Blue spectra, a multi-spectral image acquisition method, preprocessing to dynamically locate the region of interest and image fusion using Fourier and Wavelet transform based techniques.

W. Y. Han and J. C. Lee [2] use the palm vein texture and apply texture-based feature extraction techniques to palm vein authentication. In his algorithm, a Gabor filter provides the optimized resolution in both the spatial and frequency domains. For obtaining effective pattern of palm vascular, they represent a bit string by coding the palm vein features using an innovative and robust adaptive Gabor filter method. Simultaneously, two VeinCodes are measured by normalized Hamming distance. We obtain a high accuracy and a rapid enough for real-time palm vein recognition. From

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the experimental results, it is demonstrate their proposed approach is feasible and effective in palm vein recognition.

L. Nanni and A. Lumini [3] study the usefulness of multi-resolution analysis for the face and palm authentication problems. They adopt wavelet coefficients features for the authentication problem. Besides, several linear subspace projection techniques have been tested and compared. From the experiments results, it is carried out on several biometric datasets show that the application of Laplacian Eigen- Maps (LEM) on a little subset of wavelet sub-bands allows to obtain a low Equal Error Rate.

In this paper, the focus is on developing a scheme to distinguish the fingers of the palm images. Several researches proposed the hand gesture method can be seen in [4-8]. About histogram, skin color and angular criteria method to distinguish the exact fingers object can be finding in [9-12]. The remainder of this paper is organized as follows: in Section 2, the palm recognition algorithm. The empirical results are described in Section 3. Finally, Section 4 concludes this paper.

2 Recognition Algorithm

In palm recognition, several steps used to achieve the goal, it flow chart is shown in figure 1. Firstly, the background image and input image are processed by color transform. The color transform transfer the colors in RGB plans into YCbCr plans, it is superior to the skin color detection. Second, a background subtraction operation used to extract the skin color according to the background image and input image. Third, the features of the palm are computer and extracted for further fingers separation. The features include the center point of the palm image, the tip points of the fingers and the valley point of the fingers. Finally, the angles of all fingers are obtained by means of triangular method.

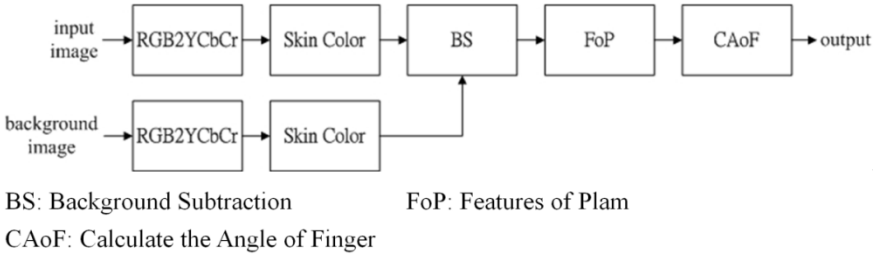

Fig. 1. The flow chart of the Palm recognition algorithm

2.1 Palm Object Extraction

Based on the concept of object extraction, a color mode is superior to the gray-scale mode in luminance variance. In the background removal stage, the background image and input image are used to extract the palm object image under the color mode. After

the RGB to YCbCr color transform, we use the conditions $130 \geq Cb \geq 70$ and $175 \geq Cr \geq 130$ to extract the skin color regions in the background image and input image, respectively. Furthermore, we subtract the two images to obtain the candidate areas of the palm object.

In this paper, we focus on the concept to computer the angle of fingers. Therefore, we need a base line use as zero angle line for counting the angle of fingers. In this research, we connect the center point of the palm and the center point of cut line of the palm use as the base line. For the center point, we calculate the center-of-gravity of the palm that get ride of the finger parts, and consider it use as the center point of the palm. For the tip of fingers, we computer the histogram of the palm image, and check each finger distribution than we can easily to obtain the tip of fingers as figure 7(f) shown. Figure 3 is the histogram analysis of the hand image. The up part of the figure 3 is a binary image with hand. The down part of figure 3 is the histogram of up part. It is making easier to cut the palm part at the center valley point. Figure 4 shows palm object extraction in case stone gesture image. The up part of figure 4 a binary image and the down part is the result image, palm image, it is extracted by our method. Figure 5 shows the palm object extraction case, it is scissors gesture image. It is also obtained a correct result like the figure 3 paper case and figure 4 stone case.

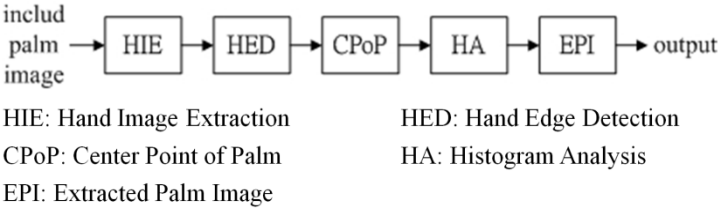

Fig. 2. Palm object extraction algorithm

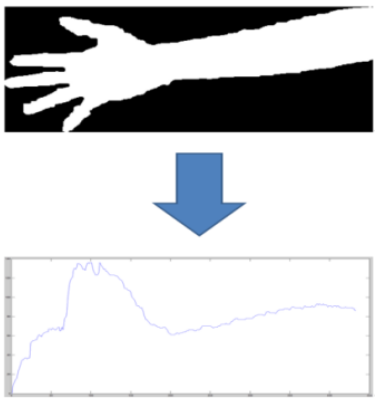

Fig. 3. The histogram analysis of the hand image

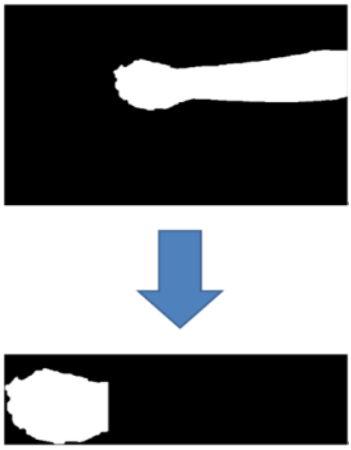

Fig. 4. Stone gesture case

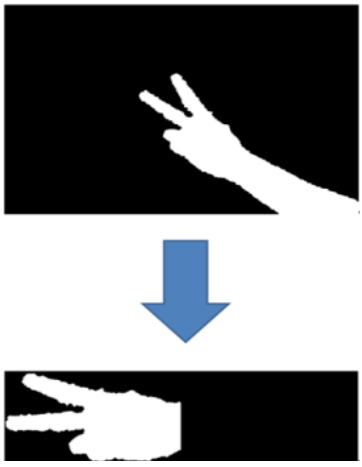

Fig. 5. Scissors gesture case

2.2 Finger Detection

In order to obtain correct palm image recognition, the finger detection is the prime task. In finger detection, we adopt three strategies to achieve the task: 1) calculate the center-of-gravity of the palm image for use as the center of the palm for further computation of the angle of the fingers. 2) Produce a baseline as the zero-axis for angle calculation. We get the cut edge of the palm using sobel edge detection. Then, calculate and draw a line between the center-of-gravity point and center of cut line of the palm for use as a baseline; and 3) calculate the angles of the fingers using triangular method associated with the tip point of finger, center-of-gravity point and center point of the cut line of the palm. The details is describing in the figure 6.

FVPC: Finger Valley Point Computing
PADFP: Plam Area Discard Finger Part
CPoP: Center Point of Palm
DBL: Draw Base Line
TPoF: Tip Point of Finger
CAoF: Calculate the Angle of Finger
DTL: Draw the Tip Line from the original point

Fig. 6. The flow chart of the Fingers detection

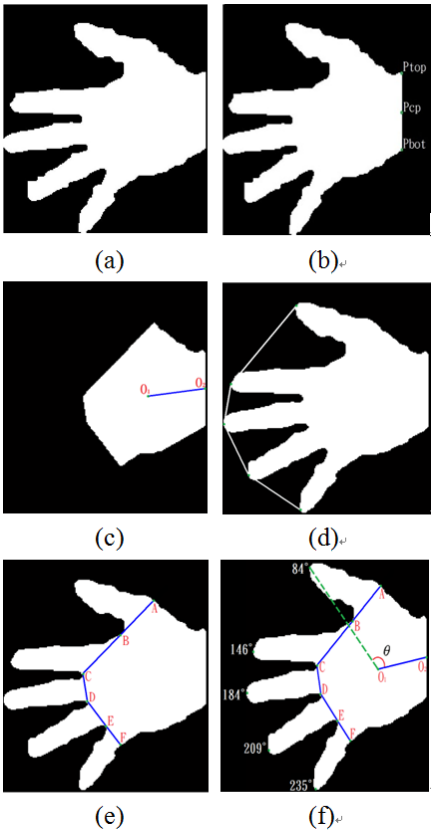

Fig. 7. The process steps of the calculating finger angle; (a) the original binary palm image. (b) the points of the cut line of the palm. (c) the baseline connected by point O1 and O2. (d) the contour of the finger tips. (e) the valley points of the fingers. (f) the angles of the fingers calculated.

In figure 6, the finger valley point computed used to find out the valley point of the finger. The palm area discard finger parts used to obtain a center point of the palm. The draw base line operation used to create a base line for further angle computation. The tip point of the finger is needed to calculate the angle of the finger. Figure 7 shows the angle of the finger computing process. Figure 7(a) is the original binary palm image. Figure 7(b) displays the points of the cut line of the palm; there are the Ptop, Pct and Pbot. Where the Pct point, it is the kernel point used to create the base line. Figure 7(c) shows the base, it is connected by point O1 and O2, and O2 is the same as the point Pct. Figure 7(d) is the contour of the finger tips. Figure 7(e) shows the valley points of the fingers, it is used to calculate the center of the palm which is the fingers part discarded. Finally, figure 7(f) shows the how the angles of the fingers calculated.

3 Experimental Results

Several (640×480) test images Rock, Paper and Scissors were used in simulation to demonstrate the performance of the proposed scheme. Figure 8 shows the angle detection process of finger in scissors case. Figure 8(a) is the original binary image; it is the extracted palm image only. Figure 8(b) is the edge image corresponding to (a); it is used to get the mid point of the cut line of the palm image. Figure 8(c) shows the three point of the cut line of the palm, denoted Ptop, Pct and Pbot; where Pct also called O2 will used to draw the base line associated with center point O1. Figure 8(d) display the histogram of the (a); we use the histogram information to extract the tip points and valley points of the finger. Figure 8(e) and 8(f) show the extracted tip point and valley points of the fingers respectively. It is obviously, the green points are the tip point of the fingers in figure 8(e). Simultaneously, the valley points denote A, B, C and D are display in the figure 8(f). Form the base line; it is generated by drawing the points from O1 into O2 as figure 8(g) shown. Finally, figure 8(h) shows the obtained angles of the finger of the palm. The angular of the fingers are 143 and 181 degree respectively.

In the other hand, the simulation on right hand image case is shown in figure 9. Figure 9(a) shows the original test image, it is the color mode image which is represented in RGB planes. In order to compact the redundant describing process, we only show the finally results in figure 9(b). There are display the base line, the valley points and the angular of the fingers. The angular are 93,145, 181, 206 and 231 respectively. It is show the results are correct. Fig. 10 shows another case; the left hand image case. The same as the figure 9 figure 10(a) shows the original test image in color mode. Figure 10(b) display the obtained angle results of the fingers tip. The angular are 77. 140, 182, 207 and 232, there are also obtained the correct results. After carefully check and compare the results of the figure 9 and figure 10, we make sure our method can get correct results no matter what the hand image is right hand or left hand. From the simulation results, we find that our algorithm can exactly identify the fingers pf the palm regardless of how the hand gestures are spread.

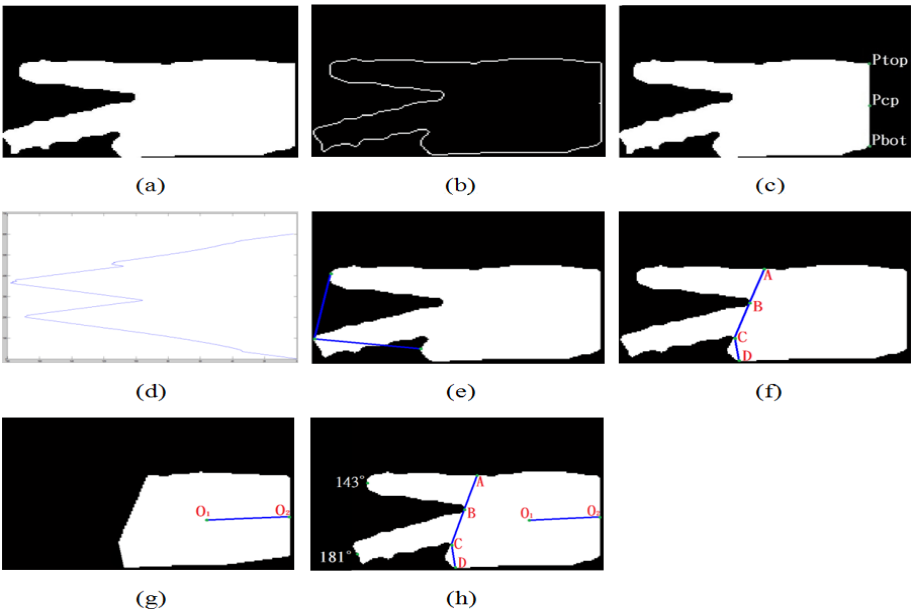

Fig. 8. The angle detection process of finger; (a) the original binary image, (b) the edge image of (a), (c) the three point of the cut line of the palm, (d) the histogram of the (a), (e) the tip point of the fingers, (f) the valley points of the fingers, (g) the obtained base line of the palm, (h) the obtained angles of the palm

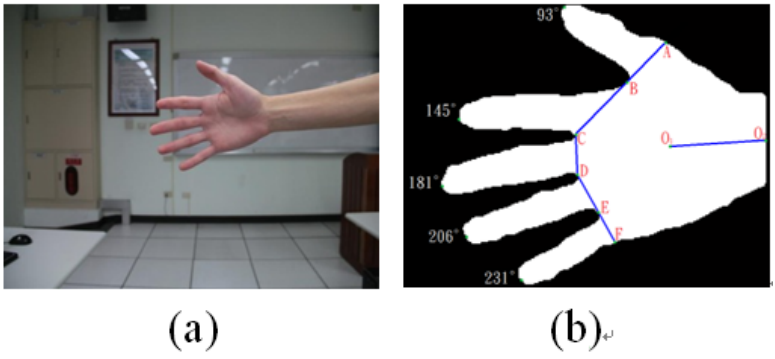

Fig. 9. The angles of the fingers tip on the right hand case; (a) the original image, (b) the obtained angle results of the fingers tip

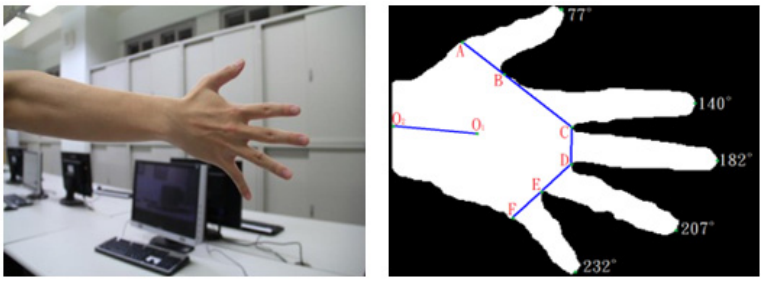

Fig. 10. The angles of the fingers tip on the left hand case; (a) the original image, (b) the obtained angle results of the fingers tip

4 Conclusions

We consider the best method of distinguish the fingers of the palm image is the angle of tip finger because it is physical features. Besides, we computer the center-of-gravity of palm area that get rid of the fingers part used as the original point. Further, we according to the original point and tip of finger can correctly to calculate the angle of finger.

From simulation results, it is show the angle of the right hand fingers in figure 10 are 93, 145, 181, 206 and 231. Likely, it is show the angle of the left hand fingers in figure 11 are 77, 140, 182, 207 and 232. The simulation data shows the different fingers have different angles no matter what it is right hand or left hand. This also demonstrates that our method is effective and correct.

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