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Date of Experiment:24/07/2025	Date of Submission: 24/07/2025
Grade:	Faculty:

Experiment No. 2:

Aim: Apply image-processing algorithms on the test image to obtain new image.

1. For the given test image, apply power law transformation with gamma.
2. For the given low contrast image, apply thresholding and contrast stretching point processing techniques to enhance the image.

Comment on the enhancement results obtained for each value of gamma.

Comment on the comparison and performance of both the techniques.

Prerequisite:

1. Knowledge of MATLAB Software.
2. Image Processing commands.
3. Knowledge of point processing operations.
4. Soft copy of Gray images for processing.

Outcomes:

After successful completion of experiment student will be able to

1. Implement following point processing image enhancement operations.
    a. Negation of an image.
    b. Thresholding of an image.
    c. Contrast Stretching of an image.
    d. Gray level Slicing.
    e. Power law transform.
2. Understand the effect of point processing operations on an Image.
3. Identify the real-life application of point processing technique.

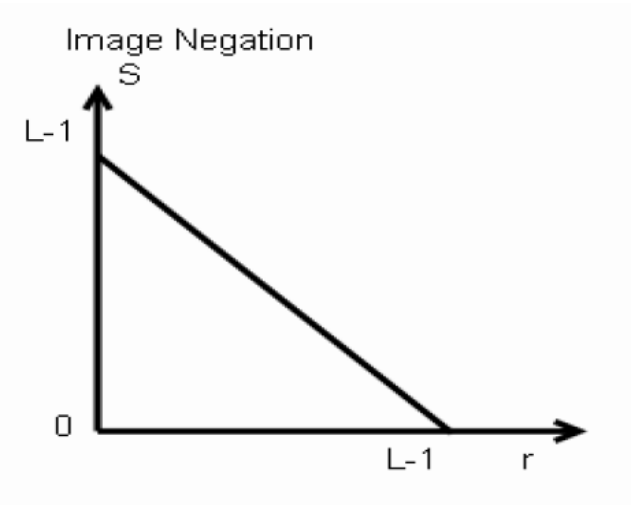
Theory:

a. Image Negative

The negative of an image with gray levels in the range [0, L-1] is obtained by using the negative transformation given by the expression

$$S = L - 1 - r \qquad (1)$$

This is according to the transformation S = T (r) In above transformation (1) , the intensity of the output image decreases as the intensity of the input increases. The type of processing is particularly suited for enhancing white or gray detail embedded in dark regions of an image especially when black areas are dominants in site.



b. Thresholding of an Image

Thresholding is a simple process to separate the interested object from the background. It gives the binary image. The formula for achieving thresholding is as follows

$$s = 0; \quad \text{if } r <= t \qquad (2)$$
$$s = L\text{-}1; \quad \text{if } r > t$$

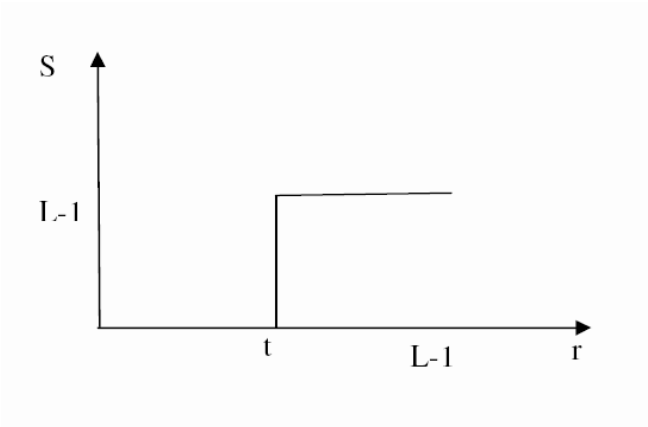


Figure 2: The concept of image thresholding

c. Contrast Stretching of an Image

Low contrast images can result from poor illumination, lack of dynamic range in the imaging sensor etc. The idea behind contrast stretching is to **increase the dynamic range of the gray levels in the image** being processed. The transformation function for contrast stretching is given by

Where: f(x, y) is the Piecewise Linear Contrast Stretch in the image, alpha, beta, and gamma are appropriate constants, which are the slopes in the respective regions and L is the maximum

intensity value.

alpha = *beta =* *gamma =*

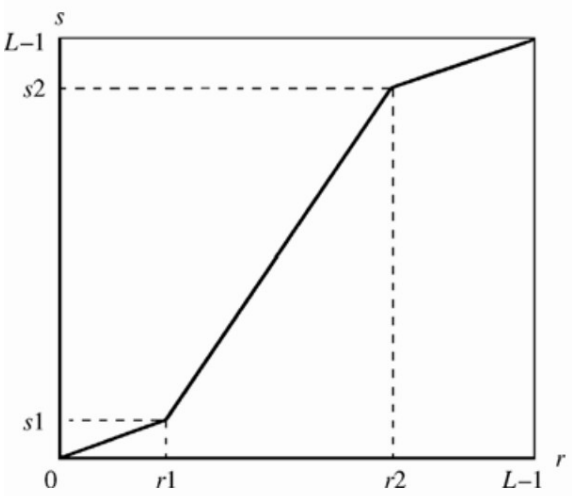


Figure 3: The concept of Contrast stretching

The location of the points (r1 , s1) & (r2 , s2) control the shape of the transformation function.

c. **Gray Level Slicing (Intensity Level Slicing) :**

Highlighting a specific range of gray-levels in an image is often desired. Applications include enhancing features such as masses of water, crop regions, or certain elevation area in satellite imagery. Another application is enhancing flaws in x-ray. There are two main different approaches:

highlight a range of intensities while diminishing all others to a constant low level.

highlight a range of intensities but preserve all others.

The fig. illustrates the intensity level slicing process. The left figures show a transformation function that highlights a range [A,B] while diminishing all the others. The right figures highlights a range [A,B] but preserves all the others.

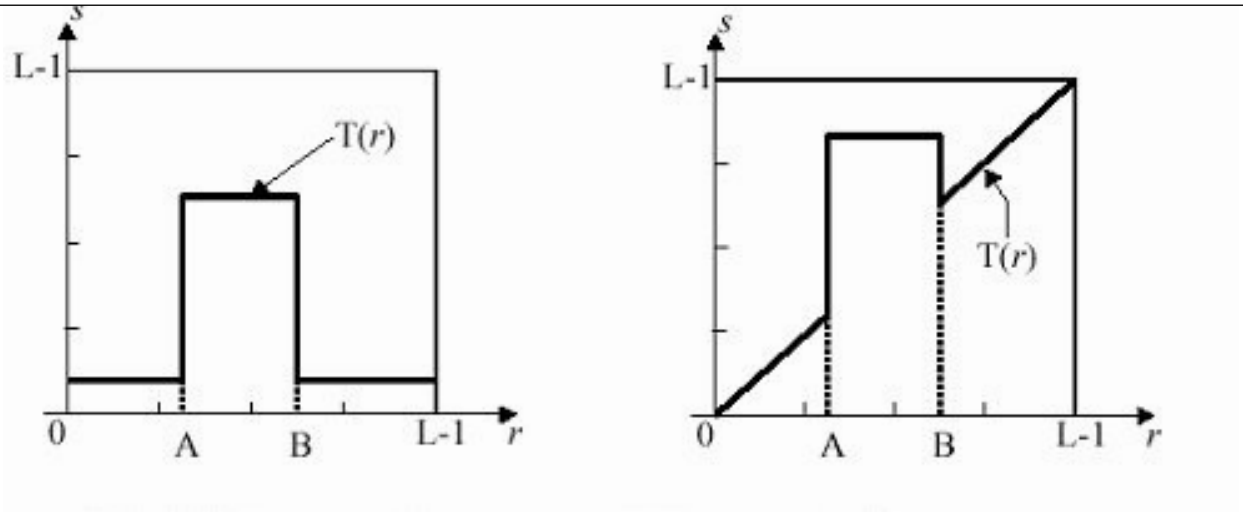


Figure 4: The concept of Gray level slicing without and with background

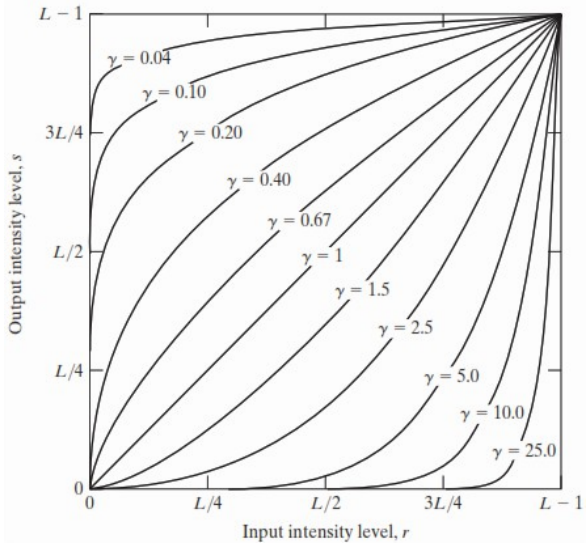
The formulation for grey level slicing without background is

$$\begin{cases} S = L\text{-}1; & \text{if } A \le r \le B \\ S = 0; & \text{Otherwise} \end{cases} \qquad \text{… Equation (4)}$$

The formulation for grey level slicing with background is

$$\begin{cases} S = L\text{-}1; & \text{if } A \le r \le B \\ S = r; & \text{Otherwise} \end{cases} \qquad \text{….Equation (5)}$$

e. Power – Law transformations



There are further two transformation is power law transformations, that include nth power and nth root transformation. These transformations can be given by the expression:

$s=cr_{\gamma}$

This symbol γ is called gamma, due to which this transformation is also known as gamma transformation.

Variation in the value of γ varies the enhancement of the images. Different display devices / monitors have their own gamma correction, that's why they display their image at different intensity.

This type of transformation is used for enhancing images for different type of display devices. The gamma of different display devices is different. For example, Gamma of CRT lies in between of 1.8 to 2.5, that means the image displayed on CRT is dark.

Procedure/Algorithm:

Task 1:

Image Negative

1. Read input image.
2. Read maximum gray level pixel of input image.
3. Replace input image by (maximum – input) = output.
4. Display output image
5. Observe the output and write conclusion.
6. Save the work and close the file.

Task 2:

Thresholding of an Image

1. Read input image.
2. Enter threshold value **t**.

3. If image pixel is less than **t** replace it by zero.
4. If image pixel is > **t** replace it by 255.
5. Display input image.
6. Display threshold image.
7. Observe the output and write conclusion.
8. Save the work and close the file.

Task 3:

Contrast Stretching of an Image

1. Read input image.
2. Enter values r_1, r_2, s_1, s_2.
3. Calculate alpha, beta and gamma slopes.
4. If input pixel value is <= r_1 then o/p = alpha x input.
5. If input pixel is > r_1 and <=r_2 then o/p = beta x $(r-r_1)+s_1$.
6. Otherwise o/p = gamma x $(r-r_2)+s_2$.
7. Display input image.
8. Display o/p image.
9. Observe the output and write conclusion.
10. Save the work and close the file.

Task 4:

Gray Level Slicing (Intensity Level Slicing)

1. Read input image.
2. Enter values A, B.
3. Use the appropriate formula for without background and with background.
4. Find the output image for without background and with background.
5. Display input image.
6. Display output image(s).
7. Observe the output and write conclusion.
8. Save the work and close the file.

Task 5:

Power law transformation

1. Read input image.

2. Give the different values of gamma.
3. Apply gamma correction formula.
4. Display all output images.
5. Observe the output and write conclusion.
6. Save the work and close the file.

Code for :
Task 1:

Image Negative

```
clc;
clear;
close;
img= imread("C:\Users\Somish\OneDrive\Desktop\image.png");
graying=rgb2gray(img);
hello=255-graying;
subplot(1,2,1);
imshow(graying);
subplot(1,2,2);
imshow(hello);
```

Input and output images

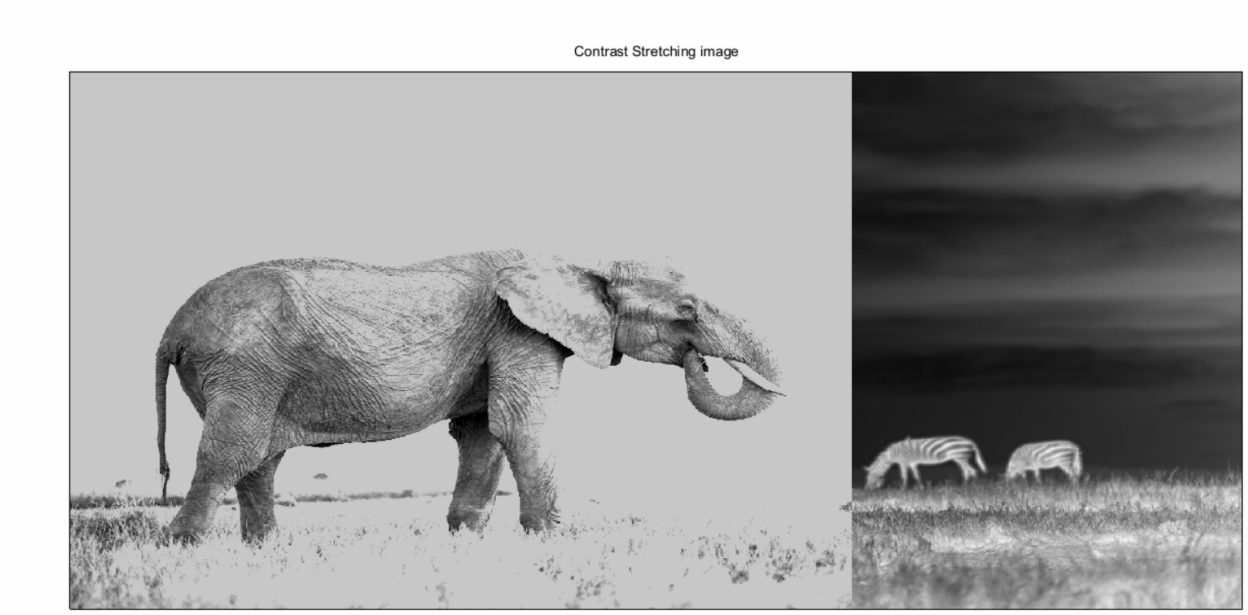
Task 2:

Thresholding of an Image

```
clc;
clear all;
close all;
r=imread("C:\Users\Somish\OneDrive\Desktop\blackandwhite.jpg");
[m,n]=size(r);
d=255-r;
r1=input("Enter r1: ");
r2=input("Enter r2: ");
s1=input("Enter s1: ");
s2=input("Enter s2: ");
a=s1/r1;
b=(s2-s1)/(r2-r1);
c=(255-s2)/(255-r2);
for i=1:m
   for j=1:m
      if r(i,j)<r1
         s(i,j)=a*r(i,j);
      elseif r(i,j)<r2
         s(i,j)=b*(r(i,j)-r1)+s1;
      else
         s(i,j)=c*(r(i,j)-r2)+s2;
      end
   end
end

imshow(uint8(r));title('orginal image');
imshow(uint8(d));title('digital image');
imshow(uint8(s));title('Contrast Stretching image');
```

Input and output images



Task 3:

Contrast Stretching of an Image

```
clc;
clear all;
close all;
r=imread("C:\Users\Somish\OneDrive\Desktop\blackandwhite.jpg");
[m,n]=size(r);
d=255-r;
r1=input("Enter r1: ");
r2=input("Enter r2: ");
s1=input("Enter s1: ");
s2=input("Enter s2: ");
a=s1/r1;
b=(s2-s1)/(r2-r1);
c=(255-s2)/(255-r2);
for i=1:m
   for j=1:m
      if r(i,j)<r1
         s(i,j)=a*r(i,j);
      elseif r(i,j)<r2
         s(i,j)=b*(r(i,j)-r1)+s1;
      else
         s(i,j)=c*(r(i,j)-r2)+s2;
      end
   end
end
subplot(1,2,1);
imshow(uint8(r));title('orginal image');
subplot(1,2,2);
imshow(uint8(s));title('Contrast Stretching');
```

Input and output images

Task 4:

Gray Level Slicing (Intensity Level Slicing)

Enter r1: 100

Enter r2: 200

Enter s1: 100

Enter s2: 200

Task 5:

Power law transformation

Conclusion:
The experiment showed that a digital negative image is obtained by subtracting pixel values from 255, which makes dark areas appear light and light areas appear dark, thereby improving hidden details. Further, contrast stretching was applied using piecewise linear transformation to enhance the overall contrast of the image. By choosing different values of r1,r2,s1,r1, r2, s1,r1,r2,s1, and s2s2s2, specific intensity ranges could be highlighted, making the image clearer and visually more informative. Thus, both techniques are effective for image enhancement and feature improvement.

Questions:

Highlight the correct answer using YELLOW color.

1. Negative of the image having intensity values [0,L-1] is expressed by
a. s = L-1-r b. s = L-1 c. s = 1-r d. s = L-r

2. Negative of the image is
a. reversing the intensity levels. b. enhancing the intensity levels.
c. reducing the intensity levels. d. adding the intensity levels.

3. Thresholding function in contrast stretching creates
a. binary image. b. high quality image. c. low quality image. d. enhanced image.

4. The dynamic range of the imaging system is a quantitative relation where the upper limit can be determined by
a. Saturation. b. Brightness c. Contrast. d. Noise

5. The lower limit of the dynamic range ratio can be determined by
a. Noise. b. Brightness. c. Contrast. d. Saturation

6. What is meant by the section of the real plane that the image coordinates have spanned?
a. Spatial Domain. b. Coordinate Axis. c. Plane of Symmetry d. None of the above

7. Power law transformation is useful in
a. MRI imaging. b. radar. c. purification. d. industry.

8. In power transformation values are dependent on value of
a. Gamma. b. beta. c. alpha. d. zeta.

Grade **Signature of Faculty In-charge**