**Assignment 0: Introduction to basic image formats and simple manipulation techniques**

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**1. Introduction**

This report details the HW-0 assignment, focusing on basic image processing techniques using the OpenCV library. The primary focus of this assignment is to implement and understand basic image manipulation techniques, which include format conversion, intensity alteration, and basic image transformations such as scaling and binarization. The practical application of these techniques is demonstrated through the manipulation of the image baboon.png.

**2. Implementation and Algorithm Concepts**

The assignment involves a series of image processing functions, each designed to manipulate the image in a specific way. The 'Convert to PGM' function transforms images into the Portable GrayMap (PGM) format, a standard format for grayscale images. The 'Add Grey' function is used to increase the intensity of grayscale images, enhancing their brightness. 'Binarize Grey' applies a threshold to convert images into a binary format, where pixels are either black or white, depending on the set threshold. 'Scale Grey' changes the size of the images, using pixel averaging for downsizing and replication for upsizing. The focus of this assignment, 'Decrease Brightness Below Threshold', selectively diminishes the brightness of pixels that fall below a specified threshold, offering a nuanced control over the image's contrast and brightness.

**3. Results with Parameters**

The assignment's outcomes are illustrated through various transformed versions of an original baboon image (baboon.png). Figure 1 shows the original image, serving as a baseline for comparison. In Figures 2, 3, and 4, we observe the results of applying the 'Decrease Brightness Below Threshold' function with varying parameters.

**Figure 1**: Original Image - **baboon.png**. This image serves as the starting point for all transformations.

**Figure 2**: **baboon\_output\_decreased\_100\_50.pgm** - This image (Figure 2) is the result of applying the decrease brightness function with a threshold (T) of 100 and a decrease value (V) of 50. The modification predominantly affects pixels with intensities below 100, reducing their brightness by 50 units, leading to a noticeable darkening in certain areas of the image while leaving higher-intensity areas relatively unchanged.

**Figure 1 Figure 2**

**Close-up of a baboon's face

Description automatically generated Close-up of a baboon's face

Description automatically generated**

**Figure 3**: **baboon\_output\_decreased\_100\_100.pgm** - In this image (Figure 3), the same threshold of 100 is maintained, but the decrease value is augmented to 100. This parameter setting results in a more pronounced darkening effect, as pixels below the threshold experience a greater reduction in intensity, demonstrating the impact of adjusting the decrease value.

**Figure 4**: **baboon\_output\_decreased\_150\_104.pgm** - The final image (Figure 4) illustrates the effect of setting a higher threshold (T = 150) and a significant decrease value (V = 104). This alteration affects a different set of pixels due to the higher threshold, and the substantial decrease value leads to a stark contrast between the altered and unaltered areas of the image.

**Figure 3 Figure 4**

**Close up of a baboon

Description automatically generated A close up of a baboon

Description automatically generated**

**4. Discussion of Results**

The varying results observed in Figures 2, 3, and 4 underscore the impact of parameter variation in image processing. The manipulation of threshold and value parameters in the decrease brightness function exemplifies how different settings can lead to diverse visual outcomes. A lower threshold (as in Figures 2 and 3) affects more pixels, resulting in a more widespread change in the image's appearance. Conversely, a higher threshold (Figure 4) targets a narrower range of pixels, but with a high decrease value, it introduces more dramatic changes in those areas.

Throughout this assignment, the experience of experimenting with different parameter settings provided valuable insights into the intricacies of image processing. It became evident how subtle adjustments can significantly influence the result, highlighting the importance of parameter selection based on the desired outcome in practical applications.

**5. Conclusion**

This assignment offered a comprehensive introduction to fundamental image processing techniques, demonstrating the powerful capabilities of OpenCV. Through hands-on experimentation with various functions and parameters, the project not only enhanced technical skills in image manipulation but also deepened the understanding of how algorithmic changes can dramatically alter visual perceptions.