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Mechanism of Fingerprint Conversion to Text

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Abstract— One of the important methods of identifying a person is fingerprint because it has several features like invariability, uniqueness and more. Nowadays, many databases hold fingerprint columns and these columns may be search based columns. Database may incur overload search on fingerprint columns which represent a bottleneck to the system. We proposed a method that convert the fingerprint to text which improves the performance of the system and many more other benefits. Fingerprint image is converted to text which is smaller in size that helps in processing as well as storage space. Smaller size of data also is better in transmission over network. In the term of data encryption, text encryption is easier and has less time complexity than of images.

Keywords— Fingerprint Conversion, Fingerprint Presentation, Minutiae Point, Database Performance.

I. INTRODUCTION

The use of unique physiological features of human is identified as Biometric recognition. This includes fingerprints, retina, face and iris. Fingerprint has additional features than of the others have. It is adapted in worldwide governments for more than a century to give accurate identification of criminals. It is the first professional certification program for forensic scientists and it is considered as inexpensive for solving crimes.

A. Methods of fingerprint matching:

In matching process, we use an algorithm to compare two given fingerprints and show results as either a degree of similarity or binary decision (Matched /Not matched).Till this moment, many algorithms have been proposed. These algorithms can be categorized to three families:

Correlation Based Matching: In this category, the two fingerprint images are setup and the correlation of corresponding pixels is computed for the difference of alignments.

Minutiae Based Matching: It is the most widely popular and used category. This kind of algorithm extract the minutiae from the tow fingerprint images and then compare them.

Ridge Feature Based Matching: This category compare fingerprints in term of features which is extracted from the ridge pattern in fingerprint image. Algorithms of this family is very useful when it is difficult to extract minutiae in very low quality fingerprint images. So minutiae Based category may not be very useful in this case.

B. Minutiae Based Matching:

A fingerprint is defined by its uniqueness of the local ridge characteristics and the relationships between them. Of these local ridge characteristics, we can extract what is called Minutiae points. There are several kinds of Minutiae points for example, a ridge ending is defined as the point that has abrupt end. The point where the ridge splits into two or more branches is called ridge bifurcation.

C. Fingerprint Classification and Indexing:

In fingerprint system, we have two terms, verification and identification. Verification means search 1:1 to make sure whether the input matches a specified stored template but, identification has to search to the entire rows to find the matched record. The last search process consumes a lot of system resources because it has to go through the entire rows. In order to reduce search time and computational complexity, fingerprint templates are pre-categorized to subclasses. Henry classification system and its variants are most adopted in many systems. According to Henry classifications, fingerprint is classified to six basic classes (Arch, Tented, Arch, Left loop, Right loop, and Whorl) [5].

Loop fingerprint: this class has one or more ridges that enter from one side, turn back, and go out the same side they came from as shown in figure [1.A, B].

Whorl fingerprint: it has some of the ridges make a turn through at least one circuit. Any fingerprint pattern which contains 2 or more deltas will be a whorl pattern as shown in figure [1.C].

Arch fingerprint: in arch fingerprint, ridges flow in one side and flow out the opposite side as shown in figure [1.D].

Tented fingerprint: this pattern is arch pattern but horizontal ridges rising up high in the middle, creating a tent-like pattern as shown in figure [1.E].

D. Fingerprint minutiae point matching process:

Fingerprint image goes through several steps to enhance minutiae point extraction and finally the ability to search matching of that image. Those processes are as following:

- Estimation of local ridge Frequency.
- Segmentation which is generally the separation of fingerprint area from the image background. This is useful to avoid extraction of features in noisy areas in the fingerprint.
- Singularity and Core Detection.
- Enhancement to the following problem.
  - Ridges are not strictly continuous
  - Parallel ridges are not well separated.

    Cuts, creases, and bruises.

    And this leads to segmentation into three categories:
    - Well-defined region.
    - Recoverable region.
    - Unrecoverable region.
- Minutiae Detection

E. Processing Fingerprint image to Text:

A variety of minutiae points can be extracted form fingerprint image to form a fingerprint in terms of fridge bifurcations, ridge endings, ridge crossovers, and islands or small ridges. Minutiae points are recognized by their coordinates (X,Y) in fingerprint image. Here, are the steps to identify the minutiae points and then convert them to a text.

1) Segmentation

It is the first step of in fingerprint enhancement process. Segmentation process means to separate the foreground regions in the fingerprint image from its background. This step results in the extraction of noisy and false minutiae.

2) Normalization

Normalization means to standardize the intensity values in an image by adjusting the range of grey level values within a desired range of values.

3) Orientation Estimation

This step defines the local orientation of the ridges contained in the image in order to enhance the fingerprint image. To compute the orientation of the image, the least mean square estimation method is used.

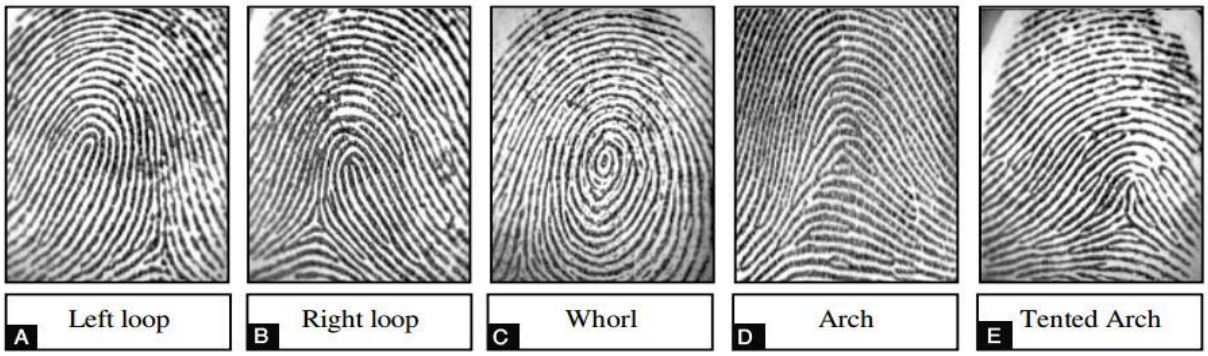

Figure [1] fingerprint sample from each of the five major classes

4) Ridge Frequency Estimation

The frequency image represents the local frequency of the ridges found in the fingerprint image where image is divided into blocks of size W*W. Then, project the grey level values of all pixels located in each block along a direction orthogonal to the local ridge orientation.

5) Gabor Filtering

A Gabor filter is a linear filter used to analyze texture, whether there are any specific frequency content in the image in specific directions in a localized region around the region of analysis.

6) Binarization and Thinning Process

The Easiest way in this process is to use a specific threshold t and then setting the pixels whose gray-level is lower than t to 0 and the remaining pixels to 1. Sometimes, especially if normalization is not included, using single and global threshold is not enough to get a correct binarization so, local threshold method is used that can change t according to the average local intensity. In thinning process, an algorithm, like algorithm proposed by Guo, is used to reduce the width of the ridges to one pixel.

II. RELATED WORK

A new scheme is proposed to eliminate duplicate data before users' encryption operation that can reduce computation overheads [1]. This scheme is a secure de-duplication by Haonan Su, Dong Zheng, and Hinghui Zhang. It realizes variable-size block-level de-duplication based on the technique of Rabin fingerprinting. It blocks file by using the Rabin fingerprinting that supports various changes.

Wahid Zafar, Tasweer Ahmad, and Muhammad Hassan [2] developed a combination of different techniques for an automatic fingerprint system. The development includes MATLAB GUI to check the performance of a practical system. The precision in marking minutia during the process of minutia marking is the core point in this system. This algorithm can be improved by including robust search algorithm and by using high quality scanner.

In this paper [3], some steps are taken to overcome the finger print database challenges. First, to standardize the process of capturing fingerprints by adhering to international standards such ones developed by ISO/IEC JTC 1/ SC 37 Biometrics. Second, to Convert multiple fingerprint databases into feature database to speed up data transfer and processing time of fingerprint recognition. Third, to replicate the PDRM-BIOFIS fingerprint database across the nation by having a copy in multiple cities.

A new presentation of an improved and enhanced fingerprint image is introduced by Ankita Mehta, and Sandeep Dhariwal [4]. Factors are taken into consideration like image quality, separation, image improvement, and feature detection. MATLAB is used to implement the proposed algorithm. There is a number of factors are detrimental to the correct location of minutia. Poor quality of image is the most serious one. So, many methods are combined to build a minutia extractor and a minutia matcher.

III. THE PROCESS OF FINGERPRINT CONVERSION TO TEXT

In minutiae extraction, we have to kinds of points that are ridge endings and bifurcations. An additional kind of minutiae point that is called island or short ridge, but it is not that much efficient. Extracting the points goes through processes that are segmentation, normalization, orientation estimation, ridge frequency estimation, Gabor filtering, binarization, and thinning as shown in figure [2].

Figure [2] fingerprint after processing.

The final step is location the minutiae on the fingerprint image. The process of fingerprint conversion to text is the same as the one of minutiae point extraction with one additional step. After positioning the minutiae points, we write the two main kinds of minutiae points, ridge endings and bifurcations. The second information is the position of that minutiae point in the form of (X, Y) pixel coordinates as shown in figure [3]. An obvious example of this process is the picture in figure 3 is converted to text { R((93,30)(62,35)(55,65)(86,87)(59,92)(136,112)(105,116)(26,122)(87,127)(124,192)(22,186)(149,197)(47,224)(32,245)(108,247))

Figure 3 fingerprint image after locating minutiae points

B((61,21)(55,30)(78,23)(64,47)(143,62)(35,66)(129,71)(112,77)(150,79)(38,91)(128,95)(148,121)(145,134)(139,148)(79,135)(46,176)(127,184)(140,199)(106,191)(52,206)(42,247)(128,240)(87,259)(15,269)(76,271)) }.

IV. RESULTS AND DISCUSSION

Size: the size of the text is much smaller than fingerprint template. A template of fingerprint can be ranged between 50 KB to hundreds of kilo bytes whereas text may at the maximum reaches to 2 KB. That means we need less space to store this data.

A. Better performance of Databases: because of small size, DBMS can deal with text with better throughput than of images.

B. Network: less network overload because of the process of sending smaller size of data.

C. Cryptography: the complexity of encrypting a text is much less than of what image has. The time complixity of text encryption is O(n) where, time complixity of image encryption is $O(n^2)$ which means encryption of image takes much more time than of what a text takes [6]. This using caesar cipher alogrithm.

V. CONCLUSION

In this paper, we tried to develop a better presentation of fingerprint that is more reliable, and efficient. Converting fingerprint from image to text leads to smaller size and subsequently, better performance in many terms like DBMS, Network, Security and Encryption. The fingerprint processing includes Estimation of local ridge frequency, segmentation, singularity and core detection, Enhancement, and minutiae detection. Finally, minutiae points are extracted. The extracted minutiae points are then written in text holding two pieces of information that are minutiae point type and location in the form of (x, y) pixel presentation which are used later on a process of matching either validation or identification. This way helps a lot to reduce the size of data to be hold, processed or even transmitted over network.

VI. FUTURE WORK

In future, we need to add more kind of points to enrich the fingerprint with more information to have more capabilities in matching process.

Studying the performance of Database when soring the fingerprint as text.

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