

The Current State of Audio Technology

Introduction

With the expansion of multimedia in all aspects of our life, inclusion of audio in that equation is increasingly important. Audio technology has expanded dramatically over the last few years. It has released the professional musician from the expensive commercial studio, allowing him/her to record from the home with the aid of a computer and a multi-tracking recording software program. It has also allowed the non-musician to successfully work with musical formats--editing, mixing, creating new effects, and manipulating sound waves. For multimedia delivery, audio compression technology has allowed the internet user to quickly download music in the format of MP-3s, and also let web designers compress music so that it can be easily added to web sites and other multimedia output formats. In this essay, I will explore the basics of digital audio, as well as some of the fundamental software, editing and compression tools.

Significance of the topic

Why is audio significant for multimedia design? It is truly a component of "multi" media, allowing the user to captivate the audience in yet another way. In web design, sound is used to highlight such effects as pushing a button, or to animate an introduction designed in flash. Simply viewing and comparing web sights designed with and without audio will expose the significance of audio addition.

Discussion

The Two main types of digital audio

Digital audio exists in two main formats: sampled and synthesized. Sampled sounds are digitally converted analog sounds. The analog sound waves are captured, converted, and transcribed into a digital format. A sampled sound will appear in the format of a sound wave, or numeric representations that is deciphered by a computer, representing sound over time. Sampled sounds are usually saved as WAV or AIFF files. Synthesized sounds, on the other hand, are recreations of many events that form together to create one sound output. Most synthesized sound is recreated though the MIDI format.

MIDI stands for Musical Instrument Digital Interface. Through MIDI data, such information such as pitch, frequency, duration, velocity, and attack are recorded as a numeric format. When replayed, this numeric format is recreated into actual sound. (MIDI playback is recreated sound, where as sampled sounds are replayed sounds.) MIDI, or synthesized format, has many advantages. Sound files are extremely small, allowing for quick delivery over the web. MIDI recreation of actual sounds also lets a musician compose for many different instruments without actually having the "real" instruments there to do the recording. The tempo (speed) of the MIDI files can also be changed at will, without changing the actual pitch of the piece. Instrumentation can also be changed instantaneously. (Changed your mind about the flute sound? That can be easily changed to a trumpet.) The drawback to MIDI is that since it is recreated sound, the quality of the output is dependent on the quality of the sound card or MIDI instrument. Some instruments and more expensive soundcards sound indistinguishable from analog sounds, while other inexpensive soundcards make the MIDI output to sound "tinny" or fake. Also, most multimedia design programs, such as Macromedia Director or Flash, cannot readily incorporate MIDI information.

How sound is converted into digital data

When analog information (such as from a CD or live recording) is converted into digital data, the information is captured and measured into Hertz. The more Hertz you can capture, the more accurate your recording will be. For example, a sampling rate of 44 kHz (kiloHertz) is far more detailed than a sampling rate of 11 kHz. It is easy to compare this to a digital picture. The higher the scanning quality, the more detailed the picture will be. Of course, file size will also increase with higher sampling rates. When preparing audio for multimedia output, especially web output, it is unnecessary to go beyond a 22 kHz sampling rate. The reason for this is that this is the average frequency that is audible to the human ear. Some highs and lows will be lost; however, it is difficult to detect this, especially with the quality of speakers found on most computers today.

Another technicality to be concerned about when sampling sounds is *bit depth*. Bit depth is essentially the dynamic range (or amplitude) of a piece. Bit rate also controls the resolution of the sound wave (higher bit resolution results in a smoother wave). For example, a highly structured classical piece would have a high bit depth, because of the great dynamic differences between a solo flute section and a full orchestral section. Many pop tunes have less of a bit depth, because they are composed on a more equal dynamic range. When sampling music for web format, a 16-bit rate is adequate. For many instances, 8-bit rate may work as well and decrease the file size.

Multi-track recording software

When recording and mixing audio, perhaps the first thing to consider is whether to go with a Digital Audio Workstation (DAW) or strictly computer software. Digital Audio Workstations are devices sold as hardware that attach to your computer, allowing you to store and mix audio through an outside device. Some common components are mixing boards, multi-track recording devices, and CD burners. The advantages to this is that processing is usually faster, allowing for more storage space of digital information. However, the price of DAWs are usually higher than the software versions. Some common manufactures of DAWs are Tascam and Mackie Designs. Perhaps the top professional multi-track recording tool is Digidesign's Pro Tools. Digidesign's previous price of \$8,000 made it impossible for private studios and desktop/home studio recorders to own and operate the equipment. However, this has all changed with the release of Digi001, which is a simpler version including both the software and hardware interface for under \$1,000. The hardware component is a single-space box and a PCI card that works with both Mac and PC. A downloadable pro tools software version is also available for free. Some of the clients who use Digidesign Pro Tools include Nine Inch Nails, Björk, Smash Mouth, Philip Glass, Third Eye Blind, Paramount Pictures, Canadian Broadcast Corporation, and such movie projects as Nutty Professor II, The Perfect Storm, The Matrix, American Beauty, and The Prince of Egypt.

Multi-track software packages are perhaps the most popular, varying in price and editing power. Some common programs include Samplitude, which samples at 24 bits and 96 kHz (Windows \$69-\$399), Vegas™ Audio 2.0 (Windows, \$449) which has unlimited tracks, 18 effects, and output options such as streaming media files (WMA and RM format). Cakewalk® Pro Suite™ is also a popular program (Windows \$429-\$599). Cakewalk differs from other programs in that it also allows for MIDI recording and editing as well as multi-track recording and editing.

In these programs, many tracks can be recorded, edited, and mixed together. The non-linear recording process allows for extreme editing capabilities (cut and paste, mix, etc.) Audio editing programs can also be expanded through the use of DX plug-ins, which are compatible to any software program. DX plug-ins can add effects. An example of a company that sells DX plug-ins is Anwida. <http://www.anwida.com/dxmod.htm>. Another type of plug-in is used for correcting pitch. Auto-Tune, <http://www.antares-systems.com/> is an example of this type of plug in. During recordings, if a singer is singing off pitch, or an instrumentalist is playing off pitch, the plug-in automatically reprocesses the pitch at the correct level.

Audio Editing Programs

When working with audio files, it is not necessary to record through a multi-track recording software program. Often, it is easy enough to create new audio files by simply manipulating pre-existing files. Sonic Foundry <http://www.sonicfoundry.com/> sells many audio editing software programs, such as Acid pro 2.0, Acid music 2.0, Acid D.J 2.0, Acid Hip Hop 2.0, Acid Latin 2.0, Acid Rock 2.0, Acid Techno 2.0, Acid Express 2.0, and Vegas audio 2.0,

Acid DJ 2.0 is an example of an inexpensive audio editing tool that is useful for creatively manipulating sound files.

<http://www.sonicfoundry.com/products/NewShowProduct.asp?PID=3> (Windows, \$59.95) Acid DJ is like a paint studio editor. The user imports pre-existing sound files which are then sent to the "mixing board" which edits the volume, panning, mute and other solo controls. Acid DJ comes with over 600 royalty-free .wav file loops, with more downloads available at SonicFoundry.com. New audio files can be recorded from a microphone or other sound source.

Sonic Foundry's more complex audio editing software is Sound Forge. <http://www.sonicfoundry.com/products/NewShowProduct.asp?PID=5> (Windows, \$499) Sound Forge can be used for both professional audio production as well as multimedia and internet development. Files can be saved in many formats, including WAV, WMA, RM, ASF, and MP3. Other features include DirectX Plug-In support, built-in effects, and video support.

Audio Compression

Since audio files are usually large, they must be compressed in order to be delivered on the web. The most common compression type is MP3. MP3 compression can reduce audio file size from about 15-20 Megabytes to 2-5 Megabytes. MP3 compression works by taking out the highs and lows that are inaudible to the human ear, and also highs and lows that are "hidden" behind other sounds. For example, if you had an audio file that contained simultaneous sounds of a train and a single bell, obviously, the sound of the bell would be unable to be heard. MP3 compression takes out the sound of the bell, thereby reducing the file sizes. Since the development of MP3 compression, several web sites have become available for downloading MP3 audio files. Some sites, like Napster, <http://www.napster.com/> offers search engines for any MP3 files. Much controversy exists over this site, with the possibility of a ruled shutdown under the accusation that the free downloads infringe on the rights of the musicians and music producers. On the flip side, recent research has shown that users of Napster who

regularly "steal" the downloaded MP3 audio files, and more likely to actually purchase the same songs in CD format. Other sites exist for downloading MP3 files, such as <http://www.mp3.com/> which contains some free downloads, and some files which can be downloaded for a small fee.

Web Audio Players

Another issue regarding audio on the web is players, or what programs internet users will be using to play audio files. Perhaps the most common application is QuickTime, designed by Apple Computers and available for both Mac and PC. QuickTime can be downloaded from the internet; however, it is also included in recent browsers.

RealAudio was the first company to introduce streaming audio and broadcasting of live events. Streaming audio is the process of having the first part of the audio files play while the remainder is being downloaded. The RealAudio player can be downloaded at <http://www.realaudio.com/>. Some of the basic players are free; the more recent players can be downloaded for \$29.99. RealPlayer 8 Basic player features a new technology developed with Sony Corp., that delivers CD quality playback at half the file size of MP3, at two-thirds the bandwidth. The new Real.com Radio Tuner (not yet accessible for Macintosh) offers access to more than 2,500 Internet radio stations from around the world. Winamp is a free digital audio player for windows, being able to play both MP3 and internet radio stations. <http://www.winamp.com/> Another free player is streamworks, <http://www.xingtech.com/mp3/streamworks/player>, which plays both streaming audio and video, utilizing MPEG-1 compression. Windows media Player 7 <http://www.microsoft.com/windows/windowsmedia/en/software/player7.asp> or <http://www.microsoft.com/windows/windowsmedia/en/download/mac7.asp> (Mac version) is another free player, which includes a CD player, audio and video player, media jukebox, media guide, Internet radio, portable device music file transfer, and audio CD burner.

Many internet sites now feature web radio stations, where you can download music based on genre. An example of this is Net Radio <http://www.netradio.net/>, which incorporates streaming audio is its 120 preprogrammed channels. These sites also link to buy music. Radio Spy <http://www.radiospys.com/> is also a site for downloading web broadcasts. It also has information on how to create your own web radio broadcast.

If you are interested in producing and editing streaming audio and video files for the web, many software programs exist. A common application program is Stream Anywhere, <http://www.sonicfoundry.com/products/NewShowProduct.asp?PID=122> for Windows (\$179) Video clips can be imported or captured, and then trimmed and edited

with common effects such as fade-ins and fade-outs. Interactivity through commands and markers for synchronization and logo watermarks can also be added. It is a simple program that saves files in RealSystem G2 web streaming formats at multiple bit rates.

Summary

A final note of concern is the copyright issue. Simply because musical formats are readily available does not mean that they are legal to copy and use for your own personal use. The rights of the composer as well as the performer(s) must be considered. Some countries, such as the Soviet Union, have strict copyright laws even on their nationalistic composers who have been dead for many years. It is important that you explore these copyright laws fully and not exploit the musicians work. Many audio sources exist that are copyright or royalty free, and can be used freely. Another option is to explore the work of living composers. Many composers (everyone needs work!) would be willing to create newly composed unique music for your web site.

*This paper is written by Kathy Winston for the course EDC385G Interactive Multimedia Design & Production at the University of Texas - Austin.