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FCMEM2: Fingerprint Classification using Minutia Extraction and Minutia Matching

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***Abstract*—The proposed FCMEM2 method is precise and quick method for biometric fingerprint classification. In this method extracts directly directional information from the damaged and noisy scan image of the fingerprint. The singular points in the region of interest to classify the images and search the center point of the region interest and consider both the direction information using octagon mask. The proposed method not only used to reduce the amount of computation but also done extracted information be used for fingerprint identification on the Automated Fingerprint Identification environment. The fingerprint is classified using three various methods which is preprocessing, Minutia Extraction and Minutia Matching. The algorithm has been evaluated to 5000 fingerprint samples and it has been tested all 4000 fingerprint images on the NIST fingerprint sample database4. In this method scored accuracy reaches 96.525% with no rejection for 4-class classification issues.**

Keywords*—Fingerprint classification, Directional information, Region of interest, AFIS, NIST-4.

I. INTRODUCTION

A finger feature pattern is called fingerprint Figure 1. It is understood with evidences that each human fingerprint is unique [1]. Every person has permanent unique fingerprint, that fingerprint collected of many furrows and ridges [2]. These furrows and ridges shows that better similarities in every small local window, like average with and parallelism.

Figure.1 Fingerprint image

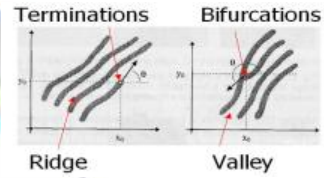

Figure.2 Minutia

The fingerprint recognition issues have been grouped into two domains [3]: first one finger print identification and second one is fingerprint, Figure 3. In adding, AFRS is different from manual approach for fingerprint regeneration by specialists. The verification of fingerprint is to confirm the authenticity of right person by his fingerprint. Fingerprint identification is to postulate one being's identity by his fingerprint(s).

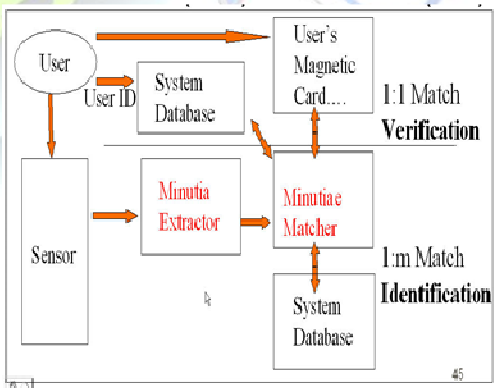

Figure. 3 Verification vs.

The proposed method has three main parts for fingerprint classification which are fingerprint image pre-processing, Minutia extraction and minutia matching. In first part preprocessing, three techniques such as Image enhancement,

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histogram equalization are used to image clearer for further operation. In second part, name is minutia-based, signifies the fingerprint by its local features, like bifurcations and terminations. This method has been intensively deliberate, also it is the mainstay of the current accessible fingerprint recognition methods. The third part is minutia matching namely fingerprint image-based methods [4] [5], tries to do matching based on the global features of an all fingerprint image. This method is an advanced and brand new emerging technique for recognition for fingerprint images and it is solve more intractable issues of the second method.

II. Proposed Architecture

The proposed method FCMEM2 is divided into three phases namely fingerprint acquiring device, minutia extractor and minutia matcher. In the first phase, fingerprint image is received using semi-conduct sensors or optical are extensively used. It is has maximum efficiency and satisfactory accuracy except for one cases which means the human finger is dry or dirty. In this algorithm, finger print image is taken from FVC2002 database. In the minutia extractor, a three stage method is widely used by researcher's namely preprocessing, minutia extraction and post processing stage Figure 4.

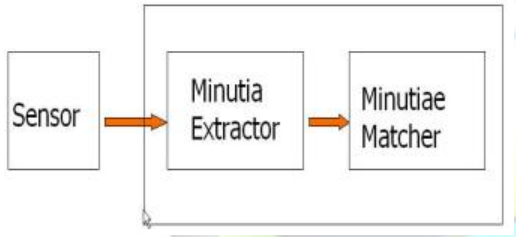

Figure.4 Simplified Fingerprint Recognition System

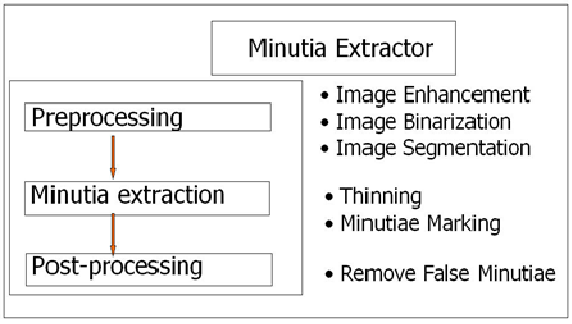

Figure.5 Minutia Extractor

The minutia extraction phase, three thinning algorithms are verified and the Morphological thinning process is lastly proposal out with high competence and attractive worthy thinning excellence.

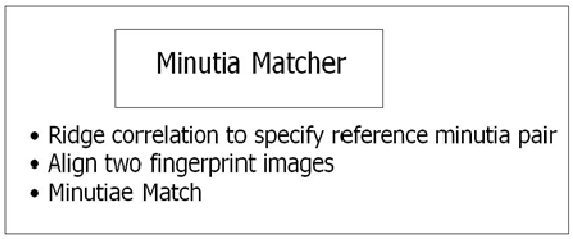

Figure 6 Minutia Matcher

Next phase minutia matcher selects any two minutia as a orientation minutia pair and then match their related edges first. If the points match well, the two fingerprint images are affiliated and matching is directed for all outstanding minutia Figure 6.

III. FCMEM2 Classification

A. *Fingerprint Image Processing*

The Fingerprint image preprocessing has two main process namely image enhance and histogram equalization.

1) *Fingerprint Image Enhancement*

The Fingerprint Image enhancement is to make the image purer for further processes. This process growing the contrast between ridges and furrows and for connecting the false broken points of ridges due to insufficient amount of ink are very useful for keep a higher accuracy to fingerprint recognition.

2) *Histogram Equalization*

The Histogram equalization process is to enlarge the pixel value spreading of a fingerprint image so as to growth the perceptional material. The source histogram of a fingerprint image has the bimodal type Figure 7, the after the histogram equalization inhabits all the variety from 0 to 255 and the visualization effect is enhanced Figure 8.

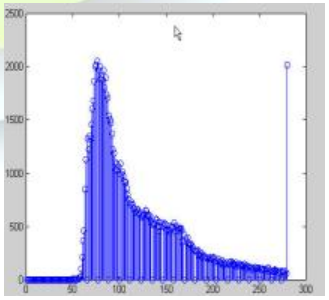

Figure.7. The Original fingerprint Image

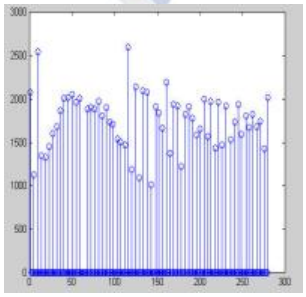

Figure.8 Histogram after the Histogram Equalization

B. *Minutia Extraction*

1) *Fingerprint Ridge Thinning*

The Ridge Thinning is to remove the terminated pixels of ridges till the ridges are just one pixel varied. The habits an parallel thinning algorithm and iterative. Every examination of the full fingerprint image, the method marks down terminated

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pixels in each small image frame (3x3) and lastly eliminates all those marked pixels after numerous scans. In my examine, iterative, parallel thinning algorithm has bad competence though it can get an ideal thinned ridge map after enough examinations. One-in-all method to extract thinned ridges from gray-level fingerprint sample straight. Their technique suggestions along the ridges having maximum gray intensity value. The thinned ridge map is then drinkable by other three Morphological operations to spikes, isolated points, remove some H breaks.

2) Minutia Marking

After the fingerprint ridge thinning, marking minutia points are relatively easy.

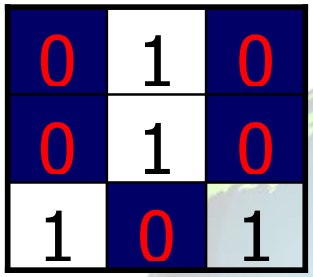


Figure.9 Termination

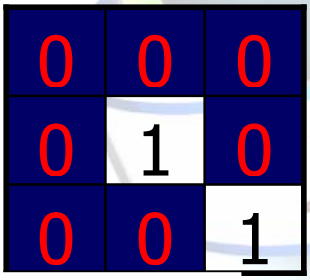


Figure.10 Bifurcation

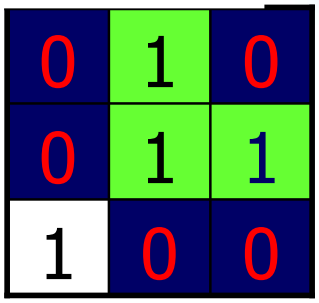


Figure11 Triple counting branch

The minutia marking, all thinned ridges in the fingerprint image are considered with a single ID for additional process.

C. Minutia Matching

The alignment-based match procedure partially derived from the method which is used in this proposed method. It includes two successive phases: one is alignment phase and the second is match phase. The ridge related with individually minutia is signified as a sequence of x-coordinates (x1, x2…xn) of the points on the ridge. An argument is tested per ridge length L initial from the minutia point, where the L is the middling inter-ridge distance. And n is set to 10 unless the total ridge distance is less than 10*L. So the relationship of associating the two ridges is derived from:

$$S = \sum^{m}_{i=0} x_i X_i / [\sum^{m}_{i=0} x_i^2 X_i^2]^{\wedge}0.5,$$

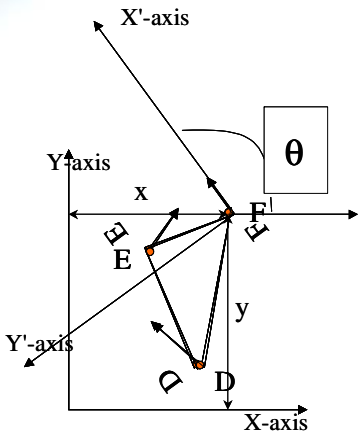
Where (xi~xn) and (Xi~XN) are the set of minutia for each fingerprint image consistently. And m is insignificant one of the n and N valuation. If the correlation score is larger than 0.8, then go to step 2, otherwise continue to equal the next pair of ridges. For individually fingerprint, translate and alternate all other minutia with respect to the reference minutia according to the following formula:

$$\begin{bmatrix} xi\_new \\ yi\_new \\ \theta i\_new \end{bmatrix} = TM * \begin{bmatrix} (xi - x) \\ (yi - y) \\ (\theta i - \theta) \end{bmatrix}$$

where (x,y,θ) is the limitations of the orientation minutia, and TM is

$$TM = \begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

The following diagram exemplify the effect of translation and rotation:



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The new organize method is invented at minutia F and the new x-axis is coextensive with the way of minutia F. No mounting effect is taken into account by presumptuous two fingerprints from the same finger have nearly the similar size.

D. Match Stage

The matching procedure for the ranged minutia designs needs to be flexible since the exacting match needful that all limitations (x, y, z) are the same for two undistinguishable minutia is unbearable due to the slight distortions and inexact quantization's of minutia. The last match ratio for two fingerprints is the number of total matched couple over the number of minutia of the pattern fingerprint. The mark is 100*ratio and ranges from 0 to 100. If the total is larger than a pre-specified threshold, the two fingerprints are from the same finger. Though, the elastic match algorithm has large calculation difficulty and is susceptible to imitation minutia.

IV. EXPIRIMENTAL RESEARCH

The fingerprint database from the FVC2000 (Fingerprint Verification Competition 2000) is used to examine the experimentation performance.

Following Figures 11, 12 shows that the Correct Score and Incorrect Score distribution:

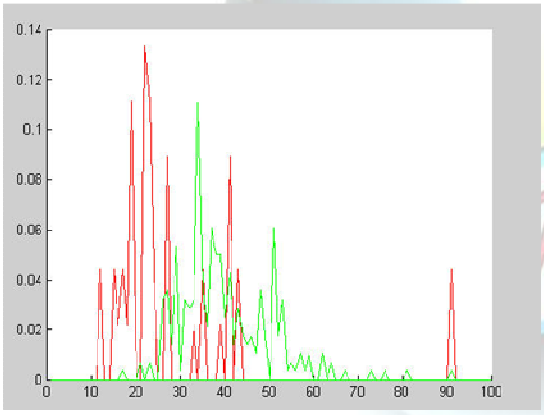

Figure.12 Distribution of Correct Scores and Incorrect Scores

Red line: Incorrect Scores , Green line: Correct Scores

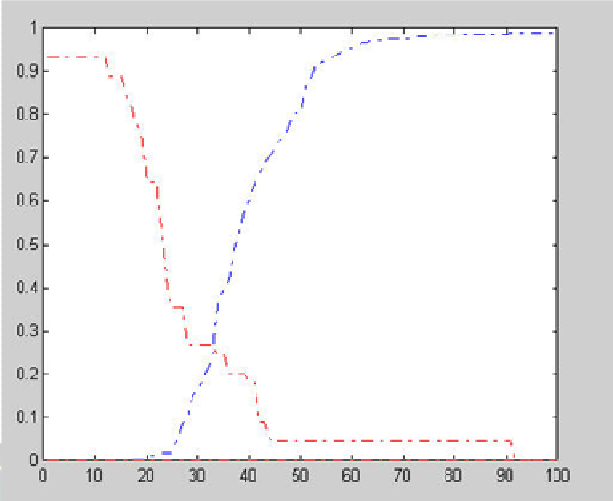

Fig.13 FAR and FRR curve

Blue dot line: FRR curve

Red dot line: FAR curve

V. CONCLUSION

The proposed method FCMEM2 has joint several methods to build a minutia extractor and a minutia matcher. The mixture of various methods comes from a wide examination into research articles. Also some original vagaries like segmentation using Morphological processes, minutia marking with superior seeing the triple branch counting, minutia unification by decomposing a branch into three conclusions, and matching in the united x-y coordinate system after a two-step alteration are used in the proposed method.

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