Batch: C1 Roll No.:16010122323
Experiment No. 7
Grade: AA / AB / BB / BC / CC / CD /DD
Signature of the Staff In-charge with date

Title: Write a program to apply the global processing technique: Histogram equalization.on a digital image

Objective: To learn and understand the concept of histogram stretching and equalization in image enhancement operations.

Expected Outcome of Experiment:

CO	Outcome
CO4	Design & implement algorithms for digital image enhancement, segmentation & restoration.

Books/ Journals/ Websites referred:

1. http://www.mathworks.com/support/
2. www.math.mtu.edu/~msgocken/intro/intro.html.
3. R. C.Gonsales R.E.Woods, “Digital Image Processing”, Second edition, Pearson Education
4. S.Jayaraman, S Esakkirajan, T Veerakumar “Digital Image Processing “Mc Graw Hill.
5. S.Sridhar,”Digital Image processing”, oxford university press, 1st edition."

Pre Lab/ Prior Concepts:

Image histogram:

In an image processing context, the histogram of an image normally refers to a histogram of the pixel intensity values. This histogram is a graph showing the number of pixels in an image at each different intensity value found in that image. For an 8-bit greyscale image there are 256 different possible intensities, and so the histogram will graphically display 256 numbers showing the distribution of pixels amongst those greyscale values. Histograms can also be taken of color images either individual histogram of red, green and blue channels can be taken, or a 3-D histogram can be produced, with the three axes representing the red, blue and green channels, and brightness at each point representing the pixel count. The exact output from the operation depends upon the implementation it may simply be a picture of the required histogram in a suitable image format, or it may be a data file of some sort representing the histogram statistics.

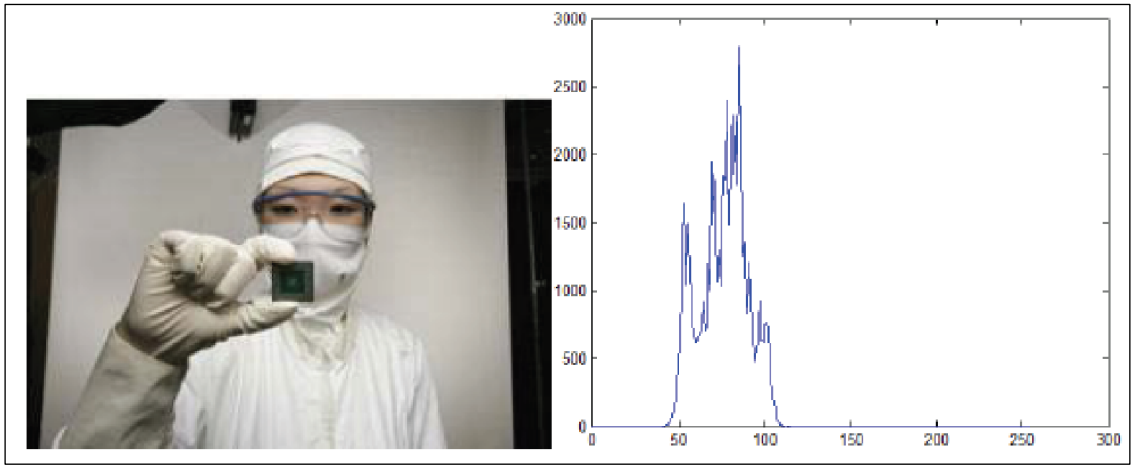


Fig. 1 An image and its histogram

Histogram Equalization:

A perfect image is one which has equal number of pixels in all its grey levels. hence our objective is not only to spread the dynamic range , but also to have equal pixels in all the grey levels. This technique is known as histogram equalization.

Basically the histogram equalization spreads out intensity values along the total range of values in order to achieve higher contrast. This method is especially useful when an image is

represented by close contrast values, such as images in which both the background and foreground are bright at the same time, or else both are dark at the same time. For example, the result of applying histogram equalization to the image in figure 1 is presented in figure 2.

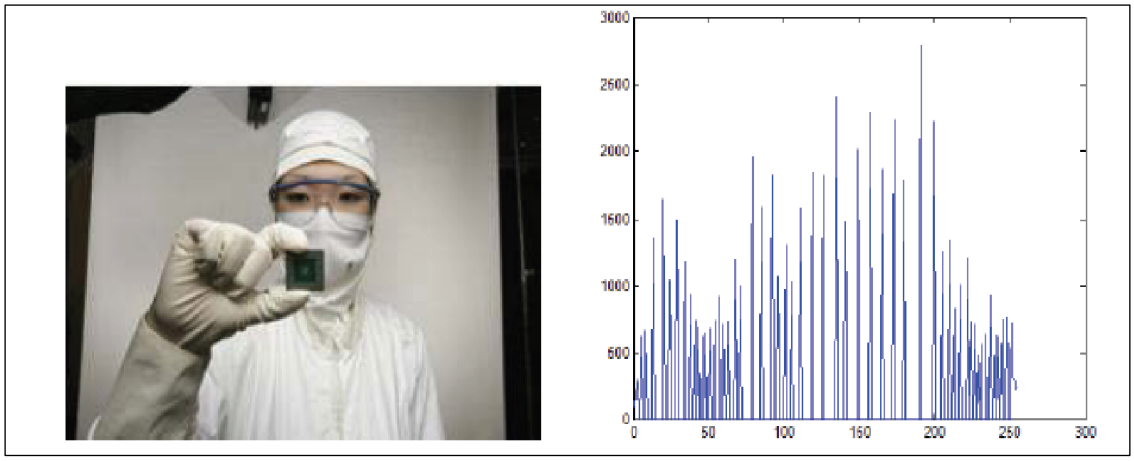


Fig. 2 New image and its equalized histogram

Description of cumulative histogram equalization:

Here are the steps for implementing this algorithm.

1. Create the histogram for the image.
2. Calculate the cumulative distribution function histogram.
3. Calculate the new values through the general histogram equalization formula.
4. Assign new values for each gray value in the image.

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

Resources Used: Matlab

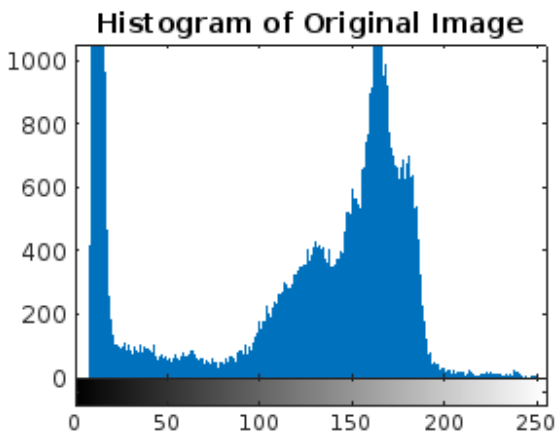
Implementation Details:

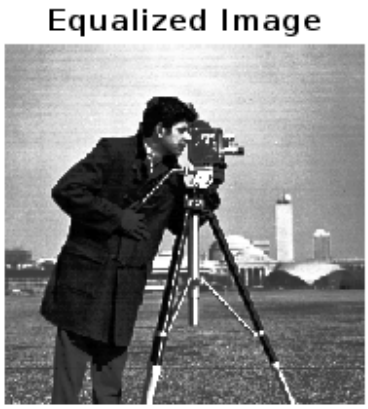
Write Algorithm and Matlab commands used

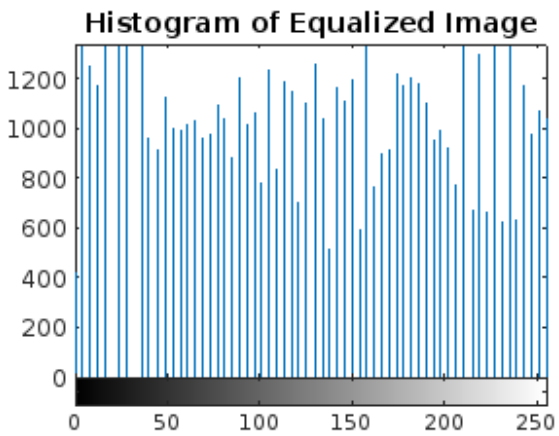
HISTOGRAM EQUALIZATION

```
>> % Read the Cameraman image
img = imread('cameraman.tif');

% Display the original image
subplot(2, 2, 1);
imshow(img);
title('Original Image');

% Calculate the histogram of the original image
subplot(2, 2, 2);
imhist(img);
title('Histogram of Original Image');

% Perform Histogram Equalization
equalized_img = histeq(img);

% Display the equalized image
subplot(2, 2, 3);
imshow(equalized_img);
title('Equalized Image');
```

```
% Calculate the histogram of the equalized image

subplot(2, 2, 4);

imhist(equalized_img);

title('Histogram of Equalized Image');
```







Conclusion:- In this experiment, we learn to apply the global processing technique: Histogram equalization.on a digital image

Date: _____ **Signature of faculty in-charge**

Post Lab Descriptive Questions

Compare between contrast stretching and histogram equalization.

Aspect	Contrast Stretching	Histogram Equalization
Purpose	Enhances image contrast by expanding intensity range	Enhances image contrast by redistributing pixel intensities uniformly
Method	Linear or piecewise linear transformation	Non-linear transformation using cumulative distribution function (CDF)
Histogram Shape	Stretches histogram but doesn't flatten it	Attempts to flatten the histogram
Control	Offers direct control over intensity range	Less intuitive control; depends on the image's histogram
Complexity	Simple and easy to implement	Slightly more complex due to CDF computation
Effect on Details	Preserves overall look, may not highlight hidden details	Enhances hidden details, but can introduce unnatural effects
Brightness Handling	Maintains original brightness better	Can shift brightness levels significantly
Best Use Case	Images with narrow intensity ranges	Images with poor global contrast
Visual	More subtle enhancement	Stronger, more dramatic