University of Tehran
College of Engineering
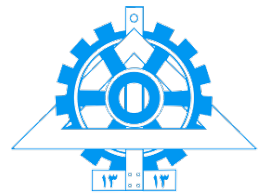
Digital Image Processing

Instructor: Dr. Hamid Soltanian-Zadeh

Homework Assignment 8:

Image Segmentation

Due date: 1404/03/04

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Contents

1 Instructions

Please answer the following questions based on Chapter 10 (*Image Segmentation*) of the textbook by Gonzalez and Woods. Submit your solutions by the due date. Read the following carefully and follow these instructions when submitting your answers:

Requirement	Description	Consideration
Standard Due Date	1404/03/04- 23:59	
Elearn HW Upload	**Only**	Only use ELearn to submit your homeworks.
Email Address	adanayidet@gmail.com	Feel free to say hello!
Submit format	Read Note 4	Extremely important
Late Submit	Penalty	$5 - 10\%$ penalty per day

Note 1: *This request is not intended to impose any hardship on you, but to help with better management of the class. Your cooperation is greatly appreciated in making the process more efficient. Thank you!*

Note 2: *We will also have a Telegram group for Q&A. The link (clickable) is provided here:* [open the link]

Note 3: *Use camera scanners if you wish to submit your handwritten answers. While readability is always important, it is especially critical in the DIP course, which focuses on quality enhancement.*

Note 4: *You must send a zip or rar file named* `DIP-HWx-std.no` *where x is the number of the homework (e.g.* `DIP-HW8-810199034`*). Inside the zipped file will be a folder for each question containing its code and output images. There should also be a single pdf file in the root folder as your main report.*

Academic Integrity: *Plagiarism, cheating, or using unauthorized external resources (including AI tools, solution manuals, or copying from peers) is strictly prohibited. All assignments will be checked for originality, and any violations will result in academic penalties. Please submit only your own work.* It's easy to detect whether your answers are generated by AI or are truly your own work, so be sure to submit original solutions.

2   Thresholding-Based Segmentation

> **Background**
>
> Global and adaptive thresholding are among the simplest segmentation methods, partitioning the image into regions by comparing pixel intensities to one or more thresholds. This is widely used in document analysis, medical imaging, and industrial inspection.

(a) Implement global thresholding by Otsu's method. Show the threshold value and the binary result.

(b) Apply adaptive (local) thresholding with a 15×15 window. Compare with the global result.

(c) Plot the histogram of the original image and indicate the chosen global and local thresholds.

(d) Discuss scenarios where adaptive thresholding outperforms global thresholding.

3   Edge-Based Segmentation

> **Background**
>
> Edge-based methods locate object boundaries by detecting intensity discontinuities. After edge detection, linking and thresholding produce closed contours—useful in applications like road detection and object tracking.

(a) Detect edges using the Canny operator (select appropriate low/high hysteresis thresholds).

(b) Perform non-maxima suppression and thresholding to obtain a clean binary edge map.

(c) Apply the Hough transform to extract straight lines from the edge map. Overlay the detected lines on the original image.

(d) Explain how noise and threshold choice affect the completeness of the detected contours.

4 Region-Based Segmentation

> **Background**
>
> Region-based methods group pixels into regions based on similarity (e.g., intensity or texture). Techniques include region growing, splitting–merging, and watershed—all used in remote sensing, biomedical imaging, and more.

(a) Implement region growing starting from manually chosen seed points (at least three). Show the grown regions overlaid on the original image.

(b) Apply the watershed transform (after computing the gradient magnitude) to segment the image.

(c) Compare the results of region growing and watershed. Which method better separates touching cells?

(d) Discuss how pre- and post-processing (e.g., smoothing or morphological operations) can improve segmentation quality.

> **Textbook Questions**
>
> **Please provide the solutions to the questions presented in the 10th chapter of the Image Processing book (Edition3): 3, 6, 15, 20, 24 and 31**