Module 2

Fingerprint Feature Extraction

- A fingerprint is a pattern of curving line structures called *ridges*, where the skin has a higher profile than its surroundings, which are called the *valleys*.

- In most fingerprint images, the ridges are black and the valleys are white.

Problem

- Due to all kinds of noise and distortions, fingerprints cannot be matched simply by taking the cross-correlation or the Euclidean distance of the gray scale images.

Solution

Extracting features from the fingerprints that are more robust to the distortions in some extent

Commonly used features

- Directional field (DF)
- Singular points (SP)
- *minutiae*

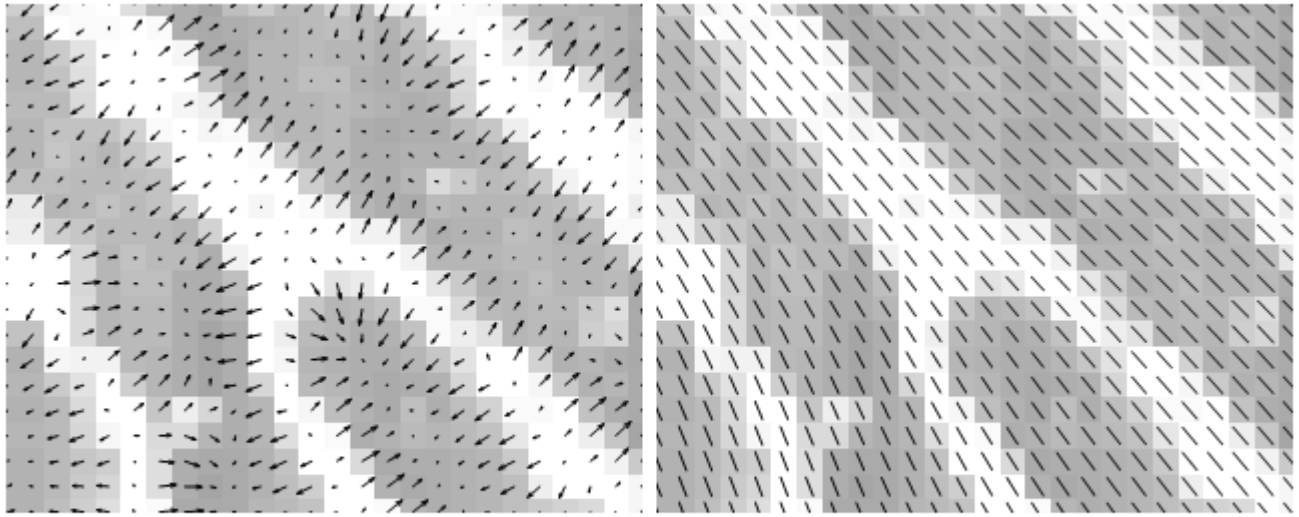
Directional field

- The local orientation of the ridge-valley structures
- Describes the coarse structure, or basic shape, of a fingerprint
- Calculated on a regular grid in the fingerprint

(a) Fingerprint (b) Directional field

- DF can be derived from the gradients by performing some *averaging* operation on the gradients, involving pixels in some neighbourhood

- Gradients indicated by small arrow



(a) Gradients (b) Directional field

Directional Field Estimation Method

- Averaging squared Gradients
- Principal component Analysis

Singular Point

- SPs are the discontinuities in the directional field
- a *core* is the uppermost point of the innermost curving ridge
- a *delta* is a point where three ridge flows meet
- For some fingerprint, SPs fall outside the image area

(a) Fingerprint (b) Singular points

- a segment of a segment of a fingerprint image around an SP has an orientation.

- provide somewhat unsatisfactory results, since they are not capable of consistently extracting the singular points

- Some segmentation method will help to extract the singular point.

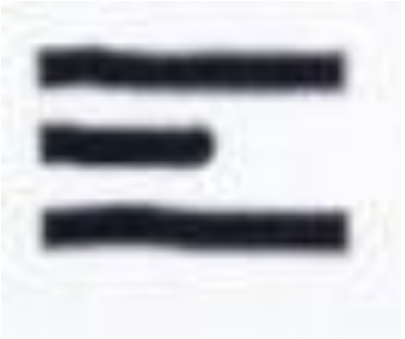
Minutiae Extraction

- The uniqueness of a fingerprint can be determined by the pattern of ridges and valleys as well as the minutiae points.

- Automatic fingerprint recognition systems use the two elementary types of minutiae that exist, being ridge endings and bifurcations

Fingerprint Basics (minutiae)

Bifurcation



Ridge ending

dot

Double bifurcation

Fingerprint Basics (minutiae)

Opposed bifurcation

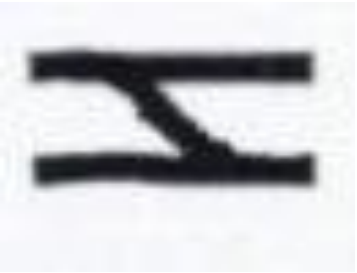
Island (short ridge)

Hook (spur)

Lake (enclosure)

Fingerprint Basics (minutiae)

Ridge crossing



Bridge

trifurcation

Opposed bifurcation/ridge ending)