AIN432 Assignment2

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1 Introduction

The widespread use of digital cameras and mobile phones has increased the number of data consisting of images exponentially. Therefore, image processing has become important in recent years. In this assignment, we will consider color transfer, which is a sub-branch of image processing. In this assignment, we will use the source image, which is our original image for color transfer, and the target image, which contains the colors that we will transfer to our source image, as data in our assignment. To apply the color transfer, I will use 2 different methods, which I will explain in more detail in the subsections. These methods:
1- Using the $\ell\alpha\beta$ color space and statistical calculations
2- Similar region detection between target and source images

2 Experiment

2.1 Color Transfer Using $\ell\alpha\beta$ Color Space

In this section, $\ell\alpha\beta$ color space is used for color transfer. If we briefly define the $\ell\alpha\beta$ color space, the $\ell\alpha\beta$ color space is a model developed by Richard Hunter in the 1940s, which is used to determine the color coordinates of the pictures and the differences between their colors.In the $\ell\alpha\beta$ color space, the letters represent
$\ell*$ – Lightness coordinate ($\ell*$=0 indicates black and $\ell*$=100 is white)
$\alpha*$ – is the red/green coordinate, $+\alpha*$ indicates red, $-\ \alpha*$ indicates green
$\beta*$ - is the yellow/blue coordinate and $+\beta*$ indicates yellow and -$\beta*$ indicates blue.

The reason for using the $\ell\alpha\beta$ color space in color transfer is that there is no correlation between the channels of this color space, such as the BGR color space. Using the BGR color space for color transfer , requires controlling the cascade change of all color channels to make the color change of a pixel. This complicates any color changing process.

Source and target images converted to $\ell\alpha\beta$ color space, color transfer process takes place with some statistical calculations (mean, standard deviation).These processes are as follows
1-For each channel of source and target images, compute means (μ_1, μ_2, μ_3) and standard deviations (ρ_1, ρ_2, ρ_3).
2-Subtract means from the data points for source image:

$$\ell^* = \ell - \mu_1$$

$$\alpha^* = \alpha - \mu_\alpha$$

$$\beta^* = \beta - \mu_\beta$$

3-Scale new data points according to the relative standard deviations of target and source images:

$$\ell^{'} = \ell^* \frac{\rho^{\ell}_{source}}{\rho^{\ell}_{target}}$$

$$\alpha^{'} = \alpha^* \frac{\rho^{\alpha}_{source}}{\rho^{\alpha}_{target}}$$

$$\beta^{'} = \beta^* \frac{\rho^{\beta}_{source}}{\rho^{\beta}_{target}}$$

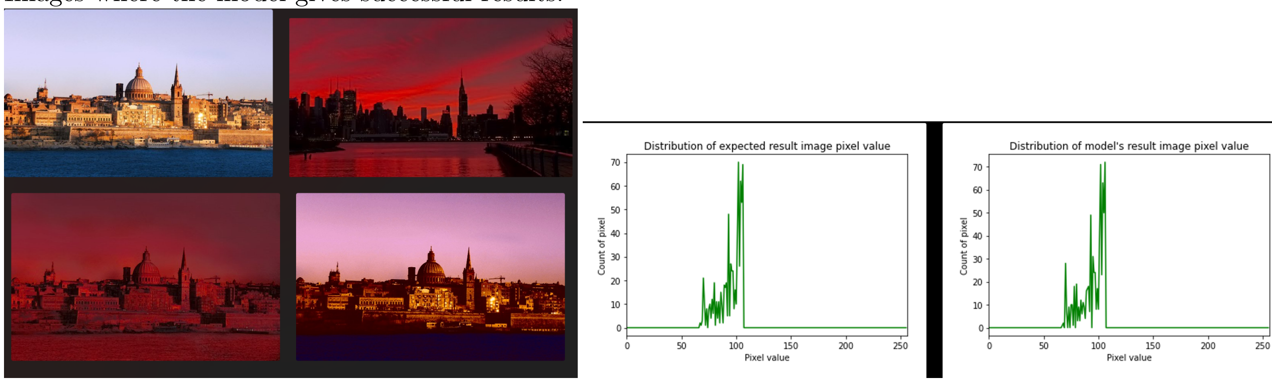
4-Add the averages computed for the target to scaled data points.

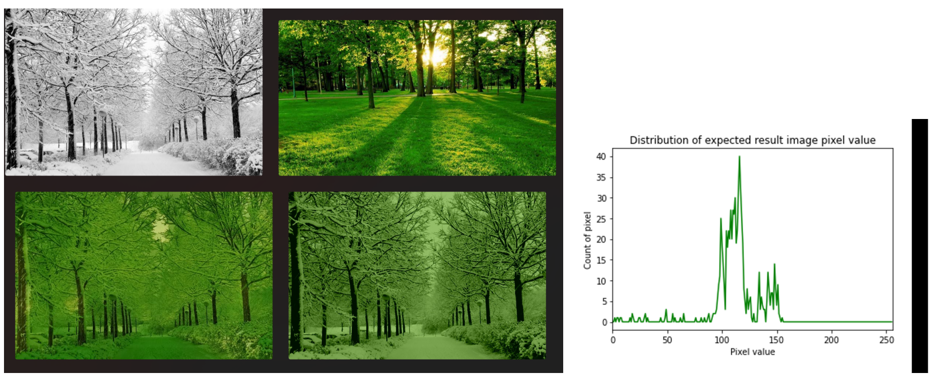
$$\ell_{result} = \ell^{'} - \mu^{\ell}_{target}$$

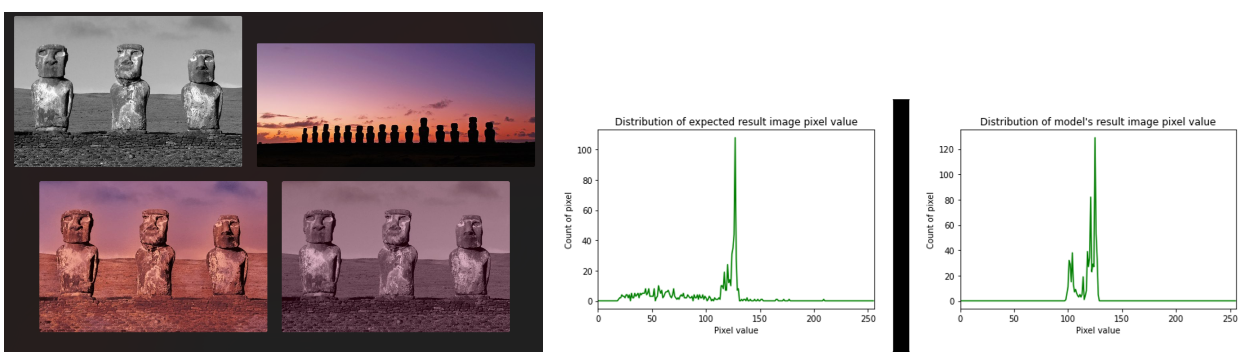
$$\alpha_{result} = \alpha^{'} - \mu^{\alpha}_{target}$$

$$\beta_{result} = \beta^{'} - \mu^{\beta}_{target}$$

I applied the steps I mentioned above to the source and target images in the dataset. The model gave good results in some pictures. Of course, there were also pictures with bad results.
Images where the model gives successful results:

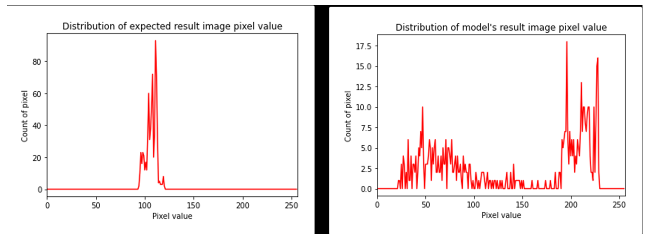


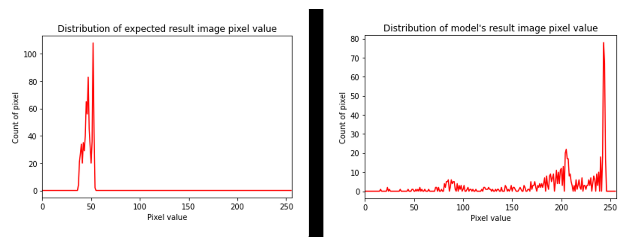


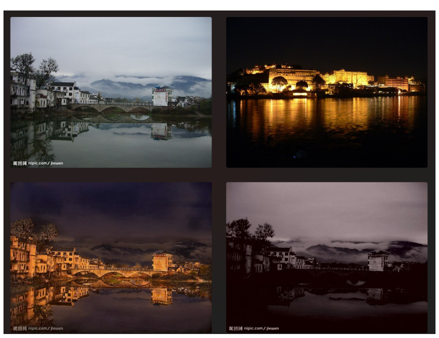


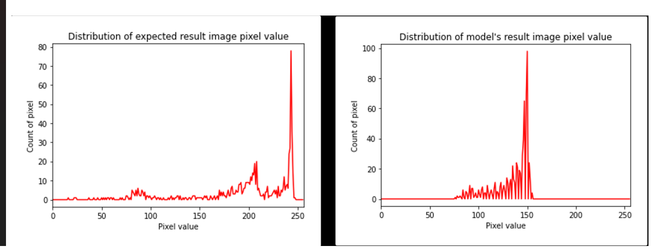
When we look at the histogram distributions of the samples with successful results, it is seen that the expected and result pixel values are concentrated in a certain region.

Images where the model fails:









In these images, which were unsuccessful compared to the others, there was no regular relationship between the pixel distributions of the expected and result images.

!! The order of the images is as follows:

source image target image

expected result result image

2.2 Part 2

In the second part of the assignment, we do the color changing process that we did in the first part.I tried to do it using a different method (SSD or NCC). I tried to do it using sum of square differences but the result is not happen as I expected .

I split the source and target images into 16 parts in 4 * 4 ways and I compared each of them with each other. Selecting the region with the least difference I tried to create a result image.

3 Conclusion

In this report, I discussed taking the color characteristic of an image and transferring it to another image. Imposing mean and covariance onto the data points is a very simple operation, which produces believable output images given suitable input images. We eliminate the transformations between color spaces and formulate the swatch-based transfer to provide parameters for user interaction. [1]

References

[1] Xuezhong Xiao and Lizhuang Ma. Color transfer in correlated color space. pages 305–309, 01 2006.