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Subject : Foundation of Signal Processing Class : TE AIML

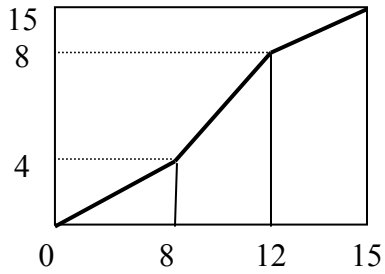
Assignment-3 Topic : Image Enhancement Date : 10-11-2023

(Contrast Stretching Transformation)

Q(1) Obtain the gray level transformation function that stretches gray scale range [0, 10] into [0, 15] shifts range [10,20] to [15,25] and compresses the range [20,30] into [25,30].

Q(2) Obtain the equation for Contrast Stretching Transformation Function as given in figure below. Apply the Contrast Stretching Transformation Function on the input image F and obtain the output image.

$$F = \begin{bmatrix} 7 & 12 & 2 & 3 & 4 \\ 10 & 15 & 1 & 6 & 7 \\ 12 & 4 & 6 & 15 & 12 \\ 8 & 2 & 7 & 15 & 2 \\ 11 & 13 & 3 & 3 & 5 \end{bmatrix}$$



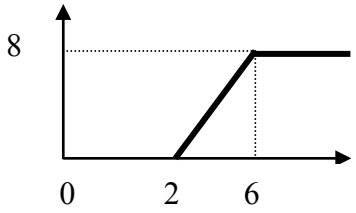
(Clipping and Thresholding Transformation)

Q(3) Convert the gray image to Binary Image. Select appropriate value of threshold from the histogram.

$$F = \begin{bmatrix} 0 & 3 & 0 & 1 & 0 \\ 1 & 7 & 4 & 5 & 2 \\ 2 & 6 & 6 & 7 & 7 \\ 7 & 4 & 0 & 1 & 0 \\ 5 & 6 & 7 & 6 & 5 \end{bmatrix}$$

Q(4) Given an image F of size (4 X 4)

(a) If the gray level intensity changes are to be made as shown in figure given below. Derive the necessary expression for obtaining new pixel value using slope.



$$F = \begin{bmatrix} 2 & 5 & 3 & 5 \\ 3 & 6 & 5 & 3 \\ 3 & 5 & 2 & 4 \\ 2 & 5 & 4 & 5 \end{bmatrix}$$

(b) Obtain the new image by applying the above transformation function.

(c) Plot Histogram for original image and new image.

(d) Compare the histogram of Input and Output Image.

(LOG Transformation)

Q(5) Given an image of size (3 X 3) $f(m,n) = \begin{bmatrix} 128 & 212 & 255 \\ 54 & 62 & 124 \\ 140 & 152 & 156 \end{bmatrix}$

Determine the output image g(m,n) using logarithmic Transformation

$g(m,n) = 107 \, Log_{10}[1+ f(m,n)]$.

(Power Law Transformation)

Q(6) Given $F = \begin{bmatrix} 2 & 3 & 5 & 10 \\ 4 & 6 & 4 & 10 \\ 7 & 1 & 3 & 3 \end{bmatrix}$

Determine the output image using Power Law Transformation $S=(r)^2$

(Intensity Level Slicing Transformation)

Q(7) A detail Enhancement Techniques is performed as per following criteria:

$$s = \begin{bmatrix} 7 & 3 \le r \le 5 \\ r & otherwise \end{bmatrix}$$

F =

0	1	0	2	1	6
2	3	5	5	1	6
2	4	4	3	2	1
1	3	5	3	0	1
2	1	2	6	6	2

where r and s are the intensities for the input and output image respectively. Determine the output image when, detail enhancement techniques is applied on the input image F.

(Thresholding, Intensity Level Slicing, Bit Plane Slicing and Negative Transformation)

Q(8) For the three bit 4x4 size image perform the following operations :-

(a) Threshold T = 4
(b) Intensity Level Slicing with background $r_1 = 2$ and $r_2 = 5$
(c) Bit Plane Slicing for MSB and LSB planes
(d) Nagation

$$F = \begin{bmatrix} 4 & 2 & 3 & 0 \\ 1 & 3 & 5 & 7 \\ 5 & 3 & 2 & 1 \\ 2 & 4 & 6 & 7 \end{bmatrix}$$

(Histogram Equalization Transformation)

Q(9) Equalize the given Histogram. What happens when we equalize it twice? Justify.

Gray Level r_k	0	1	2	3
No of Pixel N_{rK}	70	20	7	3

Q(10) A digital image F with 8 Quantization levels is given below. f(x,y)= | x - y | for x,y = 0,1,2,3,4,5,6,7.

(a) Apply Histogram Equalization Transformation on the input image F and find the output image A

(b) Apply Histogram Equalization Transformation on the image A obtained in part (a) and find the output image B.

Q(11) Perform Histogram Equalization and draw new equalized Histogram of the following image data :

GREY LEVEL r_k	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
No of Pixels N_{rk}	790	1023	850	656	329	245	122	81

(Histogram Specification Transformation)

Q(12) The gray level distribution of an 8-level image of 64 x 64 size is specified by two histogram A and B as given below.
Modify the histogram A as given in histogram B. Plot the histogram of the Input and Output Image.

- Input Image Histogram (A) :

Gray Level r_k	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
No of Pixel N_{rK}	790	1023	850	656	329	245	122	81

- Specified Image Histogram (B) :

Gray Level Z_k	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
No of Pixel N_{ZK}	0	0	0	614	819	1230	819	614

(Spatial Filtering)

Q(13) Given $f(x,y) = \begin{bmatrix} 3 & 2 & 1 \\ 5 & 2 & 6 \\ 7 & 9 & 1 \end{bmatrix}$ Find the response of the median filter at the center location using the following mask.

(a) Mask-1

	Z_2	
Z_4	Z_5	Z_6
	Z_8	

(b) Mask-2

Z_1	Z_2	Z_3
Z_4	*	Z_6
Z_7	Z_8	Z_9

(c) Mask-3

Z_1	Z_2	Z_3
Z_4	Z_5	Z_6
Z_7	Z_8	Z_9

Q(14) Define the following Spatial filters:
(a) Median (b) Min (c) Max
Consider the digital Image.
Calculate the value at point (2,2) = 3

0	1	0	6	7
2	0	1	6	5
1	1	3	5	6
1	0	6	6	5
2	5	6	7	6

Q(15) Apply the Prewit Mask on the input image F given below and obtain the output image. Assume virtual Rows and Columns with repeated border pixel values.

Input Image $F = \begin{bmatrix} 3 & 2 & 5 \\ 4 & 6 & 7 \\ 7 & 1 & 3 \end{bmatrix}$

Q(16) Given below is 4x4 image. Find the output image pixel value at (2,2) location by applying Low Pass Filter and High Pass Filter masks.

$$F = \begin{bmatrix} 2 & 3 & 4 & 2 \\ 5 & 5 & 2 & 4 \\ 3 & 6 & 3 & 5 \\ 5 & 3 & 5 & 5 \end{bmatrix}$$

Using these outputs verify that Original Image = LPF Image + HPF Image. In case of discrepancy explain the reasons.

Q(17) Given $F = \begin{bmatrix} 4 & 8 & 2 \\ 7 & 5 & 6 \\ 6 & 3 & 7 \end{bmatrix}$

Apply the following filter mask W1, W2 and W3 on the input image F and obtain the output image. Assume virtual Rows and columns with zero values.

$$W_1 = \begin{bmatrix} 0 & 0 & 0 \\ -1 & 2 & -1 \\ 0 & 0 & 0 \end{bmatrix} \quad W_2 = \begin{bmatrix} 0 & -1 & 0 \\ 0 & 2 & 0 \\ 0 & -1 & 0 \end{bmatrix} \quad W_3 = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Q(18) Apply the following filter mask W_1 W_2 and W_3 on the input image F given below and obtain the output image pixel value at the center position.

$$F = \begin{bmatrix} 4 & 8 & 2 \\ 7 & 5 & 6 \\ 6 & 3 & 7 \end{bmatrix} \quad W_1 = \begin{bmatrix} -1 & 0 & -1 \\ 0 & 4 & 0 \\ -1 & 0 & -1 \end{bmatrix} \quad W_2 = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix} \quad W_3 = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

Q(19) A gray scale image is given below. Find Laplacian Filtered image and Laplacian High Boost Filtered Image. Assume virtual Rows and columns with zero values.

Input Image $F = \begin{bmatrix} 4 & 8 & 2 \\ 7 & 5 & 6 \\ 6 & 3 & 7 \end{bmatrix}$

Q(20) Perform Zooming on the following Image by Replication and Linear Interpolation.

1	2	5	2	1
2	3	4	1	2
4	1	3	1	1
4	2	5	1	1
1	1	7	1	3

Q(21) **State whether True or False**.

(a) Image can be obtained if histogram is given :

(b) Image Enhancement process does not change the information content of image.

(c) If all the pixels in an image are shuffled, there will not be any change in the histogram.

(d) Histogram equalization and Linear contrast stretching always give the same result.

(e) Second pass of histogram equalization will produce exactly the same result as the first pass.

(f) **For** continuous image histogram can be perfectly equalized, but it may not be so for digital image.

(g) Discrete Histogram Equalization technique will not, in general, yield a flat histogram.

(h) Histogram is a unique representation of an image .

(i) Low Pass Filter is a smoothing filter.

(j) For digital image having salt paper noise, median filter is the best filter.

(k) Median filter is the best solution to remove salt and pepper noise.

(l) The principal function of median filter is to force points with distinct intensity to be more like their neighbors.
