High Efficiency Iris Feature Extraction Based on 1-D Wavelet Transform

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Abstract

In this paper, a new technique is proposed for high efficiency iris recognition, which adopts 1-D wavelet transform to extract iris texture feature and probabilistic neural network (PNN) to recognize iris pattern. A comparative experiment of existing methods for iris recognition is evaluated on CASIA iris image databases. The results reveal the proposed algorithm possesses a very high efficiency and low dimensionality of feature vectors than existing methods.

1. Introduction

Iris recognition [1], [7], [12-14] is the process of automatically differentiating the people on the basis individuality information from their iris images. The technique is used to verify the identity of a person accessing a system. It is favorable for reliable authentication system that the use of automatic identity verification systems based on biometric products.

Two types of iris recognition system are depicted in Fig. 1, which is iris identification and iris verification. Both iris identification and iris verification use a store data set based on reference patterns (templates) for N known iris image. Both involve similar analysis and decision techniques. Verification is simpler because it only requires comparing the test pattern against one reference pattern and it involves an alternative decision: Is there a good enough match against the template of the claimed face images? The error rate of iris identification can be greater because it requires choosing which of the N iris images known to the system best matches the test image or " no match" if the test image differs sufficiently from all the reference templates.

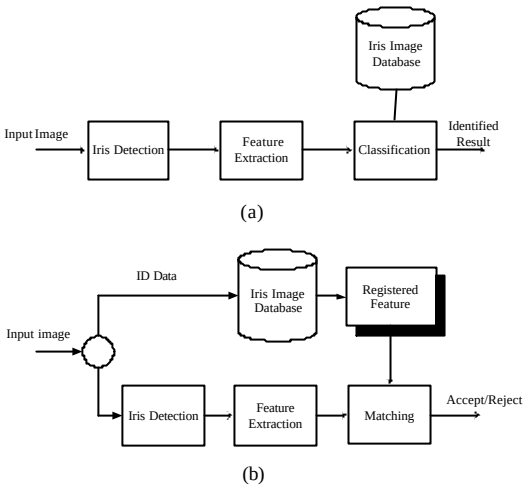

Fig 1. Iris recognition scheme (a) Identification; (b) Verification.

The iris recognition system consists of three sub-system: a iris detection system that include detecting, locating iris and extract iris circular ring, feature extraction system that composes of Sobel transform [4] and 1-D wavelet transform [2-3], and a Probabilistic Neural Network (PNN)[5] used as pattern classifier and applied successfully for different applications. However, as the increasing dimensionality could lead to higher computational cost, a dimensionality reduction procedure that eliminates information redundancy and allows for further information transform through limited channels is performed. For the purpose of dimensionality reduction procedure in iris images space is performed by implementing 1-D wavelet transform for iris image features extraction and as the consequences [15].

There are many traditional algorithms [7-14] successfully applied to iris recognition, but they are too complex to be applied in fast iris recognition. To address these problems related to computational and memory requirements, we focus our investigation on low complexity and high speed iris recognition system. Firstly, to reduce system complexity, we use 2-D wavelet transform to obtain a low resolution image and Hough transform to localize pupil position. By the center of pupil and the radius of pupil, we can acquire the iris circular ring. The more iris circular ring is acquired, the more information is

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enough to be utilized. Secondly, we adopt Sobel transform to extract iris texture in iris circular ring as feature vectors and 1-D discrete wavelet transform to reduce the dimensionality of feature vector. In our experiments, the wavelet permits to further reduce the system complexity and obtain discriminant feature vector. PNN is a very simple classifier model that has proved to be effective for iris recognition. Finally, the combination of the new method and PNN is evaluated on the CASIA iris database [6] for iris recognition. The basic conclusion drawn from our experiments is that the proposed method is well suitable for a low complex computation and low power devices.

2. Conclusions

It is well-known that if the dimension of the network input is comparable to the size of the training set, which is the usual case in iris recognition, the system will easily bring about over-fitting and result in poor generalization. In this paper, a general design approach using a PNN classifier for iris recognition to cope with small training sets of high dimensional problems is presented. Firstly, iris images are projected onto 1-D signals by the vertical projection. Then the 1-D signal features are extracted by the 1-D wavelet transform. A novel paradigm, the results of combining the vertical projection, 1-D wavelet transform, and PNN is encountering and has excellent efficiency.

3. References

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