Designing an Auditory W-LAN based Game

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Abstract:

This paper is based on a thesis written by the five students above from the department Design, Communication and Media at the IT University of Copenhagen.

The aim of this paper is to examine the potential of sound to create new user experiences and alternative modes of interaction. Our analysis is based upon the design process of an auditory location-based game we have designed and the different theories in the fields of aesthetics and interaction design our game is affected by.

Our main focus is how to create an immersive game universe through the use of sound only. We explore this by using sound as the only parameter in the game. We have constructed a multi-player game that mainly uses sound for interface and creation of atmosphere and suspense. Also, the player is physically present instead of being represented by an avatar.

The game is called *Dark Circus* and employs a mobile setup and a multiple speaker system. Dark Circus is intended for playing wherever these are made available. The sound system is based on adaptive audio, and designed for a generic context – that is the sounds can be exchanged according to the context for the particular game.

Firstly, the paper will address the design of the game, basic technological requirements for implementation and the gameplay. Secondly we will discuss more general aspects of sound and premises for sounds design and how sound effects the user experience.

Keywords: Location-based gaming, sound design, game design, auditory interfaces, soundscape composition, adaptive sound

Introduction

AS the focus in modern computing seems to switch from traditional interfaces towards new ways of comprehending the concept of computers, it seems natural to evoke different approaches to the design of games and interfaces. This switch has been underway from the early nineties when Mark Weiser published his article on the computer for the twenty-first century and introduced the term *ubiquitous computing.* While virtual reality brings the user into a universe within the computer, ubiquitous – or pervasive – computing brings the computer into the everyday life of the user, in a way that "allows the computers themselves to vanish into the background" (Weiser, 1991, p. 94).

This approach has influenced such different areas as intelligent clothing, coffee machines and surveillance systems and has had a great impact in our approach to the use of technology in general. This paper addresses the design of an auditory location-based game, though the game should be considered as a

context for design rather than a goal in itself. The main objective is how to create a complete experience of a universe only by the means of sound, and the game should therefore be looked upon as an experiment more rather than a product intended for the mass market.

We have created a concept whose predecessor is not so much the traditional video games as it is a version of traditional games, embedded in a universe of its own. Whereas the player of a traditional video game is represented as an avatar, a player in our game is physically present. Dark Circus can be related to other location-based games and projects, which for example include *Sonic City*, made by researchers from Interactive Institute in Gothenburg (Gaye & Jacobs 2003), and *Pirates!*, made by researchers from Play! Institute in Gothenburg, Sweden (Björk, Falk et al, 2001). Sonic City is like Dark Circus a sound- and location-based experience, but while our project has a gameplay; Sonic City is an audio walk and has an acoustic ecological approach to soundscape. Pirates! Is, on the other hand, a location-based game, but while a major part of Pirates! takes place on the screen of the PDA, we wanted to go further in order to make the computer interface transparent, and thereby make the presence of the player more immediate.

In that sense Dark Circus relates to traditional computer games, location based concepts, play and different forms where sound is included – installations, films, soundscape compositions, etc. Also different theorists from fields of HCI, interaction design, art history and sound art have influenced us in our process. However, the focus in this paper will be on the use of sound and movement as the main elements of the interaction.

The game

Introduction

Dark Circus resembles *Capture the flag* where two teams compete with each other, trying to capture each other's flag. Our game is augmented in the way that a system "watches" everything that is happening in the game. This finds expression in the use of an adaptive sound system where the system and the player mutually influence each other.[1] Thus, the player's movements provide input for the auditory output, and the output influences the player the way the soundtrack in a movie can influence the spectator.

Initial setting

The game we have developed takes place in a room like a sports hall or an empty warehouse. The room should be as dark as possible, by which we mean pitch black. A speaker is placed in each corner of the game area.

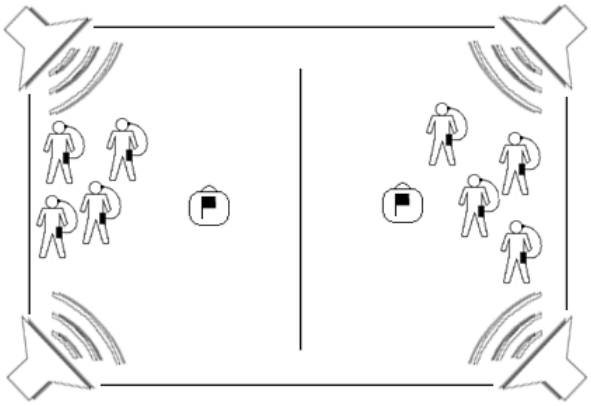

Figure 1: A rough picture of the game area from above in the beginning of the game.

[1] By adaptive we mean sound that dynamically changes according to any given game situation. We want to distinguish this from the term *interactive*, where the composition is more or less explicit in its relation to the user.

Each player wears a PDA placed on a belt. The PDA itself is camouflaged in a small container, allowing the players only to activate the touch screen. The room is provided with W-LAN that keeps track of where the players are according to where the PDA's are located. The user has an earphone in one ear only. There are two additional PDA's that represent the flags of each team, which are hidden in two separate briefcases.

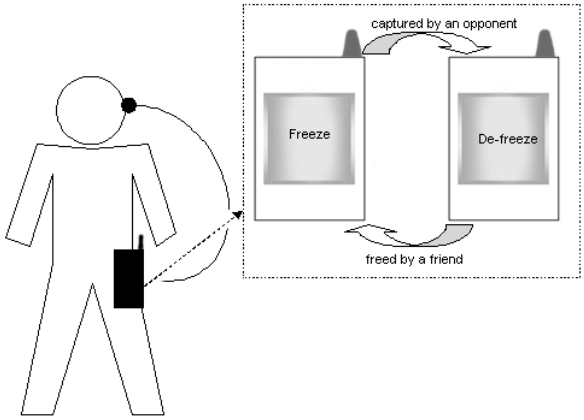

Figure 2: Picture of a player. It shows the player with a PDA at her waist and the earphone in one ear. The enlargement illustrates the visual interface of the PDA during the game – the two possible states, normal or frozen.

The game universe

There are two categories of sound in Dark Circus: Individual sound and global sound. The individual sounds are played through the earphone and are primarily informative such as event sounds related to the individual; are there any flags or players nearby? The global sounds are played through the speakers and create the atmosphere of the game and represent the status in general.
The game universe is abstract. There are no specific stories, periods or historical events attached to the game. The choice of having an abstract game universe is a result of our initial goal, which was to explore the potentials of using sound in interaction design rather than how to tell a story with sound.

Rules

The game consists of the following basic rules:

1. There are two teams, A and B, playing against each other.
2. Each team consists of a minimum of 4 players.
3. The game area is divided in two halves, one belonging to each team.
4. Each team has a flag, which can be moved around.
5. When a player enters the opponent's side or carries a flag, she becomes an outlaw and is in a position to become frozen.
6. A player can freeze an opponent, if the opponent is an outlaw, by activating the touch screen on the PDA. The opponent has to stop immediately when being touched, so the home player gets a chance to register the action in the system.
7. A player can be de-frozen if a team member comes to rescue her. This is done by de-activating the touch screen on the PDA.
8. A team wins if it brings both flags together on its own side, or if all players of the opposing team are frozen.

The rules listed here are by no means final for the game. We have considered many variations that could be accommodated with some minimal changes. These are features like additional barriers and dangers, and a no-man's-land in the centre of the room where all players would be outlaws. The game is also well suited for level design. Various levels could include the assignment of different skills, roles and settings. That would provide increasing challenge and thereby optimize the premises for a greater flow experience.

Technology

The game is based upon the principle that the system continuously registers where each player and both the flags are located, as it keeps track of the PDA's in the room.
The system registers if a player is close to another player, how close the teams are to complete their missions, how many players are frozen etc. By "watching" these facts it develops the adaptive soundtrack and sends information out to the PDA's. This information triggers the global and the individual sounds.

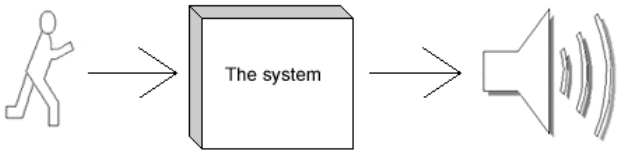

Figure 4: The input and output of the system in general: The system tracks the players' movements and sends out sound

For positioning we use a positioning server from Ekahau that has been set up at the IT University of Copenhagen. Although this positioning server is generally accurate, it has a standard precision of 2 meters when tracking the players and uses up to 2 seconds to calculate the position of each PDA. This delay of system updating is not a problem in our game because of the fact that the darkness forces the players move slowly anyway.

After considering different interactive sound system technologies and development kits we chose DirectMusic from Microsoft to build our adaptive soundtrack. It is a versatile tool that is a part of DirectX®, which is made specifically for game development on the Windows platform. We also chose this program because it gave us the opportunity of synchronizing shifts in layering, tempo and harmonics.

The ideal game will have more speakers and possibly stricter requirements on the textures of the walls and floors in the room so that optimal audio positioning and surrounding can be achieved. Also, a complete control of the sonic environment, e.g. reflecting surfaces, external sound sources would be ideal.

Design and preliminary testing

In an early state of development, we tested the gameplay and potential user experiences in different ways. One of the tests took place in a basement where we tried to locate each other and each other's flag while blindfolded. One person was still able to see simulated the system and gave auditory cues about the flags and the opponents' location. Also, we had placed a boom box in the room, playing ambient music to ascribe to the atmosphere.

Another test we made was taking a walk through town while being blindfolded and guided only by sounds from an accompanying person and the auditory environment. Also we played computer games for the blind, such as Pacman Talks (PCS Games, 2002), Shades of Doom (GMA Games, 2001) and Terraformers (Pin Interactive, 2003).[2]

[2] Here we make a distinction from the term *video game* due to the irrelevance of a video display in games for blind.

From these different experiments, and an interview with the developer and designer of sound-based games Dan Gärdenfors, we got an idea of what might work and what maybe would not work in an auditory interface/universe. We also became more convinced that a purely auditory universe could create immense emotional experience comparable to those experienced while watching films and playing traditional video games.

The intended user experience

Playing Dark Circus can, as in other multiplayer team based games, evoke different strategies and degrees of teamwork. An example of a simple strategy in a game of Dark Circus with two teams of each four players could be: Two players stay at home and protect the flag. Meanwhile one player goes after the opposing team's flag. The last player might protect the player that is going after the flag. Each player can therefore have several sub-missions like guarding her area in order to freeze outlaws, or rescuing a team member by de-freezing her.

As shown in the example, the game can develop in multiple ways, which the global sound should reflect. A very adaptive score would react on every action in the game, for example location-based events, player-state, non-playing characters and objects, and would be able to transition seamlessly on every trigger at any given point of time. Compared to soundtracks in films and dynamic sound and music in computer-games, this is a tricky challenge in our game. In films, the sound and music normally relates to what is happening in the film and that is the same to all spectators. In our game the sound has to make sense for everybody in the room at the same time even though they are experiencing different game situations. Therefore, we cannot accentuate one event without considering the effect for the other players.

The global sound consists of three musical states, or levels of intensity, based on global events and individual circumstances, but will typically exist as a mixture. The three states are as follows: A *death world* reflecting the number of frozen players, a state of suspense reflecting the threat scenario, and state of action representing the moving of the flags – whether or not they have been moved across the middle line.

Sound-based interaction

As mentioned in the introduction, the idea of entirely sound-based games is far from new. But until recently, games using sound as the primarily interface have in most cases been designed for users with a seeing disability, or games which are comparable to "sound installations", such as Sonic City. By this we simply mean that sound-installations in most cases aim at giving the user an aesthetic experience rather than a good gaming experience.

Apart from games that remind of art installations, many of the sound-based games seem to be modified versions of already known games. For instance, one of the games Dan Gärdenfors' has made is actually an auditory version of a classical arcade-style "shoot 'em up", where the player can move left and right and shoot at monsters, basically like we know it from the classic Spaces Invaders (Taito 1979). From the perspective of gameplay, such games bring forward none or little new, though they might still be entertaining concepts. But as an alternative way of mediating a gaming experience and as game interface they bring forward some interesting perspectives in relation to the creation of completely new auditory games. Studying these games tells us that even with a very simple interface it is possible to create a game world that works. With simple functions and a little practise a person should be able to orientate herself in a purely auditory space.

When experiencing mediated universes and spaces, such as movies on a screen or music on home stereo equipment, it is to a great extent an experience of watching or hearing something from the outside as a spectator. By using a real or emulated 3D environment – in our case a large room with multiple speakers – it is possible to submerge the user in a surrounding auditory virtual space; the game reality.

With the design of a purely auditory interface we try to make excessive use of a part of the human bandwidth, which we normally tend to make less use of – our hearing ability.[3] Unless if we are listening for something specific, our hearing is basically used as a more or less subconscious surveillance system monitoring the surrounding environment. This especially applies to areas we cannot see but still need information from, such as traffic and baby alarms (Wickens, 1998).

It might be hard for first time users of our game to interact and orient themselves in a purely auditory environment without any tutoring. However, studies by Brewster indicate that with simple training users quickly learn how to understand non-speech sounds in unfamiliar environments (Brewster 1998).

It raises a need for an introductory level to be able to successfully introduce the auditory mode of orientation and interaction to the novice, still keeping the number of different sounds at a minimum. At the introductory level our interface is very basic, with only a few auditory elements. Then subsequently more auditory information is gradually introduced; starting with basic information about presence and distance to other players, then gradually introducing other elements in the auditory universe, e.g. bots, changing textures of the surroundings and an increasing complexity of the adaptive soundtrack. This approach will help un-experienced users orientate themselves in a purely auditory universe.

Input through movement

As mentioned earlier, the player interacts with the system by moving around the game area. This means, for instance, that if the player receives auditory information of the approximate location of the flag, by hearing the distant sound of the flag, she will most likely start searching the area to find it. She will have to figure out which direction to move in, in order to get closer to the flag. The closer she gets to the flag, the louder it gets. The same thing will happen if the player gets information of an opponent nearby. Depending on whether she is in her own half of the game area or in the area of the opponents, she can either try to avoid or catch the opponent.

Except from the occasionally activation of the PDA to freeze or de-freeze co-players, moving around the game area is the only input from user to system. In other words, the actions taken by the player resembles the moving of bricks in a board game, but instead of having the player to move bricks, she moves herself around on the "game board". This is a major element of the invisibility of the interface, as the user will not experience the movements as an interaction with or through a computer interface, but rather as a reaction to the environment surrounding her. Thereby we hope to create a more immersive game-experience. This is not a new concept, but since we have placed the player in a dark room which exclude the outside world from the gameplay, the reality in the game is the reality the player experiences and the only thing the player can respond to.

As mentioned above, the player reacts to the game universe, which is formed according to the movements of the players. By doing so an adaptive soundscape is created. As the system is able to tell the difference between teams, status of players and the flags position and from these parameters can change the soundscape, we have created an intelligent soundscape that could not be made by the use of traditional game artefacts such as bells and balls. One could imagine our game played without the system, e.g. people running around with bells on their legs and a tape-recorder in a suitcase playing music to indicate the flags position. In doing so, the rules of the game could be more or less the same, but the experience of the game would be different. By making an adaptive soundscape, we hope to achieve a higher degree of an immersive gameplay, where it is possible to constitute different virtual universes in a physical room. Furthermore, the computer mediated game universe makes it possible to introduce virtual objects, both static and dynamic, such as transformer stations and flying birds, as known from traditional video games and films.

[3] By human bandwidth we mean the fact that we are able to hear, see, smell, taste and touch but usually in our interaction with computers mainly rely on graphical user interfaces.

Sound design

According to several music scholars, like Philip Tagg and Richard Middleton, music will always be interpreted in a cultural context but also as gestured and affective patterns where a lot of sound will be perceived universal because it relates to basic corporal movement and behaviour. That means that music is partly something acquired and self-referential, partly something that affects you directly in body and mind (Middleton, 1990 and Tagg, 2002). In our design we have considered how traditional conventions known from music and films influence the spectator by parameters like timbre, loudness and tempo.

As mentioned, we work with two categories of sounds; global and individual. Furthermore, we have divided the sounds into the types of musical and event sounds. The musical sound can be ambient and constitute the game world, but it will also always relate to the game state (death world, suspense and action state). These sounds are all supposed to have a function in the game, so they are at the same time both referential and un-referential.

The individual sounds heard through the earphone inform the player of nearby co-players and flags. We have concentrated mainly on timbre, to find sounds that coheres with the situation it relates to – warm and pleasant sounds to symbolise your team members and the flags, itchy high-pitched sounds for your opponents, and noise when you reach the limits of the game area. Secondly we have worked with pulse and tempo to symbolize the degree of danger. A quick pulse will tell you that you are in danger, whereas a very slow pulse tells you that you are in a frozen state.

For the global sound in the speakers, we also work with timbre and pulse/tempo, but as the sound is composed, it is also important to consider musical processes and parameters such as rhythm, harmonics and the relationship between figure and ground. For example, having undeterminable rhythm and shrilling sounds in contrast with sounds in slow motion and an underlying drone will create an eerie and weird atmosphere and a feeling of an indefinable enlarged space will be created. In that way, unlike most film and game scores, we avoid the question of leit-motifs and melodic themes, but instead try to make sound-textures with specific gestured qualities.

Conclusion

By this project we want to bring focus on the qualities of sound and ways of using sound to create new user experiences and alternative modes of interaction. The reason why we wanted to create a game universe, based upon sound only, was that we found, that the quality of sound is not yet extendedly explored when creating immersive game universes. Most of the games on the market today are based upon graphics. By removing this element, and making a game in a pitch black room, we created a chance to explore the effect of sound thoroughly. We are aware that a pitch dark room is far away from the reality most people know from their everyday-life. But by forcing people to move around in a totally dark room, we are able to examine sound in a pure form, isolated from its relationship with the visual and thereby investigate sound's quality as a navigator and abilities to create a virtual universe. This is why we claim this to be more of an experiment, rather than necessarily a well functioning game in the traditional sense.

The atmosphere created in the game affects the way the user acts inside the game, and these actions again affect the out-put from the system. This relates to the adaptive musical composition, which can create a connection between the immediately sensed and the added soundtrack. Thus, our work has led us to the assumption that sound can be used to create an enhanced and more immersive interaction and user-centred experience in many aspects of the entertainment industry. Sound has a transient and manageable form, and is a well suited tool for modifying existing elements, such as the experience of the texture of a room. Also, the way we have used sound relates to the users reactions, and via our game we emphasize the relation and co-existence of emotions and reactions. Hence, the connection between the players emotional state and her reactions – and hereby the interaction with the system – is infinitely tied together.

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