CAP 5400 Digital Image Processing: Assignment # 3

Palm Based Biometric using PCA

Due 3:30 pm on Nov 28, 2001 (100 pts)

1 The Data Set

The data set for this project consists of 420 palm images from 70 subjects (2 hands and 3 position of the fingers each). This data is available on `grad` at `~sarkar/PalmImages/PPM`

2 Data Preparation

Manually mark the tip of the index finger and the center of the wrist the 420 hand images. You can work in groups (Executive summary groups) for this part ONLY.

Using the code from your second assignment, normalize (rotate, translate, scale, and intensity scale) the 420 hand images to 128 by 200 sized images. The centerline through the hand should be along column 100, instead of 64, as was the case in your second assignment.

3 Code

You have to compute the PCA or KLT based similarity measure between images. You can use the PCA code available at the link from University of Colorado. Note that the PCA code accepts file in `.nrm` format, which is created by the image normalization code provided. You would have to modify your normalization code to output in *.nrm* format. You should also note that the PCA code accepts image **zero** mean intensity values and your normalization code from the second assignment results in an image with a mean intensity value of 100.

For each of images from the probe and the gallery set, produce a similarity matrix, with low number indicating more similarity than high ones.

Write code to process these similarity matrix and plot the CMC and the ROC curves.

4 Experiments to Run

For the following set of experiments choose the *training set* to the same as the corresponding *gallery set*.

4.1 Study 1

Hypothesis: If the state of the palm, i.e. closed, half, and full open fingers, is fixed, then we can identify someone from the palm image.

This study consist of the following parts with the specified gallery and probe sets.

Part	Gallery	Probe
1	Left, Closed (70)	Right, Closed (70)
2	Right, Closed (70)	Left, Closed (70)
3	Left, Half Open (70)	Right, Half Open (70)
4	Right, Half Open (70)	Left, Half Open (70)
5	Left, Open (70)	Right, Open (70)
6	Right, Open (70)	Left, Open (70)

4.2 Study 2

Hypothesis: Irrespective of the state of the fingers, i.e. closed, half, and full open fingers, we can identify someone from the palm image.

This study consist of the following parts with the specified gallery and probe sets.

Part	Gallery	Probe
1	Left, Closed (70)	Rest (350)
2	Right, Closed (70)	Rest (350)
3	Left, Half Open (70)	Rest (350)
4	Right, Half Open (70)	Rest (350)
5	Left, Open images (70)	Rest (350)
6	Right, Open images (70)	Rest (350)

4.3 Study 3

Hypothesis: If the state of the palm, i.e. closed, half,

and full open fingers, is fixed, then we can identify someone from the *magnitude of the Fourier transform* of the palm image.

This study consist of the following parts with the specified gallery and probe sets.

Part	Gallery	Probe
1	Left, Closed (70)	Right, Closed (70)
2	Right, Closed (70)	Left, Closed (70)
3	Left, Half Open (70)	Right, Half Open (70)
4	Right, Half Open (70)	Left, Half Open (70)
5	Left, Open (70)	Right, Open (70)
6	Right, Open (70)	Left, Open (70)

4.4 Study 4

Hypothesis: Irrespective of the state of the fingers, i.e. closed, half, and full open fingers, we can identify someone from the *magnitude of the Fourier transform* of the palm image.

This study consist of the following parts with the specified gallery and probe sets.

Part	Gallery	Probe
1	Left, Closed (70)	Rest (350)
2	Right, Closed (70)	Rest (350)
3	Left, Half Open (70)	Rest (350)
4	Right, Half Open (70)	Rest (350)
5	Left, Open images (70)	Rest (350)
6	Right, Open images (70)	Rest (350)

4.5 Study 5

Hypothesis: If the state of the palm, i.e. closed, half, and full open fingers, is fixed, then we can identify someone from the *phase of the Fourier transform* of the palm image.

This study consist of the following parts with the specified gallery and probe sets.

Part	Gallery	Probe
1	Left, Closed (70)	Right, Closed (70)
2	Right, Closed (70)	Left, Closed (70)
3	Left, Half Open (70)	Right, Half Open (70)
4	Right, Half Open (70)	Left, Half Open (70)
5	Left, Open (70)	Right, Open (70)
6	Right, Open (70)	Left, Open (70)

4.6 Study 6

Hypothesis: Irrespective of the state of the fingers, i.e. closed, half, and full open fingers, we can identify someone from the *phase of the Fourier transform* of the palm image.

This study consist of the following parts with the specified gallery and probe sets.

Part	Gallery	Probe
1	Left, Closed (70)	Rest (350)
2	Right, Closed (70)	Rest (350)
3	Left, Half Open (70)	Rest (350)
4	Right, Half Open (70)	Rest (350)
5	Left, Open images (70)	Rest (350)
6	Right, Open images (70)	Rest (350)

5 Report (40 pts)

You have to produce a 6 to 8 pages report (more like a paper) in IEEE two-column format, including all text, figures and references. A link to the format specifications is provided from the web-page, along with a link to a Latex Macro that conforms to the specifications.

Your report is a summary of all your assignments. It should have the following sections. Note: figures and images that are not discussed in the text will not be considered during grading.

1. The title of the report: "Investigation of palm image as a biometric." or some variation thereof.
2. An abstract summarizing the problem definition, methods used, and conclusions. (read the instructions in the abstract writing guideline link from the class web-page).
3. A short, one paragraph introductory section that should include a synopsis of the prior work on recognition from hand images and products that are available for such.
4. A section describing the similarity computation algorithm (PCA based) along with a block diagram illustrating interactions between the vari the interactions between the various parts of the algorithm.
5. A section describing the data set, examples of normalized images, Fourier magnitude, and phase images.

6. A section describing the studies that you conduced
7. An analysis section that plot the CMC and ROC curves for each of the experiments and discuss them
8. A concluding paragraph.

6 Submission

1. Submit your source code as email attachment(s) to Tong Luo at `tluo2@eng.usf.edu`. Make sure your code runs on `babbage or suntan`. You have to demonstrate your code to Tong before Dec 1.
2. Submit your written report to me.