Noakhali Science and Technology University

Department of Information and Communication Engineering

DIGITAL IMAGE PROCESSING

LAB MANUAL 4

Histogram Processing

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Lab Objectives:

The objective of this lab is to understand & implement

1. Histogram
2. Histogram Equalization
3. Histogram Specification/Matching

Histogram Equalization:

Histogram of a digital image with intensity levels in the range [0, L-1] is a discrete function $h(r_k) = n_k$ where r_k is the k^{th} intensity value and n_k is the number of pixels in the image with intensity r_k. In histogram there are 3 possibilities as follows,

1. For a dark image the components of histogram on the low (dark) side.
2. For a bright image the component are on high (bright) side &
3. For an image with low contrast they are in the middle of gray side.

Histogram equalization is done to spread their component uniformly over the gray scale as far as possible. This is obtained by function-

$$S_k = \sum_{i=0}^{k} \frac{h_i}{n}; k = 0, 1, 2, , \ldots , i - 1$$

Thus processed image is obtained by mapping each pixel with level rk into a corresponding pixel with level sk in outpup image. This transformation is called Histogram equalization.

Histogram Specification/Matching:

Histogram equalization automatically determines a transformation function that seeks to produce an output image that has a uniform histogram. But it is useful sometimes to be able specify the shape of the histogram that we wish the processed image to have. The method used to generate a processed image that has a specified histogram is called histogram specification.

$$S_k = T(r_k) = {}^{X}Pr(r_j); k = 0,1,2,3,\ldots,L-1$$

$$V_k = G(z_k) = {}^{X}Pz(z_j); k = 0,1,2,3,\ldots,L-1$$

$$Z_k = G^{-1}(T(r_k)); k = 0,1,2,3,\ldots,L-1$$

Map each pixel with level rk into a corresponding pixel with level sk . Obtain the transformation function G from a given histogram Pz(z). For any Zq this transformation function yields a corresponding value Vq. We would find the corresponding value Zq from G−1.

Background Study:

Use help command of Matlab to learn the below concept and apply them on your test data.

a. Modulus
b. Reminder
c. Bar graph
d. Axis
e. Xlabel
f. Ylebel

Practice Tasks:

TASK 1

Plot histogram of image 'lab3_2.tif'. Although Matlab has a histogram function 'imhist' but you write your code to calculate histogram. Finally compare two output and display both image in same display.

TASK 2

Write a program to equalize the histogram and repeat the task 2. (Note: For histogram equalization use *'histeq'*)

TASK 3

a. Write a program to implement Histogram Matching Algorithm in Matlab.
b. Write a program for Local Histogram Equalization and note differences between local and global histogram equalization.