International Journal of Soft Computing 9 (2): 85-87, 2014
ISSN: 1816-9503

Fingerprints Age Determination in Different Methods Using Image Processing

S. Arun, Vinson Joshua, Anuroop Pillai and A. Nageswaran
Veltech Dr. RR and SR Technical University, Chennai, Tamil Nadu, India

Abstract: In this study, researchers investigate the current techniques for fingerprint recognition. This target can be mainly decomposed into image preprocessing, feature extraction and feature match. For each sub-task, some classical and up to date methods in literatures are analyzed. Based on the analysis, an integrated solution for fingerprint recognition is developed for demonstration. My demonstration program is coded by MATLAB. For the program, some optimization at coding level and algorithm level are proposed to improve the performance of my fingerprint recognition system. These performance enhancements are shown by experiments conducted upon a variety of fingerprint images.

Key words: Fingerprint, MATLAB, preprocessing, recognition, feature

INTRODUCTION

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. 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.

The fingerprint recognition problem can be grouped into two sub-domains: one is fingerprint verification and the other is fingerprint identification. 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-base (Lin, 1998).

SYSTEM DESIGN

System level design: A fingerprint recognition system constitutes of fingerprint acquiring device, minutia extractor and minutia matcher (Fig. 1). For fingerprint acquisition, optical or semi-conduct sensors are widely used. They have high efficiency and acceptable accuracy except for some cases that the user's finger is too dirty or dry. However, the testing database for my project is from the available fingerprints provided by FVC2002 (Fingerprint Verification Competition in 2002). So, no acquisition stage is implemented (Maio and Maltoni, 1997).

The minutia extractor and minutia matcher modules are explained (Fig. 2).

Algorithm level design: To implement a minutia extractor, a three-stage approach is widely used by researchers.

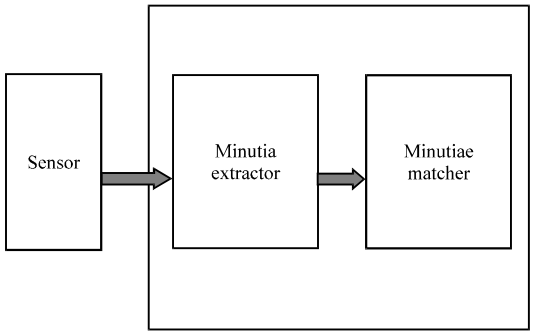

Fig. 1: Simplified Fingerprint Recognition System

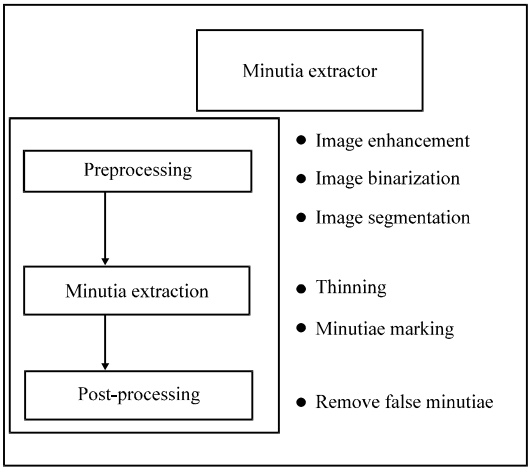

Fig. 2: Minutia extractor

Corresponding Author: S. Arun, Veltech Dr. RR and SR Technical University, Chennai, Tamil Nadu, India

They are preprocessing, minutia extraction and post processing stage (Ratha *et al*., 1995). For the fingerprint image preprocessing stage, I use histogram equalization and Fourier Transform to do image enhancement. And then the fingerprint image is binaries using the locally adaptive threshold method. The image segmentation task is fulfilled by a three-step approach: block direction estimation, segmentation by direction intensity and region of interest extraction by morphological operations. Most methods used in the preprocessing stage are developed by other researchers but they form a brand new combination in my project through trial and error. Also, the morphological operations for extraction ROI are introduced to fingerprint image segmentation by myself (Jain *et al*., 1997).

For minutia extraction stage, three thinning algorithms are tested and the morphological thinning operation is finally bid out with high efficiency and pretty good thinning quality. The minutia marking is a simple task as most literatures reported but one special case is found during my implementation and an additional check mechanism is enforced to avoid such kind of oversight. For the post processing stage, a more rigorous algorithm is developed to remove false minutia based. Also, a novel representation for bifurcations is proposed to unify terminations and bifurcations.

FINGERPRINT IMAGE PREPROCESSING

Fingerprint image enhancement is to make the image clearer for easy further operations. Since, the fingerprint images acquired from sensors or other medias are not assured with perfect quality those enhancement methods for increasing 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 (Farina *et al*., 1999). Two methods are adopted in my fingerprint recognition system: the first one is Histogram Equalization and the next one is Fourier Transform (Fig. 3).

Fingerprint enhancement by fourier transform: Researchers divide the image into small processing blocks (32×32 pixels) and perform the fourier transform according to Hong *et al*. (1998):

$$F(u,v) = \sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\times\exp\left\{-j2\pi\times\left(\frac{ux}{M}+\frac{vy}{N}\right)\right\} \quad (1)$$

for u = 0, 1, 2, ..., 31 and v = 0, 1, 2, ..., 31. In order to enhance a specific block by its dominant frequencies,

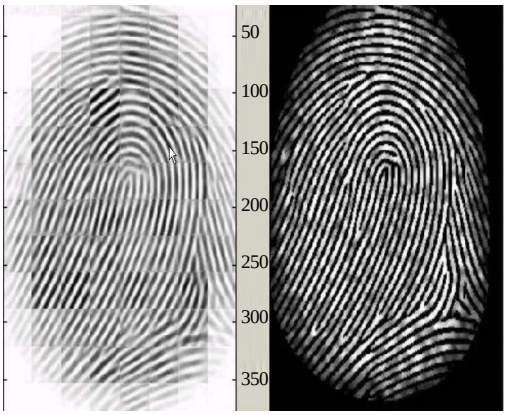

Fig. 3: Fingerprint reorganization

researchers multiply the FFT of the block by its magnitude a set of times. Where the magnitude of the original FFT = abs(F(u, v)) = |F(u, v)|. Get the enhanced block according to:

$$g(x,y) = F^{-1}\left\{F(u,v)\times\left|F(u,v)\right|^{K}\right\} \quad (2)$$

where, F^{-1} (F(u, v)) is done by:

$$f(x,y) = \frac{1}{MN}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} F(u,v)\times\exp\left\{j2\pi\times\left(\frac{ux}{M}+\frac{vy}{N}\right)\right\} \quad (3)$$

for x = 0, 1, 2, ..., 31 and y = 0, 1, 2, ..., 31. The k in Eq. 2 is an experimentally determined constant which researchers choose k = 0.45 to calculate. While having a higher k improves the appearance of the ridges, filling up small holes in ridges having too high a k can result in false joining of ridges. Thus, a termination might become.

EXPERIMENTATION RESULTS

A fingerprint database from the FVC2000 (Fingerprint Verification Competition in 2000) is used to test the experiment performance. My program tests all the images without any fine-tuning for the database. The experiments show my program can differentiate imposturous minutia pairs from genuine minutia pairs in a certain confidence level. Furthermore, good experiment designs can surely improve the accuracy as declared by further studies on good designs of training and testing are expected to improve the result. Here, is the diagram for correct score and incorrect score distribution in the Fig. 4.

It can be seen from Fig. 4 that there exist two partially overlapped distributions. The red curve whose peaks are mainly located at the left part means the

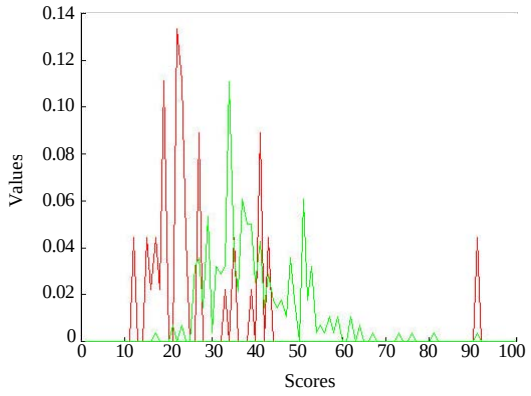

Fig. 4: Distribution of correct scores and incorrect scores. Redline: incorrect score; green line: correct scores

average incorrect match score is 25. The green curve whose peaks are mainly located on the right side of red curve means the average correct match score is 35 (Hong *et al*., 1998).

CONCLUSION

In this study, combined many methods to build a minutia extractor and a minutia matcher. The combination of multiple methods comes from a wide investigation into research work. Also, some novel changes like segmentation using morphological operations, minutia marking with special considering the triple branch counting, minutia unification by decomposing a branch into three terminations and matching in the unified x-y coordinate system after a two-step transformation.

REFERENCES

Farina, A., Z.M. Kovacs-Vajna and A. Leone, 1999. Fingerprint minutiae extraction from skeletonized binary images. Pattern Recognit., 32: 877-889.

Hong, L., Y. Wan and A. Jain, 1998. Fingerprint image enhancement: Algorithm and performance evaluation. IEEE Trans. Pattern Anal. Mach. Intell., 20: 777-789.

Jain, A., L. Hong and R. Bolle, 1997. On-line fingerprint verification. IEEE Trans. Pattern Anal. Mach. Intell., 19: 302-314.

Lin, H., 1998. Automatic personal identification using fingerprints. Ph.D. Thesis, Department of Computer Science, Michigan State University.

Maio, D. and D. Maltoni, 1997. Direct gray-scale minutiae detection in fingerprints. IEEE Trans. Pattern Anal. Mach. Intelligenc, 19: 27-40.

Ratha, N.K., S. Chen and A.K. Jain, 1995. Adaptive flow Orientation-based feature extraction in fingerprint images. Pattern Recognit., 28: 1657-1672.