Design Guidelines for Audio Games

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Abstract. This paper presents guidelines to aid on the design of audio games. Audio games are games on which the user interface and game events use primarily sounds instead of graphics to convey information to the player. Those games can provide an accessible gaming experience to visually impaired players, usually handicapped by conventional games. The presented guidelines resulted of existing literature research on audio games design and implementation, of a case study and of a user observation performed by the authors. The case study analyzed how audio is used to create an accessible game on nine audio games recommended for new players. The user observation consisted of a playtest on which visually impaired users played an audio game, on which some interaction problems were identified. The results of those three studies were analyzed and compiled in 50 design guidelines.

Keywords: audio games, accessibility, visual impairment, design, guidelines.

1 Introduction

The evolution of digital interfaces continually provides simpler, easier and more intuitive ways of interaction. Especially in games, the way a player interacts with the system may affect his/her overall playing experience, immersion and satisfaction. Currently, game interfaces mostly rely on graphics to convey information to the player. Albeit being an effective way to convey information to the average user, graphical interfaces might be partially or even totally inaccessible to the visually impaired. Those users are either unable or have a hard time playing a conventional game, as the graphical content of the user interface is usually essential to the gameplay.

Auditory interfaces [1] provide an alternative way of conveying information for user interfaces and are accessible to visually impaired users. Using an auditory interface, an entire interface can be built upon sounds. Audio games [2–4] present auditory interfaces that can fully represent game elements and gameplay, creating an auditory gaming experience. The graphical interface is not required to play the game: the game might have one (audio-based game) or not (audio-only game). Thus, as the main interface is aural, a well-designed audio game could be played by and be accessible to average and visually impaired users alike.

Although accessible game design and its challenges are discussed in [5–9] and guidelines for accessible games are available in [10, 11], we could not find specific

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guidelines to designing more accessible audio games for visually impaired players. The available information regarding the design of audio games is mostly papers on the design, implementation or analysis of particular games (c.f. [12–21]). Hence, the starting point for new audio game designers is to learn with previous designs available on the literature and play the games created.

Specific guidelines on accessible audio usage for gaming interaction could further aid new designers on creating more accessible audio games. Hence, this paper presents 50 audio games guidelines containing desirable features and audio usage to aid designers on the creation of more accessible audio games. A more comprehensive list can be found at lifes.dc.ufscar.br. The guidelines combine features described in the literature with the results of a case study and an observation of a playtest performed with visually impaired players.

This paper is organized as follows: Section 2 comments our literature research, by presenting relevant related works. Section 3 describes our research approach. Section 4 presents the case study whilst Section 5 describes the user observation. Section 6 introduces the audio game guidelines. Section 7 presents conclusions and future work.

2 Related Work

In 2004, the International Game Developers Association (IGDA) presented a white paper describing the importance of game accessibility [6]. This paper presented approaches used by games to improve the gaming experience of disabled players and suggested possible methods to improve game accessibility. General guidelines for gaming accessibility are presented in [5]. Guidelines for developing accessible games are presented in [10, 11]. Those are general accessibility guidelines, which can be applied on the development of any kind of game. Universal accessibility in games is discussed in [7, 22]. Those papers present and discuss the design of Universally Accessible Games (UA-Games), games that follow the principles of Design for All [22].

However, we could not find a compilation of specific guidelines to help designers to create audio games. Most of the papers we found focus on decisions and challenges of the design and implementation of particular games. Some parts of these papers emphasize more specific goals with more depth, such as creating auditory interfaces or game entities – like objects and scenario – with audio. The parts we considered the most relevant for our work are succinctly indicated below. They were our starting point and might provide insightful advice for new audio game designers.

The creation of auditory interfaces and auditory objects in audio games is discussed in [4, 12, 14, 18, 23–25]. Navigation and orientation in audio games scenarios or worlds are discussed in [4, 12, 14, 15, 19, 21, 23]. Those could be useful for designing interfaces and entities for the game and how to use them more effectively in the gameplay.

In audio games, sounds have to be used both to convey information to the player as for aesthetics. Different classification of game sounds, their uses and function in games can be found in [13, 14, 25, 26]. Functional and aesthetical uses of sound and their importance in the design of audio games is discussed in [4, 14, 25, 26].

The design of audio games is addressed with more depth in [4, 12, 14, 15, 17, 19, 21, 25], especially regarding audio usage for gameplay. The importance of audio feedback for user inputs is commented in [10, 23, 24]. Ideas on implementation are described in [4, 15, 18, 19, 21]. Input design is commented in [24, 25], whist provide insights on how to use different input devices is provided in [4, 16, 17, 26].

3 Research Approach

We performed a literature research, a case study and a user observation to propose the guidelines. The goal of these three studies was to find how audio is used on audio games and how to help new designers to create audio games. We researched how one could use game audio, such as music, sound effects and speech, to:

- Create and characterize game entities, such as objects, characters and puzzles;
- Create and characterize ambient, scenes and game worlds, how to handle spatial localization and how to navigate in the game's space;
- Control the player's avatar, handle control input and provide input feedback;
- Teach the player how to play or how to give instructions;
- Create game menus and how to navigate on them.

The literature research was described in Section 2. We performed the case study and the user observation to complement and to verify in the practice what we found.

The case study analyzed nine audio games with various genres regarding the audio interfaces, audio usage and interaction. The games choices were based on lists of games recommended to beginner players [3, 27]. Some were also chosen because they had versions in Portuguese, which was necessary for the user observation. The case study is discussed in Section 4. The user observation consisted of two blind users playing an audio game and describing their experience. We also observed how they interacted with the game and how they responded to the game's information and feedback. The user observation is further discussed in Section 5.

We then combined all the information, results and problems gathered to propose some design guidelines for audio games. The guidelines address problems identified on one or more of our studies and were organized in eight categories, as presented in Section 5. Each proposed guideline has the recommendation, the problem(s) it addresses and the rationale. The resulting guidelines feature advice on how to present the audio in an audio game trying to achieving better accessibility, focusing the audio usage on enhancing the gameplay, representing game objects and providing useful information to the player when needed.

4 Case Study on Audio Games

The case study consisted of the researchers playing and checking audio usage in nine audio games, with diverse genres, to verify how the games used audio to create accessible game experiences. The chosen games were: Dark Destroyer [28], an

arcade/action game; Deekout [29] an action game; Drive [30], a racing game; Fear of the Dark [31], a maze game; GMA Tank Commander [32], another action game; Lone Wolf [33], a simulation game; Mudsplat [34], an arcade game; Ten Pin Alley [35]; a bowling game and Top Speed 3 [36], another racing game.

The setup of all the games, except [29], used a graphical installer. The installer, although simple to sighted players, might be inaccessible on some screen readers – especially as the install progression was shown using progress bars. Before playing, we noted some games [35, 36] requested the player to disable assistive technologies, such as screen readers, whilst playing. However, they did not remind the player to enable them when he/she finished playing the game.

Despite the different genres, the studied audio games adopted similar strategies to those described in the literature to convey the game with audio. We found most of the sounds, especially speech and sound effects, were used in the games focused primarily on gameplay. The games' sounds were mostly used to convey relevant information to the player (such as game events) and to provide feedback on his/her performance. Music was used mostly for aesthetics. Some games also used music or played simultaneous sounds to enhance the gameplay, such as [30] which used the rhythm to report game status and progress.

All audio games provided feedback for users' inputs. Some provided different feedback for correct and incorrect player inputs. Time constraints in game events were more severe on some game than others – this was expected due to the different genres. However, the games provided enough time for reaction. Spatial sounds were mostly used to describe the games' worlds and objects positions – mostly relative to the player's position. [28, 32, 35] provided a spatial sound test, a useful feature to allow the user to check his audio hardware position and/or configuration.

The presentation of the rules, instructions and goals varied among the audio games tested. Some games provide an in-game help [30, 32–35] or tutorial [30, 32]. The others required the player to read the extern manual to learn how to play, providing little to no information in-game. Some games offered the players additional aids during gameplay, such as sonars [33], radars [32, 33] or void-acted non-playable characters [30, 36].

In menus, all games allowed skipping options without hearing it all. [34] differentiated the first from the last option in a menu - indicating when it started or when it ended – and informed the player to which menu he/she was heading back. [32, 34–36] allowed the repetition of the current option without scrolling back and forth. [32, 35, 36] allowed audio settings to be changed within the game. [28, 32, 34] provided a sound test mode which is especially useful when the sound was created to be used on the game or when the player had never heard the sound before.

5 User Observation with Visually Impaired Players

We wanted to observe how visually impaired users interacted with audio games and how would the users perceive the interface and gaming elements. To perform this observation, we went to Espaço Braille (Braille Space), a place to promote training,

leisure and entertainment for visually impaired people, in São Carlos, Brazil. Two blind users played the audio game Top Speed 3. The users played a quick race, trying to figure out how to play, by themselves, after some initial explanation about the study. Albeit we could observe only two users, their interactions with the game fulfilled our observation's goals.

Both players became visually impaired on their adulthoods. One of the players had previous experience playing conventional games; however, he had never played an audio game. The other player had no prior experience on playing games. Both users were learning how to use computers.

The users were free to race without worrying with their performance, as we were interesting in observing the interaction. We provided some basic information to the users on how to play, such as the game's goals, controls and suggested how to interpret the sound feedback. Figure 2 illustrates the users playing the game. Both users managed to navigate the game's interfaces and play the race without problems.

It was noticed that, similarly to conventional games, the comprehension of the interface facilitates the game. The user observation suggested the importance of the feedback and the controls used on an audio game in helping the user to play. The players' control on the car rose the more they understood the game and its interface, by hearing the audio cues and adjusting their inputs accordingly. In Top Speed 3, spatial sound is used to position the car in the road - the balance of the stereo sound informs the player whether the car is centralized on the road or leaning away from the center. If the car is distant from the center, it collides with a wall and the game plays a sound effect to warn the player. If the player keeps colliding with a wall, the game provides further feedback, such as an explosion sound.

Top Speed 3 features a NPC who helps the players to navigate on the track, announcing curves and allowing the users to know what was ahead of them by prerecorded speech. This feature was noted and appreciated by the players. The users also commented it was easier playing with stereo headphones, confirming the literature [15]. The headphones facilitated them to recognize on which side the sound was playing, making it easier to play.

The users' main problem with the audio game was the default keyboard keys used by the game. One of the users reported the game's keys were different from what they were used to use on assistive technologies. This made it difficult for him to reposition their hands on the game keys when his hand wandered off the keyboard. They explained it was hard positioning the hands back to the keyboard as the game's keys were not tactile marked keys – like 'A' and 'F' on a QWERTY keyboard layout. Figure 2 (c) illustrates this problem – the hand of one of the users is hovering the keyboard, but unable to find the arrow keys used by the game.

This suggests that, especially for new users, the buttons or keys used to play the game might hinder the experience if they are not properly chosen. If the game uses a keyboard, for instance, using keys the visual impaired players use regularly or allowing him/her to customize the keys for the commands may increase the accessibility of the game.

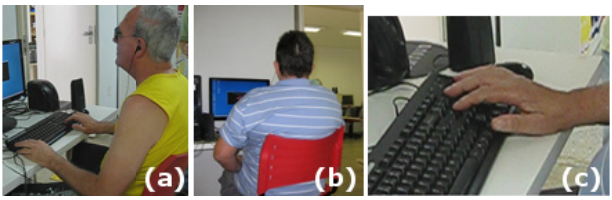

Fig. 1. (a), (b) Two blind users playing the audio game Top Speed 3. (c) The user is having trouble to reposition his left hand on the keyboard. The absence of the tactile keyboard marks on the arrow keys made it harder to the player find them after losing.

6 Guidelines for Audio Games

The results from the literature and from Section 4 were compiled and analyzed. Recurring audio games features and problems were identified. We combined the information available on the literature with the results and problems identified on the case study and the user observation to propose some design guidelines for audio games. The resulting guidelines feature advice on how to present the audio in an audio game trying to achieve better accessibility. They combine existing recommendations discussed on the literature with audio usage and features recognized on the case study. Recommendation of solutions to identified problems on the case study and user observation were also included.

The complete list of guidelines is available at lifes.dc.ufscar.br. Thirteen guidelines are present here.

- *Category 1*. Install and Access to the Game.

1.1. Easy to understand and to follow to follow setup, planned in a logical and sequential way. Problem. The setup interface might contain large texts or too many options or details. Rationale. Easy setups should be preferred [5]. The messages should be conveyed as simple as possible to the user, to avoid confusing or overwhelming him/her. As the audio interface is perceived sequentially [24], it is important the setup should also be clear. The options and its consequences should be clearly stated. Many of the studied games used wizards to be installed [28, 29, 31–36] or a single zip-file [30]. Also recommended in [11].

1.2. If the game needs to disable assistive technologies, remember the player to enable assistive technologies when he finishes playing. **Problem.** Some games require or recommends assistive technologies to disabled before playing (for instance, [35, 36]). **Rationale.** The game might be accessible if an assistive technology is disabled; however, the user's operating system might be not. It is important to remember him/her to re-enable it after quitting the game.

- *Category 2*. Interaction Output.

2.1. Use audio for all game events, and provide enough time for player reactions. **Problem.** Some audio games provide low time between events or use complementary

outputs, such as haptic or graphical, which might not be perceived the same way as audio. **Rationale.** Sound is perceived by time [4], unlike graphics. Therefore, all game events must be conveyed by sound: the player must know what is happening [23] and what will happen [17] to have enough time to act accordingly; provided the information when needed, at a very good time [24].

2.2. Allow repetition of information. Allow additional information to be requested by the player. **Problem.** Some games don't allow information to be repeated. **Rationale.** The user might not hear or understand the provided information the first time he/she hears it. This might happen especially in long explication or dialogues. It is important to allow the player to request the information to be repeated [5]. It is also interesting to allow the player to request for further information. Also recommended in [11].

- *Category 3.* Interaction Input.

3.1. Allow input controls to be customized by the player. **Problem.** Some games do not allow remapping or configuring the commands in an input device. Players might have difficulties on using some keys or buttons, as they might be hard to access or to be pressed on controllers [17] or keyboards. Our visually impaired players used the home row in a keyboard to locate the keys, and thus had difficulty finding the arrow keys. Only two of the tested audio games allowed customizing the controls [32, 36]. **Rationale.** Allowing customization, the user may choose the keys or buttons more adequate to his/her needs or preferences. This might facilitate the interaction between the user and the game. This is also recommended in [5]. Also recommended in [37].

3.2. Provide immediate sound feedback for player inputs. **Problem.** The user must know the results of his/her input command or even if the game accepted the input. **Rationale.** It is important to provide immediate feedback to the player upon his/her action [11, 14, 24]. This helps the player to know if his/her action was processed by the game. For instance, sound effects, such as footsteps when walking [12], allow the player to know his movement input was successful. Also recommended in [11].

- *Category 4.* Menu Navigation.

4.1. Suspend the menu's label reading when the player changes an option. **Problem.** Hearing the same options many times in a menu can be annoying to the player. **Rationale.** This follows the same rationale of Guideline 2.4. Allowing the user to skip the option also may increase his/her navigation speed in the menu.

4.2. Numerate options in menus. **Problem.** If the user is unsure of what option he/she needs to select in a menu, he/she will either have to count its position or remember where it is. **Rationale.** Numerating the options allows the player to remember the number and might allow him/her to navigate to the chosen option faster. Or after using a menu several times, the user might know the exact position of a desired option, however, may still have to navigate all others [23]. Allowing the number to be a shortcut to the option could be adequate.

- *Category 5.* Ambient, Scenarios and Space Representation.

5.1. Avoid reproducing many sounds at once. **Problem.** Listening to several parallel audio signals simultaneously can be confusing [22] to the user. **Rationale.** Sound is perceived by time [14]. A user listening to many sounds at once might be overloaded with information and have a hard time distinguishing or understanding each sound individually. Too many sounds at once might be detrimental to the experience [13]. When many sounds are played, the vision is used to solve ambiguities [23] – which is not possible in an audio game. If it is necessary to play many sounds, try making them complementary, with planned timing [22] and/or using them spatialized [14].

- *Category 6.* Object Representation.

6.1. Try describing objects with the most accurate and representative sound possible. **Problem.** The user has to recognize an object by hearing its sound. **Rationale.** An object should be described by using it more accurate sound or combination of sounds available [12]. The sound must match the player's mental model to be recognized [19] and should be sounds that are relevant by themselves [24]. As a rule of thumb, if objects are different, they should sound different [23] in the game. If there is no good sound to describe an object, an artificial, created sound can be used; however, it should be described and explained to the user.

6.2. Present an option to describe a new sound to the player. **Problem.** The user might not have heard the sound of an object before. For instance, this could happen if an object was created for the game or the player does not know it. **Rationale.** Sometimes, a sound will be created to describe an object. This sound should be presented to the user in the context of the game. To accomplish this, some of the games featured a sound sample mode, in which the user could listen to all the game's sounds [28, 32, 34].

- *Category 7.* Character Representation.

7.1. Use sounds of to describe the status of objects or characters. **Problem.** Inform the player about the status of objects or characters and their whereabouts in the scenario. **Rationale.** The status of an object or character can be described by using different sounds. This can be done to compensate the lack of visual information [14] in audio games. For example, different sounds can be used to describe if a machine is operating or if it is broken; the pace and tempo of the sound can suggest it activities. This can also be applied to characters, with breathing or walking sounds or exclamations and questions.

- *Category 8.* Miscellaneous.

8.1. Provide an audio tutorial to first time players or enough in-game information to help them to play the game. **Problem.** Help first time users to play the game. **Rationale.** An in game tutorial could help new users to play and get to know the game, as it could be a good idea to teach the basics to user. As the goals and objectives, sounds and controls are game-specific, the tutorial might suggest the player how to interpret the sounds in the game in order to play. This could be especially used if the game

used many sounds the user is not familiarized with. Of the case study games, only two [30, 32] offered a tutorial. Also recommended in [11].

7 Conclusions and Future Work

This paper presented some guidelines to help new designers to create audio games, an accessible gaming alternative for visually impaired player. Their goal is to complementing existing game accessibility guidelines, aiding designers on using audio to create more accessible audio games, especially for visually impaired players. They were proposed by the systematization of features, problems and solutions discussed on literature's papers and accessibility guidelines, a case study and a user observation.

As future work, the authors will follow the guidelines to implement some audio games, to improve their applicability. We want to find more effective ways of presenting the game's content, without sacrificing the interactivity or the fun. The authors are also researching ways to create accessible games to other disabilities. We are aiming to provide alternative modal representations to the same content, trying to minimize losses on the absence of one or more modalities. The goal is to allow players play a game with their friends, in a universal approach, regardless of disabilities.

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