Survey on fingerprint distortion detection & rectification

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Abstract*— Fingerprints distortion is one of the major causes for the false non - equal. While this problem touches on all biometric fingerprint identification applications, this biometrics applications especially dangerous in negative fingerprint recognition systems, such as watch lists and the duplication applications. In such applications, malicious users may deliberately distort their fingerprints to evade identification. In this report, survey is executed on various algorithms to detect and rectify skin distortion on the basis of single fingerprint image. Distortion detection is taken as a two-class classification problem, for which the fingerprint ridge orientation map and period map of a fingerprint is used as the feature vector and an SVM classifier is trained to perform the screening task. Distortion rectification is regarded as a fixation problem, where the input is a distorted fingerprint and the end product is the distortion field. Falsifying non-equal rates of fingerprint matchers are high in the case of severely distorted fingerprints. This generates a security drawback in automatic fingerprint recognition systems which can be utilized by felons and terrorists. For this reason, it is necessary to obtain a fingerprint distortion detection and correction algorithms

Index Terms— **Fingerprint, Distortion, Detection and Rectification.**

I. Introduction

During the final forty years fingerprint identification rapidly increased, at that place still exists several challenging research problems. Elastic distortion is introduced because of the inbuilt flexibility of fingertips, touch-based fingerprint capturing system, and a lateral force or torque with intent, etc. [1]. Since existing fingerprint quality evaluation algorithms are designed to study various problems in fingerprint recognition. Such as, recognizing low quality fingerprints [2], varying accuracy algorithms of fingerprint matcher in FVC2006 [3]. The accuracies of plain, rolled and latent fingerprint matching is even larger is observed In NIST [4].

Fingerprint classification is classified into two types as either be a positive or negative classification. This sorting is made out on low quality fingerprints. In negative recognition is said to be uncooperative and does not like to be identified. Lower quality of leads will run to false reject of valid users and thus bring difficulty. Some users purposely decreases the quality of fingerprint to avoid true identity [6]. Altering or damaging the fingerprints [7], are the cases done by criminals to avoid their original identity.

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It is important to fingerprint identification to detect low quality fingerprints and improve tone. Since existing fingerprint quality evaluation algorithms are designed to analyze if an image contains sufficient information. Elastic distortion is introduced due to the inbuilt flexibility of fingertips, touch-based fingerprint acquisition procedure, and a purposely lateral force. Skin distortion increases the intra-class variations and thus leads to false non-matches due to inadequate potential of existing fingerprint matchers in recognizing severely distorted fingerprints.

A major drawback of the current approach is efficiency. Both detection and rectification steps can be significantly speeded up if a robust and precise fingerprint registration algorithm can be developed. Another limitation is that the current approach does not support rolled and latent fingerprints. It is difficult to collect many rolled fingerprints with a variety of distortion types and meanwhile get accurate distortion fields for learning statistical distortion model.

II. Literature Survey

Elastic distortion is introduced due to the inbuilt flexibility of fingertips, touch-based fingerprint acquisition procedure, and a deliberately lateral force or torque, etc. Skin distortion increases the intra-class variations and therefore contributes to fake non-matches due to the limited capacity of existing fingerprint matchers in recognizing severely distorted fingerprints.

The outcome of low quality fingerprints relies on upon the kind of the unique mark acknowledgment framework. A unique mark acknowledgment framework can be delegated either a positive or negative framework. In a positive acknowledgment framework, for example, physical access control frameworks, the client should be helpful and wishes to be recognized.

Compiling case studies of incidents where persons or users were found to have altered their fingerprints for circumventing AFIS, Investigating the impact of fingerprint alteration on the accuracy of a commercial fingerprint matcher, Classifying the changes into three major types and suggesting possible countermeasures, developing a

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technique to automatically detect distorted fingerprints by analyzing orientation field and minutiae distribution, and evaluating the proposed technique and the NFIQ algorithm on a huge database of altered fingerprints provided by a law enforcement agency. Promising results show the feasibility of the proposed system in detecting altered fingerprints to highlight the need to follow this problem.

It is desirable to automatically detect distortion during fingerprint acquisition so that severely distorted fingerprints can be eliminated. Various researchers have projected to detect improper force. Bolle et al. [8] Proposed to detect unnecessary force and torque pressed by using a force sensor. They demonstrated that controlled fingerprint capturing system leads to enhanced matching performance [9]. Fuji [10] developed approach to detect distortion by analyzing deformation of a transparent film attached to the sensor surface. Doris et al. [11] aimed to detect distortion by analyzing the motion in video of fingerprint.

III. Related Work

Due to the importance of recognizing distorted fingerprints, Researchers have proposed a number of methods and several fingerprint matching approaches. Few of them are as follows:

This story indicates a novel algorithm, normalized fuzzy similarity measure (NFSM), to handle the nonlinear distortions. The proposed algorithm consists of two main steps. In the first measure, the template and input fingerprints were traced up. In this process, the local topological structure matching was presented to amend the robustness of global alignment. In the second step, the method NFSM was presented to compute the matching between the template and input fingerprints.

In Luo’s method, an uncertain bounding box was used during the matching procedure. The routine is robust to nonlinear deformations betwixt the fingerprint images. However, the distortion among the fingerprints from the same finger are captured from the Cross Match sensor is too great. In parliamentary law to endure matching minutiae pairs that are further obscure because of optical aberrations, the size of the bounding boxes has to be enlarged. However, as a parallel effect, it causes a real high probability of those non matching minutiae pairs to get matched, which results in a higher false acceptance rate. The proposed algorithm was assessed on fingerprint databases of FVC2004.

Fernando Alonso-Fernandez and Javier Ortega-Garcia, proposed a comparative study of Fingerprint Image-Quality Estimation Methods. In this employment, existing approaches have been split into three sections. First, those that uses local features of the picture. Second, those that use global features of the picture. Third, those that address the problem of quality assessment as a categorization problem. Local and global image features are extracted by using various sources: direction field, Gabor filter responses, power spectrum, and pixel intensity values. They have verified various fingerprint image quality estimation algorithms. The effect of low-quality samples in the verification performance is also hitting the books for a widely available minutiae-based fingerprint matching system.

Jianjiang Feng, Jie Zhou proposed work for Orientation Field Estimation for Latent Fingerprint Enhancement. In this case, identifying latent fingerprints is of crucial significance for law enforcement establishment to find felons and terrorists. The fingerprint image quality of latent fingerprints is much poor, with complex image background, unclear ridge structure, and even overlapping patterns as compared to live-scan and inked fingerprints. A robust orientation field estimation algorithm is essential for enhancing and recognizing poor quality latent. Nevertheless, conventional orientation field approximation algorithms, which can process most live-scan and inked fingerprints, do not provide satisfactory answers for most latent.

The primary contributions of these papers are:

1) Compiling case studies of incidents where people were found to experience altered their fingerprints for circumventing AFIS.

2) Investigating the impact of the fingerprint alteration on the accuracy of a commercial fingerprint matcher.

3) Classifying the alterations into three major categories and suggesting possible countermeasures.

4) Developing a technique to automatically detect altered fingerprints based on analyzing orientation field and minutiae distribution.

5) Evaluating the proposed method and the NFIQ algorithm on a huge database of altered fingerprints provided by a law enforcement organizations. Experimental results shows the feasibility of the proposed methods in detecting altered fingerprints and highlight the need to review this problem.

The outcome of low quality fingerprints relies on upon the kind of the unique mark acknowledgment framework. A unique mark acknowledgment framework can be delegated either a positive or negative framework. In a positive acknowledgment framework, for example, physical access control frameworks, the client should be helpful and wishes to be recognized. In a negative acknowledgment framework, for example, recognizing persons in watch lists and distinguishing various enlistment under distinctive names, the client of interest (e.g., hoodlums) should be uncooperative also, does not wish to be recognized.

Programmed unique finger impression acknowledgment advancements have quickly progressed amid the most recent forty years, there still exists a few testing research issues. A major restriction of the current approach is efficiency. Both detection and rectification steps can be extensively speeded up if a robust and accurate fingerprint registration algorithm can be broken. Another restriction is that the current approach does not support rolled fingerprints. It is difficult to collect many distorted fingerprints with various distortion types and meanwhile obtain accurate distortion fields for learning statistical distortion model.

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IV. Proposed Work

To enforce robust method for detection and rectification of distorted fingerprints. Distortion detection is believed as a two class classification problem, where the registered ridge orientation map and period map of a particular fingerprint are utilized as the feature vector and a SVM classifier is trained to execute the classification task. Distortion correction (or equivalently distortion field estimation) is considered as a regression problem, where input is distorted fingerprint and the output is the estimated distortion field. To solve this problem, a database of several distorted reference fingerprints and accompanying distortion fields is made in the offline stage, and then in the online stage, the closest neighbor of the input fingerprint is found in the database of distorted reference fingerprints and the corresponding distortion field is used to correct the input fingerprint.

In Proposed System was assessed at two levels: finger level and open level. At the finger level, we measure the performance between natural and distorted fingerprints. At the subject layer, we measure the performance of distinguishing between cases with natural fingerprints and those with altered fingerprints.

A. NORMALIZATION

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

B. ORIENTATION FIELD ESTIMATION

The orientation field of the fingerprint is computed using the gradient-based method. The initial orientation field is smoothed averaging filter, followed by averaging the orientations in pixel blocks. A foreground mask is obtained 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.

C. ORIENTATION FIELD APPROXIMATION

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

D. FEATURE EXTRACTION

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

False non-match frequency of fingerprint matchers is relatively high in severely distorted fingerprints. It creates a security hole in automatic fingerprint detection systems that could be used by criminals and terrorists. So, building up of fingerprint distortion scrutiny and reformation algorithms to fill the hole is a must.

V. Conclusion

Since existing fingerprint quality evaluation algorithms are developed to study if an image contains sufficient information such as minutiae, for matching, they have limited capability in determining if an image is a natural fingerprint or a distorted fingerprint. Obliterated fingerprints can evade fingerprint quality control software, depending on the area of the damage. If the distorted finger area is small, the existing fingerprint quality evaluation software unable to detect it as an altered fingerprint.

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