Detection and Rectification of Distorted Fingerprints

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ABSTRACT

The major problem with all fingerprint recognition system is elastic distortion. It is very dangerous in negative recognistion applications, such as deduplication applications. So more importance should be given in negative recognition application. In this paper, we suggested novel algorithms to detect and rectify skin distortion based on a single fingerprint image. Distortion detection is displayed as a two-class categorization problem, for which the registered ridge orientation map and period map of a fingerprint are beneficial as the feature vector and a SVM classifier is trained to act the classification task. Equivalently distortion field estimation is viewed as a regression complication, where the input is a distorted fingerprint and the output is the distortion field. To solve this issue, reference database of various distorted reference fingerprints and corresponding distortion fields is built in the offline stage, and then in the online stage, the closest neighbor of the input fingerprint is organized in the reference database and the corresponding distortion field is used to transform the input fingerprint into a normal fingerprints. Promising results have been obtained on three databases having many distorted fingerprints, namely FVC2004 DB1.

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1. INTRODUCTION

Since four dacades, fingerprint technology has rapidly advanced. Although we face very challenges problems such as recognizing low quality fingerprints. In FVC2006, the fingerprint matcher was very sensitive. However matching accuracy of same algorithm varies on different data sets. The variation between the accuracies of plain, rolled and latent fingerprint matching is even larger as found in technology evaluations conducted.

The result 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. If we observe in a positive recognition system, such as physical access control systems, the end-user is supposed to be cooperative recognition and desires to be recognized. When we have a look in a negative system, such as identifying persons in watch lists and discovering multiple enrollments under different names, the user of concern (e.g., thieves) is supposed to be unhelpful and does not want to be recognized. In a positive recognition system, low quality will points to false reject of justifiable persons and thus bring difficulty. The result of low quality for a negative recognition system, yet, is more serious, since cruel users may intentionally reduce fingerprint quality to stop fingerprint system from discovering the true identity. Hence it is especially important for negative fingerprint recognition systems to identify small quality fingerprints and raise their superiority so that the fingerprint system is not negotiated by cruel persons. Degradation of finger-print quality can be photometric.

Skin distortion is the main reason for geomentric distortion. On the contrary, geometrical degradation due to skin distortion has not yet received sufficient attention, despite of the importance of this problem. This is the problem this paper attempts to address. Note that, for a negative fingerprint recognition system, its security level is as low as the lowest point. Thus it is urgent to develop distorted fingerprint (DF) detection and rectification algorithms to fill the hole. 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 increased the intra-class variations (difference among fingerprints from the same finger) and thus leads to false unmatched due to limited capability of existing fingerprint matchers in recognizing severely distorted finger-prints.

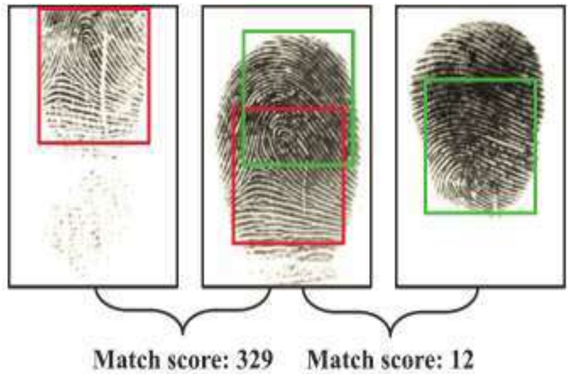

Fig-1:Matching score

Fig.1 Three impressions of the same finger. The left two are normal fingerprints, while the right one contains severe distortion. The match score in-between the left two according to VeriFinger 6.2 SDK is much higher than the match score in-between the right two. This large difference is due to distortion rather than overlapping area. As displayed by red and green rectangles, the overlapping area is same in two cases. In Fig. 1, the left two are normal fingerprints, while right figure contains maximum distortion. According to Veri-Finger 6.2 SDK, the match score in-between the left two is much higher than the match score between the right two. This large difference is due to distortion rather than over-lapping area. While it is possible to make the matching algorithms tolerate huge skin distortion, this will lead to more false matches and slow down matching speed.

2. PROPOSED SYSYTEM

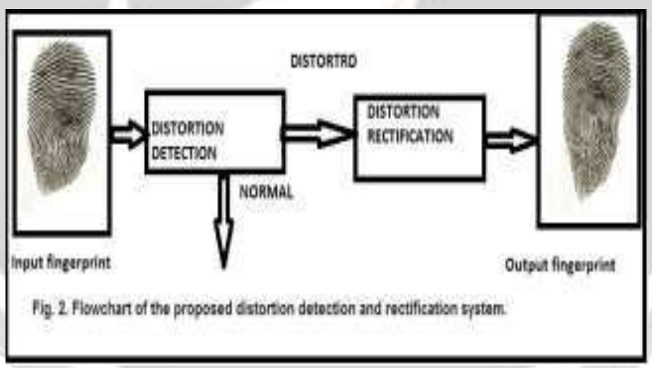

Fig. 2. Flowchart of the proposed distortion detection and rectification system.

Fig-2: Flowchart of the proposed distortion and rectification system

The Fig.2 for the flowchart of the proposed system. The proposed algorithm is based on the uniqueness take out from the orientation field and details to perform or satisfy the three required necessities for modification detection algorithm: 1) Speedy operational time, 2) Huge true positive rate at small false positive rate and 3) Ease of integration into AFIS.

In our proposed system we are going to take single image of the fingerprint. Providing an input finger-print, distortion detection of fingerprint is performed first. If it is determined to be distorted, distortion rectification is performed to convert the provided input fingerprint into normal fingerprints. A distorted fingerprint is analogous to a face with expression, which alter the matching efficiency of face recognition systems. Rectifying a distorted fingerprint into a normal fingerprint is analogous to converting a face with expression into a neutral face, which can improve face recognition performance.

3. SYSTEM ARCHITECTURE

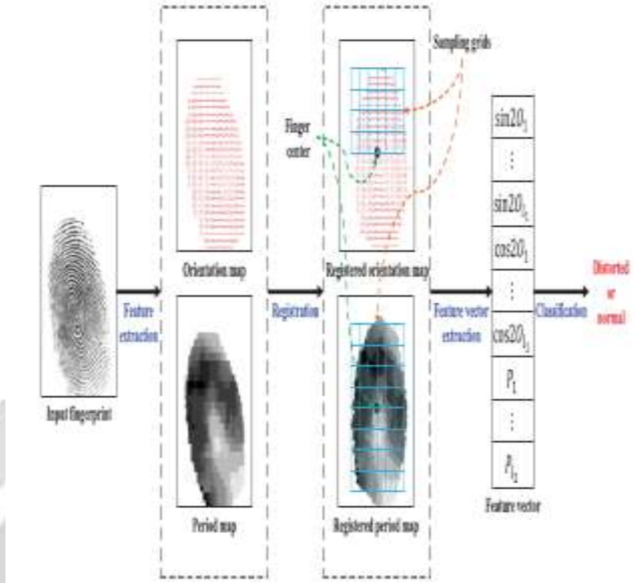

Fig-3: System Architecture

An input fingerprint image which is provided is normalized by cropping or cutting a rectangular region of the input image fingerprint, which is located at the center of the fingerprint and aligned along with the longitudinal direction of the fingerprints, using the NISTBiometric Image Software (NBIS). This step insures that the features extracted in the subsequent steps are invariant with respect to translation and rotation of finger.

Orientation Field Estimation

The orientation field of the fingerprint is estimated using the gradient-based method. The starting orientation field is smoothed moderating filter, followed by moderating the orientations in pixel blocks. A foreground mask is earn by measuring the dynamic range of gray values of the fingerprint image in local blocks and morphological process for filling holes and removing isolated blocks is performed**.**

Orientation Field Approximation

The orientation field is near by a polynomial model to obtain.

Feature Extraction

The error map is counted as the absolute difference in-between and used to construct the feature vector.

Analysis of Minutiae Distribution:

In this methodology, a minutia in the fingerprint implies the ridge characteristics such as ridge ending or ridge bifurcation. Almost all the fingerprint recognition systems usage minutiae for matching. The abnormality observed in orientation field also noted that minutiae distribution of altered fingerprints often differs from that of natural fingerprints. On the basis of minutiae extracted from a fingerprint by the open source minutiae extractor in NBIS, a minutiae density map is composed by using the Parzen window method containing uniform kernel function.

4. RELATED WORK

Bolle et al. in 2000, “Method for distortion control in live-scan inkless fingerprint images”. The advantage is detecting excessive force and torque exerted by using a force sensor. They cannot detect fingerprints distorted before pressing on the sensor.

Dorai et al. in 2004, “Dynamic behaviour analysis in compressed fingerprint videos”. Method is to detect distortion by analyzing the motion in video of fingerprint. The disadvantage is they require special force sensors or fingerprint sensors with video capturing capability.

Xinjian Chen, Jie Tian, in 2006 ,"Normalized Fuzzy Similarity Measure for Distorted Fingerprints Matching". A Novel algorithm, normalized fuzzy similarity measure (NFSM), to handle the nonlinear distortions. The algorithm used leads to false acceptance which occasionally happens. It depicts a similar pair although it is of some different fingerprint.

Jianjiang Feng, Jie Zhou, 2013, "Orientation Field Estimation for Latent Fingerprint Enhancement". A robust orientation field estimation algorithm is essential for enhancing and recognizing poor quality latent. This does not provide satisfactory results for most latent.

Xiao Yang et al, 2014, "Localized dictionaries based orientation field estimation for latent fingerprints". Though transform-based fingerprint pose estimation algorithm, in which the predictions about fingerprint pose made by all orientation patches in the latent fingerprint are accumulated. The disadvantage is that it cannot detect overlapping fingerprints.

5. CONCLUSION

Wrong non-match rates of fingerprint matchers are very high in the case of critically distorted fingerprints. This creates a security hole in automatic recognition of fingerprint systems which can be utilized by terrorists and criminals. For this reason, it is required to develop a fingerprint distortion detection and rectification algorithm to fill the hole. The distorted fingerprint detection and rectification paper described a novel distorted fingerprint detection and rectification algorithm. For distortion detection, the ridge orientation map and period map of a fingerprint are needed as the feature vector and a SVM classifier is skilled to categorize the input fingerprint as distorted or normal. For distortion rectification a close neighbor regression approach is used to conclude the distortion field from the provided input distorted fingerprint and then the converse of the distortion field is used to convert the distorted fingerprint into a normal one (un-distorted). The experimental results on FVC2004 DB1, Tsinghua DF database, and NIST SD27 database displayed that the scheduled algorithm can increase the recognition rate of distorted fingerprints manifestly. The proposed algorithm based on the features derived from the orientation field and minutiae amuse the three necessary requirements for change detection.

6. REFERENCES

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