MMGD0203
MULTIMEDIA DESIGN

Chapter 4
Sound and Video

Topics:

- Introduction to Sound

- How is Sound Produced?

- Sampling

- Storing Audio Data

- File Format

- Introduction to Video

- Advantages of Digital Video

- Video File Format

Sound

Introduction to Sound

- Sound is the best way to attract attention.

- Often audio provides the only effective way to convey an idea, elicit an emotion, or dramatize point.

- Sounds also can be combined in a multimedia presentation to provide information and enhance the other media being presented.

Sound

Why Sound is Important in Multimedia?

- To reinforce message or theme
- To set the mood
- To catch the interest of the audience
- To alert the audience
- To include narration: effective for training and educational application.

Sound

Types of Sound

- Music
  - Background
  - Attention grabber
  - Sound effect
- Speech
  - Narration
  - Instruction

Sound

Sound Wave Characteristics

- Two main characteristic in sound waves are **FREQUENCY** and **AMPLITUDE**.

- Frequency in the number of cycles a sound wave creates in one second.

- A cycle is measured from one wave peak to another.

- The standard measurement for frequency is called HERTZ (Hz).

Sound

Sound Wave Characteristics

- Amplitude is the volume or loudness a particular sound makes.

- The louder the sound, the higher the amplitude will be.

- The unit of measure for loudness or volume is decibel (dB).

Sound Wave Characteristics
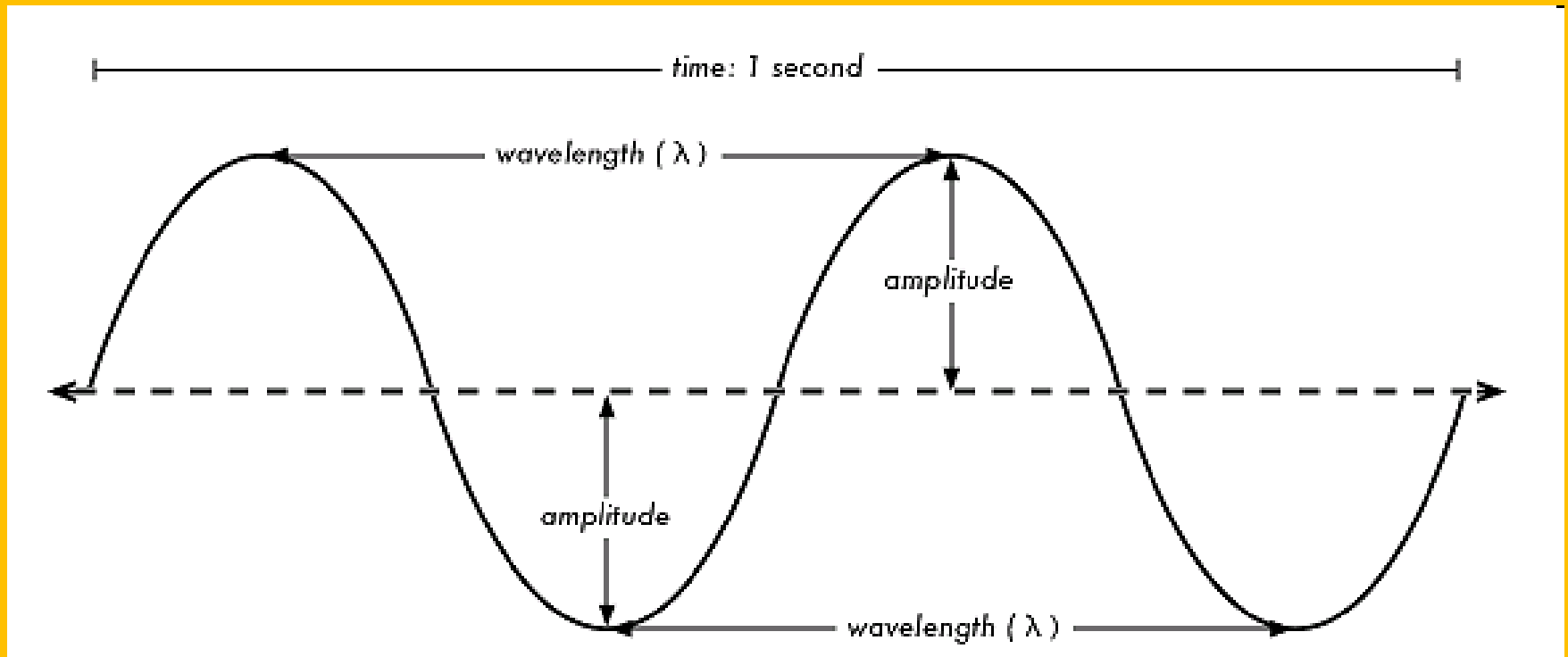
Digital Sound

- Refers to the reproduction and transmission of sound stored in a digital format.

- The digitizing and storage of sound or music on a computer or compact disc.

Conversion

- A digital audio signal starts with an **analog-to-digital converter** (ADC) that converts an analog signal to a digital signal.

- After being sampled with the ADC, the digital signal may then be altered in a process which is called digital signal processing

- The digital audio signal may then be stored or transmitted.

- The last step for digital audio is to be converted back to an analog signal with a **digital-to-analog converter** (DAC).

Conversion
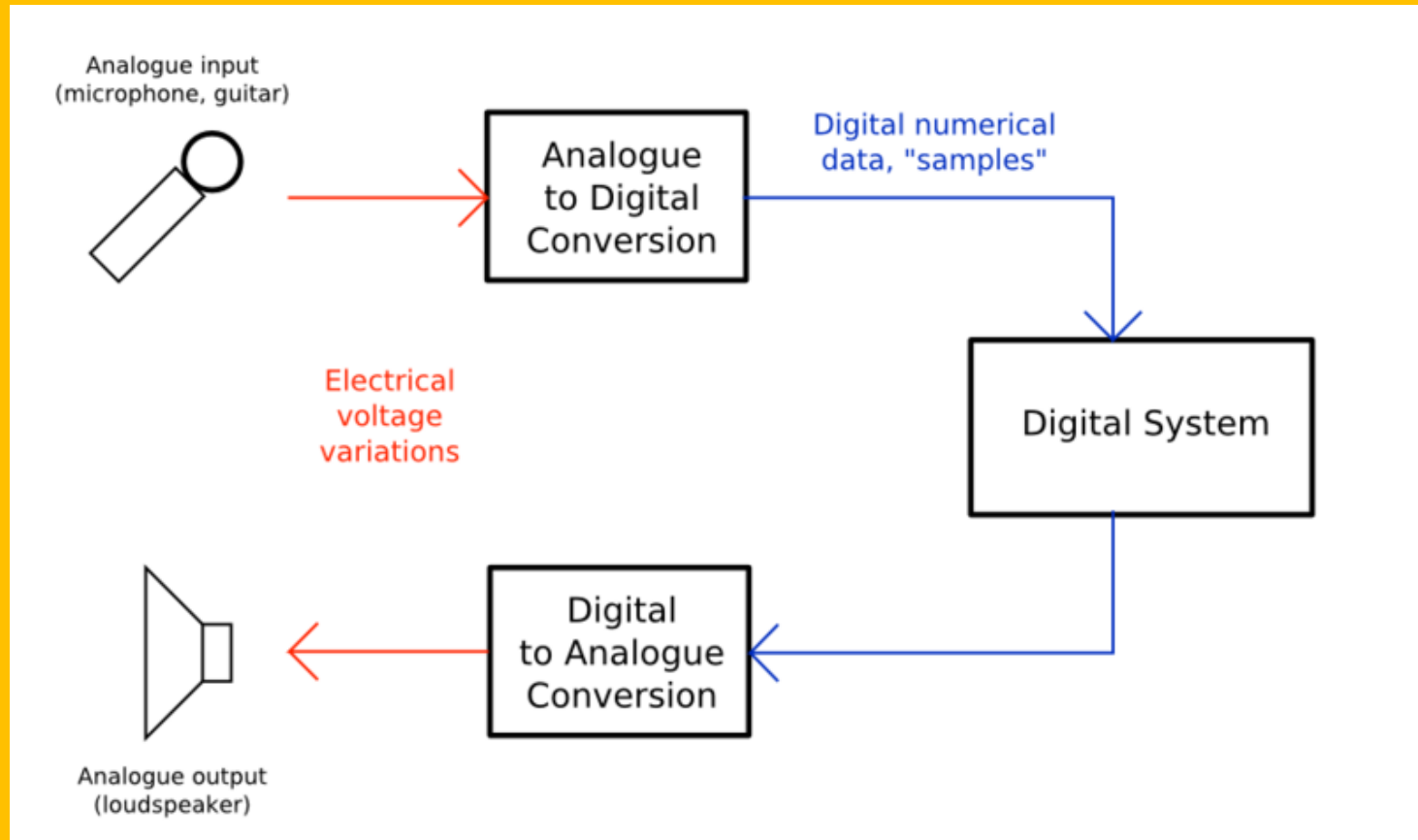
Sampling Process

- In order for a computer to work with audio waves, they must be converted from analog to digital form.
- This is done through a process called sampling, in which every fraction of a second a sample of the audio is recorded in digital bits
- There are two factors that affect the quality of the digitized audio:
 - Sample rate
  - Sample size

Sample Rate

- Sample rate is the **number of times** the sample is taken.

- The higher the sample rate, the more samples that are taken and, thus, the better the quality of the digitized audio.

Sound

Sample Rate

Sample Rate	Use
11kHz	One quarter the sampling rate of audio CDs; used for lower-quality PCM, MPEG audio and for audio analysis of subwoofer bandpasses.
22kHz	One half the sampling rate of audio CDs; used for lower-quality PCM and MPEG audio and for audio analysis of low frequency energy.
44.1kHz	Audio CD, also most commonly used with MPEG-1 audio (VCD, SVCD, MP3).
96kHz	DVD / BluRay disc Audio

Sound

Sample Rate
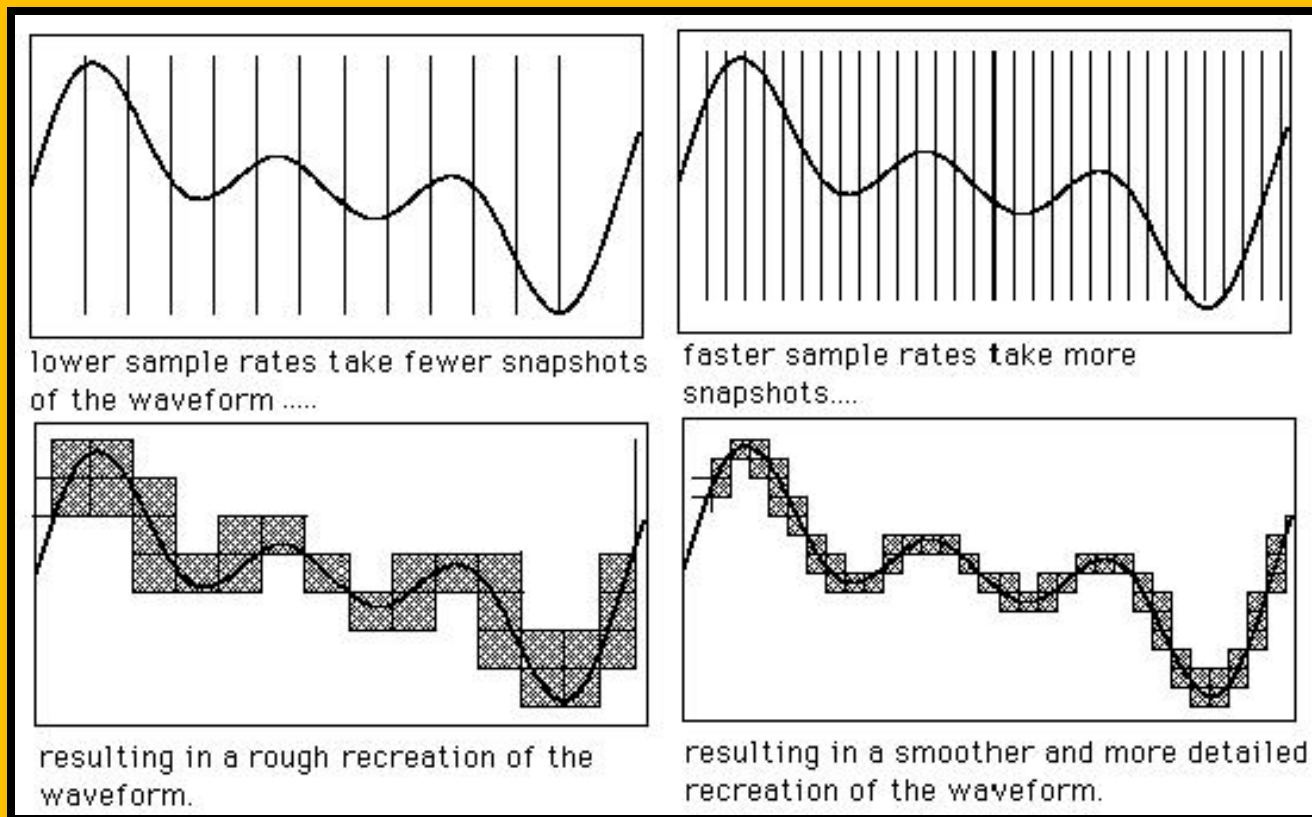
Sound

Sample Size

- Sample size is the **amount of information** stored about the sample.

- The greater the sample size, the better the quality of the audio.

Sound

Sample Size

Sample Size	Possible Integer Value
8 bit	256
16 bit	65,536
24 bit	16,777,216
32 bit	4,294,967,296

Sound

Sample Size

- Table below shows the file size (in bytes) for 10 seconds of digital audio given various sample rates and bit values.

| Sample Rate	Sample Size	File Size
44.1 khz	16	1.76mb
44.1 khz	8	882kb
22 khz	16	882kb
22 khz	8	440kb
11 khz	8	220kb

Sound

Channel

- Two types:
  - Monophonic
  - Stereophonic

Sound

Channel - Monophonic

- Commonly called *mono sound, mono,* or *non-stereo sound*, this early sound system used a single channel of audio for sound output.

- Monophonic sound is the most basic format of sound output.

- Mono (monophonic, or monaural) is sound from a single source.

- All speakers in a mono system (like an intercom) will carry the same signal.

Sound

Channel - Monophonic
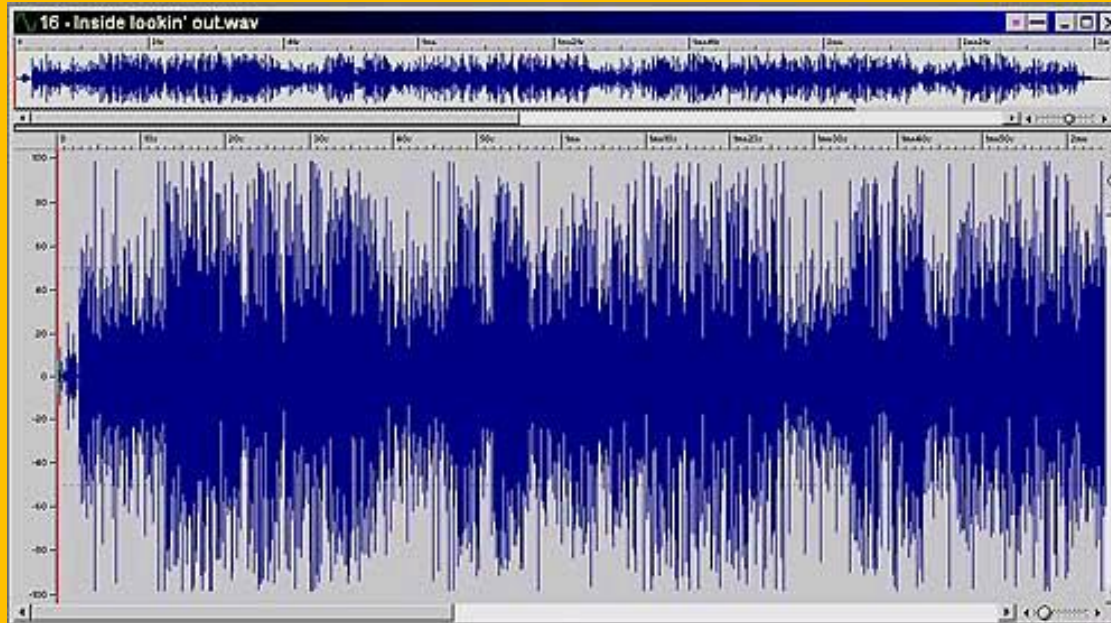
Channel - Stereophonic

- Commonly called *stereo sound or just stereo*, stereophonic sound divides sounds across two channels (recorded on two separate sources) then the recorded sounds are mixed so that some elements are channeled to the left and others to the right.

- Stereo (stereophonic) is sound from two sources, ideally spaced apart, and reproduces sound the way we hear it naturally, with two ears.

Sound

Channel - Stereophonic

Sound
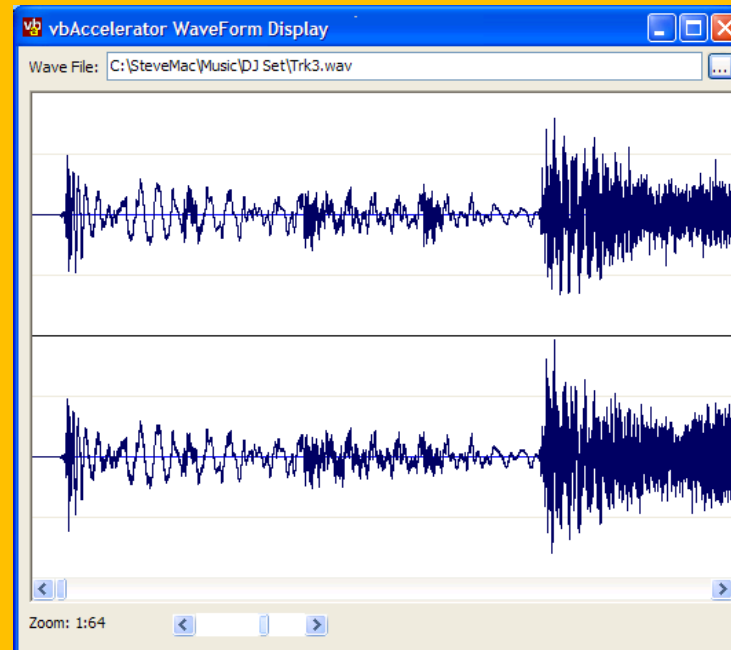
Channel – Stereo vs. Mono

	Mono	Stereo
Cost	Less expensive for recording and reproduction	More expensive for recording and reproduction
Recording	Easy to record, requires only basic equipment	Requires technical knowledge and skill to record, apart from equipment. It's important to know the relative position of the objects and events.
Usage	Public address system, radio talk shows, hearing aid, telephone and mobile communication, some AM radio stations	Movies, Television, Music players, FM radio stations

Sound

File Formats

- Wav audio (.wav)

- Sound (.snd)

- Real audio (.ra, rm)

- Audio File Format (.aiff)

- MIDI (.mid)

- MP3 audio (.mp3)

- Windows Media Audio (.wma)

Sound

Calculate Sound File Size

Sound File Size = **Sample rate** x **sample size** x **channel** x **duration**

Note:

- **Sample size**
  - **8 bit = 1, 16 bit = 2**
- **Channel**
  - **Mono = 1, Stereo = 2**

Sound

Calculate Sound File Size

Example 1:

Calculate how much storage space is needed to record a **16-bit**, **44.1khz**, **stereo** music for a duration of **30 seconds**.

Sound file size = 44100 x 2 x 2 x 30
= 5292000 bytes

Calculate Sound File Size

Example 2:

Calculate how much storage space is needed to record a **8-bit**, **11khz**, **mono** sound for a duration of **10 seconds**.

Sound file size = 11000 x 1 x 1 x 10
= 110000 bytes

Guidelines – Using Sound Elements

- Consider the appropriateness of using sound.
- Start with the highest-quality sound available and reduce the file size by converting the audio file to a compressed format.
- Consider using sound and still images as an alternative to video to reduce file sizes.
- Consider streaming the audio, especially for large files.
- If appropriate, provide a way to give the user some control over the audio.

Video

- **Video** is the technology of electronically capturing, recording, processing, storing, transmitting, and reconstructing a sequence of still images representing scenes in motion.

- Video is more towards photo realistic image sequence / live recording as in comparison to animation.

- Video makes use of all of the elements of multimedia, bringing your products and services alive, but at a high cost.

Video

- The advantage of integrating video into a multimedia presentation is the capacity to effectively convey a great deal of information in the least amount of time.

Video

- Video is also very hardware-intensive (require the highest performance demand on your computer)
  - Storage issue: full-screen, uncompressed video usesover 20 megabytes per second (MBps) of bandwidth and storage space.
 - Processor capability in handling very huge data on real time delivery

Digitizing the Video Signal

- **Analogue video** is essentially a product of the television industry and therefore conforms to television standards.

- **Digital video** is a product of the computing industry and therefore conforms to digital data standards.

Digitizing the Video Signal

- Is usually recorded and played as an analog signal.
- It must therefore be digitized in order to be incorporated into a multimedia title.

Digitizing the Video Signal
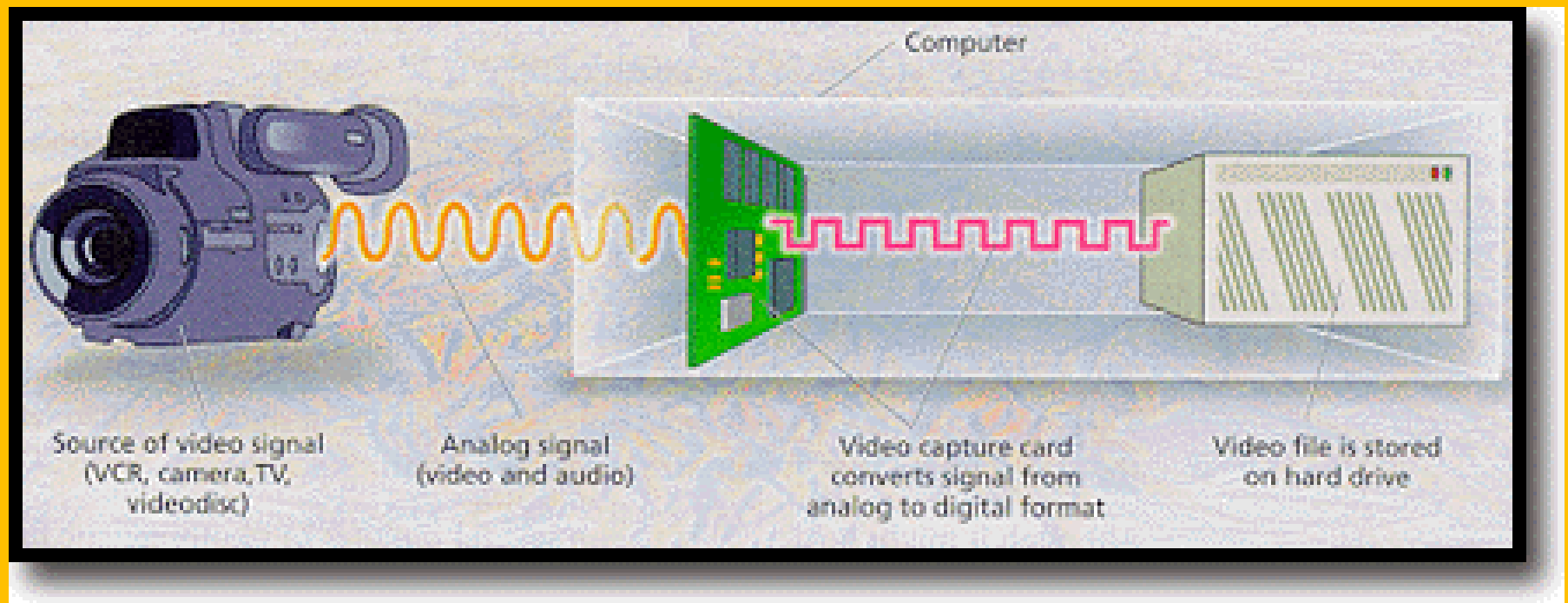
Advantages of Digital Video

- One of the advantages of digitized video is that it can be easily edited.

- The video is stored as a standard computer file.

- Software motion video does not require specialized hardware for playback.

- Digital video requires neither a video board in the computer nor an external device (which adds extra costs and complexity) such as a videodisc player.

- Long-lasting.

Disadvantages of Digital Video

- Requires large storage capacity devices.
- Copies can be made illegally.
- Need fast computer system for playback and capture.
- Requires knowledge of digital compression technology.

File Size Considerations

- Digitized video files can be extremely large.

- A single second of high-quality color video that takes up only one-quarter of a computer screen can be as large as 1 MB.

- Several elements determine the file size:
  - Frame Rate
  - Image Size
  - Color Depth
  - the length of the video

Video Compression

- Because of the large sizes associated with video files, video compression/decompression programs, known as **codecs**, have been developed.

- These programs can substantially reduce the size of video files, which means that more video can fit on a single CD and that the speed of transferring video from a CD to the computer can be increased.

Digital Video File Formats

- Motion Pictures Expert Group (.mpg)

- Quicktime (.mov)

- Audio Video Interleaved(.avi)

- Windows Media Video (.wmv)

- Adobe Flash video (.flv)

Calculate Video File Size

Video File Size = **Frame size** x **Frame rate** x **color depth** x **duration**

Notes (Color depth) : B&W video = 1 byte

Color video = 3 bytes

Calculate Video File Size

Example 1:

Calculate the file size for a video with **320 x 240 pixels**, **color** video, **30 fps**, and length **15 seconds**.

Video file size = 320 x 240 x 3 x 30 x 15
= 103680000 bytes

Calculate Video File Size

Example 2:

Calculate the file size for a video with **300 x 200 pixels**, **black and white** video, **25 fps**, and length **30 seconds**.

Video file size = 300 x 200 x 1 x 25 x 30
= 45000000 bytes

Guidelines – Using Video Elements

- Reducing the color depth to less than 256 colors gives a markedly poorer-quality image.

- Reducing the frame rate to less than 15 frames per second causes a noticeable and distracting jerkiness that is usually unacceptable.

- In most multimedia titles, you do not need to show full-screen video.

- Reducing file size to minimize the use of video in the image that appears on the screen.

Tutorial

1. What are the common usages of sound in Multimedia?
2. What are the two characteristics of sound wave?
3. What is the unit used to measure sound volume or loudness?
4. What do ADC and DAC stand for?
5. What are the factors that affect the quality of the digitized audio?
6. Explain the difference between mono channel and stereo channel?
7. Give four examples of audio file formats.
8. Calculate the audio file size for the followings:
   a. Sample rate = 11khz, sample size = 8 bit, mono, 30 seconds
   b. Sample rate = 22khz, sample size = 16 bit, stereo, 20 seconds
   c. Sample rate = 44.1khz, sample size = 16 bit, stereo, 10 seconds
   d. Sample rate = 22khz, sample size = 8 bit, mono, 15 seconds
9. Give two advantages and two disadvantages of digital video.
10. What are the factors that affect video file size?
11. Give four examples of digital video file formats.
12. Calculate the video file size for the followings:
    a. Frame size = 320x240, frame rate = 24fps, color, 30 seconds
    b. Frame size = 176x220, frame rate = 24fps, black and white, 15 seconds
    c. Frame size = 200x1300, frame rate = 24fps, color, 10 seconds
    d. Frame size = 300x400, frame rate = 24fps, black and white, 20 seconds