



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2016

Module Number: EE7207 Module Name: Computer Vision and Image Processing
[Three Hours]

[Answer all questions, each question carries 10 marks]

- Q1 a) Under basic relationships between pixels, notation $N_4(p)$ and $N_D(p)$ are neighbourhood of a pixel $p(x,y)$. Write the coordinates of $N_4(p)$ and $N_D(p)$ when p is at (5,3) as shown in Figure Q1 (a). The size of the neighbourhood is 3×3 .

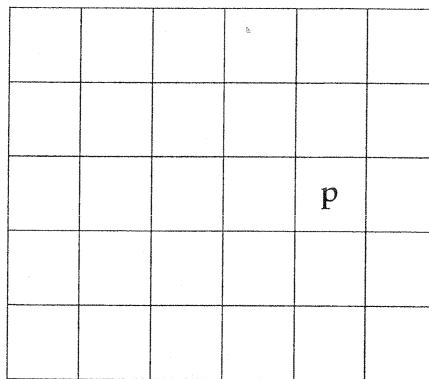


Figure Q1 (a)

[4.0 Marks]

- b) List the two main image enhancement methods. [2.0 Marks]
- c) Apply the $s = cr^\gamma$ transformation to the image in the Figure Q1 (c) where s is the gray level of the image after transformation, r is the gray level of the image in the Figure Q1 (c), $\gamma = 3$ and $c = 0.01$ (Round values of s to the closest decimal point).

| | | | | |
|----|----|----|----|----|
| 10 | 12 | 8 | 7 | 6 |
| 12 | 13 | 11 | 10 | 9 |
| 8 | 7 | 12 | 11 | 6 |
| 7 | 9 | 10 | 12 | 11 |
| 10 | 11 | 13 | 10 | 8 |

Figure Q1 (c)

[4.0 Marks]

- Q2 a) Apply the transformation on Figure Q2 (a) to the image in the Figure Q1 (c), where $L = 256$, $r_1 = r_2 = 9.5$, $s_1 = 0$ and $s_2 = 255$.

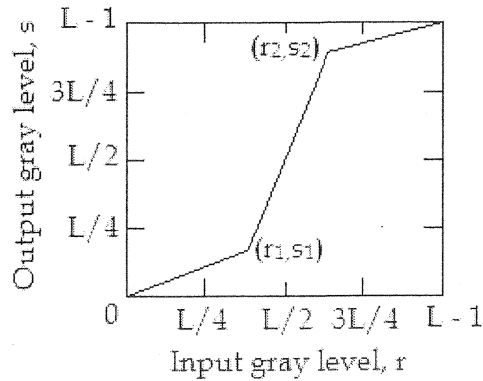


Figure Q2 (a)

[4.0 Marks]

- b) i) Draw the histogram of the gray level image shown in Figure Q2 (b), The gray levels of the image are from 0 to 7.

| | | | | |
|---|---|---|---|---|
| 5 | 5 | 5 | 5 | 5 |
| 4 | 5 | 6 | 5 | 4 |
| 4 | 6 | 6 | 6 | 4 |
| 4 | 5 | 6 | 5 | 4 |
| 5 | 5 | 5 | 5 | 5 |

Figure Q2 (b)

[2.0 Marks]

- ii) Equalize the histogram of the image in Figure Q2 (b). Fill the Table 1 by calculating the mapping for each gray level.

Table 1: Mapping for each gray level.

| Input | Output |
|-------|--------|
| 0 | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |

[4.0 Marks]

- Q3 a) "Median filter is more suitable to filter an image with salt and pepper noise"
Is the above statement True or False? Justify your answer.

[2.0 Marks]

- b) Apply the 3x3 median filter for the image in Figure Q3 (b).
Note: Pad the image with zeros if required.

| | | | | |
|-----|-----|-----|-----|-----|
| 100 | 80 | 60 | 110 | 80 |
| 120 | 105 | 102 | 100 | 70 |
| 60 | 80 | 78 | 90 | 102 |
| 110 | 102 | 92 | 97 | 78 |
| 75 | 95 | 100 | 120 | 80 |

Figure Q3 (b)

[4.0 Marks]

- c) When an image is converted by applying 2D discrete Fourier transform, we obtain two components, namely magnitude and phase.

Which component gives us the geometric structure of the spatial domain?

[2.0 Marks]

- d) If the discrete Fourier transform of image $f(x,y)$ is represented by the function $F(u,v)$.

What is the information of the image we can obtain from $F(0,0)$?

[2.0 Marks]

- Q4 a) What is the colour you will get if you mix equal amounts of cyan, magenta and yellow?

[2.0 Marks]

- b) What is main difference when smoothing an image in RGB colour model and an image in HSI colour model?

[2.0 Marks]

- c) Why it is important to smooth an image before applying 1st and 2nd derivative operators?

[2.0 Marks]

- d) Segment the image in Figure Q4 (d) using the region growing technique. Use the shaded pixel as a seed and use the intensity difference between neighbouring pixels ≤ 5 , Use 8 connected neighbours when applying the predicate.

| | | | | | | |
|----|----|----|----|----|----|----|
| 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 10 | 10 | 10 | 69 | 70 | 10 | 10 |
| 59 | 10 | 60 | 64 | 59 | 56 | 60 |
| 10 | 59 | 10 | 60 | 70 | 10 | 62 |
| 10 | 60 | 59 | 65 | 67 | 10 | 65 |
| 10 | 10 | 58 | 10 | 10 | 10 | 10 |
| 10 | 59 | 10 | 10 | 10 | 10 | 10 |

Figure Q4 (d)

[4.0 Marks]

Q5 a) In morphological image processing there exist two concepts namely Fit and Hit of the structuring element.

What is the main difference between a Fit and a Hit of the structuring element?

[2.0 Marks]

b) Briefly explain Erosion and Dilation in morphological image processing.

[2.0 Marks]

c) Use the structuring element in Figure Q5 (c) to the following questions (i) and (ii).

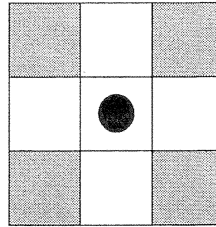


Figure Q5 (c)

i) Apply the Dilation operation on the image in Figure Q5 (c) (i) using the structuring element above in Figure Q5 (c).

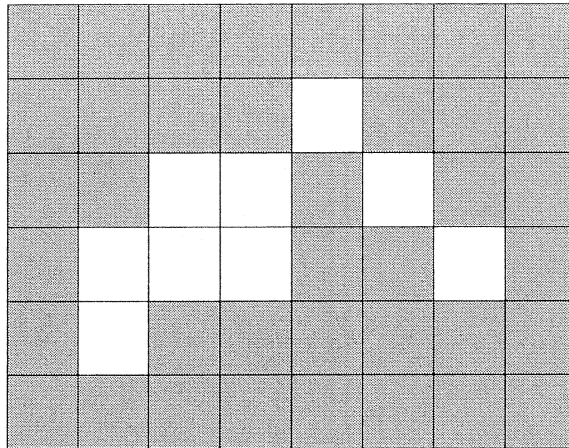


Figure Q5 (c) (i)

ii) Apply the Erosion operation on the image you obtain after Dilation in the section Q5 (c) (i), use the structuring element above in Figure Q5 (c).

[4.0 Marks]

d) What is the reason for using two cameras in stereo vision system instead of using a single camera?

[2.0 Marks]