ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

Biometric Security by Finger Print Recognition: Basic Architecture and Algorithms

Seema saini
M.Tech Scholar, Department of CSE
GIMET, Amritsar, Punjab, India
sainiseema706@yahoo.com

Amanpreet Kaur AP,
Department of CSE
GIMET, Amritsar, Punjab, India
batthamanpreet@gmail.com

Abstract

The need for robust, reliable, and foolproof personal identification, authentication systems will necessarily require a biometric component. The most widely used biometric technology is the fingerprint system. In fact, fingerprint can be used to replace the PIN or passwords in most security aspect. Fingerprints can be used instead of PIN in the smart card applications, passwords on workstations, etc. Therefore an efficient, fast and reliable finger print recognition is always required. In this paper we present the survey, need, basic architecture and various algorithms of a finger print identification system.

Keywords— ***Finger print, Minutiae, Gabor Filter, ridge***

I. Introduction

The word "biometrics" comes from the Greek language and is derived from the words bio (life) and metric (to measure). Biometric systems use a person's physical characteristics (like fingerprints, irises or veins), or behavioural characteristics (like voice, handwriting or typing rhythm) to determine their identity or to confirm that they are who they claim to be.

In the area of computer security, biometrics refers to authentication techniques that rely on measurable physiological and individual characteristics that can be automatically verified. In other words, we all have unique personal attributes that can be used for distinctive identification purposes, including a fingerprint, the pattern of a retina and voice characteristics. Some personal computers today can include a fingerprint scanner where you place your index finger to provide authentication. The computer analyses your fingerprint to

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

determine who you are and based on your identity followed by a pass code or pass phrase, allows you different levels of access [1, 2]. Access levels can include the ability to open sensitive files, to use credit card information to make electronic purchases, and so on.

A Biometric authentication is essentially a pattern-recognition that makes a personal identification by determining the authenticity of a specific physiological or behavioural characteristic possessed by the user. An important issue is designing a practical approach to determine how an individual is identified. An authentication can be divided into two modules:

a) Enrolment module; b) Identification or Verification module

A fingerprint is the feature pattern of one finger. 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.

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 [3, 4]. A fingerprint is comprised of ridges and valleys. The ridges are the dark area of the fingerprint and the valleys are the white area that exists between the ridges.

II. Fingerprint Matching Techniques

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

a) Minutiae matching method
b) Correlation matching method
c) Pattern or Ridge matching method
d) Image based matching method

A. 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

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

essentially consists of finding the alignment between the template and the input minutiae sets that result in the maximum number of minutiae pairings. Most of the finger-scan technologies are based on Minutiae. Minutia-based techniques represent the fingerprint by its local features, like terminations and bifurcations. This approach has been intensively studied, also is the backbone of the current available fingerprint recognition products.

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 those results in the maximum number of minutiae pairings [5]. In almost all countries, forensic experts use this method and the results are accepted as proof of identity in court. Minutiae points are local ridge characteristics that emerge generally at a ridge ending or a ridge bifurcation. Figure 1 show these two basic minutiae types.

Fig. 1: Minutiae: Ridge bifurcation (left), ridge ending (right).

In this figure, ridges are coloured black, whereas valleys are coloured white. A complete fingerprint consists of about 100 minutiae points on average. In practice, the measured fingerprint area contains about 30-60 minutiae points, depending on the finger, the sensor area and the way the fingertip of the user contacts the sensor.

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

- Ridge ending - the abrupt end of a ridge.
- Ridge bifurcation - a single ridge that divides into two ridges.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

- 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.

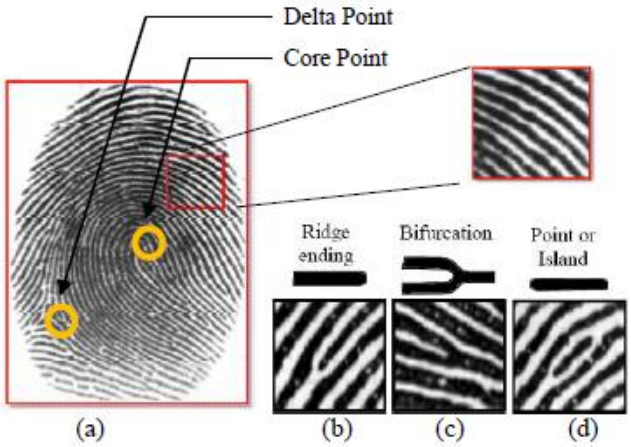

Fig. 2: Fingerprint feature (a) Whole pattern (b) Ridge ending (c) Bifurcation (d) Point of island

- Delta - a Y-shaped ridge meeting
- Core - a U-turn in the ridge pattern

B. Correlation based matching

Two fingerprint images are superimposed and the correlation between corresponding pixels is computed for different alignments (e.g. various displacement sand rotations). Two fingerprint images are superimposed and the correlation between corresponding pixels is computed for different alignments (e.g. various displacements and rotations). The cross-correlation is a well-known measure of image similarity and the maximization in (1); it allows us to find the optimal registration. The direct application of (1) rarely leads to acceptable results, mainly due to the following problems [6]:

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

- Non-linear distortion makes impressions of the same finger significantly different in terms of global structure; the use of local or block-wise correlation techniques can help to deal with this problem.
- Skin condition and finger pressure cause image brightness, contrast, and ridge thickness to vary significantly across different impressions. The use of more sophisticated correlation measures may compensate for these problems.
- Local correlation and correlation in the Fourier domain can improve efficiency.

C. Pattern based (or Ridge based) matching

Pattern based algorithms compare the basic fingerprint patterns (arch, whorl, and 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 centres 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. Feature extraction and template generation are based on series of ridges as opposed to discrete points which forms the basis of Pattern Matching Techniques [7, 8]. The advantage of Pattern Matching techniques over Minutiae Extraction is that minutiae points may be affected by wear and tear and the disadvantages are that these are sensitive to proper placement of finger and need large storage for templates.

D. Image based techniques

Image based techniques try to do matching based on the global features of a whole fingerprint image. It is an advanced and newly emerging method for fingerprint recognition [9]. In this method we directly match whole image of fingerprint with the data base or templates which is store in our data storage place.

III. Gabor Filters for Matching

Literature revealed that using a Gabor filter provides better fingerprint enhancement results than using a Fourier transform. This section describes the different processing steps from pre-processing to matching as the final step of the fingerprint authentication. The first step is the normalization, which results in a better contrast of the fingerprint image. After that, the fingerprint is segmented, which crops areas of the recorded image, which do not contain any relevant information. This is the end of the pre-processing. However, tests have shown that the subsequent reference point detection works on non-enhanced fingerprint images as well as on enhanced. Therefore, any further enhancement is not required for the subsequent processing steps. After that, the fingerprint image is filtered using a Gabor filter. Now, it is

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

possible to create the feature map, which is used as the template. This template is matched in the subsequent matching step with templates of other fingerprints. The result of the matching is the matching score, which represents how good two fingerprints resemble each other [10].

Most methods for fingerprint identification use minutiae as the fingerprint features. For small scale fingerprint recognition system, it would not be efficient to undergo all the pre-processing steps (edge detection, smoothing, thinning etc), instead Gabor filters will be used to extract features directly from the gray level fingerprint.

IV. Conclusions

This paper presents the overview of Finger print reorganization biometric system. The finger print classification, parts, types and various techniques are discussed in this paper. Each technique of finger print has drawbacks as well advantages and used in certain application.

References

[1] A.K. Jain, R. Bolle and S. Pankanti, Biometrics: Personal Identification in a Networked Society, Kluwer Academic Publishers, 2004.
[2] D. Polemi, "Biometric Techniques: Review and Evaluation of Biometric Techniques for Identification and Authentication, Including an Appraisal of the Areas Where They are Most Applicable," Final Report, April 2000.
[3] Federal Bureau of Investigation, “The Science of Fingerprints: Classification and Uses”, US Government Printing office, Washington D.C., 2001.
[4] D. Maltino, D. Maio, A.K. Jain and S. Prabhakar,“A Handbook 0f Fingerprint Recognition”, Springer Press, 2003.
[5] Gonzalez and Woods “Digital Image Processing”, PHI, 2002.
[6] W. Zhao, R. Chellappa, P.J. Phillips, A. Rosenfeld, Face recognition: a literature survey, ACM Comput. Surv. 35 (4) (2003) 399–458.
[7] R. Gross, S. Baker, I. Matthews, T. Kanade, Face recognition across pose and illumination, in: S.Z. Li, A.K. Jain (Eds.), Handbook of Face Recognition, Springer-Verlag, Berlin, 2004.
[8] Ching-Tang Hsieh and Chia-Shing Hu, “Humanoid Fingerprint Recognition Based on Fuzzy Neural Network”, International Conference on Circuit, Systems, Signal and Telecommunications, pp. 85-90, (2007).
[9] B. Bhanu, M. Boshra, X. Tan, Logical templates for feature extraction in fingerprint images, Proceedings of the International Conference on Pattern Recognition (ICPR), Vol. III, Barcelona, Spain, September 2000, pp. 850–854.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

[10] B. Bhanu, X. Tan, Learned template for feature extraction in fingerprint images, Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR), Vol. II, Hawaii, USA, December 2001, pp. 591–596.