A SURVEY ON FINGERPRINT RECOGNITION SYSTEM

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Abstract:

Fingerprints have been widely accepted throughout the world and is considered to be the most prominent biometric. Several robust techniques have been developed for fingerprint matching and identification. This paper discusses some state-of-the-art techniques of fingerprint identification or recognition using pattern matching. In The paper we are showing classifies the recognition techniques based on ridge lines and minutiae points. All fingerprint identification using pattern matching technique can be divided into the encoding phase which is to map the fingerprint to the pattern and then matching the input pattern with the template pattern.

Key Words: Image processing, minutia points, identification, recognition, pattern matching.

I. INTRODUCTION

A fingerprint is the feature pattern of one finger (Figure 1). It is believed with strong evidences that each fingerprint is unique. Each person has his own fingerprints with the permanent uniqueness. So fingerprints have being used for identification and forensic investigation for a long time.

Figure 1

A fingerprint is composed of many ridges and furrows. These ridges and furrows present good similarities in each small local window, like parallelism and average width.

However, shown by intensive research on fingerprint recognition, fingerprints are not distinguished by their ridges and furrows, but by Minutia, which are some abnormal points on the ridges (Figure 2). Among the variety of minutia types reported in literatures, two are mostly 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.

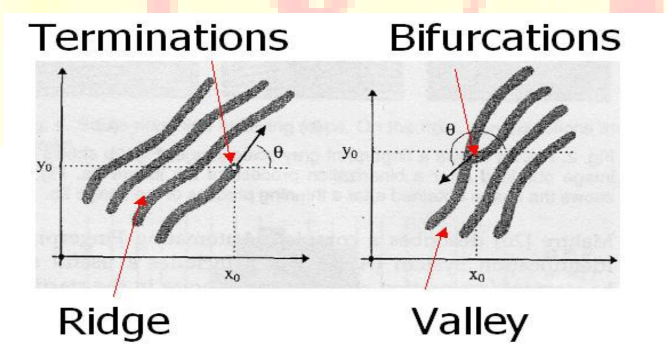

Figure 2

II. FINGERPRINT RECOGNITION

The fingerprint recognition problem can be grouped into two sub-domains: one is fingerprint verification and the other is fingerprint identification (Figure 3). In addition, different from the manual approach for fingerprint recognition by experts, the fingerprint recognition here is referred as AFRS (Automatic Fingerprint Recognition System), which is program-based.

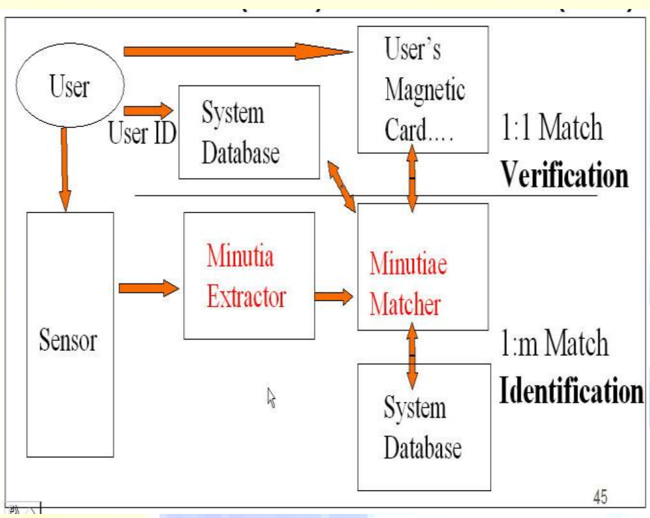

Figure 3 Verification vs. Identification

Fingerprint verification is to verify the authenticity of one person by his fingerprint. The user provides his fingerprint together with his identity information like his ID number. The fingerprint verification system retrieves the fingerprint template according to the ID number and matches the template with the real-time acquired fingerprint from the user. Usually it is the underlying design principle of AFAS (Automatic Fingerprint Authentication System).

Fingerprint identification is to specify one person's identity by his fingerprint. Without knowledge of the person's identity, the fingerprint identification system tries to match his fingerprint with those in the whole fingerprint database. It is especially useful for criminal investigation cases. And it is the design principle of AFIS (Automatic Fingerprint Identification System).

However, all fingerprint recognition problems, either verification or identification, are ultimately based on a well-defined representation of a fingerprint. As long as the representation of fingerprints remains the uniqueness and keeps simple, the fingerprint matching, either for the 1-to-1 verification case or 1-to-m identification case, is straightforward and easy.

III. FINGERPRINT CLASSIFICATION

Fingerprint classification refers to the problem of assigning a fingerprint to a class in a consistent and reliable way. Although fingerprint matching is usually performed according to local features (e.g., minutiae), fingerprint classification is generally based on global features, such as global ridge structure and singularities. Fingerprints are classified into nine categories (transverse curve, central longitudinal stria, oblique stripe, oblique loop, almond whorl, spiral whorl, ellipse, circle, and double whorl) according to the global ridge configurations. Francis Galton divided the fingerprints into three major classes (arch, loop, and whorl) and further divided each category into subcategories . Juan Vucetich, an Argentine police official, developed a different system of classification; the Vucetich classification system is still used in many Spanish-speaking countries. Ten years later, Edward Henry refined Galton's classification by increasing the number of classes the Galton Henry classification scheme was adopted in several countries: in fact, most of the classification schemes currently used by law enforcement agencies worldwide are variants of the Galton−Henry classification scheme. Figure 4 shows the five most common classes of the Galton−Henry classification scheme (*arch*, *tented arch*, *left loop*, *right loop*, and *whorl*):

• An arch fingerprint has ridges that enter from one side, rise to a small bump, and go out the opposite side from which they entered. Arches do not have loops or deltas.

• A tented arch fingerprint is similar to the (plain) arch, except that at least one ridge exhibits a high curvature and one loop and one delta are present.

• A loop fingerprint has one or more ridges that enter from one side, curve back, and go out the same side they entered. A loop and a delta singularities are present; the delta is assumed to be south of the loop. Loops can be further subdivided: loops that have ridges that enter and leave from the left side are called left loops and loops that have ridges that enter and leave from the right side are called right loops.

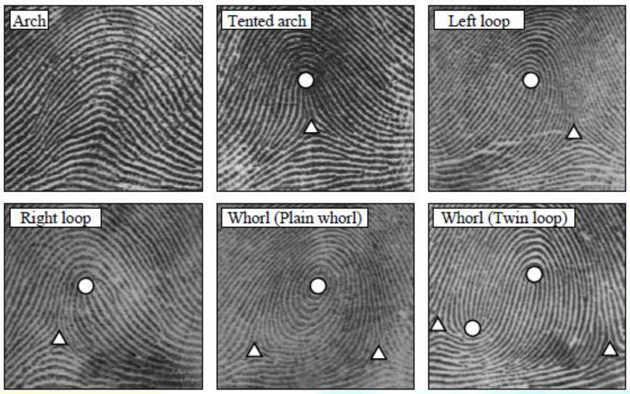

Figure 4

A whorl fingerprint contains at least one ridge that makes a complete 360° path around the center of the fingerprint. Two loops (or a whorl) and two deltas can be found in whorl fingerprints. The whorl class is quite complex and in some classification schemes, it is further divided into two categories: twin loop (or double loop).

IV. PREVIOUS MATCHING TECHNIQUES

A fingerprint matching algorithm compares two given fingerprints and returns either a degree of similarity (without loss of generality, a score between 0 and 1) or a binary decision (mated/non-mated). Only a few matching algorithms operate directly on grayscale fingerprint images; most of them require that an intermediate fingerprint representation be derived through a feature extraction stage. Without loss of generality, hereafter we denote the representation of the fingerprint acquired during enrollment as the template (T) and the representation of the fingerprint to be matched as the input (I). In case no feature extraction is performed, the fingerprint representation coincides with the grayscale fingerprint image itself; hence, throughout this chapter, we denote both raw fingerprint images and fingerprint feature vectors (e.g., minutiae) with T and I.

Fingerprint matching can be coarsely classified into three families.

Correlation-based matching: two fingerprint images are superimposed and the correlation between the corresponding pixels is computed for different alignments (e.g., various displacements and rotations).

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 feature sets that result in the maximum number of minutiae pairings.

Non-Minutiae feature-based matching: minutiae extraction is difficult in extremely low-quality fingerprint images. While some other features of the fingerprint ridge pattern (e.g., local orientation and frequency, ridge shape, texture information) may be extracted more reliably than minutiae, their distinctiveness as well as persistence is generally lower. The approaches belonging to this family compare fingerprints in term of features extracted from the ridge pattern. In principle, correlation-based matching could be conceived of as a subfamily of non-minutiae feature-based matching, inasmuch as the pixel intensity are themselves features of the finger pattern.

V. PROPOSED METHODOLOGY

Method Description:- My proposed work is combination of key points of three most fingerprint matching techniques. It is very useful method to find matching score in two fingerprint images. The three key points is being defined below.

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

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

Correlation:- In this section we find the pixels value of the two fingerprint images then check what two fingerprint images are superimposed also we compute the correlation between corresponding pixels.

Algorithm of the methodology:-

Step1). Get two query image from the user.

Step2). Morphologically create image for removing noise and small objects.

Step3). After step2 we improve the image intensity for better analysis.

Step4). Now we apply a threshold value by graythresh function for binary image.

Step5). In this step we use fusion method and get the data.

a) Calculate all minutia points.

b) Calculate the total number of Ridge ending and Ridge bifurcation

c) Calculate the total number of Y-shape Ridge.

d) Determine the pixels value of the image with position.

e) Compute the correlation between two corresponding images pixel.

f) Finally fusion the all above data.

Step6). Fusion method applies on two query fingerprint image for find matching on them. Also calculate matching score for comparison between proposed method and old method.

Step7). Show the result.

VI. CONCLUSION

In this paper, we have developed a hybrid method that is very effectively work on fingerprint images. It selects a pair of two fingerprint images then find the matching score between them. It reduces the deficiency of existing methods like minutia, ridge and correlation. This hybrid method gives better result than all the other individual method. In future we add some other concept like 2D cross correlation, shape descriptor and moment invariants with this approach and get a very good result for fingerprint matching.

It depends strongly on the quality and accuracy of the fingerprint image classification and matching which allow deciding if an image is similar.

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