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MANIPAL (A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH. (CSE/CSIS)

END SEMESTER EXAMINATION, JUNE-JULY 2022

SUBJECT: COMPUTER VISION & IMAGE PROCESSING [CSE 5005] (PE - I)

(27/ 06/2022)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

✤ Missing data may be suitably assumed.

1A. Briefly explain the following image enhancement methods:

- (i) Power-law (Gamma) transformation.
- (ii) Histogram Specification
- **1B.** Consider the following image segment with gray levels in the range [0, 9] as **4M** given in Fig 1B. Perform the histogram equalization on this and fill in the equalized gray levels in the space provided.



- 1C. Describe the process of spatial filtering of an image using convolution operation. 2M Identify the filter that can be used to remove salt and pepper noise.
- 2A. Describe a RANSAC line fitting algorithm responsible for removing outliers 3M among the matched points. Give an equation to calculate the number of trials required to find right set of inliers with a probability of 99.9%.
- **2B.** How do you detect humans using Histogram of oriented Gradients (HOG) **3M** features?
- 2C. What is the significance of Eigen values in an interest point detector? How does 4M Harris method can be used to detect interest points?
- 3A. How can you detect blob in each image using different scales? 2M

4M

- **3B.** Suppose you are given a relationship between a point in 3D to the corresponding **4M** point in 2D using $C_h = A W_h$, where C_h is a column matrix of 2D point, A is 4×4 camera matrix containing unknown coefficients and W_h is a point in 3D space.
 - (i) Provide a method to determine these 12 unknowns in camera matrix.
 - (ii) Once you determine the camera matrix, how do you use it to find camera location and orientation?
- **3C** How do you arrive at the constraint $X_r^T F X_l = 0$, where X_r^T is a point in right **4M** image, X_l is a point in left image and F is the fundamental matrix? Draw a neat diagram from the explanation.
- **4A.** What is the rank of a fundamental matrix? How do you enforce the rank on the **2M** estimated fundamental matrix?
- **4B.** What is optical flow? Derive motion vectors *U* and *V* using Lucas and Kanade **3M** method.
- 4C. How do you obtain incremental change in a parameter required to align image 5M patches between consecutive video frames used in KLT tracking? Use proper mathematical equations for explanation.
- **5A.** With a neat block diagram explain a simple pipeline for object recognition. **4M** Name and explain few challenges that are present in the existing visual recognition algorithms.
- **5B.** You are supposed to implement lane line detection for self-driving cars. How are **4M** you going to use Hough transform approach to achieve this task?
- **5C.** How will hysteresis thresholding improve detection of edges in Canny edge **2M** detection method?

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