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REFINEMENT OF LATENT FINGERPRINT

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ABSTRACT

In this paper we are taking the basic approaches used in latent fingerprint recognition. Fingerprint recognition taking by recognize all the minutiae points and after that extracting their features and finalize to match the points. Fingerprint Recognition is done by three main steps. By these steps we are getting the best result. These steps are:-1. Image Pre-processing 2. Minutiae detection and feature extraction 3. Minutiae matching. Pre-processing are an important step for fingerprint recognition system. It enhances the quality of an image so that we can mark the right minutiae. Minutiae detection and feature extraction step involves refining of the thinned image, detecting the minutiae points and then extracting features from image. Minutiae matching is the third step in which we can match the minutiae template as an input and check the output minutiae. Template image is collected during enrolment and saved in the database. During recognition phase, the input image is compared against template image. These steps give the result weather the fingerprints are belonging to same finger or not. During this phase we concentrated upon how to process the given sample so that correct minutiae can be detected.

Keywords — Minutiae, Ridge, Valley, Latent, Termination, Binarization, Thinning, Skelton.

INTRODUCTION

Now a day, fingerprint recognition system is widely used in forensics labs, police and civilization. It is believed with strong evidences that each fingerprint is unique. Everyone has his own fingerprints with the permanent uniqueness. A fingerprint is composed of many ridges and furrows. Ridges are the dark line of the image while the white area between the ridges is valleys. Among the variety of minutia types reported in literatures, two are most significant and in heavy usage: one is called termination, which is the immediate ending of a ridge; the other is called bifurcation, which is the point on the ridge from which two branches derive as shown in figure 1.

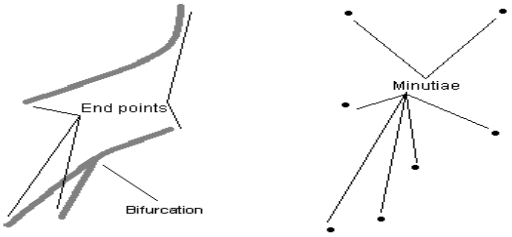

Fig. 1 (a) End points and bifurcation (b) Corresponding Minutiae

Minutiae are some special points in the fingerprint. In general, they are ridge endings and ridge bifurcation [1]. Valley is also referred as furrow, termination is also called *ending*, and bifurcation is also called *branch*. Fingerprints can be classified based on the capture: (1) Rolled: These fingerprints are taken by rolling the finger nail by nail. (2) Plain: These fingerprints are taken by placing the finger on a paper without rolling. (3) Latent: It can be founded when an object is touched an impression of the fingerprints may be visible or after sometimes it may be invisible, these fingerprints are latent fingerprints as shown in figure 2. Rolled fingerprints contain the highest information because these capture the largest surface area of finger while the latent fingerprints have the lowest information [2].

Fig. 2 (a). Rolled ingerprints (b). Plain Fingerprints (c). Latent Fingerprints

Many of the researchers have to search the plain and rolled fingerprint but the important and new task is to recognize the latent fingerprints. Latent fingerprints are collected with the help of powders, chemicals and some type of laser beam. When we find fingerprint at crime place we get distorted and broken curves.

Literature Review

The word "Biometrics" is a specified word "bio" (life) and "metrics" (to measure). Among them, fingerprint recognition is considered to be the most powerful technique for utmost security authentication. [3] introduce five steps to find the good quality image. [4] introduce when we capture the image may contain various noises, so that we found poor matching result. Directional Median Filter (DMF) was used for removing these noises. An enhance approach was taken in [5] over [4] that is Directional Weighted Median Filter (DWMF). A new impulse detector, which is based on the differences between the current pixel and its neighbours aligned with four main directions. [6] introduce enhancement of the fingerprints for less time using Fourier transformation. [7] introduce two separate directional filters are used and there result are compared. An adaptive filtering in frequency domain in order to enhance fingerprint image. [8] introduce an alignment algorithm like descriptor-based Hough transform to align fingerprints and measures similarity between fingerprints by considering both minutiae and orientation field information. [9] introduce and give the solution of touch based fingerprint recognition over the touchless fingerprint recognition system. [10] introduce extraction techniques must be used to obtain the fingerprint data.

Approach used in fingerprint recognition

We are taking the latent fingerprint where the crime has happened. Using the powders, camera we have take these fingerprints. Some types of noises are inserted in these. To eliminate these noise and enhance the quality of image these steps are taken.

1. When image is taken it may be in grey scale, so firstly it is converted to the binary image that is called binarization.
2. Thinning of the image.
3. Dilation of the thinned image.
4. Removing unwanted portions from the image (Refining).
5. False Minutiae Detection
6. Matching.

By following above steps we get a good quality of image. After finding the good quality of image we match these images with our database image.

Converting grey image to binary image

For the input stage some preprocessing steps are necessary for enhance the quality of an image. Binarization is one of the steps in which the grey scale pixel image is converted to binary image. A binary image can be processed and compared then converted to grey scale. By using the threshold value we can set the binary image. If the value is above then the threshold value then the value is 1 and if the value is below then the threshold value its value is 0 as shown in figure 3. Image binarization converts an image of up to 256 gray levels to a black and white image [11].

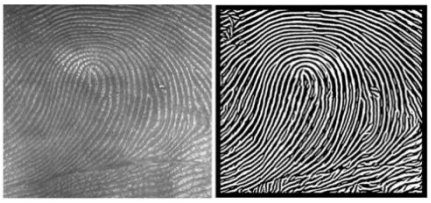

Fig. 3 Binarization

Thinning of the image

After getting the binary image the necessary step to thinning the image are given below. The process of thinning includes: (a) Ridge thinning: It eliminates redundant pixels of ridges till the ridges are 1 pixel wide. In each scan of the full fingerprint image, the algorithm marks down the redundant pixels in each small image window of (3*3) matrix and finally removes all those marked pixels after several scans [12]. (b) Skeleton Refinement: This operation takes thinned image as the input and produces refined skeleton image by converting small straight lines to curve to the maximum possible extent as shown in figure 4.

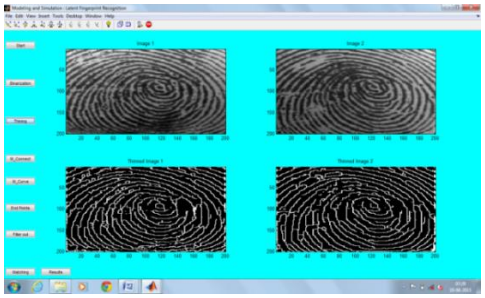

Fig. 4 Thinning Process

dilation of the thinned image

It is an important operation for morphology. It was first developed for binary images and later it was used for grey scale image also. Binary images are the part of Euclidean spaces. Dilation is also related to Minkowski addition. The dilation of P by Q is defined by:

$$P \oplus Q = \bigcup_{q \in Q} P_q$$

Where P_q is the translation of P by q.

Removing unwanted pixel

In the thinning process after we get the image there are some unwanted pixel which also creates the noise. So this is important to remove this unwanted pixel. For this we can set the pixel value. Suppose if we find at least 10 continuous pixels then we consider it and if it is less then 10 then it is discarded. The red portion of the figure 5 shows some of the unwanted portion of the image [13].

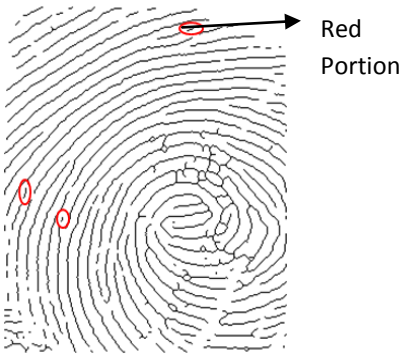

Fig. 5 Unwanted Pixels

False minutiae detection

False minutiae will significantly affect the accuracy of matching the fingerprints. Seven types of false minutia are specified as shown in figure 6 [14]. These minutiae are said to be false minutiae because:

- Minutia m1 is a pixel pointing into a bifurcation and end-point.
- In the m2 case a pixel falsely connects two ridges.
- Minutia m3 has two near bifurcations located in the same ridge.
- The two ridge broken points in the m4 case have nearly the same orientation and a short distance.
- Minutia m5 is alike the m4 case with the exception that one part of the broken ridge is so short that another termination is generated.
- Minutia m6 extends the m4 case but with the extra property that a third ridge is found in the middle of the two parts of the broken ridge.
- Minutia m7 has only one short ridge found in the threshold window.

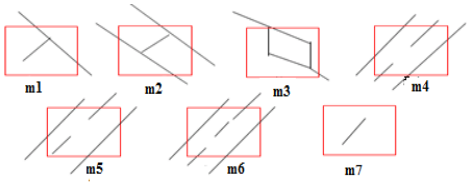

Fig. 6 False Minutiae

Matching

In this stage first we create a rectangular box of minutiae and match with the database image. We need two set of minutiae first for input image and second for output image. This box moving throughout the Region of Interest (ROI) [16] image for matching the entire fingerprint till our goal is achieved. If the matching result is more than the threshold value we say that the input and output image is same. The matched score is calculated by the given formula:

$$Matched\ Score = \frac{Match\ Minutiae}{Total\ Number\ of\ Minutia\ in\ M1\ and\ M2}$$

Where M1 is minutia of input fingerprint and M2 is minutia of test data i.e. stored in database.

Conclusion

Latent fingerprint recognition system is one of the best proposed methods for reducing the number of crime in any field. After collecting the fingerprints as a clue we can first enhance these fingerprints so that we found the better result when we match it with the database fingerprints. Latent fingerprints are of not so good quality, it can be broken curves types error. By enhancing the image quality we can also eliminate the false minutiae set in the image. After taking these steps finalize the matching process will be happen.

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