Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH MAKE UP EXAMINATION, JAN 2023

Computer Vision [ICT 4031]

Marks: 50   **Duration: 180 mins.**

A

Answer all the questions.   Section Duration: 180 mins

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1)

A) The gradient magnitude and gradient direction of the image is shown in Fig. Q.1Ai and Fig. Q.1Aii respectively. Identify the edge pixels using Canny edge detector. The higher and lower threshold values are greater than equal 50 and lower than 40 respectively. Use four connected edges. Keep the magnitude of the outer pixel as it is. These values to be used for edge detection.   (5)

20	35	30	35	10	65
45	25	50	35	20	35
80	48	62	48	23	66
96	32	47	74	37	12
28	47	35	44	48	34
10	34	42	32	67	21

70	35	50	50	10	65
45	25	40	135	20	35
80	145	260	210	250	65
95	320	47	254	37	120
28	145	135	44	240	340
10	34	56	35	67	21

Fig. Q. 1Ai   Fig. Q.1Aii

B) The relation between estimated camera parameters and the camera model is shown in Fig. Q1B. Specify whether the parameters are intrinsic or extrinsic. Also indicate what does each of these parameters signify.   (3)

$$\begin{bmatrix} \hat{m}_{11} & \hat{m}_{12} & \hat{m}_{13} & \hat{m}_{14} \\ \hat{m}_{21} & \hat{m}_{22} & \hat{m}_{23} & \hat{m}_{24} \\ \hat{m}_{31} & \hat{m}_{32} & \hat{m}_{33} & \hat{m}_{34} \end{bmatrix} = \gamma \begin{bmatrix} -f_x r_{11} + r_{31} o_x & -f_x r_{12} + r_{32} o_x & -f_x r_{13} + r_{33} o_x & -f_x T_x + T_z o_x \\ -f_y r_{21} + r_{31} o_y & -f_y r_{22} + r_{32} o_y & -f_y r_{23} + r_{33} o_y & -f_y T_y + T_z o_y \\ r_{31} & r_{32} & r_{33} & T_z \end{bmatrix}$$

Fig. Q. 1B

C) An object is originally at the location [10,10,10]. Find its location after translating by an amount [10, 5, 20]   (2)

2)

A) An image is given as in Fig. Q.2A, with the derivative along x and y direction as [-1 0 1] and [-1 0 1] ^{T} respectively. Using Harris corner detector check if the pixel with value 10 is a point of interest. The window function used is 3x3 having uniform distribution with unit value. The K value is 0.04.   (5)

1	1	1	1	1
1	2	4	2	1
1	4	10	4	1
1	3	4	3	1
1	1	1	1	1

Fig. Q.2A

B) Analyze the role of PCA on any one application   (3)

C) The world coordinate system has a pixel representation at (100,200, 400). This is in front of the camera lens and image plane. This is perspectively projected into an image at coordinates (12, 24). Compute the focal length of the camera, if the camera lens origin is at lens centre and image plane is behind the lens   (2)

3)   An image with gradient magnitude and gradient direction is shown in Fig. Q.3Ai and Fig. Q.3Aii respectively. Obtain the histogram which represent the image using HoG process.   (5)

A)

36	30	90
25	50	35
48	62	48
32	48	74

35	50	60
25	94	128
145	160	110
70	4	164

Fig.Q.3Ai   Fig. Q.3Aii

B) Bring out the relation between Correlation and Sum of square differences (3)

C) Explain the concept of scaling in SIFT (2)

4) Given an image with the pixel intensity value as shown in Fig. Q.4A Use the filter $\begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix}$ (5)

A) along x and $\begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$ along y direction of Sobel filter. Given the threshold value greater than or equal to 100, check for presence of an edge. The filter is 3x3 filter with forward difference given the threshold value of 6.

7	6	8	3	1
4	5	4	3	2
8	4	6	4	2
9	3	4	5	3
2	4	3	4	4

Fig. Q.4A

B) Prove that two dimensional Gaussian can be separable (3)

C) Classify the skin pixel in an image using Bayes theorem (2)

5) Using RANSAC method find the best fit line for the data given below: (5)

A) (15, 20), (10, 20), (15, 25), (25, 35), (25, 40), (20, 35), (30, 50)

[Note that line should fit at least 5 points, Threshold: 2]

B) Specify steps using any suitable algorithm to identify the motion of an object (3)

C) Suggest an application to identify unique features in an image using the deep learning technique (2)

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