



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2017

Module Number: EE7207 Module Name: Computer Vision and Image Processing

[Three Hours]

[Answer all questions, each question carries 10 marks]

Q1 a) Briefly explain how image processing techniques are used in image compression. [2.0 Marks]

b) The Euclidean distance between the points $p(x,y)$ and $q(s,t)$ in an image is defined as

$$Deq(p,q) = [(x-s)^2 + (y-t)^2]^{\frac{1}{2}}$$

List two image processing applications where the measurement of distance between two points is used.

[2.0 Marks]

c) Average filter is a linear filter used for noise reduction

i) Write an example of weighted average filter mask of 3×3 .

ii) What is the advantage of using a weighted average filter compared to non-weighted one?

[2.0 Marks]

d) Write a 3×3 mask which detects a line in 45° .

[2.0 Marks]

e) What is the advantage of the separability of 2D Fourier transform when applying it to an image?

[2.0 Marks]

Q2 a) What is the main difference between spatial domain methods and frequency domain methods of image enhancement?

[2.0 Marks]

b) $S = cr^k$ is a transformation function applied on a grayscale image where S is the gray level of the image after transformation, c is a constant, r is the gray level of the image before transformation. Assume the value of k is 5 and range of r is between 0 and 1.

What is the effect on the input image intensities after the transformation?

[2.0 Marks]

- c) Draw a piecewise-linear transformation function which apply the contrast stretching transformation to a grey scale image.

[2.0 Marks]

- d) Draw the histogram of the gray level image shown in Figure Q2(d), The grey levels of the image are from 0 to 15.

14	14	14	14	14	14	14	14
14	12	12	12	12	12	12	14
14	12	10	10	10	10	12	14
14	12	10	8	8	10	12	14
14	12	10	8	8	10	12	14
14	12	10	10	10	10	12	14
14	12	12	12	12	12	12	14
14	14	14	14	14	14	14	14

Figure Q2(d)

[1.0 Mark]

- e) Equalize the histogram of the image in Figure Q2(d) and fill the Table 1 by calculating the mapping of each grey level.

Input	Output
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Table 1

[3.0 Marks]

Q3 a) What are the steps in sharpening the edges in a given image in the frequency domain?

[2.0 Marks]

b) Segment the image in Figure Q3(b) using region growing technique. Use the shaded pixel as a seed and use the intensity difference between neighboring pixels ≤ 3 , use 8 connected neighbors when applying predicate.

10	10	10	10	20	20	20
40	30	20	10	20	62	30
50	74	66	68	67	70	30
65	75	68	65	66	50	30
66	76	69	66	67	65	20
68	71	30	70	20	62	10
10	20	73	20	10	20	5

Figure Q3(b)

[2.0 Marks]

c) What is the order of morphological operations in the compound operation named "opening"?

[2.0 Marks]

d) Use the structuring element in Figure Q3(d) to the following Q3(d)(i) and Q3(d)(ii) questions.

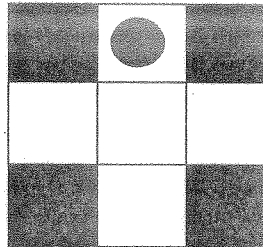


Figure Q3(d)

i) Apply the dilation operation on the image in Figure Q3(d)(i) using the structuring element Figure Q3(d).

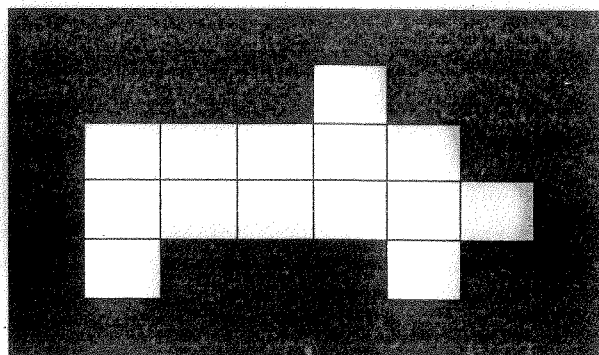


Figure Q3(d)(i)

ii) Apply the erosion operation on the image you obtain after dilation in the section Q3(d)(i). Use the structuring element in Figure Q3(d).

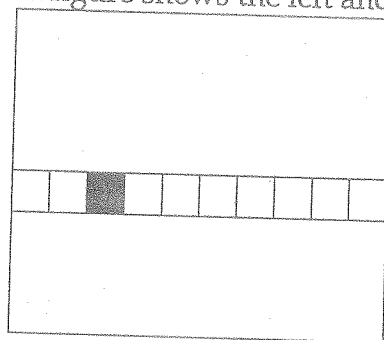
[4.0 Marks]

- Q4 a) List THREE advantages SIFT (Scale-Invariant Feature Transform). [3.0 Marks]
- b) Describe how SIFT is invariant to the scale. [2.0 Marks]
- c) What is the dimension of the SIFT descriptor? [1.0 Mark]
- d) Describe how the SIFT descriptor is robust to illumination changes. [2.0 Mark]
- e) What is the technique to improve the efficiency of nearest neighbor matching when there are multiple close matchers? [2.0 Marks]

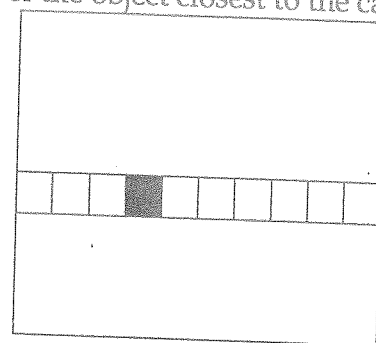
- Q5 a) List TWO camera motions that causes problems when computing motion vectors. [2.0 Marks]

- b) Figure Q5(b)(i) and Figure Q5(b)(ii) are left and right images of same object in different depths. The object is shown by the pixel in black and size of the left and right images are 10x10 pixels.

Which figure shows the left and right images of the object closest to the camera?

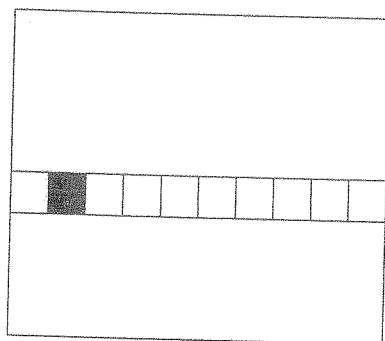


Left Image

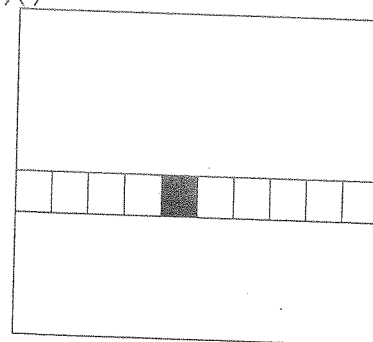


Right Image

Figure Q5(b)(i)



Left Image



Right Image

Figure Q5(b)(ii)

[2.0 Marks]

- c) List TWO ways humans perceive depth using one eye (monocular)?
[2.0 Marks]
- d) What is the difference between active vision system and passive vision system?
[2.0 Marks]
- e) Describe the TWO main operations involved in image warping.
[2.0 Marks]