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Research of Technology for Thenar Palmprint Locating and Segmentation

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***Abstract*—In the process of thenar palmprint objective and quantitative recognition, the locating and segmentation of thanar palmprint is very important. For the specificity of the region that we need, a set of approach is proposed to extract the thenar palmprint. The method to the collected palmprint image includes filtering, binary processing and contour tracking, obtaining the key point, and after choosing an appropriate location central point, the thenar palmprint is obtained. The experimental results illustrate the effectiveness of the method**.

***Index Terms*—palmprint, thenar palmprint, contour tracking, locating, segmentation**

I. INTRODUCTION

With the improvement of people's living standards, people seriously concern about their health，all hope that timely and accurate understanding of their health status, as soon as possible discover and treat the disease . The approach that use palmprints for diagnosis have the following characteristics. These characteristics include scientific ,simple and convenient, no pain, no side effects, economic and forecasting function, so more and more people favor it. This approach through observe the color, shape, texture and other characteristics of palmprints directly for diagnosis of disease. According to expert long-term clinical practice found that allergic dermatitis and asthma(exogenous) patients all exist rough thenar palmprints. Through observe the direction of stria, distance of stria, depth of stria groove, pattern features constituted by stria and palpation information, thenar palmprints will be divided into three levels [1][2].

I: The surface skin of the thenar palmprints gloss, exquisite texture, the distance between two stria short, the depth of stria groove shallow, no characteristic patterns, soft palpation.

II: The second class is divided two grades,(1): The surface skin of the big thenar palmprints gloss, texture clear and is shown as lattice-type distribution, but the distance of the stria short, soft palpation;(2) he surface skin of the thenar palmprints lack of gloss, texture clear and evident visible, Lattice-type distribution, the distance of the stria wide, soft palpation.

III: The surface skin of the thenar palmprints dry and rough, texture clear, evident visible, palpable obstruction of hand, even palpable as the leather, shown as the big lattice-type distribution, the distance between two stria uniform and obviously wider than II level second grade.

Through observe the characteristics of big thenar palmprints people whose level is more than two level's two grade can be treated early and rapidly. However the medical experts on the general clinical observation of the thenar palmprints with the naked eye, therefore, different medical experts will get different results about the same people, the results have a certain amount of subjectivity. In order to avoid this subjectivity, therefore consider using computer technology to preprocess thenar palmprints image, feature extraction, classification est., at last achieve objective and quantitative identification to thenar palmprints, for the following diagnosis and analysis of genes-related provide an objective and quantitative criteria. Palmprint identification of using computer technology has been more mature, simultaneously, some palmprint images processing algorithm [3-5]for our reference.

The thenar palmprint locating and segmentation is the key step for objective and quantitative identification, with computer processing thenar palmprint image, first of all, we should get the thenar palmprnt image from entire palmprint image. There are two major categories existing methods for palmprint image locating and segmentation:(1) using locating points: Han propose an approach based on wavelet decomposition to find locating points[6]. Li and Zhang set fixed-point as the locating point[7,8], Li using the tracking algorithm to determine locating points[9]; (2) Based on the inscribed circle segmentation method: Zhang propose an approach, which directly search the inscribed circle of the palm on binary palmprint image[10]; Wenxin Li etl propose an approach based on inscribed circle of the palmprint[11].

In this paper, we used the locating and segmentation approach based on locating point.,for the specificity of the extraction region, propose a set of region extraction method suit for thenar palmprint., by filtering binary processing and contour tracing to the palmprints image, find the key point, eventually obtain the thenar palmprint, these lay the foundation for the follow-up objective and quantitative identification.

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II. LOCATING PREPROCESSING

A. Filtering

Using a digital camera collected palmprint image contains noise. In order to avoid isolated noise point in binary processing, First of all, we use median filter to the image processing.

Median filtering is a non-line filtering technique, which can effectively suppress noise and enhance the image signal to noise ratio. Compared to mean filtering and other line filtering, Median filter can effectively filter out impulse noise and random noise, meanwhile it can able to retain the edge details of image .However median filtering is to process all the image pixels, it changed the pixel of the image that not polluted by pulse noise, so with effectively filter out the pulse noise the edge details will be over smoothed. The basic principles of median filtering is use the median pixel gray value of all points replace one point pixel gray value, these points in the neighborhood of the one point. In this paper, 5 × 5 template is used for image median filtering

B. Ostu Image Bbinary Processing

Ostu threshold method is often referred as the maximum variance between-class, use the Ostu method for segmentation palmeprint image ,the key is to find the best threshold, the Ostu threshold method is based on the histogram, algorithm description as follows:

$$P_r(r_q) = n_q / n \qquad q = 0,1,2,3,\ldots,L-1 \qquad (1)$$

Where, n is the total number of pixels in the image , n_q is the number of pixels that have gray level r_q ,and L is the total number of possible gray levels in the image. Suppose we select a threshold K that separates all the pixels in the image, This will produce two groups of pixels:C0 consisting of all pixels with gray level values <K and C1 consisting of pixels with values≤K. Compute the average gray level values μ_0 , μ_1 and μ_T for the pixels in regions C0, C1 and all pixels in the image. Ostu approach is to find the appropriate threshold K for which the variance of the Gaussian density of all pixels in the image is maximum, the equation as follows[12]:

$$\sigma^2 = \omega_0(\mu_0 - \mu_T)^2 + \omega_1(\mu_1 - \mu_T)^2 \qquad (2)$$

Where,

$$\omega_0 = \sum_{q=0}^{k-1} p_q(r_q) \qquad \omega_1 = \sum_{q=k}^{L-1} p_q(r_q)$$

,

$$\mu_0 = \sum_{q=0}^{k-1} q p_q(r_q)/\omega_0 \qquad \mu_1 = \sum_{q=k}^{L-1} q p_q(r_q)/\omega_1$$

,

$$\mu_T = \sum_{q=0}^{L-1} q p_q(r_q)$$

According to the image gray-level histogram find appropriate threshold value K make the σ^2 maximum to obtain the binary image ,by two morphological operations dilation and erosion processing can filter out noise ,meanwhile obtain the smooth palmprint contour.

III . LOCATING POINTS EXTRACTION

We will obtain the palmprint profile image and the freeman chain code of the profile, by Eight-neighborhood contour tracking to the binary palmprint image. Clockwise boundary tracking algorithm described as follows[13]:

(1) Obtain the start point (x0,y0) on the track as the current point, the access method based on the specific circumstance of the case.

(2) Determine the direction of the track Dir0 for the staring point,Dir0 determined as follows: To (x0,y0) as the center, detect each pixel from 0-7 followed by the direction, until find the Dir, makes the Dir direction point pixel is black and (Dir+1)%8 direction point pixel is white, the Dir is Dir0.

(3) Save the current point (xi, yi) coordinates and direction Diri. into a list.

(4) From the current point (xi, yi) and the direction code Diri to find a successor point(xi+1, yi+1) and make it as the current point.

(5) Suppose the current point is (xi, yi), if (xi, yi)= (x0, y0), then turn to (6), otherwise detect along the counter-clockwise direction from the direction Diri=(Diri-1) beginning, (that is, reverse rotation 45o).Detection process is divided two situations : (i) If the Diri direction point is a white point, then Diri= (Diri +7)%8, once again the implementation of (i), until the Diri point is black point, the current point's direction code Diri need to be a ring back adjustment, that is, Diri = (Diri-1+1)% 8,then turn to (3). (ii) If the Diri direction point is a black point, then Diri= (Diri +1)%8, once again the implementation of (ii),until the Diri direction point is a white point ,this Diri direction code is the current point direction code ,then turn to (3).

(6) Tracking completed.

After the completion of the eight-neighbor tracking the coordinates of the edge point was kept in a list .the list describe a closed curve the abscissa of these points as variables ,ordinate as the dependent variable ,obtain their local extremum. These local extremum points contain the auxiliary point that we need, by choosing the suitable point as the locating point.

IV. ROTARY CALIBRATION AND SEGMENTATION

After detecting the locating point, the next step is rotary calibration to the image, In order to cut the correct sub-graph of Palm print. First of all, according to the locating points calculate the angle of rotation:

$$\theta = \arctan[(Y_2 - Y_1)/(X_2 - X_1)] \qquad (3)$$

When θ >0, rotating the image in a clockwise direction, when θ <0, rotating the image in a counterclockwise

direction, after rotation the locating points A, B have the same ordinates, so when $Y_2 = Y_1$ the image is not rotating. The mid-point of A, B connection as the center of rotation. The arbitrary point (x, y) in the image around the center O (xCenter, yCenter) rotate θ degrees, the new coordinates (x', y') calculating formula as follows:

Counterclockwis:

$$x' = (x - xCenter) * \cos\theta + (y - yCenter) * \sin\theta + xCenter$$

$$y' = -(x - xCenter) * \sin\theta + (y - yCenter) * \cos\theta + yCenter$$

Clockwise:

$$x' = (x - xCenter) * \cos\theta + (y - yCenter) * \sin\theta + xCenter$$

$$y' = (x - xCenter) * \sin\theta + (y - yCenter) * \cos\theta + yCenter$$

The locating points A, B, C in original palmprint image corresponding points A'(xa, ya), B'(xb, yb), C(xc, yc) in the rotating image. According to the specificity of the region that we need, we need to select the appropriate dividing point for the image segmentation. In this paper, we select the point O' as the dividing center, its coordinates is (xCenter, yc), this point nearly is the center of the palmprint. The thenar region is a rectangular area, which we cut from the dividing point towards the direction of thumb. D is the distance between the dividing point and one rectangular corner coordinates that we cut. The rectangular corner is the upper left corner in right hand, its coordinates is (xCenter+d,, yc+d), but in left hand the rectangular corner is upper right corner, its coordinates is xCenter+d, yc-d) .

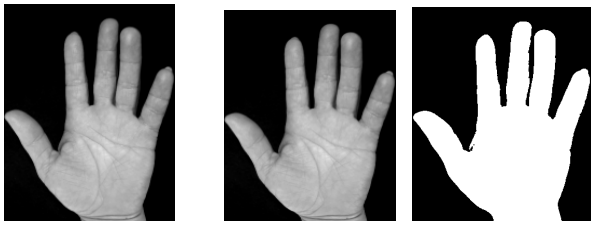
V. EXPERIMENTAL RESULTS AND ANALYSIS

In this paper, palmprint images is collected from author's palmprint database which collected with a digital camera. The palmprint database contains 100 people's palmprint, total 200 palmprint images, It contains all levels the above-mentioned.

The three images in Fig1 are original image, filtering image, binary image, in this paper we using 5 × 5 template for image median filtering, (see Fig1(b)), OSTU method used to collect a binary image ,Fig1(c) is the results of Fig1(b) using OSTU method .Boundary tracking can get the boundary coordinates and chain code, by differential operate we will get the locating points, draw the outline of the palmprint, and mark up the locating points in the outline map, the results in Fig2(a), the rotary calibration is necessary before segmentation. Though a large number of test, when d=40, the thenar palmprint we cut is more accurate, therefore, in this paper we set d=40 , the size of the thenar palmprint is 128×128, the results in Fig2(c).

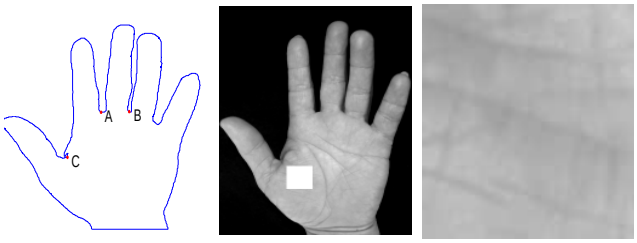
Using the above mentioned algorithm to the author's palmprint database for thenar locating and segmentation, the results is shown in table 1.

Using the left hand as an example, the process of the locating and segmentation described as follows:



(a) original image (b) filtering image (c) binary image

Figure1. Locating preprocessing results



(a) key point detecting (b) locating results (c) thenar palmprint

Figure2. Thenar palmprint locating and extraction

Analysis of these results, especially for the error location analysis showed that the angle made by the thumb and index finger determine the correct locating rate, when the angle is small that will move up the dividing point position, lead to error that in locating area contains main line. Through normalize the extending posture of the hands when collect the palmprint images, the correct rate will be further improved. Meanwhile the size of different people's hands different is a reason for error locating, when two people very different from the size of hands, it maybe bring error, affecting the correct rate. Therefore in the acquisition process some rules were set to the people who were collected, that will greatly improve correct locating rate of this algorithm.

TABLE I. THENAR PALMPRINT LOCATING AND EXTRACTION RESULTS

Total images	Correct locating images	Error locating images	Correct locating rate
200	190	10	95%

VI. CONCLUSION

In this paper, the approach through improve the locating methods in palmprint recognition, meanwhile considering the specificity of the region that we need, can be very good locate and divide the thenar palmprint .because of the locating results direct impact on the feature extraction of quantitative recognition, so this study have a great significance.

The extraction of thenar palmprint is a new application, through its research will supply help for

extracting other region of palmprint. The next step work is feature extraction based on the thenar palmprint , referring the feature extraction method of palmprint recognition, find out the feature extraction algorithm suitable for the thenar palmprint, lay the foundation for the follow-up quantitative classification.

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