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AN OVERVIEW OF THE USER EXPERIENCE IN ONLINE VIDEO GAME PLAYERS WITH COLOUR VISION DEFICIENCY

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Abstract: *This paper aims to give an overview of the user experience in online video game players with colour vision deficiency by exploring the different methods of daltonization tools given within four popular online multiplayer video games. The paper also considers the different options for improving the user experience of players with colour vision deficiency based on the noticed shortcomings of analysed games. The analysis of the potential colour confusing scenes was done for the four popular online multiplayer games: Rust published by the Facepunch studio, Valorant and League of Legends both published by Riot Games and Overwatch, published by Blizzard. The conducted research has shown that Rust has no accessibility settings, Valorant and League of Legends use partial daltonization, while Overwatch is characterised by full daltonization. Detailed analyses of the pros and cons of each daltonization level for each video game were presented along with suggestions for improvement, including the implementation of the proto-patterns method suggested by Molina-López and Medina-Medina (2019). As the result, it was shown that colour, although an essential part of video game design, can and should be a secondary element in video game graphics over which shapes, outlines and text should lead in the clear presentation of the information and reduction of mistakes due to colour vision impairments.*

Keywords: Colour perception, colour vision deficiency, video games, universal and accessible design, daltonization tools.

1. INTRODUCTION

Nowadays a considerable amount of information and entertainment is being consumed over digital devices where one of the common ways of portraying a message is with a help of colour. Due to the fact that colour is used as an information carrier, individuals with colour vision deficiency have been put in an unfavourable position, forced to navigate the world that their eyes cannot process. Graphics and video games alike use colours as a universal language. However, thanks to advancements in research and technology, a common way of user experience improvement is using some daltonization tools.
This paper looks into different implementation methods of daltonization tools and considers different options for user experience improvement for people dealing with colour vision deficiency. Four popular online multiplayer games are analysed. Each of the games utilizes different methods of image improvement for people with colour vision deficiency. Based on that analysis, some possible improvements to the already applied methods will be identified.

2. BACKGROUND

2.1 The human vision and colour perception

The key organ regarding the sense of sight is the eye. It consists of many parts, but in the context of colour vision deficiency, the most important one is the retina.
The retina is made out of different cells, the ones important in the context of this paper are cones. Three types of cones are in function as photoreceptors. Cones are commonly labelled as L (L – long), M (M – medium), and S (S – short). These labels correspond to the wavelengths that the photoreceptors are responding to. Another set of labels that can be used is R for red, G for green, and B for blue colour, which is convenient, but not necessarily correct since the sensitivity of some cones are including wavelengths of another colour (Fairchild, 2005).
The human reaction to colour is psychological and physiological, making the colour perception individual. Furthermore, colour is the sensation that results from light, which means that if the light changes, so will the colour (Anderson & Reed, 2014).

The lack of ability to differentiate colours can happen due to the lack of pigments in cones, i. e. when one or more photoreceptors in charge of colour vision are not functioning correctly. It is important to note that colour vision deficiency is a genetic disorder, more prominent in men because the gene carrying the disorder is on the X chromosome (Purves et al., 2001).
If there is a lack of sensation of the red or green light, the person will be unable to differentiate between reds and greens. The rarer case is a malfunction of photoreceptors responsible for the blues, causing difficulties in differentiating between blues and yellows (Guyton, 1971). Commonly used terms to differentiate between the types of colour vision deficiency are deuteranopia – green blindness, protanopia – red blindness, and tritanopia – blue blindness. In some cases, people have "faulty" trichromatic vision, also known as anomalous trichromacy (Colour Blind Awareness, 2010). In this case, the terms used to differentiate between the types of anomalous trichromacy are deuteranomaly, protanomaly, and tritanomaly.
Deuteranopia and deuteranomaly are the most common types of colour blindness, and around 6% of the population with XY combinations of chromosomes deals with it (Colblindor, 2015). Ones with these conditions are also consumers of software and applications that use colour as a carrier of information, and therefore it is necessary to have methods and tools that allow the adaptation of images for people with colour vision deficiencies.

2.2 Daltonization tools

Daltonization is a method of image correction that adapts the contents of an image for people with colour vision deficiency. It is a complex task that carries with it the issue of remapping a colour spectre to a smaller one, more suitable for people with colour vision deficiency (Milic et al., 2015).
Generally, there are two kinds of daltonizations, content-independent daltonization which will remap one colour to another, disregarding the content of the image, and content-dependant daltonization which will remap one colour to another, depending on the context of an image, assuring that the object in the image is standing out from the background (Simon-Liedtke et al., 2017). Currently, content-dependant daltonization is taxing for the computer, which makes it potentially inadequate for an image that is changing in real-time, which is the case in video games.
The surface of an image can be changed partly, where only one colour or one part of an image is being daltonized or fully, where the whole image is being remapped. Depending on the customization factor, some daltonizations are made for an individual or a certain group of colour blindness, while some are made universal (Simon-Liedtke et al., 2017). In some instances, the user can control the daltonization level, while in some cases it is automatic.
Other than colour remapping, the option for adding texture, shadow and complementary text to a colour can and will improve the overall clarity and user experience, especially for people with colour vision deficiency.

2.3 Video games

The term video games will be used to describe a type of interactive entertainment that is being consumed via PC (personal computer), mobile phone, consoles, and other devices. The term will most commonly be used to describe online multiplayer games.
In video games, communication with the user is the key element, ensuring that the user can adequately respond to cues and problems presented in a video game. While most games use sound to inform the player of an enemy's location in space, the visual aspect of a video game is essential. Most games successfully convey information about events without sound due to visual cues on the screen that shows where a sound is coming from. For the user to know who in the game is their teammate, who is the enemy, or whether the player has taken damage or regenerated life, many games use colours. The most common colours used were red, often as a marker for an enemy or loss of life, and green or blue, as a marker for a teammate or something positive for the player.
According to *newzoo,* the total number of video game players worldwide is projected to surpass 3 billion by 2023 (Wijman, 2020). Adding to this statement that 1 in 12 men and 1 in 200 women are affected with colour vision deficiency (Colour Blind Awareness, 2010) it becomes clear that accessibility settings in video games should become the norm. However, game developers and publishers vary in how much they take this reality into account.

Due to community pressure, video games are becoming more accessible to users. As a result, video game publishers are becoming more aware of the challenges their users face. As a result, they are increasingly introducing options to help overcome various obstacles.

2.4 Universal design

According to Ronald Mace (1991), "Universal design means simply designing all products, buildings and exterior spaces to be usable by all people to the greatest extent possible... Universal design means simply designing all products, buildings and exterior spaces to be usable by all people to the greatest extent possible.." (Mace et al., 1991)
Referring to the opinion of Ronald Mace, video games should be accessible to users without having to adapt using the currently available means.
The Game Accessibility Special Interest Group (GA-SIG) of the International Game Developers Association (IGDA) defined accessibility in video games as an ability to play under restrictive conditions because of functional disabilities. (Mangiron & Orero, 2012)
Evaluating the state of accessibility design in video games, Brown and Anderson (2020) have stated that to be of value, colour-blind modes should ensure that the critical information that is being portrayed by colour must be visible to people that deal with colour vision deficiency. They suggest that instead of using the traditional red and green combination, the more favourable palette would consist of blues and oranges (Brown & Anderson, 2020).
Accessibility in games refers to the ability to fully play and experience the game, even when players are operating under restrictive conditions (Khaliq & Torre, 2019). Users, i.e., players with colour vision deficiency, are particularly affected by the usual choice of colours (red, green or blue), as these are the colours that people with colour vision deficiencies cannot adequately distinguish. Due to colour vision deficiencies, certain players find games confusing, especially when they start playing games, and in some cases, they become impossible to play. Very often, the available accessibility settings are either not good enough or do not exist at all.
Video games are software, meaning every game contains at least one, and very often more, bugs that can cause the game to malfunction and put one player at a disadvantage compared to another. Losing due to an error in the game itself causes intense frustrations in players, motivated by a sense of injustice.
If the information is not visualized correctly, it can contribute to poor performance and, therefore to something that should be fun, turning into a source of immediate frustration. According to the same principle, frustrations occur in users with colour vision disorders.

3. ANALYSIS OF SELECTED ONLINE VIDEO GAMES

Four popular online multiplayer games were analysed in this paper. Games have been separated into three major groups based on the daltonization methods found that the developers decided to use (Table 1). The first group comprises games that have no accessibility settings. One of the representatives of such games is the game *Rust* by the Facepunch studio. The second group includes the games that have partial daltonization, meaning that only a specific aspect of the game has some daltonization methods, like the games *Valorant* and *League of Legends* both published by Riot Games. Lastly, the third group contains the games that have full daltonization, i. e. every colour of the image is remapped into another colour, which is the case in the video game *Overwatch* by Blizzard. Table 1 showcases each of the 4 mentioned games and the types of daltonization methods they support. The tick marks that the game utilizes a certain type of daltonization, while the x marks that the game is not using a certain type of daltonization.

Table 1: Daltonization methods supported by games

	Accessibility options	Partial daltonization	Full daltonization	Customizable daltonization	Content-independent daltonization	Content-dependent daltonization
Rust	x	x	x	x	x	x
Valorant	✓	✓	x	✓	✓	x
League of Legends	✓	✓	x	x	✓	x
Overwatch	✓	x	✓	✓	✓	x

The game *Rust* utilizes text and symbols to portray some crucial information. For example, to distinguish the difference between allies and enemies, the game uses a circle above the head of the allies. When it comes to understanding the health, hydration and nutrition bar one does not need to differentiate between colours, but look at the icons. Likewise, when placing an object on the ground, the colour of the object's shadow is a secondary information carrier due to the short textual description underneath the shadow. The game fails regarding cards used to access the restricted access rooms because the colour choice aligns with the colours that people with colour vision deficiency cannot distinguish properly (green, blue, and red). Figure 1 shows an example of the cards as seen by a person with regular vision (up) and a simulation of the vision of a person with deuteranopia (down).

Figure 1: An example of the cards as seen by a person with regular vision (up) and a simulation of vision of a person with deuteranopia (down) (Rust Wiki, 2019).

In both games, *Valorant* and *League of Legends,* only certain aspects of the game are changed when the colour-blind mode is turned on. In *Valorant* the key information that uses colour as an information carrier is the difference between the teams. By default, the outline around the enemy team characters is red, which for certain types of colour blindness, can become hard to see and distinguish against the background. The accessibility settings in *Valorant* allow players to choose between three different settings. Selecting the setting for protanopia or deuteranopia will change the outline from the default red to yellow,s and in case the tritanopia setting is selected, the outline's colour will change from red to purple. Looking at the simulation of colour-deficient vision (Figure 2), the settings make a big difference for players, making enemy characters easier to distinguish from the allies. They were, furthermore, improving the clarity of the game due to the outline preventing the character from blending into the game's background.

Figure 2: 1st up and down – Regular vision without filter, 2nd up – Regular vision with tritanopia adjustment, 2nd down – Tritanopia simulation with tritanopia adjustment, 3rd up – Regular vision with deuteranopia adjustment, 3rd down – Deuteranopia simulation with deuteranopia adjustment, 4th up – Regular vision with protanopia adjustment, 4th down – Protanopia simulation with protanopia adjustment (Riot Games, 2022).

Contrary to *Valorant*, *League of Legends* does not have multiple options regarding colour-blind mods. Again, the crucial information that helps the player separate between their own character, teammates, and allies is being communicated via colour. When the colour-blind filter is applied, the player's health bar changes colour from green to yellow, as well as some minor user interface (UI) changes, the most helpful change being the introduction of outlines around certain abilities. The interesting thing to point out is that the colour-blind mode in *League of Legends* is used by both people with colour vision deficiency and without. The biggest issue with this setting is that it was made only for red-green colour blindness deuteranopia. Considering that the *League of Legends* has one of the biggest player bases in the realm of online multiplayer games (150 million active players (activeplayer, 2022)), having non-customizable accessibility settings is underwhelming.

Unlike *Valorant* and *League of Legends*, *Overwatch* is the only game on the list that has implemented the full daltonization. Additionally, Overwatch offers the most detailed list of settings for colour-blind mode, including different filters for different colour vision deficiencies, a slider that adjusts the intensity of the filter and the ability for players to craft a custom colour palette as shown in Figure 3. One major flaw of full daltonization is that in some situations, the characters blend in with the background due to the number of colours being used after remapping being smaller and the daltonization is not dynamic, it is a content-independent daltonization.

Figure 3. Overwatch colour vision deficiency settings (Blizzard Entertainment, 2021).

3.2 Proto-patterns

Molina-Lopez and Medina-Medina (2019) have suggested twelve design proto-patterns (Table 2) for colour blindness. They have addressed the problem when the interaction between the game and the player is dependent on colour (Molina-López & Medina-Medina, 2019). This section aims to check if the selected games fulfil the twelve proto-pattern requirements. The proto-patterns are laid out in Table 2, together with the games, to check if the games include the 12 proto-patterns. The tick marks that the game utilizes a certain proto-pattern, while the x marks that the game is not using a certain proto-pattern.

Table 2: Checking if the games include the 12 proto-patterns

	Rust	Valorant	League of Legends	Overwatch
Set alternative colours	x	✓	x	✓
Associate label/shape with character	✓	x	x	x
Associate icons to the points on a map	✓	✓	✓	✓
Set the cursor	x	✓	✓	✓
Set text font	x	x	x	x
Set interline space	x	x	x	x
On/Off of the text-shadow effect	x	x	x	x
On/Off of the text-gradient effect	x	x	x	x
On/Off of the background animation	x	x	✓	x
On/Off of the cursor animation	x	✓	x	✓
Associate label/shape with the interactive element	✓	✓	✓	✓
Associate auditory description with the interactive element	x	✓	✓	✓

4. DISCUSSION AND SUGGESTIONS FOR IMPROVEMENT

Selected games fall under the category of being playable to an extent for people with colour vision deficiency. The developers' and designers' aim should be an overall improvement of user experience and ensuring that all players can adequately and in time respond to the cues that the games present to their player base.

Rust is the only game on the list with no accessibility options in its settings. This game is also the only game that does not use colour to differentiate between team members and enemies; instead, it uses a shape. Moreover, *Rust* uses text to describe certain states of object placement within the game. On the other hand, when it comes to using certain items in the game, Rust falls short regarding the colour palette for the access cards. Finally, in regards to the suggested proto-patterns observation, the game is lacking in aspects of customisation. It is the only game in which there is no sound effect when hovering over the list of options, making it more difficult for people with colour vision deficiency to identify interactive elements when they are not appropriately highlighted (Molina-López & Medina-Medina, 2019).

Out of the two analysed games with partial daltonization, *Valorant* is more user-oriented compared to the *League of Legends*. By allowing players to select preferred colours for the outline of the enemies, *Valorant* ensures that all players can react adequately and in time. Furthermore, while both Valorant and *League of Legends* give their players the option to change the way their cursor looks, *Valorant* is not limiting its players to in-game settings. Instead, it allows them to create and import fully customized cursors.

Looking at the table *Overwatch* scores the same way as *Valorant*, but upon inspecting the games, *Overwatch* offers a higher level of customisation. Unlike *Valorant*, *Overwatch* allows its players to select key colours from various colours, not just purple and yellow. Furthermore, *Overwatch* has text to speech option and subtitles option that aid people with colour vision deficiency when the game's UI/in-game chat or certain happenings lack clarity.

All of the games in question lack settings regarding text customization. Some games allow their users to change the size and animations of the HUD (heads-up display), but that is where it generally stops. It is clear that all of the games could use improvement regarding the text.

4.1 Suggestions for improvement

One noted problem with the game *Rust* was the colours on the access cards for restricted rooms. A simple solution, other than changing the colour palette itself, is to add text that describes the colour on the card. The disadvantage of this approach is that if the player does not speak English, the text may lose its utility value, in case it is not translated into each of the languages into which the game is translated. This problem can be avoided by using both the shape and the colour labels (Figure 4).

Figure 4: Up – Cards with added text to aid with colour recognition. Down – Cards with added symbols (circle, quadrilateral and hexagon) with the starting letters of each colour name, to avoid the language barrier (Rust Wiki, 2019).

Players of the video game *Valorant* even with character outlines and background details can still find themselves in a situation where character differentiation from the game background can be problematic, especially if they play the video game with lower graphic settings. Therefore, the background details are not displayed. A straightforward solution to this problem could be to add an option to add simple two-dimensional patterns to the background, as shown in Figure 5, to help differentiate a plain wall from a character.

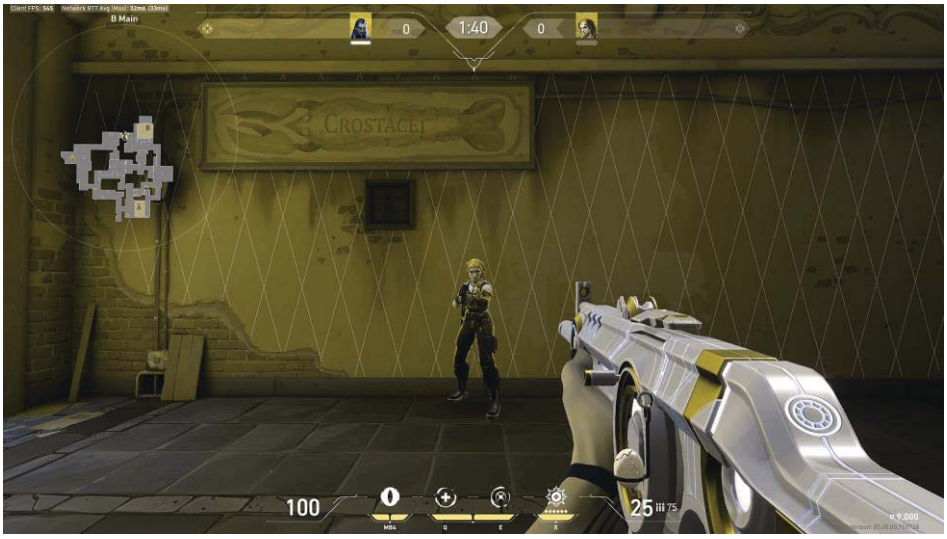

Figure 5: A simple two-dimensional pattern on the walls aids with the differentiation between the character and the wall (Riot Games, 2022).

In *League of Legends*, the first thing that would improve the experience of colour vision impaired players is to add a setting for all colour vision impairments, not just deuteranopia. Another solution could be to add noticeable outlines around all abilities. To simplify the daltonization process, instead of changing the colours of the player's and teammates' health bars, a circle or line could be added above or below the character's health bar. There is also the possibility of difficulty distinguishing characters from the background for people with colour vision deficiency. The solution to this problem can be inspired by the solution for the video game *Valorant*, which is to add clear outlines around the enemy characters, shown in Figure 6.

Figure 6: The simulated vision of a person with protanopia with added outlines to aid with the differentiation between the characters and the background (Riot Games, 2021).

Regarding the video game *Overwatch*, the benefit of full daltonization can be questioned if the game utilises outlines around characters for both teams and allows players to choose the colour of the outlines themselves. In this game, a character blending with the background can be noticed using the colourblind filter, as the colours do not change with the context of the background, an example of this can be seen in Figure 7.

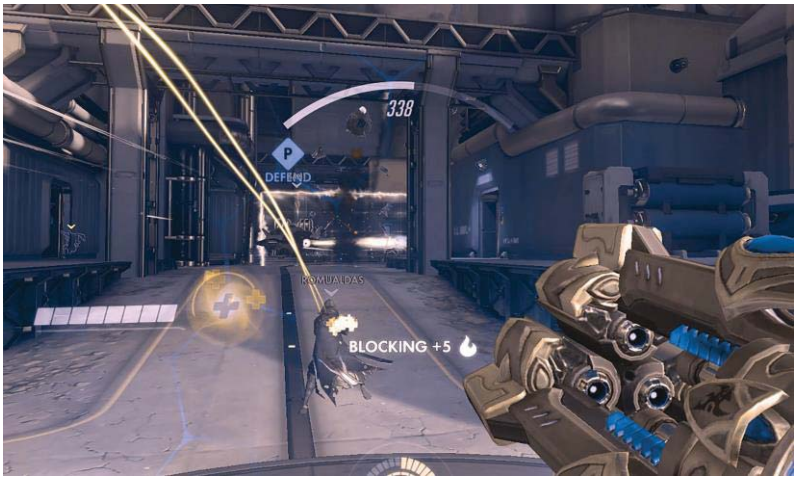

Figure 7: An enemy character is possibly difficult to notice for a person with deuteranopia while having a deuteranopia filter applied (Blizzard Entertainment, 2021).

One possible solution to this problem can be found in content-dependent daltonization. Still, it requires a lot of computing power, so there is a possibility that the computers of players who need this type of daltonization would not even be able to play the video game. Another possible solution is brighter outlines around the enemy characters to make it easier to see if they are further away from the player shown in Figure 8.

Figure 8: Adding a brighter outline for enemy characters may aid players with colour vision deficiency (Blizzard Entertainment, 2021).

It is worth noting that some players with colour vision disorders do not like full daltonization. One Reddit user expressed their feelings regarding a game adding daltonization tools: "*I hope they do it well and not just recolour the whole game. I hate it when games do that for colourblind mode, I really like it when they just change UI and the likes so I can tell the difference between enemies and friendlies. When the whole game gets recoloured it's like it's trying to force a perspective I've never seen and I feel like I'm being punished for being colourblind*" (Cregavitch, 2016). It's crucial that when adding accessibility options to games, the community and experts in the field work together to come up with the most optimal solutions.

5. CONCLUSIONS

In video games and the physical world, paying attention to a few details such as the choice of colours and simple solutions can make the game truly universal for players with colour vision deficiencies. The goal should be that players do not depend on filters, whether they are already included in the video game settings or on third-party software, and especially without the need to invest in physical aids, just to be able to experience this interactive medium.

The conclusion of the presented overview and discussions is that the colour, although an essential part of video game design, should not be the main carrier of information. Instead, research conclusions show that colour can and should be secondary. Using shapes, outlines and sometimes text, the information remains clear and reduces the room for mistakes due to colour vision impairments.

Future research should examine how much the proposed solutions help people and find optimal solutions in consultation with people with colour vision deficiency. Another possible future research direction should be to investigate the possibility of implementing effective content-dependent daltonization in video games so that personal computers can support them.

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7. REFERENCES

Activeplayer. (2020) *League of Legends Live Player Count and Statistics*. Available from: https://activeplayer.io/league-of-legends/ [Accessed 6th October 2022]

Anderson Feisner, E. & Reed, R. (2014) *Color studies*. New York, Fairchild Books, Bloomsbury Publishing.

Blizzard Entertainment. (2021) *Adding a brighter outline for enemy characters may aid players with colour vision deficiency*. Available from: https://worldofwarcraft.com/en-us/news/17964863/new-colorblind-support-in-patch-61 [Accessed 1th December 2021]

Blizzard Entertainment. (2021) *An enemy character is possibly difficult to notice for a person with deuteranopia while having a deuteranopia filter applied*. Available from: https://worldofwarcraft.com/en-us/news/17964863/new-colorblind-support-in-patch-61 [Accessed 1th December 2021]

Blizzard Entertainment. (2021) *Overwatch colour vision deficiency settings*. Available from: https://worldofwarcraft.com/en-us/news/17964863/new-colorblind-support-in-patch-61 [Accessed 1th December 2021]

Brown, M. & Anderson, S. L. (2020) Designing for Disability: Evaluating the State of Accessibility Design in Video Games. *Games and Culture*. 16 (6), 702–718. Available from: doi: https://doi.org/10.1177/1555412020971500

Reddit. (2016) *ReCore is totally dependent on colour, so it has an innovative colour blind mode (x-posted on /r/gaming)*. Available from: https://www.reddit.com/r/xboxone/comments/4ohhtf/comment/d4cu80g/?st=j7hqmp5k&sh=62af9a58 [Accessed 6th October 2022]

Colblindor. (2015) *Deuteranopia – Red-Green Color Blindness | Colblindor.* Available from: https://web.archive.org/web/20150407141010/http://www.color-blindness.com/deuteranopia-red-green-color-blindness [Accessed: 23rd November 2021]

Colour Blind Awareness. (2010) *Types of colour blindness*. Available from: https://www.colourblindawareness.org/colour-blindness/types-of-colour-blindness/ [Accessed: 6th October 2022]

Fairchild, M. D. (2005) *Color appearance models*. Chichester, West Sussex, England, Wiley.

Guyton, A. C. (1971) *Textbook of medical physiology: illustrated*. Philadelphia, Saunders.

Khaliq, I. & Torre, I. D. (2019) A Study on Accessibility in Games for the Visually Impaired. In: *5th EAI International Conference on Smart Objects and Technologies for Social Good. 25 Septembar, New York, NY, USA*. pp. 142-148.

Mace, R. L., Hardie, G. J. & Place, J. P. (1991) *Accessible Environments: Toward Universal Design*. Raleigh, North Carolina, The Center for Universal Design, North Carolina State University

Mangiron, C. & Orero, P. (2012) ¿Videojuegos para todos? Panorama actual de la accesibilidad en videojuegos. In*:* Pérez-Castilla, D. L. (ed.) *En Buenas prácticas de accesibilidad en videojuegos*. Madrid, Spain, Instituto de Mayores y Servicios Sociales, pp. 23-28

Milić, N., Novaković, D. & Milosavljević, B. (2015b) Enhancement of image content for observers with colour vision deficiencies. In: Celebi, E., Lecca, M. & Smolka, M. (eds.) *Colour and Video Enhancement*. Switzerland, Springer International Publishing, pp. 315-343

Molina-López, J. & Medina-Medina, N. (2019) Design proto-patterns to improve the interaction in video games of people with color blindness. In: *XX International Conference on Human Computer Interaction, 25-28 June 2019, Donostia, Gipuzkoa, Spain*. ACM, New York, USA. pp. 1-2

Purves, D., Augustine, G. J. & Fitzpatrick, D. (2001) *Neuroscience, 2nd edition.* Sunderland, Sinauer Associates.

Riot Games. (2021) *Annual Diversity and Inclusion (D&I) Progress Report - 2020.* Available from: https://www.riotgames.com/en/news/annual-diversity-and-inclusion-di-progress-report-august-2021 [Accessed: 1st September 2021]

Riot Games. (2022) *Colorblind Mode*. Available from: https://support-leagueoflegends.riotgames.com/hc/en-us/articles/201752844-Colorblind-Mode [Accessed: 15th September 2022]

Rust Wiki. (2019) *Rust Key Cards.* Available from: https://rust.fandom.com/wiki/Rust_Key_Cards [Accessed: 15th September 2022]

Simon-Liedtke, J., Flatla, D. R. & Bakken, E. N. (2017) Checklist for Daltonization methods: Requirements and characteristics of a good recolouring method. *Electronic Imaging*. 2017 (18), 21–27. Available from: doi: 10.2352/issn.2470-1173.2017.18.color-029

Wijman, T. (2020) *Three Billion Players by 2023: Engagement and Revenues Continue to Thrive Across the Global Games Market*. Available from: https://newzoo.com/insights/articles/games-market-engagement-revenues-trends-2020-2023-gaming-report?utm_source=Triggermail&utm_medium=email&utm_campaign=Post%20Blast%20bii-digital-media:%20Total%20video%20game%20players%20worldwide%20will%20surpass%203%20billion%20by%202023%20%E2%80%94%20here%27s%20how%20mobile%20gaming%20and%20in-app%20transactions%20are%20driving%20growth&utm_term=BII%20List%20DMedia%20Content%20ONLY [Accessed 6th October 2022]