No. of Printed Pages : 7

MINI-044

M.Tech. IN ADVANCED INFORMATION TECHNOLOGY – INTELLIGENT SYSTEMS AND ROBOTICS (MTECHSR)

00284

Term-End Examination

December, 2014

MINI-044 : ARTIFICIAL VISION SYSTEM

Time : 3 hours *Maximum Marks : 100*

Note :

(i) *Section I is **compulsory**.*

(ii) *In Section II, attempt any **five** questions.*

(iii) *Assume suitable data wherever required.*

(iv) *Draw suitable sketches wherever required.*

(v) *Italicized figures to the right indicate maximum marks.*

(vi) *Use of calculators is allowed.*

SECTION I

1. Answer all the questions. *5×3=15*

(a) List four different ways of generating a shape signature for Fourier boundary description.

(b) Write the equations for computing the first two statistical moments of an object/region.

(c) List two different distance functions with equations.

(d) Write an algorithm for Bit Plane Slicing.

(e) Give examples for 2-dimensional, 3-dimensional, 4-dimensional and 5-dimensional images.

2. You have been asked to develop a vision based robot for surveillance. The robot should be able to identify a person, greet him appropriately and activate lights, fans, AC, etc. based on the vocal command of an identified person. If a person is not identified by either visual appearance or voice, it should indicate concerned authorities about a suspected unauthorized access while providing them with live audio-visual data through wireless channel. As a designer of this robot, give its basic block diagram and justify your choice for the following : *5×3=15*

(a) The minimum fps of the camera

(b) The sampling frequency for input microphone

(c) Resolution of ADC (for microphone)

(d) Minimum bandwidth requirement for transmitting data from the camera to the central processing unit (microcontroller or microprocessor) in the robot

(e) Minimum bandwidth requirement for wireless transmission of live data

Assume that :

(i) The time required for visually identifying a person is 20 ms.

(ii) The time required for identifying a person based on voice is 5 ms.

(iii) The resolution of the camera is 640×480 pixels.

(iv) Each pixel generates 7-bit unsigned binary data.

(v) Maximum frequency with which any change can occur within the visual field of the robot is 20 Hz.

SECTION II

3. In the Figure 1 given below, two objects (A (in Black) and B) in the image are present.

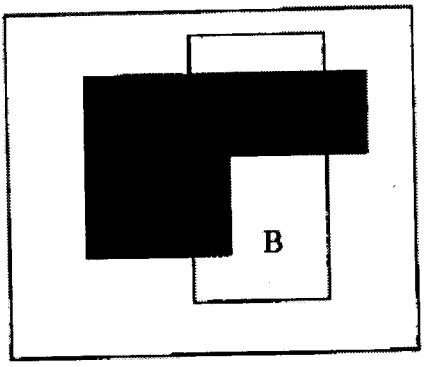

Figure 1

(a) Draw Object A and B separately.

(b) Draw the Complement of Object B.

(c) Draw A ∪ B.

(d) Draw A ∩ B.

(e) Draw A – B.

3+3+3+3+2

4. Draw the histogram of the following image (Figure 2) given in digital form. Find the mean, standard deviation and variance of the data. Perform Histogram equalization and give the resultant matrix. *4+4+6*

10	12	1	0	4
24	25	27	19	3
3	5	11	8	4
4	21	31	2	15
21	14	6	4	29
4	16	11	21	2
14	3	12	2	31
4	29	27	1	17
12	4	3	31	4

Figure 2

5. (a) What is the mathematical equation of a 2-D Fourier Transform ? *2*

(b) Define spatial frequency. How can we get back the original image by knowing its spatial frequencies ? *5*

(c) Explain why Fourier transform is invariant of translation, scaling and rotation. *4*

(d) Where is the DC component of the image located after taking the 2-D Fourier Transform ? *3*

6. In Figure 3, the black intensity is 0 and white intensity is 255. All the dimensions are in number of pixels. The image size is 250×300. The black rectangles are 20×100. The other dimensions in number of pixels are as shown. A 50×50 averaging filter is run on the image. Explain and plot an intensity plot across the dotted lines AB and CD after filtering. Note that the dotted lines are not a part of the image. The image comprises of the two black rectangles on a white background. *14*

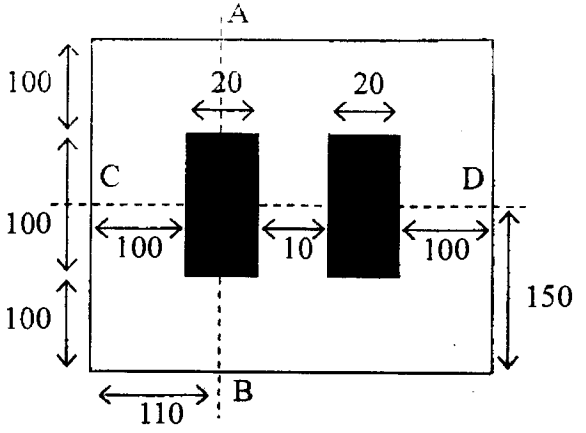

Figure 3

All distances are in number of pixels.

7. Consider the simple 4 × 8, 8-bit image, shown as Figure 4.

21	21	95	95	169	169	243	243
21	21	95	95	169	169	243	243
21	21	95	95	169	169	243	243
21	21	95	95	169	169	243	243

Figure 4

(a) Compute the entropy of the image. *4*

(b) Compress the image using Huffman coding. *7*

(c) Compute the compression achieved and the effectiveness of the Huffman coding. *3*

8. Give a morphological algorithm for converting a 4-connected binary boundary to an m-connected boundary. You may assume that the boundary is fully connected and that is one pixel thick. *14*
