

2125

M. E. (Information Technology)
Third Semester

MEIT-3206: Image Processing and Computer Vision

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 (Section-A) which is compulsory and selecting two questions each from Section B-C. Any missing or misprinted data maybe assumed suitably. All questions carry 10 marks.

x-x-x

Section-A

I. Attempt the following:-

- a. Explain the difference between sampling and quantization. Which of the two is primarily responsible for aliasing, and why?
- b. In the context of morphological operations, what is the effect of applying Opening followed by Closing on a noisy binary image?
- c. Briefly state the three main advantages of the Canny edge detector, comparing it to simple derivative filters.
- d. What is the epipolar constraint in binocular stereo, and how does it reduce correspondence search complexity?
- e. Define RANSAC in one line and state why it is useful for homography estimation from noisy matches.

Section B

- II.
 - a) If an image is digitized using a 1024 X 1024 grid and 8 bits are used to represent the intensity of each pixel, calculate the total number of distinct intensity levels available and the total storage space required for the image.
 - b) Describe a common application of Image Averaging in image processing. State the condition under which image averaging is most effective for noise reduction. Outline a scenario where Image Subtraction is used as a core. Explain how the process of image subtraction mathematically reveals the information of interest.
- III.
 - a) Compare the smoothing effect of a Low-pass spatial filter with a Median filter. For an image corrupted by salt-and-pepper noise, explain why a Median filter is significantly more effective than a Low-pass averaging filter for noise reduction while preserving edges.

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(2)

b) Describe the mechanism of a Homomorphic Filter. Explain its primary use in image enhancement, particularly for images suffering from non-uniform illumination.

IV. a) Define Erosion and Dilation for a binary image A with a structuring element B. Use set notation to express the algebraic relationship. Using these definitions, explain the purpose of the Opening operation. Illustrate how opening can be used to smooth boundaries and remove small spurious foreground points. (7 marks)

b) Describe the difference between the Thinning and Thickening morphological operations. What is the primary goal of Thinning in binary image analysis? (3 marks)

Section C

V. a) For multi-camera 3-D reconstruction, explain the difference between computing a homography and estimating a fundamental matrix. When is homography sufficient?

b) Given 8 matched points between two views, including some outliers, outline a RANSAC-based pipeline (with parameters) to robustly estimate the fundamental matrix. Explain how you chose the inlier threshold.

VI. a) Compare SIFT and SURF in detail.

b) Explain the KLT tracker: what image properties it requires, how it estimates motion and why it is described as a “feature tracker”.

VII. A Content-Based Image Retrieval (CBIR) system needs to be adapted for Content-Based Video Retrieval (CBVR).

(i) Explain the fundamental difference in the feature extraction strategy when transitioning from CBIR to CBVR.

(ii) Propose a combined feature vector for CBVR that leverages both low-level static features and temporal features. Justify the importance of the temporal component in recognizing complex events.