Assignment 3: Painting Blind

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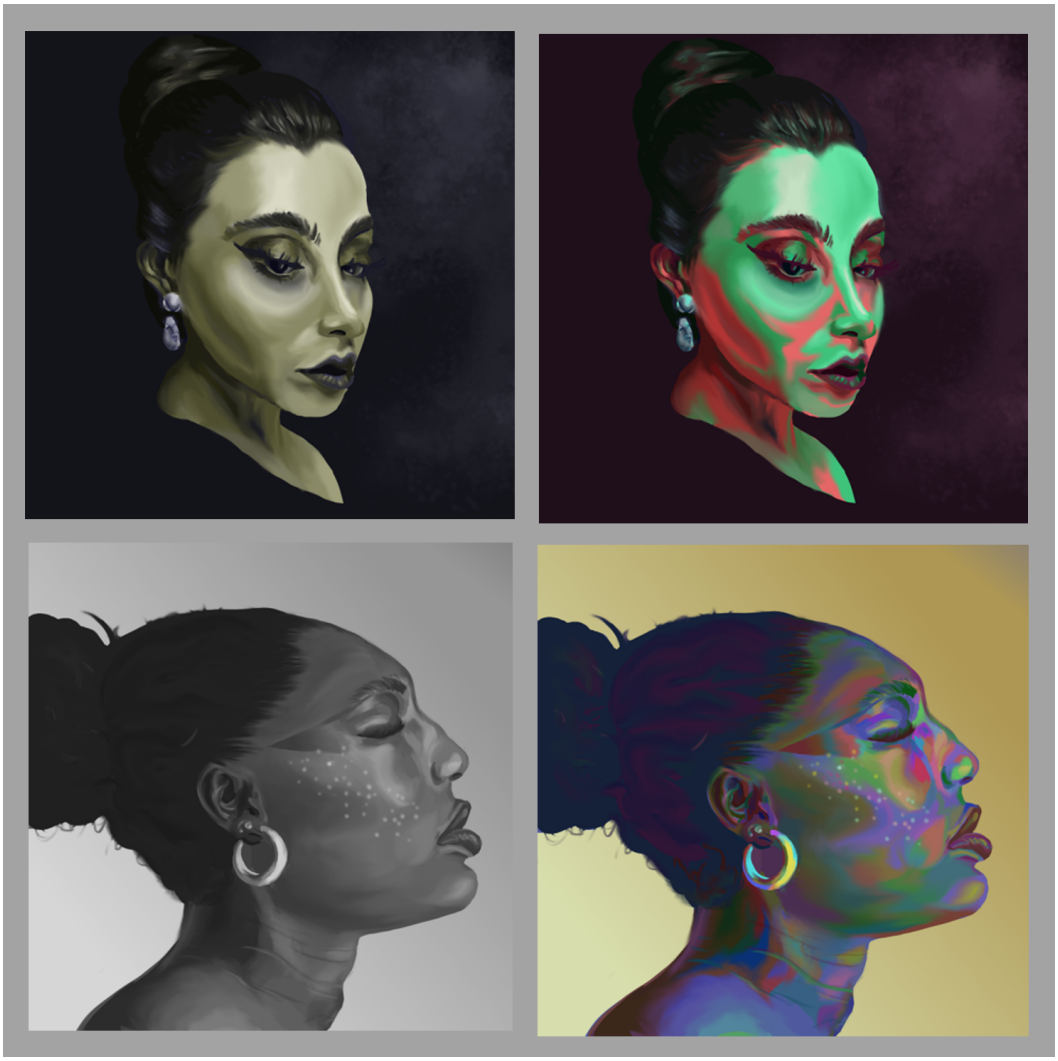

Fig. 1. 4 digital paintings that I created utilizing filters simulating 2 different types of color blindness, Deuteranopia and Monochromia. The first 2 images (top left and right) feature digital paintings of a light skinned woman with dark hair and pearl earrings. The top left utilizes a Deuteranopia filter and the right is the same image in full color. The last 2 images (bottom left and right) feature digital paintings of a dark skinned woman with striking blue makup and hooped earrings. The bottom left utilizes a grey-scale filter and the right is the same image in full color. Both original images are taken from pexels.com and are utilized under a creative commons license.

Additional Key Words and Phrases: AI, Artificial Intelligence, Copyright, Art, Inspiration

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1 Abstract

This project investigates the ways in which different types of colorblindness effect artistic color accuracy. I test 2 different variations of color blindness in order to see how a change in color perception effects the method by which colors are chosen in order to create an accurate painting.

2 Introduction and Related Works

Color Blindness (Herfore shortened to CB) is a condition that effects 4.5 percent of the population. It is particularly prevalent in men (8.8 percent of men) but also effects women (0.4 percent of women). CB comes in 4 major categories: Deuteranopia, Protanopia, Tritanopia, and Monochromia [4]. Deuteranopia and Protanopia are variations of red-green CB, Tritanopia is blue-yellow CB, and Monochromia is a complete cessation of the ability to see color and is extremely rare. Usually CB is experienced in degrees of severity with more severe forms of the condition being rarer.

People with color blindness have historically struggled in the art world due to the difficulties an inability to see color can cause. That is not to say there are not colorblind artists, there are many examples of artists that are theorized to be colorblind due to their work [2]. One way to ease these struggles is the use of modern color filter technology. CB filters work by converting standard red, green, and blue (RGB) values into the colorspace that the human eye sees (LMS) [1] and using a process called Daltonization [3] to alter those values into colors that are more accessible for the colorblind.

This project explores the ways in which Monochromia and and Deuteranopia specifically alter the ability to accurately pick colors for portraiture in order to highlight the specific issues colorblind artists face and possibly suggest means to alleviate them.

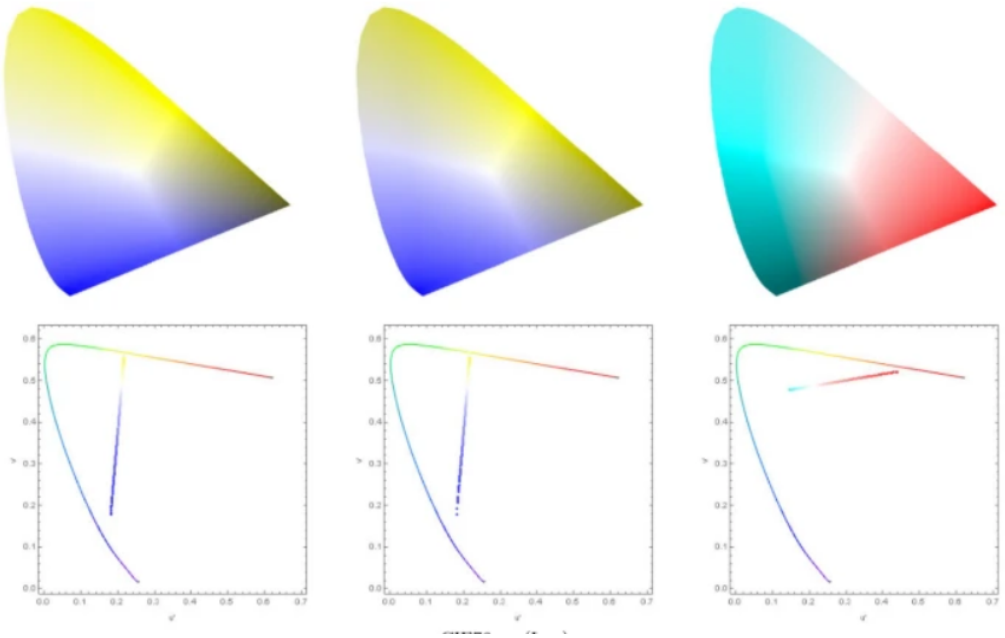

Fig. 2. A still showing the color ranges and color confusion lines experienced by people with Protanopia, Deuteranopia, and Tritanopia from "Customized Daltonization: Adaptation of Different Image Types for Observers with Different Severities of Color Vision Deficiencies." by Keresteš, Neda Milić, et al. These charts show which colors are visible to people with the aforementioned conditions and which colors they struggle to see.

3 Methodology

I started this process by downloading the ColourSimulations app for windows as it allowed me to both simulate the sensation of color blindness on my screen without correcting the image through Daltonization [3] as well as interface with my computer normally (most other filter software is temporary and only shows a snapshot of a design in CB mode before reverting back to normal). I set the filter at 100 percent severity for both filters in order to both account for the most severely impacted people with color blindness and to give the most unique possible image.

I then proceeded to attempt to recreate the source image as accurately as I could with the CB filter on the entire screen including the color wheel. I started by sectioning the painting into smaller

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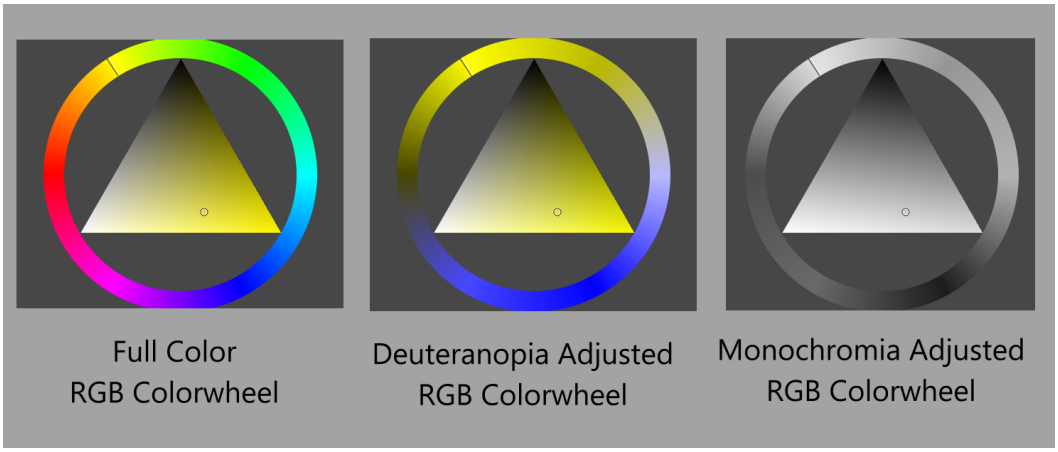

Fig. 3. A series of images showing the process of creating the Deuteranopia filter painting. The images show the order in which the process of creating the final image was completed. First the initial photograph is run through a Deuteranopia filter. Then it is recreated in a block in method where distinct color areas are chosen from a color wheel. This block in is smoothed and then structured areas reintroduced to create the final image.

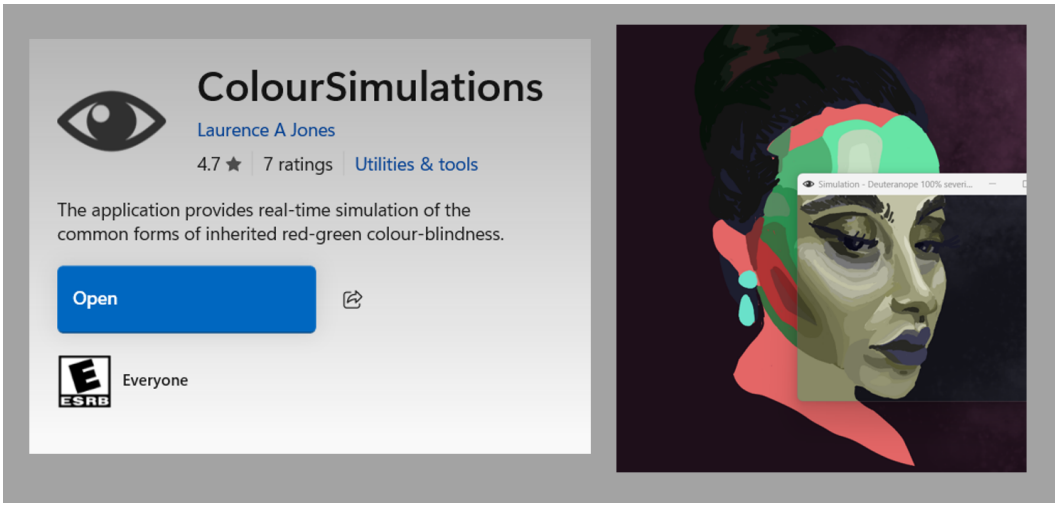

Fig. 4. The first image is a screen capture of the ColourSimulations page on the Microsoft store. The second image is an example of the ColourSimulations software being used on the Deuteranopia painting with part of the face in full color and part of the face changed by the filter.

shapes and using attempting to accurately simulate the hue, value, and saturation that I was seeing in the same section of the source image.

Once the painting was sectioned off into discrete color blocks I used a smoothing brush to obscure the section edges and add a smooth finish to the painting. Finally, I added a final restructuring layer that re-introduced areas of detail that were obscured by the smoothing pass.

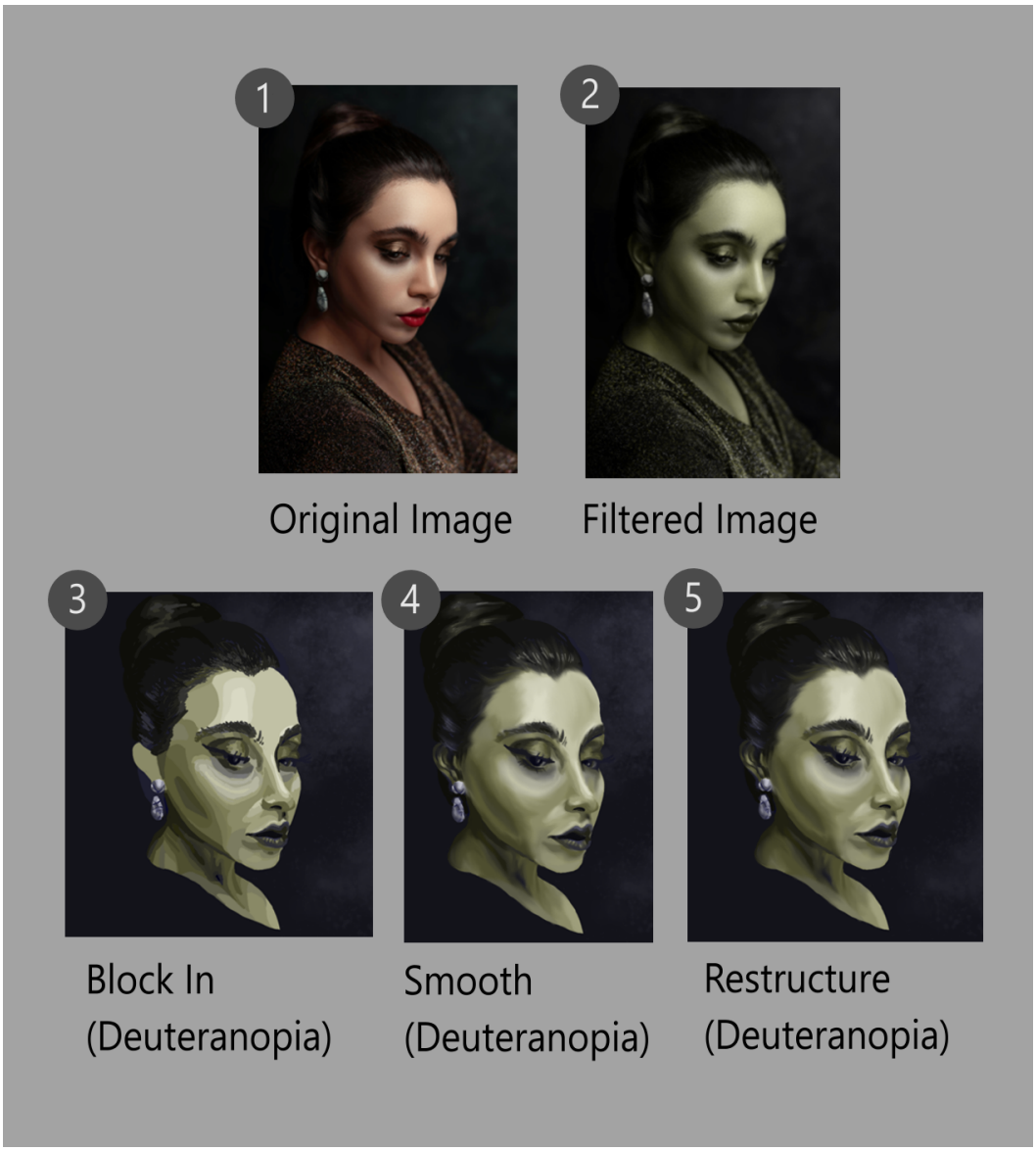

Fig. 5. A screen-capture of the 3 different color wheels I worked from when creating the digital paintings on Krita. The first is the standard RGB color wheel. The second is the same wheel adjusted for Deuteranopia. The last image is the standard wheel adjusted for Monochromia. All 3 colorwheels allow for adjustments in hue, saturation, and value.

I repeated this process for 2 different types of color blindness. First deuteranopia (red-green CB) , then monochromia (Full CB). I chose not to use the filter for Protanopia because of the similarity to Deuteranopia. I was not able to do a painting for Tritanopia (Blue- yellow CB) as I could not find a filter that both contained the condition as an option, allowed simulation rather than adjustment, as well as allowed real-time computer interaction.

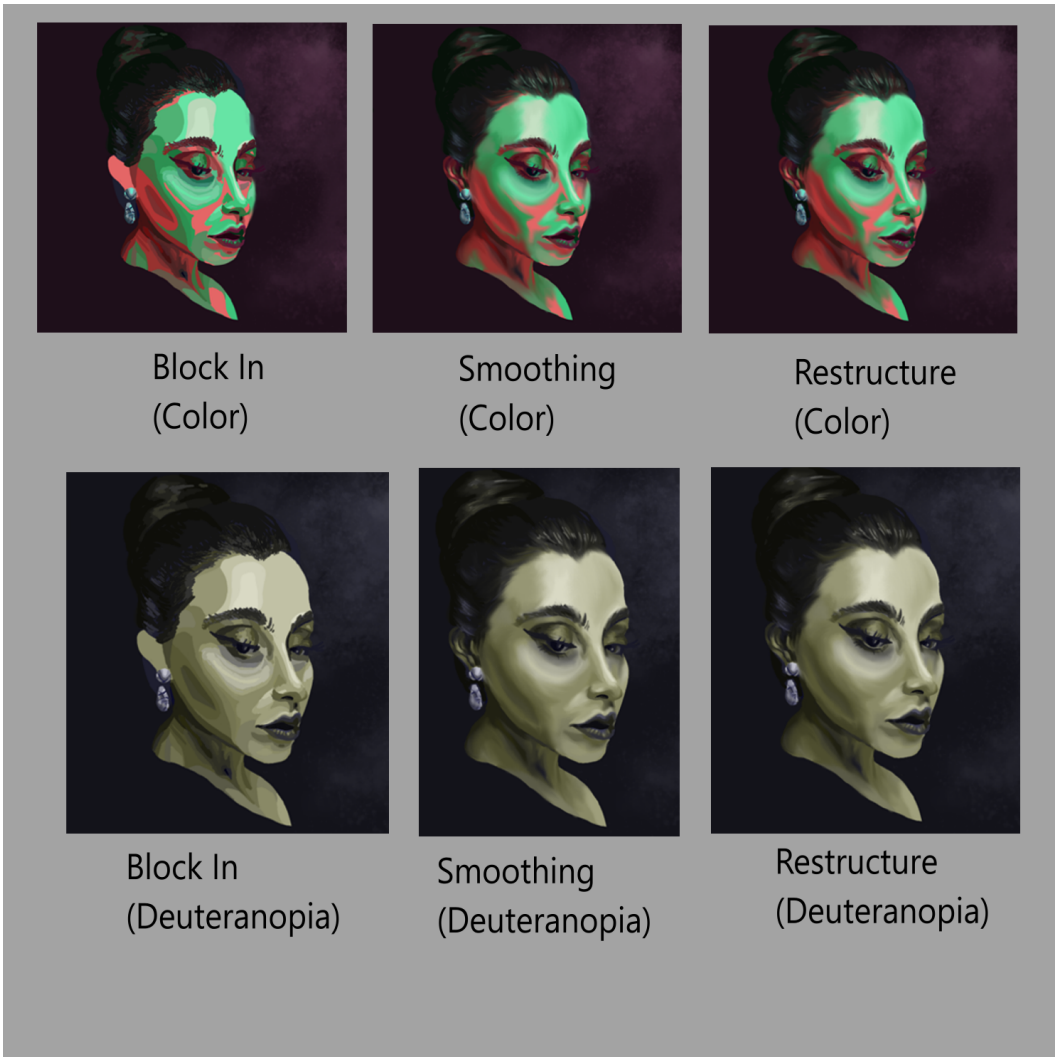

Fig. 6. A series of images showing the process of creating the Deuteranopia filter painting and then comparing it to its full color counterpart. The first image is the initial block in stage, then the smoothing stage, and finally the restructuring phase. The second row features the images with a Deuteranopia filter following the same previous 3 stages.

4 Result and Future Work

I found that the greatest challenge was the fact that there were a number of ways to achieve the same hue and saturation value as in the adjusted source image. Often adjusting the saturation or value of a color gave the same effect on one hue as another. This was especially prevalent in the Monochromia example.

I also noticed that cooler colors (blue, purple, green) were often found in the places where shadows were cast due to the ease of darkening the already naturally dark hues. In tandem warmer colors commonly populated the highlights.

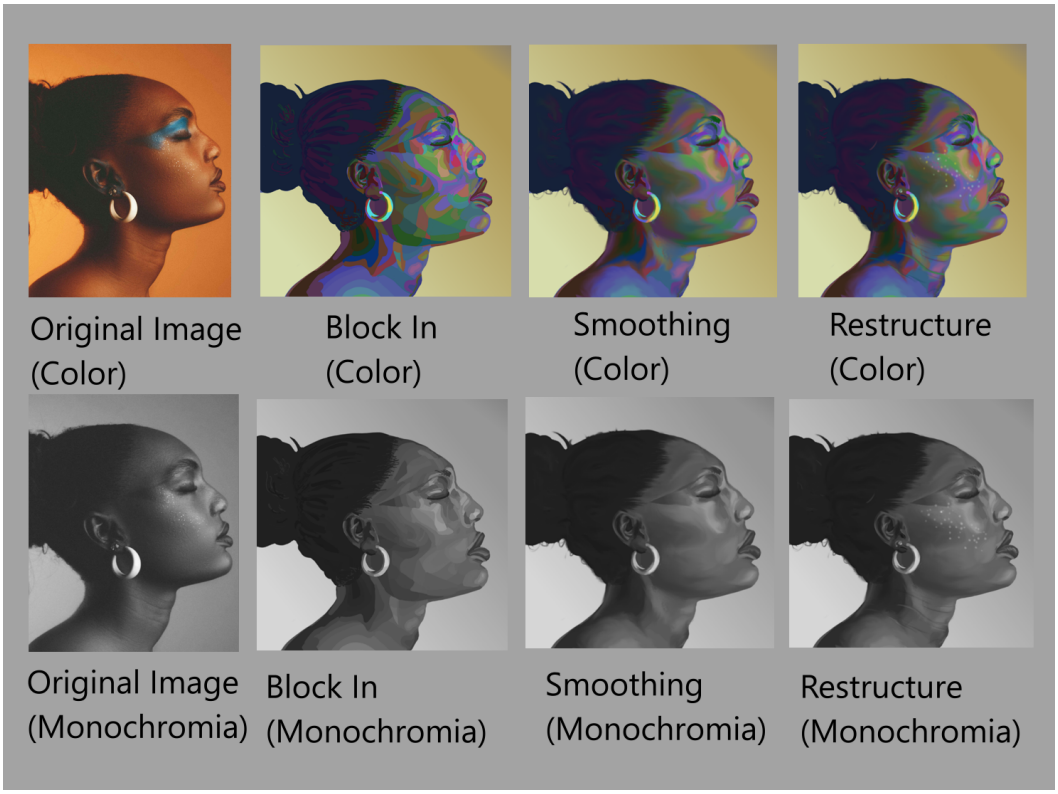

Fig. 7. A series of images showing the process of creating the Monochromia filter painting and then comparing it to its full color counterpart. The first image is the initial block in stage, then the smoothing stage, and finally the restructuring phase. The second row features the images with a Greyscale filter following the same previous 3 stages.

I noticed an over prevalence of purple in the Monochromia painting and a dearth of yellow. I assume that it is because of the ease of interpreting certain shades of blue and red as purple and because darker shades of yellow are often interpreted as oranges.

I noticed that despite the fact that they are the only colors invisible on the Deuteranopia color wheel the ending painting is overwhelmingly red and green. I have no good explanation for this phenomena. Overall, I've noticed that sections with increased contrast in color tend to be more accurate than sections with subtle changes in mid-tones.

I would like to create another series featuring Daltonized versions of these filters to see how that changes my options as well as a version with Tritanopia included. I think that seeing how Daltonized filters improve the usability of color pickers would be useful for designing better, more inclusive systems for the colorblind. I also think that including Tritanopia in this experiment could help in also making any differences in art program UI more inclusive to rarer forms of CB.

5 Conclusion

Colorblindness hinders color picking by merging different hues of colors into fewer choices and as such making saturation and value much more important in accurate painting creation. Increasing

contrast in a composition would be a good way to account for this in order to limit the confusing mid-tones that cause problems for colorblind artists.

Acknowledgments

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