Programming Assignment 3 Report
BBM413
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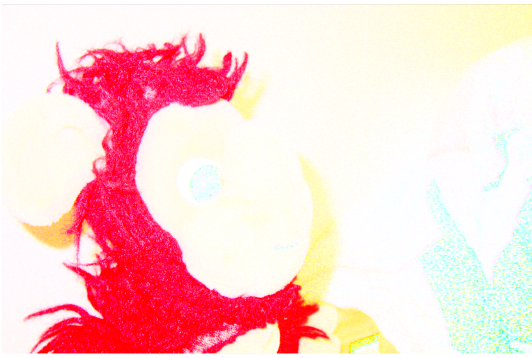
Part 1

Bilateral Decoupling and Reconstruction

In this part firstly I have decoupled the images into intensity and color layers. I got the intensity layers by converting the images to grayscale.


And then I divided the flashed image to its grayscale version to get the color layer of it. We do not need the color information of the non-flashed image because the reason in this task is to get good lightning with true colors. So non-flashed image has corrupted colors because the lack of light. That's why we only need the colors of the flashed image.



After that I have applied Bilateral filter. The reason of using bilateral filter is getting rid of the noise on the non-flashed image. We can surely apply Gaussian filter to achieve that but when we use Gaussian filter edges also get smooth and we want the edges stay sharp. That's why we used Bilateral Filter.


Then, I got the edge/sharpness details by dividing the flash imagess intensity layer to its large-scale layer. It is difficult to see in the report but it's in the below.

I multiplied the large-scale layer and detail layer to obtain intensity values that include the sharp edge information as well. After that, I multiplied this intensity with each channel of color layer to get the reconstructed and enhanced image. Finally I converted results to uint8. In the below images the first one is non-flashed, second one is flashed and the third one is result image.



Part 2

Experiments

In this part we are expected try different sigma values and kernel sizes with the bilateral filter and observe the differences. In the images below I have tried 5 for the kernel size and 10 for the both sigma values.

I got the best resulting images with these values. In the below pictures I have tried 5 for kernel size and 100 for the sigma values.

And the below images are tried with the same kernel size and 200 for the sigma values.

And the first one in the below images is the result of the one with 5 for kernel size and 10 for the sigma values. Second result is with 5 for kernel size and 200 for the sigma values.

When we look closer to the images we can see that when we increase the sigma values the image gets less sharp. In the below images you can see the difference of kernel size. In the first image kernel size is 5 and in the second image it's set to 20.

Bilateral filter also takes a Gaussian filter in space, but one more Gaussian filter which is a function of pixel difference. Gaussian function of space make sure only nearby pixels are considered for blurring while Gaussian function of intensity difference make sure only those pixels with similar intensity to central pixel is considered for blurring. So it preserves the edges since pixels at edges will have large intensity variation.

Also I have experimented with different intensity layers using the method in the appendix(Intensity-Color Decoupling). Result is below.

With this method red fur became darker. Quality of the intensity layer is important for this problem because snder the same illumination, a linear intensity computation results in lower values for primary-color albedo (in particular blue) than for white objects. As a result, the intensity transfer might overcompensate.

Lastly, results with the different image sets can be seen below.

As you can see in the above images when the non-flashed image is too dark, I couldn't get a satisfying result. Generally color is more accurate but the blur background of the cake image couldn't recovered. And there are color artifacts over the candle fire. The second image set is more satisfying because the non-flashed image has much more detail. So the general mood of the image pretty much recovered. But of course there are so much shadow artifacts. To sum up, with this parameters pixels with high-end intensity results in color artifacts and the pixels with low-end intensity results as dark, not successfully recovered.