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A Study on Latent Fingerprint Matching Techniques

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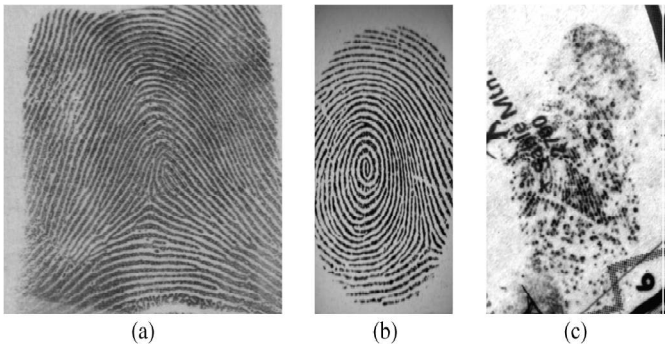
ABSTRACT: This paper present a crime scenes, forensic and Law enforcement Application (Latent fingerprint matching Techniques) Latents fingerprint Identification is the most important role for crime scenes and Law enforcement Latent fingerprint Identify to catching the criminals. Due to the Latent is poor quality image i.e. like Smudgy, Blurred Images cannot easy to extract. The main goal provide Latent fingerprint matching to rolled and plain fingerprint it is a difficult task it's necessary to extracting feature for improving the Latent (fingerprint) matching Accuracy. The various Latent matching Approaches and Techniques are discussed.

KEYWORDS: Rolled and Plain Fingerprint, Latent fingerprint features, segmentation, Latent matching Approaches or Techniques.

I. INTRODUCTION

In Biometric and Law enforcement using fingerprint recognize techniques to identify. It is latent fingerprint mainly used in law enforcement and crime scenes application. There are 3 categories of fingerprint matching in forensics and law enforcement.
(i)Rolled fingerprint: - rolled images are obtained by a rolled a finger nail to nail (from one side to another side)
(ii)Plain fingerprint:-plain fingerprint impressions are those in which the fingerprint not rolled but it is pressed down on finger flat surface.
(iii)Latents fingerprint: Latents fingerprint images impression on surface of object which is indvently handled by human or criminals at crime scenes.
Rolled prints contain the largest amount of information about the ridge structure on a fingerprint since they capture the largest finger surface area; latents usually contain the least amount of information for matching or identification because of their size and inherent noise. Compared to rolled or plain fingerprints, latents are smudgy and blurred, capture only a small finger area, and have large nonlinear distortion due to pressure variations[3].Due to these characteristics,latents have a significantly smaller number of minutiae points comparedto full (rolled or plain) fingerprints. The small number ofminutiae and the noise characteristic of latents make it extremely difficult to automatically match latents to their mated full prints that are stored in law enforcement databases [3].



(a) (b) (c)

Fig. 1.Three types of fingerprint impressions. (a) Rolled; (b) plain; (c) latent [3].

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II. PREPROCESSING

The Preprocessing Technique includes 5 Categories. A process enhancement the Latent fingerprint image quality.

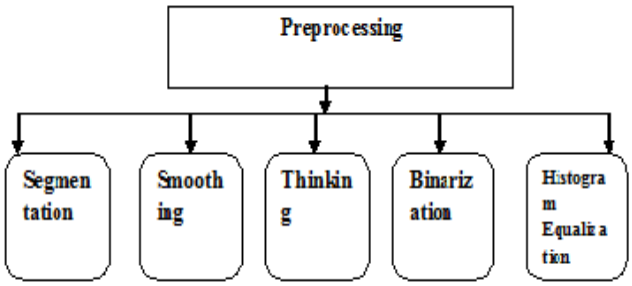

Fig. 2. Preprocessing Techniques.

The Preprocessing Techniques can be using includes 5 Categories.
(1)Segmentation: - Segmentation process mostly involved the background and foreground separation of fingerprint image area, because overlapped with another latents fingerprint images.
(2)Smoothing: - Smoothing process is main fact on orientation ridges are flow across the flat surfaces of fingerprint images.
(3)Thinning: - Thinning is a process fingerprint images Thinning to one pixel fingerprint image which process mainly performance to clearing useful and useless ridges.
(4) Binarization: - Binarization is a process of fingerprint gray- scale image converted into Binary image.
(5)Histogram equalization: - A process to the Bad, ugly means poor quality image (latents) fingerprint image converting particular manner sequence order to the ridge structure are clearing [1][2].

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III. FEATURE EXTRACTION

The Feature Extraction Process is Main goal in Latent fingerprint matching Due to Latent Bad, ugly means poor quality images and it is mainly to capture all feature includes in latent finger image for an efficient matching**.**

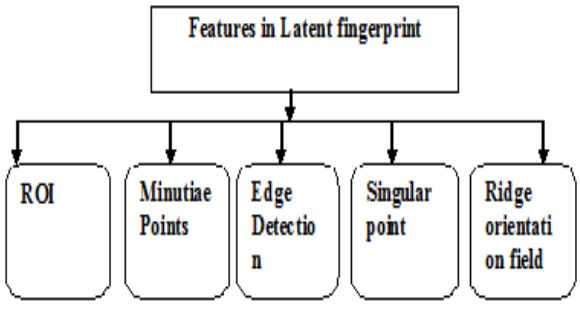

Fig.3. Features in Latents fingerprint.

(1) ROI: - The Region of Interest (ROI) is a closed region that is bounded at outer most trim of the latent. Only the fingerprint features in the ROI are regarded as valid [3].
(2) Minutiae points: - a minutia is defined as the point and fingerprint images such as ridge lines bifurcation (single ridge is divides into 2 ridges)

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(3) Edge Detection: - The edge detection is a process of extracting the most important features in fingerprint image. The most important goal of the edge detection tech is detect and localize of finger images edges.
(4) Singular points: - The Singular pointsare singularities observed in almost all the fingerprints fall into one of the following categories: (i) no singularity arch type of fingerprints (ii) one core and one delta loop and tented arch type (iii) two cores and two deltas whorl and twin loop type [3][1].
(5) Ridge orientation field: - The Ridge Orientation fielddescribes the global structure of fingerprints and It provides robust discrimination information other than traditional widely-used minutiae points [10][1].

IV. LATENT FINGERPRINT MATCHING

Latents are partial fingerprints that are usually smudgy, with small area and containing large distortion. Due to these characteristics, latents have a significantly smaller number of minutiae points compared to full (rolled or plain) fingerprints. The small number of minutiae and the noise characteristic of latents make it extremely difficult to automatically match latents to their mated full prints that are stored in law enforcement databases. Recent research and development efforts on latent fingerprints can be classified into three streams according to the manual input required from fingerprint examiners: consistent with existing practice, increasing manual input, or reducing manual input. Because of large variations in latent fingerprint quality and specific requirements of practical applications (crime scenes, border crossing points, battle fields), each of the three streams has its value [3].

V. RELATED WORK

Various Goals New Approaches and algorithms that use in Additional application and features the latent fingerprint to improve matching.

Alessandra A. Paulino, *Student Member, IEEE*, Jianjiang Feng, *Member, IEEE*, and Anil K. Jain, *Fellow, IEEE*[3]in this paper work on**"**Latent Fingerprint Matching Using Descriptor-Based Hough Transform**".** In this paper they proposed a robust alignment algorithm (descriptor-based Hough transform) to align fingerprints and measures similarity between fingerprints by considering both minutiae and orientation field information. A new fingerprint matching algorithm which is especially designed for matching latents. 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. To be consistent with the common practice in latent matching (i.e., only minutiae are marked by latent examiners), the orientation field is reconstructed from minutiae. Since the proposed algorithm relies only on manually marked minutiae, it can be easily used in law enforcement applications. The proposed matching approach uses minutiae and orientation field from both latent and rolled prints. Minutiae are manually marked by latent examiners in the latent, and automatically extracted using commercial matchers in the rolled print. Based on minutiae, local minutiae descriptors are built and used in the proposed descriptor-based alignment and scoring algorithms.
A minutia cylinder records the neighbourhood information of a minutia as a 3-D function. A cylinder contains several layers and each layer represents the density of neighbouring minutiae along the corresponding direction. The cylinder can be concatenated as a vector, and therefore the similarity between two minutia cylinders can be efficiently computed. Orientation field can be used in several ways to improve fingerprint matching performance, such as by matching orientation fields directly and fusing scores with other matching scores, or by enhancing the images to extract more reliable features. The performance of the COTS matchers, each using its own proprietary templates for latents (including automatically extracted minutiae and possibly other features), is worse than using manually marked minutiae for both the databases.The proposed algorithm outperforms two well optimized commercial fingerprint matchers. Further, a fusion of the proposed algorithm and commercial fingerprint matchers leads to improved matching accuracy [3].

Anil K. Jain, *Fellow, IEEE*, and Jianjiang Feng[4]in this paper they Work on "Latent Fingerprint Matching" paper in this forensics and civilian applications. Tremendous progress has been made in plain and rolled fingerprint matching; latent fingerprint matching continues to be a difficult problem. Poor quality of ridge impressions, small finger area, and large non-linear distortion are the main difficulties in latent fingerprint matching, compared to plain or rolled fingerprint matching. Propose a system for matching latent fingerprints found at crime scenes to rolled fingerprints enrolled in law enforcement databases.

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In addition to minutiae, and consists of the following steps:
1) Local minutiae matching: Similarity between each minutia of latent fingerprint and each minutia of rolled fingerprint is computed.
2) Global minutiae matching: Using each of the five most similar minutia pairs found in Step 1 as an initial minutia pair, a greedy matching algorithm is used to find a set of matching minutia pairs.
3) Matching score computation: A matching score is computed for each set of matching minutia pairs and the maximum score is used as the matching score between the latent and rolled prints.
A pair of fingerprints is classified by a traditional classifier, such as Artificial Neural Network (ANN) or Support Vector Machine (SVM), as a genuine match or an impostor match based on a feature vector extracted from matching these two fingerprints. The minutiae-based baseline was improved to extended features were used the indicate that singularity, ridge quality map and ridge flow map are the most effective features in improving the matching accuracy [4].

Soweon Yoona, Jianjiang Fenga, and Anil K. Jain*a, b [5] in this paper they Workon "On Latent FingerprintEnhancement": propose a latent fingerprint enhancement algorithm, which expects manually marked region of interest (ROI) and singular points. The core of the proposed algorithm is a robust orientation field estimation algorithm for latents. Short-time Fourier transforms is used to obtain multiple orientation elements in each image block. This is followed by a hypothesize and test paradigm based on randomized RANSAC, which generates a set of hypothesized orientation fields.
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 model to coarse orientation field estimated from skeleton outputted by a commercial fingerprint SDK One of the irreplaceable functionality of fingerprint recognition is its capability to link partial prints found at crime scenes to suspects whose fingerprints are previously 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 simple weighted averaging filter or more complicated model-based methods. It is better to use only reliable initial estimate or to give it larger weight. To overcome this limitation, estimate a coarse orientation field from skeleton image generated by a commercial SDK [5].

Alessandra A. Paulino, Eryun Liu, Kai Cao and Anil K.Jain [7], in this work on "Latent Fingerprint Indexing: Fusion of Level 1 and Level 2 Features". In this paper, they introduced an indexing technique, primarily for latents, that combines multiple level 1 and 2 features to filter out a large portion of the background database while maintaining the latent matching accuracy. These consist of combining minutiae, singular points, and orientation field and frequency information. Their approach consists of combining a constrained version of triplet indexing, MCC indexing and a new orientation field descriptor indexing technique that uses hash function, filtering based on singular points and averaged ridge period comparison.
Orientation field descriptor indexing is carried out first by converting the descriptor in a binary vector, using a hash function; similar to as above Singular points provide useful characterization of a fingerprint. To order the singular points in a pair of singular points. A better fusion scheme would take into account the differences in the latents so that the weights assigned to different features used in indexing can be adaptively determined, or the different features could be used sequentially as opposed to in parallel as implemented here. The approach, five-fold reduction in the latent search (indexing + matching) time, while maintaining the latent matching accuracy [7].

VI. PROPOSED METHOD

The proposed work is based on the Template matching method to improving the matching Accuracy when the latent to rolled and plain fingerprint images. Latent fingerprint technique uses ridge structure available in latent fingerprint process. This New method is used to improve the matching accuracy and better performance and result also planned new approaches Template matching method to the database into improving the matching speed result.

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VII. CONCLUSION

The Latent fingerprints are found at crime sense, Biometrics and Law enforcement agencies. The Latent fingerprint matching plain fingerprint and rolled fingerprint images. Due to Bad or ugly means poor quality images it is use to various enhance process to obtaining the clearing ridges orientation field. The literature survey or study on various existing latent fingerprint matching techniques was involve done in to provide fast speed matching accuracy result and improving good matching accuracy performance to fingerprint images

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BIOGRAPHY

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