

TDI2131 Digital Image Processing 2009/2010

Assignment 2: Fingerprint Minutiae Extraction (10%)

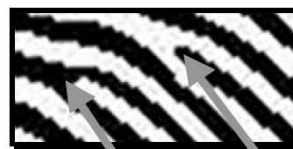
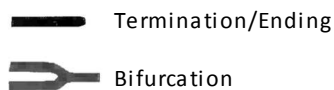


Fingerprint recognition is an automated method of verifying a match between two human fingerprints. Fingerprints are one of the many forms of biometrics that are widely used in various security systems such as smart homes, airport identity verification, and border checkpoints.

However, before verification can be done between two sets of fingerprints, the most important step before that is to extract relevant information from a fingerprint image that can be used to make comparisons. The important features that we are interested in are called *minutiae*, which literally means “small details”. All our fingerprints have ridges, or fine lines that one can observe. Ridge patterns can be discontinuous in various ways. For example, a ridge can suddenly come to an end (*termination*), or can divide/split into two ridges (*bifurcation*). Although several other types of minutiae can be considered (point, spur, crossover, lake), the FBI minutiae-coordinate model from 1982 considers only terminations and bifurcations for person identification using fingerprints. In practice, an ambiguity exists between termination and bifurcation minutiae, depending on the finger pressure against the surface where the fingerprint is left – terminations can appear as bifurcations, and vice versa.

Task

1. You are required to **extract all minutiae** of a given fingerprint image, considering only the two important types – **terminations/endings** and **bifurcations**.



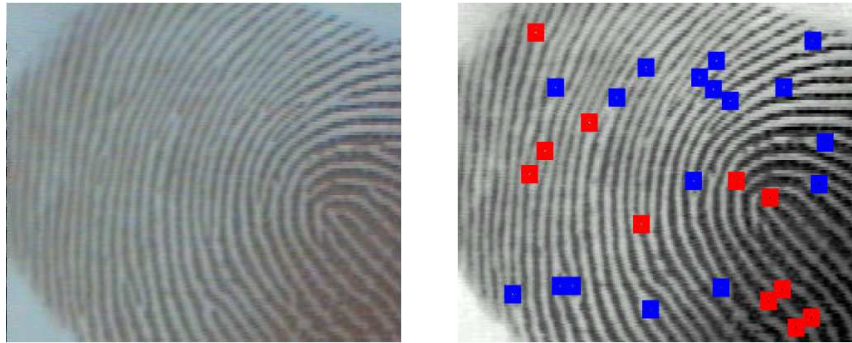
Bifurcation Termination/Ending

Note that this is a feature extraction process, **NOT** a recognition process, as there is only one fingerprint provided for you to process, so it is not possible to do any matching with no minutiae database provided.

2. Your final output should be your fingerprint image, complete with **markers/indicators of where the minutiae are detected and located**. The indicators are to be **drawn using Matlab**.

The extraction process **MUST** be automated, and manual finding of minutiae locations are **NOT** allowed.

Here are some suggestions on how you can display the location of extracted minutiae in the image using markers/indicators. If you have better ideas, feel free to do it your own way!



Suggestion #1: Extracted minutiae are colour-coded with squares (terminations in blue, bifurcations in red)



Suggestion #2: Extracted minutiae are indicated by different shapes (terminations with squares, bifurcations with circles)

3. Include an analysis of your choice of techniques/method used to extract the minutiae from the image.

All students will be processing a different fingerprint image, as indicated by their ID number. The image is in JPG format, with filename “fp_STUDENT ID.jpg”.

Please access <http://pesona.mmu.edu.my/~johnsee/teaching/tdi2131/as2> to obtain your image.

Note: There can be many possible answers or solutions to this task, though there are some techniques that are proven to work more effectively than others. Different images may require different ways of enhancement. Some images may need more enhancement steps than others. Some images may also be more difficult to process than others, so you will be evaluated fairly based on the difficulty of your task.

Enhancement Required?

The general condition of certain images may not be of the best quality, and enhancements may be needed. Meanwhile, certain images may not even need any enhancement if the quality of the image is already satisfactory for feature extraction.

Note that in this assignment, the enhancement techniques that you use should *work towards helping you achieve accurate minutiae detection*, unlike the case of Assignment 1 where judgment is by visual evaluation.

Deliverables

1. You are required to submit a short report, highlighting the condition of your image and any necessary enhancements applied, your proposed steps taken to extract the minutiae (termination/ending and bifurcation), and a brief analysis of your proposed techniques/methods or other relevant issues. There is **NO** format for the report. Feel free to present it the way you think is best. Images to illustrate your steps would be a useful addition. Code print-outs should be presented with fixed-width fonts (such as Courier New, Consolas).
2. Include your Matlab m-file(s) that accomplishes your task. Both scripts or functions are acceptable. If you are submitting a function, please comment clearly on its usage.

Please name your submission files with the following naming style, by filling in the “StudentID” (required) and “optionalfilename” (only needed if you have more than 1 file) accordingly.

Report	fp_StudentID.doc or for other file formats (.docx, .pdf, etc.)
Matlab Code(s)	fp_StudentID_optionalfilename.m

You are **NOT** allowed to use any graphic/image-editing softwares to enhance your images. After all, you have to hand-up your proposed steps to solve the problem, and your codes will also be run to verify your proposed solution.

Submission

Do not submit any printed hardcopy. Save the trees!

All files for submission should be zipped up and sent to tdi2131@gmail.com with

Subject: **[AS2] <Your ID number>**

Please do not make multiple submissions or spam the submission email. Only submit your final version of files. For questions/enquiries about the assignment, please do not direct them to this submission email.

Deadline for Assignment 2 is at **11.59PM, 5 April 2010 (Monday of Week 11)**. Email timestamp will be regarded as submission time.

Plagiarised work and **late submissions** will be penalized. Your work will be considered plagiarised if it includes text, implementation, and/or codes from various sources (your coursemates', Internet, etc.). Remember, if you can find it in the Internet, so can everybody else!

Useful Reads

- S.Kasaei, M.Deriché, B.Boashash, “**Fingerprint Feature Enhancement Using Block-Direction on Reconstructed Images**”, ICICS, 1997.
- X. Sun, Z. Ai, “**Automatic Feature Extraction and Recognition of Fingerprint Images**”, ICSP, 1996.
- D. Maio, D. Maltoni, “**Direct Gray-Scale Minutiae Detection in Fingerprints**”, IEEE PAMI 1997.
- A. Farina, Z. M. Kovacs-Vajna, A. Leone, “**Fingerprint Minutiae Extraction from Skeletonized Binary Images**”, Pattern Recognition, 1999.

These papers are available from <http://pesona.mmu.edu.my/~johnsee/teaching/tdi2131/as2/papers>