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## Visualized sound effect icons for improved multimedia accessibility: A pilot study

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### ABSTRACT

Sound effects are often used to communicate important information in multimedia such as video games. For instance, they may tell the player that a character has just snuck up on them, is firing at them, or is about to paddle over a waterfall. Nevertheless, there are times when playing sound may be inappropriate, may be inaudible, may become fatiguing and/or may be inaccessible for hard of hearing and deaf users. Therefore, an alternative to sound that can relay the same information would be beneficial to many users. The majority of studies into alternative presentations of sound for these purposes have focused on dialogue at the expense of music and sound effects. The paper introduces a pilot study of “SoundSign”, a prototype symbolic representation of sound effects for multimedia, using an innovative icon and compass that indicates direction, sound cue and proximity. Users who have disabled the sound, are hearing-impaired or are otherwise unable to hear sound will still get the information needed. A description of SoundSign and the results of a usability test are presented.

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### 1. Introduction

Accessibility in user interfaces has been the subject of much work in interaction design, but research and technology in video game accessibility has lagged behind [1]. As others have pointed out [2], however, in addition to serious games and educational games that serve a direct function (learning, rehabilitation and so on), games play an important role in social play, and the creation of accessible games can ensure social inclusivity and reduce feelings of isolation or difference amongst those with impairments. The International Game Developers Association Game Accessibility Special Interest Group (IGDA GA-SIG) was formed in 2004 as an attempt to raise awareness about accessibility issues with games, and outlined a definition of video game accessibility as “the ability to play a game even when functioning under limiting conditions. Limiting conditions can be functional limitations, or disabilities—such as blindness, deafness, or mobility limitations”.<sup>2</sup> Despite the efforts of the IGDA GA-SIG, however, accessibility has been a low priority within the game industry, with large companies such as Ubisoft only recently (in 2008) even including basic options such as subtitles in their games [3]. In part due to limited time and financial resources for “extras” like accessibility, but also in part due to a lack of awareness, the games industry has yet to make a serious commitment to

making games more accessible. Nevertheless, when one takes into account the amount of people with some form of disability (approximately 23% of the US population if one defines disability broadly) [4], as well as the fact that many users may use accessible options without having a disability (one study suggests 32% of users who use built-in accessibility options on computers) [2], there is clearly a need for more accessible options in games.

Game accessibility research has focused primarily on creating games that are accessible for the blind, cognitively or mobility-disabled. Miller et al. [5], Sánchez et al. [6] and Friberg and Gårdenfors [7], for instance, discuss games for the blind (a popular area of research), and more recently this concept has advanced to games that attempt to be accessible to all [8]. There has been very little research into making games more accessible to the hearing-impaired, although other areas of hearing-impaired accessibility permeate the human–computer interaction literature [9–11].

One particular point of note regarding accessible gaming is that the focus has been on *functional usability*—that is, the physical ability to play a game—rather than user *enjoyment* or *experience* of a game. Games are, by their very nature, created for the purpose of enjoyment and fun. Part of this fun and enjoyment certainly is attributed to usability, but the enjoyment of a video game goes beyond merely being able to physically play a game (usability). The difficulty of a game (thereby its frustration levels) can be greatly increased by a lack of access to some of the information being output by the game. Sepchat et al. [12] make a distinction between *interaction problems* (problems in information perception from the game and problems in transmitting commands to the game) and what they term *level problems* in which the game difficulty level is too high, there are problems understanding the game

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<sup>2</sup> The IGDA GA-SIG offers a timeline of accessibility in games, and demonstrates that many of the ideas are not new, but are just now gaining acceptance and interest.

play, game speed and so on. These types of level problems do not mean that the game is unplayable, but rather that the game is less enjoyable for the disabled/impaired player. The IGDA white paper on accessibility describes the problem in terms of user satisfaction: gamers play games for entertainment, “not to experience a sense of frustration. Unfortunately, once a player gets shot for the tenth time because they can’t hear the footsteps of someone coming up behind them, they are not likely to be entertained” [4]. It can also be argued that, from an economic standpoint, the frustrated user is unlikely to recommend the game to others.

### 1.1. Hearing-impaired game accessibility

When it comes to hearing-impaired gaming, the focus of accessibility has been on dialogue at the expense of music and sound effects. At best, in most media music is represented in captions by a title and/or musical note to indicate that music is playing (and there have been attempts to include colour to display emotion [9]), but in many games, music is used to indicate rhetorical, emotional and affective information to the player. One particularly ignored accessibility issue with video games is sound effects. Sound effects add information to the narrative, foreshadow events and actions, hint at off-screen action, serve as symbols or leitmotifs for characters and locations, create a sense of time and place, provide proximity and location cues of adversaries, and most importantly, can warn the player to take a particular action [13]. In many cases, playing without the sound effects in a game leads the player into peril. For example, in many stealth games (a sub-genre of first-person shooters), sound effects inform the players of nearby enemies, and also cue enemies to the player’s whereabouts. The more noise the player makes, the more likely they are to be tracked by an enemy.

One study into the role of sound in games [14] tested the reaction of gamers to games with and without sound. The responses of the participants indicate the importance of sound in games: “The first thing I notice is that my time of reaction has increased by ten...”; “I didn’t always notice things happening.” These quotes hint at several important factors: most importantly, sound enables shorter learning curves and guides a player through a game. Other research into the physiological responses to games has shown that physiological arousal is significantly increased by audio [15,22]. In a document for mobile phone game developers, Nokia [16] points out, “From a cognitive point of view, the auditory channel is an excellent way to relay information and give feedback to the player. While the background music can be used to enhance the emotions and mood of the game, a specific sound effect can be used to *communicate meaningful game information*” (our emphasis).

Websites such as Deafgamer.com rate games with letter grades according to hearing-impaired accessibility. *Hitman: Blood Money* (Eidos 2006) for instance received a “C” with the comments, “There is no gauge to show you visually how much noise [agent] 47 is making. Non-essential conversations and comments from NPC’s [non-playing characters] are not subtitled... There are also no captions”. In addition to the hearing-impaired, of course, there are other times when an alternative to sound cues is needed. Nokia’s same guide, for instance, warns, “the game should be playable without the sounds. Allow silent starting of games. If intro music is implemented, there must be a way to switch it off. Prompt for sound settings at the start of the game...” [16]. Indeed, most mobile games need to provide some alternative, as the assumption is that these devices are often played in a public space and therefore the player is either using headphones or playing with sound off. Other games may be played in shared social spaces also, such as in the home. Another reason players may want to turn sound off is the concept of listener fatigue. When playing a game for a lengthy amount of time, hearing many sounds can get tiring, and therefore

the player may want periods of silence. There is, therefore, a clear need for some form of alternative way to represent sound effect information in another modality.

This paper presents a pilot study of a prototype method of displaying audio information for when sound is unable to be heard or turned off in a game. We first present previous approaches to the problem, followed by a description of the methods of our own approach. We follow this with a usability pilot study with objective and subjective feedback, and a discussion of our results.

## 2. Previous approaches

### 2.1. Text-based approaches

While many games are still released without captioning, there are an increasing number of games that include some form of closed or open-captions (text and/or emoticons) for some auditory information.<sup>3</sup> For example, colour coding of captioned text has been used sometimes to distinguish between speakers, and some games show a speaker portrait of the speaking character next to the caption. Animated speaker portraits or avatars can also increase readability by showing facial expressions to add context (e.g. *Freedom Force vs. The Third Reich*, VU 2005). *Action captions*, originating from comic books, have been used very rarely to represent sound effects on screen using onomatopoeic text (“bang!” “pow”). *Speech balloons*, similar to those found in comic books, for example, help to tell the user which character is speaking, or where a sound source is emanating from (e.g. *Mario and Luigi: Partners in Time*, Nintendo 2006). Speech balloons can also be used to indicate events that have been typically used to represent sound effects, such as in *Legend of Zelda: Phantom Compass* (Nintendo 2006), in which a balloon is used in conjunction with a sound change to indicate approaching enemy. This *Zelda* game, for Nintendo DS (a portable device), is highly effective in integrating speech balloons so that the user can play the game with the sound off and still be cued to important changes. *Sound balloons*, like speech balloons, can also indicate sound effects, where descriptions of sounds can be provided in text with an indication showing location of sound, although these are rarely found [17].

There are several difficulties with text, however, most notably the speed with which text must be read. Games occur in real-time in high speed and the player needs to be able to read very quickly in order to take in all the information required, as well as react to that information. Language barriers are common, in that even where games are localized (translated for another market), there are generally only a limited number of languages that games are translated into—and some players play in a second language, which means reading speeds vary. Third, there are, as intimated above, problems of interpreting speaker, location and emotion in text captions.<sup>4</sup> Finally, of course, the use of text captions assumes that all users can read, whereas many children play video games before they can read (or at least, read at the level/speed required).

### 2.2. Non text-based approaches

Alternatives to text do exist. It is possible, for instance, to use the sub-woofer to convey some information through the vibrations that occur with loud bass sounds, and controller vibrations to provide some haptic feedback, although other than a message that there is “some kind of sound occurring”, the communication is limited. Videos of animated sign language could be implemented in

<sup>3</sup> Closed captions are encoded in a media stream and require a decoder to display. Open captions are “hard coded” into the screen, so there is no way to switch them on or off.

<sup>4</sup> A new TV enhanced captioning standard, CEA-708, allows for alternative fonts, colours, caption positioning and other options related to text-based enhancements.

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