MP3 Report

In this project, I aimed to enhance the visual quality of the grayscale image provided by applying contrast improvement techniques. These included histogram equalization, linear lighting correction, and quadratic lighting correction. The focus was to observe how each technique modifies the image's pixel intensity distribution, also visualized using histogram plots.

Method Overview

- The original image is read in grayscale mode.
- Histogram equalization is applied using OpenCV's *equalizeHist()* to redistribute pixel intensities for better contrast.
- Linear correction was implemented using *cv2.normalize(),* which linearly stretches pixel intensities across the full range (0 – 255)
- Quadratic correction was applied through a square root transformation to boost higher intensity values more significantly.
- Images and histogram plots for all four versions were generated to visualize the changes.

Key Observations from the Histogram Plots

- **Original Histogram:** The original image showed a narrow, high peak centered around mid-gray levels (~120). This indicated low contrast with most pixel values concentrated in a small range. Visually, this suggested a dull image with little variation in brightness.
- **Equalized Histogram:** Histogram equalization redistributed the pixel intensities across a wider range. The histogram appeared flatter, though not perfectly uniform, indicating improved contrast. More details become visible in both darker and brighter regions after equalization.
- **Linear Corrected Histogram:** The histogram of the linearly corrected image was spread across the full intensity range, forming a shape close to a triangle. This suggested a balanced enhancement of both low and high intensity regions. The visual result is an image with more vibrant contrast without over-amplifying brightness.
- **Quadratic Corrected Histogram:** This method pushed many pixel values toward the higher intensity end of the spectrum. The histogram skewed heavily to the right, indicating a brightened image. This is particularly useful for underexposed images but is resulting in some loss of detail in shadow areas due to compression of lower intensity values.

Combining histogram equalization with lighting correction techniques provides a powerful approach to image enhancement:

- Histogram equalization improves contrast by expanding pixel intensity distribution.
- Linear correction stretches contrast uniformly, making it visually balanced.
- Quadratic correction brightens the image significantly, ideal for low-light images.