

Digitizing Sound Files

Introduction

Sound is one of the major elements of multimedia. Adding appropriate sound can make multimedia or web page powerful. For example, linking text or image with sound in a meaningful way facilitates learning with multimedia. A multimedia designer can use sound files that are available on the net. However, when sound files are unavailable on the net, a designer should create his/her own sound files. Digitizing sound/audio is an important part of the process of creating a sound file. In this paper, I will introduce digitizing sound files. The issues, including what is sound digitizing, how to do it, and what are needed to do it, will be discussed. One example will be provided to demonstrate the procedures of digitizing in detail.

Significance of the topic

The first step to create a sound file, undoubtedly, is to record sound or music that would be used by a multimedia designer. The sound can be recorded in audio cassette, minidisk, DAT (digital audio tape) or CD. As aforementioned, these sound resources should be digitized in an appropriate format. Not until these sound resources are digitized can they be used in any computer application, like multimedia. Thus, it is important to know what is it and how to do it, especially for a novice.

Discussion

Definitions: digital vs. analog

Sound is produced when objects vibrate producing pressure waves that can be picked up by human's ear. The vibrating pressure waves move in a pattern called waveform. If we graph the intensity or motion of the wave over time, we can get a curve consisting of a series of waveforms. We can say that sound is stored by waves. These are *analog signals*. In other words, analog signals are continuous variable signals that consist of waves. When the sound is needed to be used in any computer application, we need to convert the air vibrations of sound into an electrical signal, which is called *digital signal*- a stream of 0's and 1's. The process of converting analog signals to digital signals is called *digitizing*.



What you need to consider when you digitize sound?

When we digitize sound, we need to consider some parameters that determine the amount of information stored in a file and the quality of the digital sound.

- **Sampling rate:** A sampling rate is the number of times the analog sound is sampled during each period (one complete waveform) and converted into digital information. The most common sampling rates are 44.1, 22.05, and 11.025 kHz

(kilo-Hertz). A sampling rate of 44.1 kHz means that 44,100 samples of the analog audio will be taken. Therefore, the more samples taken, the closer the digital version will approximate the original analog version.

- **Bits per sample:** Bits per sample describes how much information (number of amplitudes) in each sample the computer is collecting. It involves a process of converting a sampled sound into an equivalent digital value. The number of individual sounds that can be represented depends on the number of bytes used to store the digital values. Naturally, more bytes, more possible sound and higher quality of digitized sound.
- **Mono vs. stereo:** Mono describes a system where all the audio signals are mixed together and routed through a single audio channel. Stereo sound systems have two independent audio channels, and the signals are reproduced by two channels separated by some distance. It is difficult to decide which one is the best. The two sound channels give the illusion that the sound is coming from a certain location. However, going to mono will reduce the file size by half. Sometimes a well-designed mono system is better than a low quality stereo system.

Note: It is important to balance the sampling rate, bits per sample to come up with an acceptable quality of the sound with the minimum file size. The following comparison is provided by Michael Kennedy (2000):

Sound quality	Sampling rate (kHz)	Bit Depth	File size (MB)	Stereo/Mono
Compact disc quality	44.100	16	30.2	stereo
good quality	44.100	16	15.1	mono

	44.100	8	15.1	stereo
	22.050	16	15.1	stereo
	22.050	16	7.5	mono
	22.050	8	7.5	stereo
low quality	11.025	8	3.7	stereo
	8.000	8	1.3	mono

What do you need to digitize sound?

The following equipments are essential for digitizing sound.

1. **Audio source**, such as digital audio tape (DAT), audio cassette, and compact disk (CD) etc.
2. **Mac or PC** computer.
3. **Software**, such as Cool Edit or Sound Edit 16. Software can help users to digitize and edit sounds.
4. **Mini-mini or RCA-mini audio cable**. This is used for connecting audio source to the computer.
5. **Headphones or speakers**. This helps you to hear the sounds in the process of digitizing and editing, so that you can adjust volume or other features if needed.

How to digitize sound?

1st step: connect the output source to the computer: This can be done by connecting a mini audio cable from the headphone output on the tape recorder to the sound input on the computer. (DAT and CD work in essentially the same way.)

2nd step: connect headphones or speakers for monitoring into the computer's headphones jack.

3rd step: open up software, such as Sound Edit 16 or CoolEdit.

4th step: Start playing the tape and listen to the sound. Observe the sound level and make sure that it does not go into the red zone.

5th step: control the sound level with the tape recorder volume controls.

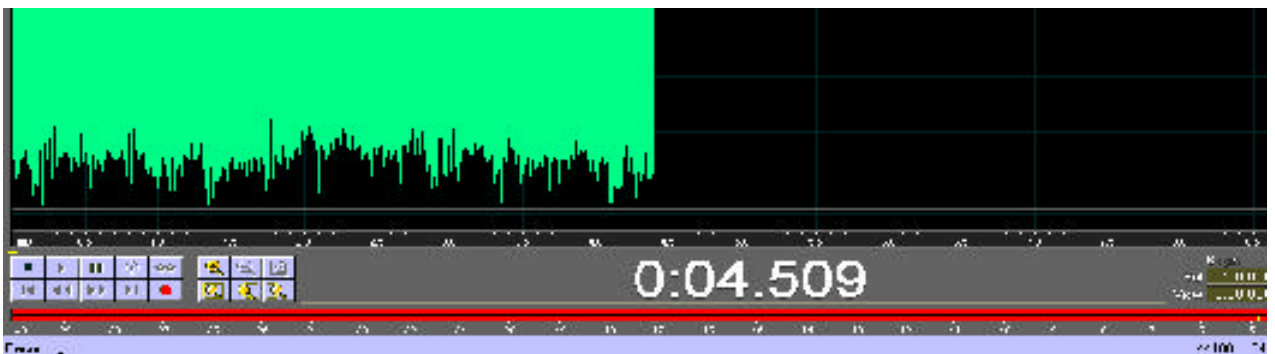
6th step: after digitizing the sound, save it in an appropriate format.

Example: Digitizing audio from an audio cassette with Cool Edit on PC

1. Put cassette into tape recorder and connecting it to computer.
2. Open Cool Edit
3. Go to *File > New*
4. A *New Waveform* window shows up. Choose sampling rate, channel, and resolution (bits per sample) and then click *OK*.
5. Open volume control on the button right hand part of the screen. Turn the input level on in Cool Edit.



- Too high input levels will make the sound distorted, and too low will make the sound muffled. Thus, with volume control open, we can adjust sound according to the indication of the input level.
6. Start recording. Locate the record button left hand side of the program. Click the record button and a window will pop up asking if there will be a time limit on the recording (You can choose “No Time Limit”).
 7. Press *Play* on the tape recorder. Observe the input level on the bottom of the screen. Adjust volume if needed.
 - Input levels are red horizontal bars moving from left to right according to the audio. If you don't see them moving, as in they are solid red bars that stretch all the way across the screen, then the input level is too high. You can lower the input level by lowering the “Line In” volume in the volume control window until the red bars come down to where they are shown.



8. After you accomplish recording, click the *Stop* button and stop the tape recorder.
9. Listen to what you have recorder.
10. Save your recording. Go to *File > Save As*, and choose the format of file you want to save. Then, click *Save*.

Tutorial: <http://www.albany.edu/cetl/resources/howtos/digitizing.html>

Other useful linkages:

Digitizing audio using Sound Edit:

http://www-camil.music.ucui.edu/classes/358/projects/web_proj/digitizing_audio.htm

[http://twist.lib.uiowa.edu/radio/Greg's Folders/digitizing and Editing.html](http://twist.lib.uiowa.edu/radio/Greg's_Folders/digitizing_and_Editing.html)

Digitizing sound from a CD audio disc:

<http://www.nyu.edu/classes/jacobson/director/sound.html>

[http://sjw.hct.ac.ae/ilc/how%20to/how to create a sound file.htm](http://sjw.hct.ac.ae/ilc/how%20to/how_to_create_a_sound_file.htm)

For Software

- Cool Edit: <http://www.syntrillium.com/cooledit/index.html>
- Sound Edit 16: <http://www.macromedia.com/software/sound>

Sound file formats

There are a lot of types of sound file formats. Here, the most common three are introduced.

- **WAV (.wav):** Windows Waveform format. The WAV format is developed by Microsoft. Many players including QuickTime can play WAV files. It is an uncompressed file format.
- **AIFF (.aif):** Apple and SGI's Waveform. The AIFF is developed primary for use on Mac. Mac-based digital audio recording system and multimedia applications allow importing and exporting of this kind of file format. It is an uncompressed file format.

- **AU (.au):** Sun's and NeXT's Waveform format. It is developed by Sun Microsystems and is sometimes referred to as "audio/basic" format. This format is one of the most common audio formats used on the web. Most browsers support the au format with their internal sound players.

Summary

This paper briefly introduces basic concepts of digitizing sound and process of digitizing sound. Digitizing refers to the conversion from analog signals to digital signals. Sounds should be digitized and then can be used in any computer application. The procedures of digitizing include connecting audio sources to computer, using software to record and adjusting volume if needed. When digitizing sounds, users should consider three parameters that determine the quality and size of digital sound file-*sampling rate*, *bits per sample* and *channel*. In addition, the files should be save in an appropriate format after digitizing is done.

Reference

Basic concepts:

http://www.usask.ca/education/coursework/edcmm898_01/sound/2Bscs/2B4.htm

In this site, basic concepts of digitizing are introduced in detail. Besides, it also consists of many aspects of sound, like function of sound and sound tips.

<http://www.cit.cornell.edu/atc/materials/dig/digav.shtml>

This is site containing course materials. It provides clear information about digitizing audio, including definitions and file formats. It also incorporates digitizing video.

<http://www.cortland.edu/flteach/mm-course/sound.html>

In this site, basic concepts of digitizing is introduced. It also roughly describes how to use computer built-in accessory and Cool Edit.

<http://zappa.tvu.ac.uk/MM98SejnowiczT/sound.html>

This site provides basic definitions of terminology that is used on digitizing sound. It also describes the quality considerations.

<http://www.projectcool.com/developer/audioz/AZmaking/creating.html>

This site simply discusses how to create sound files by recording from CD and microphone. MIDI, digital audio, and common file formats are discussed.

<http://www.mcsquared.com/mono-stereo.htm>

This site introduces mono vs stereo sound channel in detail. Advantages are discussed as well.

How to digitize sound:

<http://childes.psy.cmu.edu/html/audiodig.html>

This site provides information of what you need and how to do in the process of digitizing sound.

<http://www.albany.edu/cetl/resources/howtos/digitizing.html>

This site describes the procedures to digitize sound with Cool Edit on PC.

<http://www.kickinthehead.com/Features/MP3/tape.cfm>

This site talks about digitizing audio from tape. It simply describes how to use Cool Edit to digitize audio, and then the .wav file can be converted into MP3.

<http://cts.rice.edu/tutorials/Webav/audiohow.html>

This site describes the process of digitizing audio on Mac. It also discusses how to include audio in HTML file.

[http://twist.lib.uiowa.edu/radio/Greg's Folders/digitizing and Editing.html](http://twist.lib.uiowa.edu/radio/Greg's%20Folders/digitizing%20and%20Editing.html)

This site provides information of how to digitize sound from audio cassette and CD with Sound Edit 16 on PowerMac.

Applications:

<http://www.webdiner.com/webadv/inter/audio.htm>

This site describes how to add sound to the web site. It also provides links to useful free software.

<http://ww2.lafayette.edu/~kayserj/tutorials/sound/sound.html>

This site discusses placing sound on the web site in detail.

Multimedia Authoring at the University of Texas-Austin.