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REVIEW ON: FINGERPRINT RECOGNITION USING MINUTIAE EXTRACTOR

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Abstract: Fingerprint Recognition or fingerprint authentication refers to the automated methods of verifying a match between two human fingerprints. Fingerprints are the oldest and most widely used form of biometric identification. Everyone is known to have unique, immutable fingerprints. Fingerprints are widely used in daily life for more than 100 years due to its feasibility, distinctiveness, permanence, accuracy, reliability, and acceptability large number of approaches to fingerprint matching and various algorithm and methods are behind their matching procedure, Example of these matching are correlation matching ,Minutiae Based matching and pattern based matching. In this seminar we projected Fingerprint Recognition using Minutia Score matching method.

Keywords: Biometric authentication, Fingerprint recognition, Minutiae matching, Correlation Matching, Pattern Matching.

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INTRODUCTION

Fingerprints have been scientifically studied for a number of years in our society. The characteristics of fingerprints were studied as early as the 1600s. In 1684, the English plant morphologist, Nehemiah Grew, published the first scientific paper reporting his systematic study on the ridge, furrow, and pore structure. In 1788, a detailed description of the anatomical formations of fingerprints was made by Mayer. In 1823, Purkinji proposed the first fingerprint classification, which classified into nine categories. Sir Francis Galton introduced the minutiae features for fingerprint matching in late 19th century. [1]

Fingerprint recognition or fingerprint authentication refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of many forms of biometrics used to identify an individual and verify their identity. Because of their uniqueness and consistency over time, fingerprints have been used for over a century, more recently becoming automated (i.e. biometric) due to advancement in computing capabilities. Fingerprint identification is popular because of the inherent ease in acquisition, the numerous sources (ten fingers) available for collection, and their established use and collections by law enforcement and immigration. [1]

2. LITERATURE REVIEW

1. Deepak Kumar Karna et al. [5] proposed normalized cross-correlation based fingerprint matching. To perform fingerprint matching based on the number of corresponding minutia pairings, has been in use for quite some time. But this technique is not very efficient for recognizing the low quality fingerprints. To overcome this problem, some researchers suggest the correlation technique which provides better result. Use of correlation-based methods is increasing day-by-day in the field of biometrics as it provides better results. In this paper, they propose normalized cross-correlation technique for fingerprint matching to minimize error rate as well as reduce the computational effort than the minutiae matching method.

2. Ratha et al [6] proposed a minutiae extraction algorithm in which the flow direction of ridges is computed by viewing the fingerprint image as a directional textured image. A ridge segmentation algorithm based on a waveform projection is then used to accurately locate the ridges and a thinned ridge image is obtained and smoothed using morphological operators. Finally the minutiae are extracted from the thinned ridges based on the number of crossings and a post processing step applied to remove spurious minutiae.

3. Manvjeet Kaur et al. [9] proposed a fingerprint verification system using minutiae extraction technique. Most fingerprint recognition techniques are based on minutiae matching and have been well studied. However, this technology still suffers from problems associated with the handling of poor quality impressions. One problem besetting fingerprint matching is distortion. Distortion changes both geometric position and orientation, and leads to difficulties in establishing a match among multiple impressions acquired from the same finger tip. Marking all the minutiae accurately as well as rejecting false minutiae is another issue still under research. Our work has combined many methods to build a minutia extractor and a minutia matcher.

4. Barua et al.(2010) [7]defines the fingerprint identification is one of the most popular and reliable personal biometric identification methods. this paper describes an on-line fingerprint identification system consisting of image acquisirtion, edge detection, thinning, feature extractor and classifier. The pre-processing part includes steps to acquire binarized and skeletonzed ridges, which are needed for feature point extraction. Feature points (minutia) such as endpoints, bifurcations, and core point are then extracted, followed by false minutia elimination. Human fingerprints are rich in details called minutiae, which can be used as identification marks for fingerprint verification.

The goal of this project is to develop a complete system for fingerprint identification.

5. Drahansky et al.(2012)[8]: Has studied that many people who suffer from some of the skin diseases. These diseases have a strong influence on the process of fingerprint recognition. People with fingerprint diseases are unable to use fingerprint scanners, which is discriminating for them, since they are not allowed to use their fingerprints for the authentication purposes. First in this the various diseases, which might influence functionality of the fingerprint based systems, are introduced, mainly from the medical point of view. This overview is followed by some examples of diseased finger fingerprints, acquired both from dactyloscopic card and electronic sensors.

6. Modi et al. (2007) [10] introduce the increasing use of automated fingerprint recognition puts on it a challenge of processing of diverse range of fingerprints. The quality control module is important to this process.

3. PROPOSED WORK

3.1. FINGERPRINT FEATURE EXTRACTION

Fingerprint pattern exhibits different types of fingerprint features:

- Level 1 (Global Level): When the ridges are parallel. They are classified as loop, delta, and whorl are shown in Figure.

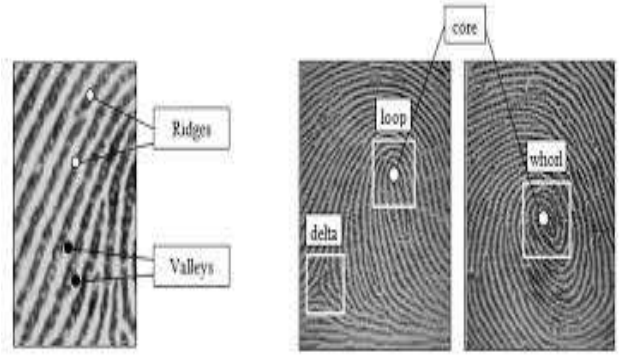

Figure 1.1 Delta, loop, whorl

- Level 2 (Local Level): It is based on minutiae in which the ridges are discontinuous. They are classified as ridge ending, ridge bifurcation, lake, independent ridge, point or island, spur, crossover Independent ridge, Point or Island, Spur, Crossover are shown in Figure 3.2

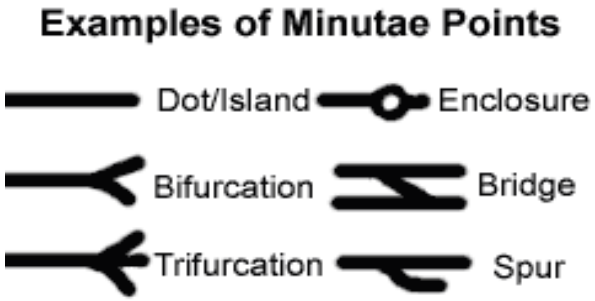

Figure 1.2Ridge ending, Bifurcation, Lake

- Level 3 (Very Fine Level): Intra ridge details are detected. Sweat pores are considered at this level.

3.2 FINGERPRINT MATCHING TECHNIQUES

The large number of approaches to fingerprint matching can be coarsely classified into three families.

1. **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).

2. **Minutiae-based matching**: This is the most popular and widely used technique, being the basis of the fingerprint comparison made by fingerprint examiners. Minutiae are extracted from the two fingerprints and stored as sets of points in the two- dimensional plane. Minutiae-based matching essentially consists of finding the alignment between the template and the input minutiae sets that results in the maximum number of minutiae pairings.

3. **Pattern-based (or image-based) matching**: Pattern based algorithms compare the basic fingerprint patterns (arch, whorl, & loop) between a previously stored template and a candidate fingerprint. This requires that the images be aligned in the same orientation. To do this, the algorithm finds a central point in the fingerprint image and centers on that. In a pattern-based algorithm, 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.

In Our project we have implemented a minutiae based matching technique. This approach has been intensively studied, also is the backbone of the current available fingerprint recognition products.

3.3 METHODOLOGY

We have concentrated our implementation on Minutiae based method. In particular we are interested only in two of the most important minutia features i.e. Ridge Ending and Ridge bifurcation.

The outline of our approach can be broadly classified into 2 stages - Minutiae Extraction and Minutiae matching. Figure 3.3 illustrates the flow diagram of the same.

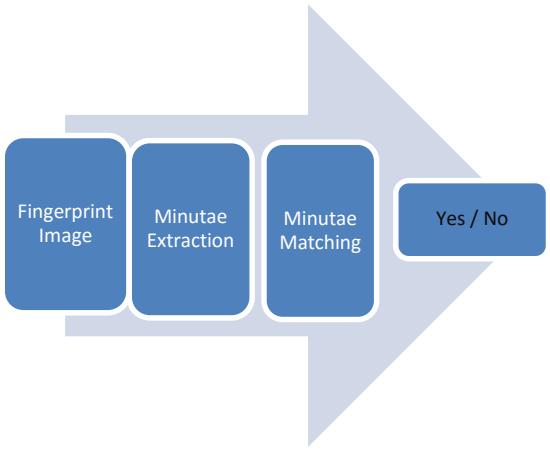

Figure 3.1 System Flow Diagram

The system takes in 2 input fingerprints to be matched and gives a percentage score of the extent of match between the two. Based on the score and threshold match value it can distinguish whether the two fingerprints match or not. Minutia Extraction includes Image Enhancement, Image Segmentation, and Final Extraction processes include minutiae alignment &Match Processes.

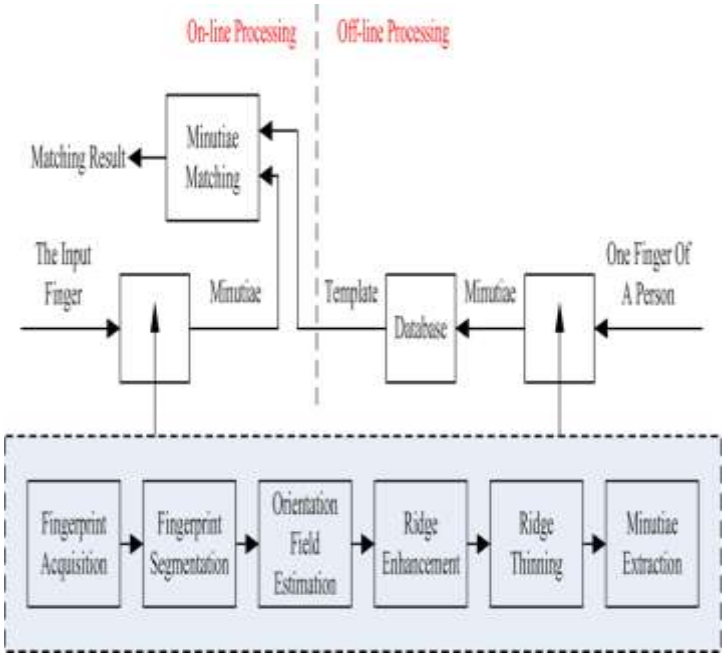

Figure 3.2 Implementation Procedure

3.4 MINUTIAE EXTRACTOR

As described earlier the Minutiae extraction process includes image enhancement, image segmentation and final Minutiae extraction. As shown in flowchart.

•Thinning •Minutiae Marking •Remove False Minutiae Minutia extraction Preprocessing •Image Segmentation •Image Enhancement •Image Binarization Post-processing

Flowchart in explains the minutiae extraction process from the fingerprint. In the first stage Image maps are generated from the input fingerprint. The quality maps indicate internal quality of the fingerprint. The values 0-4 mark different conditions (low contrast, high contrast, high curvature, low ridge flow) within the fingerprint [3].

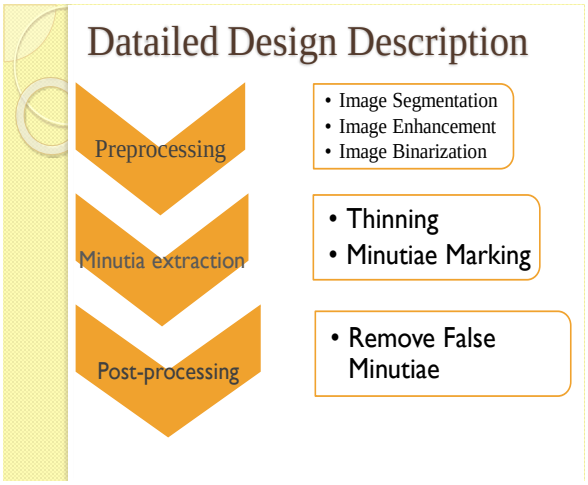

Figure 3.3 Detailed Design Description

Flowchart in explains the minutiae extraction process from the fingerprint. In the first stage Image maps are generated from the input fingerprint. The quality maps indicate internal quality of the fingerprint. The values 0-4 mark different conditions (low contrast, high contrast, high curvature, low ridge flow) within the fingerprint.

These values help in removing the false minutiae from the fingerprint. In the second stage image binarization is performed and the minutiae are detected from the binarized fingerprint image. Removal of false minutiae from the fingerprint is based on the quality factor. After removing false minutiae the minutiae which are left are known as real minutiae.

3.4 MINUTIAE MATCH

After successfully extracting the set of minutia points of 2 fingerprint images to be tested, we perform Minutiae Matching to check whether they belong to the same person or not.

We use an iterative ridge alignment algorithm to first align one set of minutiae w.r.t other set and then carry-out an elastic match algorithm to count the number of matched minutia pairs.

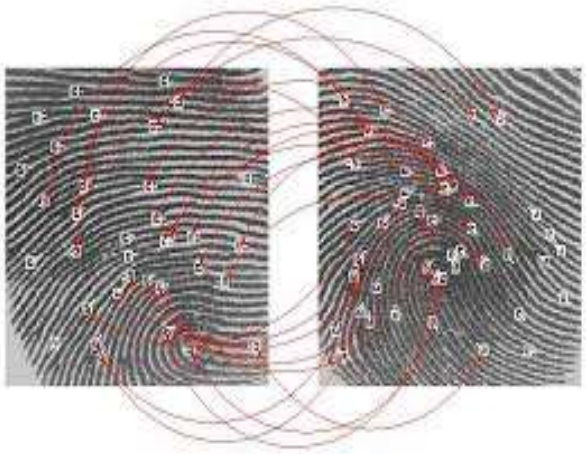

Figure 3.4 Minutiae match

4. CONCLUSION

The above implementation was an effort to understand how Fingerprint Recognition is used as a form of biometric to recognize identities of human beings. It includes all the stages from minutiae extraction from fingerprints to minutiae matching which generates a match score. Various standard techniques are used in the intermediate stages of processing.

The relatively low percentage of verification rate as compared to other forms of biometrics indicates that the algorithm used is not very robust and is vulnerable to effects like scaling and elastic deformations. Various new techniques and algorithm have been found out which give better results.

Also a major challenge in Fingerprint recognition lies in the pre processing of the bad quality of fingerprint images which also add to the low verification rate.

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