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RESEARCH ARTICLE

LATENT FINGER PRINT MATCHING USING ROBUST ALIGNMENT ALGORITHM

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ABSTRACT

Identifying suspects based on impressions of fingers lifted from crime scenes is a custom procedure that is extremely important to forensics and law enforcement agencies. Latents are partial fingerprints that are usually smudgy, with small area and containing large distortion. Latents have a significantly smaller number of minutiae points compared to full fingerprints due to latent characteristics. The fewer minutiae and the noise characteristics of latents make it harder to automatically match latents with their mated full prints, stored in law enforcement databases. Although a number of algorithms for matching full-to-full fingerprints have been published in the literature, they do not perform well on the latent to full fingerprint matching problem. The proposed algorithm uses a robust alignment algorithm (descriptor-based Hough transform) to align fingerprints and measures similarity between fingerprints by considering both minutiae and orientation field information.

Key words: Latent, Minutiae, Noise, Orientation, Fingerprint.

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INTRODUCTION

Latent fingerprint is mostly used in crime scenes and forensics Applications. It is Matching essentially in three categories of fingerprint in Biometrics forensic application (i) Roll fingerprint, which fingerprint image are obtained by Rolling a finger from one side to the other nail to nail in order to capture all ridge details of a finger. (ii) Plain fingerprint which are plain impression are those in which the finger is pressed down on flat surface but latents are accidentally handled by crime scenes (Latents print).The latents fingerprint are smudgy and blurred which are usually with short area and long Distortion.

The latent fingerprints have smaller number of minutiae points compared to full plain fingerprint and rolled full fingerprints. The little number of minutiae and noise uniqueness of latents are compared to their mated full prints that stored in Law enforcement database. There are number of algorithms for full to full fingerprint matching but they do not perform well on latent full to full matching problems and not easy to extract from poor quality latents impressions. Rolled and plain fingerprints are also called full fingerprints. (a) Rolled; (b) plain; (c) latent. Anil K. Jain, Fellow, IEEE, and Jianjiang Feng (Anil *et al.*,). This paper contains — automated Fingerprint Identification Systems (AFIS) have played an important role in many forensics and civilian applications. Wonderful growth has been made in plain and rolled fingerprint matching; latent fingerprint matching continue to be a tricky problem.

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Poor quality of ridge impressions, small fingerprint area, and large non-linear deformation are the main difficulties in latent fingerprint matching, compared to plain or rolled fingerprint matching. This paper proposed a system for matching latent fingerprints found at crime scenes to rolled fingerprints enrolled in law enforcement databases. Besides to minutiae, they also use extensive features, together with singularity, ridge quality map, ridge flow map, ridge wavelength map, and skeleton. The baseline matching algorithm takes only minutiae as input and consists of the following steps: 1) Local minutiae matching: Similarity between each minutiae of latent fingerprint and every minutia of rolled fingerprint is computed.

Global minutiae matching: Using each of the five most parallel minutiae pairs found in Step 1 as an original minutiae pair, a greedy matching algorithm is used to find a set of matching minutiae pairs.3) Matching score computation: A matching score is computed for each set of matching minutiae pairs and the highest score is used as the matching score among the latents and rolled prints. A pair of fingerprints is classified by a conventional classifier, such as Artificial Neural Network (ANN) or Support Vector Machine (SVM), as a actual match or an impostor match based on a feature vector extracted from matching these two fingerprints. They indicated that singularity, ridge quality map and ridge flow map are the most useful features in improving the matching correctness (Anil *et al.*,) (Qi *et al.,* 2005). Soweon Yoona, Jianjiang Fenga, and Anil K. Jain*a,b . This paper contains — Latent Fingerprint Enhancement .

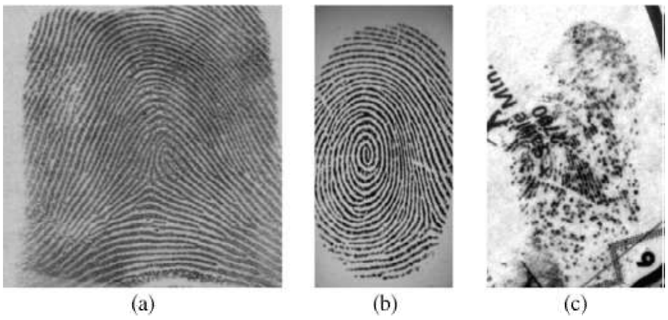

Fig1. Three types of fingerprint impressions Rolled and plain fingerprints are also called full fingerprints. (a) Rolled; (b) plain; (c) latent

This paper proposed a latent fingerprint enhancement algorithm which requires manually marked region of interest (ROI) and singular points The proposed enhancement algorithm is a novel orientation field estimation algorithm, orientation field is estimated from skeleton outputted by a commercial fingerprint SDK is one of the unique functionality of fingerprint recognition is its ability to association partial prints establish at crime scenes to suspects whose fingerprints are previous enrolled in a large database of rolled fingerprints. Most orientation field estimation algorithms consist of two steps: initial estimation using a gradient-based method followed by regularization. The regularization may be done by a easy weighted averaging filter or by more complex model based methods. It is better to use only reliable initial estimate or to give it larger weight. To overcome this constraint, estimate a common orientation field from skeleton image generated by a commercial SDK. Kai Cao, Eryun Liu, Member, IEEE and Anil K. Jain, Fellow, IEEE. This paper contains ―Segmentation and Enhancement of Latent Fingerprints: Latent fingerprint matching has played a critical role in identifying suspects and criminals. They compared to rolled and plain fingerprint matching, latent identification correctness is drastically lower due to difficult background noise, poor ridge quality and overlapping structured noise in latent images. To decrease this markup rate and to get better the reliability in feature markup, fully automatic and very correct latent matching algorithms are necessary. In this paper, a dictionary-based approach is proposed for automatic latent segmentation and enhancement towards the goal of achieving ―lights-out latent identification systems. The algorithm can be additional enhanced along the following aspects: 1) a robust patch quality definition, particularly for dry fingerprint images, where ridges are broken. 2) A better definition of confidence measure for the segmentation and enhancement results. 3) Improve the computational efficiency of the algorithm. The proposed algorithm out performs the state-of-the-art segmentation and enhancement algorithms and boosts the act of a state-of-the-art business latent matcher (Kai Cao *et al.,*) (Gu *et al.,* 2006).

MATERIALS AND METHODS

Latent fingerprint is specified with physically distinct minutiae and rolled fingerprint, we obtain out extra features from both prints, align them in the comparable coordinate system, and compute a match score between them. These three steps are described in the following subsections. An overview of the proposed algorithm is shown in Fig. 3.

Feature Extraction: The proposed matching approach uses minutiae and orientation field from both latent and rolled prints. Minutiae are physically marked by latent examiners in the latent fingerprint, and automatically extracted with commercial matchers in the rolled print. Based on minutiae, local minutiae descriptors are built and used in the projected descriptor-based alignment and scoring algorithms. Orientation field is reconstructed from minutiae location. orientation field is automatically extracted from the rolled print images by resources of a gradient-based method. Local minutia descriptors and orientation field reconstruction are handy in the following subsections.

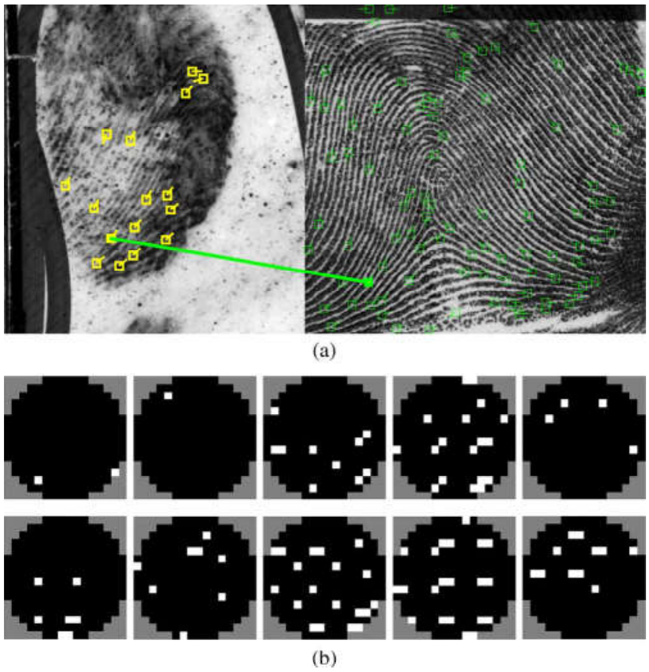

Fig 2. Sections of two cylinders associated with the two corresponding minutiae, one in latent and other in rolled print. (a) Latent and corresponding rolled print with a mated minutiae pair indicated. (b) Sections of the cylinder corresponding to the minutia indicated in the latent (first row) and in the rolled print (second row)

Local Minutia Descriptor: Local descriptors have been widely used in fingerprint, the performance of local descriptors related with fingerprint matching in four categories of fingerprints: good quality, poor quality, small widespread region, and large plastic deformation. They also roughly classified the local descriptors as image-based, texture-based, and minutiae based descriptors. Their consequences show that the minutiae- based descriptor, Minutiae Cylinder Code (MCC), performs improved in three of the four categories, and texture-based descriptor performs better for the small widespread region category. A minutiae cylinder records the neighborhood information of minutiae as a 3-D function. A cylinder contains a number of layers and each layer represents the thickness of neighboring minutiae along the corresponding direction. The cylinder can be concatenated as a vector, and as a result the likeness between two minutiae cylinders can be efficiently computed. Fig. 2(b) shows the sections of two valid cylinders related with the two equivalent minutiae (in the latent and in the rolled print) indicated in Fig. 2(a).

Orientation Field Reconstruction

Orientation field can be used in numerous ways to progress fingerprint matching performance, such as by matching orientation fields directly and fusing scores with additional matching scores, or by enhancing the images to extract extra consistent features.

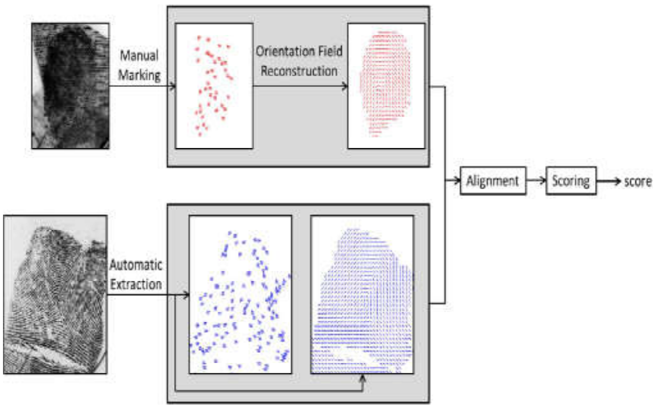

Fig 3. Overview of the proposed approach

Orientation field evaluation with gradient-based method is extremely consistent in good quality images. However, when the image contains noise, this estimation becomes very difficult. A few model-based orientation field estimation methods have been proposed that use singular points as input to the model. In the latent fingerprint matching case, it is very tricky to approximate the orientation field based only on the image due to the poor quality and small area of the latent. In addition, if singular points are to be used, they required to be manually marked (and they are not always present) in the latent fingerprint image. Consequently, we use a minutiae-based orientation field reconstruction algorithm proposed in which takes physically marked minutiae in latents as input and outputs an orientation field. This approach estimates the local ridge orientation in a block by averaging the direction of neighboring minutiae. The orientation field is reconstructed only inside the convex full of minutiae. Since the path of manually marked minutiae is very consistent, the orientation field reconstructed using this approach is quite accurate apart from in areas deficient of minutiae or very close to singular points for rolled fingerprints, orientation field is automatically extracted using a gradient- based method.

Alignment

Fingerprint alignment consists of estimating the parameters (rotation and translation) that align two fingerprints. There are multiple features that may be used to estimate alignment parameters between two fingerprints, as well as singular points, orientation field, ridges, and minutiae. There are also a number of methods to align two fingerprints: Generalized Hough Transform, local descriptors, energy minimization, etc., In the latent matching case, singularities are not always present in latents, making it hard to base the alignment of the fingerprint on singular points alone. To get manually marked orientation field is costly, and to automatically extract orientation field from a latent image is a very difficult problem. Since manually marking minutiae is a frequent practice for latent matching, our approach to align two fingerprints is based on minutiae. Local descriptors can also be used to align two fingerprints. In this case, frequently the most similar minutiae pair is used as a base for the transformation parameters (rotation and translation), and the most similar pair is preferred based on a measure of similarity between the local descriptors of the minutiae pair.

Similarity Measure : For each of the 10 different alignments, a matching score between two fingerprints is computed by comparing minutiae and orientation fields of each fingerprint. The highest value of all the 10 scores is selected as the final matching score between the two fingerprints.

Latent Fingerprint Capture

Latent fingerprint detection, lifting and capturing are some of the most intensely considered topics in latent fingerprint matching. Advancements in chemical and physical science has solved several challenges in latent fingerprint lifting. There are a variety of techniques used for latent fingerprint lifting together with powder based, solvent based, UV based, ultra sound based, fuming based, electromagnetic based techniques, and contact-less fingerprint lifting (Jiang *et al.,* 2000).

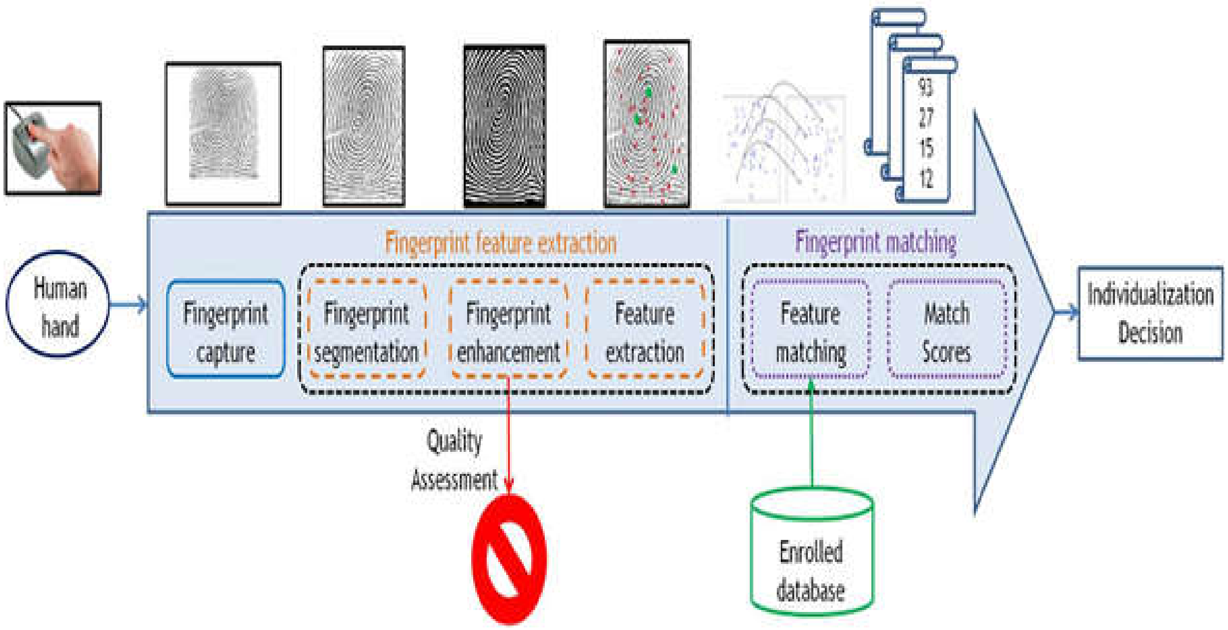

Fig 4. The overall schema of an automated latent fingerprint matching system

Fig. 5.Latent fingerprint lifted using different chemical techniques. Images are obtained from different source in Internet

The explicit technique to be used depends on the material and geometry of the surface from which the latent fingerprints are lifted, the ability of the surveyor and the location (Jiang *et al.,* 2000). A small study on dissimilar methods employed on a variety of background surfaces is shown in Sample latent fingerprints lifted using different techniques are shown in Fig. 5. The forensic surveyor might carry out some preface tests such as magnifying glasses and UV light to decide if a latent fingerprint is accessible at a exacting locality. Normally it is left to the surveyor on the crime scene to choose from where to lift the latent fingerprint and which method to use. Lee and Gaensslen and Thompson showed a thorough process followed by forensic experts for lifting fingerprints from diverse surfaces. Some of the prime challenges encountered in common latent fingerprint lifting techniques is: Smudges and strokes introduced by chemical reagents or brush adds to the noise and information loss during latent fingerprint lifting.

The surface from which the latent fingerprint is lifted, the contact pressure and the contact duration of the finger with the surface, and contamination of finger skin with oil and sweat will differ the eminence of fingerprints (Chen *et al.,* 2006). The tape process used to lift fingerprints introduces non-linear distortion in the ridge flow of fingerprints. Sometimes a small mistake committed by a forensic expert leads to the removal of latent fingerprint before it is lifted. This can lead to some grim failure to collect evidence from a crime scene. To overcome the above mentioned challenges, researchers at present focus on contact-less latent fingerprint lifting techniques. Hildebrandt *et al*. proposed a extremely helpful application of contactless latent fingerprint lifting in airport luggage handling. Kiltz *et al.,* in 2012, presented a recent survey of the a variety of contact-less latent fingerprint lifting methods and it's challenges. An analysis of various sensor techniques, spectroscopy and multi sensor fusion approaches were studied and seven prime challenges in contact less latent fingerprint lifting were identified and summarized below:

- Need for the integration of different methods in lifting
- Determination of sensor parameters
- Sensor types for different surfaces
- Non-planar surface
- Influence of dust and dirt
- Age detection of fingerprints and separation of overlapping fingerprints
- Extension of benchmarking scheme.

RESULTS AND DISCUSSION

The proposed Latent Fingerprint detection system is implemented in Matlab and the simulation results are provided as follows. The gray scale image is converted to a binary image through the process of simple thresholding or some form of adaptive binarization as shown in Fig 6.

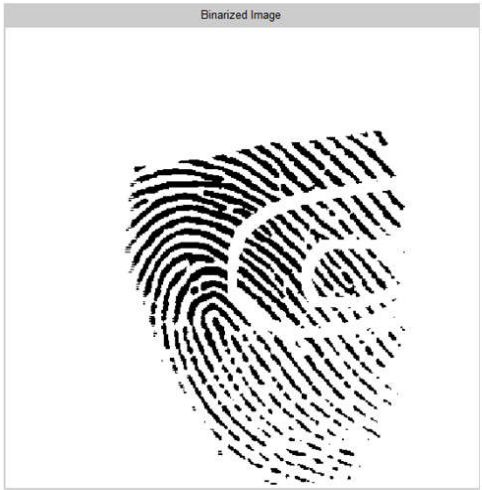

Fig.6. Image after binarized work process

Fig 7. Thinned Fingerprint

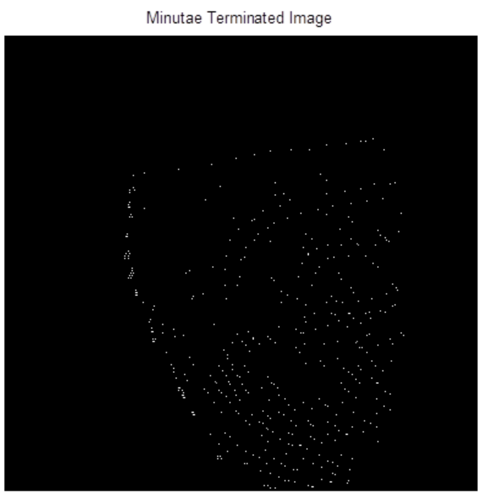

Fig 8. Minutiae feature Termination

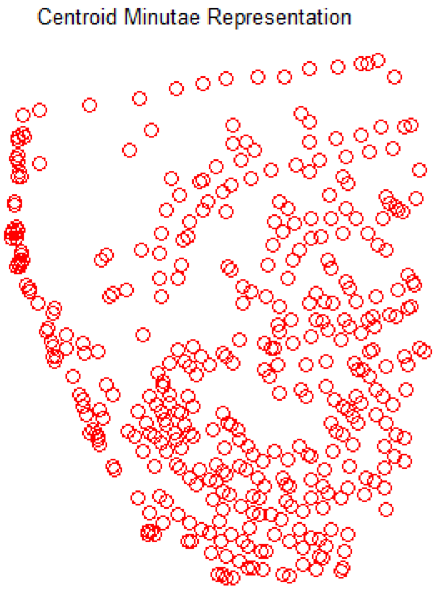

Fig 9. Centroid Minutiae representation

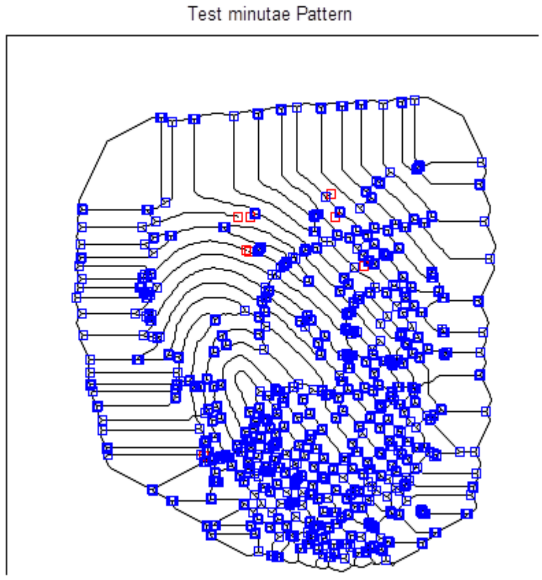

Fig 12. Test Minutae Pattern

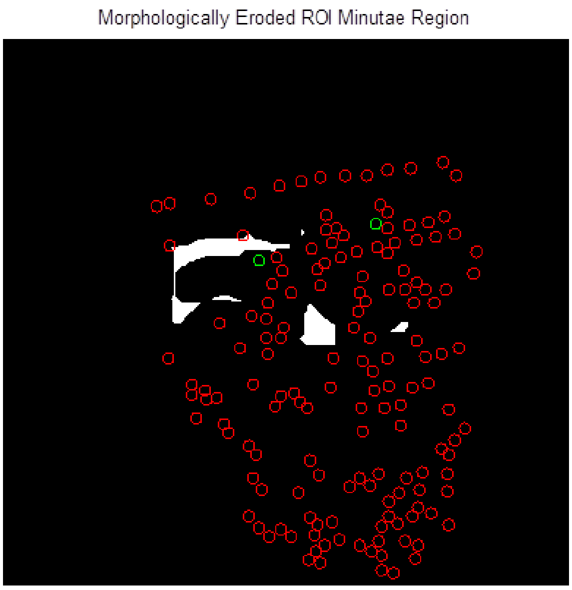

Fig 10. Morphological Processing

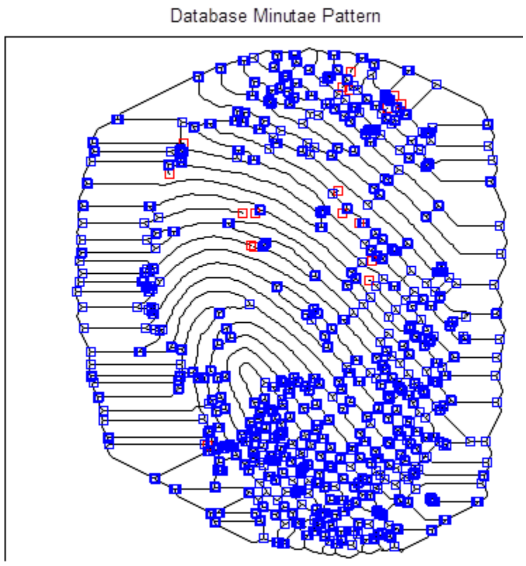

Fig 13. Target Minutiae Patten

Fig 11. Extrema Minutiae subtraction

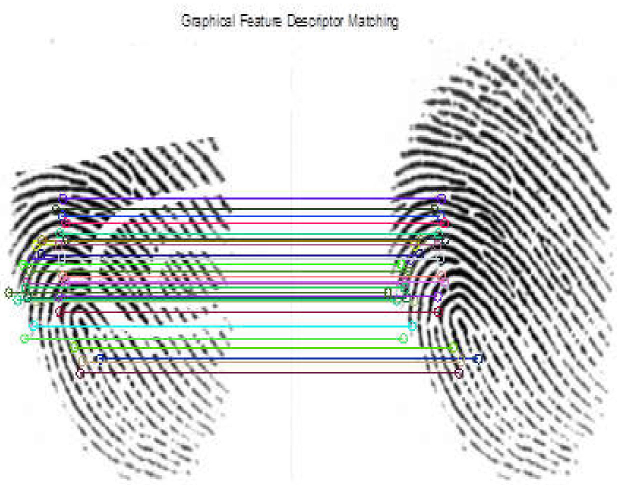

Fig 14. Graphical Matching between the Latent Fingerprints using

The quality of the binarization output is improved if the gray scale image is enhanced prior to this process. This step is also referred to as segmentation in literature. However, this should not be confused with segmentation of the fingerprint foreground from the background during region mask generation. The resulting binary image is thinning by an iterative morphological process resulting in a single pixel wide ride map as shown in Fig 7 Some algorithms such as MINDTCT and our proposed approach does not require this stage. From thinning image we find the mintiuae features termination as shown in Fig 8.For that minutiae centroid distances are measured as shown in Fig 9.we perform the morphological operations on this image as shown in Fig 10 and Fig11.we compare the test minutiaes pattern and target minutiae patterns as shown in Fig12 and Fig 13. If match is found then the graphical matching between the latent fingerprint and rolled fingerprints is shown in Fig 14.

Conclusion

The proposed fingerprint matching algorithm intended for matching latents to rolled/plain fingerprints which is based on a descriptor-based Hough Transform alignment. A similarity between the alignment performance of the proposed algorithm and the well-known Generalized Hough Transform shows the greater performance of the proposed method. We also reported matching consequences for two dissimilar latent fingerprint databases with a large background database of around 32K rolled prints. We compared the performance of the proposed matcher with three dissimilar state-of-the-art fingerprint matchers. Experimental consequences show that the proposed algorithm performs superior than the three fingerprint matchers used in the study across all image qualities. A score-level fusion f the projected matcher and one of the commercial matchers (COTS2) show a further improvement in the matching performance. This work can be comprehensive to include a texture-based descriptor to get better the matching accuracy particularly when the overlap between the latent and rolled prints is small and include extra automatically extracted features to progress the matching performance without an increase in manual labor (latent examiner's markups).Even though the proposed matcher is more accurate than the two COTS matchers, they are considerably quicker. Indexing algorithms cam also developed to speed up latent matching.

REFERENCES

Alessandra, A. 2013. Paulino, Student Member, IEEE, Jianjiang Feng, Member, IEEE, and Anil K. Jain, Fellow, IEEE, Latent Fingerprint Matching Using Descriptor-Based Hough Transform‖ IEEE Transactions On Information Forensics And Security, Vol. 8, No. 1, January.

Alessandra, A. 2011. Paulino, Student Member, IEEE, Jianjiang Feng, Member, IEEE, and Anil K. Jain, Fellow, IEEE,Latent Fingerprint Matching Using Descriptor-Based Hough Transform‖, in Proc. Int. Joint Conf. Biometrics, Oct. pp. 1–7

Anil, K. Jain, Fellow, IEEE, and Jianjiang Feng, ―Latent Fingerprint Matching, IEEE Transacations On Pattern analysis and Machine Intelligence.

Soweon Yoona, Jianjiang Fenga, and Anil K. Jain*a,b,On Latent Fingerprint Enhancement‖.

Kai Cao, Eryun Liu, Member, IEEE and Anil K. Jain, Fellow, IEEE. ―Segmentation and Enhancement of Latent Fingerprints: A Coarse to Fine Ridge Structure Dictionary (4) Alessandra A. Paulino, Eryun Liu, Kai Cao.

Feng, J. and Jain, A. K. 2011. "Fingerprint reconstruction: From minutiae to phase," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 33, no. 2, pp.209–223, Feb.

Jiang, X. and Yau, W.-Y. 2000. "Fingerprint minutiae matching based on the local and global structures," in Proc. 15th Int. Conf. Pattern Recognit, pp. 1038–1041.

Jain, A. K. and Feng, J. 2011. "Latent fingerprint matching,"IEEE Trans. Pattern Anal. Mach. Intell., vol. 33, no. 1, pp. 88–100, Jan.

Qi, J. Yang, S. and wang, Y. 2005."Fingerprint matching combining the global orientation field with miutia,"pattern Recognition.Lett.vol26.pp.2424-2330.

Gu, J., Zhou, J. and Yang, C. 2006. "Fingerprint recognition by combining global structure and local cues,"IEEE Trans. Image Process., vol.15, no. 7, pp. 1952–1964, Jul.

Jiang, X. and Yau, W.-Y. 2000. "Fingerprint minutiae matching based on the local and global structures," inProc. 15th Int. Conf. Pattern Recognit., pp. 1038–1041.

Chen, X., Tian, J. and Yang, X. 2006."A new algorithm for distorted fingerprints matching based on normalized fuzzy similarity measure,"IEEE Trans. Image Process., vol. 15, no. 3, pp. 767–776, Mar.

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