



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2015

Module Number: EE7239 Module Name: Computer Vision and Image Processing

[Three Hours]

[Answer all questions, each question carries 10 marks]

- Q1 a) Image blurring can be occurred due to many reasons. State two reasons that can cause a blurred image. [2 Mark]
- b) Principle categories of spatial processing for image enhancement are intensity transformations and spatial filtering. How does the intensity transformations differ from spatial filtering? [1 Mark]
- c) What is the difference between histogram equalisation and histogram matching? [2 Marks]
- d) i) What is dynamic range compression?
ii) Sketch an example transformation function for dynamic range compression. [2 Marks]
- e) Histogram processing can be used to double the size of an image. Is this statement true? Explain your answer. [1 Mark]
- f) i) In which image enhancement application do we use Unsharp masking?
ii) How does Unsharp masking differ from high-boost filtering? [2 Marks]
- Q2 a) Figure Q2 (a) gives the mask for point detection. Describe the process of point detection using this mask. [2 Marks]

-1	-1	-1
-1	8	-1
-1	-1	-1

Figure Q2 (a)

- b) What is an edge? [1 Mark]
- c) What is the difference between the Laplacian Operator and the Laplacian of Gaussian operator for edge detection? [1 Mark]
- d) Describe the process of Hough transform for line detection in ab-parameter space. [5 Marks]
- e) Give two properties of an image which will result successful intensity thresholding. [1 Mark]

Q3 a) Image subtraction is often used in industrial applications. The approach is to store a "golden" image that corresponds to a correct assembly. This image is then subtracted from incoming images of the same product. Give two conditions which you think have to be met in practice for this method to work? [1 Mark]

b) What is the purpose of hit or miss transform? [1 Mark]

c) Region filling is one of the morphological algorithms. The key equation for region filling is $X_k = (X_{k-1} \oplus B) \cap A^c$.

i) How do you find X_0 for this iterative operation?

ii) Perform region filling on figure Q3 c) i) with the given structuring element clearly giving the intermediate steps (X_0, X_1, \dots). The origin of the structuring element is indicated with a dot.

Use the grid given in Figure Q3 c) ii) in page 5 of this paper to perform the operations. Indicate a white pixel with a clear cross (⊠) sign. Detach the page of the paper and attach it to your answer script.

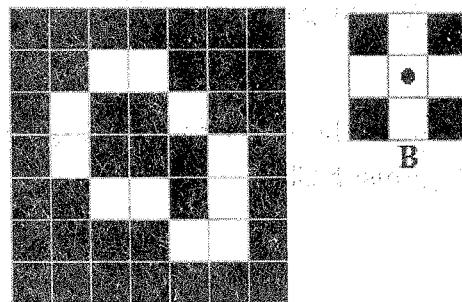


Figure Q3 c) i)

d) State two imperfections that we can repair using dilation. [1 Mark]

- Q4 a) Shape number is one way to represent the boundary of an object.
- What is the difference between the chain code and the shape number?
 - Figure Q4 a) shows a set of grid points obtained by approximating a set of boundary points of an object to the nearest grid point. Calculate the shape number of the object using 8-directional chain code.
 - Why the approximation of boundary points to a grid is necessary?

[5 Marks]

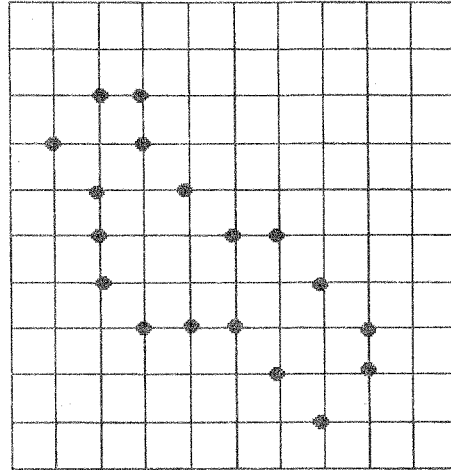


Figure Q4 (a)

- In the statistical approach of measuring texture descriptors, the grey-level histogram is analyzed.
 - Give a limitation of computing a measure of texture using only histograms and explain it using an example.
 - Calculate the co-occurrence matrix (normalized for the image size) for the given image in Figure Q4 (b). Take the position operator as "one pixel to the right".
 - What can you say about the texture of the image by looking at the co-occurrence matrix?

[5 Marks]

0	1	0	1	2	3
1	1	0	1	1	3
2	2	3	4	4	4
1	2	3	3	6	7
0	2	4	6	7	7

Figure Q4 (b)

- Q5 a) An analysis was carried out to recognize three types of objects. A set of 15 bananas, 5 from each category was imaged using a digital camera in a white background.
- i) The area (A) and the length (L) of the objects in the images were determined using some image processing techniques. The results are given in the Table Q5. How do you train a classifier using these results? Give the output.

Table Q5

Object type 1		Object type 2		Object type 3	
Area	Length	Area	Length	Area	Length
20	10	21	6	30	5
21	9	19	5	28	5
19	8	23	7	29	4
25	10	20	5	27	6
22	11	20	6	31	7

- ii) If you are given a new sample with an area of 20 and a Length of 7, classify the new sample using one nearest neighbor rule (1 NN).
- iii) Why the three nearest neighbor rule (3 NN) gives better accuracy than one nearest neighbor rule (1 NN)?

[4 Marks]

- b) What is the difference between motion field and optical flow? Explain with an example.

[2 Marks]

- c) Sketch the optical flow from the side window of a car. Explain the details you can get out of the sketched optical flow field.

[2 Marks]

- d) What is the advantage of using stereo vision system with two cameras instead of using a single camera?

[1 Mark]

- e) What is the relationship between disparity and depth?

[1 Mark]

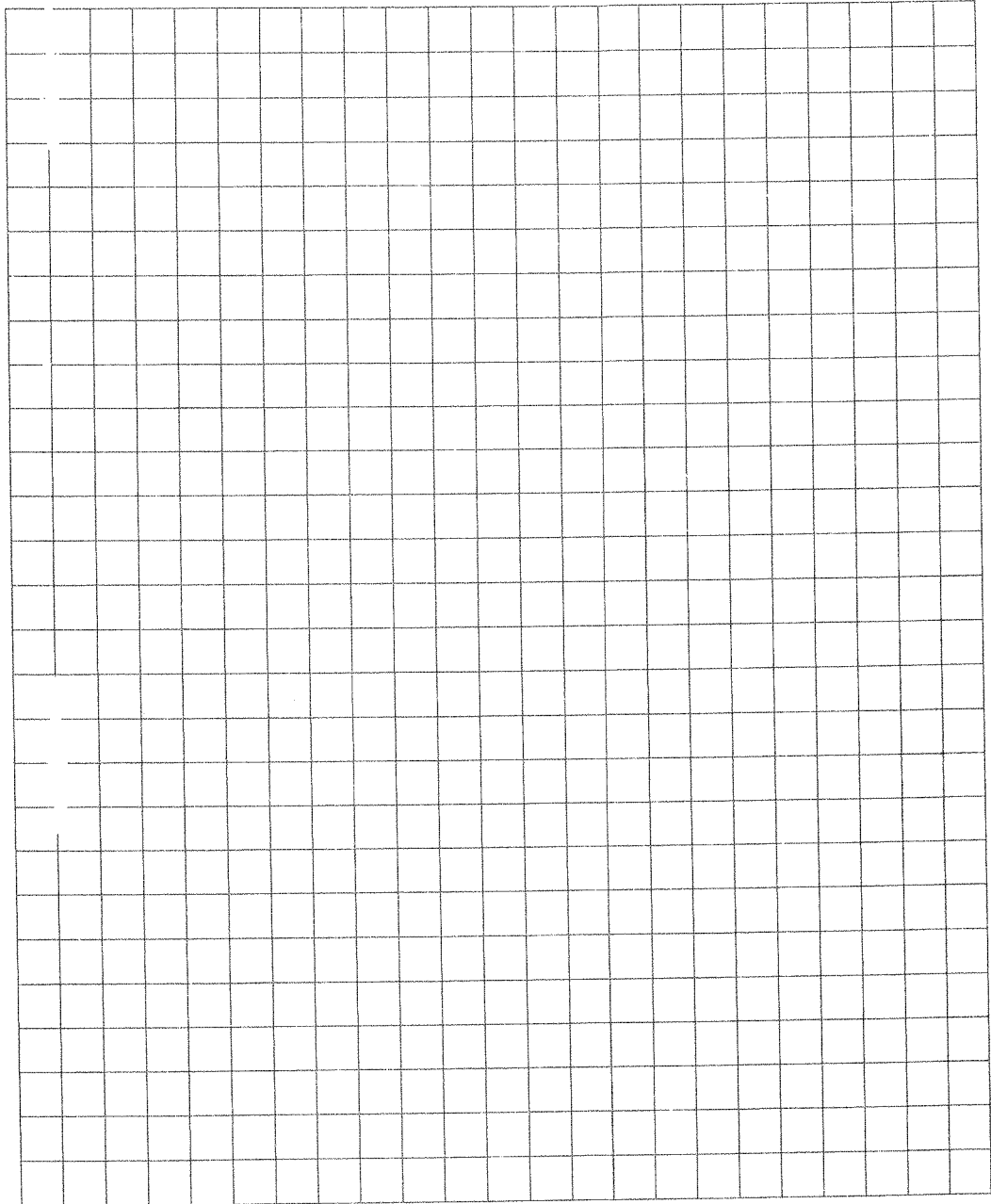


Figure Q3 c) ii)