

CS 675 – Computer Vision – Fall 2007

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Assignment #1

Posted on September 24 – due by October 6

Question 1: Adding Binary Image Functions to the JImageTool Program

Please familiarize yourself a bit with the JImageTool program that you can download from the course homepage. In its original version, all it can do is load a grayscale bitmap, apply a simple filter (horizontal flip), and write the resulting image to the hard drive. With each assignment, you will expand the capabilities of the program. This time, you will add functionality for binary image processing.

The first thing you need to do is add a button labeled “Create Binary Image” (or similar, you can always be creative in designing layout and labeling in your program). Also, there should be a field labeled “Threshold” where you can enter the value (0 ... 255) of your brightness threshold. This field could be either static or pop up once you press the “Create Binary Image” button. The result should be a binary image (only values 0 or 255) showing up in the window on the right side of your application. Let us say that brightness values above or equal to the threshold value will become 255, the others 0.

Then add buttons on the right side “Expand” and “Shrink” that perform the corresponding actions on the binary image on the right and display the result there.

Another button should have the label “Label Components.” It will trigger a component labeling algorithm. You can implement any component labeling algorithm you like. However, instead of assigning the labels 1, 2, 3, and so on, assign the labels 10, 20, 30, ... and so on. Once you exceed 255, you start over with 10 again. This way the resulting image shows the individual connected components in distinguishable gray values.

The next button to add on the right side is labeled “Apply Size Filter,” combined in some way with a field where you can enter a positive integer. This will apply a size filter of the indicated value to the binary image on the right side and display the result there.

Finally, on the right side add a button “Analyze Components.” It should also allow you to specify a file name in a separate field. When the user presses this button, the current binary image on the right is analyzed in the following way: First, the connected components are identified. Then for each component the following variables are determined: its size (area) A , its center of gravity (\bar{x}, \bar{y}) , and its compactness. A file with the specified name is written, looking like this:

component no.	position x	position y	size	compactness
1	211.4	189.5	853	24.76
2	322.0	57.3	155	29.81
3	99.3	341.1	201	27.62
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Question 2: Adding Gaussian Smoothing

The next addition to your program will be a “Gaussian Smoothing” button. After pressing this button, the user can enter the size of the Gaussian filter (e.g., input “3” indicates a 3×3 filter). Then the convolution will be performed on the left image, and the result will be displayed on the right side.

Instead of actually performing the convolution with a two-dimensional filter, successively use two one-dimensional filters (one horizontal, one vertical). Choose the standard deviation σ of the Gaussian function to be one fourth of the filter size (e.g., for a 5×5 filter, $\sigma = 1.25$). Implement the smoothing operation in such a way that the resulting image has the same size as the original and that no pixels at the boundary of the image are just set to 0. Find a way to assign sensible values to the boundary pixels so that they are included in the smoothing operation.

General Remarks:

Do not use any specific packages or pieces of code that you have not written yourself. You can discuss your problems and ideas with anyone you like, including me (by e-mail or in person), you can consult any books and the web, but you cannot copy any code from other students, from books, or from the web. Just submit an electronic version by putting it into your CS675 directory (use the ‘apply’ command to get one). Please also include a file (.txt, .doc, or .pdf) that explains your solution. Also, please comment your code sufficiently.