# **Question Paper**

Exam Date & Time: 02-Dec-2023 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B. TECH END SEMESTER EXAMINATIONS, NOV/DEC 2023

Computer Vision [ICT 4031]

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Marks: 50

Duration: 180 mins.

#### Answer all the questions.

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

- A point in an object is given by the coordinates (3, 2, 1). Compute the final coordinates of that point after (5) carrying out the following transformations sequentially. The object is rotated along Y axis in the clockwise direction by an amount 45 degree, this is followed by scaling by an amount (3,2,2) followed by translation by an amount (1,4,3). Show all the intermittent result with each transformation
  - B) The camera model matrix is shown in Fig. Q.1B. Compute the three parameters T, o and f. The variables  $\frac{\Lambda}{m}$  (3) represents the estimated matrix, T the translation, f the focal length, r the rotation,  $\gamma$  the multiplication factor and o the image centre.

$$\begin{bmatrix} \hat{m}_{11} & \hat{m}_{12} & \hat{m}_{13} & \hat{m}_{14} \\ \hat{m}_{21} & \hat{m}_{22} & \hat{m}_{23} & \hat{m}_{24} \\ \hat{m}_{31} & \hat{m}_{32} & \hat{m}_{33} & \hat{m}_{34} \end{bmatrix} = \gamma \begin{bmatrix} -f_x r_{11} + r_{31} o_x & -f_x r_{12} + r_{32} o_x & -f_x r_{13} + r_{33} o_x & -f_x T_x + T_z o_x \\ -f_y r_{21} + r_{31} o_y & -f_y r_{22} + r_{32} o_y & -f_y r_{23} + r_{33} o_y & -f_y T_y + T_z o_y \\ r_{31} & r_{32} & r_{33} & T_z \end{bmatrix}$$
  
Fig. O.1B

- C) Prove that Euclidean transformations preserves the distance between pair of points (2)
- 2)

3)

Given the set of data points as shown in Fig. Q.2A. Find the reduced one dimensional data using Principal (5) Component Analysis algorithm?

A)

х	4	6	5	3	7
у	6	8	7	5	9

### Fig. Q.2A

- B) Obtain the relation between the gradient of probability density function and mean shift for any set of data (3) points.
- C) Prove that nearer objects are lower in the image

(2)

Using Random Sample Consensus method, given a set of data points (5, 20), (50, 30), (15, 35), (10, 40), (20, (5) 55), (30, 60), (45, 10), obtain the best fit line. The line should fit at least 4 points. The threshold value given is
A)
2. The relation between N, the number of computations required, p the probability at least one random sample is free from outlier is given by

$$N = \frac{\log(1-p)}{\log(1-(1-e)^{s})}$$

Threshold is 2

Fig. Q.3B shows the Gradient Magnitude in the Canny edge detector. Given that upper and lower threshold (3) values of the gradient magnitude to be 50 and 10 respectively, identify the edge pixels using 4 connectedness. Show in the intermittent result, initial selected edge as E and connected edges as C, dropped

30	9	40	20	3	47
23	11	56	6	98	30
2	67	24	8	22	55
6	12	4	21	1	34
56	2	7	67	4	65
11	4	8	11	23	4
56	2	88	6	21	43

edges can be discarded

C) Let (x,y,t) and (x+dx, y+dy,t+dt) denote the brightness value of a point at the time t and t+dt. Obtain the (2) relation between these two points using Taylors series method

Fig. Q.3B

Given an image as in Fig. Q. 4A, Check if the given central pixel 6 is a corner /edge /flat region using Harris(5)corner detector. Use the uniform window of size 3x3 for smoothing. For the derivative along the x and y(5)A)direction, use the filtersand



Harr value greater than 200 represents large positive value. Value of the constant K used in the Harr computation is 0.04

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

4)

6 8 8 5 4

# Fig. Q. 4A

Given images of a person with size MxN and n views of p persons, find the computationally inexpensive (3) method to compute the eigen vectors during eigen face creation

- C) Provide the pseudocode using Hough transform for fitting a circle
- 5)

B)

A)

Create a 8 bin histogram for 4 x 4 SIFT descriptor. The magnitude and direction at a specific location are as shown in Q.5A.1 and Q.5A.2 respectively. Compute the major direction of the orientation of the pixel at specified location?

(5)

(2)

10	10	15	5
10	5	15	5
15	10	5	5
5	5	10	15

91	47	22	67
359	180	273	224
85	40	20	60
342	173	204	252

# Fig Q.5A.1

## Fig. Q.5A.2

- B) Consider a scenario with a world coordinate point P and two Cameras all placed in the same plane. The two (3) cameras are separated by a distance T. Obtain the expression for the Fundamental matrix
- C) Given an image as in Fig. Q.5C. There are four colored regions 1 representing Red (R), 5 yellow (Y), 9 (2) Green(G) and 3 Blue (B. At each step, indicate how region growing takes place using 4 connectedness

10	10	90	90	90
10	10	90	9-	90
50	10	10	90	90
50	50	50	30	90
30	30	30	30	34

Fig. Q.5C

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