

EE3005.01 Homework 1

Homework Assignment 1: Introduction to Image Processing

Objective:

The primary goal of this homework assignment is to provide students with hands-on experience in image processing using MATLAB. Through a series of tasks, students will learn fundamental concepts such as image reading, matrix representation, RGB channel separation, DICOM image handling, histogram equalization, and brightness/contrast adjustments. The assignment aims to enhance their understanding of image processing techniques and their practical applications.

Task 1: Image Reading and Matrix Representation

1. Image Reading:

- Choose a grey level biomedical image of your choice (ensure it is available in a common format like JPEG or PNG).
- Use MATLAB programming language to read the image into your code.

2. Matrix Representation:

- Once the image is loaded, represent it as a matrix. Explain how each pixel in the image corresponds to an element in the matrix and how the color information is encoded.

3. Display Matrix:

- Write a function to display the matrix representation of the image. This should provide a clear visual of how the image is represented as a collection of numerical values.

Task 2: Separating RGB Channels

1. RGB Image:

- Explain the concept of RGB images, where each pixel is a combination of Red, Green, and Blue components.

2. Separation of Channels:

- Choose a biomedical image and implement a function to separate the RGB image into its individual Red, Green, and Blue channels. Discuss how this separation is achieved using matrix operations.

3. Display Individual Channels:

- Display each separated channel as a grayscale image. Discuss the visual characteristics of each channel and how they contribute to the overall color of the original image.

Task 3: Summary and Analysis

1. Write-up:

- In a brief summary, explain the importance of understanding image representation as matrices and the significance of separating RGB channels in image processing.

2. Applications:

- Discuss potential real-world applications of these image processing techniques. How might understanding image matrices and RGB channel separation be useful in fields such as computer vision, medical imaging, or multimedia processing?

Task 4: DICOM Image Reading, Display, and Metadata Extraction

1. DICOM Image Reading:

- Obtain a DICOM (Digital Imaging and Communications in Medicine) format medical image. Explain the significance of DICOM in medical imaging and how it differs from standard image formats.

2. Read and Display DICOM Image:

- Use MATLAB programming language with DICOM support to read and display the DICOM image. Highlight any specific considerations or challenges associated with DICOM format.

3. Metadata Extraction:

- Develop a function to extract and display relevant metadata from the DICOM image. Include information such as patient details, acquisition parameters, and any other pertinent data.

Task 5: Basic Histogram Equalization

1. Basic Histogram Equalization:

- Implement basic histogram equalization on the grey level biomedical image chosen in Task 1. Explain the concept and discuss how it enhances the overall contrast of the image.

2. Display Equalized Image:

- Display the image after applying histogram equalization. Compare the visual characteristics of the original and equalized images.

Task 6: Brightness and Contrast Adjustment

1. Brightness and Contrast Adjustment:

- Implement a function to adjust the brightness and contrast of the grey level biomedical image. Discuss the impact of these adjustments on the image appearance.

2. Display Adjusted Image:

- Display the image after applying brightness and contrast adjustments. Compare the visual characteristics of the original and adjusted images.

Task 7: Parameter Exploration and Results Analysis

1. Varying Parameters:

- Apply different parameters for histogram equalization and brightness/contrast adjustments to observe the impact on image quality and appearance.

2. Results Visualization:

- Display visual comparisons of the original and processed images using various parameter values for each technique.

3. Comments and Analysis:

- Provide comments on the effectiveness of different parameters in achieving desired results. Discuss the trade-offs and considerations when selecting parameters for image processing tasks.

Submission Guidelines:

- The number of group members should be 2 or 3. One submission is enough per group.
- The entire report should be in a single Word document, including MATLAB code and images.
- Include the images and the source code for each steps with their explanations.
- Present visual comparisons of the original and processed images using various parameter values for each histogram equalization technique.
- Write a comprehensive report discussing your observations, insights, and any challenges faced during the implementation.
- Your reports will be checked by an AI detector. You will receive a grade of zero if AI is detected. Even if you use it only for grammar correction, the AI detector may detect AI. For your information.

Note: This assignment aims to provide students with a well-rounded understanding of image processing, including common image formats, medical imaging considerations, and advanced techniques for contrast enhancement. Students will gain practical experience in implementing and analyzing various image processing tasks.