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Batch: C-1 Roll No.: 16010122323
Experiment No. 5
Grade: AA / AB / BB / BC / CC / CD /DD
Signature of the Staff In-charge with date

Title: Implement the following point processing techniques in spatial domain:

- Image Negative.
- Thresholding.
- Gray level slicing with and without background
- Bit plane slicing

Objective: To learn & understand point processing techniques.

Expected Outcome of Experiment:

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

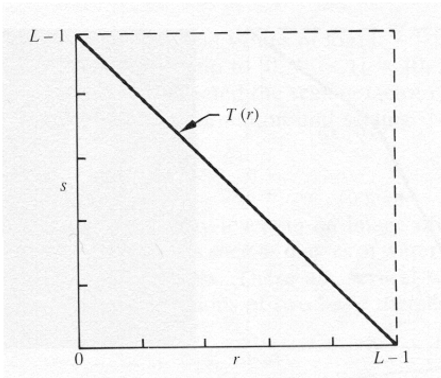
Books/ Journals/ Websites referred:

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 Negative:

Negative images are useful for enhancing white or grey detail embedded in dark regions of an image. Image negatives are obtained by using the transformation function s=T(r).

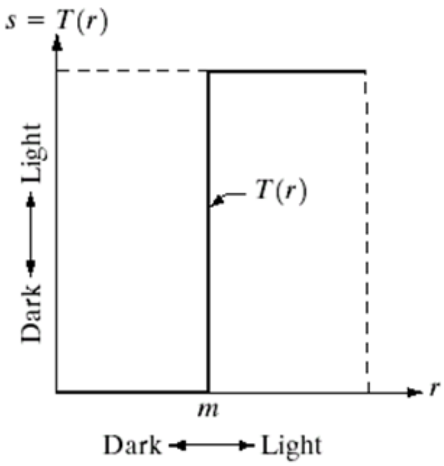


[0,L-1] is the range of gray levels

$S = L-1-r$

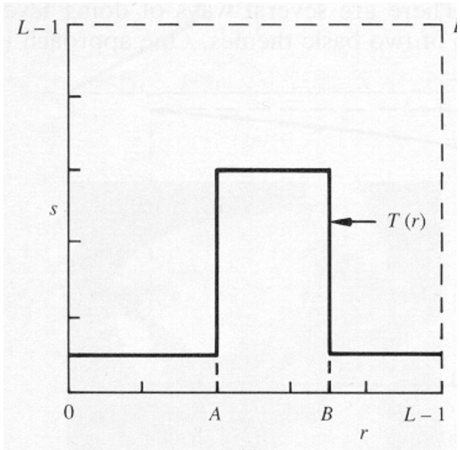
Thresholding

From a grayscale image, thresholding can be used to create binary images. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T or a white pixel if the image intensity is greater than that constant.

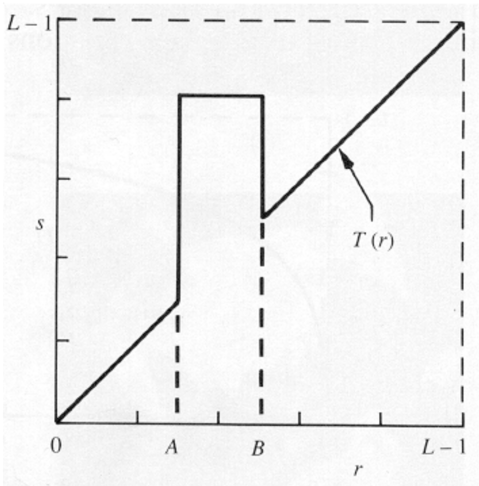


Gray Level Slicing

To highlight a specific range of gray levels in an image (e.g. to enhance certain features). One way is to display a high value for all gray levels in the range of interest and a low value for all other gray levels (binary image).

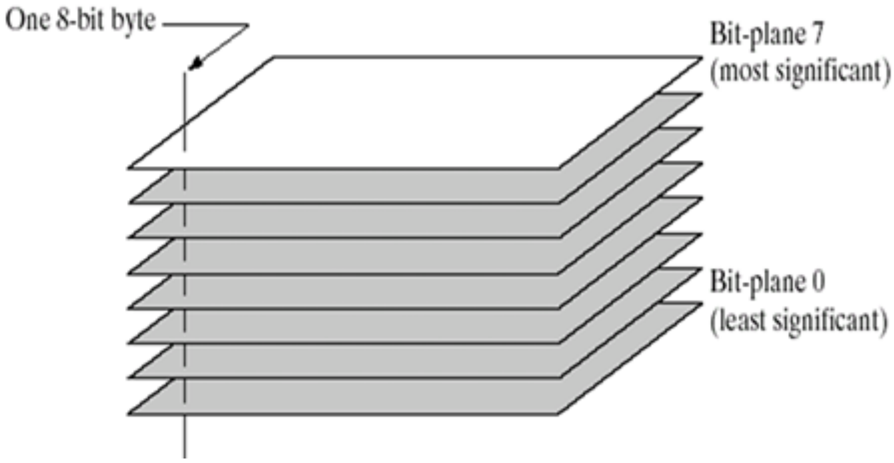


The second approach is to brighten the desired range of gray levels but preserve the background and gray-level tonalities in the image:



Bit plane slicing

Bit plane slicing is used to highlight the contribution made to the total image appearance by specific bits. Assuming that each pixel is represented by 8 bits, the image is composed of 8 1-bit planes. Plane 0 contains the least significant bit and plane 7 contains the most significant bit. Only the higher order bits (top four) contain visually significant data. The other bit planes contribute the more subtle details. Plane 7 corresponds exactly with an image thresholded at gray level 128.



Implementation steps with screenshots:

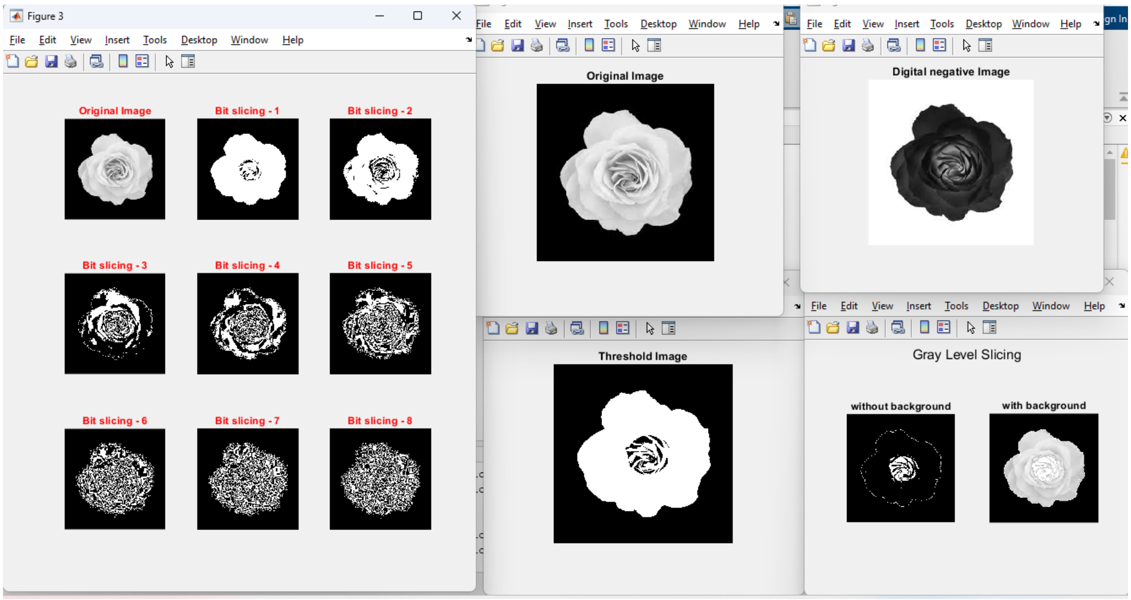
```
clear all;

close all;

a = imread("pixabay.jpg");

figure(1);

imshow(a);

title('Original Image');

%Digital Negative

dn = 255 - a;

figure(2);

imshow(dn);

title('Digital negative Image');

%Bit plane slicing

p = rgb2gray(a);

[r, c] = size(p);

b1 = zeros(r,c);

b2 = zeros(r,c);

b3 = zeros(r,c);

b4 = zeros(r,c);
```

```
b5 = zeros(r,c);

b6 = zeros(r,c);

b7 = zeros(r,c);

b8 = zeros(r,c);

for m = 1:r

for n = 1:c

b1(m,n) = bitget(p(m,n), 1);

b2(m,n) = bitget(p(m,n), 2);

b3(m,n) = bitget(p(m,n), 3);

b4(m,n) = bitget(p(m,n), 4);

b5(m,n) = bitget(p(m,n), 5);

b6(m,n) = bitget(p(m,n), 6);

b7(m,n) = bitget(p(m,n), 7);

b8(m,n) = bitget(p(m,n), 8);

end

end

figure(3);

subplot(3,3,1);

imshow(a);

title('Original Image', 'color', 'r');

subplot(3,3,2);

imshow(b8);

title('Bit slicing - 1', 'color', 'r');

subplot(3,3,3);

imshow(b7);

title('Bit slicing - 2', 'color', 'r');

subplot(3,3,4);

imshow(b6);
```

```
title('Bit slicing - 3', 'color', 'r');

subplot(3,3,5);

imshow(b5);

title('Bit slicing - 4', 'color', 'r');

subplot(3,3,6);

imshow(b4);

title('Bit slicing - 5', 'color', 'r');

subplot(3,3,7);

imshow(b3);

title('Bit slicing - 6', 'color', 'r');

subplot(3,3,8);

imshow(b2);

title('Bit slicing - 7', 'color', 'r');

subplot(3,3,9);

imshow(b1);

title('Bit slicing - 8', 'color', 'r');

%Thresholding

x = rgb2gray(a);

[r, c] = size(x);

y = x;

T = input("Enter value of threshold: ");

for i = 1:1:r

for j = 1:1:c

if(y(i, j) < T)

x(i, j) = 0;

else

x(i, j) = 255;

end
```

```
end
end
figure(4);
imshow(x);
title('Threshold Image');
%Gray level slicing
X = rgb2gray(a);
Y = X;
Z = X;
[r, c] = size(X);
T1 = input('Enter value of threshold T1 for gray level slicing:');
T2 = input('Enter value of threshold T2 for gray level slicing:');
for i = 1:1:r
for j = 1:1:c
if ((X(i,j)>=T1)&&(X(i,j)<=T2))
Y(i,j) = 255;
Z(i,j) = 255;
else
Y(i,j) = 0;
Z(i,j) = X(i,j);
end
end
end
figure(5);
subplot(1,2,1);
imshow(Y);
title('without background');
subplot(1,2,2);
```

```
imshow(Z);

title('with background');

sgtitle('Gray Level Slicing');
```



Conclusion:- In this experiment, we understood point processing techniques

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

Post Lab Descriptive Questions

1. Explain the role of bit plane slicing in achieving Steganography concept.

Bit Plane Slicing is a technique used in image processing where an image is divided into different bit planes to analyze its importance at various bit levels. Each pixel in an 8-bit grayscale image is represented by 8 bits, and these bits can be split into separate images, each representing a bit plane (from the least significant bit (LSB) to the most significant bit (MSB)).

Role in Steganography:

- **Least Significant Bit (LSB) Embedding:**
    - The LSB of each pixel is often used for embedding secret data without significantly altering the overall appearance of the image.
    - Since changes in LSB have minimal impact on the image quality, it makes detecting hidden data difficult.
    - This is commonly used in image-based steganography where a secret message (text, image, or audio) is embedded into an image by modifying its LSB.
- **Separation of Important and Less Important Data:**
    - The higher bit planes (MSB) contain most of the significant information, while the lower bit planes (LSB) contain finer details.
    - By modifying only the lower bit planes, steganography can be implemented without making noticeable changes to the image.

Example of LSB Steganography Using Bit Plane Slicing:

1. Convert an image to an 8-bit grayscale representation.
2. Extract the LSB plane of each pixel.
3. Embed secret data into the LSB plane of the cover image.
4. Combine all bit planes back to get the stego-image.
5. The receiver extracts the LSB to retrieve the hidden message.

Thus, bit plane slicing helps in isolating and modifying lower bit planes, making it an effective method for implementing steganography while ensuring minimal visual distortion.

2. Explain the use of gray level slicing

Gray Level Slicing is a technique in image processing used to highlight specific intensity ranges within an image while suppressing others. It is mainly used for **enhancement and feature extraction**.

Types of Gray Level Slicing:

1.**Without Background Preservation:**

1. Only a specific range of gray levels is kept, and all other pixel values are set to a uniform intensity (e.g., black or white).
2. Useful for segmenting an object from an image (e.g., extracting tumors in medical imaging).

2. **With Background Preservation:**

1. The desired range of gray levels is enhanced while keeping the rest of the image unchanged.
2. Useful for highlighting important features while maintaining context.

Applications of Gray Level Slicing:

- **Medical Imaging:** Enhancing specific gray levels to highlight tissues, tumors, or fractures.
- **Industrial Inspection:** Identifying defects in materials by isolating specific intensity levels.
- **Remote Sensing:** Enhancing satellite images by highlighting vegetation, water bodies, or urban areas.
- **Fingerprint and Pattern Recognition:** Extracting specific details in biometric applications.

Thus, gray level slicing is an effective technique for enhancing specific details in an image by isolating and modifying intensity levels.