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Identification of Distortion and Rectification of Fingerprints in Negative Fingerprint Recognition

Harsh Anand

Student, Dept. of C.S., Sinhgad Institute of Technology, SPPU, Lonavala, India

ABSTRACT: Automatic fingerprint recognition technologies have rapidly adapting during the last few years, there still exists several challenging research problems, for example, recognizing low quality fingerprints. One of the disadvantages of fingerprint confirmation is the lack of robustness against image quality degradation. Low quality images result in misleading and missing features, thus degrading the performance of the overall system. Hence it is of utter importance for a fingerprint acknowledgement system to estimate the quality and validity of the captured fingerprint image samples. Distortion of fingerprint hides the identity of the person, while this problem affects the procedure of identifications. It is very dangerous in negative recognition application. Many places malicious users distort their fingerprints to hide their identification. We proposed novel algorithm to detect and rectify skin distortion based on a single fingerprint image. Distortion detection is viewed as two-class classification problem, the registered ridge orientation map and period map of fingerprint are used. SVM classifier performs the classification task.

KEYWORDS: Fingerprint, distortion, registration, nearest neighbour regression

I. INTRODUCTION

Fingerprint recognition refers to the automated method of identifying or confirming the identity of an individual based on the comparison of two fingerprints. Fingerprint recognition is one of the most well-known biometrics, and it is by far the most used biometric solution for authentication on computerized systems. The reasons for fingerprint recognition being so popular are the ease of acquisition, established use and acceptance when compared to other biometrics, and the fact that there are numerous (ten) sources of this biometric on each individual. The success of fingerprint recognition systems in accurately identifying individuals has prompted some individuals to engage in extreme measures for the purpose of circumventing these systems. The primary purpose of fingerprint alteration is to evade identification using techniques varying from abrading, cutting, and burning fingers to performing plastic surgery. The three basic patterns of fingerprint ridges are the arch, the loop, and the whorl. An arch is a pattern where the ridge enters one side of 1 the finger, then rises in the centre forming an arch, and exits on the other side of the finger. With a loop the ridge enters one side of the finger, then forms a curve, and exits on the same side of the finger from which it entered. Loops are the most common pattern in fingerprints. Finally a whorl is the pattern you have when ridges form circularly around a central point. Fingerprint matcher is very sensitive to the image quality, the matching accuracy of the same algorithm is significantly different among various datasets due to variation in image quality. Imaging sensor inaccuracies can be considered as a unique fingerprint identifying a specific acquisition device, enabling various major forensic operations, such as device identification, device linking, and recovery of processing history, etc. The effect of low quality fingerprints depends on the type of the fingerprint recognition system. The fingerprint recognition system can be classified as either a positive or negative system. In apositive recognition system, for example, the physical access control systems, the user is assumed to be cooperative and is willing to get identified. In a negative recognition system, such as identifying individuals in watch lists and identifying multiple entries or enrolments under different names, the user of interest (e.g., criminals)
is assumed to be uncooperative and does are not willing to be identified. In a positive recognition system, low quality will result in to false rejection of legitimate users and as a result bring inconvenience. The consequence of low quality

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for a negative recognition system, is more serious since malicious users may purposely reduce fingerprint quality such that fingerprint system fails

From finding the true identity [5]. In fact, law enforcement officials have encountered a number of cases in which the criminals tried to avoid identification by damaging or surgically altering their fingerprints. Elastic distortion occurs due to the flexibility of fingertips, contact-based fingerprint acquisition procedure, and an explicitly applied lateral force or torque. The skin distortion increases the intra-class variations and thus leads to false non-matches due to limited capacity of initial existing fingerprint. Matchers in recognizing severely distorted fingerprints. As shown in fig 1, the left two are normal fingerprints, and right one contains severe distortion. According to Veri-Finger, the matching index in between the left two is much higher than the matching index amongst the right two. This major difference is a result of distortion rather than the overlapping area. While it is possible that matching algorithms can handle bigger skin distortion, it may result into to more false matches and slow down matching speed. Distorted rectification is shows a regression problem, where we take input as a distorted fingerprint and the output comes in distortion field. To solve this problem, a database (called reference database) having many distorted reference fingerprint and corresponding distortion field is built in offline stage. The reference database and the corresponding distortion field is used to rectify the input fingerprint to the normal one. We use two database containing many distorted fingerprint, namely FVC2004DB1,and the NIST SD27 [6] latent fingerprint database.

II. RELATED WORK

A. In Detecting fingerprint distortion from a single image

The effect of intrusion detection and response on the reliability of a cyber physicalsystem (CPS) comprising sensors, actuators, control units, and physicalobjects for controlling and protecting a physical infrastructure. We developa probability model based on stochastic Petri nets to describe the behaviourof the CPS in the presence of both malicious nodes exhibiting a range of attackerbehaviours, and an intrusion detection and response system (IDRS) fordetecting and responding to malicious events at runtime. Our results indicate that adjusting detection and response strength in response to attacker strengthand behaviour detected can significantly improve the reliability of the CPS. Wereport numerical data for a CPS subject to persistent, random and insidiousattacks with physical interpretations given [1].

B. Localized dictionaries based orientation field estimation for latent fingerprints

Dictionary based orientation field estimation approach has shown promising performance for latent fingerprints. In this paper, we seek to exploit stronger prior knowledge of fingerprints in order to further improve the performance. Realizing that ridge orientations at different locations of fingerprints have different characteristics, we propose a localized dictionaries-based orientation field estimation algorithm, in which noisy orientation patch at a location output by a local estimation approach is replaced by real orientation patch in the local dictionary at the same location. The precondition of applying localized dictionaries is that the pose of the latent fingerprint needs to be estimated. We propose a Hough transform-based fingerprint pose estimation algorithm, in which the predictions about fingerprint pose made by all orientation patches in the latent fingerprint are accumulated. Experimental results on challenging latent fingerprint datasets show the proposed method outperforms previous ones markedly [4].

C. Orientation field estimation for latent fingerprint enhancement

Identifying latent fingerprints is of vital importance for law enforcement agencies to apprehend criminals and terrorists. Compared to live-scan and inked fingerprints, the image quality of latent fingerprints is much lower, with complex image background, unclear ridge structure, and even overlapping patterns. A robust orientation field estimation algorithm is indispensable for enhancing and recognizing poor quality latents. However, conventional orientation field estimation algorithms, which can satisfactorily process most Livescans and inked fingerprints, do not provide acceptable results for most latent. We believe that a major limitation of conventional algorithms is that they do not utilize prior knowledge of the ridge structure in fingerprints. Inspired by spelling correction techniques in natural language processing, we propose a novel fingerprint orientation field estimation algorithm based on priorknowledge of fingerprint structure. We represent prior knowledge of fingerprints using a dictionary of reference orientation patches. which is constructed using a set of true orientation fields, and the compatibility constraint between neighbouring orientation patches. Orientation field estimation for latent's is posed as an energy minimization problem, which is solved by loopy belief propagation. Experimental results on the challenging NIST SD27 latent fingerprint databaseand

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an overlapped latent fingerprint database demonstrate the advantages of the proposed orientation field estimation algorithm over conventional algorithms [3].

III. PROPOSED ALGORITHM

A. *DESIGN CONSIDERATIONS:*

- Modeling of distortion parts.
- Generate the distorted reference fingerprint database.
- Estimation of nearest neighbor search.
- Orientation Field approximation.
- Region masks estimation.
- Initial orientation field estimation.
- Context-based orientation field correction.

B. *DESCRIPTION OF THE PROPOSED ALGORITHM:*

In Proposed System was evaluated at two levels: finger level and subject level. At the finger level, we evaluate the performance of distinguishing between natural and altered fingerprints. At the subject level, we evaluate the performance of distinguishing between subjects with natural fingerprints and those with altered fingerprints. This paper described a novel distorted fingerprint detection and rectification algorithm.[1] For distortion detection, the registered ridge orientation map and period map of a fingerprint are used as the feature vector and a SVM classifier is trained to classify the input fingerprint as distorted or normal

IV. SIMULATION RESULTS

The popular way to handle the distorted to make the fingerprint matcher tolerant to distortion. It deal with case by case basis. It is widely used minutiae-based fingerprint matching method. Three types of strategies has been applied to handle distortion (I) assume global rigid transformation use of tolerant box of fixed size[8] to rectify the distortion.(II)The spatial transformation by thin plate spline(TPS)model[9].(III)Enforce constraint on distortion locally [24].Method for handling the distortion during matching have also been used in Skelton-based matcher[10].Allowing larger distortion is matching will inevitably result in higher false match rate. The purpose of rectifying distorted fingerprint is to improve matching performance. To evaluate the contribution of the proposed rectification algorithm to matching accuracy. We take four database: FVC 2004 DB1, distorted subset of FVC 2004 DB1,tringhua DF database and FVC 2006 DB2_A.All the four database Senior and Bolle algorithm actually reduces the matching accuracy. On the database containing many distorted fingerprint (FVC2004 DB1 and tringhua DF database) the proposed algorithm significantly improve the matching accuracy; the cumulative match characteristic (CMC) curve is commonly used to report latent matching accuracy, To prove the experiment correctly ,we use all 27,000 file fingerprint in the NIST SD14 database as the background database, Due to the complex background ,The ridge orientation map and period map extracted from the original image is not reliable. We use extracted from the enhanced fingerprint by the algorithm [11]. Because of the small area of many latents,the distortion detection result is not reliable. We apply the rectification algorithm to all the latent fingerprint, then we use a max rule to fuse the two matching. No rectification latent fingerprint rectified senior and bolle approach and latent fingerprint rectified by the proposed approach. Senior and Bolle approach also help to improve the matching accuracy because of the max fusion rule. Unsuccessful rectification can be classified, No normal fingerprint is incorrectly detected as a distorted one and then undergoes the rectification process. In these cases there is no sufficient information for correctly estimating the distortion field.

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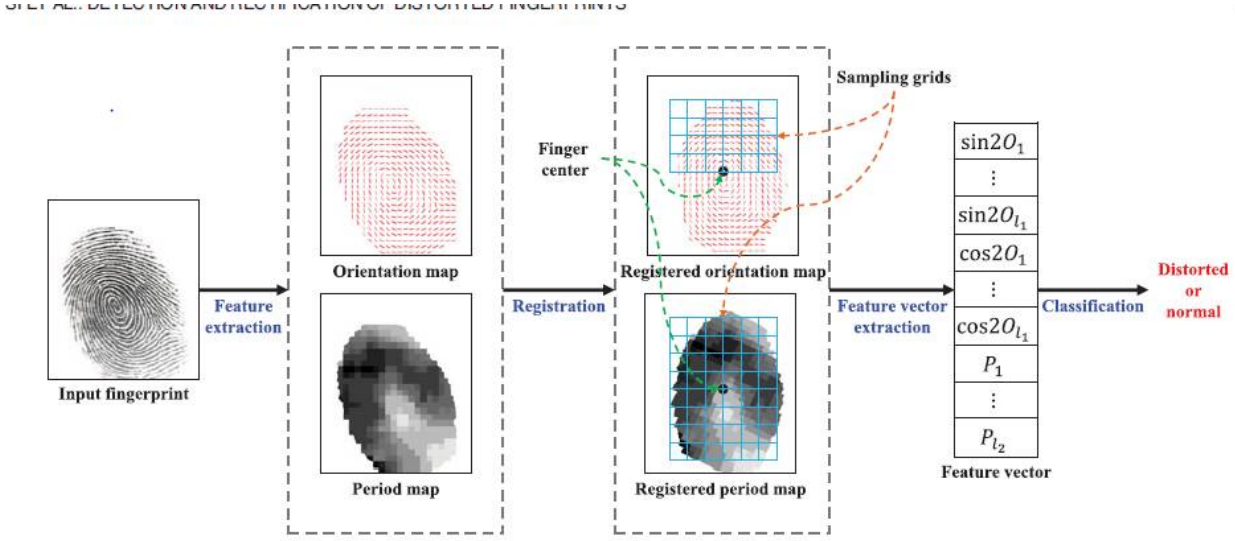

Fig. 1. Flowchart of fingerprint distortion detection. Oi represents ridge orientation at the ith sampling grid of registered orientation map, while Pj represents ridge period at the jth sampling grid of registered period map. l1 and l2 represent the number of sampling points in registered orientation map and registered period map, respectively

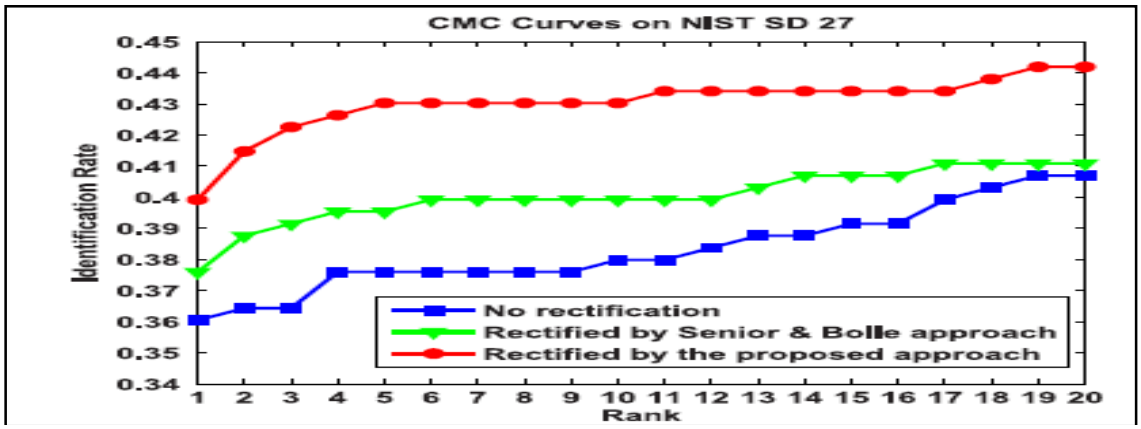

Fig.2. The CMC curves of three matching experiments on NIST SD27:

V. CONCLUSION AND FUTURE WORK

The above effectuation was an attempt to understand how Fingerprint Recognition is utilized as a form of biometric to sustain individuality of human beings. All the stages are included in this that is, minutiae extraction from fingerprints to minutiae matching that are utilized to generate a match score. Several standard techniques are utilized in the intermediate stages of processing. Comparing with other forms of biometrics the comparative low percentage of substantiation rate indicates that the algorithm utilized is not very robust and is vulnerable to effects like scaling and elastic deformations. There are large numbers of cases present on severely distorted fingerprints. This create a security problem in automatic fingerprint recognition system, this can be used by criminal for hiding their identity. For this reason, we proposed a fingerprint detection and rectification to reveal the identity of the criminal. This paper describes a novel distorted fingerprint detection [1] and rectification algorithm. For distortion detection, the registered ridge orientation map and period map of a fingerprint are used as the feature vector and a SVM classifier is trained to classify the input fingerprint as distorted or normal. For distortion rectification a nearest neighbor regression approach predict

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the distortion field from the input distorted fingerprint and then inverse of the distorted field is used to transform the distorted fingerprint into a normal one. The database we used to take result is FVC 2004 DB1 and NIST SD27 [6] database. The limitation of the current approach is efficiency. Detection and rectification done fastly if robust and accurate fingerprints registration algorithm can be developed. Another limitation is also present that the current approach does not support rolled fingerprint. It is our ongoing work to address the above limitation.

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BIOGRAPHY

Harsh Anand is a student in the Computer science Department, Sinhgad institute of technology, Pune University. He received Batchelor of Computer Science degree in 2017 from Pune University, Lonavala, , India. His research interests are Image processing, Artificial Intelligence, etc.