

Analysis: Accessibility of VR Games Could Be Better

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Abstract: The rapid growth of the video game industry, including the niche of virtual reality (VR) gaming, highlights the significant market potential and demand for accessible gaming options. Despite many people with disabilities engaging in video games, a substantial part of this group finds current offerings inaccessible, thereby restricting their gaming experience. This study assesses the accessibility of popular VR games by applying a comprehensive set of guidelines adapted from existing guidelines. We analyzed the five top-rated VR-compatible games: *Beat Saber*, *Tetris Effect: Connected*, *Half-Life: Alyx*, *Microsoft Flight Simulator (MFS)*, and *Assetto Corsa*. Our findings indicate that the overall accessibility of these games is not good, with only 42.36% of the accessibility tests passed on average. The MFS is a positive outlier with 74.71% of the tests passed, which may be attributed to Microsoft's development of accessibility guidelines and controllers. Our study underscores the necessity for improved awareness and implementation of unified accessibility guidelines within the gaming industry. We also recommends some low-cost but high impact improvements for the tested games.

1 INTRODUCTION

It was estimated that there will be 3.22 billion video game players worldwide in 2023 (Howarth, 2023). The total turnover of the video game industry was 187.7 billion US dollars (De, 2023). This suggests that video games are a popular entertainment medium worldwide. A small but still important part of the video game industry is *Virtual Reality (VR) Gaming* that has become more prevalent due, *e.g.*, to the consumer friendly head displays (Epp et al., 2021).


In 2021, approximately 43% of individuals with disabilities engaged in gaming (Mosely et al., 2022). Yet, 50% of these players agree that current games lack accessibility, and 71% would play more if games are more accessible (Baltzar et al., 2023). This demonstrates huge potential for the current games market, since currently, 1.3 billion or 1 in 6 people have a physical or mental disability (World Health Organization, 2023). This means, that about half of this population currently cannot play, and thereby will not buy, video games. Designing games in an accessible manner is important, not only for the market, but also for disabled users. Increased accessibility would


support people with permanent disabilities, but also people who are temporarily impaired due to an accident (Grammenos et al., 2009). Since VR games are still a young field, potential shortcomings are not fully investigated yet, *e.g.*, the application of gamification and virtual reality in higher education (Nagel and Rauschenberger, 2024). Hence, in this paper, we present an analysis of the accessibility in popular VR games. Thereby, showing that the accessibility in VR needs improvements and giving recommendations on how to achieve a better accessibility.


2 BACKGROUND & RELATED WORK

Recent research about the accessibility of VR-Experiences concentrates, *e.g.*, on the analysis of individual experiences regarding the accessibility of VR (Hamilton, 2018; Mott et al., 2020), and on more details like the usability of VR controllers for elderly (Cook et al., 2019).

For a more systematic approach to the evaluation of the accessibility of digital applications, there are numerous accessibility guidelines. For example, Accessible Player Experience (AbleGamers Foundation, 2022), GAG (Game Accessibility Guidelines) (Game

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Accessibility Guidelines, 2023) and Xbox Accessibility Guidelines (Microsoft, 2023a). There are also VR-specific guidelines like XR Accessibility User Requirements (W3C, 2021) and Oculus VRCs: Accessibility Requirements (Meta, 2023). Guidelines, that are specifically for analyzing the accessibility of VR-Games are available with the guidelines of Heilemann (Heilemann et al., 2021). They are based on the aforementioned guidelines and include all test cases relevant for VR-games.

Previous research, that applied these guidelines, was for example based on the locomotion technique used in VR Games, where it was found that most VR-Games already adhere to the best practices (Anderson et al., 2024). But, to the best of our knowledge, there is no comprehensive comparison of the accessibility of current popular VR-games yet. We plan to use the summary of accessibility guidelines for VR from Heilemann (in the following called *Heilemann Guidelines*) (Heilemann et al., 2021) to get an overarching understanding of the current status of accessibility of VR games, in contrast to previous research which focused more on specific details or subjective experiences.

3 METHODOLOGY

To analyze popular VR-Games, we apply the following research process shown in Figure 1. The overarching process consists of step 1, 2 and 7 (blue, top level), the detailed test is described in step 3-6 (yellow, lower level).

In the first step (Figure 1, step 1), we define the Heilemann Guidelines as our evaluation criteria (Heilemann et al., 2021). The Heilemann Guidelines consist of 7 categories with overall $N = 104$ test cases. They are based on the GAG, but also include the other guidelines mentioned above. For the creation of the Heilemann Guidelines, several established accessibility guidelines were evaluated and filtered by what is directly relevant for VR environments and games. Afterwards, the texts were adjusted towards VR use. Repeating parts of the analyzed guidelines were summarized. The result of these steps is a set of guidelines that combine and summarize all rules for accessible VR games based on current research (Heilemann et al., 2021). The 7 categories tested were *Input and Controls*, *Audio and Speech*, *Look and Design*, *Subtitles/Captions*, *Simplicity*, *VR* and *Others*. All test cases can be found in the original paper (Heilemann et al., 2021). Test cases are sorted into the categories that are most fitting for them, but can also be relevant for other categories (Heilemann et al., 2021).

Next, we chose to evaluate the 5 highest rated VR games in the last 10 years, according to *Metacritic* a website that aggregates reviews of various media (Metacritic, 2023). The games needed to be VR compatible and did not need to be VR exclusive, to not exclude the majority of VR games, as most games are not platform exclusive. Hence, for the analysis we have these 5 games *Beat Saber*, *Tetris Effect: Connected*, *Half-Life: Alyx*, *Microsoft Flight Simulator (MFS)* and *Asseto Corsa* (Metacritic, 2023) (Figure 1 step 2). From the evaluated games, only *Beat Saber* and *Half Life Alyx* are VR exclusive. Beginning with step 3, we applied the following process for each game: Prior to the game analysis itself, a minimum length for the test run was defined, after which no significant additional findings were expected (Figure 1 step 3). For example, in *Asseto Corsa* one race had to be completed. Because the general game mechanics of further races stay the same throughout the game, we found no further gameplay necessary. Next, the actual analysis of the game was performed (see Figure 1 step 4): We tested the accessibility and gameplay settings of the game by going through the settings menus and comparing it to the guidelines (Figure 1 step 4.1). Following, the gameplay was tested for any accessibility violations (Figure 1 step 4.2). Meanwhile, all findings for each evaluation criterion were noted (Figure 1 step 5). This test was performed as an expert evaluation. After finishing the test run we went through all evaluation criteria to decide which passed and failed (Figure 1 step 6). Finally, we compared the overall results for every analyzed game and the results of each category separately (Figure 1 step 7). The detailed results of each test are available in the research protocol (Meiser et al., 2024).

4 RESULTS

The results of the accessibility tests of each game are shown in Table 1.

In Table 1, on the left side the test categories are displayed and on the top the tested games. The average of test cases that have passed per game are displayed at the bottom and on the right per category. Every test category has a different amount of tests, so the categories affect the average differently. On average, the MFS (51, 67%) delivers the best results and *Beat Saber* (29, 87%) the worst. The best results per category are in the category *Subtitles/Captions* (61, 11%) and the worst results in the category *Other* (27, 94%). The results are displayed as percentages because different categories have different amounts of criteria and so the results could be misinterpreted.

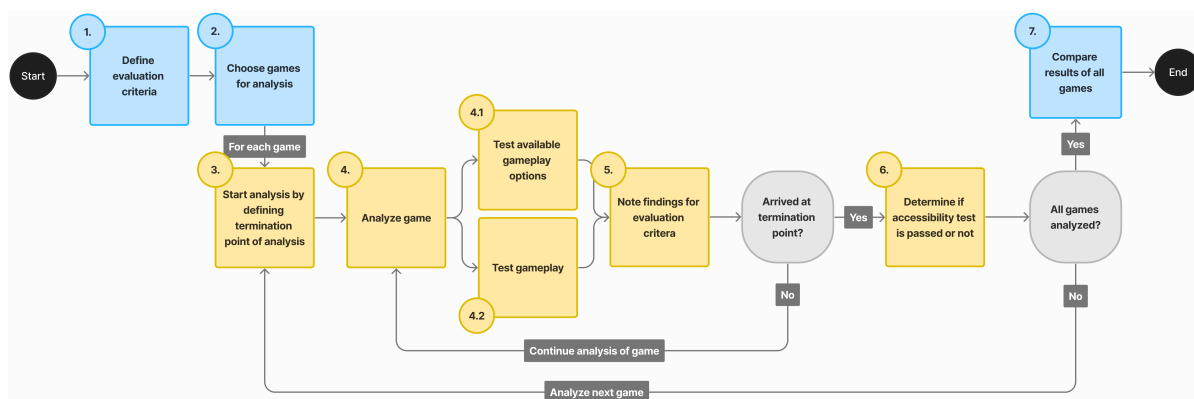


Figure 1: Evaluation Methodology.

Table 1: Results of the tested Categories for each game.

Test Categories	VR-Games					Average
	Beat Saber	TE: C	HL: A	MFS	Asseto Corsa	
Input and Controls	27,27%	66,67%	16,67%	76,92%	66,67%	51,67%
Audio and Speech	25,00%	27,27%	30,77%	73,33%	41,67%	41,27%
Look and Design	33,33%	26,67%	31,25%	81,25%	40,00%	42,86%
Subtitles/Captions	0,00%	0,00%	71,43%	85,71%	0,00%	61,11%
Simplicity	37,50%	37,50%	25,00%	81,25%	12,50%	38,75%
VR	57,14%	80,00%	37,50%	42,86%	66,67%	54,55%
Others	14,29%	15,38%	20,00%	69,23%	23,08%	27,94%
Average	29,87%	36,99%	29,89%	74,71%	37,33%	42,36%

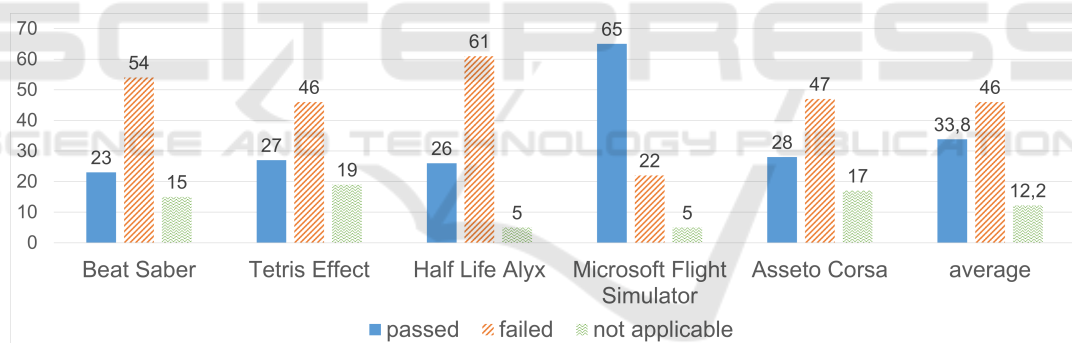


Figure 2: Results of all Games in absolute numbers.

Figure 2 shows the absolute numbers how many tests have passed, not passed or could not be applied to this specific game.

The only game that passed more test cases than failed is the MFS. On average, the games failed $n = 46$ and passed $n = 33.8$ tests. Only $n = 8$ test cases were passed by all games. $n = 17$ test case were not passed by any game, examples for this are *Avoid (or provide an option to disable) VR simulation sickness triggers (GAG)* and *Allow for alternative Sound Files (International Game Developers Association White Paper)*. Furthermore, $n = 14$ test cases were only passed by the MFS and no other game, examples for this are *Provide a stereo/mono toggle and adjustment of balance of audio channels (GAG)* and *Provide pre-*

recorded voiceovers and screen reader support for all text, including menus and installers (GAG). Especially the results in the categories *Look and Design* and *Simplicity* are noticeable when excluding the MFS: In the category *Look and Design* 7 of 15 test cases were not passed by any of the remaining games and in the category *Simplicity* 6 of 15 test cases.

5 DISCUSSION

The results show, that the accessibility of VR-games has huge potentials for optimization, only 42.36% of accessibility test were passed. The result of the MFS shows that it is at least possible to fulfill 74% of the

applied accessibility guidelines. This shows considerable differences to the other 4 games, which did not even reach 40%. The reason for the results of the MFS could be that Microsoft themselves developed their own accessibility guidelines and accessibility controllers (Microsoft, 2023b) in corporation with the disabled community (Microsoft, 2023a). This indicates MFS wants to have and follow guidelines and prioritize accessibility in the development of VR games.

The lack of accessibility in the other games could have various reasons, *e.g.*, due to the game play, lack of awareness, technical challenges, market perception, or resource constraints. To give more insights, many developers think that it would take up too many resources to improve the accessibility of games (Yuan et al., 2010). But there are many steps based on the accessibility guidelines that demand no extensive resources to be fulfilled. These guidelines should be easy to implement and would improve the experience of the player massively (Game Accessibility Guidelines, 2023):

For example, the guideline *Allow controls to be remapped / reconfigured* should be one of the fastest improvements, especially for players with a motor disability. To pass this guideline, you have to implement the option for the player to customize their inputs (Game Accessibility Guidelines, 2023; Bierre et al., 2004; Microsoft, 2023a; W3C, 2021; Meta, 2023). This is a feature most game engines should already offer with little effort necessary (Brown and Anderson, 2021). Players without a disability could also profit from a feature like this (Game Accessibility Guidelines, 2023).

Provide details of accessibility features in-game and/or as accessible documentation, on packaging or website is also a low-cost guideline, that does not need any additional development resources (Game Accessibility Guidelines, 2023). For example, the Xbox and PlayStation store offer the option to display accessibility features already (GameAccess, 2023; Sony, 2023). The implementation of this guideline makes it easy for disabled players to decide if they should buy the game. It can also increase the potential player base for the game, because player with disabilities search specifically for games with certain support features (Game Accessibility Guidelines, 2023; Microsoft, 2023a; ETSI, 2018; IGDA Game Accessibility SIG, 2021). This can also apply, when including game elements in a non-game context. Researchers should describe the implemented game elements (Hallifax et al., 2023) and one additional information they should give would be the accessibility of said game elements.

Indicate/allow reminder of current objectives during gameplay should be a more advanced improvement to the game, especially for players with a cognitive disability (Game Accessibility Guidelines, 2023). One good solution for this would be a quest log which shows what objectives need to be or are already completed. Thereby, the player has an easy way to re-identify their objective. Similar implementations are mostly seen in role-playing games like Skyrim (Game Accessibility Guidelines, 2023).

Other categories with low-cost, high-value potentials, which are still rarely implemented in the tested games are, *e.g.*, *Use simple clear language*, *Allow interfaces to be rearranged*, *Provide a choice of text color*, *low/high contrast choice as a minimum*, and *Ensure no essential information is conveyed by sounds alone*.

Avoid (or provide an option to disable) VR simulation sickness triggers (GAG) is a guideline that was only partly implemented in the tested games. This is a problem many players suffer from in VR Games (Munafo et al., 2017), so we expected the games to at least try to solve this problem, but there were no or only lackluster options in all tested games. Options that reduce motion sickness could be to *Dynamically reducing amount of peripheral vision during movement* or *Giving the player a frame of reference* (Game Accessibility Guidelines, 2023).

By implementing guidelines like these, the accessibility of the tested games could be increased significantly. But at least they would be given the option to know in advance if the games have the accessibility features they need.

6 CONCLUSION AND FUTURE WORK

In total, we evaluated 5 games for their accessibility. The results show, that the accessibility in 4 of the 5 games could be improved. One outlier being the MFS, which delivers better results. We have shown, that there are common accessibility guidelines that are easy to implement with low effort, like the option to remap controls that would also benefit players that have no special needs for accessibility. We recommend to at least implement a documentation of accessibility features in the game, so people with disability know if they can play that particular game. Overall, game developers should read through accessibility guidelines like the GAG at least once, so they realize how easy and low effort it could be to implement many accessibility features.

For future work, we aim to get more insights into

the accessibility of VR-games, through user testing the games with disabled people and comparing the results with our expert-driven approach. Through this, it may be possible to find accessibility features that were missed or misjudged in this test. Thereby, it will be possible to assess the practical applicability of the results of a test performed with the Heilemann Guidelines. Finally, we plan to provide developers with a blueprint for better VR-accessibility.

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