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Designing Sound-Based Computer Games

Dan Gärdenfors

Narrativity Studio, Interactive Institute
Beijerskajen 8, 205 06
Malmö, Sweden
dan.gardenfors@interactiveinstitute.se

Abstract

Designing sound-based interactive entertainment for visually impaired users poses several challenges. This article points out some central issues faced when developing sound-based computer games. The three games described here were developed for the Swedish Library of Talking Books and Braille (TPB), to be published on the TPB Internet site [1]. These games, Towers of Hanoi, Memory and Tag, can be played without the aid of graphics, although they do also feature animations of a style designed for partially sighted players. The games are quite small Flash applications, suitable for web publishing, and while not so complex as some other titles, they still emphasise some crucial design issues of creating sound-based computer games.

Background

Recent progress in computer audio technologies has enhanced the importance of sound in interactive "multimedia". The new possibilities to use sound in interactive media are very welcome to computer users that have difficulties in using graphical displays. Today, it is possible to create sound-based interactive entertainment, such as computer games, that is accessible to visually impaired computer users.

There are several computer games that focus on sound, from sound toys such as Toshio Iwai's *Sim Tunes* [2], to the sonic puzzles of *Myst* [3] and the soundtrack-generated levels of Masay Matsuura's *Vib Ribbon* [4]. While most new computer games feature high quality sound effects, and sometimes even advanced interactive soundtracks, they usually still rely on graphics to present most of the information. Mainstream computer games are generally graphics-oriented, with sounds added mainly as decorative effects. Therefore, they are most often inaccessible to visually impaired computer users.

However, there are alternative ways in which computer games can be created. If approaching the design from a position where sound is the central medium and graphics, when present, are added to complement the sounds, it is possible create games that offers new, innovative challenges. Sound-based games need not be exclusively produced for the visually impaired community; they can be enjoyable and educational for anyone. Good examples of existing sound-based games are *Monkey Business* and *Pinball* [5], *Shades of Doom* [6] and *Troopanum* [7].

Design Methods

The central feature of all sound-based applications is that all information has to be conveyed aurally, by an *auditory interface*. Auditory interfaces can contain speech, music or "sound effects" for communication. (See Gaver [8] for an introduction to auditory interfaces.) Recorded or synthesised speech is useful for conveying very precise information. It is often necessary to rely on speech when conveying game instructions. However, within a game, speech tends to grow tedious if repeated too often. It is also generally too slow to communicate events occurring in the high tempo that characterises the real-time interactive environments of many types of games. Neither is speech suitable if more than one message is conveyed simultaneously. In many cases it is better to illustrate events by the use of recorded sounds and music. So how does a designer of sound-based games communicate the status, the progress and the events of a game with non-speech sounds?

An obvious method is to use actual sound recordings of the event one intends to illustrate. However, since all objects or events do not emit sounds, authentic sounds are not always available, and when they are, they are not always recognisable. Still, it is often desirable to use sounds that the player has some previous experience of. In the *Towers of Hanoi* game (see Figure 1), I have tried to use sounds that are related to what they are to illustrate, thus the stone discs make "clink" sounds, while the wooden poles sound somewhat like poles being stuck into the ground. When moving a disc sideways, one hears a "swish" that gives the impression of an object being moved, even though stone discs rarely make such sounds.

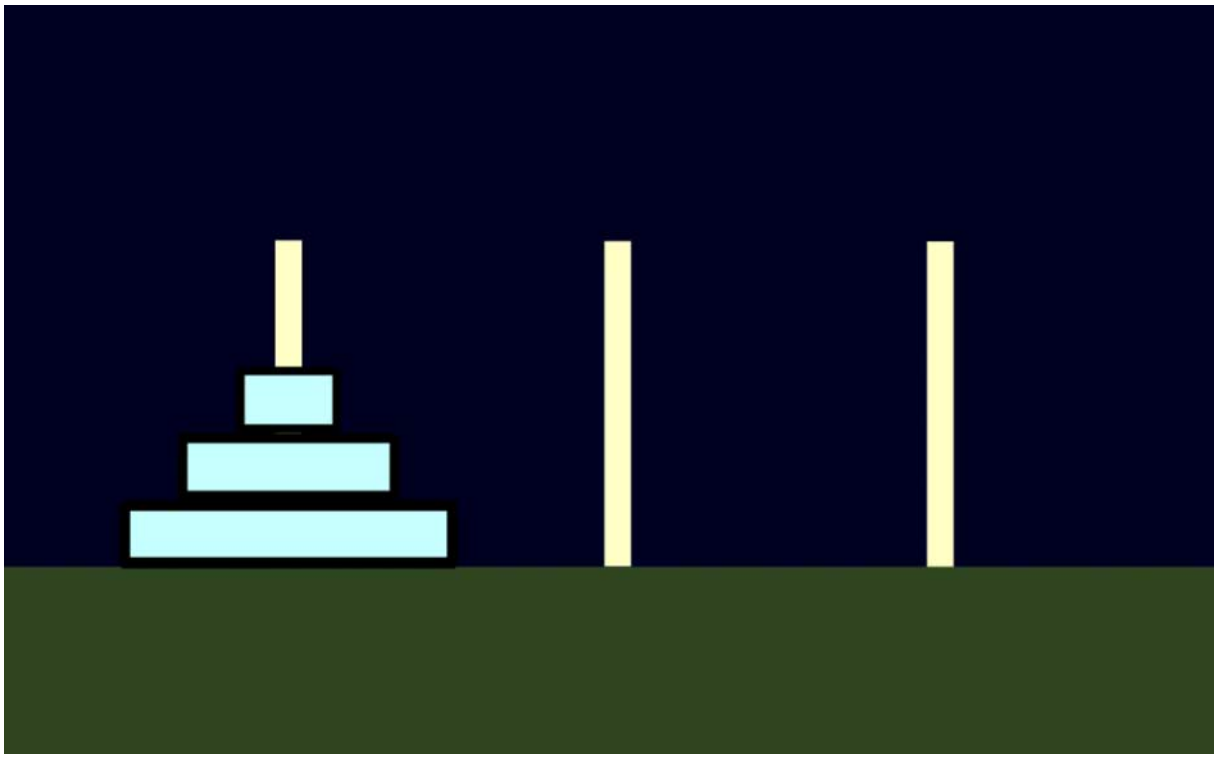

Figure 1. The Towers of Hanoi game. Graphics by Maria Beskow.

Some objects and events do not relate to sounds in any straightforward way. It can then be necessary to assign the intended meaning to a completely abstract, musical sound. While abstract sounds might take longer for the player to learn, they can generate very pleasant, musical interfaces, since the sounds can be chosen for their aesthetic qualities. In the *Memory* game (see Figure 2), pitched percussion instruments are used to indicate different positions in a matrix of cards. These sounds are used since positions are abstractions that are not associated with sounds in the real world. Other examples of events that are musically illustrated in *Memory* are the rewarding sounds of finding a pair of cards or when winning the game, and the error alert sound when attempting an impossible move.

Indicating progress and events with sounds is easier than conveying the overall status of the game. For an auditory interface to be complete, the sounds of objects must convey an overview of the game to the player. There is a risk that a set of continuous object sounds blend into a cacophony that makes very little sense to the listener. Sounds can be separated spatially in a standard stereo sound system. However, as stereo only represents one dimension, the images that can be conveyed are limited. If one wants communicate spatial structures closer to the complexity of graphics on a two-dimensional computer screen, some kind of surround sound system is needed. Still, there are other difficulties with positioning sounds even in a multi-channel sound system, since they tend to mix together if they are not easily distinguished from other simultaneous sounds. Sounds can be hard to

locate and it is often impossible to convey spatial relationships with sounds as accurately as graphics can do.

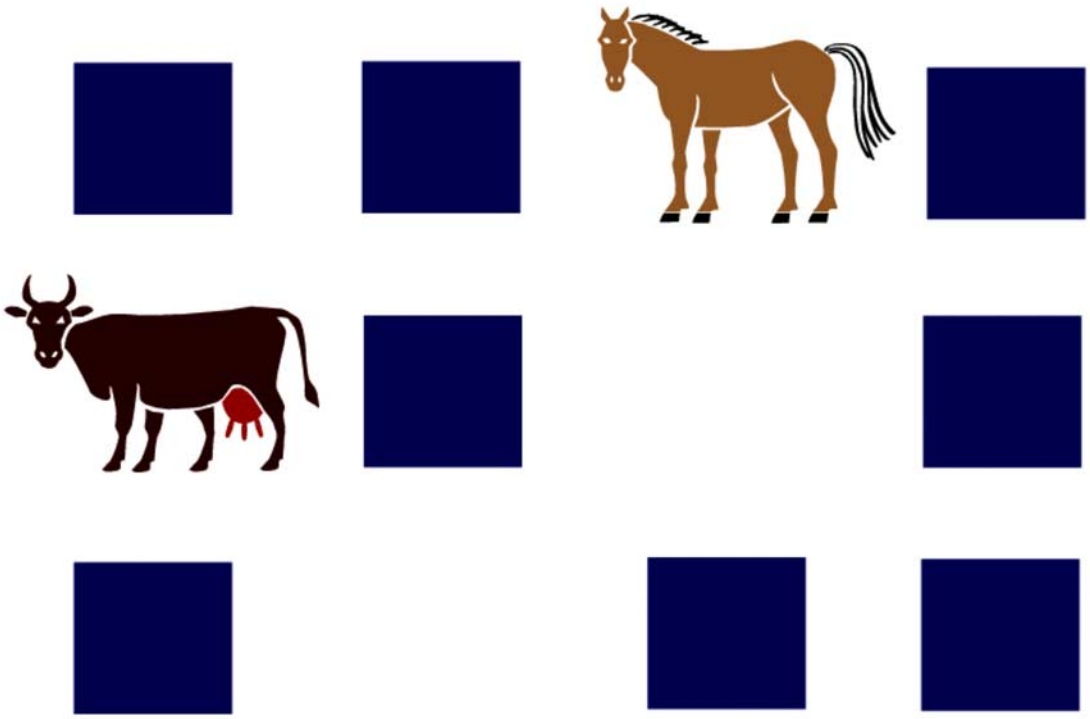

Figure 2. The Memory game. Graphics by Maria Beskow.

The *Towers of Hanoi* and *Memory* games are both based on very simple images that contain few objects. Since they both use stereo sound, they fake the height dimension by playing sounds in sequence or by mapping height to pitch. The position sounds of the *Memory* game alter in stereo position as one moves sideways and changes pitch as one moves upwards or downwards. The convention in *Towers of Hanoi* is that when checking a pole, the objects on it are presented from the bottom and up. Thus, neither of these games presents any simultaneous information. Instead, each object sound is played when the player "checks" its position only, or when the object is moved. This way, sounds always appear in sequence, which relieves the player of having to perceive too much information simultaneously. However, this is not the only possible solution, as has been shown by Fredrik Winberg and Sten Olof Hellström [9] in their auditory *Towers of Hanoi* application where the overall image is conveyed continuously.

There are many more types of computer game apart from the puzzle-solving genre of the two games mentioned so far. Many computer games today feature fast paced action, quite different from the player-controlled tempo of games that wait for user input for events to take place. The *Tag* game (see Figure 3) is an attempt to create a game where the events

occur in real time, which means that the player has to react to events initiated by the computer. In this game, a character runs in front of the player, who has to keep up with her and follow her turns in order to win the game. This approach generates a game with a distinct rhythm, composed of two simultaneous sounds: the footsteps of the character running ahead of the player and a bass line that indicates that the player is running.

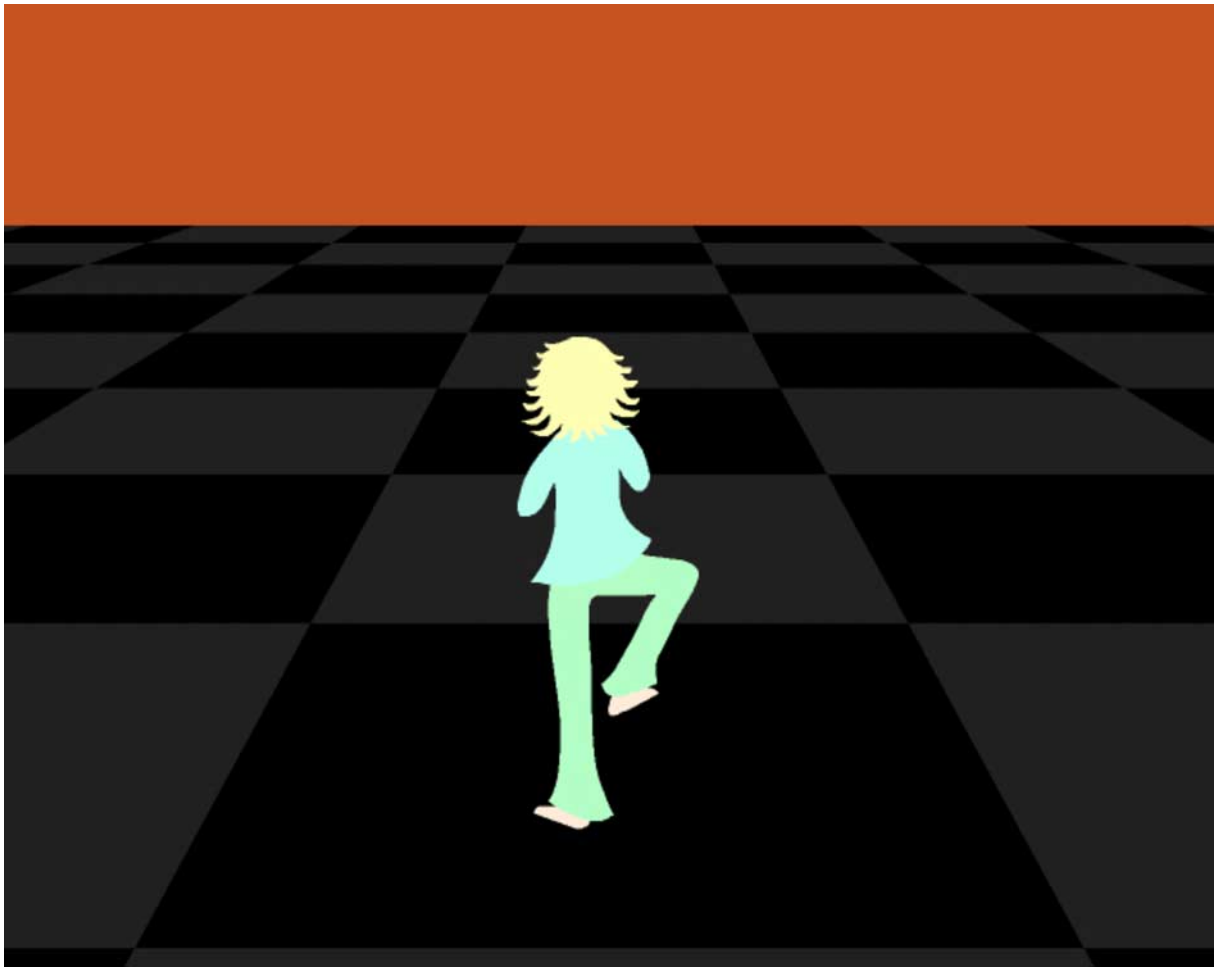

Figure 3. The Tag game. Graphics by Annica Norberg.

Real time sound-based games can be created as a kind of interactive compositions with defined goals. In the *Tag* game I have attempted to emphasise its musical qualities by "quantising" all events so they fit into the rhythm and never interrupt the musical flow. This approach enhances the musicality of the game at the sacrifice of immediate player control over the events. I believe that many exiting games could emerge from attempts to design abstract, but musically beautiful sound-based games.

Conclusions

The games described in this article are attempts to create simple interactive environments that can be experienced by using sound only. More advanced games could be built from

sequences of environments of this complexity, or one could use completely different strategies. Regardless of style, it seems like some general design issues emerges from any attempt to convey spatial structures and interactive possibilities with sound only.

The key points when designing sound-based interactive media are how to design sounds that can communicate the status and the events in the game, and how these sounds should be arranged spatially and in time. As few objects generate sound while at rest, dynamic events are generally easier to illustrate with sound than static overviews. Therefore, one often has to rely on a strategy where the sounds of different objects are heard only when the player moves his or her "focus" towards them. An alternative method is to design an environment where all objects are associated with continuous ambient sounds. This approach will usually generate abstract musical settings.

The lack of conventions to draw material from is obviously a major obstacle when communication relies on non-speech sound. While Western culture has a rich tradition of visual iconography, there is no well-established auditory counterpart. Still, one can find inspiration in the musical languages of film and television, radio and programme music. Speech recordings are seldom useful for illustrating fast-paced action, as they generally are slow. Abstract sounds, in contrast, can symbolise anything although they take some time to learn. Ironically, the lack of an established canon of auditory icons means that most abstract sounds used in a sound-based game needs to be explained with words before the game can be played. However, if the genre of sound-based computer games becomes more established, the instructions to each game need not be so elaborate.

I hope that more designers of interactive audio applications will consider making their art accessible to visually impaired users. While traditional musical instruments, such as pianos, string or wind instruments have tactile interfaces that allow visually impaired people to master them, this is rarely the case for modern, virtual instruments. By considering some of the points made here, designers might find that their art can be made accessible with some adjustments. Lessons learned from creating media for people with special needs can often be useful in other contexts.

Acknowledgements

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References

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[4] © Sony Computer Entertainment Europe. http://www.vib-ribbon.com/

[5] © ESP Softworks Co. http://www.espsoftworks.com/

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