FLASE MINUTIA REMOVAL IN FINGERPRINT RECOGINITION USING IDENTIFICATION CASES

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***Abstract*— Fingerprint recognition is defined as the authentication of user after confirming the results of matching of its fingerprint prints. It is most successful technique for human being identification which provides highly accurate results. This paper presents an analysis on fingerprint recognition which uses false minutia removal techniques to evaluate Minutiae extracted from a fingerprint. The false minutia removal technique is quite frequently used in various fingerprint recognition systems and techniques. This approach mainly involves extraction of unique identification points called minutiae points from the captured fingerprint images and then performing 7 cases for fake minutiae detection. The spurious minutia are removed by identifying the false percept minutia at the extraction stage**

***Index Terms*— Fingerprint Extraction, Authentication, False Minutia Removal, Minutiae, Biometric, Fingerprint Recognition**

I. INTRODUCTION

Fingerprint recognition refers to the automatic method of identifying and verifying a match between two human beings[1]. In biometric system iris and fingerprint technologies are widely used system as these two modalities are most reliable and possess uniqueness[5]. Identification of fingerprint is most popular due to its unique characteristics which are used in application for identification of person. Fingerprint classification is the process of dividing a large amount of fingerprint database in which the input fingerprint is first determined and then a classification is carried out to observe the set of same class[6]. A database usually contains a number of fingerprints with different number of individual features. The identification of input fingerprint within this database becomes an extremely long process. Therefore classification of fingerprint can help to increase the speed of identification. The input fingerprint is classified among the set of classes of fingerprint database. Thus each fingerprint is only need to match against the corresponding class contained in database.

II. WHAT IS FINGERPRINT?

A fingerprint is the feature pattern of one finger (Figure 1.1). It is a pattern of the ridges and furrows on a finger [2]. These ridges and furrows form various layouts which makes a fingerprint different from the other.

Figure 1.1 Fingerprint image

Usually, Fingerprints are distinguished by the particular unique points formed by combinations of ridges and furrows, called Minutia [8]. (Figure 1.2). There are different types of minutia like ridge rend, bifurcation, core, delta, island among which two that are mostly significant are: Ridge End and Ridge bifurcation [3].

Figure 1.2 Types of Minutiae

III. WHAT IS FINGERPRINT RECOGNITION?

Fingerprint recognition is the process of matching two fingerprint patterns for possible similarity. It is processed under two sub-domains: Fingerprint Verification and Fingerprint Identification [2] (Figure 1.3).

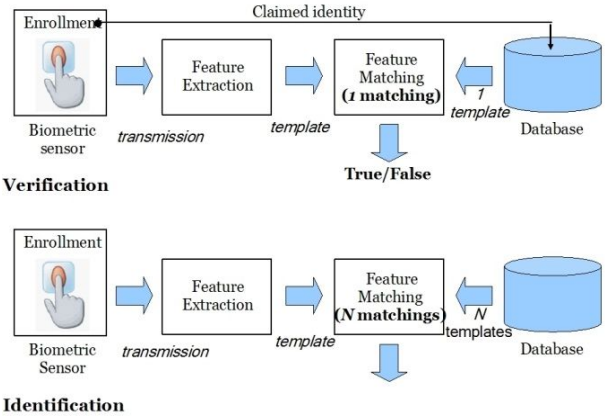

Figure 1.3 Verification vs. Identification

Manuscript received May 18, 2015

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IV. FINGERPRINT MATCHING TECHNIQUES

There are 3 main types of fingerprint matching techniques:

- Correlation-based matching: Two fingerprint images are superimposed and the correlation between corresponding pixels is computed for different alignments (e.g. Various displacements and rotations).
- Minutiae-based matching: Unique points called Minutiae are extracted from the two fingerprints and stored as sets of points in the two- dimensional plane. This type of matching generally consists of finding the similarities between the template and the input minutiae [11].
- Pattern-based (or image-based) matching: Pattern based algorithms compare the basic fingerprint patterns (arch, whorl, and loop) between a previously stored template and a candidate fingerprint. The template contains the type, size, and orientation of patterns within the aligned fingerprint image. The candidate fingerprint image is graphically compared with the template to determine the degree to which they match.

V. MINUTIAE DETECTION STEP

Minutiae Extraction

Minutiae extraction process includes image enhancement, image segmentation and false minutiae removal [10, 12]. This paper concentrates on the details of false minutiae removal techniques.

VI. FALSE MINUTIAE REMOVAL

At this stage false ridge breaks due to insufficient amount of ink & ridge cross connections due to over inking are not totally eliminated [15]. Also some of the earlier methods introduce some spurious minutia points in the image. So to keep the recognition system consistent these false minutiae need to be removed.

Here we first calculate the inter ridge distance D which is the average distance between two neighbouring ridges. For this scan each row to calculate the inter ridge distance using the formula:

$$\text{Inter ridge distance} = \frac{sum\ all\ pixels\ with\ value\ 1}{row\ length}$$

Finally an averaged value over all rows gives D.

All we label all thinned ridges in the fingerprint image with a unique ID for further operation using a MATLAB morphological operation BWLABEL.

Now the following 7 types of false minutia points are removed using these steps (Figure 3.13).

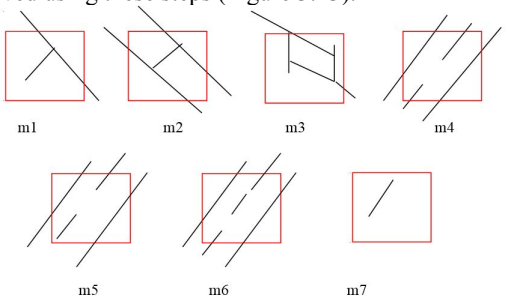

Figure 3.13 False Minutiae removal techniques

If d(bifurcation, termination) < D & the 2 minutia are in the same ridge then remove both of them (case m1) [4]

If d(bifurcation, bifurcation) < D & the 2 minutia are in the same ridge them remove both of them (case m2, m3) [4]

If d(termination, termination) ≈ D & the their directions are coincident with a small angle variation & no any other termination is located between the two terminations then remove both of them (case m4, m5, m6) [4]

If d(termination, termination) < D & the 2 minutia are in the same ridge then remove both of them (case m7) where d(X, Y) is the distance between 2 minutia points.

All the 7 cases are matched for presence and detection of the false minutia. Also it takes a lot of time at the real minutia extraction stage and the fingerprint matching stage.

VII. MINUTIAE MATCHING

After successfully extracting the set of minutia points of 2 fingerprint images to be tested, Minutia Matching is performed to check the similarity between them.

VIII. RESULTS

Two parameters are used for the fingerprint matching [7, 9]:

False Rejection Rate (FRR): For an image database, each sample is matched against the remaining samples of the same finger to compute the False Rejection Rate.

False Acceptance Rate (FAR): Also the first sample of each finger in the database is matched against the first sample of the remaining fingers to compute the False Acceptance Rate.

CONCLUSION

The above study is an effort to analyse and understand how fingerprints are matched after removing of the false minutiae to recognize identities of human beings. It includes the study of all the 7 cases of false minutiae removal after detection. Various standard techniques are used in the intermediate stages of processing. Detection of possible false minutiae indicates that the technique can be further extended which gives better results.

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