

C7-R4: DIGITAL IMAGE PROCESSING & COMPUTER VISION

NOTE:

1. Answer question 1 and any FOUR from questions 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

Time: 3 Hours

Total Marks: 100

1.

- a) Give properties of Discrete Fourier Transform through which the processes like image enhancement and restoration are possible.
- b) What is difference between image sampling and image quantization?
- c) Explain the operation of encoding and decoding in image compression with the help of block diagrams only.
- d) Define the stereo correspondence problem in image formation and explain how do we solve the stereo correspondence problem?
- e) Write the basic principle steps of stereo vision required to cover during 3D Vision.
- f) Explain the binary morphological operators namely Dilation and Erosion that are related to describe or analyze the shape of a digital object.
- g) Write limitations of Gradient based edge detection technique which is mostly used in the computer vision community

(7x4)

2.

- a) How to compute the Discrete Fourier Transform (DFT) for a given $M \times N$ size image? To transform any image in discrete domain, what are the problems associated with?
- b) Explain the features and algorithm steps used in Huffman coding during lossless data compression.
- c) Gaussian filtering is usually a preferred averaging method. Why?

(6+6+6)

3.

- a) Unlike in audio compression, the filters for image subband coding do not need high out-of-band rejection. However a number of other constraints have to be satisfied. Explain each constraint and requirement to be satisfied while selecting filters in image processing.
- b) Explain complete transformation steps for full color image processing and also write expressions for each transformation.

(9+9)

4.

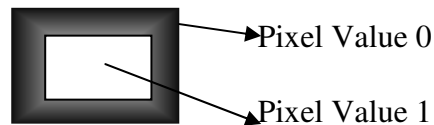
- a) Shortly explain the types of redundancy in image data using which major compression algorithms are developed.
- b) Explain why the discrete histogram equalization technique does not, in general, yield a flat histogram.
- c) How the opening and closing operators are useful in morphological image processing?

(6+4+8)

- 5.
- Give name of sequential steps required to perform during edge detection in any image data. Further explain each in short.
 - Write a significant advantage of active contours like Snakes to approximate the perimeter of an object. Briefly explain the entire procedure of finding contours in images and write only expression of its energy function.
 - How many different shades of gray are there in a color RGB system in which each RGB image is an 8-bit image? Give possible solution for detecting three different colors from available images through monochrome TV camera.

(6+6+6)

- 6.
- Write short note on Lempel-Ziv-Welch (LZW) Algorithm for compression and decompression image data. Why the LZW is also known as dictionary-based compression method?
 - Sketch the gradient of the below binary image,



and then consider the Sobel operators values as

$$H_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \quad \& \quad H_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

and use the approximation to compute gradient as, $g \approx |G_x| + |G_y|$. Find all relevant different values in the gradient image. With assumption of image size 128x128 pixels, sketch the histogram of edge directions from the above computation of gradient.

(9+9)

7. Write short notes on:
- Discrete Cosine Transform (DCT): Features and Properties
 - Region oriented segmentation
 - JPEG compression technique

(6+6+6)