Sound and Music In Video Games

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Introduction:

Despite recent promising trends, the visual, graphical component of video games continues to get the biggest slice of the pie. Indeed, this visual bias within the industry is apparent even within the industry's traditional name - *Video* Games.

There is, however, a growing trend to move away from using this term and instead use more general terms such as "computer games", "interactive games", or even simply, "interactive entertainment" (1).

One reason for this shift in perception is perhaps due to the widespread availability of cheap, high-powered graphics hardware and because of the widespread availability of tools, artistic and engineering talent. High-quality, realistic graphics have become the expected standard for any major game. As a result, consumers have grown desensitized to "amazing" graphics and expect more from their games. Increasingly, games have begun to explore more fully the potential for sound and music to raise the level of engagement with players.

This paper will present an informal and brief historical outline of key developments of interactive sound and and music in video games. It will then outline and discuss examples of current trends interactive audio and music. The paper will then conclude with a discussion of possible future directions for interactive sound and music.

Brief Historical Review

The First Games

The first video games had no means of producing sound, let alone music. The first video game, made in 1958 at the Brookhaven National Laboratory by engineer

William Higinbotham, was a proto-pong game called “Tennis for Two” and was written for an oscilloscope and was programmed with electronic circuitry rather than computer software (1,6). The next game was created five years later in 1963 by MIT graduate student Steve Russel. It featured a dueling spaceship combat game written for the impressively gigantic, yet soundless PDP-1 (2,6).

The first sound-producing game, *Pong*, was finally developed almost a decade later in 1972. Developed by Nolan Bushnell, *Pong* was indeed named for the game’s now famous sonic blip. Bushnell would later found Atari as a direct result of Pong’s success (3). *Pong* was followed in by a string of successful games which made similar use of early sound-producing hardware. Games such as *Space Invasion*, *Asteroids*, *Pac Man* and *Defender* solidified the importance of sound and in some cases, music, for games. The blips and bloops produced by these games grew to become synonymous with the “video game sound” that persists today.

Arcade Games

The importance of sound effects having been established early in the development of games, the first game which seriously focused on music was the 1981 release of the vector-graphics game *Tempest: Sound and Fury*. *Tempest* featured two dedicated sound-generating chips which had the ability to play eight sounds at once on separate channels. Each channel could control a sound’s pitch and volume independently. The game eventually saw the release of the first stand-alone audio soundtrack (4).

The early 80s continued to see an explosion of popularity for video game development and without clear quality control, the market was flooded with low-quality knock-offs of previous successes. As a result, American consumers quickly grew disinterested in video games and the game industry virtually collapsed by 1984 (5).

Nintendo Revolution

However, in Japan, the industry was just taking off. In 1985, fresh from success Donkey Kong in the arcade business, the 100 year-old Japanese firm, Nintendo, tentatively introduced it's own home video game console in Japan, the "famicon" (family computer). After destroying the Japanese competition, Nintendo tentatively introduced the system to the languishing American market. Trying to distance itself from the American low-quality game systems, it named its console, the respectable name, "Nintendo Entertainment System" (NES). Furthermore, it implemented the industry's first extensive quality assurance program to ensure quality games. Within 5 years, Nintendo had 80 percent of the American video game market (6).

One of the Nintendo's key to success was undoubtedly a result of an unprecedented focus on sound and music. Nintendo's most successful franchise, *Super Mario Bros.,* was the first game to employ truly interactive music. Composed by Koji Kondo, more than any game to date, the music continually changed according to the game's state (7).

From Hardware To CD

Video game audio technology continued to improve throughout the 90s, with most systems relying on hardware-specific signal processors such as the 8-bit Sony SPC700 sound chip for the Super Nintendo Entertainment System (SNES), capable of sound playing on 8 separate channels (8) or with the more advanced Yamaha FH1 24-bit digital signal processor used by the Sega Saturn (9). Though increasingly versatile, programmable, and interactive, these processor chips essentially limited the aesthetic depth that video game music might achieve.

With the release of the purely CD-based Playstation system in 1995 by Sony Computer Entertainment Division, cinematic quality audio found its way into games. The playstation offered 16-bit audio at 44.1 kHz sample rate on 24 channels (10). The pre-recorded audio was streamed in-game and no longer sequenced using built-in sound processing systems.

Computer Games

While the market for video games was primarily in console systems, computer game systems were growing more prevalent in the mid-90s. In addition to being prohibitively expensive to justify extensive investment for gaming, early home computers had severely limited audio capabilities, if any at all. In 1980, the IBM PC 5150, the first mainstream home computer, essentially ignored audio. It's only built-in capabilities were a 1-bit tone generator (11) though later, audio hard-ware expansions became available which allowed for MIDI-sequenced, economical FM synthesis. Early MIDI systems also employed wavetable synthesis with pre-recorded standardized General MIDI instruments. It has been argued that, though lacking in production quality, during this time, computer game music had achieved a interactive high-point in that game data often had direct, real-time control over music sequences (12).

During this time, because of the fundamentally limited scope of music in computer hardware, there was quite a bit of research into new sequencing systems for MIDI-based music. The greatest example of this direction of research is Lucas Arts' iMuse (Interactive MUsic Streaming Engine). iMuse was the first MIDI-based system which employed complex compositional structures such as transition stitching and real-time thematic blending which could respond to game states such as combat intensity or mission completion (13).

By the mid 90s, the gap between games on the computer and games for consoles was small. With the widespread adoption of CDs on personal computers as well as increased hard-drive space and performance capabilities, streaming audio also became the standard method of audio playback for computer games. Today, streaming audio, either on fixed media such as DVDs or CDs or through stored sound file formats (compressed or otherwise), continues to dominate both video game console games and computer games.

Recent Trends in Interactive Audio and Music

As already mentioned, the high-quality audio made possible through more storage space and processor power initially resulted in a focus on producing cinematic or at the least, more traditional forms of music. Indeed, many famous film composers have crossed over to scoring game music and there have been several cases of pop stars using a games potential mass-audience to further their careers (5). However, there have been developments which points toward completely new trends.

Music Games

One emerging and popular trend centers on the idea of the game being not just a story, but about the music, or about interacting with the music. These types of games have been labeled, “Music Games”. Though starting 10 years ago with *Dance Dance Revolution* in 1998, the genre has grown increasingly in popularity. *Rock Band*, released last year by Electronic Arts, has swept many video game award categories including best multiplayer game, sound design, music game, etc. In Rock Band, up to four players play together, miming pre-recorded bands through the use of specialized game controllers (drums, microphone, and guitars) (14).

Casual and Mobile Games

Another important trend is how interactive music has become increasingly used in the growing casual and mobile game market. Because of the essentially limited game design scope, specialized audience, as well as smaller, more agile development teams, games produced for this market are able to experiment more with innovative use of audio and music. One major, and successful example of this trend is the 2005 release of *Electroplankton* for the portable game system, the Nintendo DS. Described accurately and humorously by one reviewer “as a collection of interactive multimedia art installations you can take with you” (15), *Electroplankton* defies all normal expectations for what constitutes a game as there are no rules, or objectives, or anything other than a

bunch of strange environments and creatures that produce music and sound interactively (16).

Art Games

In addition to mobile gaming production for systems like the Nintendo DS, there is also a growing movement in experimental interactive music composition systems developments. Similar to *Electroplankton,* many of these experimental systems are not necessarily games or even just software but more interactive multimedia environments. For example, the experimental audio project, *ixi*, is an independent British software team working to create digital musical instruments and environments for generative music (17). They have produced a wide variety of small, experimental applications which explore interactive, generative music which are available on their website.

Experimental Systems in the Mainstream

Most mainstream games avoid experimental systems at all, let alone experimental interactive music and audio systems. However, one of the most anticipated mainstream games, SPORE, produced by game-giant Electronic Arts, employs several experimental interactive audio systems. Commissioning generative and ambient music pioneer, Brian Eno, SPORE will feature the game industry's first use of procedural and generative music techniques on a major title (18). The advantages offered by generative and procedural audio production for a large, and essentially endless game are numerous. For example, endless looped repetition is minimized without the need to commission the equivalent number of compositions let alone allocating the resulting needed hard-drive space. Furthermore, procedural and generative systems afford greater immediate feedback to game-system data.

The vast majority of the procedural content for SPORE was written using Miller Pucket's open-source music programming language, PureData. With such a specialized language, composers and sound designers had unprecedented access to game data as well as rapid, real-time feedback of aesthetic tuning. Though implementing many of the

same ideas from the old MIDI sequencing days, the sounds actually used were streamed from small instrumental samples. This provided not only a compromise for minimizing devoted CPU processing power for the audio system but also produced a higher production quality.

Though innovative, the techniques implemented by SPORE may not necessarily find widespread usage. SPORE is a unique game with unique resources backed by a game development team which thrives and specializes in experimental and innovative system development. Though perhaps if the audio system receives positive reviews after it is released in September 2008, more mainstream game companies will consider implementing more innovative interactive music systems.

Non-Experimental Mainstream Techniques

The vast majority of games that have been developed recently have not employed any radically innovative interactive audio system. However, almost every well-funded game development effort now employs some level of iMuse-style stitching of streamed audio. Indeed, composition techniques for games are now taught at both normal mainstream music conservatories as well as school specializing in multimedia development. There are several proprietary middle-ware audio engines and software libraries available which specialize in this task. The most widely used middleware audio system is currently the FMOD Ex system by Firelight Technologies (19). FMOD provides an advanced streaming sample management system with unlimited virtual software channels for audio playback. FMOD also has a GUI interface, called the FMOD Designer, which allows for rapid tuning and stitching of pre-recorded compositions by composers and sound designers.

Due to FMOD's primary function as a sample stream playback system, it has highly limited synthesis or custom DSP functionality. Though there are callbacks for constructing custom DSP processing, it is not well-supported, and the general design structure of FMOD generally discourages such usage. Therefore, it is not immediately apparent how FMOD might be used in a more abstract procedural or generative interactive music and audio system.

The Future of Interactive Audio and Music In Games

The current trend of interactive audio and music in games towards more innovation and interactivity is promising. Though technologically behind what has already been explored within academic contexts, there are many opportunities for innovative applications. With the potential for unlimited, cheap distribution via the internet, as well as emerging cross-platform development tools for the web and mobile devices and technologies such as the iPhone, there is an ever increasing market for new interactive multimedia experiences.

However, there is still a lack of libraries and tools which directly address many of the issues in game development. Currently, C++ is the development language for almost every non-mobile or web-based game. This poses a potential integration problem as most of the work in developing complex interactive music systems have been done in specialized languages for music such as csound, max/msp, PD, Chuck, or SuperCollider. Language integration or code porting is a headache that any sane game development company would want to avoid at all costs. Therefore, it is absolutely vital that an effort is made to develop a toolset which can be quickly and seamlessly integrated into the widely used interactive audio and music systems such as FMOD. It is only a matter of time before such innovations are realized.

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