

Computer Game Audio: The Unappreciated Scholar of the Half-Life Generation

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Abstract. Audio has been present in computer games from the original sinusoidal beeps in Pong to the Grand Theft Auto soundtracks recorded by world-famous musical artists. Far from being an overemphasis, the word “soundtrack” is highly appropriate to the role that audio in games has played up until now. It sits comfortably-and as an equal-alongside Computer Graphics, Artificial Intelligence, online multiplayer gaming and new interactive environments as one of the main driving forces in both technology development and the acceptance of gaming as a core social activity.

In this paper we provide a historic synopsis of the integration of audio in games and attempt to establish if the auditory field has advanced the *diversity* of games and driven the *market* to the same extent as its visual counterpart - computer graphics. From this perspective, we discuss possible reasons for gaming trends and propose how a new generation of computer games could be driven by enhanced *aural* stimulation and/or excitement, the potential for which has not yet been realised. In particular, we consider how developments in soundtracks and other audio material, along with innovative interfaces, can make games and gaming more accessible to those with various disabilities, in particular, limited vision.

1 Introduction

All but the earliest, most basic, of computer games have contained some element of sound and audio. The complexity of in-game audio and music has grown at roughly the same speed as the field of computer graphics and, as games have developed in these areas, so has the game audio. To this end, soundtracks in games are coveted by international recording artists and games music is now usually written by professional composers and musicians. Games are scored just like a big-budget Hollywood movie.

This started as the games did in the early 1970’s with games such as Pong and Space Invaders which were supported by the inclusion of simple sounds using primitive synthesis techniques. Games would often have limited voices and a small range of actual sound effects. Early attempts were made at producing music to accompany games, which generally consisted of rather quantised rhythmic sequences being constructed from the available sets of tones. In the 1980’s the music and sound effects in games took steps towards what we now know as a game soundtrack with the development of FM and Wavetable synthesis and the emergence of the MIDI set of standards. Most notable in this decade were the Atari ST, Commodore 64 with the SID chip and the Nintendo Entertainment System (NES). The 1990’s saw the PC become a more dominant player in the games market with the release of the popular SoundBlaster series of sound cards and processors. Sampled audio was no longer a rarity. This trend has proliferated to the present day and sample-based, waveform audio is the standard method by which sound effects and music are achieved in games. Most recently, games have diversified by taking advantage of surround sound systems; the processors for which are now almost a standard option on most new computers. Games like Wing Commander III used well-known actors in-game, and recently the Grand Theft Auto series has seen big name recording artists being employed on the development of the soundtrack.

Although the support and inclusion of sound in games has diversified as faster processors, larger storage discs, and CD and DVD technology proliferated, the main focus to grab the a player’s

interest has traditionally always been the visuals and graphic effects. This is perhaps second only to the playability of a game. Still, one finds it much easier to be impressed quicker by the dazzling visuals of a product than by spending time interacting with it. Perhaps we are judging the book by its cover. To this end, games are traditionally graphically oriented, and it is often recognised that the audio factors in games tend to act as background fillers [1, 2]. However, we believe that the diversification of audio in games can lead to new and innovative products which can stimulate interest, and moreover, be useful to a variety of users some of whom might not have full access to traditional games due to some impairment. This is generally recognised by other experts in the field [1, 2, 3, 4, 5, 6, 7, 8]. Therefore, investigation into this area is vital.

As part of our research, we undertook a pilot study of computer and video game players. This allowed us to determine particular gaming preferences and also to begin to assess to what extent audio in games is important to these users, and whether or not it influences them in deciding if they would purchase a game. Furthermore, we also investigate whether or not users would be interested in games which were developed to employ sound and audio as the principal method of interacting with, and controlling, the game environment.

2 The Importance of Audio in Games

As part of our study into the factors which influence gamers when choosing a new game, we attempted to ascertain how important the gamer considers the audio artefacts and the musical soundtrack. This was achieved by asking each subject to designate what the most important factor was when they are choosing a game to purchase.

Our aim is to show that users will usually rate other factors such as the playability and visuals of a game much higher than the sound and music, further demonstrating that the focus upon computer and video games tends to be in the areas of the graphical domain. The results of this are depicted in Figure 1.

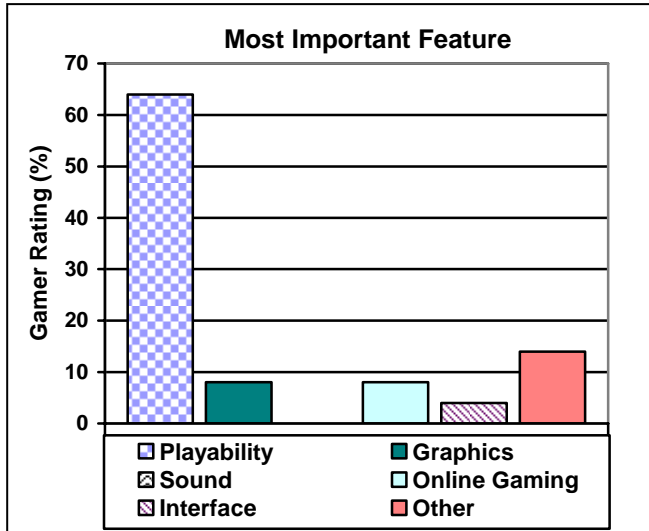


Figure 1 - Most Important Game Feature

Not surprisingly, we found that the most important factor to users who intend to buy a game is the playability. The rating for all of the other possible factors are negligible, although perhaps somewhat surprising is that fact that none of the users rated the sound or musical elements of a game to be in any way important to them when deciding upon a game to buy (*QED!*). In fact, the ability to play a game online with other users took favour over audio which is an intriguing insight into the mind of the 21st Century games player. Users who chose the 'Other' category were prompted to provide an explanation of what that particular factor was. Some samples of the responses received here were: "*Depth and Creativity*", "*The whole package*", and two users stated that the story or scenario were the most important.

To get a deeper insight into what is important to users in a game, and in anticipation that playability would be the top priority; we then asked the same users what the next most important feature was in a game. This took the same form, and had the same categories as the initial question. The responses received are shown in Figure 2.

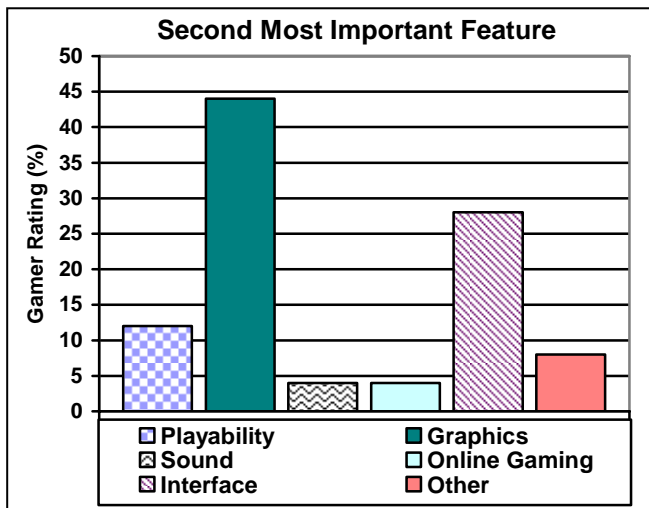


Figure 2 - Second Most Important Game Feature

The results in Figure 2 give us a more useful insight into the other factors which users look for in a game. This time we see that, as we expected, the graphics and visual stimulation presented by games was easily the most popular factor (*QED!*). We also found it useful that a relatively high-proportion of users believed that the interface of a game was also of high importance, since we discuss, in this paper, the potential for audio to be used as a way of interfacing to-and-from a game scenario. It may be that users would be more amenable to auditory interfaces driving their interest in a product, rather than the actual content of any music or sounds. As expected, the sounds present in a game were cited by a low percentage of those surveyed as being an influencing factor. The users who chose the 'Other' category on this occasion also stated that the factor important to them was the story of the game.

Finally, in order to determine that users have some interest in the audio or music contained in a game, we specifically queried whether or not the musical soundtrack in a game would influence them, given that this has been a particular growth area in the games industry. The result of this is shown in Figure 3.

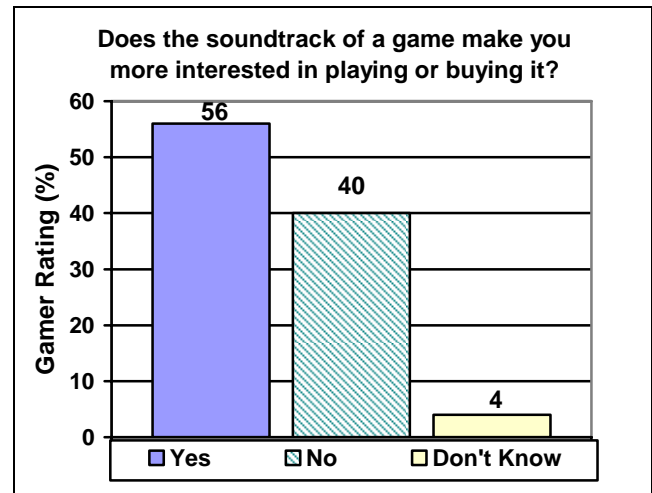


Figure 3 - Interest in Game Soundtrack

The results gained from this very specific question show that there is no distinct defining trend among the sampled users. This is reflective of that fact that playability and graphics are top priority with most gamers, and that the soundtrack appears to be of some interest, but perhaps would not have a heavy influence on a prospective game buyer. For this reason, it is probably that a lot of developers choose not to risk large sums of money on new ideas for audio technology, only to find that it only appeals to small audience. The game development industry is already a risky business and most game development companies go bankrupt after releasing their first title.

As a passing note it was interesting to note the particular genre of games favoured by the users who were studied. Of the users we surveyed the majority favoured Role-Playing Games (RPGs), followed closely by those who preferred Shoot-'em-up style entertainment. We believe a future study of interest could be to investigate whether the favoured game genre affects the particular factors which users specifically look for in games. For example, role-playing games have been traditionally much more limited in terms of their graphic and aural flamboyance, which much more

emphasis being placed upon the game story, whilst action and adventure games are often much more visually stimulating.

It can be seen in these results that users do not place any particular emphasis on game audio driving them heavily in deciding to purchase a new game. As was expected the main aspects users were interested in were the playability and graphics of a game. However, the interface of a game did become clear as another area which is important to gamers, and since we are particularly focussed on diversifying the use of audio to provide intuitive and novel interfaces, this generates scope for further development into the area of deeper audio integration.

3 Audio Focussed Gaming

In the current games market a number of new innovations over the last few years have seen focus in directly drawn to the integration of supportive audio exposure. That is to say, games are becoming more reliant on audio and music since it has an important role to play in supporting the user interaction with the gaming environment.

Investigations by Targett and Fernström [6] outline the potential effectiveness for purely audio-based gaming, and attempt to evaluate the usefulness of such a system in the context of the general games market, the effectiveness for users with disabilities, and potential applications in the field of complementary therapies. Crucially their work attempts to ascertain if these games are actually entertaining- a key factor in the success of any game, regardless of the novelty or innovativeness of its interface.

Early work in the field of integrating a stronger audio presence in software environments was undertaken by Lumberas and Sánchez [3, 4]. Their work involved the creation of interactive worlds and environments which utilised 3D audio to help provide structure and support navigation within the virtual environment [3]. This specific interaction is achieved through the use of haptic interfaces. Additionally, stories which could be accessed by blind children were developed, which involved them in a virtual world, with which they could have a degree of interaction [4]. This proved successful as a game, but was also found to have therapeutic effects, which allowed the children to better deal with everyday challenges outside of the game environment.

The work by Lumberas and Sánchez has been further developed and explored by Eriksson and Gårdenfors [9] and their paper provides a very useful insight into the key issues of developing audio interfaces, particularly for blind children. They discuss how to interpret particulars of game interfaces and challenges to that they can be effectively presented sonically.

McCrindle and Symons revisited the classic game of Space Invaders and developed stimulating audio interfaces which could be used by both blind and partially sighted users as well as fully sighted gamers [1]. Their main concentration in this work was in the area of providing useful audio feedback and cues to the user and relied on a more traditional keyboard/joypad interface. However, they received strong results which indicate that their methods of providing audio cues are simple and effective. This removes the challenge to an extent of being able to provide more intuitive interfaces to such games.

Another good example of audio technology of this nature is Rainbow Six 3 and the expansion pack RS3: Black Arrow. They allow users to actually issue voice commands and hold (limited) conversations with computer controlled players via the XBOX Communicator system. This has huge potential and has perhaps been under-used, particularly for users with limited vision. Care must be taken when developing new and original methods of interacting with computers, particularly with games. The biggest challenge to the user may be to learn the actual interface, which at worst may become exhaustive before the player even gets deeply involved with playing, and being absorbed into, the game virtual world. This can be derogatory to the overall experience. Once learned, interface in an audio game should effectively become pervasive and transparent to the user.

The move towards audio gaming has been realised by the development of software and interfaces for users with disabilities which can be overcome by finding other interactive domains with which they can engage. In order to facilitate useful interaction with the game some form of multimodal or haptic interface system is often employed. Indeed, there would be many challenges associated with creating a purely audio-only interface environment, especially for a game. This reiterates the argument that pervasive interfaces are required. Beneficially, the most entertaining and novel games will often involve some form of physical interaction. A prime example of this kind of supportive audio application comes in games which have been seen as innovative in their multi-modal interfaces, and a *prima facie* case would be that of the Dance Dance Revolution (DDR) game, which is not totally audio focussed, but relies heavily on the fusion of physical interfacing, sound, and a less intensive, more supportive visual role for computer graphics.



Figure 4 - Playing Konami Dance Dance Revolution

Konami's DDR game, pictured in Figure 4 (note the large speakers), is highly successful and popular, and has become integrated with youth culture [10]. Indeed, there are Worldwide International championships held; testament to the success of this particular multimodal game.

Still, a visual element of following on-screen prompts are present, but the audio generated by the game is assistive to the process of interaction. This said, the ability to maintain rhythm and timing is crucial to success in the game scenarios. This kind of intense physical response to audio cues is perhaps an extreme example. One would often expect users to much prefer not having to physically involve themselves so profoundly in the interactive environment. Especially in the case where auditory interfaces make software and games accessible to disabled or impaired users, the physical activity required may not be preferable.

However, although this game relied intensely on the supportive sound environment which it provided, without which it would be lost, the user is not necessarily conscious of the importance of the music in this game. Nevertheless, the user does indeed interact with an audio environment in order to be able to dance and keep rhythm whilst playing the game.

4 Analysing Potential Market Appeal

Of course, the technological and design challenges of developing audio games are a purely superfluous area of work if there is not sufficient requirement in the market for such a system. Although there may be sufficient demand in the areas of making game accessible to impaired users, there is no reason why such innovative and exciting developments should be limited to these users. To attempt to establish if there is interest and demand for games which have a particular focus upon the audio artefacts and presence contained within, we further probed our studied gamers to see what their interest would be.

First, we attempt to find out how much users are influenced by the general sounds that would be expected in a computer game. Given that response was low in our earlier investigation into the importance of sound in games, we attempt to determine whether the *quality* of the audio in games is therefore significant. The results of this are shown in Figure 5.

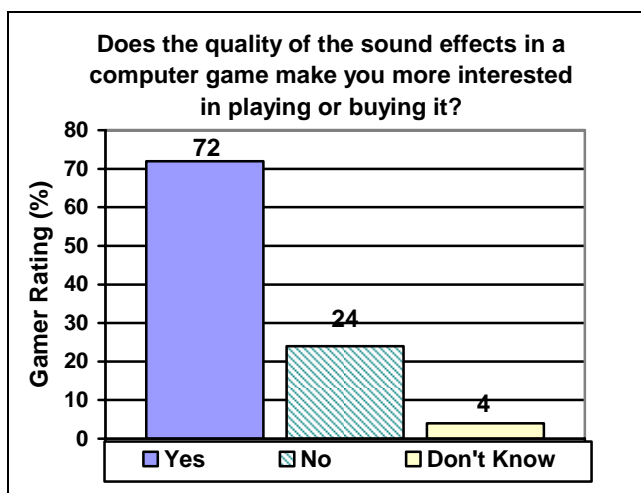


Figure 5 - Importance of In-Game Sounds

It is clear from these results, that although users may not be initially attracted to a game, the quality of the audio is still of importance. There is an element of doubt which remains however, since this was not indicated by an excessively large amount of the sampled population. It is also possible that users may be taking a

consumer view, due to the phrasing of the question, and are insisting on the maximum quality in a product they might wish to buy or use. What is clear is that audio contained in games must be of significant quality to be of interest. This may be as a result of the use of high-quality soundtracks in games as mentioned earlier. Next, we attempt to establish whether or not the use of spatial audio within games is seen as a novelty, or a particular point which can be used to sell and drive a game in the market. The results of this part of the investigation are shown in Figure 6.

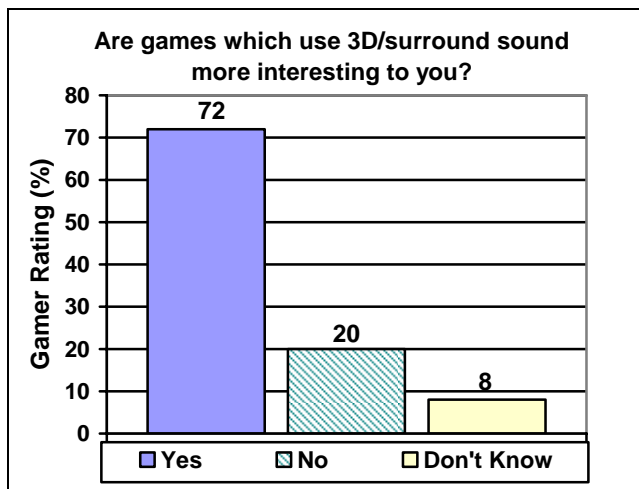


Figure 6 - Interest in 3D Sound

The incorporation of surround sound in games is not a new concept, and again the high positive response rate may again be due to the expectations of users, based on their previous experiences. However, it would be argued that the use of spatial audio in games further deepens the experience and level of immersion experienced by the user. Nevertheless, these results indicate that users would be amenable to playing games where some form of 3D or spatial audio is used.

Finally, to see how users would respond to the notion of a game which uses audio as the main method of feedback and interaction with a game, we asked users if they would be interested in such a product. The results of this are shown in Figure 7.

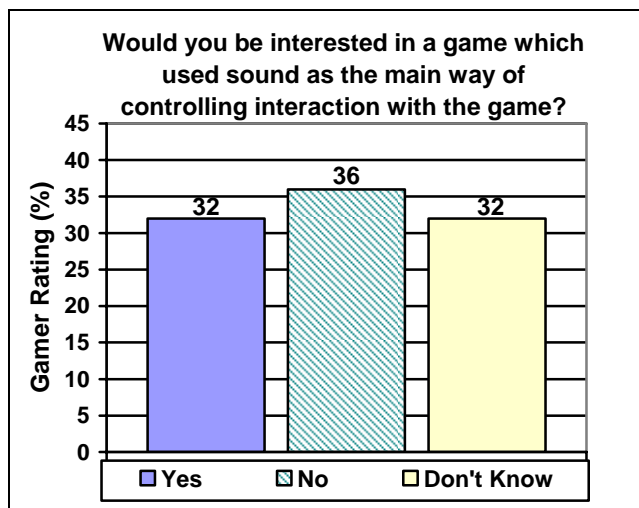


Figure 7 - Interest in Audio Interfacing

The results from this final query yield some of the most interesting results. Given the responses received from the previous two questions it was expected that users would be intrigued and interested at the concept of using such an innovative audio game. There is a distinct lack of any particular trend in response to this question. We would hypothesise at this stage that suggesting an immersive audio environment where control is also achieved through sound may be too extreme for the majority of users and gamers at this stage, who perhaps do not know enough about this particular area. We suggest that further development and exposure of such products is probably required.

From these results we see that there is further strengthening of the case for developing audio interfaces and audio games. The use of audio as a feedback mechanism has certainly had the case strengthened, although presenting a more extreme scenario where audio may be used for control purposes may have been too inventive at this stage. Clearly, deeper research is needed into why users may or may not be interested in the concept of much more involved audio environments for games.

5 The Future of Audio Games

The development of new and innovative audio games will be an interesting and challenging field in the years to come. We can already gain insight into the main areas of development by examining some of the more recent research developments to transpire and the issues surrounding these. We can see that integration of audio is best achieved through either an indicative set of audio sounds, such as earcons [11], or by employing more continuous sounds which evolve with the game scenarios they represent [1].

In their work on audio-only gaming, Röber and Masuch [12] present a good overview of the current range of developments and challenges in the field of audio gaming, both from the technological perspective as well as dealing with important issues relating to the playability and design requirements of audio games. In this work a number of audio-only games are developed which demonstrate how audio interfaces can be applied and combined with a varied array of gestural or movement-tracking control systems. Additionally, there is a large step taken in this work since the developers often employ complex sounds in their 3D auditory worlds, such as the sound of the traffic on the road in the *AudioFrogger* game. These sounds were recorded from the real-world, and are not indicative synthesised sounds as often encountered in audio control environments. However, since the use of the 3D audio space allows for more space in the environment, this may not be an issue, and in their paper the authors do not make any reference to the usage of these sounds being derogatory or of them creating any major problems in usability. This is promising, and is also an interesting area for future work to be carried out. Particularly, because gamers now expect realistic audio samples to be used in games, and critically, the use of such sounds will make the audio world more immersive and thus, effective.

The game play and addictive factors of audio games will certainly be an area at the forefront of the minds of many developers although it can be regarded as a separate and distinct challenge from the technological aspects of designing audio games. Many technologically innovative games have been short-lived, mainly

due to poor game playability and also the cost associated with any extra equipment or components required. To varying different degrees of success we have seen light-guns (can we forget the Nintendo Super-Scope?), Game Boy Camera, Nintendo Power Glove, Sega Activator, the Barcode Battler, and the list goes on. Few of these novelty accessories have really made significant impact on the market, with the exception perhaps of the Sony Playstation I-toy, and the aforementioned Konami DDR dance mat based games.

To ensure that playability of audio games is achieved, there must be in-depth testing carried out upon any software developed. A useful set of heuristic evaluation methods has been proposed and developed by Desurvire et al. [13]. Although not specifically focussed on audio games, the methods used specifically concentrate on a number of areas of gameplay, as well as taking into account the game usability which overall provide a Heuristic Evaluation for Playability (HEP). Particularly in the important initial stages of game development, the HEP testing mechanism has proved more useful at highlighting potential issues in a game's playability than standard user testing mechanisms. Many of the usability heuristics proposed for the HEP system are generic and would apply equally to any game, regardless of whether the primary interface mechanism was visual, haptic, auditory, or a combination of interfaces. However, an interesting area for future research could be to further build-upon the HEP process set out by Desurvire et al., particularly with a focus upon being able to successfully evaluate audio games.

3D audio environments are a key area to focus on if more involving and realistic audio and control environments are to be realized in the computer games world. Since the human hearing system is used to dealing with 3D sound in everyday life, this is doubtless an area which should be further exploited. Indeed, the reaction of users to a 3D audio environment is often instinctive and there is general consistency in the responsiveness of subjects when working in 3-Dimensional control environments, even across international and cultural constraints [14]. The use of 3D spatial audio within computer games is also an area for rapid expansion. Though it is fairly standard for new games to embrace 3D or surround sound environment, there is still much work which can be done in this area. For example, Virtual Reality systems are now embracing 3D audio, and results show that when interacting with a VR or virtual environment, the responses from users are far better and more accurate when in the 3D sound domain [7, 8].

6 Conclusions & Discussion

Evidently, there is significant work being undertaken both in the commercial and academic sectors of computer games development. However, one of the key issues which we believe will have to be addressed is how to make these novel methods appealing, and receive sufficient uptake by the general public. It seems from our study that perhaps the main way in which to increase the interest and usage of such new technologies is simply through increasing awareness, and reinforcing the value that such methods of interaction need not be expensive nor that they are another novelty phenomenon which will disappear overnight.

We can see that use of complex sounds mixed in a stereo or 3D audio space may not currently be the driving force behind consumer market demand for games, but that the users in the

market are certainly open to, and interested in, the use of a diverse range of audio and innovative techniques within their games. This is especially relevant to games, and although the technologies and interfaces should be embraced, developers should not lose sight of the fact that it is a *game* which is being developed.

The thrust of this is that audio games must have high levels of playability, which is the single most important factor cited in our research of games players. The exploration into audio games and multimodal games must not become overshadowed by the need to learn the interface before playing the game. Audio games must become as the audio sense is to human users everyday, it must be pervasive, instinctive, and intuitive

References

- [1] McCrindle, R. J., Symons, D., *Audio space invaders*. Proceedings of 3rd International Conference on Disability, Virtual Reality & Associated Technologies, Alghero, Italy, (2000).
- [2] Yuille, J., *Smearing Discontinuity :: In-Game Sound*. Proceedings of 5th International Conference on Digital Arts and Culture (DAC), Melbourne, Australia, (2003).
- [3] Lumberas, M., Sánchez, J., Barcia, M., *A 3D sound hypermedial System for the Blind*. Proceedings of the 1st European Conference on Disability, Virtual Reality and Associated Technologies, Maidenhead, UK, (1996).
- [4] Lumberas, M., Sánchez, J., *3D Aural Interactive Hyper Stories for Blind Children*. Proceedings of the 2nd European Conference on Disability, Virtual Reality and Associated Technologies, Skövde, Sweden, (1998).
- [5] Mereu, S., Kazman, R., *Audio Enhanced 3D Interfaces for Visually Impaired Users*, Proceedings of International Conference on Human Factors in Computing Systems '96, Vancouver, Canada, (1996).
- [6] Targett, S., Fernström, M., *Audio Games: Fun for All? All for Fun?*, Proceedings of International Conference on Auditory Display, Boston, MA, USA, (2003)
- [7] Zhou, Z., Cheok, A. D., Yang, X., Qiu, Y., *An experimental study on the role of 3D sound in augmented reality environment*. Interacting with Computers, 16, 1043-1068, (2004).
- [8] Zhou, Z., Cheok, A. D., Yang, X., Qiu, Y., *An experimental study on the role of software synthesized 3D sound in augmented reality environments*. Interacting with Computers, 16, 989-1016, (2004).
- [9] Eriksson, Y., Gärdenfors, D., *Computer games for children with visual impairments*. Proceedings of 5th International Conference on Disability, Virtual Reality and Associated Technologies, Oxford, UK, (2004).
- [10] *Welcome To My World - Lord of the Dance Machine*, Episode 2, TV. BBC Three, July 27, (2006). Synopsis available at: http://www.bbc.co.uk/bbcthree/tv/my_world/lord_dance.shtml
- [11] Brewster, S.A., *Providing a structured method for integrating non-speech audio into human-computer interfaces*. PhD Thesis, University of York, UK, (1994).
- [12] Röber, N., Masuch, M., *Leaving the Screen: New Perspectives in Audio-Only Gaming*. Proceedings of 5th International Conference on Auditory Displays (ICAD), Limerick, Ireland, (2005).
- [13] Desurvire, H., Caplan, M., Toth, J.A., *Using Heuristics to Evaluate the Playability of Games*. Proceedings of Conference on Human Factors in Computing Systems, Vienna, Austria, (2004).
- [14] Cunningham, S., Hebblewhite, R., Picking, R., Edwards, W., *Multimodal Interaction and Cognition in 3D Music and Spatial Audio Environments: A European Compatible Framework*. Proceedings of CSSI International Conference on System Integration in Integrated Europe, Liberec, Czech Republic, (2004).