

# Training on Fingerprint Pattern Recognition

Nanang Syahroni

(JICA Expert on Digital Communication)

EEPIS – Surabaya – Indonesia

nanang@eepis-its.edu

Electronics & Telecommunication Department - Tumba College of Technology

## Fingerprint Application

Fingerprint recognition applications are divided here into three categories:

- Forensic applications have used forensic experts.
- Government applications have used token-based systems.
- Commercial applications have used knowledge-based (password) systems.

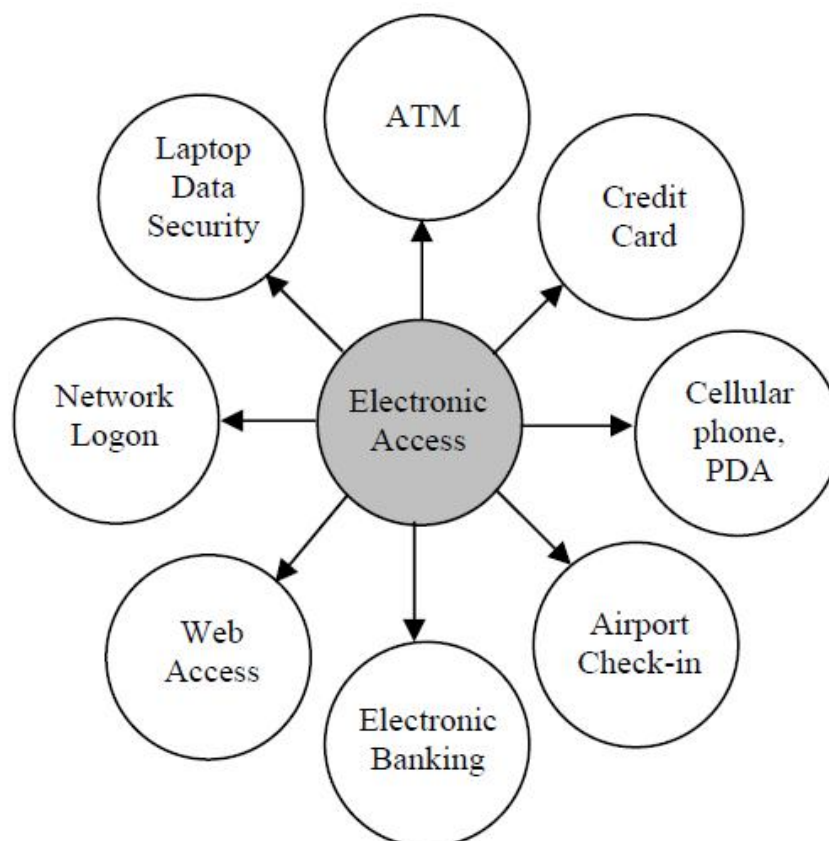
# Three major of critical application

Forensic	Government (Civil)	Commercial
Corpse Identification Criminal Investigation Missing Children	Social Security Welfare Disbursement Border Control Passport Control National ID card Driver License Credentialing	Computer Network Logon Electronic Data Security e-Commerce Internet Access ATM, Credit Card Physical Access Control Cellular Phones Personal Digital Assistant Medical Records Management Distance Learning

13/06/2011

2

## Various applications of automatic user recognition

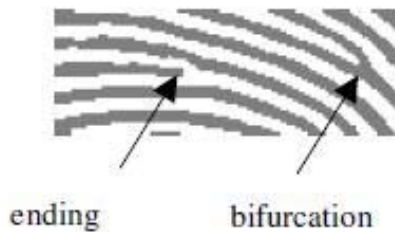


13/06/2011

3

# Feature Type

- The lines that flow in various patterns across fingerprints are called ridges and the spaces between ridges are valleys, these ridges that are compared between one and another when matching.
- The more microscopic of the approaches is called minutia matching. The two minutia types are a ridge ending and bifurcation. An ending is a feature where a ridge terminates.



13/06/2011

4

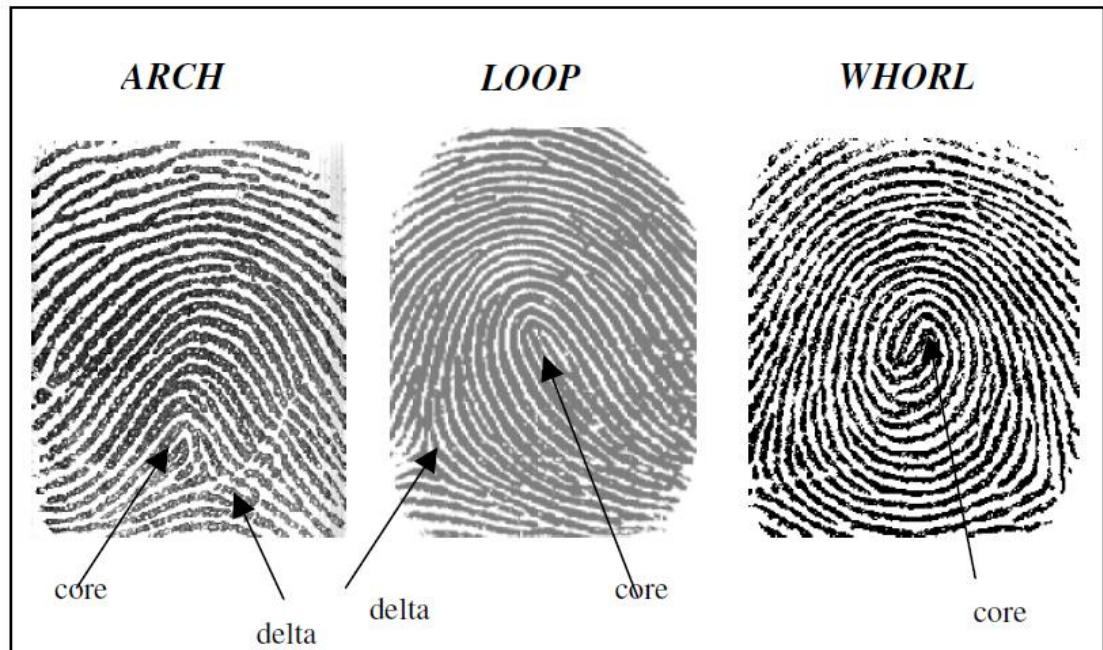
## Pattern Matching

- Fingerprint patterns are: arch, loop, and whorl. Fingerprint landmarks are: core and delta.
- The more macroscopic approach to matching is called global pattern matching or simply pattern matching. In this approach, the flow of ridges is compared at all locations between a pair of fingerprint images.
- Two other features are sometimes used for matching: core and delta. The core can be thought of as the center of the fingerprint pattern. The delta is a singular point from which three patterns deviate. The core and delta locations can be used as landmark locations by which to orient two fingerprints for subsequent matching.

13/06/2011

5

# Fingerprint Patterns & Landmarks



13/06/2011

6

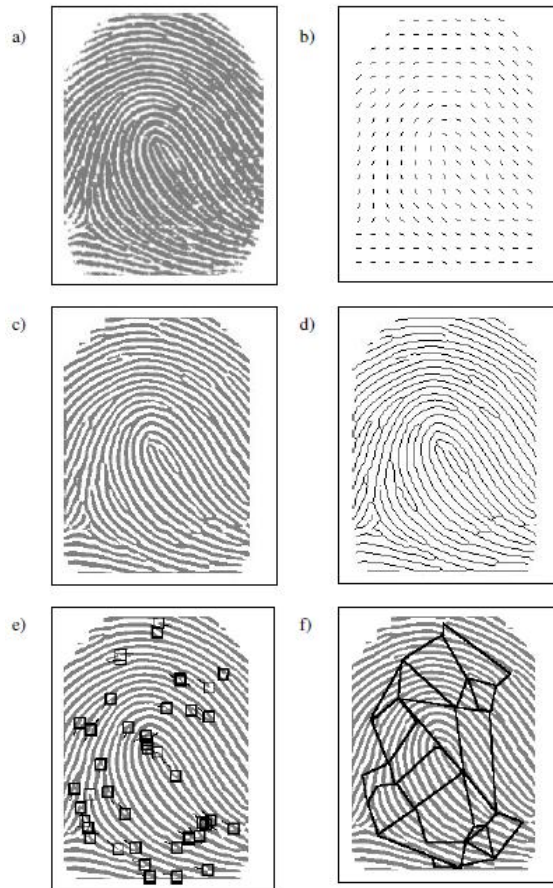
## Feature Extraction

- Sequence of fingerprint feature extraction processing steps are: 1) Original, 2) Orientation, 3) Binarized, 4) Thinned, 5) Minutiae, and 6) Minutiae graph (template).
- Feature attributes are determined for each valid minutia found. These consist of: ridge ending or bifurcation type, the (x,y) location, and the direction of the ending or bifurcation.

13/06/2011

7

# Feature Processing Steps



13/06/2011

8

# False Minutiae Structures

<b>Break</b>	<b>Spur</b>	<b>Merge</b>	<b>Triangle</b>
<b>Multiple Break</b>	<b>Bridge</b>	<b>Break and Merge</b>	<b>Ladder</b>
<b>Lake</b>	<b>Island</b>	<b>Wrinkle</b>	<b>Dot</b>

13/06/2011

9

# Minutiae (Template) Size

- The image is reduced in intensity levels from the original 256 (8-bit pixels) to 2 (1-bit pixels).
- The result of the feature extraction stage is what is called a minutia template (minutia graph). This is a list of minutiae with accompanying attribute values.
- An approximate range on the number of minutiae found at this stage is from 10 to 100. If each minutia is stored with type (1 bit), location (9 bits each for x and y), and direction (8 bits), then each will require 27 bits (say 4 bytes), and the template will require up to 400 bytes.

13/06/2011

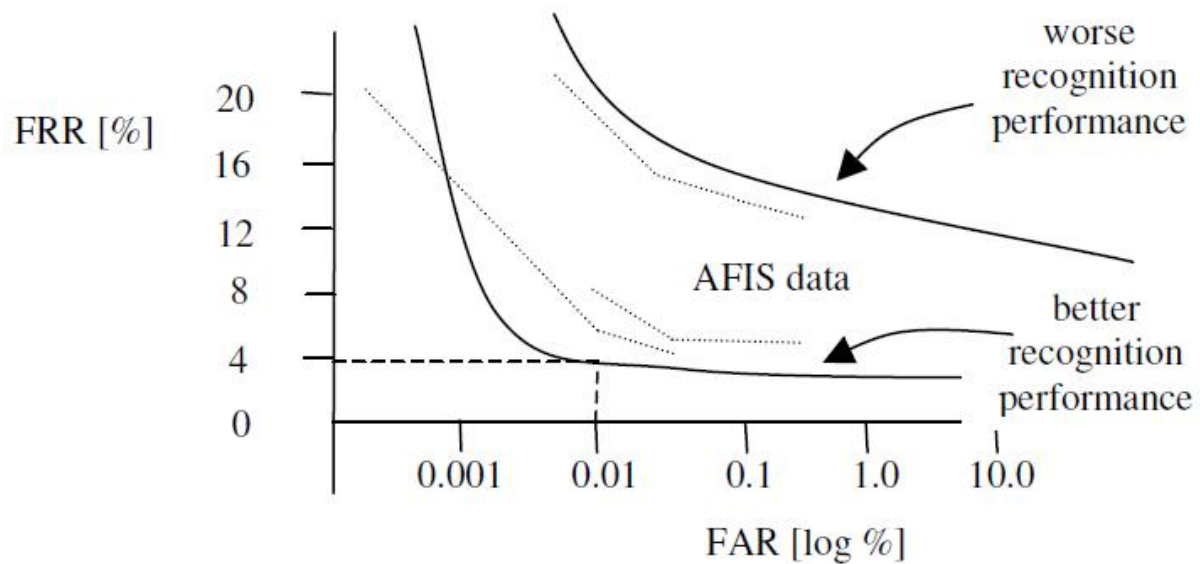
10

## Recognition Rate

- The ultimate measure of fingerprint system is recognition rate. This can be described by two values: FAR and FRR.
- The false acceptance rate (FAR) is the ratio of the number of pairs of different fingerprints found to match to the total number of match attempts.
- The false rejection rate (FRR) is the ratio of the number of pairs of the same fingerprint are found not to match to the total number of match attempts.
- FAR and FRR trade off against one another. That is, a system can usually be adjusted to vary these two results for the particular application, however decreasing one increases the other and vice versa.

13/06/2011

11



- ❖ The 2 solid curves are of hypothetical data illustrating desirable and less desirable recognition performance.
- ❖ The 3 dotted curves are of real data measuring the performance of 3 commercial AFIS.

## References

1. Davide Maltoni, Dario Maio, Anil K. Jain, and Salil Prabhakar (editors), *Handbook of Fingerprint Recognition*, 2nd edition, Springer-Verlag, London, 2009.
2. Stan Z. Li and Anil K. Jain (editors), *Handbook of Face Recognition*, Springer, 2005.
3. Frank Y. Shih, *Image processing and pattern recognition : fundamentals and techniques*, IEEE & John Wiley & Sons, 2010.

# Morakoze