LAB 6

Fall 2010, BESE- 13 & 14

Digital Image Processing with MATLAB

Objective

The purpose of today's lab is to have an insight into the gray intensity slicing and histogram equalization. Also, we will explore MATLAB function to equalize image histogram. By the end of this lab you should be able to perform gray level slicing and to equalize image histogram.

Submission Requirements

You are expected to complete the assigned tasks within the lab session and show them to the lab engineer/instructor. Some of these tasks are for practice purposes only while others (marked as '*Exercise'* or '*Question*') have to be answered in the form of a lab report that you need to prepare. Following guidelines will be helpful to you in carrying out the tasks and preparing the lab report.

Guidelines

- In the exercises, when you are asked to display an image, you have to put the image displayed in your project report. You may either save the image as 'jpeg' (File->Save As) or add it to the report or use the 'Print Screen' command on your keyboard to get a snapshot of the displayed image. This point will become clear to you once you actually carry out the assigned tasks**.**

- Name your reports using the following convention:
  - ***Lab#_Rank_YourFullName***

  - '#' replaces the lab number
  - '*Rank'* replaces Maj/Capt/TC/NC/PC
  - '*YourFullName*' replaces your complete name.
- You need to submit the report even if you have demonstrated the exercises to the lab engineer/instructor or shown them the lab report during the lab session.

Tasks for Today

1. Gray-Level Slicing

Highlighting a specific band (or range) of gray-intensities in an image is referred as gray-level slicing. The purpose of gray-level slicing is to assign more weight to certain details/information in an image for the purpose of analysis or to make them more visible in an image.

Exercise 1:

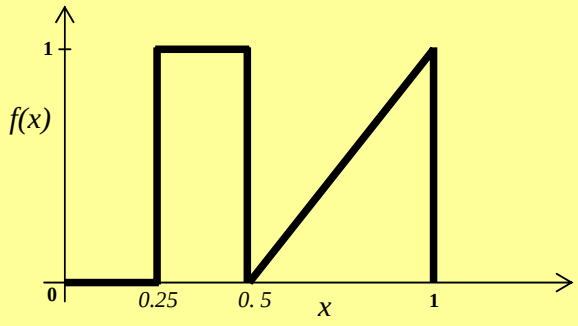
Consider a function *f(x)* defined over an image 'cameraman.tif' with the intensities in the range [0 1], as defined below:

$$f(x) = \begin{cases} 1 - x & 0 < x \le 0.25 \\ 1 & 0.25 < x \le 0.5 \\ x & x > 0.5 \end{cases}$$

a) Draw a graph for *f(x)* to show its influence on image intensities.
b) Write a MATLAB program to implement *f(x)* on an input image. Also, show your results after transformation.

Exercise 2:

Write a MATLAB program for the following function on an input image 'cameraman.tif'. Also show your results.



2. Histogram Equalization

Histogram equalization is the process of re-allocating intensity values of the pixels in an image such that the output image contains uniform distribution of intensities defined by a monotonically increasing function *T(r)*.

2.1 MATLAB Function for histogram equalization:

ou_img = histeq(in_img, L); equalizes histogram of an input image *in_img* for the specified gray levels L.

Example:

```
>> img_i = imread('cameraman.tif');
>> img_o = histeq(img_i, 256);
>> imshow(img_i), figure, imshow(img_o)
```

2.2 How to Equalize a Histogram?

Consider an image of order 4x4 with 2^4 = 16 (0 – 15) gray levels.

$f(r_k)$	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
n_k	0	1	3	1	1	1	1	2	1	3	1	0	1	0	0	0
cum. n_k	0	1	4	5	6	7	8	10	11	14	15	15	16	16	16	16

Original image:

2	**5**	**9**	**9**
7	**6**	**2**	**2**
8	**9**	**7**	**3**
4	**10**	**12**	**1**

4	**7**	**14**	**14**
10	**8**	**4**	**4**
11	**14**	**10**	**5**
6	**15**	**16**	**1**

Use the following transformation:

s= round((L-1) x cdf (r)/(MxN))

2.3 Algorithm to Equalize an Image Histogram:

a) Compute histogram, as follows:

h(in_image(i, j) + 1) = h(in_image(i, j) + 1) + 1;

b) Compute cumulative histogram, as follows:

cum_h(1) = h(1);

cum_h(k) = cum_h(k - 1) + h(k); *% for all k ≥ 2*

c) Copy intensities from *in_image* into a new image *out_image,* as follows:

out_image(i, j) = round((L-1) x cum_h(in_image(i, j) + 1)/(MxN));

Exercise 3:

Write a function named 'myhist_equ' to **MANUALLY** equalize histogram of an image 'cameraman.tif' and map corresponding results:

INPUTS: image

OUTPUTS: display an input image as well as equalized (resultant) image alongwith histogram before and after histogram equalization.

(DON'T USE histeq FUNCTION)