Second experiment

1. Negative of a Grayscale image.

Objective: To find the negative of the given grayscale image

Theory: For a given Grayscale image the Negative image is one in which all pixels values are replaced by its complementary value. That means a white pixel will be replaced by a black pixel and vice a versa. A perfect white pixel has pixel value as 255 and perfect black pixel has value 0. Any other intermediate value of pixel will indicate a mixture of white and black. For example if pixel value is 210 then it represents a pixel which is more whitish than black.

Figure a below is the original gray image and image b is corresponding Negative image.

Fig a: Original Image

Fig b: Negetive of the Image

MCQ:

1. Consider a gray scale image which is added to its negative image. Then all pixels in the resulting image will have value=

a) 0 b) 100 c) 255 d)256

2. Which expression is obtained by performing the negative transformation on the negative of an image with gray levels in the range[0,L-1] ?
   a) s=L+1-r
   b) s=L+1+r
   c) s=L-1-r
   d) s=L-1+r

Matlab Assignment:

1. Write a matlab program to find the negative of the grayscale image and display the result.

Steps to get the Negative Image:

i) Read a Gray scale image. (Use: imread)
ii) Each pixel in the image is to be replaced by its complementary pixel. (Pixel value + Complementary Pixel value=255)
iii) Display original and converted image.(Use: imshow)

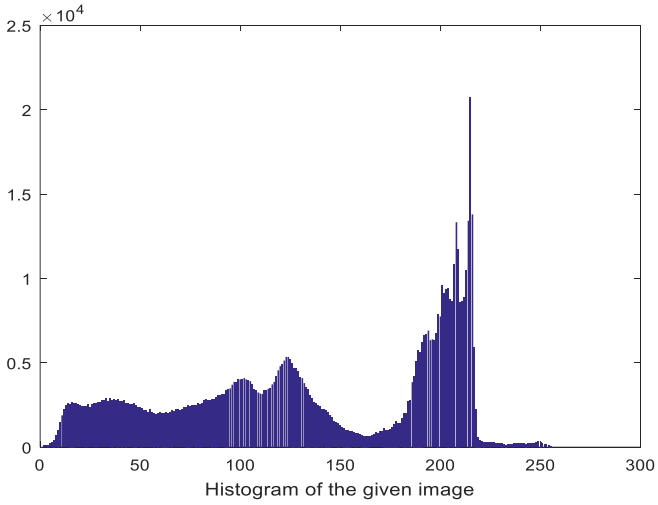
2. Histogram of an Image

Objectives: To find the histogram of the image
To perform histogram equalization of images

Theory: Histogram of an Image gives the tonal (color) distribution of a digital image. X-axis of the histogram is the pixel value from 0 to 255 and Y-axis gives number of pixels having that pixel value. So left side of the histogram represents black and dark pixels and right side indicate light and pure white pixels. Thus, the histogram for a very dark image will have the majority of its data points on the left side and center of the graph. Conversely, the histogram for a very bright image with few dark areas and/or shadows will have most of its data points on the right side and center of the graph.
The normalized histogram of an image is obtained by dividing each value in the histogram by total number of pixels in the image. It serves as PDF (Probability Density Function) of the image.

A gray scale image with corresponding histogram can be found below.

Original Image



MCQ:

1. Consider a gray scale image 'A' and its negative image 'B', the histogram of negative image is related to histogram of original image as:
   a) Same as that of A
   b) Mirror image about horizontal axis
   c) Mirror image about the vertical axis
   d) No relation

2. What is the method that is used to generate a processed image that have a specified histogram?
   a) Histogram linearization
   b) Histogram equalization
   c) Histogram matching
   d) Histogram processing

3. In a dark image, the components of histogram are concentrated on which side of the grey scale?
   a) High
   b) Medium
   c) Low
   d) Evenly distributed

Matlab Assignment:

1. Write a Matlab program to plot the histogram of a given image.

Steps to get Histogram if an Image

I) Read a Gray scale image
II) Create an Array with 256 elements which represents counters for each possible value of pixel.
III) Find the value of each pixel and increment the corresponding counter.
IV) Display the Histogram
V) Compare the it with the histogram obtained using "imhist" function.

Histogram Equalization (imadjust, log scaling)

Histogram equalization is a method of contrast adjustment of an image such that the histogram becomes almost uniformly distributed. Contrast is the difference in luminance or colour that makes an object in an

image distinguishable from the background. In simple words, Contrast is the difference in brightness between objects or regions. The contrast adjustment in an image can be done using Matlab function "imadjust"

More details about Histogram equalization and image contrast can be seen at:

Digital Image Processing Using MATLAB by Rafael C Gonzalez, Page no: 76-82

Matlab Assignment:

1) Write a program to read a gray scale image and perform histogram equalization on it.

Steps:

I) Read a gray scale image and plot its histogram.

ii) Perform histogram equalization on it. (You may use: "histeq" in Matlab)

iii) Plot the the equalized histogram and compare with unequalized histogram.

2) Improve the contrast of an image using "imadjust" function in Matlab.

3. Basic arithmetic operations on images

Objectives: To perform basic arithmetic operations such as addition, subtraction, multiplication and division on images

Theory:

Basic arithmetic operations can be performed quickly and easily on image pixels for a variety of effects and applications. Adding a positive constant value to each pixel location increases its value and hence its brightness.

Image Addition: Image addition is used to create double exposure. If $f(m,n)$ and $g(m,n)$ represent two images then the addition of these two images to get the resultant image is given by

$$c(m,n) = f(m,n) + g(m,n)$$

Image subtraction: Image subtraction is used to find the changes between the two images. $c(m,n) = f(m,n) - g(m,n)$

Image multiplication: Image multiplication is basically used for masking. If the analyst is interested in a part of an image then extracting that area can be done by multiplying the area by one and the rest by zero.

Image division: Dividing the pixels in one image by the corresponding pixels in the second image is commonly used in transformation.

Table 1: Applications of arithmetic operations

Sl. No.	Arithmetic Operation	Application
1	Addition	Superimposing one image on another
2	Subtraction	Change detection

3	Multiplication	Masking operation which can be used for background suppression
4	Division	Background suppression

MCQ's:

1. Image processing approaches operating directly on pixels of input image work directly in _____

a) Transform domain
b) Spatial domain
c) Inverse transformation
d) None of the Mentioned

2. The subtraction operation results in areas that appear as dark shades of gray. Why?
a) Because the difference in such areas is little, that yields low value
b) Because the difference in such areas is high, that yields low value
c) Because the difference in such areas is high, that yields high value
d) None of the mentioned

3. If the images are displayed using 8-bits, then, what is the range of the value of an image if the image is a result of subtraction operation?
a) 0 to 255
b) 0 to 511
c) -255 to 0
d) None of the mentioned

4. The subtracted image needs to be scaled, if 8-bit channel is used to display the subtracted images. So, the method of adding 255 to each pixel and then dividing by 2, has certain lim its. What is/are those limits?
a) Very complex method
b) Very difficult to implement
c) The truncation inherent in division by 2 causes loss in accuracy
d) All of the above

Matlab Assignment:

Write a program to perform addition, subtraction and multiplication on 2 images

Steps:

- Read 2 images using imread
- Convert them into suitable datatype to perform arithmetic operations
- Add the images and display the resultant image
- subtract the images and display the resultant image
- Take one of the image , create a small mask which contains black everywhere except the selected region
- Multiply the 2 images and display the result image which contains only portion of the image under masked region

3. Power law transformation/ gamma correction of images

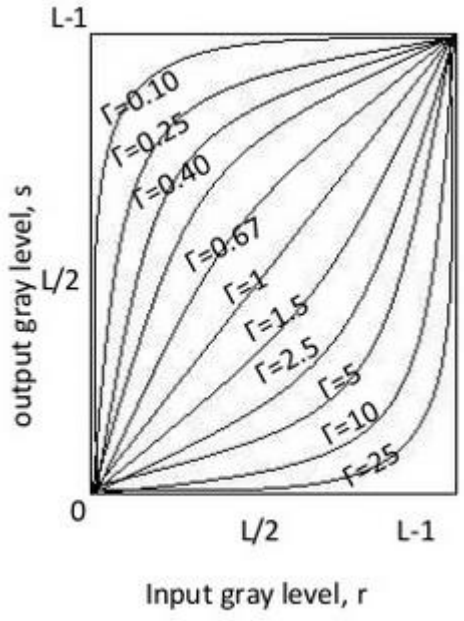
Objectives: To understand the effect of power law transformation on images

Theory:

The power law transformation is given by,

$$g(m,n) = [f(m,n)]^{\gamma}$$

Where $f(m,n)$ is the input image and $g(m,n)$ is the output image. Gamma (γ) can take either integer or fractional values. The characteristic curve is shown in figure below. This transformation function is also called as gamma correction. For various values of γ different levels of enhancements can be obtained. This technique is quite commonly called as Gamma Correction. If you notice, different display monitors display images at different intensities and clarity. That means, every monitor has built-in gamma correction in it with certain gamma ranges and so a good monitor automatically corrects all the images displayed on it for the best contrast to give user the best experience.



MCQ

1. Which of the following shows three basic types of functions used frequently for image enhancement?
   a) Linear, logarithmic and inverse law
   b) Power law, logarithmic and inverse law
   c) Linear, logarithmic and power law
   d) Linear, exponential and inverse law

2. What is the general form of representation of log transformation?
   a) s=clog10(1/r)
   b) s=clog10(1+r)
   c) s=clog10(1*r)
   d) s=clog10(1-r)

3. What is the name of process used to correct the power-law response phenomena?
   a) Beta correction
   b) Alpha correction
   c) Gamma correction
   d) Pie correction

4. Dark characteristics in an image are better solved using _____.
a) Laplacian Transform
b) Gaussian Transform
c) Histogram Specification
d) Power-law Transformation

Matlab assignment:

Write a matlab proram to perform power law transformation on images

Steps:

1. Read the grayscale image using imread
2. Display it using imshow
3. Perform power law transformation on the image for different values of γ say 0.5, 1.5 and 3.
4. Display the result images and observe the effect