ISSN : 0974 - 7435 Volume 10 Issue 16

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(16), 2014 [9105-9111]

Design of full hand feature recognition system

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ABSTRACT

The technology of all hand-shaped feature recognition in a parallel way is one of biometric identification technologies. This technology both has single-mode system lower cost advantage, but also has a higher recognition rate and better robustness. All hand-shaped features contain palmprint features, fingerprint characteristics and features of the hand. Fingerprinting feature recognition is a method of based on node and direction field. The palmprint feature recognition is based on weighted city distance's method of wavelet analysis. The hand feature recognition is based on Euclidean distance's method of feature vectors. The way of getting end result is three crude results of recognition through a way of parallel combination to obtain. The experimental results showed that: the system is stable, real-time, high recognition rate, and can achieve the desired objectives. The system is well positioned to meet the actual demand, and has broad application prospects.

KEYWORDS

All hand-shaped; Biometric identification technologies; Parallel fusion.

INTRODUCTION

All hand-shaped feature recognition technology is one of three-modal biometric feature identification technologies. The technology is one of the effective means to effectively solve the bottleneck problem of single-mode currently. So it has much attention abroad researchers[1, 2]. All hand-shaped features have a lot of advantages, for example they are easy to accept, easy to collect, identify high and difficult to counterfeit, etc., which was chosen as the object of this paper. The hand-shaped features include: palmprint features, fingerprint characteristics and features of the hand. The core of this paper is through three coarse recognition results to get the final result in the way of parallel integration at the decision-making layer. This method not only can improve the accuracy and stability of the system, but also improve the performance based on a single biometric identification system.

HAND RECOGNITION

Hand skeleton extraction

Hand image preprocessing purpose is to extract a clear outline of a hand, lay the foundation for extracting hand geometry features[3]. The fuzzy C-means clustering algorithm is applied to the image pre-processing[3]. The basic principle is to use pixel grayscale Euclidean distance as the similarity distance; the objective function calculation is repeated until the difference is less than a pre-set value of the objective function has twice won the threshold. The image $I = \{ f(i, j), 0 \le i \le M, 0 \le j \le N \}$ is divided into Class C, in accordance with the principle of closeness to recognize the objective function for image segmentation, wherein $f(i, j)$ is the gray level of the pixel.

Fuzzy clustering centers $C(i = 1, 2, 3..., m)$ represent each cluster center vector in the input space, namely $C_i = (C_{1i}, C_{2i}, \cdots, C_{si}) \in R_s$. The distance of the jth input vectors X_j and the ith fuzzy cluster centers C_i are:

$$d_{ij} = \left\| \sigma_i - X_j \right\| = \sqrt{\sum_{l=1}^{s} (\sigma_{il} - x_{jl})} \quad \textbf{(1)}$$

Matching method based on fuzzy C-means analysis gets a hand as follows:

Step1: Random number on the membership function matrix is initialized attention constraints.

Step2: Computing cluster center.

Step3: Calculation to determine the function:

$$H(X, \upsilon, C)(k) = \sum_{i=1}^{m} \sum_{j=1}^{p} \upsilon_{ij}^{n}(k) \left\| C_i(k) - X_j \right\|^2 \quad \textbf{(2)}$$

Step4: Calculation of membership function:

$$\upsilon_{ij}(k) = \frac{1}{\sum_{k=1}^{m} \left(\frac{d_{ij}(k-1)}{d_{kj}(k-1)} \right)^{\frac{2}{n-1}}} \quad \textbf{(3)}$$

Step5: Calculated using fuzzy cluster center fuzzy sets, fuzzy subsets calculate closeness and female principles in accordance with closeness to get a hand.

Application of fuzzy recognition method than traditional hand shape image preprocessing image preprocessing method can effectively reduce the amount of computation to improve the operating speed, while producing relatively sharp edge lines, without further refinement, to improve the positioning accuracy of the edges.

Hand Positioning

Because the flexible thumb activities when image acquisition by the majority of the palm to be tested is placed in an arbitrary position, but also to pose any hand, the situation is likely to cause the fingers and thumb and the other hand in different dimensions, so the anchor system design hand thumb to remove the image on each fingertip unexpected point and each of the outer root pointers.

The paper adopts fingertips and finger curvature method to find the root of the feature point area. Curvature of the plane curve is to use the points on the curve tangent direction angle on the arc of rotation rate, to indicate the degree of deviation from a straight line curve. The straight line curve k shows as:

$$k = \frac{\Delta\omega}{\Delta\delta} \quad \textbf{(4)}$$

$\Delta\delta$ is arc length, and $\Delta\omega$ is Tangent angle change.

Opponents shaped profile image on an image from the right edge of the first point -by-point counter-clockwise curvature calculation purpose is to find the root of the fingertips and finger area. Because the fingertip and bending of the finger root boundary curves are more obvious, so the system design threshold of 2.5. When the point of curvature is less than the threshold value, it means that the point is in the area where the root or fingertip. After traversing the end of the finger by calculating the relative position of the root fingertips, testing found the fingertip point or point refers to the root point. As shown in Figure 3.6, four regional and three fingertips refers to the root zone. Refers to the area to determine the root fingertips were found fingertips refers to the highest point and the lowest point of the root feature points as a hand -shaped hand positioning.

Hand feature extraction and recognition

The recognition method based on Euclidean distance is a common feature vector hand-shaped pattern matching method. The system designs relative length of fingers as a feature for feature extraction. This feature has a lot of advantages, for example it is readily available and easy to extract. Count the absolute length of the fingers' key points according to the method of features vector. Then, it calculates relative the length of the fingers as the feature vector to achieve the purpose of identification.

According to the method based on Euclidean distance feature vector get the result of hand rough recognition. Steps are as follows:

Calculate the absolute eigenvalues of fingers. Connect any fingertips and finger root vertex point, the distance value as the absolute finger length feature.

The ratio between the absolute length of each finger as a relative length, That is, two absolutely different than the characteristic length of the fingers, hand shape feature vectors constitute.

Make the Euclidean distance to match. The distance is smaller the similarity is higher. When the distance is less than a certain threshold, the match can be achieved that the two criteria. Euclidean distance is calculated as follows:

$$T = \sum_{i=1}^{n} \sqrt{(d_i - d_i^{'})^2} \quad \textbf{(5)}$$

Among, the T shows distance, the n shows the number of relative features, the d_i shows the relative features of the hand need to recognize and $d_i^{'}$ show relative features of the hand within the database d_i.

PALMPRINT RECOGNITION

According to the literature[5, 6], the system is also designed to match which applicants the method of weighted city distance based on wavelet analysis. Robustness of the method is better, higher recognition rate, and characteristics required storage space is small, fast matching speed.

The recognition's method of weighted city distance based on wavelet analysis is as follows:

- Make the palm pretreatment diagram to decompose in fifth wavelet.
- The resulting detail image is divided into 3×3 disjoint blocks equally.
- Calculate the energy of each block image block, forming a feature vector.
- The characteristic quantities normalized to obtain wavelet energy feature.
- Applicant the method of weighted city distance to calculate the similarity between wavelet energy. The formula for weighting the city distance is as follow:

$$D(V,U) = \sum_{i=1}^{m} (c_i \sum_{j=1}^{3\times S\times S} \left| V_{(j)}^{i} - U_{(j)}^{i} \right|) \quad \textbf{(6)}$$

Among shows blocks, c_i shows weights, S shows direction shows the relative features of the palm need to recognize and U shows relative features of the palm within the database.

FINGERPRINT RECOGNITION

According to the literature (Cong Bi-Hui, et al, 2014), the system apply the method of nodes and direction to match fingerprint. The method of nodes and direction is to select a node as a reference from the input fingerprint and the template fingerprint. In the same time align the reference node to match the node, and then review the matching degree of other nodes.

Suppose that M and W are the input fingerprint and the fingerprint database. When the image feature points extracted by a number of feature points of the image, when the position of the center position of the feature point, the gradient direction, the type and frequency of the fingerprint feature information, carrying out a feature point than on the basis of the information alignments. First pan-aligned M and W. Meeting the horizontal and vertical coordinates within the allowable error range and under the same conditions as the type of feature points,find similar characteristics match the image 45 degrees in the direction of the field point deviation range.

FUSION MATCHING

The design of the system considering the whole hand shape recognition of the advantages and disadvantages of feature information, using the parallel decision fusion methods In the decision layer, to improve the performance of recognition system based on the single biological characteristics. The parallel fusion method refers to each biometric respectively using matching device specific, comprehensive utilization of matching scores three biological characteristics to identify user identification[7].

Set the matching scores of hand shape recognition system as M_C , Matching scores of palmprint recognition system as M_b and matching scores of fingerprint recognition system as M_a. Using the linear fitting method to get comprehensive recognition score last, the formula is as follows:

$$M = \alpha_1 \times M_a + \alpha_2 \times M_b + (1-\alpha_1-\alpha_2) \times M_c \quad \textbf{(7)}$$

The design of the system setting the result is qualified when $M \geq 0.6$. According to the single mode recognition technology research. The system designs the α_1 value is 0.6, the α_2 value is 0.2, then the hand shape weight is 0.2.

SYSTEM DESIGN

The hand shape feature recognition technology is a kind of multi-model information fusion recognition technologies. Through the acquisition of palmprint, palmprint's image preprocessing, features' extraction for region of interest and features' recognition, get the palmprint identification information。 Through the collection of fingerprint, the fingerprint image preprocessing, fingerprint feature extraction and fingerprint recognition get fingerprint identification information. Through the acquisition of hand shape, hand shaped pretreatment, hand shape feature extraction and hand shape recognition, get hand shape recognition information. Three identification information parallel fusions will be the final recognition results. The whole process is full of hand shape feature recognition process, the technical flow chart as shown in Figure 1. This technology can effectively improve the security and stability of the system, and maintain the characteristics of low cost single mode system[8].

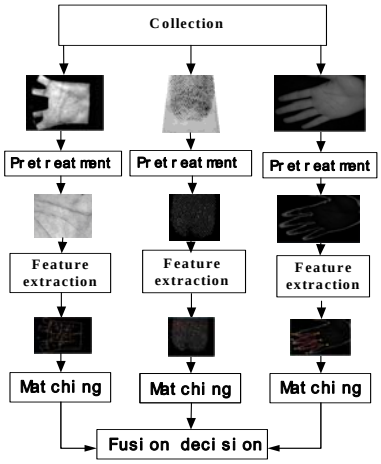

Figure 1 : Hand shape feature recognition technology flow chart

According to the feature recognition technology, hand shape design system software of whole hand shaped features parallel fusion recognition. The design of the system is divided into two functional modules: registration and recognition function. Registration function is to build a personal information database. Identification function is identity.

Registration is the foundation. Through registration, fill in the name, identity card number and the 8 basic personal information, personal information database contains basic information, palm print, fingerprint and hand geometry information. The final results obtained identification by palmprint recognition, fingerprint recognition and hand shape recognition.

TABLE 1 : Mter and weighted coefficient of each level wavelet

Level number	1	2	3	4	5
MTWR (R_i %)	11.42	7.07	4.91	4.84	5.35
weighted coefficient	0.11	0.17	0.25	0.25	0.23

Before showing the conclusion of palmprint rough recognition, introduce the parameter of the wavelet energy feature's MTWR and weighted coefficient. The relation between MTER and weighted coefficient is as shown in TABLE (1).

Click on the "Collection" to collect the palmprint. Click "Palmprint recognition" to recognize palmprint. Schematic diagram of palmprint recognition is shown in Figure 2.

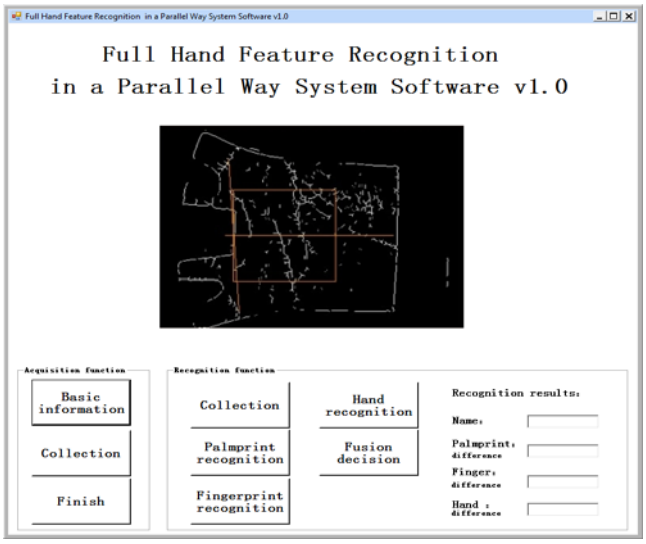

Figure 2 : Schematic diagram of palmprint recognition

Click on the "Collection" to collect the hand. Click "Hand recognition" to recognize hand. Schematic diagram of hand recognition is shown in Figure 3.

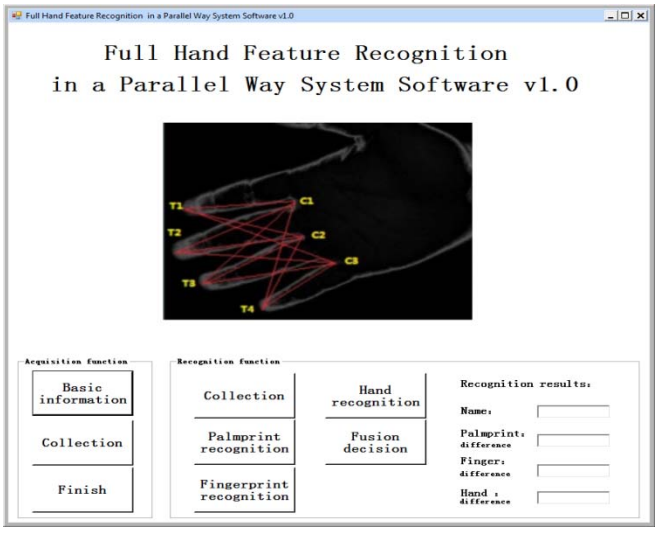

Figure 3: Schematic diagram of hand recognition

Click on the "Collection" to collect the finger. Click "Fingerprint recognition" to recognize finger. Schematic diagram of finger recognition is shown in Figure 4.

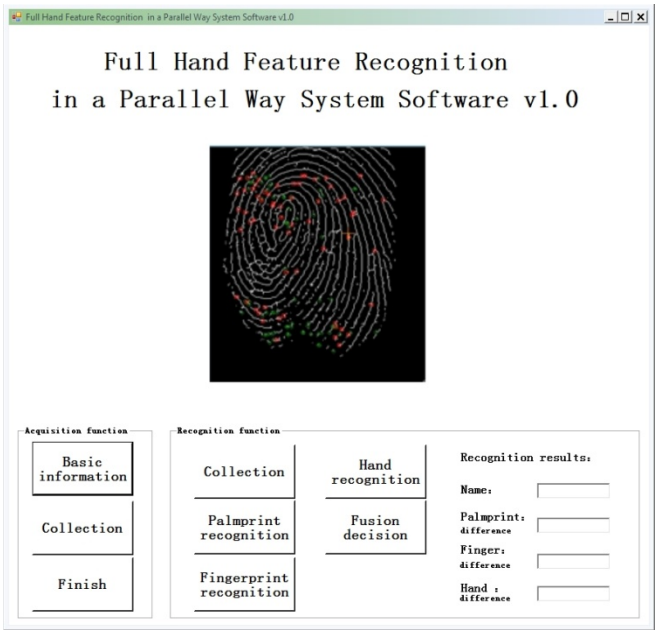

Figure 4 : Schematic diagram of finger recognition

The palmprint recognition, fingerprint recognition, hand shape recognition and fusion decision to get the final recognition results. The final recognition results as shown in Figure 5.

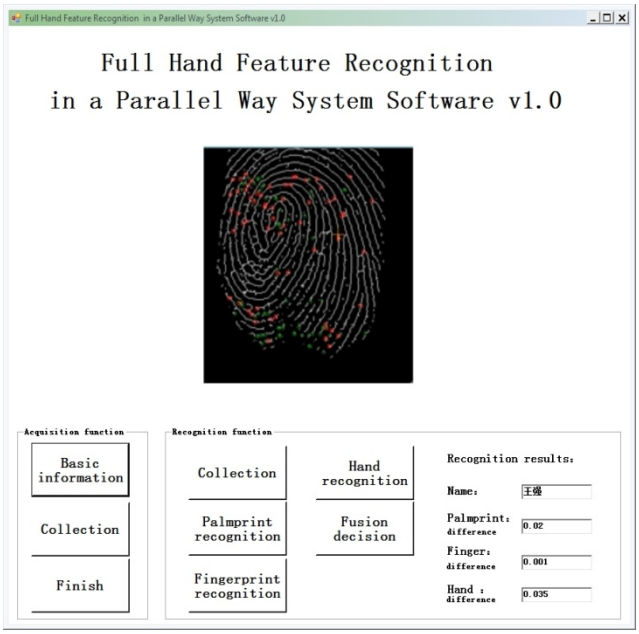

Figure 5 : Schematic diagram of final recognition result

CONCLUSION

All hand feature information biometric identification technology is a new technology in the field of technology. All hand feature information recognition technology first is Bain set to full hand images for effective positioning segmentation to extract valid characteristic values, and then select and design more advanced single-mode identification method for coarse recognition, and finally through the application of multi-mode feature recognition crude state recognition results fusion theory decisions ultimately get more accurate recognition results. In this paper, multi-modal fusion main line parallel to

fingerprint feature recognition, palmprint recognition and single-mode characteristic features of hand shape recognition method based on feature recognition, the crude fusion decisions recognition results obtained final recognition result.

CONFLICT OF INTEREST

This article content has no conflict of interest

ACKNOWLEDGEMENT

This works are partly supported by the Fundamental Research Funds for the Central Universities (Grant No. DC120101132).

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