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Minutia based Verification Technique for Fingerprint – A Evaluation Text

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Abstract: This paper presents a review on different approaches of Minutiae based verification techniques for fingerprint. In Minutiae matching technique we have an input or a template fingerprint image, then minutiae are extracted first. After that by applying certain techniques like using metric, minutiae extraction, edge enhancement, matching method based on partial fingerprints, using minutiae score matching, minutiae-based template synthesis etc.As information technologies have advanced greatly in the last few decades, the security problem within a network creates a major problem. For solving this, biometric identification techniques have been given considerable attention. Fingerprint-related techniques, due to their desirable properties, e.g., universality, uniqueness, permanence, perpetuity, collectability, performance, acceptability and particularity, are most widely applied and documented. A minutia matching is widely used for fingerprint recognition and verification. By this review paper we want to compare between various techniques based on minutiae and checks the effectiveness of accuracy fingerprint verification.

Keywords: Fingerprint verification, Minutiae based technique, correlation based technique. Minutiae extraction, minutiae score matching, minutiae-based template synthesis.

I. INTRODAUCTION

BIOMETRICS; are automated methods of recognizing an individual based on their physiological (e.g., fingerprints, face, retina, iris) or behavioral characteristics (e.g., gait, signature). Each biometric has its strengths and weaknesses and the choice typically depends on the application. No single biometric is expected to effectively meet the requirements of all the applications. Fingerprint recognition has a very good balance of all the properties. A number of biometric characteristics are being used in various applications as Universality, Uniqueness, Permanence, Measurability, Performance, Acceptability, and Circumvention [1].

Fingerprint matching is one of the most popular and reliable biometric techniques used in automatic personal identification. There are two main applications involving fingerprints: fingerprint verification and fingerprint identification. While the goal of fingerprint verification is to verify the identity of a person, the goal of fingerprint identification is to establish the identity of a person. Specifically, fingerprint identification involves matching a query fingerprint against a fingerprint database to establish the identity for an individual. The approaches to fingerprint matching can be coarsely classified into three classes: [2]

a. Correlation-based matching.
b. Minutiae-based matching
c. •Ridge-feature-based matching.

II. MINUTIA

A fingerprint is made of a number of ridges and valleys on the surface of the finger. Ridges are the upper skin layer segments of the finger and valleys are the lower segments. The ridges form so-called minutia points: ridge Ease of Use endings (where a ridge end) and ridge bifurcations (where a ridge splits in two). Many types of minutiae exist, including dots (very small ridges), islands (ridges slightly longer than dots, occupying a middle space between two temporarily divergent ridges), ponds or lakes (empty spaces between two temporarily divergent ridges), spurs (a notch protruding from a ridge), bridges (small ridges joining two longer adjacent ridges), and crossovers (two ridges which cross each other).The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as the minutiae points. There are five basic fingerprint patterns: arch, tented arch, left loop, right loop and whorl. Loops make up 60% of all fingerprints, whorls account for 30%, and arches for 10%.Fingerprints are usually considered to be unique, with no two fingers having the exact same dermal ridge characteristics. [3]

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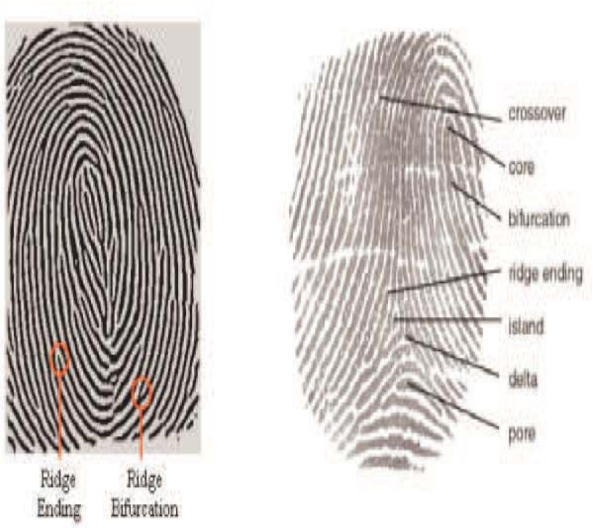

Figure 1: Fingerprint images

III. HOW DOES IT WORK?

There are two main algorithm families to recognize fingerprints:

Minutia matching compares specific details within the fingerprint ridges. At registration (also called enrollment), the minutia points are located, together with their relative positions to each other and their directions. At the matching stage, the fingerprint image is processed to extract its minutia points, which are then compared with the registered template.

Pattern matching compares the overall characteristics of the fingerprints, not only individual points. Fingerprint characteristics can include sub-areas of certain interest including ridge thickness, curvature, or density. During enrollment, small sections of the fingerprint and their relative distances are extracted from the fingerprint. Areas of interest are the area around a minutia point, areas with low curvature radius, and areas with unusual combinations of ridges. [4]

IV. MINUTIA FEATURES

Minutiae are major features of a fingerprint, using which comparisons of one print with another can be made. Minutiae include:

a. Ridge ending - the abrupt end of a ridge
b. Ridge bifurcation - a single ridge that divides into two ridges
c. Short ridge, or independent ridge - a ridge that commences, travels a short distance and then ends
d. Island - a single small ridge inside a short ridge or ridge ending that is not connected to all other ridges
e. Ridge enclosure - a single ridge that bifurcates and reunites shortly afterward to continue as a single ridge
f. Spur - a bifurcation with a short ridge branching off a longer ridge
g. Crossover or bridge - a short ridge that runs between two parallel ridges
h. Delta - a Y-shaped ridge meeting
i. Core - a U-turn in the ridge pattern

V. DIFFERENT APPROACHES OF MINUTIAE BASED VERIFICATION TECHNIQUES FOR FINGERPRINT

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

A. Minutiae Extraction Technique:

Most of the finger-scan technologies are based on Minutiae. Minutia-based techniques represent the fingerprint by its local features, like terminations and bifurcations. [5].

Minutiae Extraction steps are explained below

a. Fingerprint Ridge Thinning:

Thinning is the process of reducing the thickness of each line of patterns to just a single pixel width [6, 8]. The requirements of a good thinning algorithm with respect to a fingerprint are

a) The thinned fingerprint image obtained should be of single pixel width with no discontinuities.
b) Each ridge should be thinned to its centre pixel.
c) Noise and singular pixels should be eliminated.
d) No further removal of pixels should be possible after completion of thinning process. [9]

b. Enhanced Thinning:

Ridge Thinning is to eliminate the redundant pixels of ridges till the ridges are just one pixel wide. Ideally, the width of the skeleton should be strictly one pixel.

c. Minutia Marking:

After the fingerprint ridge thinning, marking minutia points is the next important step. As the number of minutiae detected is more the probability of accurate result increases.

d. Minutia Post processing:

a) False Minutia Removal
b) Minutia Match

e. Using Metrics:

This method use a binarization and thinning based minutia detection procedure. Then, a mathematical models for fingerprint feature extraction, fingerprint feature vector supervised classification and fingerprint verification is developed. After that a new special metric

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for computing the distance between fingerprint feature vectors and demonstrate its distance function properties is created. [10]

B. Minutiae-based template synthesis:

It's a new, minutiae-based, template synthesis approach which employs a novel hierarchical matching strategy to combine a number of enrolment minutiae feature sets into a super-template. Assuming that each finger is represented by multiple enrollment impressions, the key objective of our approach is merging the feature sets of each finger into a super-template to improve the quality of features used, reduce space requirements, and improve speed. To build a super-template from a number of enrollment feature sets, one of the enrollment templates is selected first to initialize the super-template. Then, the remaining enrollment feature sets are aligned and merged with the super-template on an incremental basis. Minutiae in the super-template are assigned a weight based on the frequency of their occurrence in the enrollment feature sets. These weights serve as a quality measure of the minutiae. To merge an enrollment feature sets with the super-template, we search for minutiae correspondences between the enrollment template and the super-template using a hierarchical matching algorithm. [11-13]

C. Image enhancement:

In this approach a fingerprint image enhancement method based on orientation field and introduced a minutiae matching algorithm, which is superior to the previously reported in (Jain et al., 1997), in which minutiae matching was done by point pattern matching in the polar coordinate system. In this method, simpler but more effective alignment is used where ridge information is introduced into the matching process apart from a variable sized bounding box in the matching process. These modifications make this method more robust to non-linear deformations between two fingerprint images. This approach show that fingerprint images can be well matched using the minutiae matching method. But some fingerprint images of bad quality exist as well as unclear ridge structures that could not be matched by minutiae matching. The problem lies in the fact that in such images it is very difficult to extract minutiae correctly. [14-16]

VI. CONCLUSION

This paper review gives brief knowledge about different approaches of Minutiae based verification techniques for fingerprint. System performance and accuracy is primarily determined by two parameters – FAR and FRR [17]. A genuine individual could be mistakenly recognized as an imposter. This scenario is referred to as "false reject" and the corresponding error rate is called the false reject rate (FRR); an imposter could be also mistakenly recognized as genuine. This scenario is referred to as "false accept" and the corresponding error rate is called the false accept rate (FAR). FAR and FRR are widely used measurements in today's commercial environment.

Each approach has its own merits. Due improved thinning in minutiae extraction technique:

a) The image becomes perfectly thinned to single pixel width.
b) More number of bifurcations can be detected, which were missed earlier due to the presence of erroneous pixels in the thinned image.
c) Probability of getting refined image free of erroneous minutiae will be more. [18]

Fingerprint Image enhancement, Minutiae-based template synthesis, and use of METRIC gives more robust and fast identification method for verification. Value of FAR and FRR is also maintained.

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