Assistant Tools and Accessibility Features for Blind People Playing Visual-Centric Digital Games

Marco Prescher
FHV University of Applied Sciences
Dornbirn, Vorarlberg, Austria
marco.prescher@students.fhv.at

ABSTRACT

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CCS CONCEPTS

• **Applied computing** → **Computer games**; • **Human-centered computing** → **Accessibility**; • **Human computer interaction (HCI)**;

KEYWORDS

blind, accessibility, gaming, digital games, navigation, tools, AI

ACM Reference Format:
Marco Prescher. 2024. Assistant Tools and Accessibility Features for Blind People Playing Visual-Centric Digital Games. In *Proceedings of ACM Conference (Conference'17).* ACM, New York, NY, USA, 5 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

1 INTRODUCTION

Today's accessible games for blind people are mainly games which are directly developed for them (Gonçalves et al. [7]). While these games are enjoyable, mainstream games are a serious challenge for blind people because they consist of complex environments, mechanics and interactions with *Non-Player Character* (NPC) players or even real players in *Player versus player* (PvP) games.

Conference'17, July 2017, Washington, DC, USA

ACM ISBN 978-x-xxxx-xxxx-x/YY/MM…$15.00
https://doi.org/10.1145/nnnnnnn.nnnnnnn

Implementing accessibility features is much needed in digital games to ensure that everyone, including people with disabilities can enjoy gaming. However, game developers in general face various problems in the process of developing games, some of them are:

- Diverse Needs
- Technical Challenges
- Design Compromises
- Standardization

So, the main idea of this paper is to give a broad insight of different and innovative accessibility features and tools, including haptic feedback and its ways to improve game experience which is a major technical challenge. Additionally, this study explores design compromises and their associated problems as well as the need for standardization in the gaming industry developing games. This raises two relevant research questions (RQ):

- RQ1: Which innovative accessibility features and tools can enhance the gaming experience for blind players?
- RQ2: In what ways can haptic feedback enhancements improve the game experience for blind players?

Contributions...

1.1 Motivation

One big step forward making mainstream games more accessible for blind people was the game *The Last of Us Part II* (TLOU2) [15, 14]. According to Leite and Almeida [12] the game company *Naughty Dog* implemented more than 60 accessibility features and is considered as the most accessible game ever produced. Additionally, Dale [6] described that the game can be played all the way through with audio cues and navigation aids. It includes preset accessibility options for common disabilities like hearing or vision impairments. It also introduces accessibility menus when the game is first started, making it easier for players with disabilities to adjust settings. To top that, *Naughty Dog* released a remastered version of TLOU2 in 2024 with a reworked *Cinematic Audio Descriptions* feature [16].

2 THE PROBLEM

Blind players encounter many different barriers when playing visual-centric digital games which often rely greatly on graphical interfaces and visual cues. To top that, the collection of those mainstream games have different perspectives such as top-down, first-person, and third-person views, where all three views give the player unique challenges in navigating game environment, understanding game objectives and interacting with in-game elements like players or objects. Building on that, the authors of Gonçalves et al. [7] have categorized seven themes and identified unresolved barriers (see Figure 1) which still represent a great challenge for both players and developers.

Figure 1 gives a great overview what accessibility features and assistant tools are still missing and in which direction the gaming industry should focus.

3 MY IDEA

The gaming industry came a long way from no accessibility features and assistant tools at all to implementing more than 60 accessibility features in one game [15]. According to research papers [7, 9, 8, 3] some of the most important accessibility features for blind people in visual-centric games include:

- Audio Cues and Descriptions
- *Text-to-Speech* (TTS) and Voiceover
- Navigation Aids and Wayfinding Tools
- Comprehensive Audio Design
- Customizable Controls and Inputs
- Tactile Feedback and Controller Design

Some of these have already been implemented to a certain extent in some games, but as Figure 1 notes, there are still problems. Especially when it comes to the environment, pathfinding, perspective and interacting with the world, blind players face major challenges, which according to Gonçalves et al. [7] could mean they stop playing these games because they simply can not find the right way to play.

To address the environment and pathfinding problems, one new technology was introduced in 2018 by Andrade et al. [2] to use echolocation to explore a virtual environment which could drastically improve navigation in it. As for perspective (camera) and interacting with the world, hardware solutions like haptic feedback or AI assistant tools could be a solution when developed and integration further. Whereas the haptic feedback [4] of for example PS5-Controllers [1, 5] could indicate when players aim too high or too low while an AI tool could provide the player with enhanced audio descriptions and how to interact with the world.

In summary, it can be said that the game industry already takes into account the most important accessibility features, yet most modern visual-centric digital games are still a major challenge for blind players. In the following section we will delve deeper into some of the listed features above, their problems and possible solutions, as well as how to improve the overall experience of blind people.

4 RELATED WORK

As digital games continuous to evolve making them more complex to play, accessibility becomes increasingly more important. This section provides a deeper insight into related work that has contributed to the understanding of the importance of accessibility in visual-centric digital games.

4.1 Themes of accessibility

The paper Gonçalves et al. [7] explores the strategies blind players use to play visual-centric mainstream games. It analyzes over 70 hours of YouTube content from blind players to identify the strategies and methods they use to navigate and interact within games environments.

The study highlights that blind players often rely on audio cues to understand and navigate game environments. They use repetitive actions like bumping into a wall to create a mental map of the environment. Players also try to create landmarks by interacting with the game world, for example, by leaving enemies behind to know in which area they are at the moment. This approach helps to navigate in game environments but also scare of new blind players due to frustration if the player become disorientated.

The result of their findings are seven themes focusing on describing strategies blind players created and adopted: (See Figure 1)

- Understanding the surroundings
- Wayfnding in virtual environments
- Dealing with perspective
- Interacting with the world
- Preparation, demand and cognitive load
- Automation and difficulty
- Playing with others

Additionally, Figure 1 shows us the existing barriers mainstream games have.

The paper also acknowledges the efforts of some game developers to make new and existing games more accessible to blind players. This approach by developers is essential for reducing the accessibility gap in the upcoming years of game development.

T1. Understanding the surroundings. Leveraging spatial audio, discerning sound effects (e.g., footsteps, voice lines) and soundscape changes (e.g., audio treatment). Feeling through bumping and interacting with objects.	*Surroundings (Untackled barriers):* Elements not interacting with the player are often silent; Time-sensitive challenges hinder feeling around; Occlusions.
T2. Wayfinding in virtual environments. Navigating based on landmarks (sound or collision) and authoring new ones; Re-orienting by reaching a familiar spot (respawning, save states); Semi-automatic navigation.	*Wayfinding (Untackled barriers):* Objective indications are visual-only (markers, text); Own movement is not perceived; Irrelevant sounds attracting players.
T3. Dealing with perspective. Remapping camera control, recentering through key-binds, and adjusting sensitivity; Leveraging aim assistance; Perceiving height changes based on landing sounds.	*Perspective (Untackled barriers):* Misunderstanding camera yaw (aiming too high or too low); Height changes are ignored and platforming is inaccessible.
T4. Interacting with the world. Experimenting with controls; Button mash to check for interactions; Avoiding fine-grained interactions (resorting to area effects); Curating abilities and features (accessibility paths).	*Interacting (Untackled barriers):* Prompts are inaccessible or do not provide context; Precise aligning and aiming; Complex interactions (e.g., stealth, taking cover).
T5. Preparation, demand & cognitive load. Memorizing controls; Maintaining a mental map; Consulting walkthroughs and guides; Unintuitive and overwhelming sounds; Keeping up with the game state (e.g., health).	
T6. Automation & difficulty. Settings automating or reducing the challenge; Playing a game differently but able to participate.	
T7. Playing with others. Sighted co-players and spectators describing the surroundings, menus, and controls; Co-piloting by distributing controls; Collaborating and gaining autonomy; Latency and cumbersome assistance.	

Figure 1: Seven themes and respective unresolved barriers (Source: Gonçalves et al. [7])

4.2 Inaccessibility in Games

In 2008 Grammenos [8] developed a game called *Game Over!*, which is the first universally inaccessible game, created as an educational tool to teach game developers about accessibility guidelines. This approach aimed to raise awareness and motivate game developers to make their games accessible for everyone.

The developed game *Game Over!* has 21 levels implemented, each one violating a specific game accessibility guideline to frustrate but also educate by directly showing the developer what impact their design decisions have. Some of the guidelines are:

- Require complex key combinations
- Rapidly changing control schemes
- Presenting information in inaccessible formats

Collected feedback from developers and players through surveys and public discussions indicate that the game raises awareness and educates about accessibility as intended. It also suggested for the game to include direct access to additional information about each violated guideline, such as how specific accessibility can improve the game experience for disabled players.

The feedback also highlighted to add more levels to cover a wider range of accessibility guidelines which would add the potential to adapt the concept and further improve it as well as to highlight the importance of game design in digital games.

4.3 Navigate a virtual environment using echolocation

In 2018 Andrade et al. [2] investigates the use of echolocation in a game environment to help blind players to navigate in them. This approach aimed to investigate whether it is possible to create a *virtual environment* (VE) where players can simulate echolocation to navigate and understand complex scenes within that VE.

Therefore, they developed a VE with Unity 5.6 and the SteamAudio plug-in. This VE basically represents a three level house called *Echo-House*, where users can navigate using sounds such as mouth-clicks, claps and footsteps, which generate echoes to receive information about the environment. Each level had a goal players needed to reach to get to the next level of the house (See Figure 2).

The evaluation consists of a 45-minute playing session and a interview. They found out that the echolocation provided the player with an improved sense of space within the VE. However, challenges in orientation and mobility were still present which indicates the need of further support.

The paper highlighted the limitation of the study such as the small sample size and the need for further research to validate their findings. Nevertheless, this work provides an important insight into the possibilities of using echolocation to help blind players.

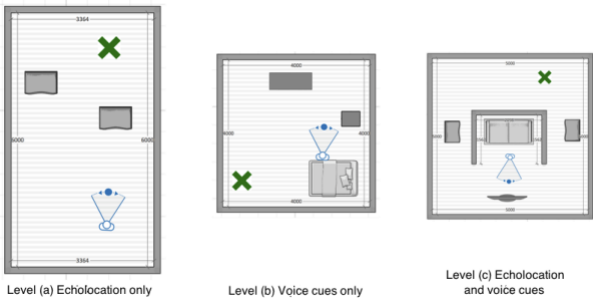

Figure 2: Layout of the three levels (Source: Andrade et al. [2])

5 THE DETAILS

In this section, we delve into enhancing accessibility in digital games for blind players. Firstly, we aim to explore previously mentioned developing problems, from universally accessible game design affecting diverse needs followed by technical challenges. Secondly, we explore various types of feedback which are essential in enhancing of accessibility in digital games and focus on haptic feedback as well as further possibilities to use that to improve the experience in digital games for blind players. Lastly, we propose enhancements of already existing accessibility features and tools.

5.1 Universally Accessible Game Design

In recent years, the awareness of accessible game design has been growing tremendously. According to *World Health Organization* [13], one out of ten persons has disabilities which often results in limitations in hearing, memory, vision or motor functions.

Digital games are getting more demanding in terms of the limitations we described before and this is where *Universally Accessible Game Design* (UAGD) comes into play. Through the implementation of UAGD, players with disabilities can benefit from features such as support for alternative input devices, including switches, eye-tracking systems, and mouth-operated controllers, which as a result can drastically enhance the game experience. One of the key aspects is the implementation of settings that allow players to customize the features they need to improve their game experience.

We found a promising user-centered approach in the paper Grammenos et al. [10] to apply UAGD in the development cycle of games. The basic steps are summarized in Figure 3, whereas an elaboration of these is provided in Grammenos et al. [10].

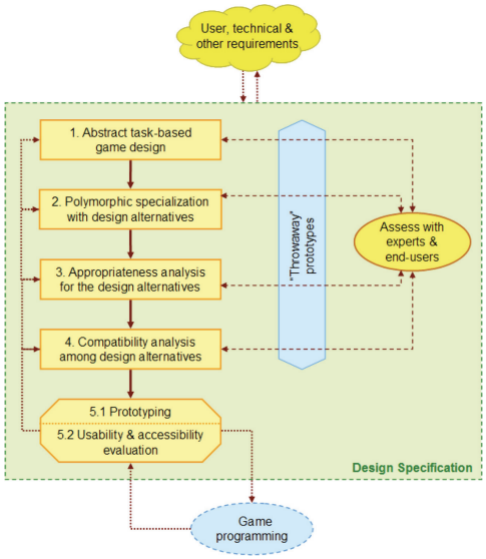

Figure 3: Applying UAGD (Source: Grammenos et al. [10])

5.2 Assistive haptic feedback

Short introduction into feedback variants and where it is used "visual perception (sight), haptics (tactile) and aural (hearing)". [11]

5.3 Further possibilities to use haptic feedback

Combination with echolocation?

5.4 Ways to improve existing accessibility features and tools

AI-tools?

6 CONCLUSIONS AND FURTHER WORK

A recap of the problem addressed and the proposed solution. The implications of your research for the gaming industry and the broader accessibility community. Any remaining challenges or unanswered questions that need to be addressed. Suggestions for future research directions or enhancements to your proposed idea. How your work contributes to advancing the state-of-the-art in accessibility technology for blind individuals playing digital games.

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