Assignment 2 - Pyramid Blending

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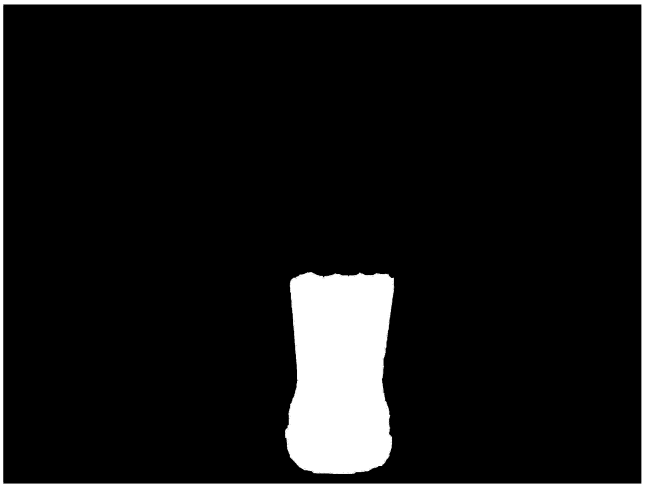
(a) Black Image

(a) White Image



(b) Completed Mask

(b) Final Blended Image

I. Original Black, White, and Mask Images

Image	Exposure	Aperture	ISO
Black	1/24 s	f/1.6	800
White	1/24 s	f/1.6	800

1) **Describe your original black and white images. What were your images of?**
My original images are of two specialty Diet Coke™bottles, set on my home bar cabinet. The background is a white wall, with some books poking out of the side. I used the Moment camera app to take the pictures. I also used a tripod to try and align the images as closely as possible.
Using Gimp, I resized the images to 2400W x 1800H and reformatted them to JPGs, but no other changes were made.

2) **How did you create your mask?**
I imported the white image into GIMP. Using the scissor select tool, I selected points along the bottom edge of the Coke™logo, trying to stick as closely as possible to the logo lines. Once I reached the end of the logo, I followed the right, bottom, and then left edges of the bottle as closely as possible to create a full loop. After completing the loop, I used the Bucket Fill option to fill that area in with white.
I then used the "Rectangle Select" tool to choose most of the area around the bottle and filled it with black. Of course, this meant I had some small areas around the edge of the bottle to finish.
I exported this image as a grayscale JPG and then used a quick python script to convert all non-white pixels to black. This script is shown in Figure 3. Once all the pixels were converted, I replaced the Gimp-exported mask and resized the new mask to match the 2400x1800 images.

```
mask_img = cv2.imread(mask_names[0], cv2.IMREAD_COLOR)
mask_img = np.where(mask_img % 255 == 0, mask_img, 0)
cv2.imwrite('mask.jpg', mask_img)
```

Fig. 3: "Code 1. Mask Cleaning Code"

II. Discussion Questions

1) **How might you automate the blending point?**
One possible way to do it would be to combine the seam carving techniques described by Professor Issa in Lecture 04-04 10 [1] to minimize the energy loss of the image combination. From there, a mask can by assigning each image to one side of the boundary. Using the original images and this automated mask, pyramids can be created and the blending process can occur automatically.

2) **What is the significance of using a = 0.4 for the generating kernel?**
As described in Burt and Adelson, At a = 0.4, the generated kernel becomes roughly Gaussian [2]. The 5x5 kernel will have a peak of 0.16 at the center pixel and smaller values further from the edges.
This can be confirmed by using the function call cv2.getGaussianKernel(5, 1), which results in the kernel [0.0545, 0.2442, 0.4026, 0.2442, 0.0545]. Multiplied together, this results in a very similar Gaussian to the one used at a = 0.4.

3) **Why does the output of expand_layer() have to be multiplied by 4?**
Each successively larger stage of the Gaussian or Laplacian pyramid has four times the number of pixels. When a layer is expanded, there is one pixel with non-zero intensity values and three pixels with zero value. Therefore, the expand layer result must be multiplied to approximate the original intensity since three quarters of pixels have no value.

4) **Do you think blending or using a cut (as discussed in Module 04-04) is a better approach for YOUR input images? Why?**
Blending is a more suitable technique for this image. As these images have similar background features, those areas would likely be used as the best point to cut instead of features on the bottle itself. Meanwhile, blending allows the seamless transition of the two bottle artworks without an obvious line or cut point at the aligned locations.

III. Project Retrospective

If you were to do this project again, what approaches, concepts, or methods would you use to try and improve upon your final blended result? Discuss at least two.

I would try experimenting with different images. For this project, I simplified the mask by using two objects with very similar shapes: this would allow the final image to be as believable as possible. But I think I could have attempted a blend with more dissimilar images to try and test the limits of the algorithm's ability to seamlessly blend.

I also would have experimented with non-binary masking. The Burt and Adelson algorithm [2] used in this assignment does not explicitly require a binary mask, and some creative approaches could have been taken with various gray-like approaches, such as a cleaner or less obvious Coke™logo.

References

[1] Essa, I. (n.d.). 04-04 10. Seam Finding Using Graph Cuts. https://edstem.org/us/courses/50608/lessons/85081/slides/468318

[2] Burt, P., Adelson, E. (1983). The laplacian pyramid as a compact image code. IEEE Transactions on Communications, 31(4), 532–540. https://doi.org/10.1109/tcom.1983.1095851