THE DESIGN OF INTERACTIVE AUDIO SOCCER

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ABSTRACT

The questions involved in the design of an interactive, audio only computer-based football game are explored. The game design process starts by exploring basic questions such as size of playing area, orientation, awareness of team mates and opponents and basic navigation. The project goes on to explore more advanced design issues, not addressed by previous audio only ball games, involving the provision of a multi-player perspective, requiring the provision of an intuitive means of supporting changes in the focus of the interaction in audio. In general the dynamic, multi-player perspective poses interesting questions of how to provide real time and interactive sonification of ball and player positions and how these should be managed within the context of the changes in interaction focus mentioned above. A further interesting issue relates to how, within an auditory game context, to handle aspects of the game which are essentially silent, such as the sides of the pitch, positions of the goals and players who are not currently moving. To assist with these and other design questions, advice was sort from past and present players of the British blind soccer squad. The information gathered ranged from basic facts about the rules and conditions under which games are played, through to discussions about the role of echo location in providing an awareness of physical features of the pitch and the proximity of other players. This in turn led to the question of how realistically to present the information provided through echo location in a virtual auditory display. The paper concludes with a discussion of the potential roles of this type of system in team coaching, exploring the practical applications of audio game representations to realistic coaching scenarios.

[Keywords: interactive sonification, audio game, spatial sound]

1.INTRODUCTION

Audio plays a very important role in video games – imagine trying to play a favourite sports or fiction-based game without music to set the mood and sound effects to bring realism to the action. Compared to technology interfaces for work related systems, where audio remains largely under exploited, audio in games is used in relatively sophisticated ways, often providing a multi-layered audio environment used to render complex auditory scenes, making a substantial contribution to the feeling of being immersed in the action. The use of ambient sounds, music and increasingly the option of employing dynamically synthesised sounds are important elements in this process.

A relatively new development in the gaming arena is that of sophisticated, audio-only games. These are often, but not exclusively, targeted at a visually impaired audience. Audio-only games have in fact been around since the early '80s, when they typically used synthetic speech output supplemented with relatively simple sound effects. Today's audio games however, such as Shades Of Doom (first person shooter), Grizzly Gulch (adventure) and Lone Wolf (submarine simulator) use sound in sophisticated ways, transitioning smoothly between a series of multi-layered soundscapes to provide a real feeling of emersion. Many of today's audio games designed for the blind can be played over the Internet, and sometimes provide a visual interface to promote collaborative game play between visually impaired and sighted gamers. The AudioGames web site [1] is dedicated to the discussion of computer games which, through accident or design, are accessible to the blind. It contains links to numerous production and experimental games and includes issues of the audio gaming magazine Audyssey.

The project described here explores the development of an audio football game as a vehicle for examining a number of questions involved in the design of interactive audio displays. It is interesting to note that in spite of the fact that ball games such as football, cricket, golf, goalball and baseball are played by significant numbers of visually impaired people, in schools and on a national and international basis, there are very few examples of computer-based audio ball games, and those that do exist generally provide only greatly simplified representations of real game situations.

2.MOTIVATION

Key questions that we wish to explore in relation to the use of interactive auditory displays include the following:

- Orientation: what auditory cues are effective in assisting someone to orientate themselves in a virtual audio environment (VAE)?
- Comprehension: how can audio be used to convey both an overview of a complex auditory scene and specific details of the location and state of objects of immediate interest?
- Hand-ear coordination: at what speeds can someone interacting with such a VAE perform proactive and reactive interventions in the environment? How much does this ability vary between individuals? and how much can it be changed by learning?

- Communication/dissemination: Can information about dynamically changing auditory scenes depicted in such a VAE be effectively communicated between users of the system?

- Applications in mobility training/sports coaching: do experiences obtained through interactions in such a VAE have any value in assisting the user to deal with similar situations in the real world?

Football was chosen as a suitable medium through which to explore these questions because it is a simple and widely understood game which can easily be used to generate moderately complex, dynamically changing auditory scenes, and so provide a suitable environment for the exploration of the above questions. Furthermore, the increasing development of blind football within Europe, including its designation as a sport in the 2012 Paralympics, was seen as providing potential for the exploration of the dissemination and coaching questions described above.

3.RELATED WORK

The only other football simulation game we are aware of is Super Football, by Igor Khmelevtsov [2]. This game enables a player to play against the computer or against another player over the Internet. It provides 11-a-side teams based on a 6 by 7 grid layout. Players are located in cells on the grid and do not move from their allotted cell. Only one player on each team can be "active" at one time, this need not be the player currently in possession of the ball. The game supports scoring (by fixed players only), passing (forwards or to either side), tackling and free kicks. There is limited support for player orientation in that the direction of passing and shooting is determined by whether the player is currently facing forward or to either sides. The game has attracted some interest from blind players playing over the Internet, but its greatly simplified model of the pitch and lack of player dynamics means that it does not address the orientation and navigation questions described above. There are several examples of non-ball games which do provide dynamic and sophisticated auditory scenes. A good example of this genre is David Greenwood's Shades of Doom, version 1.2 [3], in which you go through a top-secret research base shooting monsters while attempting to shut down the ill-fated experiment. This game has dynamic and realistic Multi-layered, 3D sound with up to 32 sounds playing simultaneously. It makes use of a stereo or surround sound system, and has synthesized 3D effects for non-surround sound systems. However, because this and other games of its type are played in the first person, they do not present the same requirement for context switching with its consequent issues for orientation and navigation.

4.RULES, REQUIREMENTS, AND ENVIRONMENT

It was decided as far as possible to mirror the rules and environment in which blind football is usually played so that the game behaviour would match the expectations of its target audience and would maximise the potential of the game as a means of communicating realistic scenarios between players and coach. The rules of blind football are in general very similar to those of usual 5-a-side football, other than the fact that there is no offside rule and players are not generally allowed to encroach into the goal area of their opponents. Blind football is usually played on an astro turf pitch surrounded by boards with goal posts set close to the ends of the pitch to minimise the danger of players colliding with the posts.

Discussions with current and former members of the British blind football squad determined the following features and issues to be taken into account in designing the interactive sonification of the game:

The way the ball is made audible is by including a small quantity of lead shot inside it. This is sufficient to make the ball audible without adding unduly to its weight. It is a reasonable approximation to continue to use the physics model of the ball without lead shot.

Player orientation and navigation is achieved through a combination of practice, sounds in the environment such as calls and footsteps from other players, sounds from the ball, for example when it hits the sides or ends of the pitch, noise from spectators (which is generally discouraged), instructions from team coaches and the use of echolocation.

Standard international rules dictate that a player should signal the intention to tackle by saying the word “voi” prior to making the tackle. On the other hand, domestically in the UK, many players prefer to omit this requirement and simply rely on hearing where opponents are. Because of the conflict of opinion it was decided to provide the “intention to tackle” signal as a feature that can be switched on or off according to preference.

Generally in international games, a team coach stands behind the opposing teams goal and issues instructions to players, in particular when to shoot. Again player preferences varied on this and so it was decided to implement this as a switchable feature also.

5.DEVELOPMENT

5.1.The System

The implementation of the audio soccer game was realised using Java to handle both the graphical and auditory aspects of the game as played by blind players. The system is composed of three main modules; two of these independently deal with graphically displaying and animating the interaction and generating the appropriate sounds. A third module, a mapping algorithm, synchronises the two displays.

The sonification is based on the idea of assigning dynamic distributions of sound sources to the spatial characteristics of objects’ positions in the graphics component. Essentially, the user interaction triggers changes in the graphical scene, which are captured and sent to the mapping module to be transformed and used to control the settings of the auditory component. Initially, a three dimensional auditory scene is generated and calibrated to the dimensions of the pitch, in which sound sources are created representing the audible objects in the game. Their positions relative to the main listener, represented

by the current user player, are updated throughout the game play to render the appropriate 3D transformations.

5.2.The Mapping

In the game play, the pitch is laid out horizontally with the players of the opposing teams distributed across the left and right sides. The user controls the current player under focus using the keyboard arrow keys to move around the pitch, other keyboard commands are used to control player actions such as kicking the ball or tackling an opponent. We define two main types of sound sources in the scene; static and dynamic sources. The static sources represent objects that are physically fixed in the game; in our system, these are the pitch borderlines and the goal posts, which are represented by different ambient sounds. In the real soccer game, blind players rely on a combination of ordinary hearing and echolocation to gain information about their position in relation to such objects. In this system, echolocation is simulated by the audibility of the static sources; as the user approaches these objects, their audibility is increased to reflect their proximity. Dynamic sources on the other hand represent moving objects in the game play, mainly the ball and the players. The relative positions of these objects in relation to the user-controlled player is used to communicate dynamic changes in their location. Other sounds were used to reflect actions taken by the players, such as a kick, a tackle, or a goalkeeper's catch, or other events which do not have an obvious auditory representation, such as the focus shift from one player to the next. The combination of these sound sources updates and communicates rich and dynamic auditory scenes to reflect the current state and arrangements of the visual scene.

Figure 1: *A scene from the application showing the various active sound sources in given game state. Red shows the ball source, yellow the boundary and the white the opponent's position.*

We used a beads sound for representing the ball (recorded from a ball used by blind players), and footsteps for the players. These are always present at different amplitudes and positions. If an opponent gains possession of the ball, the footsteps sound source is changed to a dribbling sound, as long as the ball is still in possession, if successfully tackled, the sound changes back to footsteps.

If the opponent is close to the goal area, a warning sound is played. When this happens, the listener perspective is changed from the current user player to the goalkeeper, in which case a perfect alignment with the opponent player is necessary for a successful catch or save.

The user player, also referred to as the listener, is only assigned a sound source when in possession of the ball, in such instance we use a dribbling sound that is different from the one used for the opponent players. The direction of movement is represented by stereo panning, thus if the user is moving toward the right, the dribbling sound and the beads sound will be audible through the right channel, and vice versa. For up and down movements, the dribbling and beads sounds will be audible through both channels, the differences between and up or down movement will be indicated by either an increase or decrease in the amplitude of the borderlines ambient sounds. The closer the user-player is to the left most borderline and the more aligned with the opponent goal keeper, the lower is the goalpost ambient sound. In order to score a goal the user must avoid a perfect alignment with the opponent's goalkeeper.

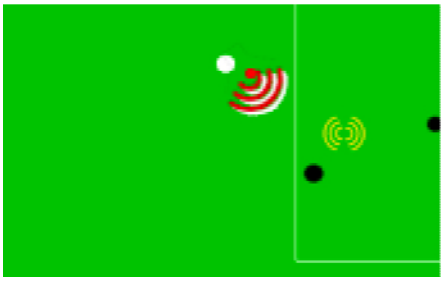

Figure 2: *Red shows the ball source, the white the opponent's position and the yellow denotes the warning sound to prompt change in player perspective.*

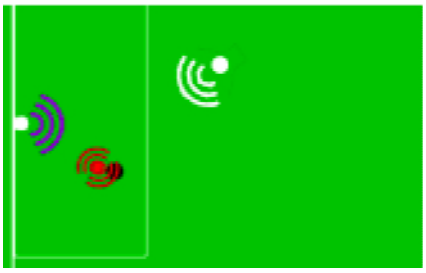

Figure 3: *The left or right position of the beads source (Red) denotes the direction of movement; the Blue source denotes the goalposts ambient sound.*

5.3.Iterative Development

It was decided to depart from the approach taken in [2] and not to provide a sound indicator of the player with the current focus. The approach taken is intended to better mirror the situation in real blind football where one's orientation is provided by the sounds of other players and through Echo Location of the sides and ends of the pitch. "In the strict sense of the term, echolocation is determining the location of objects in the environment on the basis of how they reflect sounds produced by the listener. However, some researchers have used the term to include the use of ambient reflected sound that is not produced by the listener" [5].

Other early design issues considered included the overall size of the pitch, the speed of players movements, how to sonify key events such as the outcome of tackles, changes in the player in focus, how to simulate echolocation of the sides and ends of the pitch.

The usual iterative approach to interactive system development was supplemented by a modular approach to development and prototyping, both to simplify the development process and the design of the interaction. For example, the first prototype contained only one opponent player, so that a careful investigation could be made of viable pitch dimensions and the speed of player movements. Experiments with this initial prototype of the game clearly showed that, as with several other audio games for blind users, the overall responsiveness of the game was improved considerably by unloading screen reader software. This has an implication for game development, as it means no reliance can be placed on the screen reader to deliver information, the game must be self voicing. It was decided as far as possible to simulate the sounds that facilitate orientation and navigation (see section 4). One departure from this is echolocation. True echolocation could only be brought about by the player of the game actually moving near physical objects such as the sides and ends of a real pitch. It was decided to experiment with implementations of echolocation by using sounds to indicate when the player in the game was approaching the side or end of the pitch. How realistic this representation of echolocation in practice, or at least how well it worked in facilitating interactive game play, became interesting questions which can only be determined by formative evaluation. As a starting point, it was also decided to commence simulation of echolocation within 5 key presses of the sides and ends of the pitch.

Finally, an additional consideration within the audio game compared with real games of blind football is the need to change the current focus, for example when the player with the current focus passes to another player, or when the player with the current focus is effectively taken out of the game by an opponent with the ball getting out of tackling range. Rather than relying purely on the natural sounds of the game to indicate such changes in focus, a specific audio indicator of such changes is employed.

6.DISCUSSION

The current status of the project is that evaluation experiments have begun with early prototypes of the audio game, which are focusing on orientation and navigation issues. Further development is ongoing, which will increasingly address multi-player aspects and more realistic audio representations of the pitch and other game sounds.

Discussion with players and a coach indicate that there is real potential for a game of this type to be used to convey ideas about specific aspects of the game, such as where players should be and should react in set plays such as free kicks, throw in and corner kick situations. A problem experienced by players in real training scenarios is obtaining an overview of game positions as envisaged by a coach. A good auditory representation of such situations could be used to indicate initial positions of players at the start of a set play, and provide an auditory representation of the set play as it develops. Interestingly, the audio within the game should provide a much clearer representation of such situations than would be normally available to a blind player in a real match environment, as within the game all relevant aspects can be sonified as opposed to only those that are readily audible within a real game. An interesting question arises as to whether such an enhanced audio representation as that feasible within the game can A) be used to assist with learning in real life coaching scenarios and B) whether the improved representation of overall context available within the game has any impact on decision making in specific situations, firstly within audio game play and secondly whether this transfers in any meaningful way into real game situations.

7.REFERENCES

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