

CAP 5400 – DIGITAL IMAGE PROCESSING

Assignment 2: The purpose of this homework is to experiment with image augmentation based on histogram modification and color processing and utilization of OpenCV library. Your program should be able to do the following (operate all functions within specified ROIs (up to three ROIs):

1. Histogram modification [6 points]

- A. [2 points] Add histogram stretching function for grey level images to your choice of options in image processing toolbox. Stretching is defined by user provided intensity range parameters (A, B): stretch the intensities in the image range [c,d], described next) on the input image to the range of [A, B] as output.
 - [0, c] \rightarrow A,
 - [c, d] \rightarrow [A, B],
 - [d, 255] \rightarrow B.
 - Utilize $c=1.05 \cdot I_{\min}$ and $d=0.95 \cdot I_{\max}$ as input ranges while mapping pixels less than $1.05 \cdot I_{\min}$ to A and pixels brighter than $0.95 \cdot I_{\max}$ to B
 - Generate images of the histograms for the ROI before and after the procedure, this is good for debugging.
- B. [2 points] Add histogram equalization to your toolbox. Utilize OpenCV to process images of ROIs.
- C. [2 points] Augmentation of grey level images: generate 11 additional similar same-size images from each ROI via
 - a. Take the original ROI image and rotate 90, 180, and 270 degrees.
 - b. Take the original ROI image and stretch the histogram using user provided (A, B). Then rotate by 90,180, 270.
 - c. Take the original ROI image and modify using histogram equalization, then rotate 90/180/270.
 - d. Display all 12 images.

2. [extra credit – 3 points] Combine histogram equalization with thresholding (T – user provided) by dividing the image into two parts: dark ($<T$) and bright ($\geq T$), then applying equalization to dark pixels only. Note that you need to modify the image prior to OpenCV call.

3. Color Processing [4 points]

- A. [1 point] Apply the histogram equalization to one of the R, G, B components at a time or all three together, then combine in one color image for display. User defined parameter should allow for choice in which of the R,G,B components to apply histogram equalization to.
- B. [1 point] Implement RGB to HSI conversion utilizing OpenCV. Apply intensity histogram equalization by applying it to the I-component, display I as grey level image, then convert back to RGB for display. Perform histogram equalization on both H and S components separately. How about including all three I, S and H components? Experiment. Compare utilization of RGB vs HSI for histogram equalization.
- C. [2 points] Augmentation of color images: generate 11 additional same-size images from each ROI via [4 points]
 - a. Take the original ROI image and rotate 90, 180, and 270 degrees.
 - b. Take the original ROI image, perform histogram equalization on I component. Then rotate by 90,180, 270.
 - c. Take the original ROI image, perform histogram equalization on S component. Then rotate by 90,180, 270.
 - d. Display all 12 images

Make sure that you have completed report for this assignment (not just few comments).

- Include input and output images (use several gray level and color images).
- Discuss performance of histogram processing on grey level and color images

How to submit: See TA help desk for instruction on report and program submission and testing.