ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
Vol. 2, Issue 5 May 2016

Adaptive Weighted Fusion Based Multimodal Palmprint Identification

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Abstract: Palm print identification is an important personal identification technology and it has attracted much attention. In preprocessing a filter is used to smooth the image and next the features are extracted using *t* test algorithm. The edge detection operation is proposed to extract principal line features. The edge direction and gradient strength of each pixel in the preprocessed image is found the proposed algorithm. Then edges are traced using that information. Finally, non-maximum edges are suppressed by finding parallel edges and eliminating those with weaker gradient strengths. In this way principal lines are extracted and resultant image is obtained. The matching is done by using decision tree classifier which classifies the resultant image into blocks. Personal identification is done based on the distance matching between the stored templates and the test palmprint image.

Keywords: Palmprint recognition, biometrics, multi-biometrics.

1. Introduction

Automatic personal authentication using biometric information is playing an important role in the applications of public security, access control, forensic, e-banking, etc. Many kinds of biometric authentication techniques have been developed based on different biometric characteristics, including Physiological-based (such as fingerprint, face, iris, palmprint, hand shape, etc.) and behavioral-based (such as signature, voice, gait, etc.) characteristics. The palmprint is a relatively new biometric feature; it has several advantages compared with other currently available characteristics. The palmprint contains more information than fingerprint, so they are more distinctive. And also palmprint capture devices are much cheaper than iris devices. Palmprint is one of the important biometrics characteristics with higher user acceptance.

The palmprint is the most important characteristic because of its uniqueness and stableness. A palmprint image contains various features, including geometrical features, line features, delta and minutiae points, etc. However, geometrical features, such as the width of the palm, can be faked easily by making a model of a hand. Delta points and minutiae can be extracted only from the fine-resolution images. Principal lines and wrinkles, called line features, are the most clearly observable features in low-resolution palmprint images.

Several research works on palmprint biometrics have been reported. The De-Shuang Huang, Wei Jia and David Zhang, proposed a novel palmprint recognition approach based on principal lines. In this approach the principle lines are extracted by using the modified finite radon transform. When the transformation is applied, lines in Cartesian coordinate are converted to lines in energy and direction. The energies and directions are used to detect the differences between principle lines and wrinkles. After that, those differences are finally used to verify people.

The Leqing Zhu, Sanyuan Zhang, Rui Xing and Yin Zhang,proposed a method for personal recognition, which is based on PFI and Fuzzy logic. In this the grayscale image is smoothed with an 8-neighbourhood mean filter. Canny edge detector and locally self-adaptive threshold binarization method are combined to extract the principal lines. The Probability Feature Image (PFI) was used in order to suppress random noises in feature image. The fuzzy logic was employed in matching. The Leqing Zhu and Rui Xing, proposed a new hierarchical palmprint recognition method. First the gradient images along the four directions are computed. Then these four gradient images are overlapped and de-noised. Edges are detected with Canny detector and merged with the de-noised gradient image with AND operation. The result is then dilated and blurred with a probable template to get the major line features. The bidirectional method is used for matching.

The Wei Jia, Yi-Hai Zhu, Ling-Feng Liu and De-Shuang Huang, proposed the palmprint retrieval based on principal lines for palmprint recognition. In this principal lines are extracted using modified finite radon transform method. Then key points of principal lines are detected.

The Wei Li, Lei Zhang, David Zhang and Jingqi Yan, proposed the principal line based ICP Alignment for Palmprint Verification. First the modified finite Radon transform (MFRAT) is used to extract principal line. The iterative closest point (ICP) alignment algorithm is used to compute the shifting, rotation and scaling between the ROI images, and then presented an efficient way to combine the alignment result with the competitive code for palmprint recognition.The Cong Li, Fu Liu and Yongzhong zhang, proposed a method to extract the principal lines based on their cartelistic of roof edges.In this at first gray adjustment and median filtering are used to enhance contrast and weaken noise. Then, palm-lines are detected based on diversity and contrast. And an improved Hilditch algorithm is used to do thinning, an edge tracking approach is applied to get rid of twigs and short lines, and then, the broken lines are connected. Finally, the single pixel principal palm-line image is obtained.

The Feng Yue, Wangmeng Zuo and David Zhang, proposed the iterative closest point (ICP) algorithm for palmprint alignment before matching. The palm-lines are extracted using steerable filter. However, due to nonlinear deformation and inconsistency of extracted palm line feature, the ICP algorithm using only position information would fail to obtain optimal alignment parameters. To improve its accuracy orientation feature is used, which is more consistent than palm line, to make ICP registration more robust against noise.

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2. Existing system

In existing system a novel framework was proposed to perform multibiometrics by comprehensively combining the left and right palm print images. This work has the following contributions. First, it for the first time shows that the left and right palm print of the same subject are somewhat correlated, and it demonstrates the feasibility of exploiting the crossing matching score of the left and right palm print for improving the accuracy of identity identification. Second, it proposes an elaborated framework to integrate the left palm print, right palm print, and crossing matching of the left and right palm print for identity identification. Third, it conducts extensive experiments on both touch-based and contactless palm print databases to verify the proposed framework.

Modules description:

Preprocessing

The image is first processed in order to extract the features, which describe its contents. The processing involves filtering, normalization, segmentation, and object identification. The output of this stage is a set of significant regions and objects. In this the preprocessing is based upon the extraction of ROI. First it removes the translation and rotation of images introduced in the data collection process. Second, ROI extraction extracts the most informative area in the images. It reduces a lot of data amount without losing much useful information.

Feature extraction

- The SIFT based method firstly searches over all scales and image locations by using a difference-of-Gaussian function to identify potential interest points. Then an elaborated model is used to determine finer location and scale at each candidate location and keypoints are selected based on the stability. Then one or more orientations are assigned to each keypoint location based on local image gradient directions. Finally, the local image gradients are evaluated at the selected scale in the region around each keypoint.
- Palmprint principal lines can be extracted by using the Gobor filter. The pixel-to-area matching strategy is adopted for principal lines matching which defines a principal lines matching score as follows:

$$S(A, B) = \left(\sum_{i=1}^{m} \sum_{j=1}^{n} A(i, j) \ \& \ \bar{B}(i, j)\right) / N_A$$

Similarity score

The matching score between two palmprint images is calculated by using the angular distance. The competitive code can be represented by three bit binary codes then the Hamming distance can be used to measure the similarity between two competitive codes, which can be calculated by

$$D(\mathrm{P}, \mathrm{Q}) = \frac{\sum_{y=1}^{N} \sum_{x=1}^{N} \sum_{i=1}^{3} (\mathrm{P}_i(x, y) \otimes \mathrm{Q}_i(x, y))}{3N^2}$$

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Weighted fusion

By employing the similarity measure, the weighted fusion scheme uses a method to integrate the three kinds of scores generated from the left and right palmprint images. The weight-sum matching score level fusion is preferable due to the ease in combining three kinds of matching scores of the proposed method. The first and second matching scores are obtained from the left and right palmprint, respectively. The third kind of score is calculated based on the crossing matching between the left and right palmprint. wi (i =1,2,3), which denotes the weight assigned to the ith matcher, can be adjusted and viewed as the importance of the corresponding matchers.

3. Proposed Method

In propose accurate personal identification using palm print images. In preprocessing a filter is used to smooth the image and next the features are extracted using *t* test algorithm. The edge detection operation is proposed to extract principal line features. The edge direction and gradient strength of each pixel in the preprocessed image are found the proposed algorithm. Then edges are traced using that information. Finally, non-maximum edges are suppressed by finding parallel edges and eliminating those with weaker gradient strengths. In this way principal lines are extracted and resultant image is obtained. The matching is done by using decision tree classifier which classifies the resultant image into blocks. Personal identification is done based on the distance matching between the stored templates and the test palmprint image.

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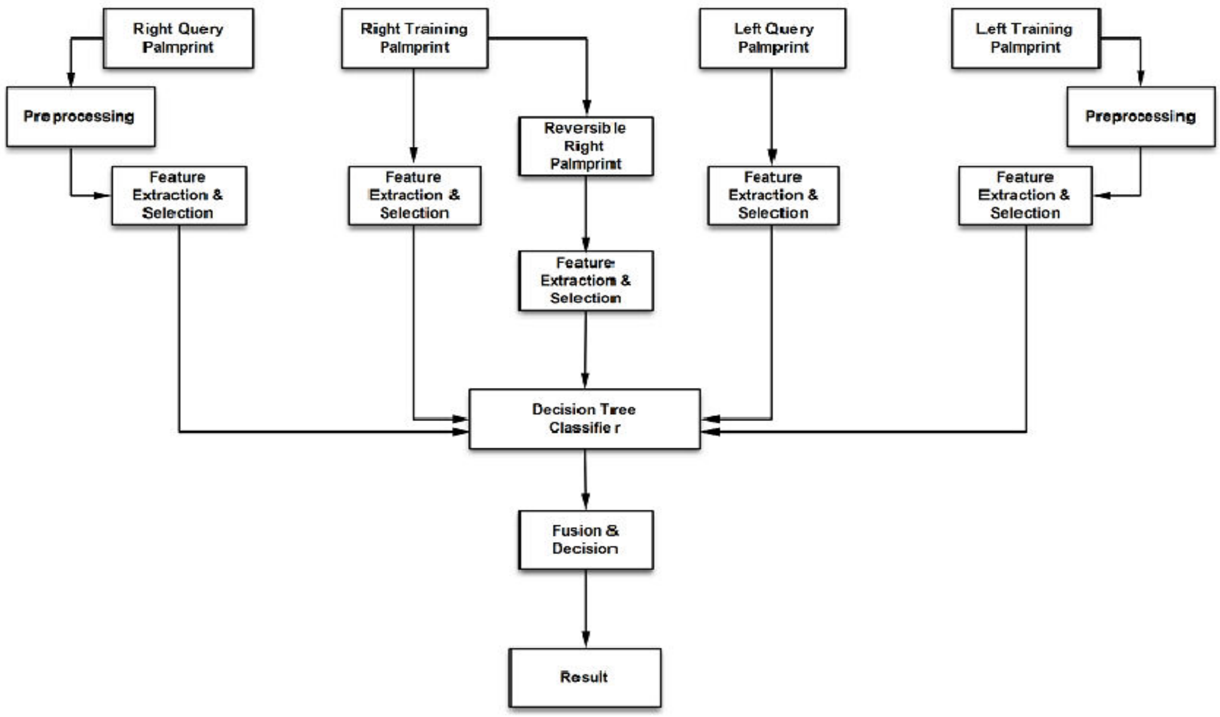

Fig: Block diagram of Proposed Method

Decision tree

A decision tree is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. It is one way to display an algorithm.

Overview

A decision tree is a flowchart-like structure in which each internal node represents a "test" on an attribute (e.g. whether a coin flip comes up heads or tails), each branch represents the outcome of the test and each leaf node represents a class label (decision taken after computing all attributes). The path from root to leaf represents classification rules.

In decision analysis a decision tree and the closely related influence diagram are used as a visual and analytical decision support tool, where the expected values (or expected utility) of competing alternatives are calculated. A decision tree consists of 3 types of nodes:

1. Decision nodes - commonly represented by squares
2. Chance nodes - represented by circles
3. End nodes - represented by triangles

Decision trees are commonly used in operations research, specifically in decision analysis, to help identify a strategy most

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likely to reach a goal. If in practice decisions have to be taken online with no recall under incomplete knowledge, a decision tree should be paralleled by a probability model as a best choice model or online selection model algorithm. Another use of decision trees is as a descriptive means for calculating conditional probabilities.

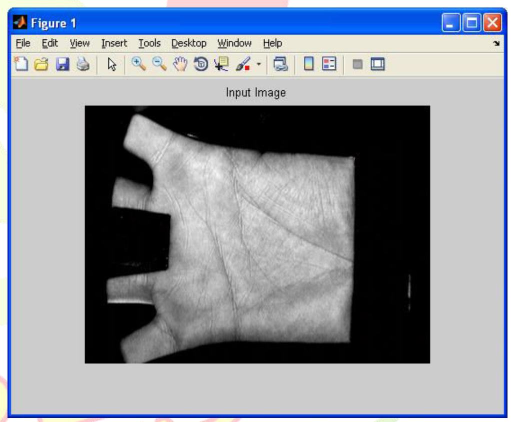
Decision trees, influence diagrams, utility functions, and other decision analysis tools and methods are taught to undergraduate students in schools of business, health economics, and public health, and are examples of operations research or management science methods.

Matching Score Level Fusion

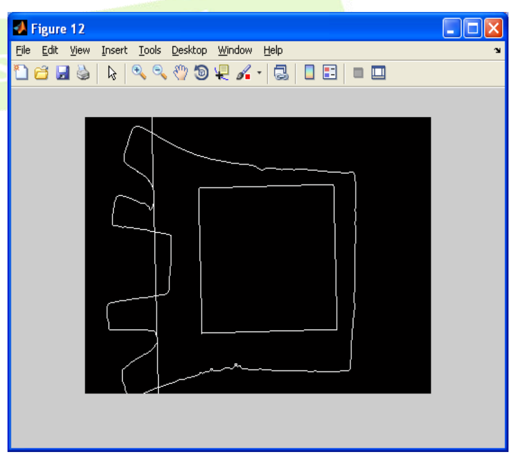
In the proposed framework, the final decision making is based on three kinds of information: the left palmprint, the right palmprint and the correlation between the left and right palmprint. As we know, fusion in multimodal biometric sys-tems can be performed at four levels. In the image (sensor) level fusion, different sensors are usually required to capture the image of the same biometric. Fusion at decision level is too rigid since only abstract identity labels decided by different matchers are available, which contain very limited information about the data to be fused. Fusion at feature level involves the use of the feature set by concatenating several feature vectors to form a large 1D vector.

The integration of features at the earlier stage can convey much richer information than other fusion strategies. So feature level fusion is supposed to provide better identification accuracy than fusion at other levels. However, fusion at the feature level is quite difficult to implement because of the incompatibility between multiple kinds of data. Moreover, concatenating different feature vectors also lead to a high computational cost. The advantages of the score level fusion have been concluded and the weight-sum score level fusion strategy is effective for component classifier combination to improve the performance of biometric identification. The strength of individual matchers can be highlighted by assigning a weight to each matching score.

4. Experimental result



Read left palmprint image



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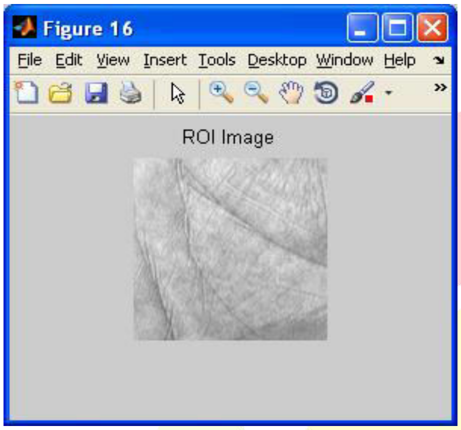
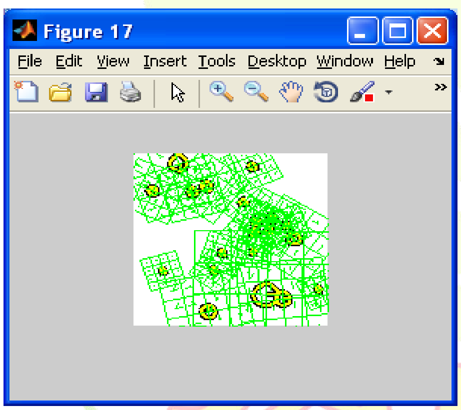
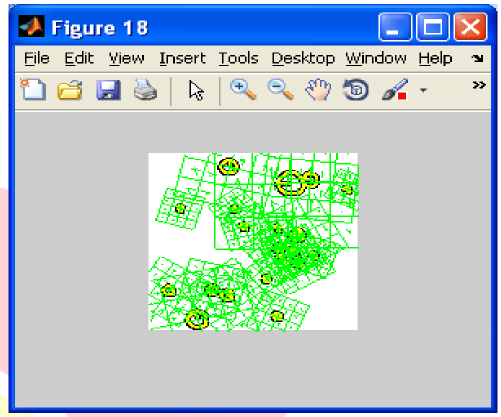
Inside Square indicate ROI Region



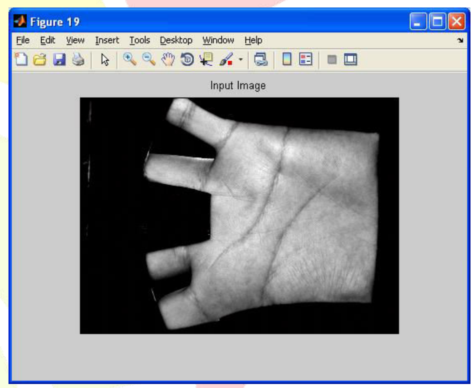
ROI Cropped image



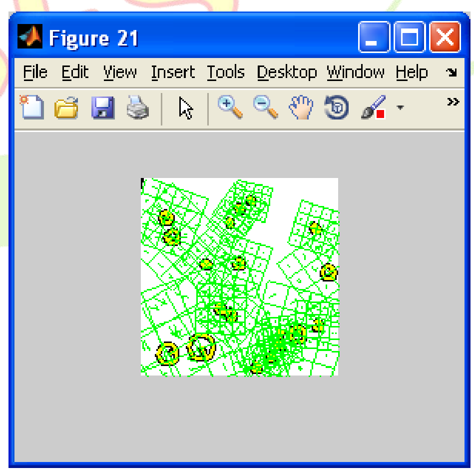
SIFT Features of Left image



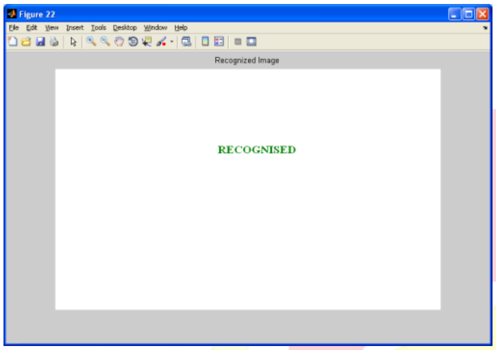
SIFT Features of Reverse Left Image



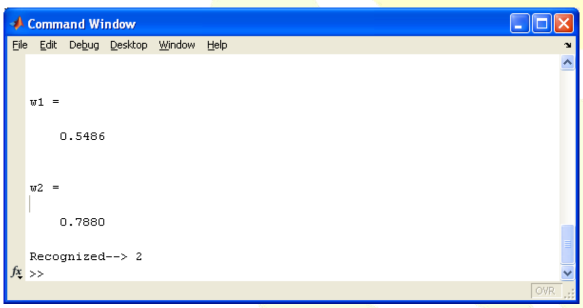
Input Right palmprint image



SIFT Features of Right Plamprint



Recosnized Result



Display the Recognize index

5. Conclusion

The left and right palmprint images of the same subject are somewhat similar. The use of this kind of similarity for the performance improvement of palm-print identification has been explored in this paper. The proposed method carefully takes the nature of the left and right palmprint images into account, and designs an algorithm to evaluate the similarity between them. Moreover, by employing this similarity, the proposed weighted fusion scheme uses a method to integrate the three kinds of scores generated from the left and right palmprint images. Extensive experiments demonstrate that the proposed framework obtains very high accuracy and the use of the similarity score between the left and right palmprint leads to important improvement in the accuracy. This work also seems to be helpful in motivating people to explore potential relation between the traits of other bimodal biometrics issues.

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