CSC320 Assignment4 Winter 2015

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1 Introduction

This paper is where I present my report for Assignment4 of CSC320 Winter 2015. There is no starter code for this assignment.

2 Executing Code

I have included the code for this assignment called p4.py. It contains all code to generate the output images for this report. However, you must ensure the proper input image files and output directory folder are created before running the code. The code can be compiled with Python 2.7.5 with Anaconda's Full installation.

3 Part 1

This section is to prove the final equation below

$$\begin{pmatrix} 1 & 0 & 0 & -B_1^r \\ 0 & 1 & 0 & -B_1^g \\ 0 & 0 & 1 & -B_1^b \\ 1 & 0 & 0 & -B_2^r \\ 0 & 1 & 0 & -B_2^g \\ 0 & 0 & 1 & -B_2^b \end{pmatrix} \begin{pmatrix} F_r \\ F_g \\ F_b \\ \alpha \end{pmatrix} = \begin{pmatrix} C_1^r - B_1^r \\ C_1^g - B_1^g \\ C_1^b - B_1^b \\ C_2^r - B_2^r \\ C_2^g - B_2^g \\ C_2^b - B_2^b \end{pmatrix}.$$

The matting equation is provided to be

$C = F + (1-\alpha)B$ where C represents the composite image, F represents the foreground of image that refers to the object of interest, and B refers to the background of the image. α is used to determine the opacity of the current pixel.

Triangulation matting refers to the art of taking a picture of the same object of interest, behind two different backgrounds. One can compute all foreground red, green, blue components to extract the object out of the image and solve for the alpha component as well. The reason we take two different pictures behind two different backgrounds is so that we are able to solve a system of 4 unknown F_r, F_g, F_b, and α with these 6 different equations.

$$C_{r1} = F_r + (1-\alpha)B_{r1}$$
$$C_{g1} = F_g + (1-\alpha)B_{g1}$$
$$C_{b1} = F_b + (1-\alpha)B_{b1}$$
$$C_{r2} = F_r + (1-\alpha)B_{r2}$$
$$C_{g2} = F_g + (1-\alpha)B_{g2}$$
$$C_{b2} = F_b + (1-\alpha)B_{b2}$$

You get the B values from the background images and the C values from the composite images for each pixel. You can then re-arrange each of these equations to solve for the unknown as shown below.

$$F_r - \alpha B_{r1} = C_{r1} - B_{r1}$$
$$F_g - \alpha B_{g1} = C_{g1} - B_{g1}$$
$$F_b - \alpha B_{b1} = C_{b1} - B_{b1}$$
$$F_r - \alpha B_{r2} = C_{r2} - B_{r2}$$
$$F_g - \alpha B_{g2} = C_{g2} - B_{g2}$$
$$F_b - \alpha B_{b2} = C_{b2} - B_{b2}$$

Then, you can group up the Right Hand Side of these equations into a 6 by 2 matrix, as well as group up the Left Hand Side of these equations separated by knowns and unknowns into a matrix multiplication. Then, you will result in the final equation shown above which is derived.

4 Part 2

The first set of input images to this section are shown in Figure 1. The first two images are the backgrounds, whereas the next two images are the composite images. Finally, the last image is the new background that is going to be combined with the foreground object, which in this case is the flower pot.

Similarly, the second set of input images, whereby the foreground object are leaves is shown in Figure 2.

4.1 Results

Figure 3 demonstrates the output of the alpha matte, the foreground image and the composite images of the foreground component together with the new background from Figure 1.

Figure 4 demonstrates the output of the alpha matte, the foreground image and the composite images of the foreground component together with the new background from Figure 2.

Figure 1: Flowers: First Set Of Input Images

Figure 2: Leaves: Second Set Of Input Images

Figure 3: Flower: Alpha Matte, Foreground, and Composite Outputs

5 Part 3

I used my camera to capture 5 new JPEG images with my camera and use them as input for my implementation of the matting algorithm. The images are shown below in Figure 5.

My image acquisition procedure is to put the camera on the floor so that it doesn't move. Then, I put

Figure 4: Leaves: Alpha Matte, Foreground, and Composite Outputs

the object in front of the camera so that the object itself doesn't move. Then, I take the picture. Next, I take the second picture by sliding in a new background to cover the previous background. Without moving the camera, I then remove the object and take the picture of the new background by itself, then remove the new background and take the picture of the old background by itself. This guarantees consistency in the positions of the object and the background with respect to the camera. Later, I take a picture of a whole new background image.

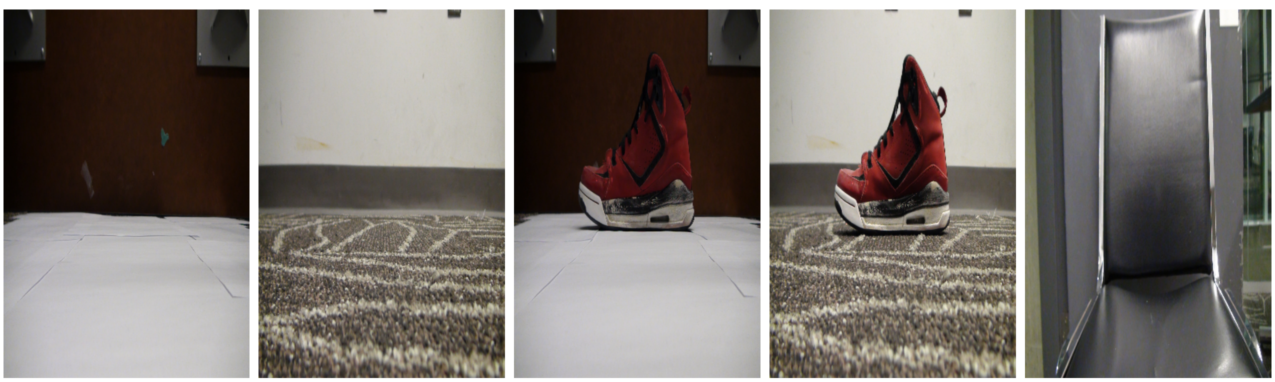

Figure 5: New Composite: Final Set Of Input Images

5.1 Results

Figure 6 demonstrates the alpha matte, foreground image, and the new composite image when running the matting algorithm on my own set of input images. As you can see, there are parts of the shoe that appears transparent. This is due to the fact that the shoe was of the same color as the background. Therefore, the algorithm did not distinguish the shoe as an object instead of a background and resulted in the shoe appearing transparent at its background similar parts in the final composite output. Also, both backgrounds share common white spots, which explains the dotted white spots on the alpha output.

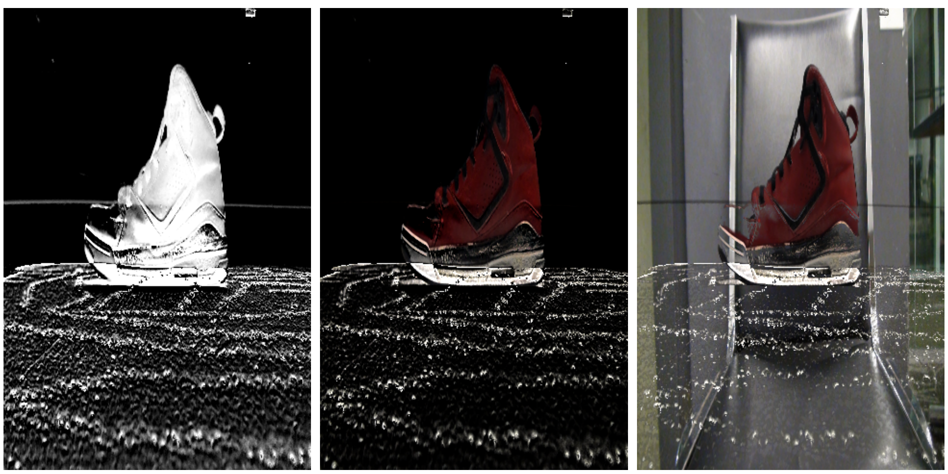

Figure 6: New Composite: Alpha, Foreground, and Composite Outputs