

Hi, welcome to this video on sound design, audio codecs and file formats. This is part of the multimedia technology for BA CSG108 and I am Dr. Shilpa Neenad Desai, Associate Professor at Fr Agnel College of Arts and Commerce Pilar-Goa.

In this video, we're going to look at sound design characteristics of the sound wave digital audio. What is meant by audio codecs and file formats which are used for audio.

The learning outcomes are: The student will be able to understand the concept of sound design and audio codecs and list the audio file formats. So let's get started.

What is sound design? Sound comprises of spoken words, voices, music and even noise. Whenever there is a sound, something is vibrating and that vibrating object is actually the source of the sound, which is transmitted through the air, that's called the transmission medium, and there is a receiver over here and the brain is the one which makes sense of the sound. So sound requires something to vibrate in the air. There is a wave pressure created, so when something vibrates it generates a wave and my eardrum will translate these changes in wave into a sound and sound is measured in decibels. Sound waves are known as a wave form.

Sound is described using two characteristics. A sound wave has frequency, also referred to as pitch and an amplitude which represents the loudness of the sound. So let's look at what we mean by frequency. Frequency is a measure of how many vibrations occur in one second. This is measured in Hertz and directly corresponds to the pitch of the sound. So the more frequent vibrations occur the higher the pitch of the sound, so we can have this wave over here, you can see this has certain frequency and now if I draw another wave this has a higher frequency. So wave A has a lower frequency, low pitch, and B has a higher frequency, high pitch.

The more frequent vibrations occur in the higher pitch of the sound. We cannot hear all the sounds we can hear from 20 Hertz to 20 kilohertz, so there is a limit. There are vibrations which are below 20 Hertz. Sounds below 20 Hertz are called infrasonic and sounds which are above 20 kilohertz, are called ultrasonic, but we can hear only from 20 Hertz to 20 kilohertz.

Besides frequency, there is another characteristic of a sound wave, which is the amplitude. Amplitude is the maximum displacement of a wave from an equilibrium position. So if this is the equilibrium position and this is the sound wave which is generated, then this is referred to as the amplitude. The louder the sound, the more energy it has and the amplitude will be more. This means a loud sound will have a larger amplitude. So if we look at this, so if I have two sound waves, and if I'm speaking softly, then this wave which is generated will be soft and if I speak loudly then the wave which is generated will have a higher amplitude, it has more energy, more amplitude.

Digital audio data is the representation of sound that is stored in the form of sample points. So whenever we speak, a sound wave is generated and it is, we take sample points on that sound wave and generate the digital audio data. Quality of the digital audio data depends on sampling rate, that is the number of sample points taken per second, which is measured in Hertz. So suppose we have a wave and we

choose some points on this, so these are our sample points. The wave generated corresponding to the sample point will be something like this. If the sampling rate is high, that means we have more number of sample points on the wave. The wave generated will be more like the actual wave, which will improve the quality.

There are three sampling frequencies, most often used in multimedia. Amongst this the best which is used as 44.1 kilohertz. You could use a higher sampling rate too and besides that there are the sampling rates also, the higher the sampling rate, more the measurements are taken, better quality, lower sampling rate. So this has a low sampling rate. This has a high sampling rate, higher sampling rate. It will be better quality, low sampling rate, low quality of the audio.

Factors that affect the quality of a digital audio are sampling rate and sample size. We saw what the sampling rate is. The other factor is Sample Size, also referred to as resolution. It refers to the number of bits used to record the value of a sample or sample point in a digitized signal. Besides sampling rate and sample size, there are other features also which affect the quality of the audio. That includes quality of the original audio source, the devices which are used, the capture devices, and the supporting hardware, the characteristics which are used for the capture, and obviously the playback environment.

Now when we capture any sound data in its raw form is a huge data size file size. So whenever we want to transfer this over the network or store it, we would want to compress it so for transferring data, especially we use codecs which refer to a compressor, decompressor software, or a coder decoder software. A codec is a software that compresses a stream of audio or video data for storage or transmission, and then decompresses it or gets it back to the original form for playback. There are many codecs that do this with special attention to the quality of music or voice after decompression. So some codecs are lossy and trade quality for significantly reduced file size. That means whenever we refer to as a lossy codec, you won't get exactly the original sound back, but normally somebody who doesn't know or is not an expert will not notice the difference. So lossy codec gives you reduced file size and it's good for transmission speed. Some codecs are lossless, so they don't alter the original data. You get back the original data when the decompression happens. So while editing your audio files, be sure to save your files using lossless format or codec. Repetitive saves in a lossy format will cause quality degradation. You will get a not so good quality audio output each time. So the codecs are used for transmission and now let's look at audio file formats.

What is a file format? An audio file format is simply a recognized methodology for organizing and usually compressing the digitized sound data bits and bytes into a data file. That is how the data will be stored, and then the playback environment will use it to play the audio file. The file name extension usually identifies which method of storage is used, so it's basically some kind of storage method which is used for the file. Now we have three major platforms. That is your Macintosh, Windows and Unix and each of this has its own file format, which is called the raw uncompressed file format. For Macintosh operating system or Mac OS, the audio interchange file format AIFF is used. By default, Windows uses the WAVE file format and Unix uses AU file format.

There are a large number of sound file formats and multimedia containers. Many a times file formats and multimedia containers are confused. Multimedia containers have additional data besides the file format. Normally, multimedia containers are also used for video file formats like MP3 or MP4 is a multimedia container that store sound data, so there are large number of file formats for sound data. In fact, there are more than 300 different file name extensions which are used for sound files, but we won't look into all the 300 different file formats for audio, but we'll look into some of the more famous ones and one of the most famous which changed everything is the MP3 format, which is MPEG one layer 3 audio.

Besides that, another windows format, which is a lossless format, is Windows Media audio format. Then we have the mobile sound format which is used in mobile phones and we have advanced audio coding format. So there are various different types of formats.

The most common found formats you may have seen are wave, aiff and so on. So these are all the file format for ringtones, we have these file formats. So there are a large number of file formats, some uncompressed, some compressed file format. Amongst this, this one is the most popular and which has changed quite a bit of how audio codecs and compression in audio works, so be sure your audio software can read and write the format you need. Normally VLC player, is able to play a lot of file formats.

One of the most important file formats most popular is the MP3 file format, which achieves compression ratios of ten is to one while maintaining high quality. Although it's a lossy file format which results in loss due to compression of some data, but that data is not the data which is really required, which we cannot hear, or which we cannot make a difference out of. An MP3 is popular, as a means of compressing audio, particularly for music and for downloading over the Internet, MP3 is one of the most used file formats for audio. Besides that, before MP3, many of the websites used a file format called MIDI audio. The musical instrument digital interface. It's more over used for karaoke nowadays where you don't have the sound, but you don't have the speech (the wordings), but only the background score. This was used before MP3 and this stores data in a different format, as music notes, it was popular when audio was required for websites earlier because of its small file size, but now mostly we go for MP3.

So these are the different file formats which we see. These are mainly MIDI file formats, and they are moreover used for karaoke. These are the uncompressed file formats and this is one of the most popular audio file format.

So in this video we saw the characteristics of a sound wave and digital audio under sound design, audio codecs and the various file formats used in audio. These are the references. Thank you.