Video streaming application design for color blind users

E S Soegoto1, M A Fadlurrahman2 and Y A Hermawan2

1 Departemen Manajemen, Universitas Komputer Indonesia, Indonesia
2 Departemen Teknik dan Ilmu Komputer, Universitas Komputer Indonesia, Indonesia

*alifarhan_andri@email.unikom.ac.id

Abstract. Nowadays Video Streaming application becomes more popular in the world. Unfortunately, there is still few Video Streaming application that Color Blind Users friendly. The Color Blind Users can not enjoy Video Streaming application due to limitation color they can see. The purpose of this study is to investigate the design of Video Streaming application for Color Blind Users, so that it is expected that the Video Streaming application design can provide the same experience for users when using online video streaming web. The descriptive analysis was used as the method to analyze the research data. Interview with the Color Blind Users was conducted to sharpen the data analysis. The results of the research indicated that the design of Video Streaming application should be made in specific color. There are some color can be seen clearer by the Color Blind Users compare to the other colors. The result of the research contribute literature for building Video Streaming application in the right design to make the blind more convenient to play game approaching the normal situation.

1. Introduction
Bo Liu explained that there are about 8% of men and 0.8% of women suffer from color blindness. They have difficulty distinguishing several colors, and thus many colorful images and videos that have high quality for normal users may not be easily understood by users of color blindness. Bo Liu proposed an efficient re-coloring approach in order to modify images and videos so that color blind users can enjoy the same things as normal users [1]. So even with Mohammed Tawfik, explained that color blindness could be a real weakness for anyone in the design field because of the theory of color that plays an important role in the world of design, it can be a threat if a web designer does not design for users with disabilities, especially blind users color. Mohammed Tawfik's main objective is how web design designers can still take into account the needs of users of color blindness, especially in terms of 5 colors (black, red, green, blue and yellow) that are often used in designing web designs [2].

Color vision is determined by three different colors: hue (like red vs. green), saturation (pure color vs mixture), and brightness (light reflection and dull). The fundamental difference between color blindness and most people is a color that looks different to most people the same as color blind people. In other words, having defective color vision means the ability to distinguish color, saturation and brightness decreases [3]. According to Luke Jefferson and Richard Harvey, explained that color blindness or color vision deficiency (CVD) is known to be a significant barrier to using an effective computer. Based on usability studies conducted by the UK Disability Rights Commission, reports that color accessibility is the second most common problem in using the web. Therefore, there is a need to model CVD and simulate the effect for users of color blindness in using the web [4]. CVD problems affect 1 in 12 boys and 1 in 200 girls. There are around 400,000 color blind students in English schools.
to date, but teachers are even less likely to realize that some of those they teach have these conditions. Likewise, most parents are unaware of their child's condition. Lack of awareness by children does not mean they are not affected by these conditions; the child also develops a strategy to overcome the color blindness problems he experienced [5]. According to Ruki Harwahyu explained that color blindness is a deficiency where the patient loses the ability to recognize color. Color blindness is caused by anomalies in the retina. The retina in the human eye uses cone cells to detect color. Each specific wavelength of light is detected using certain cone cells. Partially color blindness, one or several specific cone cells do not function perfectly; this causes defects to distinguish each color [6]. According to Subhash C Gupta explained that the term color blindness can be divided into dyschromatopsia and achromatopsia. Dyschromatopsia is caused by a lack of seeing color, usually, these patients still have good vision. Patients usually cannot distinguish red and green, even those who cannot distinguish between blue and yellow. Meanwhile, people with achromatopsia are unable to distinguish colors. Some of these sufferers usually only see gray. A person with this condition usually has short visibility, is sensitive to light, and rapid eye movements [7]. According to Dede Kurniadi, color blindness occurs when the light receptor nerve in the retina of the eye changes, especially cone cells. Retinal nerve cells consist of stem cells and cone cells, for stem cells sensitive to black and white, for cone cells sensitive to other colors besides black and white. In general, color blindness is divided into 2 parts, namely total color blindness and partial color blindness, where in total color blindness a person only sees all colors black and white. Whereas in partial color blindness, a person has difficulty in distinguishing certain colors such as red, green, and blue [8]. According to Eddy Soeryanto Soegoto, being an entrepreneurship is a noble job, which can help the community, one of which helps someone with color blindness in using online video streaming [9]. According to Bhagya R Navada, said that color blindness is a common condition, from a total population of 8-10%. Noteworthy is that in the majority of cases there are no drugs or rehabilitation to overcome this problem, this makes a color blind person have difficulty in obtaining information that has color in the information. So, there needs to be an image and presented in the form of high contrast, this allows a color blind to read information. In addition, sending information in the form of text such as SMS can make a color blind person get information well [10].

The purpose of this study is to investigate the design of Video Streaming application for Color Blind Users, so that it is expected that the Video Streaming application design can provide the same experience for users when using online video streaming web. The descriptive analysis was used as the method to analyze the research data. Interview with the Color Blind Users was conducted to sharpen the data analysis. The results of the research indicated that the design of Video Streaming application should be made in grey color. Specific color can be seen clearer by the Color Blind Users compare to the other colors. The result of the research contribute literature for building Video Streaming application in the right design to make the blind more convenient to play game approaching the normal situation.

2. Method
This research uses descriptive method to find out things related to video streaming web design for color blind and using previous research related to color blind. So that you can find out what needs to be made in designing a video streaming web design. This study also conducted interviews with several color blinders to strengthen the results of this study.

3. Results and discussion
Designing web video streaming can be easily forgotten by a web designer because most designers do not experience color blindness. There are several explanations below, which can improve the colour-blind user experience and also benefit normal users. Text that is easy to read, for ease of reading a text, a good combination of color, background color and size of the text is needed. The illustration below illustrates how contrast is based on a combination of colors and sizes (Figure 1).
In displaying images and writing, choose a background that is not in contrast, so that the text presented is illegible, the text with the image as the background. If you want to display text with a background image, it must have blurred first (Figure 2).

In the picture above, there are text and background images that are very difficult to see. Instead, a text with a background image must reduce the background opacity of the image and increase its contrast, making text easy to see. Here is a good picture of a text combined with the background of the image (Figure 3).
A color filter, the screenshot below shows that there is a color filter that can be seen by a normal person and a protanopia color blindness (red and green blindness). Without the text description besides the color box, it is very difficult for a protanopia color blind to choose the color (Figure 4 & Figure 5).

![Figure 4](image1.png)

**Figure 4.** An unlabelled color filter, making it difficult for a protanopia color blindness.

![Figure 5](image2.png)

**Figure 5.** Color filters with labels, make it easy to see by a protanopia.

Avoid color combinations, in web design; it is better not to combine a color that is seen by a colour-blind as a unitary color (Figure 6). We recommend using one color. Here are some color combinations to avoid: green with red, green with brown, blue with purple, green with blue, light green with yellow, blue with ash, green with ash, green with black.

![Figure 6](image3.png)

**Figure 6.** Color combination when seen by a protanopia.

Graphs, colors are often used to distinguish categories in a graph. The picture below explains how someone sees a color difference. The color-friendly image is on the right. Use a pattern, and if possible place the text in each graph this makes it comfortable for a color-blind person to see a graph (Figure 7, 8, 9).
The zoom feature, one of the features that is owned by the web, allows one to enlarge the screen according to the user's wishes. This can improve the user experience in viewing a text or image. So, it is recommended for a video streaming web designer to activate this zoom feature; this can make normal and colour-blind users have a good user experience, and can increase the number of web visits.

Use a good text size, almost similar to the points described above, use text sizes that are comfortable to see. For example, if you want to display subtitles in a video, you should use a maximum text size of 14 with only white color combinations. Thus, a normal user and a color blind user have similarities in seeing a video.

Using a color-blind color palette, a normal person can see color combinations without problems. However, in some conditions, sometimes a color blind person has problems seeing the color palette. The color-blind color palette supports color combinations such as blue and orange, blue and red, or blue and brown. Thus, color-blind people can distinguish between the colors of the comparison, which ultimately leads to data visualization that can be optimized (Figure 10).
Figure 10. A color palette that can help color blind.

By using this color blind friendly palette (Figure 10), it is hoped that everyone can capture the differences and meaning of the information presented, and easily remember the things that have been focused on. A combination of light and dark colors is needed, compared to displaying a color combination between red and green. Therefore, if you present a combination of light and dark colors, color-blind people will be able to distinguish the two, almost everyone in the world can distinguish between very bright and dark colors, so if you have to use a combination of red and green, you should use a green combination very bright and very dark red.

Besides using different color values, you can also use other alternatives that help someone who is color blind to get information well. Color-blind people have a problem distinguishing certain colors, but can see information well if an information is visualized using labels, icons, directions, or other indicators not related to color. In building a web video streaming, use a minimalist web, meaning it doesn’t contain too many color combinations, for example a good color can be seen by a normal person or a person with color blindness is a color combination between black and white. The fewer color combinations used, the color problems seen by a person with color blindness can be minimized (Figure 11).

Figure 11. Examples of minimalist web.
The results obtained by the author, because normal users with color-blind users have different experiences in viewing content, whether in the form of text, images or video. So that there is a need for caution in creating content, other alternatives can also display special features that are user-friendly. Thus, video streaming web designers must pay attention to users of color blindness, especially in 5 colors (black, red, green, blue and yellow) which are often used in designing web designs.

Using color with high-quality contrast can help people with color blindness in seeing the information. A video streaming web designer can take advantage of this condition to help people with color blindness. Namely, by using bright colors and using high-contrast colors. For example, game word feud use colors that are easily distinguishable for someone who has color blindness.

Figure 12. Game word feud.

Beside the result there are technique must be used at video streaming application to blind color users to enjoy the video streaming application like a normal people. So that choosing the right color that is specific to color blindness is a priority. By choosing the right color will help color blindness using video streaming application, this is supported by research for color blind compensation on the augmented reality system that makes color selection for color blindness [11].

4. Conclusion
The development of web technology today requires a web video designer to pay attention to a web that is designed to be friendly to everyone, especially users of color blindness. Thus, normal users and color blind users no longer have differences in viewing a web-based streaming video.

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