## Assignment 1: Image Thresholding

1. a) Write a program to show the minimum and the maximum pixel values of an 8 bits/ pixel grayscale image. Also write a program to convert grayscale image to a binary image using threshold (Tth) operation where Tth = (minimum pixel value +maximum pixel value)/2.

   Mathematically, G(x,y)= 0 if f(x,y) ≤ (minimum gray value+maximum gray value)/2
   =1, otherwise

   b) Do the same thresholding operation considering Tth = 128.

   G(x,y) = 0 if f(x,y) ≤128
   =1 otherwise

   Highlight the differences in the two images obtained.

   2) Write a program to implement down sampling of an image by a factor of 2. Apply the same effect for 2/3 successive times and comment on visual content. Finally, write a program to upscale the down sampled image through interpolation and comment on visual quality of the image.

3. Write a program to implement image negation operation

   S=L-1-R

   Where R=Pixel value of input image
   S=Pixel value of output image
   L=Maximum gray value

   See the effect of image negation operation for enhancing white or gray detail embedded in dark regions of an image dominant in size.

4. Write a program to implement change in dynamic range of an image from [a, b] to [c, d]. Here 'a' and 'c' are the minimum pixel value of input and output image, respectively where b' and 'd' are the maximum for the two. Comment on visual quality of the image after the operation.

5. Implement image negation operation using logical NOT operation and verify results with using linear transformation function in Assignment 3.

6. Write a program to develop histogram of an image and show it through display. The size of the image and pixel values is made flexible. Show and comment about the effect on the histogram of the image if (i) lower-order bit planes and (ii) higher order bit plane are set to zero.

7. Write a program to implement histogram equalization of an 8-bit/pixel gray scale image. Show that a second pass of histogram equalization will produce exactly the same result as the first pass.

8. Write a Program to implement additive noise corruption of an image by manipulating p% randomly selected pixel values by an amount of q% ( may be a rand function from 0 to 15%) for respective gray values.

9. Do the image averaging operation for K=8, 16, 32 number images (changing the value of p and q) and find the difference between the original and averaged image.

Plot the histogram of difference image
Repeat the steps for k=16, 32….
See the histogram in all cases…
Observe the shifting in width and the mean position of the histogram of difference images.
Plot the histogram of the difference image for all three cases.

10. Write a Program to implement spatial mean operation( say considering 3x3 window) and applying it on a gray scale noisy image. Show the filtering effect after the variable window size (5x5, 7x7). Discuss the limiting effect of repeatedly applying a 3x3 low pass spatial filter to a digital image. (apply 3x3 window two times i.e. twice)
Show that the filtering results are equivalent i.e. output image obtained after applying 3x3 window twice is equivalent applying 5x5 window once.

11. Write a program to implement both mode and median filtering operation and applying it on gray scale noisy image. Show the filtering effect for variable window size.
Show that the median filtering results are equivalent i.e. output image obtained after applying 3x3 window twice is equivalent applying 5x5 window once.

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12. Write a program to calculate $\Delta x$ and $\Delta y$ for each pixel of an input image f(x,y) using gradient operator (1,-1) and $\binom{1}{-1}$. Replace each pixel point by $|\Delta x| + |\Delta y|$ and then implement image-sharpening operation.

13. Write a program to calculate Δx and Δy for each pixel of an input image f(x,y) using Sobel Operator (gradient operator) shown below

| | |
|---|---|
| -1 0 1 | -1 -2 -1 |
| -2 0 2 | 0 0 0 |
| -1 0 1 | 1 2` 1 |

Replace each pixel point by |Δx| + |Δy| and then implement image-sharpening operation.

14. Write a program to calculate Δx and Δy for each pixel of an input image f(x,y) using Prewitt's operator (gradient operator)

| | |
|---|---|
| -1 0 1 | -1 -1 -1 |
| -1 0 1 | 0 0 0 |
| -1 0 1 | 1 1` 1 |

Replace each pixel point by |Δx| + |Δy| and then implement image-sharpening operation

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15. Write a program to implement Laplacian operation for the input image f(x,y) using the following operator

| | | |
|---|---|---|
| **0** | **1** | **0** |
| **1** | **-4** | **1** |
| **0** | **1** | **0** |

| | | |
|---|---|---|
| 1 | 1 | 1 |
| 1 | -8 | 1 |
| 1 | 1 | 1 |

16. Write a program to implement high boost filtering using the operator as shown below. Show the effect for different 'A' values

| | | |
|---|---|---|
| **0** | **1** | **0** |
| **1** | **A-4** | **1** |
| **0** | **1** | **0** |

| | | |
|---|---|---|
| -1 | -1 | -1 |
| -1 | A+8 | -1 |
| -1 | -1 | -1 |

17. Write a program to implement 2D transformation by an amount of 5 units in the right and 7 units upward to each pixel of a given input image $f(x, y)$.

18. Write program to implement image scaling operation in Horizontal direction by an amount 14.2 and Vertical direction by an amount 1.6.

19. Write a program to implement image rotation operation by amount of
a) $25^o$ b) $45^o$ c) $60^o$

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