Enhancement of Latent Fingerprint Recognition Using Global Transform

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Abstract— Latent Fingerprints plays a vital role in identifying thefts, crime etc. Latent fingerprints are of 3 types. Noise in the Latent Fingerprints is removed by smoothing. Manual marking in Latent Fingerprint is slow and also latent examiner may make mistake while marking. The minutiae in the same latent marked by different latent examiners or even by the same examiner (but at different times) may not be the same. To overcome this issue new Orientation field estimation algorithm is introduced. It based on latent fingerprint feature extraction and edge detection. Orientation field estimation algorithm has dictionary construction stage. Dictionary Construction has 2 Stages. i) Offline stage ii) online stage [1]. Orientation field estimation algorithm is applied for Overlapped fingerprint[1]. Hough transform is used for detecting edges. It is shown that this method is slower to recognize latent fingerprint feature extraction and edge linking. In order to further increase the speed and perfect edge linking Hough transform method can be modified for better performance. Global transform is used for perfect edge linking and get the full fingerprint structure and comparison is made between two transforms to show which transform is better.

Keywords— *Latent **fingerprint**, Dictionary, Orientation Field, Transform.*

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I. INTRODUCTION

Latent fingerprints refer to the impressions unintentionally left on items handled or touched by fingers. Such fingerprints are often not directly visible unless some physical or chemical technique is applied to enhance them. Compared to fingerprints captured using inking or live scan techniques the quality of most latent fingerprints is very low, with unclear ridge structure, uneven contrast, and overlapping patterns, such as printed letters, handwriting, or even other fingerprints. The word latent means hidden or invisible, in modern usage for forensic science the term latent prints means any chance or accidental impression left by friction ridge skin on a surface, regardless of whether it is visible or invisible at the time of deposition.

Electronic, chemical and physical processing techniques permit visualization of invisible latent print residues whether they ***are*** from natural sweat on the skin or from a contaminant such as motor oil, blood, ink, paint or some other form of dirt. The different types of fingerprint patterns such as arch, loop and whorl. Because of the poor image quality, features (such as minutiae) in latents need to be manually marked by latent examiners so that they can be searched against large fingerprint databases by Automated Fingerprint Identification Systems (AFISs) [1].

TYPES OF LATENT FINGERPRINT

1.1 Good Quality

Good quality fingerprint have clear ridge structure and no background noise. Ridge ending and Bifurication are both combined and known as ***minutiae*** points. Good quality fingerprints can be get from live scan devices, inked fingerprint.

1.2 Bad Quality

Bad quality fingerprint have background noise and unclear ridge structure. Background noise means background pictures, letters present in the fingerprint. The fingerprint may be ***partially*** retrieved due to background noise present in the fingerprint.

1.3 Overlapped

Overlapped fingerprint has one fingerprint over the other. Ridges in the one fingerprint overlapped in the other [1]. This can be removed by using some techniques.

The ***poor*** image quality, features (such as minutiae) in latents need to be manually marked by latent examiners so that they can be searched against large fingerprint databases by Automated Fingerprint Identification Systems (AFISs). Noise in the Latent Fingerprints is removed by smoothing technique. This technique is applied during manual marking of latent fingerprint.

Orientation field estimation algorithm is used to process poor quality fingerprints, especially latents. Given prior ***knowledge*** of fingerprint structure, which is represented by a dictionary of reference orientation patches and compatibility constraints between adjacent orientation patches.

Orientation field estimation algorithm has Dictionary construction stage. Dictionary construction has 2 stages. In the offline stage, a set of good quality fingerprints of various

pattern types (***arch***, loop, and whorl) is manually selected and their orientation fields are used to construct a dictionary of orientation patches. In the online stage, given a fingerprint image, its orientation field is automatically estimated using i) Initial estimation ii) Dictionary lookup iii) Context-based correction. By using dictionary lookup the set of candidate orientation patches and selected orientation patches is combined to form a correct orientation field.

Full Fingerprint generation is the major issue in latent fingerprint while examine the latent fingerprint sometimes we will get partial fingerprint. The partial fingerprint is used to generate the full fingerprint. Hough Transform is used to detect all the edges in the latent fingerprint and linking all the detected edges. To generate the full fingerprint perfectly and this can be done by perfectly linking all the edges of minutiae points using global transform.

II. RELATED WORK

In the Enhancement of Latent Fingerprint the Orientation field estimation is done to get the full fingerprint [1]. But the Orientation field estimation is made as a simulation but when going for real time application of latent fingerprint we need to have more security. A novel approach to reconstruct fingerprint images from standard templates and investigates to what extent the reconstructed images are similar to the original Ones. Minutiae-based template is a very compact representation of a fingerprint image, and for a long time, it has been assumed that it did not contain enough information to allow the reconstruction of the original fingerprint. The efficacy of the reconstruction technique has been assessed by estimating the success chances of a masquerade attack against nine different fingerprint recognition algorithms [2].Minutiae are very important features for fingerprint representation, and most practical fingerprint recognition systems only store the minutiae template in the database for further usage [3].

III. ORIENTATION FIELD ESTIMATION

The Enhancement of Latent Fingerprint in real time is a long term process since one or more Latent fingerprints are needed to be compared. Latent Examiner may make mistakes while ***marking*** minutiae in the latent fingerprints [1]. It took some time to mark the minutiae points and to get the full fingerprints.

To deal this issue we are implementing the orientation field estimation to get the initial orientation field and to get the full fingerprint. ***Hough*** transform and Global transform is used. To find the initial orientation field and to get the full fingerprint following methods are used:

1) Orientation field estimation (Previous Work)
2) Edge Linking and Global Transform (Proposed)

In the orientation field estimation online stage and offline stages are carried out. In the offline stage a set of good quality fingerprints of various pattern types (arch, loop, and whorl) is manually selected and their orientation fields are used to construct a dictionary of orientation patches [1]. Good quality ***fingerprints*** are taken using fingerprint scanner [2]. It will scan the fingerprint of any types by reading its pixels and the values as 0's and 1's. It will convert the binary values into digital image. We can use this digital image to construct the dictionary of reference orientation patches.

In the online stage given a latent fingerprint image as input, its orientation field is automatically estimated by using initial estimation, Dictionary lookup, Context based correction. The initial orientation field is obtained using a simple algorithm [1]. Other local estimation algorithms, such as gradient-based and slit-based, should also suffice for this initial step. Due to the poor quality of latents, the initial orientation field is usually very noisy. Noise can be removed by later stages [1].

Dictionary lookup is done by using the initial orientation field. The initial orientation field is divided into overlapping patches. For each initial orientation patch, its six nearest neighbours in the dictionary are viewed as candidates for replacing the noisy initial orientation patch [1].

Context based correction is done by finding the similarity between the candidate orientation patches with the initial orientation patches [1]. Also find the compatibility between the candidate orientation patches with the initial orientation patches [1].

IV. PROPOSED SYSTEM

Edge Linking is done by using Global transform. After context based correction the latent fingerprint have only few real minutiae points. By using interpolation approach virtual minutiae points can be created [4]. Red colour and Purple colour minutiae points are real and virtual minutiae points respectively. Hough transform consider both the real and virtual minutiae points in the latent fingerprint and detect the edges at the boundaries. Global Transform is used to link all the detected edges perfectly to get the full fingerprint. The reconstructed image can be used in matching stage for further improvement.

Hough and Global transform is used to get the full fingerprint. Hough transform is used to detect all the edges in the latent fingerprint at the boundary region. Global transform is used for linking all the detected edges and to get the full fingerprint structure.

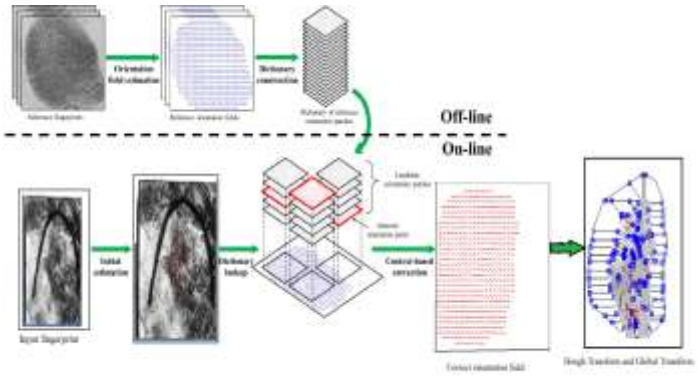

Fig 1: Enhancement of Latent Fingerprint using dictionary construction and Transforms

V. ARCHITECTURE DESIGN

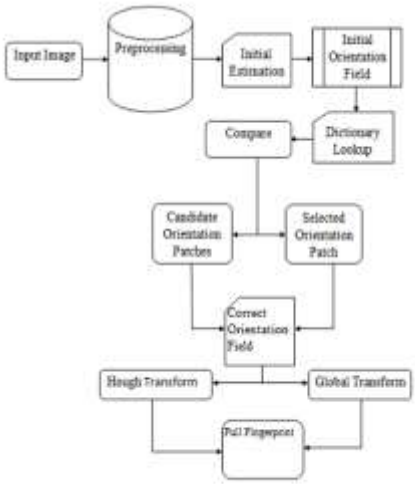

Fig 2: Architecture followed for the Enhancement of Latent Fingerprint

The Latent fingerprint image is given as input and the image is pre-processed. Initial Estimation is done for the latent fingerprint and we get the initial orientation field. For that initial orientation field Dictionary lookup is done. Dictionary lookup is comparing candidate orientation patches with the six neibouring reference orientation patches [1]. The last stage is context based correction. In this stage Hough transform and Global transform is used. Hough transform is used to detect all the edges in the latent fingerprint. Global transform is used for linking all the detected edges and to get the full fingerprint structure. By using both transforms we will get the correct orientation field.

VI. CONCLUSION AND FUTURE WORK

In this paper a new approach is adopted to get the full fingerprint. Global Transform approach can be used further to get the full fingerprint perfectly. This approach will link all the real and virtual minutiae points at the detected edges in the latent fingerprint. Thus the global transform can be used efficiently for the perfect edge linking and to get the fingerprint structure. The comparison graph between Hough and Global Transform is made to see which transform is better to get the full fingerprint. The global transform is used in the simulation and it can be modified for the future work.

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REFERENCES

[1] J. Feng, J. Zhou and A.K. Jain, "Orientation Filed Estimation for Latent Fingerprint Enhancement"," IEEE Transactions Pattern Analysis and Machine Intelligence, Vol. 35, No. 6, pp. 925-940, April 2013.
[2] R. Cappelli, A. Lumini, D. Maio, and D. Maltoni, "Fingerprint Image Reconstruction from Standard Templates," IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 29, No. 9, pp. 1489-1503, September 2007.
[3] J. Zhou, F. Chen, and J. Gu, "A Novel Algorithm for Detecting Singular Points from Fingerprint Images," IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 31, No. 7, pp. 1239-1250, July 2009.
[4] F.Chen, J.Zhou and C. Yang, "Reconstructing Orientation Field from Fingerprint Minutiae to Improve Minutiae-Matching Accuracy," IEEE Transactions on Image Processing, Vol. 18, No. 7, pp. 1665-1670, July 2009.
[5] A.K. Jain and J. Feng, "Latent Fingerprint Matching," IEEE Transactions Pattern Analysis and Machine Intelligence, Vol. 33, No. 1, pp. 88-100, January 2011.
[6] F. Chen, J. Feng, A.K. Jain, J. Zhou, and J. Zhang, "Separating Overlapped Fingerprints," IEEE Transactions on Information Forensics and Security, Vol. 6, No. 2, pp. 346-359, June 2011.
[7] F. Turroni, D. Maltoni, R. Cappelli, and D. Maio, "Improving Fingerprint Orientation Extraction," IEEE Transactions on Information Forensics and Security, vol. 6, no. 3, pp. 1002-1013, September 2011.
[8] Q. Zhao and A.K. Jain, "Model Based Separation of Overlapping Latent Fingerprints," IEEE Transactions Information Forensics and Security, Vol. 7, No. 3, pp. 904-918, June 2012.
[9] Sheng Li and Alex C. Kot, "An Improved Scheme for Full Fingerprint Reconstruction," IEEE Transactions on Information Forensics and Security, Vol. 7, No. 6, pp. 1906-1912, December 2012.