Image Processing Assignment Report (2021102016)

Introduction

This report summarizes the work completed for the image processing assignment, which involved implementing various image processing techniques using Python. The primary tasks included reading and writing images, adjusting brightness and contrast, converting color images to grayscale, applying pseudo-color mapping, replacing green screen backgrounds, and processing videos.

Tasks and Approaches

1. Reading and Writing Images

Objective: Implement functions to read an image file into an array and write an array into an image file, handling both color and grayscale images.

Approach: Used OpenCV to read and write images. The `cv2.imread` function was used for reading images, and `cv2.imwrite` was used for writing images to disk.

3. Changing Brightness

Objective: Adjust the brightness of an image.

Approach: Implemented a function that adjusts the brightness by adding a constant value to each pixel's color channels. The results are clipped to ensure they stay within the valid range (0-255).

4. Changing Contrast

Objective: Adjust the contrast of an image.

Approach: Implemented a function that enhances the image by stretching the pixel intensity values to span the full range from [0, 255]. The minimum and maximum intensity values in the original image are identified, and all pixel values are rescaled accordingly to improve the overall contrast.

5. Converting Color Images to Grayscale

Objective: Convert color images to grayscale using different methods.

Approach: Implemented four methods for grayscale conversion:

- **Average:** Average of RGB values.
- **Luminosity:** Weighted sum of RGB values based on perceived brightness.

- **Lightness:** Average of the maximum and minimum RGB values.
- **Desaturation:** Average of the RGB values and their maximum and minimum values.

Visual Effects: Each method produces a different grayscale image based on how color information is averaged or weighted.

6. Converting Grayscale Images to Pseudo-Color

Objective: Apply pseudo-color mapping to grayscale images.

Approach: Implemented a pseudo-color mapping function that transforms grayscale values into a color representation using simple transformations for red, green, and blue channels.

7. Replacing Green Screen Backgrounds

Objective: Replace green screen backgrounds in images with pixels from a background image.

Approach: Used a mask to identify green pixels in the foreground image. These pixels were replaced with corresponding pixels from the background image. This approach handles color replacement effectively.

8. Video Frame Extraction and Reconstruction

Objective: Extract frames from a video and reconstruct the video from extracted frames.

Approach: Implemented functions to read a video file, extract frames, and save them as images. Another function reconstructs the video from these frames using OpenCV's `cv2.VideoWriter`.

9. Creating Fade Transition Video

Objective: Create a transition video that fades from one image to another.

Approach: Implemented a fade transition by manually interpolating between two images for each frame of the video. This approach smoothly blends the two images over the specified duration.

Results

The implementation of each function was verified using sample images and videos. Results include:

- Adjusted brightness and contrast images demonstrating clear visual changes.
- Grayscale images converted using different methods showing varying levels of detail and contrast.
- Pseudo-color images providing enhanced visualization of grayscale data.
- Green screen replaced images showing successful background replacement.

- Videos successfully extracted, reconstructed, and transitioned between images with smooth fading effects.

Conclusion

The assignment involved a comprehensive set of image processing tasks, each implemented with careful attention to detail. The approaches used provided effective solutions for image manipulation and video processing tasks. The results demonstrated the successful application of these techniques to achieve the desired outcomes.