Commentary: Contactless and Pose Invariant Biometric Identification Using Hand Surface

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1. Introduction

In recent years, with the increase of the people's security awareness, the rise of various national security industries as well as the development of human interaction technology, more and more researchers and countries started to focus on the technology of biometric identification. In fact, there are a lot of types of biometric identification, various biological features and characteristics are applied to this field to do identification like face identification and hand surface identification.

Although we can see that some biometric identification systems can achieve better results in some areas and have success in business, there are still many problems. In this paper, a method about contactless and pose invariant biometric identification by using hand surface has been introduced and the author aims to solve several problems. One is the inconvenience caused by image acquisition and the limitation of imaging set up. The second is the sanitation problems caused by placing the hand on the imaging platform in the process of image acquisition. The third one is some discriminatory information exist in feature extraction.

Therefore, it is really important to solve these problems in biometric identification. The improved imaging set up and image acquisition methods could increase the universality of this method and make it more widely used and user-friendly because it can increase the accuracy of the identification of the old people and people with low dexterity. In addition, solving these problems can also make the process of the image acquisition easier and avoid some sanitation problems and transmission of disease at the same time. Furthermore, the users do not need to be identified under a specific manner in actual application.

Users who decide to use this method to do biometric identification will be the biggest beneficiaries when these existing problems can indeed be solved because whatever young or old, health person or patients, this system will get the relatively good and safe results in security area due to its characteristics. In addition, the companies and countries which use this system will also benefit from it.

In addition, it is indeed to make some difference to current practice in this field. The application of this approach can offer a reliable authentication to protect personal information and make sure the safety of their property. At the same time, it will also make some difference to the national security industry. At the same time, this method will also facilitate the development of human interaction technology because it can increase the accuracy of identification of hand poses.

2. Methods

There are totally three parts in the method section, respectively hand pose normalization, hand feature extraction and dynamic fusion method.

For the hand pose normalization part, the author aims to use a plane to fit the 3-D data points which are extracted from the palm center and a normal vector of the plane should also be computed in order to verify the correction of the pose. The first step is to find the hand from the hand images. In this step, the Otsu's threshold method and opening operation in morphology are used because it need to distinguish the hand from the image background and remove the noise from the image to get a good quality image. Next step is to find the palm center. In this step, a distance transform method is introduced to solve this problem and the pixel with the maximum Euclidean distance between pixels on foreground and the pixels on the contour of the hand will be determined as the center of the palm. After finding the center of the palm, the iterative reweighted least squares method is used to fit the plane. For the hand feature extraction part, the author adopts different methods to different types of the images. For 3-D palmprint images, the author mainly uses the Surface 3-D palmprint representation, every point in the image can be classified into one of the types. For 2-D palmprint images, the author mainly uses the Gabor filtering to do the feature extraction. In addition, the author extracts the 3-D hand geometry images' features through finger cross section. And for the 2-D hand geometry, the author extracts the features like length of finger and width of the hand palm. The last part of method is the dynamic fusion. In this part, in order to avoid the interference of the poor samples and the difficulty of the computation, the author introduces a new fusion method which combines the scores of the palmprint and hand geometry to evaluate the results.

As far as I am concerned, the author makes a right choice for most methods. For example, the Otsu's threshold method is a self-adaption method, which can find a good threshold value of the image and achieve a good thresholding performance. In addition, the use of the opening operation in morphology is good for noise removal. Furthermore, the dynamic fusion method introduced by author has many strengths in application because this method can combine palmprint score and geometry score together to remove the interference of the poor-quality samples. But this method still exists some weakness like losing the significant part of image, which should be improved in the future work.

3. Results

Since there is no available dataset to evaluate the results, therefore, the author creates their own dataset to implement the evaluation experiment. The dataset totally includes 1140 right hand images and in order to demonstrate that the method has a good performance on identifying the different hand pose variations, there are five different types of the hand poses in this dataset.

In the evaluation part, there are two mainly experiments which are implemented to evaluate the methods mentioned in this paper. The first experiment is to evaluate whether the hand pose correction method can improve the performance of the biometric identification. The other experiment is to compare the performance when using dynamic fusion method mentioned in this paper and using weighted sum rule based fusion method. Both two experiments use comparison strategy and the leave-one-out strategy. After implementing these two experiments, we can easily find that using hand pose correction method can significantly reduce the overlap of two evaluation scores and decrease the equal error rates. At the same time, we can also see that the accuracy of the method with pose correction is higher than the method without pose correction from the ROC curves. In addition to demonstrate the accuracy of the identification, the author also introduces two parameters, respectively FAR and FRR. As for the second experiments, the author uses the same evaluation strategy to evaluate the performance and we can also see the performance of using dynamic fusion approach is better than the performance of using weighted sum rule method. Apart from these findings based on these two experiments, the author also describe some other findings of this method mentioned in this paper, which is the 2-D and 3-D palmprint features are more suitable to use than the hand geometry features because the hand geometry features are easily affected by the occlusion and the loss of significant information.

As far as I am concerned, these findings based on these experiments can convince potential users to choose this proposed method. There are several reasons about that. First one is that this method is based on contactless, which will reduce the occurrence of the hygienic problems and reduce the transmission of the disease. Secondly, this method is more innovative because it solves the problem of hand pose variations, which will impress the potential users. The third one is the dynamic fusion approach introduced in this paper has a low equal error rates in the results, which will eliminate the interruptions of the poor samples and get a good performance.

Finally, there are some other experiments which could be conducted to make the proposed method more convincing. For example, more types of the hand pose image and left hand side images can be added to the dataset to evaluate the performance of this method.

4. Conclusions

There are many strengths of this proposed method mentioned in this paper. The first one is this method is more creative, the use of the hand pose normalization method can solve the problem of different pose variations, which has not been mentioned in the previous research. The second one is the combination use of the 2-D and 3-D images can easily make sure the orientation of the hand and make a better biometric identification performance. The third one is the use of the new dynamic fusion approach, which can rapidly decrease the equal error rates and have the better performance than the performance when using weighted sum rule.

However, it still exists some weakness of this method. The first one which is mentioned in the conclusion part of this paper is the constrained reason of the commercial 3-D scanner. Due to this reason, this method is hard to be used to some biometric identification applications. Another weakness I think is that the implementation of this method is based on the condition that the user must be willing to show the front view of their hand, which adds the limitation of this approach.

In addition, there are still some issues which are not mentioned in the introduction part we need to solve. One of the problems I think is how to deal with the user privacy issues in the process of the image acquisition.

For the future research, there are some recommendations. As far as I am concerned, more types of the hand pose images should be tested which could make this proposed method more convincing. In addition, finding the substitution of the 3-D scanner to increase the speed and lower the cost of this method could make it apply for more situations. Finally, a neural network can be constructed, using different kind of hand pose images to train this neural network and combine it with the proposed method mentioned in this paper, which could significantly increase the performance of biometric identification.