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IDENTIFICATION OF BIOMETRIC SYSTEM WITH EVEN DISTORTED AND RECTIFICATION STATES

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ABSTRACT— **Elastic distortion of fingerprints is one of the major causes for false non-match. While this problem affects all fingerprint recognition applications, it is especially dangerous in negative recognition applications, such as watchlist and deduplication applications. In such applications, malicious users may purposely distort their fingerprints to evade identification. In this system, we proposed novel algorithms to detect and rectify skin distortion based on a single fingerprint image. Distortion detection is viewed as a two-class classification problem, for which the registered ridge orientation map and period map of a fingerprint are used as the feature vector and a SVM (Support Vector Machine) classifier is trained to perform the classification task. Distortion rectification (or equivalently distortion field estimation) is viewed as a regression problem, where the input is a distorted fingerprint and the output is the distortion field. To solve this problem, a database (called reference database) of various distorted reference fingerprints and corresponding distortion fields is built in the offline stage, and then in the online stage, the nearest neighbor of the input fingerprint is found in the reference database and the corresponding distortion field is used to transform the input fingerprint into a normal one. In existing work they quoted the user have to analyze the fingerprints by using trained datasets, but in our system the option is quite different, means users can dynamically give the fingerprint as an input and precede the output with it. Further the system is extended as a common biometric system which is suitable for Fingerprint, IRIS and Face Identification Systems.**

General Terms: *Fingerprint, distortion, registration, nearest neighbor regression, PCA*

1. INTRODUCTION

The consequence of low quality fingerprints depends on the type of the fingerprint recognition system. A fingerprint recognition system can be classified as either a positive or negative system. In a positive recognition system, such as physical access control systems, the user is supposed to be cooperative and wishes to be identified. In a negative recognition system, such as identifying persons in watchlists and detecting multiple enrollment under different names, the user of interest (e.g., criminals) is supposed to be uncooperative and does not wish to be identified. In a positive recognition system, low quality will lead to false reject of legitimate users and thus bring inconvenience. The consequence of low quality for a negative recognition system, however, is much more serious, since malicious users may purposely reduce fingerprint quality to prevent finger print system from finding the true identity. A fingerprint is composed of many ridges and furrows. These ridges and furrows present good similarities in each small local window, like parallelism and average width.

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Figure1.1 A fingerprint image acquired by an Optical Sensor

2. FINGERPRINTS RECOGNITION

The consequence of low quality fingerprints depends on the type of the fingerprint recognition system. A fingerprint recognition system can be

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Finger-scan technology is the most widely deployed biometric technology, with a number of different vendors offering a wide range of solutions. Among the most remarkable strengths of fingerprint recognition, we can mention the following:

- .Its maturity, providing a high level of recognition accuracy.
- The growing market of low-cost small-size acquisition devices, allowing its use in a broad range of applications, e.g., electronic commerce, physical access, PC logon, etc.
- The use of easy-to-use, ergonomic devices, not requiring complex user-system interaction. On the other hand, a number of weaknesses may influence the effectiveness of fingerprint recognition in certain cases:
- Its association with forensic or criminal applications. 51 52 F. Alonso-Fernandez, J. Bigun, J. Fierrez et al.
- Factors such as finger injuries or manual working, can result in certain users being unable to use a fingerprint-based recognition system, either temporarily or permanently.
- Small-area sensors embedded in portable devices may result in less information available from a fingerprint and/or little overlap between different acquisitions.

The fingerprint recognition problem can be grouped into two sub-domains: one is fingerprint verification and the other is fingerprint identification. In addition, different from the manual approach for fingerprint recognition by experts, the fingerprint recognition here is referred as AFRS (Automatic Fingerprint Recognition System), which is program-based.

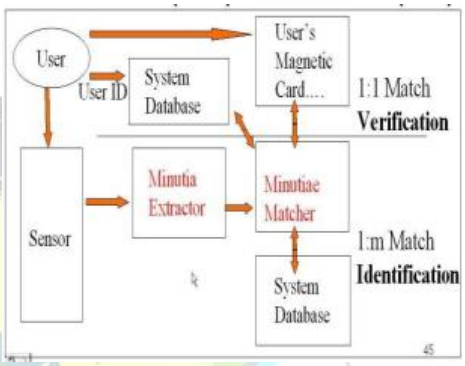

Figure 2.1 Verification vs. Identification

Fingerprint verification is to verify the authenticity of one person by his fingerprint. The user provides his fingerprint together with his identity information like his ID number. The fingerprint verification system retrieves the fingerprint template according to the ID number and matches the template with the real-time acquired fingerprint from the user. Christo Ananth et al. [6] proposed a method in which the minimization is per-formed in a sequential manner by the fusion move algorithm that uses the QPBO min-cut algorithm. Multi-shape GCs are proven to be more beneficial than single-shape GCs. Hence, the segmentation methods are validated by calculating statistical measures. The false positive (FP) is reduced and sensitivity and specificity improved by multiple MTANN. As long as the representation of fingerprints remains the uniqueness and keeps simple, the fingerprint matching, either for the 1-to-1 verification case or 1-to-m identification case, is straightforward and easy.

3.EXISTING SYSTEM

In the past systems, the consequence of low quality fingerprints depends on the type of the fingerprint recognition system. A fingerprint recognition system can be classified as either a positive or negative system. In a positive recognition system, such as physical access control systems, the user is supposed to be cooperative and wishes to be identified. In a negative

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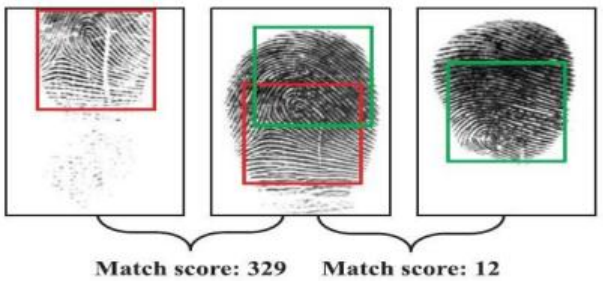
recognition system, such as identifying persons in watchlists and detecting multiple enrollments under different names, the user of interest (e.g., criminals) is supposed to be uncooperative and does not wish to beidentified. In a positive recognition system, low quality will lead to false reject of legitimate users and thus bring inconvenience. The consequence of low quality for a negative recognition system however, is much more serious, since malicious users may purposely reduce fingerprint quality to prevent fingerprint system from finding the true identity. In fact, law enforcement officials have encountered a number of cases where criminals attempted to avoid identification by damaging or surgically altering their fingerprints. As well as all the existing biometric systems are only suitable for fingerprints, IRIS and face identifications require to identify as separate.

4. PROPOSED SYSTEM

Elastic distortion is introduced due to the inherent flexibility of fingertips, contact-based fingerprint acquisition procedure, and a purposely lateral force or torque, etc. Skin distortion increases the intra-class variations (difference among fingerprints from the same finger) and thus leads to false non-matches due to limited capability of existing fingerprint matchers in recognizing severely distorted fingerprints



In the above figure, the left two are normal fingerprints, while the right one contains severe distortion. According to Fingerprint identification system, the match score between the left two is much higher than the match score between the right two. This huge difference is due to distortion rather than overlapping area. While it is possible to make the matching algorithms tolerate large skin distortion, this will lead to more false matches and slow down matching speed. Given an input fingerprint, distortion detection is performed first. If it is determined to be distorted, distortion rectification is performed to transform the input fingerprint into a normal one. A distorted fingerprint is analogous to a face with expression, which affects the matching accuracy of face recognition systems. Rectifying a distorted fingerprint into a normal fingerprint is analogous to transforming a face with expression into a neutral face, which can improve face recognition performance. An important property of the proposed system is that it does not require any changes to existing fingerprint sensors and fingerprint acquisition procedures. Such property is important for convenient incorporation into existing fingerprint recognition systems. In existing work they quoted the user have to analyze the fingerprints by using trained datasets, but in our system the option is quite different, means users can dynamically give the fingerprint as an input and precede the output with it. Further the system is extended as a common biometric system which is suitable for Fingerprint, IRIS and Face Identification Systems

5. EXPERIMENTAL ARCHITECTURE AND IMPLEMENTATION

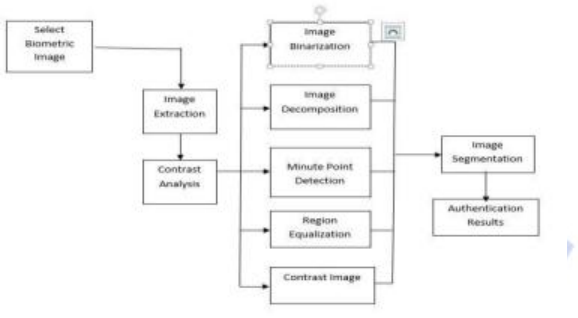


Figure 5.1. Experimental architecture Feature Extraction

In machine learning, pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction. When the input data is too large to be processed and it is suspected to be redundant (eg the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a "features vector"). This process is called feature extraction. The extracted features are expected to

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contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data.

Contrast Analysis

In statistics, particularly in analysis of variance and linear regression, a contrast is a linear combination of variables (parameters or statistics) whose coefficients add up to zero, allowing comparison of different treatments.

Image Binarization

Image binarization is a fundamental research theme in image processing and an important preprocessing method in image recognition and edge/boundary detection. It is very difficult to select the corresponding threshold for each image in different application domains.

Image Decomposition

An image can be decomposed into base and texture layers. A base layer consists of smoothly varying regions, and conveys large-scale structural information of an image. A texture layer depicts small-scale variations, and contains details of image appearance. Since these two layers provide different types of information, image decomposition helps solving many kinds of problems in computer vision and graphics, e.g. Segmentation, object matching, and non-photorealistic image abstraction.

Fingerprint distortion detection

Fingerprint distortion detection can be viewed as a two class classification problem. We used the registered ridge orientation map and period map as the feature vector, which is classified by a SVM classifier.

Fingerprint Registration

1.Reference Fingerprints

In order to learn statistics of realist fingerprint distortion, we collected a distorted fingerprint database called Tsinghua distorted fingerprint database. A FTIR fingerprint scanner with video capture functionality was used for data collection. Each participant is asked to press a finger on the scanner in a normal way, and then distort the finger by applying a lateral force or a torque and gradually increase the force.

2. Online Fingerprint Registration

In the online stage, given an input fingerprint, we perform the registration w.r.t. registered reference fingerprints. Level 1 features (orientation map, singular points, period map) are extracted using traditional algorithms. According to whether the upper core point is detected or not, the registration approach can be classified into two cases. If the upper core point is not detected.

3. Feature Vector Extraction

I extract a feature vector by sampling registered orientation map and period map. The sampling grid is shown in Fig. 3, where finger center is also marked. Note that the two sampling grids are different. The sampling grid of period map covers the whole fingerprint, while the sampling grid of orientation map covers only the top part of the fingerprint. This is because the orientation maps below finger center are very diverse even within normal fingerprints.

5.2 Distorted Fingerprints Rectification

A distorted fingerprint can be thought of being generated by applying an unknown distortion field d to the normal fingerprint, which is also unknown. If we can estimate the distortion field d from the given distorted fingerprint, we can easily rectify it into the normal fingerprint by applying the inverse of d. So we need to address a regression problem, which is quite difficult because of the high dimensionality of the distortion field (even if we use a block-wise distortion field). In this paper, a nearest neighbor regression approach is used for this task.

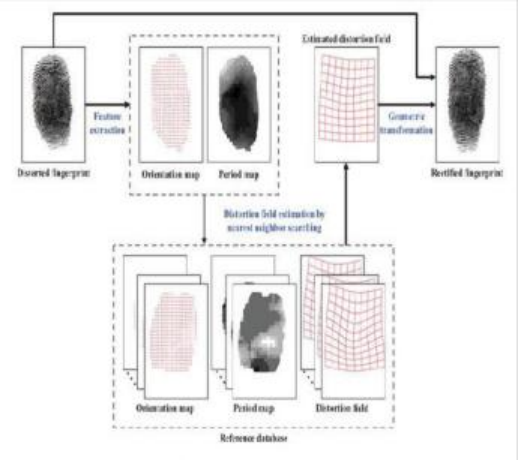

Figure 5.1 Distorted Finger Print Rectification

1 .Statistical Modeling of Distortion Fields

In order to learn statistical fingerprint distortion model, we need to know the distortion fields (or deformation fields) between paired fingerprints (the first frame and the last frame of each video) in the training set. The distortion field between a pair of fingerprints can be

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estimated based on the corresponding minutiae of the two fingerprints. Unfortunately, due to the severe distortion between paired fingerprints, existing minutiae matchers cannot find corresponding minutiae reliably. Thus, we extract minutiae in the first frame using Veri Finger and perform minutiae tracking in each video. Since the relative motion between adjacent frames is small, reliable minutiae correspondences between the first frame and the last frame can be found by this method

2. Generation of Distorted Reference

Fingerprint Database: To generate the database of distorted reference fingerprints, we use nref ¼ 100 normal fingerprints from FVC2002 DB1_A which are same. The distortion fields are generated by uniformly sampling the subspace spanned by the first two principle components. For each basis, 11 points are uniformly sampled in the interval for an example of generating distortion fields and applying such distortion fields to a reference fingerprint to generate corresponding distorted fingerprints.

6. CONCLUSION

Several Conclusions may be extracted from the propose results which will be presented in the experimental sections. The proposed method is able to consistently perform at a high level for different biometric traits ("multi-biometric"); The proposed method is able to adapt to different types of attacks providing for all of them a high level of protection ("multi-attack"). The error rates achieved by the proposed protection scheme are in many cases lower than those reported by other trait-specific state-of-the-art anti-spoofing systems which have been tested in the framework of different independent competitions; and In addition to its very competitive performance, and to its "multi-biometric" and "multi-attack" characteristics, the proposed method presents some other very attractive features such as: it is simple, fast, non-intrusive, user-friendly and cheap, all of them very desirable properties in a practical protection system.

Future Enhancement

Further work have to develop a new framework for fingerprint recognition by using multilevel structural technique for fingerprint representation and matching to achieve a high accuracy by a reasonable cost. A fingerprint template has then been formulated as three-level feature vectors with levels for global, neighborhood, and local features. The idea of using multilevel feature vectors (MFVs) ensures that the finger print template contains all the available useful information from the fingerprint image.

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