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Color Compensation for Vision Defects

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Abstract: Color blindness is the shortcoming of color vision. It is the reduced ability to distinguish references between different colors. There are many kinds of colorblindness that affects the eye vision in different ways such a red-green, blue-yellow etc. But nowadays the common type of color blindness referred to as red-green in which people are not able to differentiate between red and green. Deficient people finds both the colors as the same one and some people viewed it as beige color. In this paper, we study on some color transformation scales such as RGB to HSV algorithm. This study focus on criteria based on the ease of use, accuracy, easy to analyze the different colors for color deficient people. The output of my research is to improve the red-green deficiency by enhancing the RGB image into HSV scale.

Keywords: Color blindness, Image processing, color vision, red-green color deficiency, RGB to HSV conversion.

I. INTRODUCTION

As we know to see anything in the world we require some small receptors which are present inside our eyeballs called as photoreceptors. These are nothing but are the cells that respond to light. It converts the light into signals for biological process. So generally there are two types of photoreceptors in the human retina i.e. rods and cones. These rods and cones both are located at the backside of our eye and transfer the information to our brain. Rods are responsible for light vision and sensitive than cones while cones are sensitive to pick up color. There are three types of cones which are present in the retina and named as

- Short(S-blue)
- Medium(M-green)
- Long(L-red)

Each of these cones is represented by a curve with peaks at different points in the color spectrum. On mixing these three types of different cones it can make up color vision. In case when any one type of cone is absent or failed to visualize the color then cone changes from its normal absorption of perceiving the color. This changes in the color perception results in a different way of perceiving the color. This is what we call color blindness. Due to the recently development in the field of e-health contains better understanding of ICT application to health from improving the diagnosis to control on disease parameters to provide assistance to the disable community.[2]

Many techniques have developed but that has a advantage that they are based on single uniform light source which is always not true. [3] There is an online platform named as color blindor in which color blind people interact with each other and discussing their features which are related to color blind applications.[1] In our daily lives the selection and designing of the emerged colors is a practicable way to help the color-deficient people and to remove certain color confusion [12].

A. Types of color blindness:

Generally there are three types of color blindness. But the most common types of color blindness are protanopia, protanomaly, deutranopia and deutranopia.[11]

1. Red-green colorblindness : It is actually composed of four kinds of colorblindness.

- Protanopia
- Deuteranopia
- Protanomaly
- Deuteranomaly

If a cone is missing or simply shifted then the color blindness is of protanopia tor deutranopia type while if a cone is defected or weak then the color blindness is of protanomaly or deutranomaly type. They are explained as

- Protanopia : In this kind of colorblindness the long wavelength cone i.e. red is missing. Colors that are red –green-yellow are difficult to distinguish.
- Deutranopia : In this kind of colorblindness the medium wavelength cone is missing i.e. green is missing.
- Protanomaly : in this type, the l-cones i.e red-cone is defective. And they occur in different intensity. It results in either stronger or weaker color blindness. So if l-cones are not missing but defective then it is referred as protanomaly.
- Deutranomaly : In this type the M-cones i.e green cones are defective. This is called deutranomaly. So it results in either stronger or weaker color blindness. The peak of sensitivity of green cones is moved towards the red sensitive cones.

2. Blue-yellow colorblindness: This type of colorblindness is further divided on the basis of tritanopia and tritanomaly.

- Tritanopia : In this kind of colorblindness the short wavelength cone is missing i.e. blue is missing. But this case is very rare. Blue and yellow are difficult to distinguish.

- Tritanomaly : In this type the S-cones i.e blue cones are defective. These cones operates below normal capacity to interfere with a person's ability to see some shades of blue. This is called tritanomaly. But it exists in rare cases.

3. Gray scale: It includes achromatopia and achromatopsia. It is complete color blindness. In this type it is very difficult to see the color part. Color deficient people visualize the color in the black or white or gray scale. It is referred to rod monochromacy or cone monochromacy. This means having rod only (no cones) or only having a single cone. Monochromacy is the highest level of color blindness in which an individual is unable to see any color instead of colors appear as shades of grey.[7] Different types of studies have been done to identify the effected people. According to a study done in 2011 by BUPA in the world around 8% of men and 0.5% of women are affected by the color vision deficiency.[8]

B. Background of the problem :

Basically color blindness is genetic problem. The genes encode the l-cone photopigments which are located on X-chromosome. This chromosome is known as sex chromosome because a female has two X's while a male has only one X combined with Y chromosome. Due to encoding it is observed that they often more on men than women because a women always has second X-chromosome which can compensate the defect. So it is mostly present in males rather than females. Because of its heredity depends upon the x-chromosome more. This is reason mostly men are affected than women.

II. METHODOLOGY

A. RGB to HSV conversion :

According to the authors the color perception of an image is improved and it is a color conversion method.[6] Color vision can be processed using RGB color space or HSV color space. RGB color space describes colors in terms of the amount of red, green and blue present. HSV color space describes colors in terms of the Hue, Saturation and Value. There are different ranges of red, green and blue in terms of their hues. Green color's range is 120° because its hue value starts from between 60° to 180°. Blue color's range is from 180° to 300°because its hue value comes between 180° to 300°.[10] In situations where color descriptions plays an integeral role, the HSV color model is often preferred over the RGB model. The HSV model describes colors similarly to how the human eye tends to perceive color.RGB defines color in terms of a combination of primary colors, where as HSV describes color using more familiar comparisons such as color, vibrancy and brightness. Figure1 shows the orignal image and figure2 shows the transformed image. The approach of proposed system is to recognize the color difference by color blind people. So the developed system provides color compensation algorithm. In this system the captured image in RGB colorspace is transformed into HSV color space to enhance or to recognize the color difference depending on the defective color type. They become able to differentiate the colors after the transformation. And also we can adjusts the values of images RGB so as to enhance the contrast between red and green. It results in making the green pixels appear to be bluer. It is proved to be efficient in modification of an image in respect to enhancement of its contrast.[4]The objective of this algorithm is to modify reds and greens of an image to increase color contrast and clarity for a color blind person. [5]

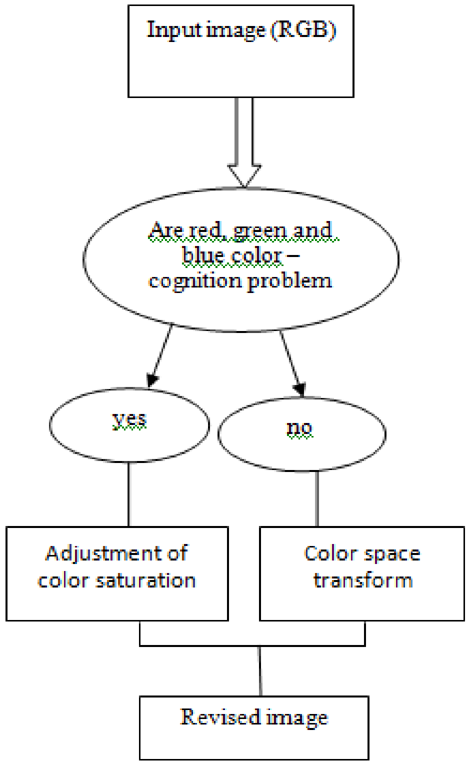

Fig 1 : Flowchart of the color perception correction.

III.RESULTS

Experimental results for red-green deficiency :

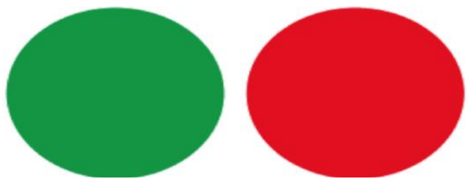

Fig 2 : Original image(RGB)

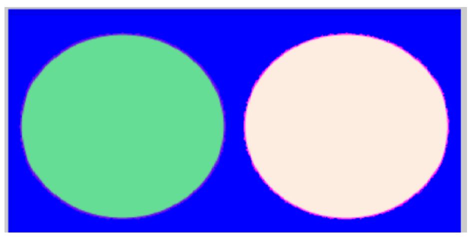

Fig 3 : Transformed image (HSV)

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IV.CONCLUSION

It is concluded that the proposed method in the previous chapter is better and gives us the opportunity to see the world through eyes of someone who are suffering from color blindness. This study determines a better algorithm which will be implemented to help color deficient people. In reality, no method is considered as universal.

We can't improve the color vision deficiency completely because it is a genetic problem also but atleast we can improve their visibility on colors so they can distinguish the colors and analyze them on the image. The results shows that images can be modified for two types of color blindness that are protanopia and deutranopia color viewers. They are able to distinguish between the colors that are not visible to them.

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BIOGRAPHIES

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