Project 2

CSE 402 - Biometrics and Pattern Recognition
Instructor: Dr. Arun Ross
Due Date: November 21, 2018 (12:40 pm)
Total Points: 50

Note:

(a) While you may discuss this project with others, the final submission *must be your own effort*. Any indication to the contrary will be considered an act of academic dishonesty.

(b) Your zipped code (labelled as proj01_yourname.zip) should be sent to rossarun at cse.msu.edu with the subject line "cse402: proj01_yourname" before the lecture begins on the due date.

(c) A hard-copy showing the results of your work should be turned in before the lecture begins on the due date. The appendix of your report should include the code developed in this project.

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1. [20 points] Based on the algorithm discussed in class write a program to compute the *orientation field* of a fingerprint image. The orientation should be computed for each pixel location. (So the number of rows and columns in the orientation field matrix should be the same as that of the image). Use the Sobel Operator to compute the x and y *gradient* value at each pixel location. Use a window size of 9 $\times$ 9 when computing the *orientation* field value associated with a pixel location. Run your program on the set of 10 fingerprint images available here.

   Use the drawOrientation.m program to display the orientation field as an overlay on the original fingerprint image. Include these overlay images in your submission.

2. [20 points] Recall that a minutiae set, M, is a set of 3-tupled values $M = \{(x_i, y_i, \theta_i)\}$, $i = 1, 2 \ldots N_M$, where (x_i, y_i) is the location of minutiae i, θ_i is its orientation, and N_M is the total number of minutiae in M. Implement the minutiae matching method discussed in class (RANSAC method) that compares two minutiae sets M_1 and M_2, and outputs the transformation parameters t_x, t_y and t_θ relating M_2 with M_1, along with the number of matching minutiae pairs.

   You are given a set of 10 minutiae files pertaining to 5 different fingers (the orientation value is denoted in "degrees"). Run your program on all possible pairings of the minutiae files and present a table listing the results in the following format: First File Name (M_1), Second File Name (M_2), t_x, t_y, t_θ, Number of Matching Minutiae Pairs (s). For example, the first line of the table will be:

   user001_1.minpoints user001_2.minpoints -65 -6 0.052360 19

   For determining the number of matching minutiae pairs, you can use a bounding box of 10 pixels.

3. [10 points] You will be using the fingerprint images you had collected using your smartphone *camera* for this problem.

   (a) Use any image editing program (e.g., PhotoShop, Gimp, Matlab, etc.) to manually crop out and obtain one image each of the following 8 fingers: left and right index fingers, left and right middle fingers, left and right ring fingers, and left and right pinky fingers.

(b) Use any image editing program to improve the “quality" of each image so that the ridges and valleys are clearly discernible (e.g., you can perform histogram equalization, change image contrast and brightness, apply gamma correction, etc.). Note: You do not have to necessarily write a program to enhance quality - the adjustment can be done “manually", if needed.

(c) What type of image processing operations did you conduct to improve the quality of each image? If you developed code to improve image quality, then you must include it here.

(d) Print the 8 images and manually mark at least 10 minutiae points in each of them.
