ECE547 Image Processing Tuesday Sep 15, 2009

Machine Problem 2

Lecturer: Prof. Minh Do *Due: Thursday Sep 24, 2009*

1 Description

For this machine problem, you will use skin color feature to segment the face region of an image.

You are asked to write a MATLAB program to perform the following tasks for each of the three given test images:

- `http://courses.ece.illinois.edu/ece547/mp/ashu1.jpg`
- `http://courses.ece.illinois.edu/ece547/mp/ashu2.jpg`
- `http://courses.ece.illinois.edu/ece547/mp/ashu3.jpg`

You are asked to perform the following steps on each of the images. When the instructions call for saving a file as `filename-n.png` replace the "n" with the appropriate image number. For example, you should save `segment-1.png` and `edge-1.png` when working with `ashu1.jpg`.

1. Apply a Sobel or Canny edge detector on the image. Save this result as `orgedge-n.png`.
2. Convert the image from RGB color space into your favorite color space, i.e., normalized-RGB or HSV. Hint: The hue and saturation components in the HSV space are widely used for skin color based segmentation.
3. Find a binary classifier that best segments the face region in the image. The classifier returns 1 if a pixel belongs to the skin region, and 0 otherwise. The decision rule will be one or more inequalities based on the color of the pixel. After applying the pixel-wise classifier, you will have a binary image that have the skin region in white and background region in black.

   Hint: You can try some simple inequalities by tuning the thresholds manually. Or you can cut a patch of pure skin region from the test image and use it to train a maximum likelihood classifier.

   The likelihood of a given pixel belongs to skin region can be estimated (trained) by collecting the color histogram in the training patch of skin. The histogram is two-dimensional with 8 bins in hue and 8 bins in saturation.

   Save this result as `segment-n.png`.
4. Apply a Sobel or Canny edge detector on segmented images to find the contour of the skin region. Save this result as `edge-n.png`.
5. Extra credit: Use Principal component analysis (PCA) to find the principal axes of the contour points. Based the PCA results, find the angle between the principle axis of the face and the vertical axis of the image.

2 Hand-in

Please create an archive of your work named `netid.zip` or `netid.tar.gz`, where `netid` is your NetID. In this archive, include:

1. MATLAB files for performing the steps above.
2. The `segment-n.png` and `edge-n.png` as specified in the description.
3. A short report (plain text will be fine, doc or pdf will be accepted) containing:
   (a) Your name.
   (b) A brief description of why you chose your colorspace.
   (c) The way you made your classifier.
   (d) The angles that you found in step 5 (for each of the three images) if you have done it.

Please email a copy of the archive to `vuongle2@ifp.uiuc.edu`

3 Additional Resources

3.1 Some Useful Matlab functions

You may want to use some of these MATLAB function `rgb2hsv`, `edge`, `princomp`.

3.2 Sample Output

Below are examples of what you should expect for `ashu1.jpg`.