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REVIEW ARTICLE

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SURVEY ON REFINEMENT OF FINGER PRINT BY REMOVING DISTORTION

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ABSTRACT
Distortion of rubbing ridge skin is one of the major challenges in fingerprint matching. Existing fingerprint matching systems cannot match seriously distorted fingerprints. While this problem affects all fingerprint recognition applications, it is especially unsafe in negative recognition applications, such as watch list and deduplication applications. In such applications, malicious users may intentionally distort their fingerprints to evade identification. In this paper, a novel algorithm is proposed to detect and rectify skin distortion based on a single fingerprint image. Distortion rectification is a regression problem, where the input is a distorted fingerprint and the output is the distortion field. To solve this problem, a reference database of various distorted reference fingerprints and corresponding distortion fields is calculated in the offline stage, and then in the online stage, the nearest neighbor of the input fingerprint is found in the template database and the corresponding distortion field is used to transform the input fingerprint into a normal one. Results have been obtained on three databases containing many distorted fingerprints, namely FVC2004 DB1, NIST SD27 latent fingerprint database and Tsinghua Distorted Fingerprint database.

Keywords— Fingerprint, distortion, rectification, regression, Feature extraction, nearest neighbour regression, PCA, support vector machines (SVMs, LibSV)

INTRODUCTION

Identification of attacker in both private organization and governments is a major apprehension. Recently, the most used technique for prevention and Identification of attack are intrusion Identification systems. Biometric authentication is simply the dimension and use of the unique characteristics of humans to distinguish them from one another. Fingerprint and Palm print provide more authentication, as Biometric traits cannot be easily shared, lost and duplicated. Hence, Biometric recognition is more superior and resistant to social engineering attacks. However, Fingerprinting is used for unique identification of human being malicious users may purposely distort their fingerprint to evade identification. Elastic distortion of fingerprint is a major cause of unidentifiaction. This problem affects all fingerprint

recognition applications; it is especially unsafe in negative recognition applications, such as watch list and de- duplication applications. Proposed approach present a novel algorithm to detect and rectify skin distortion based on a single fingerprint. Distortion Identification classified as two-class classification problem, for which period map and registered ridge orientation map of a fingerprint as the feature vector and a SVM classifier is trained to perform the classification task. Distortion rectification is a regression problem, where the input is set of distorted finger print and the output is distortion field. To solve this problem, a reference database of various distorted reference fingerprints and corresponding distortion fields is calculated in the offline stage, and then in the online stage, the nearest neighbor of the input fingerprint is found in the template database and the corresponding distortion field is used to transform the input fingerprint into a normal one.

The major focus of the proposed system is on the rolled fingerprint. Rolled fingerprint is captured by rolling the same fingerprint in ten or more times in different direction. It is difficult to collect many rolled fingerprints with various distortion types and meanwhile obtain accurate distortion fields for learning statistical distortion model. It's a crucial and challenging task to rectify the rolled fingerprint and find its correspondence using nearest neighbor method. The proposed work is focused to improve the SVM classification method and fingerprint rectification method for rolled fingerprint. Formatter will need to create these components, incorporating the applicable criteria that follow.

Motivation

Using biometric systems for identifying human beings offers some reward like it can be used to identify you as you. Tokens, like smart cards, magnetic stripe cards, photo ID cards, physical keys etc. can be lost, stolen, duplicated, or left at home. PINs can be forgotten, shared, or observed. Moreover, today's fast-paced electronic world means people are asked to recall a large number of passwords and personal identification numbers for computer accounts, bank ATMs, email accounts, and web sites and so on. Biometrics holds the promise of fast, easy-to-use, accurate, reliable, and trustworthy authentication for a variety of applications. The biometric authentication provides the facility to require additional instances of authentication in such a quick and easy manner that users are not bothered by the supplementary requirements. As biometric systems mature and come into wide-scale commercial use, dealing with multiple stages of authentication or multiple instances of validation will become less of a burden for users.

Literature survey

Xuanbin Si, Jianjiang Feng, Jie Zhou, and Yuxuan Luo represented an elastic distortion of fingerprints is one of the major reasons for false non-match. While this problem affects all fingerprint recognition applications, it is especially dangerous in negative recognition applications, like watchlist and deduplication applications. In such applications, malicious users may intentionally distort their fingerprints to evade identification. In this paper novel algorithms used to identify and rectify skin distortion based on a single fingerprint image. Distortion Identification is a two-class classification problem, for this the registered ridge orientation map and period map of a fingerprint are used as the feature vector and SVM classifier is trained to perform the classification task. Distortion rectification (or distortion field estimation) is seen as a regression problem, where the input is a distorted fingerprint and the output is the distortion field. [1]

Xuanbin Si, Jianjiang Feng, Jie Zhou proposed an approach for detecting fingerprint distortion from single image. This approach detects distortion based on a single fingerprint image which is obtained using traditional fingerprint sensing techniques. An important advantage of their approach is that it can be easily incorporated into existing automatic fingerprint recognition system. This algorithm computes a distortion degree, a real number in [0, 1], by examining its ridge period image and ridge orientation field. The ridge period image and orientation field are estimated from the skeleton image outputted by VeriFinger. [2]

Manisha Yadav, Parveen Yadav proposed a fingerprint recognition system using Core Identification Technique. This algorithm improves the performance of the fingerprint recognition process using Core Identification technique. First, image of fingerprint is binaries and then applying thinning process for further process of Identification. Core Identification Technique works best at level for recognition of fingerprint in biometric system. [3]

S. Kasaei, M. Deriche, And B. Boashash suggested another approach for fingerprint feature extraction using Block-direction on reconstructed images. The unique properties of fingerprint texture are used to enhance the fingerprint images and improve the fidelity of their feature. The ridges of fingerprint are extracted from enhanced foreground areas of the fingerprint image based on local dominant ridge direction. The resulting bit-mapped images are thinned and smoothed to detect structural features. The large numbers of false features are eliminated in this system. The proposed algorithm results in an efficient and fast representation of fingerprints which precisely retains the fidelity in minutiae. [4]

Andrew Senior and Ruud Bolle presented an Improved Fingerprint Matching by Distortion Removal. Their attempts are to reconstruct a canonical version of the fingerprint without distortion. The fundamental assumption underlying this process is that the ridges in a fingerprint are constantly spaced, and that deviations from constant spacing indicate distortions introduced by elastic deformation of the finger surface. Distortion is removed by enforcing this constraint mapping the fingerprint image into one in which the assumption is true. [5]

Miroslav Goljan and Jessica Fridrich presented a system based on Sensor Fingerprint Based Identification of Images Corrected for Lens Distortion. Their approach adopts a simple model for radially symmetric barrel/pincushion distortion. The basis of the sensor fingerprint is the Photo-Response Non-Uniformity (PRNU), which quantifies the fact that each pixel on the sensor continuously outputs a photon count (charge) that very slightly but consistently differs from its nominal value. Accordingly, each image the sensor takes is overlaid with a unique noise-like pattern modulated by the scene light intensity. The incidence of the fingerprint in an image can be established using standard deterministic-signal detectors, whose form be subject to the statistical nature of the modelling noise. An especially convenient Identification statistic is peak to Correlation Energy (PCE) ratio. [6]

System Architecture

Give an input fingerprint, first distortion Identification is performed. If it is determined to be distorted and rolled, distortion rectification is done to transform the input distorted and rolled fingerprint into a normal one. A distorted and rolled fingerprint is similar to a face with different expression, which affects the matching accuracy of face recognition systems. Rectification of a distorted and rolled fingerprint into a normal fingerprint is similar to transformation of a face with expression into the neutral face, which can improve the face recognition system performance. Fig. shows the system architecture of the proposed system.

A database of various distorted and rolled reference fingerprints and corresponding distortion fields is calculated in the offline stage, and then in the online stage, the adjacent neighbour of the input fingerprint is found in the database of distorted and rolled reference fingerprints and the corresponding distortion field is used to rectify the input fingerprint. An important property of the proposed system is that it does not require any changes to existing fingerprint sensors and fingerprint acquisition procedure. Such property is important for convenient incorporation into existing fingerprint recognition systems.

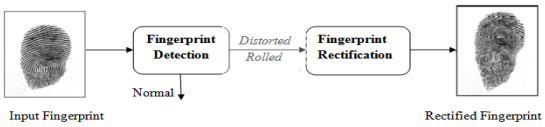

Fig 1. Proposed System

Fingerprint Identification

Fingerprint distortion Identification can be viewed as a two class classification problem. Proposed system uses the registered ridge orientation map and period map (feature vector),

which is then classified by SVM classifier. The architecture for fingerprint distortion Identification is shown in Fig. O_i represents ridge orientation at the i^{th} sampling grid of registered orientation map, while P_j represents ridge period at the j^{th} sampling grid of registered period map. i_1 and i_2 represent the number of sampling points in registered orientation map and registered period map, respectively.

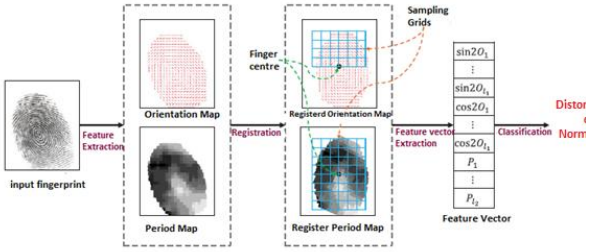

Fig 2. Fingerprint Identification

Fingerprint Registration

To extract the meaningful feature vector, fingerprint need to be registered in a fixed coordinate system. Multi-reference based fingerprint registration approach is used the proposed system. First the reference fingerprints are prepared in the offline stage, and then register an input fingerprint in the online stage.

Flow of registration process:

I. Registration form creation in C sharp.
II. Create the field global id that stores the unique id of each student.
III. Create the field User name, the name related to the unique global id.
IV. Fingerprint acquisition from the device and store it in database with global id and user name.

Feature Vector Extraction and Classification

Feature vector is extract by sampling registered orientation map and period map. 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. The feature vector is defined as [sin (2O) cos (2O) P] where O denotes the orientation vector on sampling grids, and P denotes period vector of sampling grids. Feature value at sampling points external to fingerprint region is set as 0.

Distorted and rolled fingerprints are viewed as positive samples while normal fingerprints are viewed as negative samples. SVM classifier along with LibSVM was used to train a Support Vector Classifier with quadratic polynomial kernel.

Using MapReduce Style Processing to Extract and Compare Image Fingerprints:

Algorithm Map Task:

```
Vectors <- load and cached from files
Centroids  <- load from memory cache
minDis <- new int[numVectors]
minCentroidIndex <- new  int[numVectors]
for(i<-0;i<numVectors;i<-i+1)
for(j<-0;j<numCentroids;j<-j+1)
dis <- getEuclidean(vectors[i].centroids[j])
if(j = 0)
minDis[i] <- dis
minCentroidIndex[i] <- 0
if(dis < minDis[i])
minDis[i] <- dis
minCentroidIndex[i] <- j
localSum <- new int[numCentroids][512]
localCount <- new int[numCentroids]
for(i<-0;i<numVectors;i<-i+1)
        localSum[minCentroidsIndex[i]] + <-
        vectors[i]
localCount[minCentroidsIndex[i]] + <- 1
collect(localSum,localCount)
Find the Distance Matrix for clustering the
similar Images
```

Fingerprint Rectification

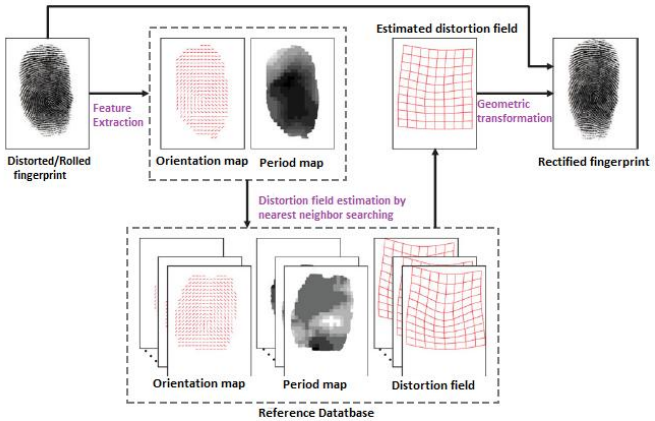

Fig 3. Fingerprint Rectification

To find the statistical fingerprint distortion model, we need to know the distortion fields (or deformation fields) among 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 calculated based on the corresponding minutiae of the two fingerprints. Given the matching minutiae of a pair of fingerprints, we calculate the transformation using thin plate spline model. We define a regular sampling grid on the normal fingerprint and the corresponding grid (called distortion grid) on the distorted fingerprint using the TPS model.

Distorted reference fingerprint database is generated from the FCV2002DB [18] and this database is used as reference database. The distortion fields of the above database are generated by uniformly sampling the subspace spanned by the principle components. The components are generated by principle component analysis (PCA). Fig 4 shows the principle component as distortion grids. These fields are uniformly sampled in the interval of [-2, 2]. Fig. is an example of producing distortion fields and applying such distortion fields to a reference fingerprint to generate corresponding distorted fingerprints.

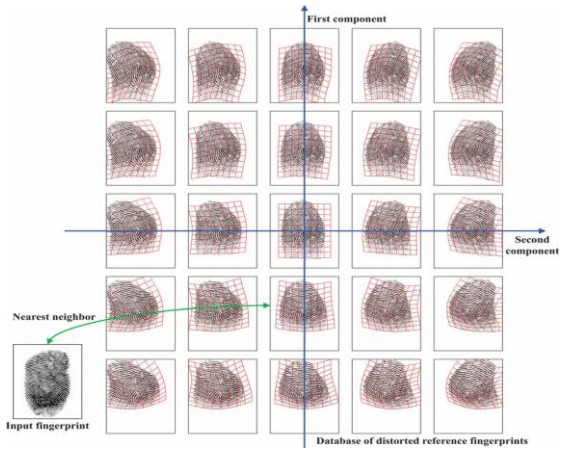

Fig 4. Estimation of the distortion field of an input fingerprint

Distortion field estimation is equivalent to finding the nearest neighbour among all distorted reference fingerprints as shown in Fig 4. The similarity is measured based on features of fingerprint, namely ridge orientation map and period map. The similarity computation method is different depending on whether the upper core point can be detected in the input fingerprint.

If the upper core point is detected, then the input fingerprint will be translated by aligning the upper core point to center point and full search of Θ will be perform in the interval of for the maximum similarity. For a specific Formula, the similarity between two fingerprints is computed as follows:

$$s = \frac{s_1^O + s_2^O}{m}(w_1^O s_1^O + w_2^O s_2^O) + \frac{s_1^P + s_2^P}{m}(w_1^P s_1^P + w_2^P s_2^P)$$

where m signifies the number of blocks in the overlapping area, s_1^O and s_2^O denote the number of blocks with similar orientation above and below the center point, s_1^P and s_2^P denote the number of blocks with similar period above and below the center point, and the four weights w_1^O ;w_2^O ;w_1^P ;w_2^P are empirically set as 1, 0.5, 1, 1.5, respectively. The thresholds for similar orientation and similar period are empirically set Formula degrees and 1 pixel, respectively.

If no upper core point is detected, then the generalized Hough transform algorithm [19] is used to compute the similarity between two fingerprints, which is more efficient than computing Eq. for all possible translation and rotation parameters.

V. Conclusion

Fingerprint image classification is based on comparison of featured extracted from fingerprint. The features used for the classification are fingerprint orientation map and period map. These features are used to construct a features vector which classifies the fingerprint either distorted or normal. This distorted fingerprint is used to estimate the distortion field and matching is performed by rectifying the distorted fingerprint.

References

[1]. Xuanbin Si, Jianjiang Feng, Jie Zhou, and Yuxuan Luo, "Identification and Rectification of Distorted Fingerprints," IEEE Trans. Patterns and Machine Intelligence, vol. 37, no. 3, March 2015.

[2]. Xuanbin Si, Jianjiang Feng, Jie Zhou, and Yuxuan Luo, "Detecting Fingerprint Distortion from A Single Image," IEEE, December 2012.

[3]. Manisha Yadav, Parveen Yadav , "Fingerprint Recognition Using Core Identification Technique," International Journal of recent development in Engineering and technology, vol. 3,Issue 1,July 2014.

[4]. S. Kasaei, M. Deriche, And B. Boashash, "Fingerprint Feature Extraction Using Block-Direction on Reconstructed Images," IEEE TENCON -speech and Image Technologies for computing and Telecommunication.

[5]. Andrew Senior and Ruud Bolle, "Improved Fingerprint Matching By Distortion Removal," IEICE Trans. On Inf & Syst, Vol.E84-D, No-7, July 2001.

[6]. Miroslav Goljan and Jessica Fridrich, "Sensor-Fingerprint Based Identification of Images Corrected for Lens Distortion, 2011."

[7]. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, "Handbook of Fingerprint Recognition," 2nd ed. Berlin, Germany: Springer-Verlag, 2009.

[8]. S. Yoon, J. Feng, and A. K. Jain, "Altered fingerprints: Analysis and Identification," IEEE Trans. Pattern Anal. Mach. Intell, vol. 34, no. 3, March 2012.

[9]. F. Turroni, R. Cappelli, and D. Maltoni, "Fingerprint enhancement using contextual iterative filtering," Proc. Int. Conf. Biometrics, 2012.

[10]. C. W. E. Tabassi and C. Watson, "Fingerprint image quality," Nat. Inst. Standards Technol., Aug. 2004.

[11]. Y. W. L. Hong and A. K. Jain, "Fingerprint image enhancement: Algorithm and performance evaluation," IEEE Trans. Pattern Anal. Mach. Intell., vol. 20, no. 8, pp. 777-789, Aug. 1998.

[12]. R. L. G. J. L. L. S. U. P. N. K. R. R. M. Bolle, R. S. Germain and M. A. Schappert, "System and method for distortion control in live-scan inkless fingerprint images," U.S. Patent., no. 6064753, May. 2000.

[13]. N. Ratha and R. Bolle, "of controlled image acquisition on fingerprint matching," in Int. Conf. Pattern Recognition, vol. 2, pp. 1659-1661, 1998.

[14]. Y. Fujii, "Detection of fingerprint distortion by deformation of elastic film or displacement of transparent board," U.S. Patent, no. 7660447, feb. 2010.

[15]. N. K. R. C. Dorai and R. M. Bolle, "Dynamic behavior analysis in compressed fingerprint videos,," IEEE Trans. Circuits Syst. Video Technol., vol. 14, no. 1, pp. 58-73, jan. 2004.

[16]. S. C. N. K. Ratha, K. Karu and A. K. Jain, "A real-time matching system for large fingerprint databases," IEEE Trans. Pattern Anal. Mach. Intell., vol. 18, no. 8, pp. 799-813, Aug. 1996.

[17]. M. Bazen and S. H. Gerez, "Fingerprint matching by thin-plate spline modelling of elastic deformations," Pattern Recognition., vol. 36, no. 8, pp. 1859-1869, Aug. 2003.

[18]. Z. O. J. Feng and A. Cai, "Fingerprint matching using ridges," Pattern Recognition, vol. 39, no. 11, pp. 2131-2140, 2006.

[19]. S. C. D. A. Ross and A. K. Jain, "A deformable model for fingerprint matching," Pattern Recognition, vol. 38, no. 1, pp. 95-103, 2005.

[20]. Senior and R. Bolle, "Improved fingerprint matching by distortion removal,," IEICE Trans. Inf. Syst.,, vol. 84, no. 7, pp. 825-831, 2001