Department of Computer Science and Engineering

CS4043D IMAGE PROCESSING
Assignment Set I

Date of posting : 26/08/2019
Date of Submission : 18/09/2019

1. Read an image and display it.

2. Find the mean pixel intensity of the sample_image given. Write a program that converts the image to a binary image by using the following transformation.

$$G(i,j) = \begin{cases} 1 & \text{if I(i, j)} > \text{mean} \\ 0 & \text{if I(i, j)} \leq \text{ mean} \end{cases}$$

3. Create an image of size 64x64 where

$$I(i,j) = \left| cos\sqrt{(i^2 + j^2)} \right|$$

   Display the image? **[1 mark]**

4. Quantize the intensity levels in the above image by dividing the range [0,1] into four equal intervals. Quantization happens according to the following table.

Image gray level	Output gary level
0≤ I < 0.25	0
0.25≤ I < 0.5	0.25
0.5≤ I < 0.75	0.5
0.75≤ I < 1	0.75
1	1

[2 marks]

5. 4 level quantization of the intensities of the image in Question 3.(max_intensity interval divided into 4 equal intervals and follow the scheme in the previous question). **[2 marks]**

6. 8 level quantization of the intensities of the image Question 3.(max_intensity interval divided into 8 equal intervals and follow the scheme in the previous question). Observe the difference in image quality.

7. Read 2 sample images and perform the following arithmetic operations on them.

   (a) Addition

   (b) Subtraction

   (c) Multiplication by a constant factor

   (d) Division by a constant factor

   Comment your observations.

8. Perform the following arithmetic operations on the given images.

   (a) AND

   (b) OR

   (c) COMPLEMENT

9. Perform following operations on the given image.

   (a) Find DFT of the given image.

   (b) Find the magnitude spectrum.

   (c) Find the phase spectrum.

   (d) Double the magnitude spectrum.

   (e) Reconstruct the image using the IDFT.

   (f) Reconstruct the image removing phase spectrum.

   (g) Put the results together in one window.

   Explain your results

10. Pick an image and follow the operations

    (a) Multiply image by $(-1)^{x+y}$.

    (b) Compute the DFT.

    (c) Take the complex conjugate of the transform.

    (d) Compute the IDFT.

    (e) Multiply the real part of the result by $(-1)^{x+y}$.

    Compare the input image and output image. Explain (mathematically) why the output image appear as it does.

11. Obtain the Fourier spectrum of a given image. Pad the image with zero's, obtain Fourier spectrum.

    (a) Explain the difference in overall contrast

    (b) Explain the significant increase in signal strength along the vertical and horizontal axes of spectrum on the second output image.

12. What is the result of two DFT performed in sucession? Apply a DFT to an image, and then another DFT to the result. Can you account for what you see?

13. Perform following operations on the given image.

    (a) Find the Walsh Transform.

    (b) Find the Hadamard Transform.

    (c) Find the Haar Transform.

    (d) Find the Discrete Cosine Transform.

    Remove some transform coefficients and reconstruct the original image. Discuss the energy compaction properties of above transform. Which one will be better for image compression ?

Outputs Required

- Create Assignment1.tar file containing code for all questions with following naming convention.
  $EXE < number > \_ < rollnumber > \_ < firstname > \_ < questionnumber > if < partnumber > . < extension >$

- Output images with naming convention $< questionnumber > if < partnumber >$

- Observations (comparing images) in a Text file with naming convention $< questionnumber > if < partnumber >$.