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B.Tech DEGREE EXAMINATION, DECEMBER 2023

Fifth Semester

18MHE455T - COMPUTER VISION AND ITS APPLICATIONS

(For the candidates admitted during the academic year (2020-2021 & 2021-20222))

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

		Marks	BL	CO
1.	Which of the following colour models are used for colour printing? (A) RGB (B) CMY (C) CMYK (D) CMY and CMYK	1	1	1
2.	Of the following, _____ has the maximum frequency. (A) UV Rays (B) Gamma Rays (C) Microwaves (D) Radio Waves	1	1	1
3.	Which of the following fields starts with the engineering of light? (A) Image processing (B) Image Registration (C) Image enhancement (D) Computer Vision	1	2	1
4.	Which of the following is preserved in perspective projection (A) Length (B) Angles (C) Straight Line (D) Ratio	1	1	1
5.	Dynamic range of imaging system is a ratio where the upper limit is determined by (A) Saturation (B) Noise (C) Brightness (D) Contrast	1	2	2
6.	The colour of an object is determined by the light (A) Refracted (B) Transmitted (C) Reflected (D) Absorbed	1	1	2
7.	What effect does a larger camera aperture (lower f-number) have on an image? (A) Increased depth of field (B) Decreased depth of field (C) No impact on depth of field (D) Sharper image	1	1	2
8.	What role does the concept of "illumination normalization" play in computer vision? (A) Adding artistic effects to images (B) Balancing color saturation (C) Adjusting exposure time (D) Minimizing the impact of varying lighting conditions	1	2	2
9.	Which image enhancement technique is commonly used to adjust the overall brightness and contrast of an image by stretching the range of pixel values? (A) Histogram equalization (B) Median filtering (C) Edge detection (D) Saturation adjustment	1	1	3
10.	In spatial domain filtering of an image, which filter is commonly used for edge detection by emphasizing rapid changes in intensity? (A) Gaussian filter (B) Sobel filter (C) Median filter (D) Low-pass filter	1	2	3

11. What is the Nyquist theorem related to image sampling? 1 1 3
(A) It determines the image brightness levels.
(B) It specifies the minimum sampling rate for accurate reconstruction.
(C) It defines the color space of the image.
(D) It governs the choice of artistic filters for sampling.

12. In morphological image processing, what is the primary purpose of the dilation operation? 1 2 3
(A) To shrink and erode the image
(B) To highlight edges and fine details
(C) To expand and emphasize features
(D) To reduce noise and smooth the image

13. In Harris corner detection, what role does the parameter "k" play in the calculation of the corner response function? 1 2 4
(A) Adjusts the overall brightness of the image
(B) Controls the sensitivity to corner-like structures
(C) Modifies the color representation of corners
(D) Determines the size of the neighborhood for corner analysis

14. In the SIFT (Scale-Invariant Feature Transform) descriptor, what information does the histogram of gradient orientations represent? 1 1 4
(A) Color distribution of the feature
(B) Scale variations in the feature
(C) Gradient magnitude of the feature
(D) Spatial location of the feature

15. In gray-level image matching, which technique involves sliding a template over an image and calculating the sum of squared differences between the template and the corresponding pixels in the image? 1 1 4
(A) Normalized Cross-Correlation
(B) Hamming Distance
(C) Mean-Shift Algorithm
(D) Sum of Squared Differences

16. In feature extraction, what does the term "Scale-Invariant Feature Transform (SIFT)" primarily aim to achieve? 1 2 4
(A) Adjusting the scale of image features
(B) Enhancing color contrast in images
(C) Extracting features invariant to scale and rotation
(D) Applying artistic effects to image features

17. In a stereo vision system, what is the primary purpose of computing the disparity map? 1 2 5
(A) Estimating the depth information of the scene
(B) Adjusting the brightness of stereo images
(C) Enhancing color contrast between stereo pairs
(D) Detecting edges and contours in the images

18. What is the baseline in a stereo vision system? 1 1 5
(A) The distance between the camera and the object
(B) The distance between the left and right cameras
(C) The focal length of the camera lens
(D) The depth of the scene being captured

19. In computer vision, what does the correspondence problem refer to? 1 2 5
(A) Matching keypoints between images
(B) Adjusting the brightness of images
(C) Estimating the depth of a scene
(D) Enhancing color contrast in images

20. In epipolar geometry, what is the epipole? 1 1 5
(A) The point where the optical axis intersects the image plane
(B) The center of projection of the camera
(C) The point where the epipolar line intersects the baseline
(D) The point where the projections of both camera centers meet

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

		Marks	BL	CO
21.	Enumerate the distinct intrinsic and extrinsic parameters associated with a camera system.	4	3	1
22.	Enumerate the various types of optical filters and light sources.	4	3	2
23.	Provide an enumeration of the varied technical specifications of lenses employed in industrial cameras.	4	4	2
24.	Briefly describe the methodologies underlying thresholding operations in image processing.	4	4	3
25.	Briefly explain utilization and implications of padding in convolution within the domain of image processing.	4	3	3
26.	Enumerate the multiple factors influencing template matching in the realm of image processing.	4	3	4
27.	List the various classifications of visual servoing architectures	4	3	5

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

		Marks	BL	CO
28.	(a) Explain the process of camera modelling with relevant expressions and illustrative figures.	12	3	1
	(OR)			
	(b) Elaborate on the camera calibration process employing direct parameter estimation, incorporating with relevent expressions and illustrative figures.			
29.	(a) Detail the step-by-step process of constructing a vision system considering scene constraints. Provide a comprehensive account of the procedure, highlighting key elements and limitations within the context of the given scene.	12	3	2
	(OR)			
	(b) Explain in detail about the systematic classification of various lighting techniques available for machine vision applications with a neat sketch.			
30.	(a) Explain in detail the steps involved in frequency domain high filtering of a digital image. Write relevant expressions and necessary figures.	12	4	3
	(OR)			
	(b) Given below is a digital image of size 5x5. Perform a linear filtering operation with 3x3 edge detection filter for at least three different ways of addressing the border issue. Present the three resultant images. Show sample calculation for only one pixel.			

100	101	102	101	103
101	200	201	200	102
101	201	202	202	103
102	202	203	203	102
101	99	100	100	101

31.	(a) Explain in detail the following steps involved in SIFT algorithm for key point detection and description. • Gaussian scale space construction • Difference of Gaussians • Extrema detection • Sub-pixel extrema detection	12	3	4
	(OR)			
	(b) Explain in detail with illustration closed system figures the various classifications visual servoing architectures			

32. (a) Describe the various steps involved in reconstructing a scene from 2D images using computational stereo vision technique. 12 4 5

(OR)

(b) Explain in detail an application case study in vision guided robots highlighting the various hardware and software stack selection

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