Image Enhancement- Histogram Equalization

Wednesday, 31 July 2024

2:09 PM

**Task 1: Introduction to Histogram Equalization**

**Objective**: Understand the basics of histogram equalization and its impact on image contrast.

1. **Load and Display an Image**:
   * **Load a grayscale image and display it.**
   * **Plot the histogram of the original image to show the distribution of pixel intensities.**
2. **Calculate and Plot Histogram**:
   * **Calculate the histogram of the image manually.**
   * **Plot the histogram to visualize the pixel intensity distribution.**
3. **Calculate Cumulative Distribution Function (CDF)**:
   * **Compute the CDF from the histogram.**
   * **Normalize the CDF to the range [0, 255].**
4. **Apply Histogram Equalization**:
   * **Map the original pixel values to equalized pixel values using the CDF.**
   * **Display the equalized image and plot its histogram.**
5. **Compare Results**:
   * **Compare the original and equalized images.**
   * **Discuss the differences in visual quality and histogram distributions.**

**Task 2: Comparing Histogram Equalization Techniques**

**Objective**: Compare standard histogram equalization with adaptive histogram equalization.

1. **Implement Adaptive Histogram Equalization (AHE)**:
   * **Divide the image into smaller regions (tiles).**
   * **Apply histogram equalization to each tile separately.**
   * **Combine the tiles to form the final image.**
2. **Implement Contrast Limited Adaptive Histogram Equalization (CLAHE)**:
   * **Enhance the AHE implementation by limiting the contrast.**
   * **Apply CLAHE to the image and display the result.**
3. **Compare Results**:
   * **Display the original image, standard histogram equalized image, AHE image, and CLAHE image side by side.**
   * **Discuss the differences in visual quality and histogram distributions.**

**Task 3: Implementing Histogram Equalization on Color Images**

**Objective**: Apply histogram equalization to color images.

1. **Separate Color Channels**:
   * **Split the color image into its Red, Green, and Blue (RGB) channels.**
2. **Apply Histogram Equalization to Each Channel**:
   * **Perform histogram equalization on each color channel separately.**
3. **Reconstruct the Color Image**:
   * **Combine the equalized color channels to form the final image.**
4. **Compare Results**:
   * **Display the original and equalized color images.**
   * **Discuss the visual differences and effects of equalization on color images.**

**Task 4: Histogram Equalization in Different Applications**

**Objective**: Explore the use of histogram equalization in various applications.

1. **Medical Imaging**:
   * **Apply histogram equalization to medical images (e.g., X-rays, MRIs).**
   * **Discuss how equalization can enhance the visibility of important features.**
2. **Satellite Imagery**:
   * **Apply histogram equalization to satellite images.**
   * **Analyze how equalization improves the contrast and details in the images.**
3. **Document Scanning**:
   * **Apply histogram equalization to scanned documents.**
   * **Evaluate how equalization enhances text readability and clarity.**
4. **Night Vision**:
   * **Apply histogram equalization to night vision images.**
   * **Discuss how equalization improves the visibility of objects in low-light conditions.**

**Task 5: Histogram Equalization for Low Contrast Images**

**Objective**: Improve the visibility of features in images with low contrast.

1. **Select a Low Contrast Image**:
   * **Choose an image with low contrast or uniform intensity distribution.**
2. **Apply Histogram Equalization**:
   * **Perform histogram equalization on the low contrast image.**
   * **Display and compare the results to the original image.**
3. **Analyze Results**:
   * **Evaluate the improvement in contrast and feature visibility.**
   * **Discuss how histogram equalization addresses low contrast issues.**

**Task 6: Multi-Scale Histogram Equalization**

**Objective**: Explore the effects of applying histogram equalization at different scales.

1. **Image Rescaling**:
   * **Resize the image to different scales (e.g., 50%, 100%, 200%).**
2. **Apply Histogram Equalization**:
   * **Perform histogram equalization on the resized images.**
3. **Compare Results**:
   * **Compare the equalized images at different scales.**
   * **Discuss how the scale affects the equalization results and image details.**

**Task 7: Histogram Equalization for Image Enhancement**

**Objective**: Use histogram equalization to enhance images for better visual analysis.

1. **Select Images**:
   * **Choose images with varying levels of detail and contrast.**
2. **Apply Histogram Equalization**:
   * **Perform histogram equalization on the selected images.**
3. **Evaluate Enhancement**:
   * **Compare the equalized images to the originals in terms of detail enhancement and clarity.**
   * **Discuss how histogram equalization improves visual analysis in different scenarios.**

**Task 8: Histogram Equalization in Image Segmentation**

**Objective**: Assess the impact of histogram equalization on image segmentation performance.

1. **Image Segmentation**:
   * **Perform segmentation on an image using thresholding or region-based methods.**
2. **Apply Histogram Equalization**:
   * **Apply histogram equalization to the original image and perform the same segmentation.**
3. **Compare Segmentation Results**:
   * **Analyze the differences in segmentation results before and after histogram equalization.**
   * **Discuss the impact of equalization on segmentation accuracy and effectiveness.**