

Bleeps, Blops, Clicks, and Pops

Sound Design in Games

- The History of Sound Design •
- Diegetic Sound •
- Non-Diegetic Sound •
- Sound Effects Layers •
- Formats for Sound Files •
- Birth of Sound Design in a Game •
- The Asset List •
- Where do Sounds Come From? •
- Editing Techniques •
- Creating Your Own Sounds •
- Meet the Team •

Learning Outcomes:

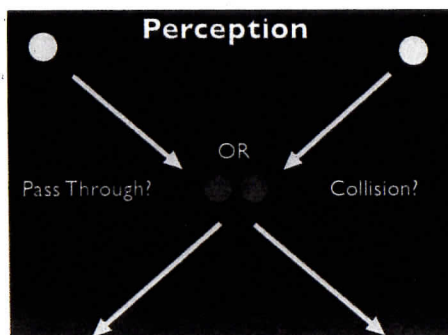
- Understand the workflow associated with sound design for games •
- Learn the role of the sound designer in games •
- Know the difference between interactive and adaptive audio •

The History of Sound Design

Throughout recorded history, sound has been used in order to express emotions, feelings and moods within society in general, and the dramatic arts in particular. Although music was a more common form of expression, the craft of sound design had its beginnings in the use of sound to underscore dramatic actions in various forms of theater, such as Elizabethan plays and Japanese Kabuki. One example of this is a thin metal sheet shaken vigorously to evoke the sound of thunder. Over the



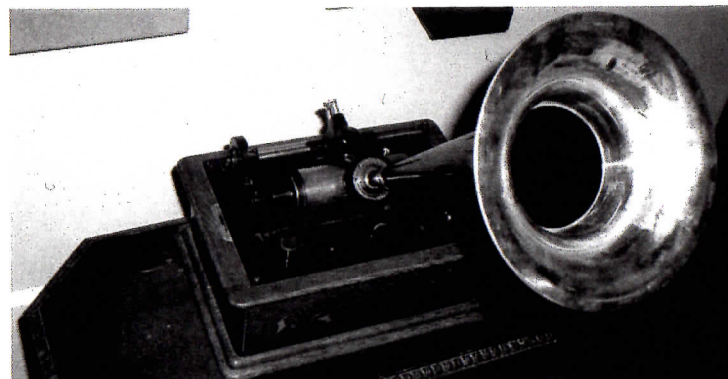
If you're curious and want to learn more about this phenomenon, and to experience it firsthand, just go to the application, click on the Videos area and choose **Animation Fascination!**



Do these objects collide with each other or pass through each other?

years, increasingly complex and intricate props and machines have since been used to create a wide range of sounds both onstage and off.

From Italian composer Luigi Russolo's fantastical mechanical sound-making devices called **intonarumori** in 1913, to the rise in popularity of radio and real time sound effects to enhance the drama in live theatrical productions, the creative use of sound became an integral part of the mystique of the middle of the twentieth century.



Thomas Edison's original phonograph used wax cylinders and could both record and play back sound without the use of any electronics.

Credit: John Guano.

These sounds were originally made fresh and could not be stored by themselves, but as recording technology developed over the years, so did storage technology. Starting with the first wax cylinders and progressing to today's modern digital workstations, the sound of almost everything you can think of in the world has been captured, stored for playback, and made readily available for later use in a plethora of productions.

In the game design industry, the term *sound designer* may mean many things. The sound designer may only create sound effects, or may also integrate the audio into the final product. For the purposes of this book, we will explore the basic concepts that sound designers should be familiar with. In addition we'll also highlight important tips to keep in mind when you're given the task of designing audio for a game.

Sound fundamentally changes the way we perceive things. Games contain a lot of animations, and animated movement without sound can frequently be perceived differently than animation with sound.

In film, the creation of sounds that correspond in real life to what is on the screen is called *sound design*. The artists who create these sounds are called *sound designers*. This branch of the art is named after Jack Warner, who created the first sound effects for "talkies" (sound films) by recording sounds as footsteps and as they watched the film. Their method required the audio to be synced with the film. Today, although the modern day non-linear editing system (NLE) like Pro Tools can be recorded later with the action.

In film and television, the sound is a product of all the elements of the mix is completely different. It works exactly the same way.

In games, however, the sound is a medium, we can create sounds that are needed. As a result, the sound is a product of all the elements of the mix is completely different. It works exactly the same way.

When a game is created, sound effects are added that call the sound to life. The sound may create custom sounds. In some cases, the sound is added to the game. In some cases, the sound is added to the game.

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In film, the creation of sound effects to
correspond in real time with the action on
the screen is called **Foley**, and the people
who create these sounds are called foley
artists. This branch of sound design is
named after Jack Foley, who originated
the art in 1927. He and his crew created
effects for "talkies" (the first movies with
sound) by recording sound effects (such
as footsteps and closing doors) in real time
as they watched projections of the movies.
Their method required perfect timing so
the audio synced with the action in the film.
Today, although the art is still practiced,
modern day non-linear audio editing from
a DAW like Pro Tools means that the sound
can be recorded first and then synchronized
later with the action on the screen.



Vancouver Film School student recording old typewriter foley in sync with
a video. Foley for games is recorded the same way, sometimes with and
sometimes without the need to see the action on a screen.
Credit: Vancouver Film School.

In film and television, sound designers work in a linear way; they follow the timeline of the story, and the
product of all these sound effects, ambiances, music and voice-over is carefully mixed all together. Once
the mix is completed it always sounds the same when played back. In games, a cutscene, or a cinematic
works exactly the same way.

In games, however, it's a bit of a different story, as we've mentioned. Because games are a non-linear
medium, we can't mix all of our various sounds into a single file, because *we don't know when they might
be needed*. As a result, we have to be prepared to trigger any sound at any time in the game.

When a game sound designer is working on interactive gameplay areas, all the elements—music,
sound effects, and voice-over—are rendered out as individual files, and added into a database of code
that calls the sounds when specific events take place in the game. In the game world, sound designers
may create custom libraries by recording their own sounds or they may use pre-made sound libraries.
In some cases, they may use processing and synthesizers to create brand new, never-before-heard
noises.

In the end, the computer processor actually calls the audio on the fly in real time as the player moves
through the world. In simple platforms such as most mobile and social games, the sounds must be pre-
mixed (or balanced in terms of level) before they are triggered. In more sophisticated platforms such
as console games, the audio engine can actually mix audio in response to the player's actions. These
engines can act like virtual foley artists by adding signal processing effects to the sounds in real time.
Note, however, that not all games are alike; the platform specifications define the parameters of what
can and cannot be done with sounds inside a game—all of these can be different—which continually
presents audio professionals in games with new challenges.

Let's discuss the function of sound both inside and outside of the game environment. For this we'll introduce a new term to keep in mind—**diegetic**. No, it's not a book by L. Ron Hubbard. The word comes from the Greek word *diegesis*, which means "recounted story", and refers in this case to whether a sound seems to come from the game environment, or not. Let's examine further:

Diegetic Sound

Diegetic sound is sound from sources that are visible on the screen or that are implied to be present because of actions occurring in the game.

Examples of diegetic sound can include the following:

- character voices
- sounds from objects on screen
- music from musical instruments shown in the game.

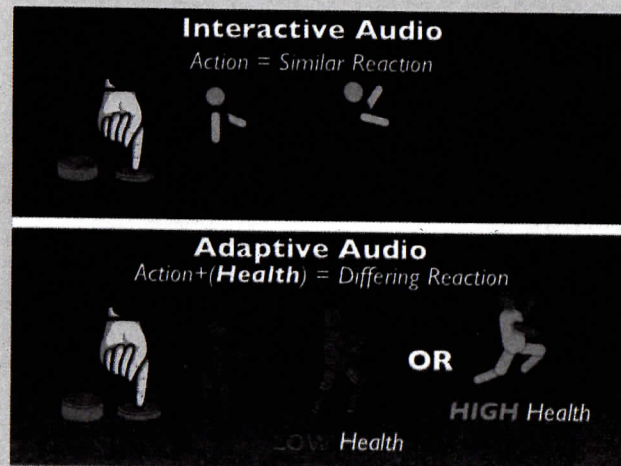
Diegetic sound is any sound originating from a source within the game's world. This can also be referred to as actual sound.

Non-Diegetic Sound

Non-diegetic sound, as you have likely guessed, is sound from sources that are neither visible on the screen, nor present in the action.

Examples of non-diegetic sounds include the following:

- the voice of a narrator
- a sound effect that is added for dramatic effect
- the music soundtrack.



Interactive audio provides a direct relationship to an action that produces identical or similar results. Adaptive audio takes into account one or more game factors (Health in this example) in addition to the action to create different results.

Non-diegetic sound comes from a source outside the game's story space. Non-diegetic sound is also called commentary sound, though it certainly includes much more than just commentaries.

- **Dynamic audio** is audio that is designed to change, either in response to the user, or in response to changes in the gameplay environment. Dynamic audio encompasses both of what we call interactive audio and adaptive audio.
- **Interactive audio** is a sound event that occurs in response to the player directly. In other words, if a player presses a button on a controller, the character on screen might move in

some way, and really matter. If it's an example of a sound effect, it's **Adaptive audio** directly. Adaptive

Sound Effects

You can further categorize sound effects into several categories we mentioned earlier: voice-over, You level is about sound

Background ambient creates the setting in which the action will take place. These sounds last for several seconds and avoid sounding repetitive. Background ambient sound is used for background ambient sound in a haunted house.

Foreground sound occurs when a character or object within the game environment makes a sound. A non-diegetic foreground sound is an announcement over a character's voice or an object but not an action.

Interface sounds are sounds attributable to the player's actions. Some interface sounds are the player clicking a button. Others might be the player's health, for example, there is a sound associated with a player running out of energy.

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some way, and that event creates a particular sound—it might be a sword swish, or a footstep—it doesn't really matter. If the player presses the button again, the sound will re-occur. The sound involved is an example of a simple interactive sound effect.

- **Adaptive audio** occurs in the game environment in reaction to gameplay rather than to the user directly. Adaptive audio changes as the game changes.

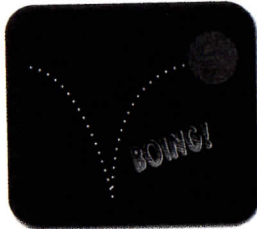
Sound Effects Layers

You can further categorize sounds. Remember the big three categories we mentioned in Level 1: music, sound effects, and voice-over. You can break those down further. Since this level is about sound, let's look at the various subcategories here.

Background ambience is environmental audio. It creates the setting and mood in which the action will take place. These sounds usually last at least several seconds and may last a couple of minutes to avoid sounding repetitive. An example of diegetic background ambience might be the sound of water if the character were near water. A non-diegetic background ambience might be spooky noises in a haunted house.

Foreground sounds are the individual sounds that occur when a character moves around or encounters objects within the game space. Diegetic foreground sounds might include laser blasts or impact sounds when a character encounters an object. A non-diegetic foreground sound might be an announcement over a public address system to warn of an intruder, or a power-up associated with an object but not otherwise related to on-screen action.

Interface sounds are sounds that are directly attributable to the game interface and which the player uses to view status or change settings. Some interface sounds may be directly related to the player clicking or rolling over an icon or a button. Others might be notifications or changes in status; for example, there may be an interface sound associated with a player's health as a result of running out of energy.





Now that you know a little bit about what kinds of sounds you might find inside a game, let's put you in an interactive environment. Go to the App in the Holodeck Section and select the 'A Day In the Forest' demo. Enjoy a nice walk through a little mushroom village. A special place where you will have the opportunity to observe changes in your sonic reality in real time, and to experience how game sounds are triggered.



Credit: Jeremy Engel.

Formats for Sound Files

Sound files come in many formats. Some game platforms use proprietary formats, while others use open standards such as Ogg Vorbis. The list is long, so for the purposes of this course, we will look at a select few, the ones you're most likely to see.

Open, Uncompressed Audio File Formats

These file types are examples of linear pulse-code modulation (PCM) audio. The workings of PCM audio is a complex topic, but what you should know is that an uncompressed format generally offers you the best quality audio (depending on the sampling rate or bit depth the sound was originally recorded at). As we mentioned in Level 3, audio file size is dependent on sampling rate and bit depth. For example, a sound recorded with a bit depth of 16 bits at a sampling rate of 44.1KHz results in a file of approximately 10MB per minute of stereo sound or 5MB per minute of mono sound (also commonly known as the Red Book standard).

Interleaving

Besides bit depth and sample rate, there is another characteristic of audio files to be aware of, and this pertains to how a sound channel is treated in the file. If a file contains more than a single channel, it is referred to as an *interleaved* file. The term means essentially to join channels together. So a single stereo file that has two channels is called an interleaved file, whereas two separate Left and Right files with the same material are referred to as non-interleaved (sometimes referred to

as multi-mono). Mono video track is also c

WAV is the standard uncompressed (PCI

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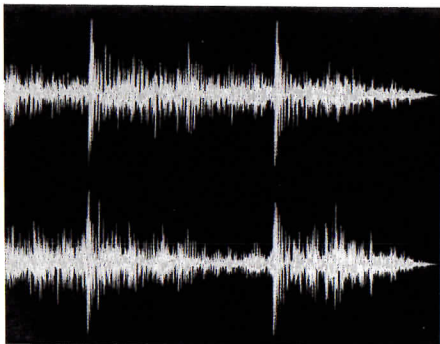


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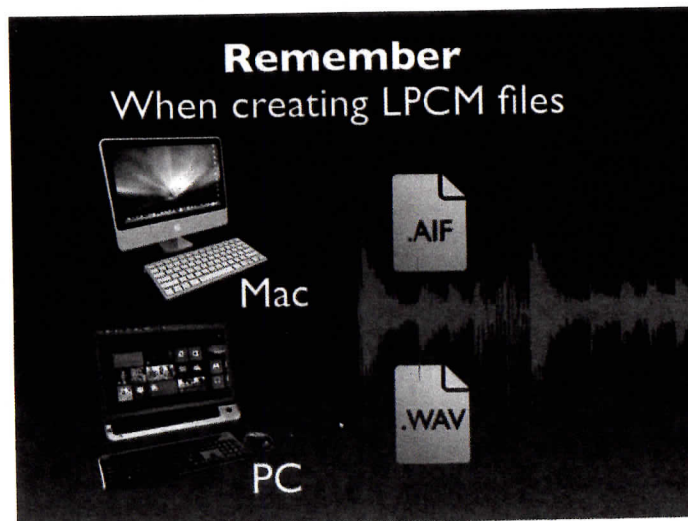
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as multi-mono). Movie files can have interleaving too—in this case the video track is also considered a channel as well as the audio.

WAV is the standard audio file format used natively in Windows PCs for uncompressed (PCM) sound files.

AIFF is a standard audio file format used natively in Macintosh computers for uncompressed (PCM) sound files.



Open, Compressed Audio File Formats

Compressed formats take up less data space than uncompressed formats, but they lose audio quality in the compression process (how much they lose depends on the bit rate of the compression). These perceptually based formats take advantage of a limitation in human hearing called **auditory masking**. This means that a lot of data existing outside of our perceptual limit can be removed from the sound file, thus saving space.

The format of compressed files in general requires the presence of a **codec** (short for COmpression/DECompression), a specialized piece of code that runs on software or hardware to decompress and playback the file. The encoder can process the files at a constant rate of speed (constant bit rate, known as CBR) or it can vary the rate depending on the complexity needed (variable bit rate, known as VBR). Be aware that some hardware devices and audio engines may not support playback of VBR encoded files.

MP3 (MPEG Layer 3) is currently the most popular format for downloading and storing music, and it is also used in games. 'MP3 files are compressed to roughly one-tenth the size of an equivalent PCM file.' MP3s can be compressed at a variety of bit and sample rates depending on the desired size and quality of the final audio.

Pro Tip

To make your life a little bit easier, as a general rule, if you know your developer is using a Mac give them .AIF files, if they are using a PC give them .WAV. If you are not sure, deliver both. This way you will mitigate the chances that the developer will have to come back to you for a re-delivery if for some reason software compatibility with these formats becomes an issue.

Pro Tip

One thing to know about MP3s is that they are not the most reliable at looping audio smoothly. This makes it tricky to use MP3 for things like ambiences or music. Using MP3 for triggering one shot sound effects or voice-over files is no problem, however. The reason for this is that MP3 was designed on an older, video frame-based approach. If a sound's length does not fill the frame completely, a gap is introduced that uses up the rest of the frame. This can cause significant headaches for sound designers and the solution is often determined by the game engine or platform that the developer is using, so make sure you ask questions and speak with the developer or integrator/programmer about this specific annoying issue in advance of delivery.

Ogg is a free, open-source container format supporting a variety of codecs, the most popular of which is the audio codec Vorbis. Vorbis files are often compared to MP3 files in terms of quality. Ogg files are not as commonly supported as MP3 files; there is no support for Ogg playback on any Apple device natively.

FLAC is a lossless compression codec. You can think of lossless compression as like zip but for audio. If you encode a PCM file to FLAC and then decode it again while playing, it will be a perfect copy of the original. (All the other codecs discussed here are lossy.)

Proprietary Audio File Formats

WMA (Windows Media Audio) is the format owned by Microsoft. It is Microsoft's closed source alternative to MP3.

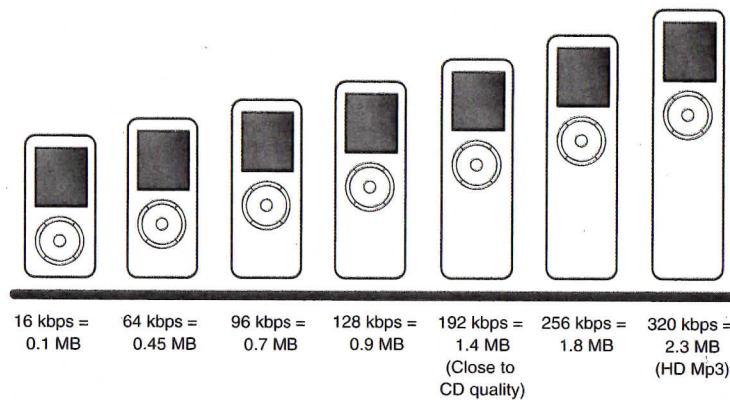


Chart showing a range of MP3 bit rates with relative quality. Measurements are based on a 10MB, 1 minute uncompressed stereo WAV file 16 Bit @ 44.1KHz

AAC (Advanced Audio Coding) is the format based on the MPEG4 audio standard owned by Dolby. A copy-protected version of this format has been developed by Apple for use in music downloaded from their iTunes Music Store.

Other Formats

.AU is the standard audio file format used by Sun's version of Unix and Java.

.CAF Core Audio Format—also known as 'Cripes Another Format!' (respect to the late Jeff Essex). This format is the new

Apple-based format prominently in

.BWF Broadcast Wave by PCs and use .BWF or .WAV extensions. .WAV files.

.SD2 is the once used by from Digidesign. WAVs in Pro Tools.

.MIDI is the extension at all. MIDI is a protocol to speak with electronic sound-making sources include machines or, multiplatform device

Birth of Sound

OK, let's say you've so sounds for a game. You need to do before starting

Before you start any game expected of you. Ask your

What Kind of

Is it a side-scrolling kind budget console game

What Is the Target Game?

Is the game for adults boys or girls? Some considerations affect

What Is the Performance

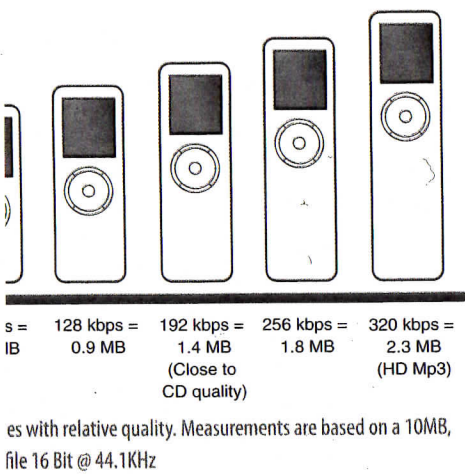
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Apple-based format for audio files in Logic Pro and used prominently in iOS for seamless looping.

.BWF Broadcast Wave Format is a new version of WAV files supported by PCs and used in the Pro industry. They can be found with either .BWF or .WAV extensions. Pro Tools is now using BWF formatted .WAV files.

.SD2 is the once venerable, now obsolete Sound Designer 2 format from Digidesign (now AVID). It is now largely replaced with BWF WAVs in Pro Tools.

.MID is the extension for a MIDI file, which is not an audio file format at all. MIDI is a communication protocol for electronic instruments to speak with each other. It is non-proprietary and requires a sound-making source to produce sound. Such sound-making sources include external MIDI devices such as keyboards or drum machines or, more commonly, sound sets inside computers or platform devices.

Birth of Sound Design in a Game

OK, let's say you've somehow managed to get your first gig designing sounds for a game. Fantastic! But there's a lot of preparatory work you need to do before starting out in earnest.

Before you start any game project, you should know the scope of what is expected of you. Ask yourself and others the following questions:

What Kind of Game Is this?

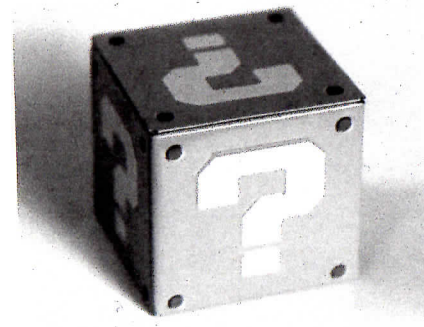
Is it a side-scrolling kids' game with goofy cartoon graphics, or is it a big-budget console game with super life-like animations ?

What Is the Target Audience for this Game?

Is the game for adults, or is it for small children? Is the game aimed at boys or girls? Some sounds are more appropriate for certain audiences than others.

What Is the Pace of the Game?

Is the game fast or slow? Is it supposed to feel frenetic or mellow? These considerations affect sound choices. A puzzle game will likely have more



Credit: Raymond Bryson.

relaxed sounds, while a fast-paced action title will result in a more frenetic palette.

What Platform Is the Game being Developed for?

The platform determines how you will prepare the sound for final delivery. You can generally expect different workflows for different platforms. Also, the more you know about each system, the more optimized your sound design can be.

What Is the Audio Budget for the Game, and How Big can the Files be?

Sorry, this isn't what you're getting paid, but rather how much space you'll get in the game itself for your assets. It is important to know what you are up against before you get too far down any road. Nothing is worse than spending considerable time creating awesome sounds only to find out there is no room for them in the game.

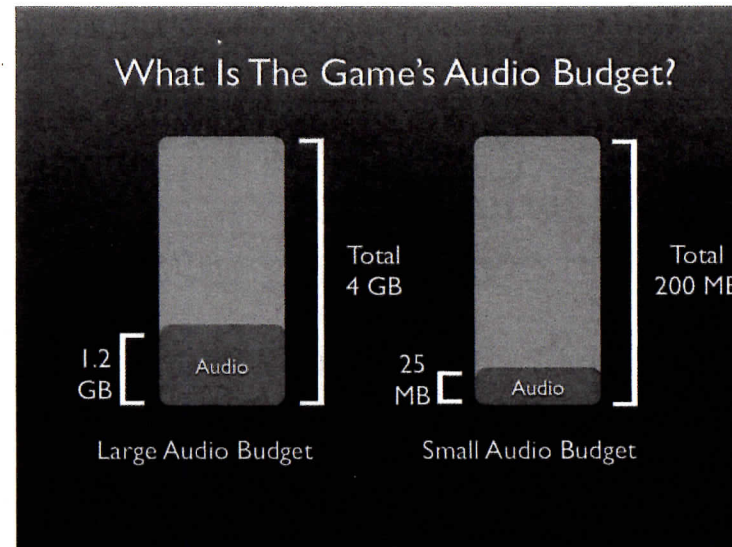


Diagram showing differences in hardware budgets. Sometimes you can be restricted by the space you're allowed, and other times you can be restricted by what the hardware itself will allow.

What Is the Platform of this Game

Even if you have the final say, you may not have the final say, especially true for portable platforms.

In many cases, the game designer has to answer to these questions. In some cases, the programmer or integrator may be afraid to ask questions.

After you have gotten the platform, you can make creative decisions. When you make overall creative decisions, you are making decisions.

The Asset List

As you make these choices, you will have to decide that will occur in the game. This is called the **audio asset list**.

This list is incredibly important. It is a list of sounds that will be used in the game. It keeps you on track during development. Producers or developers will have it included in the game. It has nothing at all. It has one yet, go above and beyond already use elaborate in the game.

Each item in an audio asset list has information:

- the name of the sound (voice-over);
- a file name that follows the naming convention;
- a description of the sound (dialogue);
- an indication of when the sound will be triggered.

What Is the Hardware Space Budget of this Game?

Even if you have the financial budget to make all those cool sounds, you may not have the allotted physical memory space to put them in. This is especially true for portable and mobile games.

In many cases, the game designer or producer will have the answer to these questions. In other cases, you may need to speak with the programmer or integrator to get the information you need. Don't be afraid to ask questions—in game development, knowledge is king!

After you have gotten the information you need about the game type, environment, platform and budgets, it is time to start making some creative decisions. What will and won't be sonified in the game? What overall creative direction do you plan to take?

The Asset List

As you make these choices, you'll also need to create a list of every sound that will occur in the game. The document that contains this information is called the **audio assets list**.

This list is incredibly important because it is your master list of all the sounds that will be used in the game, and is also your road map to keep you on track during the development process. Sometimes the producers or developer will already have this information. Sometimes they will have it included in a game design document. Or they may have nothing at all. It's up to you to ask about this list and if they don't have one yet, go about creating it. Additionally, some companies may already use elaborate asset management systems to track each sound in the game.

Each item in an audio assets list should contain at least the following information:

- the name of the sound broken out by type (music, sound effect, or voice-over);
- a file name that follows a standardized file naming convention;
- a description of the function of the sound (e.g., car sounds or dialogue);
- an indication of whether the sound is looping or a one-shot (play once) trigger.

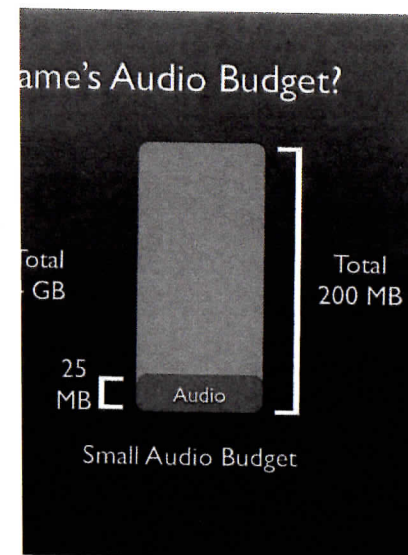
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Pro Tip

We can't stress enough the importance of a well-thought-out asset list and file naming convention in game audio design. Without it, hundreds or thousands of assets (or more) will have no version control or description as to their function within the game. Imagine editing hundreds of nifty sound effects and calling them all SFX_01, SFX_02 and on and on. This is easy and quick to do, but when this gets over to the programmer or integrator who's tasked with putting these sounds into the game, without an asset list, they will have no idea how these sounds function or when they are to be called. In some cases, they'll have no way to move forward, and in others, they will have to listen to every one of them and try and figure out their function and rename them, and they will *not* be happy. So, getting together with the producer and programmer ahead of time, and settling on a coherent file naming convention and asset tracking system in advance is a very smart thing to do!

Example of an Audio Assets List from the Game *Kinderbach*, produced by Zephyr Games

KinderBach - Audio Matrix				
Zephyr Games Inc.				
Location	Trigger	Description	File Name	Line
Title Screen	End of Music Start or Continue	Background Music Loop		
	Entrance	Background Music Start		
	Entrance from Game Start	VO	KinderBack_Line__01	Welcome to KinderBach!
	ALT	VO	KinderBack_Line__02	KinderBach!
	Idle Reminder	VO	KinderBack_Line__03	Let's learn about music!
	User Taps Upsell Button	SFX		
	User Taps on Games Button	SFX		
	User Taps on Lessons Button	SFX		
	User Taps on Store Button	SFX		
	User Returns from Sub-Menu	VO	KinderBack_Line__04	Welcome back!
Credits	Continued from Title	Background Music Loop		
	Entrance from Title	VO	KinderBack_Line__05	These people made this game!
	User Taps on Back Button	SFX		
Upsell Screen	Continued from Title	Background Music Loop		

An example of a basic Sound Asset document, usually found in spreadsheet form. Get used to seeing a lot of these! For really large game they may even use a database to organize sounds.

Credit: Zephyr Games.

In this example, the filename of the asset is listed in the fourth column. You can organize your list by whatever criteria you want. In this case, the creators of this game thought game location was the most important category, followed by the trigger of the sound (a button, an object in game, and so forth), the description (or category) of the sound, the file name, and, finally, a comment, which acts more like a description here.

Where do Sounds Come From?

Sounds come from many sources, some natural and some not so natural. The sources of sounds depend on the needs and requirements of the game.

Once upon a time, the only way to get sound for production was to create it yourself. If you needed the sound of a gentle stream flowing through a meadow, you went out to find a stream and record it. If you needed footsteps for a video, you created them yourself. For a science fiction feature, you might create the sound from scratch with a synthesizer. Shortly after the CD attained significant popularity, film companies and engineers began creating vast libraries of sound effects and making these libraries available to other designers for purchase. The practice continues today, but the Internet has changed the dynamics.

Industry-Sta

Today, the open market for ambient background sounds from these libraries to create your own soundscapes is not as costly. There is no shortage of sound designers to customize anything you need.



Sound Ideas and Hollywood sound makers, and were among the first to use sound libraries for television purposes. They are often the first to process these sounds, creating a unique sound for each project.

Download

With the advent of the Internet, sound libraries online are now available for download. You can listen to clips and download them for your project.



A few paid websites with sound libraries are available, and soundranger.com. The sound designers provide a variety of sound effects for download.

s List from the ed by Zephyr

te	Line
ack_Line__01	Welcome to KinderBach!
ack_Line__02	KinderBach!
ack_Line__03	Let's learn about music!
ack_Line__04	Welcome back!
ack_Line__05	These people made this game!

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Industry-Standard Sound-Effects Libraries

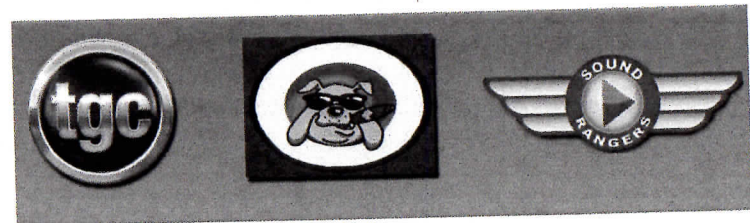
Today, the open market offers libraries of all kinds, from cartoon sounds to ambient backgrounds. Sound designers mix, edit, and recombine sounds from these libraries to produce original creations. It is generally advisable to create your own sounds, but original sounds take time and can be costly. There is no shame in using sound libraries, but it is preferable to customize anything you source to avoid sounding too generic.



Sound Ideas and Hollywood Edge are two very well-known and respected sound effect collection makers, and were among the first to offer complete libraries of sound effects on CD for film and television purposes. They are still used frequently today, though experienced sound designers will often process these sounds, due to their overly common usage in the industry.

Downloadable Sound-Effects Libraries

With the advent of the Web, many companies have begun providing sound libraries online. Such libraries offer immediate access: the ability to listen to clips and download them on the spot.



A few paid websites with sound effects. Left to right: thegamecreators.com, sounddogs.com and soundranger.com. These sites contract with a number of established as well as independent sound designers to provide a wide variety of sound effects that can be purchased digitally and downloaded.



These websites offer free sound effects for designers on a budget, which can be useful, but are often of dubious quality and may require processing to be effective.

Free Sound-Effects Libraries

The growing open source movement means that often you can find sounds at no cost at all. But you must be careful to ensure that you have the rights to use these sounds in commercial products.

Once you have found your cool sounds, you'll want to insert them into a multi-track digital audio workstation (DAW) to edit and layer them. DAWs provide sound designers with toolboxes for recording, editing, and manipulating sounds in creative ways. Sound designers may use software plug-ins, and other editing techniques to create custom effects and evocative landscapes. The job of the sound designer is to manipulate sounds to enhance the events on the screen. Simple games may call for just a few sounds, while more complex games may require thousands. Let's go over some of the types of techniques and processing sound designers regularly use.

EDITING TECHNIQUES

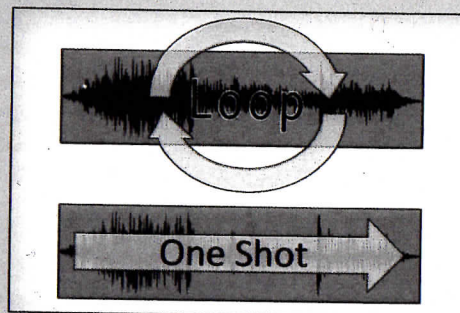
One Shots and Looping

A One Shot file is a file that plays only one time when it is triggered. These were originally triggered from tape cartridges and used a lot in radio stations to create canned laughter and on the spot pre-recorded sound effects. The term has since developed but it still refers to a file that plays in entirety one time only, with no interruptions. A One Shot file should be carefully edited so that it starts and ends smoothly, with no clicks or pops.

Looping is, of course, absolutely important, both from a resource perspective as well as a gameplay perspective. The creation of seamless loops in games is essential, because games are often indeterminate with regards to time, and you don't have a lot of audio budget with which to store files on the platform.

Loops can be of background ambient material, or of foreground local sound effects. Testing your loops for clicks and pops is a must. One common way to avoid this nasty issue is to make sure your audio waveform comes very close to the exact middle of the waveform on both the beginning and at the end—what's often referred to as a *zero crossing*. Other techniques of looping can include copying and reversing the sound, crossfading the ending material into the beginning, and many more.

Take it from us—learning how to seamlessly loop audio will be an absolutely required skill. Anyone who provides loops that have pauses, clicks, or pops, will soon find themselves having to redo their work. And



Credit: Jeremy Engel.

unfortunately, even with all the situation and having to deal with

Beyond the simple editing task, part of a sound designer's job is to use 4 or 5 effects you'll be encountering



Equalization, or the process of adjusting the frequency spectrum of a sound, in order to produce a desired effect. Credit: Jeremy Engel.

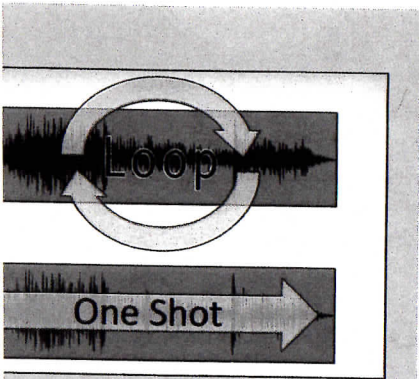
Equalization

Filtering or equalization (EQ) is the process of adjusting the entire frequency spectrum of a sound, so that you can hear from the prime of your life. But you know that every note from an instrument you hear actually contains a complex set of frequencies or pitches occurring together. Each of these individual frequencies is called a **harmonic**; the combination of these particular relationships creates a unique sound. Between a human voice, a guitar, and the squeal of brakes. Each sound has a definable frequency range, from the fundamental (the lowest frequency) to the overtones (the higher frequencies) and proceeding up through a harmonic series. Harmonics are defined in terms of the color and the quality of the sound.

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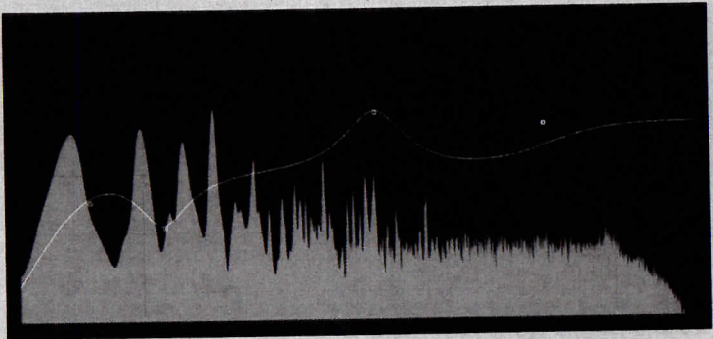
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Beyond the simple editing tasks that we've discussed here, processing audio with plug-ins is also a huge part of a sound designer's job. Again the categories of processing are absolutely vast, so here's our top 4 or 5 effects you'll be encountering.



Equalization, or EQ, controls the filtering of the frequency spectrum or harmonics of a sound in order to produce desired results. This is very commonly used when preparing any kind of audio assets for film or TV or recordings, in live sound mixing and of course, in games.
Credit: Jeremy Engel.

Equalization

Filtering or equalization (EQ for short) affects the entire frequency spectrum of a sound. You already know that you can hear from 20Hz to 20KHz in the prime of your life. But you may not be aware that every note from an instrument or any sound you hear actually contains a complex array of frequencies or pitches occurring simultaneously. Each of these individual frequencies is called a **harmonic**; the combination of all harmonics in a particular relationship creates the sonic differences between a human voice, a guitar, an explosion, and the squeal of brakes. Each of these sounds has a definable frequency range, starting with the fundamental (the lowest harmonic—there may be more than one of these in more noise-like sounds) and proceeding up through what is called a harmonic series. Harmonics are often perceived in terms of the color and the quality of the sound.

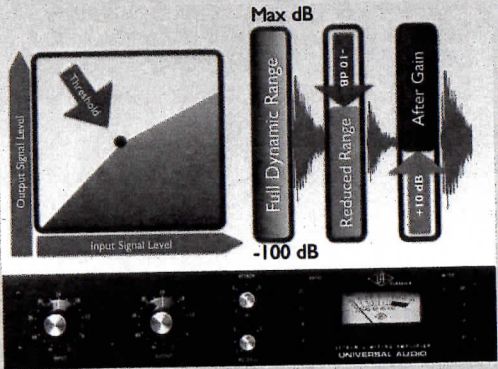


Diagram of Compression/Limiting: When a signal passes over a particular threshold level, its dynamic range is reduced. This signal can then be increased in overall volume afterwards, resulting in a much louder sound. Compression will still allow the input signal to increase in level, while limiting will keep the sound held to the level of the threshold regardless of input volume. Compression/Limiting is an extremely common effect to use both in asset preparation and mixing/mastering.

Credit: Jeremy Engel and Scott Looney.

In general, the more harmonics a sound has, the brighter and buzzier the sound will be. Higher harmonics add a buzzy, thin quality to a sound; lower harmonics add roundness and fullness. Reducing the number of higher harmonics makes the sound rounder, duller, and more muffled. Starting from the fundamental and eliminating lower frequencies makes the sound thinner and buzzier; the sound loses its body. All sounds have a wide frequency spectrum; changing or emphasizing areas of EQ can make a phone call sound as though it is coming through a small speaker or a call from headquarters sound as though it is being played inside a helmet, like in *Halo*. EQ also plays a vital role in the final mix of a game; the proper use of EQ puts all sounds in the proper places, so they can be clearly delineated in the final mix.

Compression

Unlike the compression discussed earlier, this type of compression does not reduce file size; instead, it reduces dynamic range. This compression is accomplished through automatic detection of a certain threshold. If an audio signal goes over this threshold, the output level is reduced in volume. That may not sound useful, but if the reduced audio is then increased in volume, the result is a much louder and more present sound. In a game, compression can be very useful in balancing out the volume levels of a multitude of different audio files and channels.

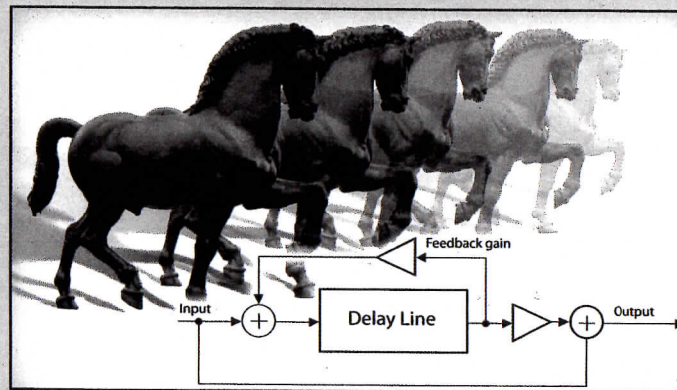


Diagram of Delay effect: Although based on a simple concept similar to an echo, the effect is then 'fed back' to the input to produce repeated echoes, eventually fading out to silence, as shown here with the horse sculptures.

Credit: Jeremy Engel.

Delay

Delay is a popular form of time manipulation, closely related to echo. Delay can be used to create a variety of effects. Multiple delays (often called tap delays) can make a character sound as though he is on the surface of the moon or make a single pair of horse hooves sound like a pack of wild ponies.

Reverberation

Another common effect is reverb (short for reverberation) to simulate various environments. Reverberation results in sound bouncing off every available surface in an enclosed space. Imagine the acoustics in a large church or a big concert hall and imagine what footsteps would sound like in a place that large. Reverb is a dynamic effect that changes when a character enters a room of a different size.

Sound Layering

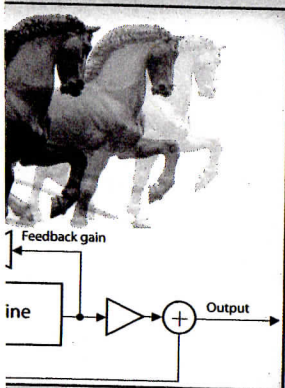
One of the most common sound-design techniques is layering, which involves creating a new sound from a combination of sounds. For example, the sound of a bat hitting a baseball may consist of several sounds mixed together. The first layer is a simple wood bat. The second layer is a pile driver as it pounds a large stake. The third layer is a firing gun, and the fourth layer may be a crowd cheering. All four elements are mixed together to create the final animation of a batter hitting a ball.

3D Sound

3D sound has become very popular in video games. It allows sound to come from the screen and exit on the other. Other sound recording techniques called binaural recording can make characters appear larger than life when listened to through speaker placement to produce the effect. These techniques enhance the player's immersion. In some cases, hyper-realism. In most cases, middleware. You don't have to worry about the sound for triggering within the game.

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Sound Layering

One of the most common sound-design techniques is layering, which involves creating a new sound from a combination of sounds. For example, the sound of a bat hitting a baseball may consist of four sounds mixed together. The first layer may be a live recording of a baseball player hitting a ball with a simple wood bat. The second layer may add an extra-low end by combining the impact thud of a pile driver as it pounds a large stake into the earth. The third layer may introduce the explosion of a firing gun, and the fourth layer may add the sound of a large piece of paper catching on fire. When all four elements are mixed together, the resulting sound becomes the perfect accompaniment to an animation of a batter hitting a ball so hard that it bursts into flames in the game.

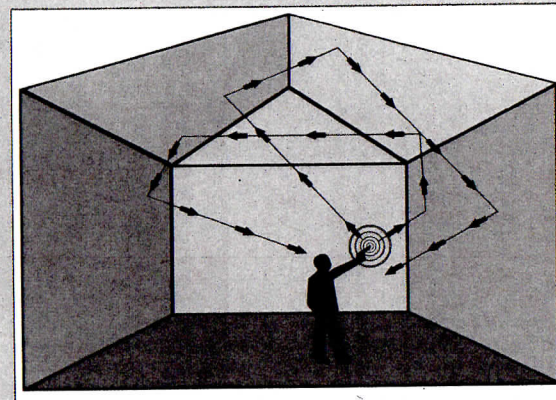
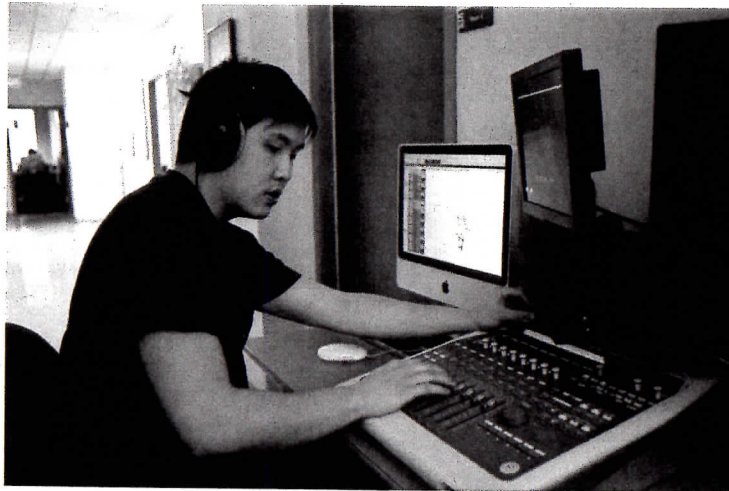


Diagram of Reverb effect: If the man in the picture was shooting a blank instead of a bullet, the sound from the gun would reflect off every surface in an enclosed area until its energy was used up. These reflections then get summed up together as reverb.

3D Sound

3D sound has become very popular in games. It is common to have a sound enter from one side of the screen and exit on the other. Other sounds play differently as they move front to back on screen. Special recording techniques called binaural recording are used to create three-dimensional sound fields that appear larger than life when listened to through headphones. Still other systems use surround-sound speaker placement to produce the effect of sounds coming from the side of or behind a player. These techniques enhance the player's immersion in the artificial environment and create a sense of realism or, in some cases, hyper-realism. In most cases, spatial sound is accomplished in the game engine or in audio middleware. You don't have to worry about 3D sound within a DAW, but you do have to prepare the sound for triggering within the game engine.



~ A sound designer at work, editing foley.

Credit: Vancouver Film School.

Creating Your Own Sounds

When designing your own sound effects, you should always keep an open mind. Let your imagination, eyes, and ears provide the answer. There is no one right or wrong way to design sound; this is a creative process with many solutions. In some cases, you may need very realistic sounds; in others cases, synthesized sounds may work better. You must consider every sound in relation to visual action. Sounds heard by themselves, while technically accurate, may not come across right when they are married to images and animations on screen. It is a strange phenomenon, but one you will find to be true.

It's always a good idea to record and edit your own custom sounds. Creating a custom library is a huge subject and a complex endeavor. In this book we are going to concentrate a bit more on the editing part rather than the recording. We do provide a few recording tips and tricks on page 115, in Level 7 of this book. All of the information below should also apply quite well to any custom library's.

Let's go over some advice for you to consider as you are sourcing and editing sound effects.

Use Synonyms

When you are searching for sounds, think of synonyms. For example, if you want a creaking sound, you might also search for the word 'stretching.'

Go General

If you can't find something in a specific category, searching for general categories helps. Let's say you're looking for a horse galloping. Instead of searching for the term 'horse' to see how many

Listen to the Who

You may find a sound buried in a large file. For example, let's say you need to find a minute-long ambient recording of a horse galloping. Instead of searching for the term 'horse' to see how many

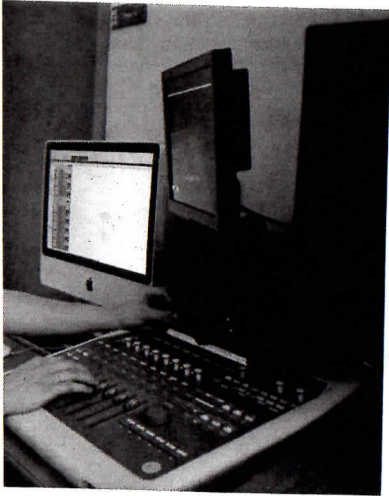
Think Interesting

When you are using existing sounds, think of interesting ways to edit or process sound effects. A sound that is often used in a genre and regarded as instant

A perfect example of such a sound is the Wilhelm Scream. This sound, which originated in the movie *Target*, has been used numerous times, yet it's still a



This screenshot from the movie *Distant Drums* shows the use of the Wilhelm Scream (originally titled 'Alligator'), which predated the *Charge of the Light Brigade*. It has since become synonymous with the movie *Jungle Drums*.



Go General

If you can't find something in a specific search, sometimes searching for general categories helps. Let's say you are looking for the sound of a horse galloping. Instead of searching for 'horse galloping,' search for the term 'horse' to see how many matches and variations turn up.

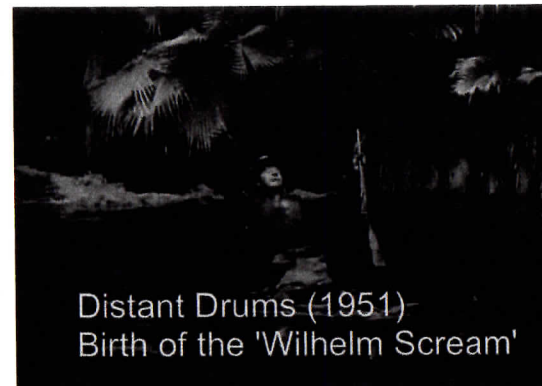
Listen to the Whole Sound

You may find a sound buried within the audio of another sound. For example, let's say you need to provide a hoof clomp. If you are having no luck finding anything useful, you might generalize your search and find a minute-long ambient recording of a horse cart passing in front of somebody in Italy. This file might contain a couple of isolated horse clomps that are perfect for your project. You can cut these sounds out of the original file to obtain the sounds you need.

Think Interesting and Original

When you are using existing sound effects, find interesting and original ways to edit or process sounds. Many sounds are well defined in the genre and regarded as instant clichés when they are heard.

A perfect example of such a recognizable sound is the Wilhelm Scream. This sound, which originated in the 1950s, has been around the block numerous times, yet it's still a good sound due to its over-the-top



Distant Drums (1951)
Birth of the 'Wilhelm Scream'

This screencap from the movie *Distant Drums* shows the first recorded use of the Wilhelm Scream (originally titled 'Man Being Eaten by an Alligator'), which predated the *Charge At Feather River* movie scene that has since become synonymous with the Wilhelm character. From the movie *Jungle Drums*.

1 Sounds

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intensity. Its original title was 'Man Getting Eaten by Alligator', and it originally came from the 1951 movie *Distant Drums*. However, the name 'Wilhelm' came from a character in a later film from 1953 called *Charge At Feather River*, which used the same sound for a scene where he gets struck by an arrow in the leg. You can thank Ben Burtt, the sound designer of the *Star Wars* films, for the revived popularity of the Wilhelm Scream. The Wilhelm Scream is used in every *Star Wars* movie—sometimes more than once!

In all cases, spend time polishing your sounds and making them as creative and original as possible. Elegant design takes time and is well worth the effort. You will also want to spend time fitting your sounds into the smallest footprint possible. Tight editing and file size conservation is always at the top of the list for game sound—file size matters!

Meet the Team

Over the years, the team of sound designers dedicated to game projects has grown. The following is a short list of the different jobs performed by sound designers on a range of games, from mobile games to AAA titles. Keep in mind that in smaller companies, many of these jobs are done by the same person. For the purposes of this level, we are breaking them out into the most general categories that you are likely to find out in the field.

Audio Director

The audio director oversees teams of audio designers, and usually directs those teams as they work on multiple titles simultaneously. The audio director will deal with everything from resources and schedules, to hiring talent. Most importantly, the audio director works with the game designer and producers to develop a coherent overall vision and sonic concept for the game, then translates that vision to the audio leads and designers who will bring it to life inside the game.

Audio Lead

The audio lead coordinates all the audio for a single game title. In smaller companies, where there is not as much simultaneous game development, the audio director and audio lead may in fact be the same person. It is not uncommon for an audio lead to create game assets, as well as meet with the game designers and producers on a regular basis during the production cycle.

Sound Design

The sound designer creates audio workstations and other audio and electronic sounds. As created using foley techniques and libraries. In some cases, the implementing the audio through using a variety of tools. middleware applications or programmers.

Audio Program

The integrator, or program and other production tools. Programmers are not usually. They have coding experience in Python and more, to go along with hardware capabilities. applications and tools that

Conclusion

So as you can see, there's a lot of sounds for games. On the one hand, the sound is nearly identical to film or TV, but on the other hand, in a gaming environment, it's dynamically at each moment, reacting to actions, or to open-ended events. That keeping track of exact timing to the game audio process wasn't enough, you have to deal with hardware standards. It's a somewhat of a technical challenge to know what's possible and what's out there, being a game

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Sound Designer

The sound designer creates sounds of all types for games using digital audio workstations and other sound-editing programs to blend natural and electronic sounds. As discussed, these sounds may be custom made using foley techniques, synthesis, or sourced from sound-effect libraries. In some cases, the sound designer may also find themselves implementing the audio they create into the game they are working on using a variety of tools. These tools may be off-the-shelf popular middleware applications or proprietary software developed by in-house programmers.

Audio Programmer

The integrator, or programmer, works with a game engine, middleware, and other production tools to integrate all sounds into the game. Programmers are not usually given the role of designing sounds. They have coding experience with languages like C++, Objective-C, Python and more, to go along with a deep knowledge of audio systems and hardware capabilities. Audio programmers often write custom applications and tools that are used by the rest of the creative team.

Conclusion

So as you can see, there's a lot of things to keep in mind when designing sounds for games. On the one hand the process of creating or sourcing the sound is nearly identical to what you'd do when making sounds for film or TV, but on the other hand, the open-ended nature of sounds in a gaming environment means the sound has to potentially react dynamically at each moment. Sounds can be directly linked to player actions, or to open-ended looping backgrounds. In addition, we see that keeping track of exactly which sound has triggered is as integral to the game audio process as designing the sound itself. And if that wasn't enough, you have to contend with constantly changing software and hardware standards. A good game audio sound designer, is also somewhat of a technical evangelist, so it becomes part of your job to know what's possible and what's not. It's definitely a crazy mixed up world out there, being a game audio denizen.



The Interactive Quiz for this Level is available in the App. In the main Classroom, click on the Quiz book to test your knowledge!