SOMAIYA VIDYAVIHAR UNIVERSITY

K. J. Somaiya College of Engineering, Mumbai-77

Batch: B2	**Roll No.: 16010122221**
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:

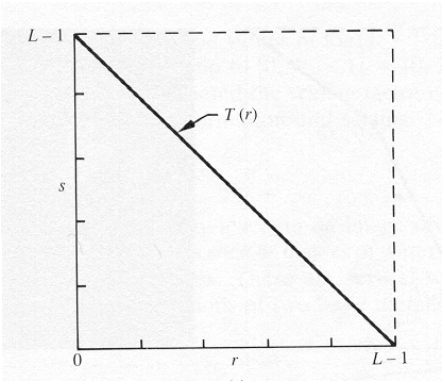
1. http://www.mathworks.com/support/
2. www.math.mtu.edu/~msgocken/intro/intro.html.
3. R. C.Gonsales R.E.Woods, “Digital Image Processing”, Second edition, Pearson Education
4. S.Jayaraman, S Esakkirajan, T Veerakumar “Digital Image Processing “Mc Graw Hill.

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).

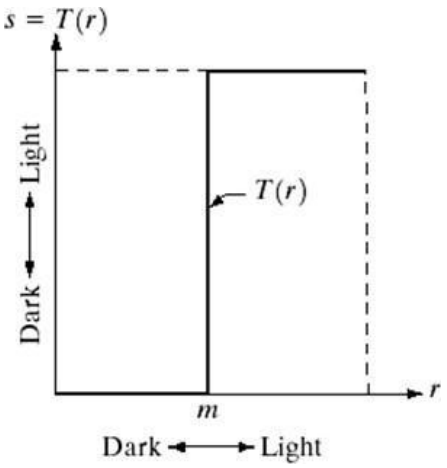


[0,L-1] is the range of gray levels

$S = L\text{-}1\text{-}r$

Thresholding

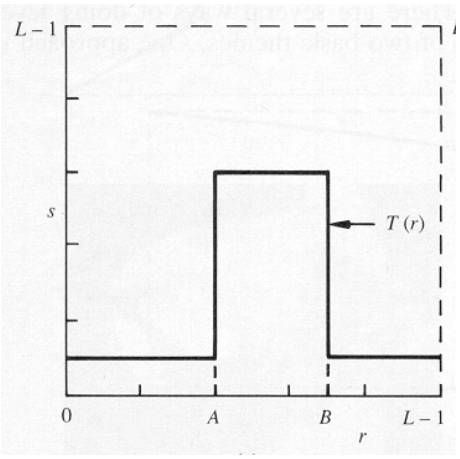
From a grayscale image, thresholding can be used to create binary images. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T or a white pixel if the image intensity is



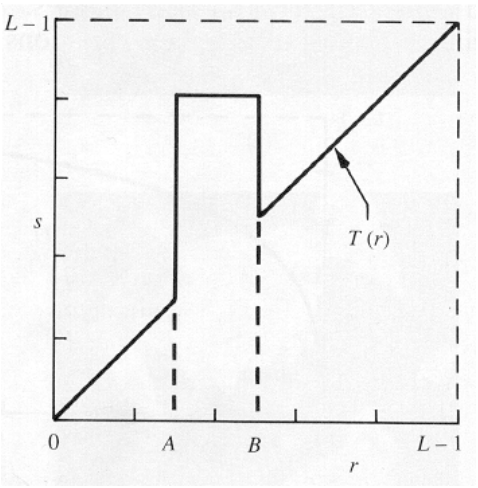
greater than that constant.

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).



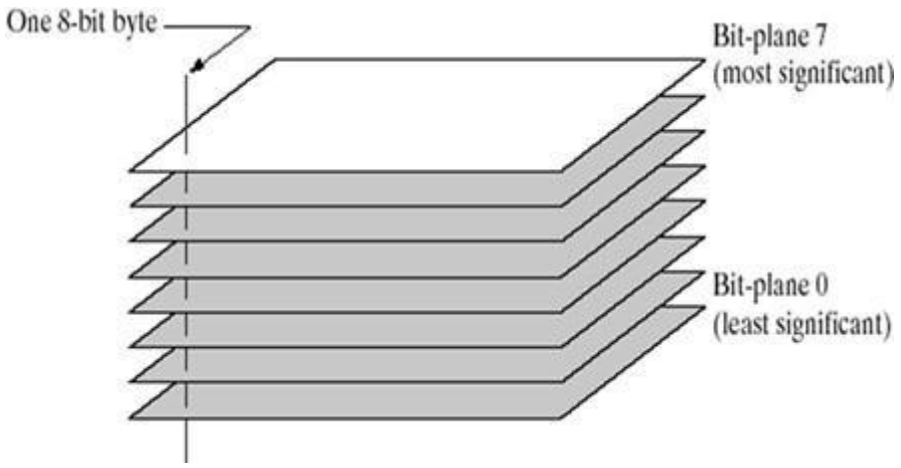
The second approach is to brighten the desired range of gray levels but preserve the background and gray-level tonalities in the image:



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.



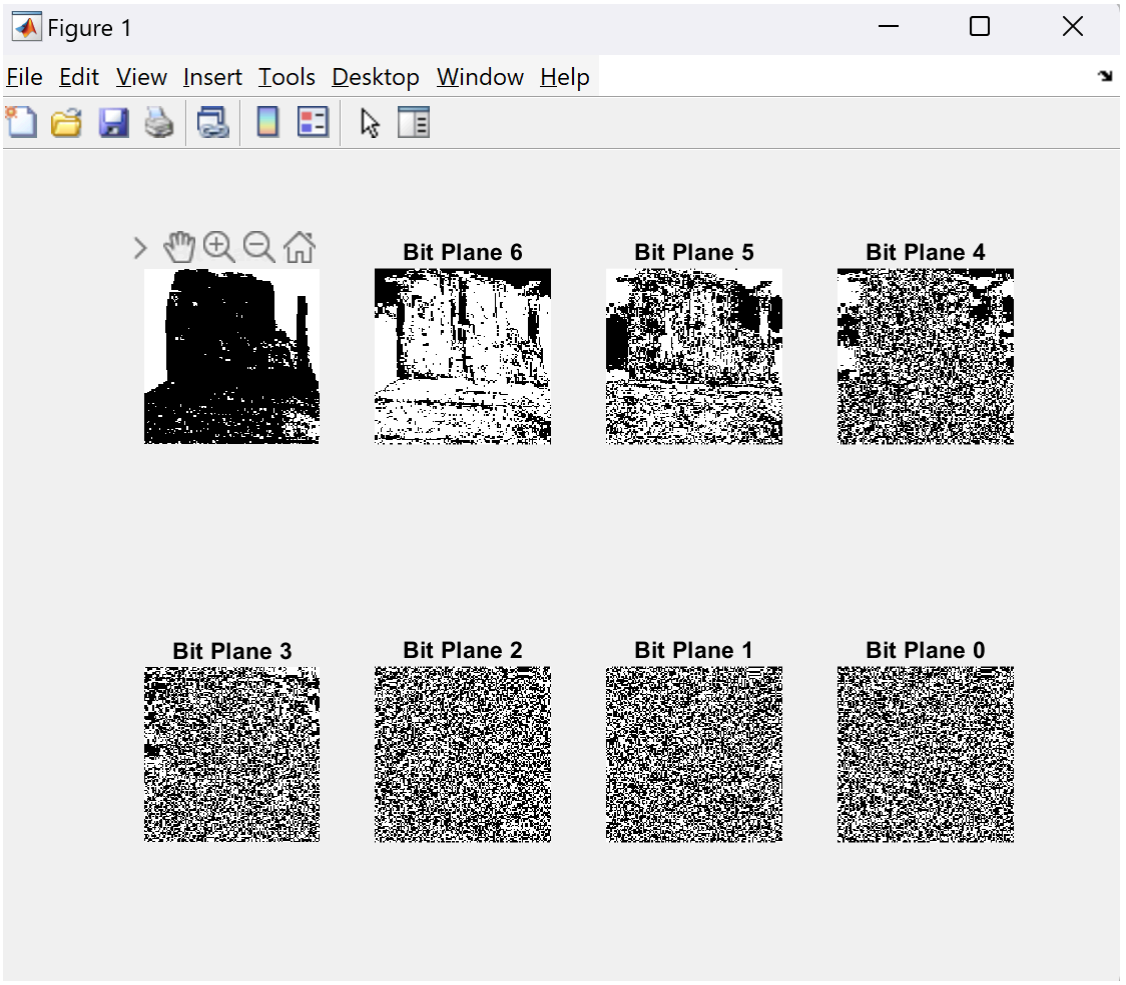
i

Implementation steps with screenshots:

```
img = imread('rock.bmp');
if size(img, 3) == 3
   img = rgb2gray(img);
end
[rows, cols] = size(img);
bit_planes = false(rows, cols, 8);
for i = 1:rows
   for j = 1:cols
       pixel = img(i, j);
       for bit_idx = 0:7
           bit_planes(i, j, bit_idx + 1) = bitand(pixel, bitshift(1,
bit_idx)) > 0;
       end
```

```
    end
end
figure
;
for bit_idx = 1:8
    subplot(2, 4, bit_idx);
    imshow(bit_planes(:, :, 8 - bit_idx + 1), []);
    title(['Bit Plane ', num2str(8 - bit_idx)]);
end
for bit_idx = 1:8
    filename = ['bit_plane_', num2str(8 - bit_idx), '.bmp'];
    imwrite(logical(bit_planes(:, :, bit_idx)), filename);
end
```

Output-



Conclusion:-

Successfully implemented and understood point processing techniques like bit plane slicing.

Observed the visual significance of higher-order bit planes (4–7).

Gained hands-on experience in using MATLAB for digital image processing.

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Post Lab Descriptive Questions

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

Bit Plane Slicing plays a significant role in steganography, a method of hiding secret data within an image, audio, or video. Here's how it is utilized:

1. **Data Embedding in Least Significant Bits (LSBs):**
   - The least significant bits (e.g., Bit Plane 0 or 1) of an image contribute very little to the overall appearance of the image.
   - These bits are often used to embed secret information such as text, images, or other data.
   - Because changes in these bits cause minimal distortion, the hidden data remains imperceptible to the naked eye.
2. **Separation of Planes for Manipulation:**
   - By slicing the bit planes, the LSBs of an image can be isolated and replaced with the secret data.
   - Higher-order bit planes remain untouched, preserving the main structure and quality of the image.
3. **Efficiency in Data Extraction:**
   - During the decoding process, the LSBs are extracted from the bit planes to retrieve the hidden information.
   - Bit plane slicing simplifies both embedding and extraction, making it an efficient approach for steganography.
4. **Minimizing Detection:**
   - Using LSBs ensures that the image's visual quality is preserved, reducing the risk of detection by steganalysis tools.

2. Explain the use of gray level slicing

Gray level slicing is used to emphasize specific ranges of gray levels in an image. This technique is applied in the following scenarios:

1. **Highlighting Features:**
   - Gray level slicing can be used to enhance features of interest in medical images (e.g., highlighting tumors in X-ray scans) or satellite images (e.g., highlighting water bodies or vegetation).
2. **Binary Gray Level Slicing:**
   - Assigns a high intensity to a specified range of gray levels while setting all other intensities to a low value.
   - Example: Highlighting objects within a specific brightness range while suppressing the background.

3. **Preserving Tonality:**

- Brightens the range of interest while preserving the tonalities of the background.
- This approach is often used in images where maintaining the overall structure is important, such as in geological or astronomical imaging.

4. **Applications in Image Analysis:**
   - Useful in segmenting regions of interest for further analysis.
   - Example: Detecting and enhancing regions of specific brightness in industrial defect inspection or biometric applications.