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University Examinations 2023/2024

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF COMPUTER SCIENCE, BACHELOR OF INFORMATION
TECHNOLOGY, BACHELOR OF DATA SCIENCE AND BACHELOR OF INFORMATION
SCIENCE

CCS 3453/3481: DIGITAL IMAGE PROCESSING

DATE: APRIL 2024   **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) Imagine you are tasked with developing an algorithm to enhance the visibility of underwater images, which are often distorted due to light absorption and scattering by water. What techniques would you consider applying to address these specific challenges, and why?   (5 Marks)

b) Drawing on the concept of dimensions as outlined in the document, discuss the implications of moving from 2D to 3D imaging technologies in medical imaging. Propose a study that compares the efficacy of 2D versus 3D imaging in diagnosing a specific medical condition, considering the additional information provided by the third dimension and the computational challenges involved.   (5 Marks)

c) Write a MATLAB script to calculate the dot product of two vectors and the multiplication of two matrices. Include error checking to ensure the operations are valid before attempting to perform them.   (5 Marks)

d) Discuss how the size and quality of a CCD array influence the overall image quality in digital cameras. Propose an analysis comparing images taken with cameras of varying sensor sizes under identical conditions, focusing on aspects like detail resolution and noise levels.   (5 Marks)

e) Write a MATLAB function that increases the brightness of an image by adjusting its pixel values.The function should take an image and a value by which to increase the brightness as inputs.   (5 Marks)

f) Develop MATLAB code to crop an image to a specified aspect ratio without distorting the image content.   (5 Marks)

QUESTION TWO (20 MARKS)

a) Design a digital image processing system for an automated quality control assembly line in a manufacturing plant. The system must identify defects in products at high speed. Discuss the types of image processing algorithms you would incorporate and justify their choice based on the nature of defects and products.   (6 Marks)

b) Discuss the differences in image formation between analog and digital cameras, focusing on the role of silver halide in analog cameras and the CCD array in digital cameras. How do these differences affect the quality and characteristics of the images produced?

(6 Marks)

c) Develop a MATLAB script that crops a given image to a specified aspect ratio, ensuring the cropped section is centered on the image.   (8 Marks)

QUESTION THREE (20 MARKS)

a) Analysis of Digital vs. Analog Image Processing: Compare and contrast digital and analog image processing in the context of processing satellite images for meteorological

studies. Which method provides better accuracy and detail for analyzing cloud patterns and weather formations? Provide reasons for your preference. (6 Marks)

b) Describe a scenario where manipulating the intensity values of pixels could significantly enhance the quality of an image. How would you approach this task, and what impact would it have on the image's visibility or detail? (7 Marks)

c) Discuss the practical applications of digital and optical zoom in professional photography. How do the differences impact the final image quality, and in what scenarios is one preferred over the other? (7 Marks)

QUESTION FOUR (20 MARKS)

a) Machine Vision for Autonomous Vehicles: Develop a scenario where machine vision significantly improves the safety and efficiency of autonomous vehicles. Describe the image processing tasks required and the challenges that must be overcome in this application. (6 Marks)

b) Write MATLAB code that performs zooming in on an image by oversampling, increasing pixel density in a specified area. (7 Marks)

c) Write MATLAB code that downsamples an image by a factor of 2, effectively reducing its resolution. (7 Marks)

QUESTION FIVE (20 MARKS)

a) Image Restoration from Historical Archives: Propose a method for restoring damaged historical photographs using digital image processing. Include considerations for dealing with common issues like fading, stains, and tears. (6 Marks)

b) Discuss how pixel value manipulation and perspective transformations could be applied to satellite images to improve features' visibility for environmental monitoring or urban planning. (7 Marks)

c) Create MATLAB code that converts Hex color codes back to RGB values. (7 Marks)