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| **Course Name:** | Digital Signal & Image Processing Laboratory | **Semester:** | **VI** |
| **Date of Performance:** |  | **Batch No:** |  |
| **Faculty Name:** |  | **Roll No:** |  |
| **Faculty Sign & Date:** |  | **Grade/Marks:** | **/20** |

**Experiment No: 6**

**Title:** Implementation of the point processing techniques in spatial domain.

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| **Objective:** Implement the following point processing techniques in spatial domain:   * Image Negative. * Thresholding. * Gray level slicing with and without background * Bit plane slicing |

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| **COs to be achieved:** |
| **CO3** Understand basics of image fundamentals. |

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| **Materials Required:** MATLAB software  **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." |

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| **Theory:**  **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).  Z:\DIP\4-4a.bmp[0,L-1] is the range of gray levels  *S= L-*1*-r*  **Thresholding**  From a [grayscale](https://en.wikipedia.org/wiki/Grayscale) image, thresholding can be used to create [binary images](https://en.wikipedia.org/wiki/Binary_image). The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity {\displaystyle I\_{i,j}} 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).  Z:\DIP\4-7a.bmp  The second approach is to brighten the desired range of gray levels but preserve the background and gray-level tonalities in the image:  Z:\DIP\4-7b.bmp  **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:**   1. **Negative Image:**   % negative image  originalImage = imread('meow.jpg');  negativeImage = 255 - originalImage;  figure;  subplot(1,2,1);  imshow(originalImage);  title('Original Image');  subplot(1,2,2);  imshow(negativeImage);  title('Negative Image');     1. **Thresholding:**   % thresholding  img = imread('meow.jpg');  gray\_img = rgb2gray(img);  threshold = input('Enter threshold (0-255): ');  binary\_img = gray\_img > threshold;  subplot(1,2,1), imshow(gray\_img), title('Original Image');  subplot(1,2,2), imshow(binary\_img), title('Thresholded Image');       1. **Gray level slicing:**   % gray level slicing  img = imread('meow.jpg');  gray\_img = rgb2gray(img);  T1 = input('Enter lower threshold (T1): ');  T2 = input('Enter upper threshold (T2): ');  binary\_sliced = (gray\_img >= T1) & (gray\_img <= T2);  bright\_sliced = gray\_img;  bright\_sliced(binary\_sliced) = 255;  subplot(1,3,1), imshow(gray\_img), title('Original Image');  subplot(1,3,2), imshow(binary\_sliced), title('Binary Slicing');  subplot(1,3,3), imshow(bright\_sliced), title('Gray Level Slicing with  Background');       1. **Bit plane slicing:**   % bit plane slicing  img = imread('meow.jpg');  gray\_img = rgb2gray(img);  bit\_plane0 = uint8(bitget(gray\_img, 1) \* 255);  bit\_plane1 = uint8(bitget(gray\_img, 2) \* 255);  bit\_plane2 = uint8(bitget(gray\_img, 3) \* 255);  bit\_plane3 = uint8(bitget(gray\_img, 4) \* 255);  bit\_plane4 = uint8(bitget(gray\_img, 5) \* 255);  bit\_plane5 = uint8(bitget(gray\_img, 6) \* 255);  bit\_plane6 = uint8(bitget(gray\_img, 7) \* 255);  bit\_plane7 = uint8(bitget(gray\_img, 8) \* 255);  subplot(2,4,1), imshow(bit\_plane0), title('Bit Plane 0');  subplot(2,4,2), imshow(bit\_plane1), title('Bit Plane 1');  subplot(2,4,3), imshow(bit\_plane2), title('Bit Plane 2');  subplot(2,4,4), imshow(bit\_plane3), title('Bit Plane 3');  subplot(2,4,5), imshow(bit\_plane4), title('Bit Plane 4');  subplot(2,4,6), imshow(bit\_plane5), title('Bit Plane 5');  subplot(2,4,7), imshow(bit\_plane6), title('Bit Plane 6');  subplot(2,4,8), imshow(bit\_plane7), title('Bit Plane 7'); |

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| **Conclusion:**  In this experiment, we applied bit plane slicing, gray level slicing, and thresholding to analyze different image processing techniques. These operations helped in enhancing specific features, extracting hidden details, and understanding image representation at a pixel level, demonstrating their practical applications in areas like steganography, medical imaging, and object detection. |
| **Post Lab Question:**   1. **Explain the role of bit plane slicing in achieving Steganography concept.**   Bit plane slicing plays a significant role in steganography, particularly in the Least Significant Bit (LSB) substitution method, which is one of the most widely used techniques for hiding data in digital images. In an 8-bit grayscale image, each pixel is represented by 8 bits, ranging from the least significant bit (Bit Plane 0) to the most significant bit (Bit Plane 7). The lower bit planes, especially Bit Planes 0 and 1, contain minimal visual information, making them ideal for embedding hidden messages without significantly altering the overall appearance of the image.  In steganography, secret data such as text, images, or binary information is embedded within these lower bit planes by modifying their values. Since the least significant bits contribute very little to the image's visual perception, these modifications remain nearly imperceptible to the human eye. The process of embedding involves replacing the LSBs of an image with the binary representation of the secret message, which can later be extracted by accessing the corresponding bit plane. This technique ensures a high level of imperceptibility, meaning the hidden data remains unnoticed while the image retains its original appearance.  The advantages of using bit plane slicing for steganography include minimal distortion, high embedding capacity, and ease of implementation using bitwise operations. It is widely applied in secure communication, watermarking, and covert data transmission. However, advanced steganalysis techniques can sometimes detect modifications in the LSB planes, which is why additional encryption or randomization techniques are often combined with bit plane slicing to enhance security.   1. **Explain the use of gray level slicing.**   Gray level slicing is an image processing technique used to emphasize specific intensity ranges while suppressing or reducing the effect of others. This method is particularly useful in **medical imaging, industrial inspection, and remote sensing**, where highlighting specific gray levels can enhance important features. Gray level slicing can be categorized into two approaches: **binary slicing** and **gray level enhancement**.  In **binary slicing**, all pixels within a defined intensity range are assigned a high value (white), while all other pixels are assigned a low value (black). This method is commonly used for **object segmentation** where certain features need to be isolated from the background, such as detecting tumors in medical images or highlighting roads in satellite imagery. Since it converts selected intensities to distinct values, binary slicing is useful when the objective is to detect specific objects with clear boundaries.  On the other hand, **gray level enhancement** retains the background but enhances the selected intensity range to make specific details more visible. Instead of completely eliminating other intensity values, it selectively brightens the target gray levels while preserving the gradual transitions of the image. This technique is frequently applied in **X-ray imaging**, where tissues of interest are enhanced for better diagnosis, and in **remote sensing applications**, where certain landforms or water bodies need to be highlighted for analysis. |

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| **Signature of faculty in-charge with Date:** |