



## Matching Techniques for the Development and Detection of Latent Fingerprints-A Review

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**Abstract:** *Biometric technologies are automated approaches for recognizing individuals based on biological and behavioral characteristics. Human identity, reliably and accessibly has become a major challenge for a present-day society. There are many biometric scan technologies such as finger-scan, facial scan and retinal-scan DNA etc. Latent fingerprint matching has played an important role in identifying suspects and criminals. In the area of latent fingerprint describes the different matching techniques to detect the latent fingerprints use in forensics, crimes aspect and law enforcement. With the use of these techniques the system of verification and identification is highly secured. In crime aspect and forensics Latent fingerprint identifying is an important. The fingerprint identification and verification process and the different latent matching algorithm and techniques are discussed in this paper.*

**Keywords:** *Fingerprint recognition, fingermarks, identification and verification process, latent fingerprint, Latent matching Techniques.*

### I. INTRODUCTION

The meaning of 'latent' word is invisible or hidden. But, in today's forensic science industry usage for the term latent print means any chance of accidental impression left by friction ridge skin on a surface. With the distributive improvement of security requirement, it is highly in demand to have reliable system of personal identification or verification. In high safety demanding applications, the password based authentication is not secured sufficient. Therefore over the past few years, the biometrics based applications has experienced high level growth, Among all biometric techniques, automatic fingerprint based systems are most popular and promising for automatic personal identification. Fingerprint evidence is normally used in forensic investigates and has been a widely recognized form of identification evidence for over hundreds of years [1]. Fingerprints are mostly used for automatic personal authentication [2]. The automatic system means, before authentication process execution the person give his/her fingerprint impressions and shows his/her identity. The system matches the given input fingerprints with the associated person and stores his/her identity in its database. If the given identity is accepted by system then the person is classified as genuine user and if the system is fail to identify given identity means that the person is false and system discard the person. The centre of any automatic fingerprint verification system is accepted by the fingerprint representation technique and the matching algorithm used. A latent print results from the reproduction of friction ridges found on parts of the fingers, hands, and feet [3]. These prints belong to combination of different chemicals that develop from natural secretions, blood, and contaminants. In the case of fingerprint recognition, the ridge flow orientation, or the extraction of particular points, called "minutiae", that measure up the endpoint or the bifurcation of such ridges. Figure 1 elaborates the key views of these two fundamental concepts. (a) Shows the minutiae points extracted from a fingerprint image. (b) Shows the ridge flow of the fingerprint.

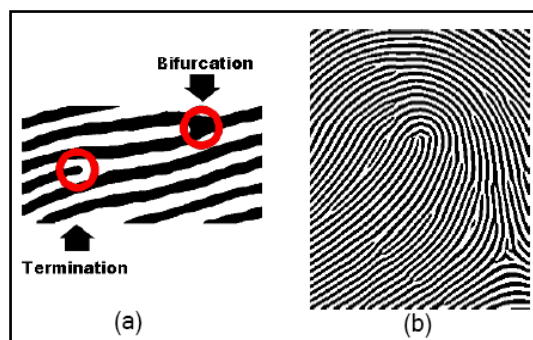


Figure 1(a) shows the minutiae points extracted from a fingerprint image. Figure 1(b) shows the ridge flow of the fingerprint. The ridge flow defines the "texture" of fingerprint.

In the next section II discuss the basic overview of latent fingerprints. Section III presents matching techniques for latent fingerprints. Section IV briefly describes the other matching techniques. At the end of this paper in section V we examining conclusions.

## II. LATENT FEATURES EXTRACTION

In the process to detect the latent fingerprints, the first step is to extract the features of fingerprints. Sometimes, due to the poor quality of latent fingerprints it is necessary to capture all the features in latent fingermarks for an expert matching. Following number of fields are necessary to identify the fingermarks as:

- a) Minutiae Points
- b) ROI (Region of Interest)
- c) Ridge Orientation field
- d) Singular Point
- e) Edge detection

a) The minutiae point is defined as the points of concern in a fingerprint such as ridge bifurcation in which a single ridge that divides into two simultaneous ridges. b) The ROI, also known as the Region of Interest. It is a congested state that is enclosed at outside trim of the latent [4]. c) ROF has to extract the ridge orientation field which describes the overall structure of fingerprints. It gives strong asymmetrical information other than existing used information [5]. d) The area of singularity points exist in almost all the fingerprints. These points are covered the basic categories such as in fingerprints there is no singularity means finger is of arch type, one core and one delta means loop and tented arch type, and two cores and two deltas means whorl and twin loop type. e) At the last step it detects the edges of finger mark by edge detection techniques. To detect the edge and localize of finger image edge is the most important goal of edge detection technique.

## III. MATCHING TECHNIQUES FOR LATENT FINGERPRINTS

A variety of techniques have been used to detect the latent fingerprint on any surface. Some techniques have proven to be unsuitable and some techniques are appropriate in the field of detection. Latent fingerprints are generally invisible, require some form of chemical or physical treatment to discriminate from the substrate material. A usual latent fingerprint deposit is a composite combination of natural production and contaminants from the environment. Knowledge of the major constituents of this deposit is required for effective fingerprint detection. Concern of how these elements are affected by different environmental conditions is also important.

Following techniques are as follows:

- Optical methods (Absorption, Diffuse Reflection, Luminescence, UV absorption and Reflection) [6]
- Physical Methods (Powdering, Small Particle Reagents, vacuum Metal Deposition) [7]
- Chemical Methods (Ninhydrin, DFO, Genipin) [8]

These methods are categorized on the basis of surface pattern. What technique will be useful to detect the latent fingerprints is based on the knowledge of all constituents. Surfaces are generally divided into three categories such as:

1. Porous surface
2. Non-Porous Surface
3. Semi-Porous Surface

These techniques are described as follows:

### 1. Porous surface

These types of surface absorb water and water soluble deposits in the sweat very quickly after depositions such as paper, checks, currency, tissue paper, fabrics etc. In the case of latent fingerprint when a latent fingermark is to be found on a porous surface, the water soluble compounds are absorbed easily. These types of fingermarks are comparatively stable and the probability of getting usable prints is high. Best method of developing prints fall in the category of chemical methods such as visual examination, DFO, Ninhydrin, Physical developer [9].

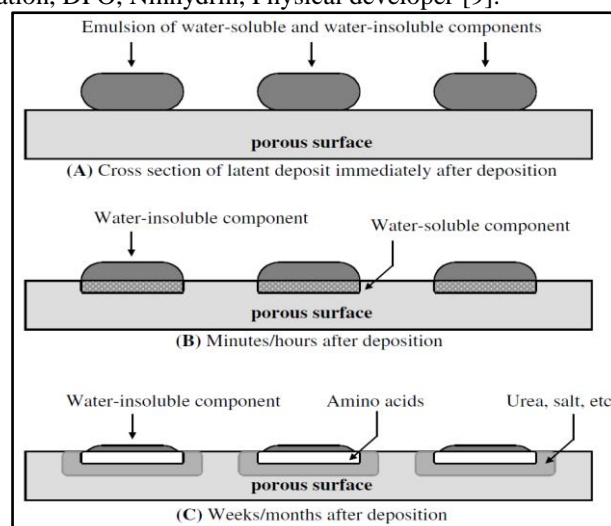


Figure 2: The effect of time on the deposition of latent fingerprint components on porous surfaces. Taken and reproduced from Champod et al [9].

## 2. Non-Porous surface

These types of surface do not absorb water and water soluble deposits in the sweat. The fingerprint deposits can remain on the surface for a very long time such as glass, certain type plastics, polythene bags, metal surfaces, paints etc. The probability of getting usable print in non-porous surface is also high. In the case of latent fingerprint when a latent fingerprint is to be found on a non-porous surface, an emulsion of water and water-soluble compounds is formed on surface and may remain there for a large amount of time. Due to this reason, fingerprints can be easily damaged or rubbed off. Best methods for developing prints fall in the category of physical methods such as powdering, visual examination, superglue, fluorescent dye stain, small particle reagents and vacuum metal deposition.

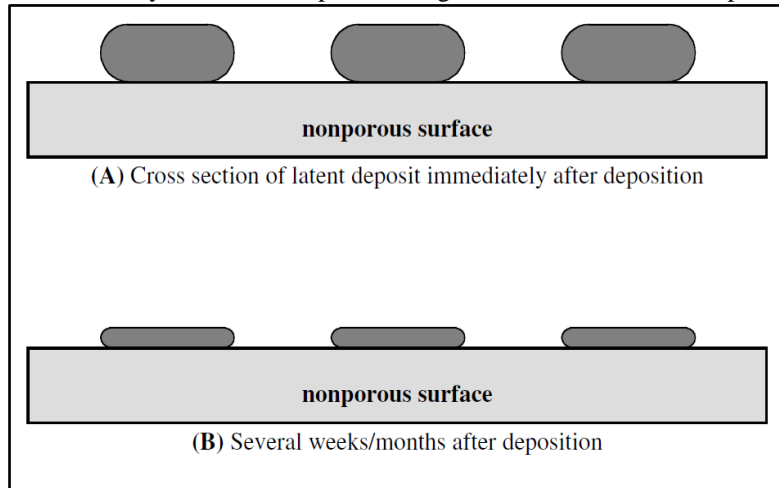


Figure 3: The effect of time on the deposition of latent fingerprint components on nonporous surfaces. Taken and reproduced from Champod et al[9].

## 3. Semi-Porous Surface

In these kind of surfaces absorbs water and water soluble compounds into the surface but at a slower rate than porous surface. The level of absorbency of semi-porous surface is in between of porous and non-porous surface. Best methods for developing prints fall in the category of optical methods such as waxed surfaces, wall paints, glossy finish paper, rubber gloves, varnished wood etc. The probabilities of getting usable prints are also high.

Hence, the type of surface is major concern when selecting a sequence of latent fingerprint detection techniques for a particular set of situations.

## IV. OTHER MATCHING TECHNIQUES

However, the above mentioned techniques are the most general for use in law enforcement and forensic sense laboratories. In these techniques various kind of compounds, chemicals and reagents are use in specific situations by certain forensic laboratories. These compounds can be of use when dealing with fingerprints on any device, human skin or any particular object [10] [11]. Some of the more common detection techniques are as follows:

- Dimethylaminocinnamaldehyde (DMAC)
- Ruthenium tetroxide (RTX)
- Silver nitrate
- Iodine/benzoflavone
- Gentian violet
- Sticky-side powder

## V. CONCLUSION

There is variety of techniques to detect the latent fingerprints. Latent fingerprint found on any surfaces or in condition such as rolled, rough and plain fingerprints. Sometimes images are found in very poor or bad quality. These techniques such as optical method, physical method and chemical method are use in latent for improvement of bad and poor quality images. The goal of matching techniques is to provide accuracy, better performance and high processing.

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