

## INTRODUCTION

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The word multimedia comes from two Latin words, multi and media: multi-, meaning several or many, and media-, meaning in the middle. This multimedia definition tells us that materials on the internet, or in your business presentations, involve several forms of communication to connect (that is, to be in the middle of) the sender and receiver. Multimedia is simply multiple forms of media integrated together.

An example of multimedia is a web page with an animation. Besides multiple types of media being integrated with one another, multimedia can also stand for interactive types of media such as video games, CD ROMs that teach a foreign language, or an information Kiosk at a subway terminal. Other terms that are sometimes used for multimedia include hypermedia and rich media. The term “rich media” is synonymous for interactive multimedia.

Everything we see, hear, read, and touch in web sites, video games, phone apps, retail kiosks, and bank ATMs are all forms of multimedia, and the list of uses grows daily.

Multimedia has become an inevitable part of our life. It has found a variety of applications right from entertainment to education. The evolution of the internet has also increased the demand for multimedia content.

### **Hypertext and Hypermedia**

**Hypertext** may refer to plain simple text that contains links to access other chunks of text within the same or different documents. It provides a means to organize and present information in a way that is easily accessible to the end users. It's more like a user-driven tool to

represent textual information which are linked together to provide more flexibility and a greater degree of control. This allows users or readers to move from one location to another via hyperlinks or “go to” links.

**Hypermedia** is an extension of hypertext that employs multiple forms of media such as text, graphics, audio or video sequences, still or moving graphics, etc. The structure of hypermedia is quite similar to that of a hypertext, except it's not constrained to be just text-based. It extends the capabilities of hypertext systems by creating clickable links within web pages to create a network of interconnected non-linear information which users can both access and interact with for a better multimedia experience. The most common hypermedia type is image links which are often linked to other web pages.

## 1 CATEGORIES OF MULTIMEDIA

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Multimedia may be broadly divided into linear and non-linear categories.

- **Linear active content** progresses without any navigation control for the viewer such as a cinema presentation. Linear presentations are used in place of nonlinear ones when there is no requirement for interactivity. For instance, movies are presented in a linear format, which allows for greater submersion in the experience. Someone is delivering the content to the audience in the order that it was intended with a predictable conclusion.
- **Non-linear content** offers user interactivity to control progress as used with a computer game or used in self-paced computer based training. Non-linear content is also known as **hypermedia content**. Nonlinear programs are inherently interactive and require active

audience participation. The Web is a primary example of this type of multimedia, considering the endless pathways the embedded links provide.

An example of linear vs. nonlinear multimedia is viewing a video. By its very nature, video is a type of single, independent medium that is typically played and viewed from point A to point B. If presented to an audience, such as in a theater, it is linear, sequential, and noninteractive. There is no viewer participation other than sitting back and watching.

However, if a video is viewed on a DVD player or streamed via the Internet on a computer or TV, there are many ways to interact with it and control the experience. The video can be paused, rewind, or advanced; different scenes can be selected at random; closed captioning can be displayed; audio can be adjusted; and the list goes on. This is undeniably a much more lively way to view a movie, even though the video medium itself is inherently designed for passive observation.

Multimedia presentations can be live or recorded. A recorded presentation may allow interactivity via a navigation system. A live multimedia presentation may allow interactivity via interaction with the presenter or performer.

## 2 APPLICATION OF MULTIMEDIA

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A few application areas of multimedia are listed below:

Creative Industries, Commercial, Entertainment and Fine Arts, Education, Engineering, Industry, Mathematical & Scientific Research, Medicine, Multimedia in Public Places.

## 3 STAGES OF MULTIMEDIA APPLICATION DEVELOPMENT

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Following are the four basic stages of multimedia project development :

**1. Planning and Costing :** This stage of multimedia application is the first stage which begins with an idea or need.

**2. Designing and Producing :** The next stage is to execute each of the planned tasks and create a finished product.

**3. Testing :** Testing a project ensure the product to be free from bugs. It is necessary to test whether the multimedia project works properly on the intended deliver platforms and they meet the needs of the clients.

**4. Delivering :** The final stage of the multimedia application development is to pack the project and deliver the completed project to the end user. This stage has several steps such as implementation, maintenance, shipping and marketing the product.

## 4 DELIVERING METHODS OF MULTIMEDIA CONTENT

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(a) CD-ROM

(b) DVD

(c) About Flash Drives

(d) About Internet

## 5 MULTIMEDIA ELEMENTS

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These are typically the elements or the building blocks of multimedia environments, platforms, or integrating tools. Any multimedia application consists any or all of the following components:

- Text
- Graphics/Images
- Audio
- Video
- Animation
- Interactivity

Melded together, they allow for a more dynamic and engaging experience. The final result is improved on even further when there is cooperation and coordination between the disparate media components.

### 5.1 TEXT:

Text is the most common multimedia element. Words and symbols in any form, spoken or written, are very important for communication in any medium. Text expresses the information the developer is trying to get across to their viewers. Even though pictures grab the viewers' attention, text is a good idea to include, as well, just in case the picture does not load.

Text deliver the most widely understood meaning to the greatest number of people. All multimedia content consists of texts in some form.

Text in multimedia presentations makes it possible to convey large amounts of information using very little storage space. Proper use of text and words in multimedia presentation will help the content developer to communicate the idea and

message to the user. With the recent explosion of the Internet and World Wide Web, text has become more important than ever. Web is HTML (Hyper text Markup language) originally designed to display simple text documents on computer screens, with occasional graphic images thrown in as illustrations.

Computers customarily represent text using the ASCII (American Standard Code for Information Interchange) system. The ASCII system assigns a number for each of the characters found on a typical typewriter. Each character is represented as a binary number which can be understood by the computer.

### 5.1.1 ABOUT FONTS AND TYPEFACES

The graphic representation of speech can take many forms. These forms are referred to as fonts or typefaces.

**TYPEFACE** - A **typeface** is family of graphic characters that usually includes many type sizes and styles. A typeface contains a series of fonts. For instance, Arial, Arial Black, Arial Narrow and Arial Unicode MS are actually 4 fonts under the same family. Font family is the set of fonts that have the same basic qualities in their design, yet their sizes, styles, and weights can vary.

Typefaces of fonts can be characterized by their proportionality and their serif characteristics.

- **Non-proportional fonts**, also known as **monospaced fonts**, assign exactly the same amount of horizontal space to each character. Monospaced fonts are ideal for creating tables of information where columns of characters must be aligned. Text created with non-proportional fonts often look as though they were produced on a typewriter. Two commonly-used

non-proportional fonts are Courier and FixedSys on Windows.

- **Proportional fonts** vary the spacing between characters according to the letter. For example, an "l" requires less horizontal space than a "d". Text created with proportional fonts look more like they were typeset by a professional typographer. Two commonly-used proportional fonts are Times New Roman and Arial on Windows.
- The **serif** is the little decoration at the end of a letter stroke. These are designed with small ticks at the bottom of each character. These ticks aid the reader in following the text. Serif fonts are generally used for text in the body of an article because they are easier to read than Sans Serif fonts. Commonly-used serif fonts are Times New Roman, Bookman and Courier New.
- **Sans Serif fonts** are designed without small ticks at the bottom of each character. Sans Serif fonts are generally used for headers within an article because they create an attractive contrast with the Serif fonts used in the body text. The section headers in this article are written using a sans serif font. Arial, Optima, Verdana are some examples of sans serif font.

The following fonts shows a few categories of serif and sans serif fonts.

**F**

**F**

(SerifFont) (Sans serif font)

### Font Samples

Times and Times New Roman are proportional serif fonts.

Helvetica and Arial are proportional sans serif fonts.

Courier and Courier New are non-proportional serif fonts.

Monaco and FixedSys are non-proportional

sans serif fonts.

**FONT** - A **font** is a collection of characters of a single size and style belonging to a particular typeface family. A font is a group of characters that you can print or display in a certain size and style. These characters include letters, numbers, punctuation and additional symbols. A font has various characteristics such as:

- **Font style:** the indication of the spacing between the characters in a font, whether italic, oblique, bold, underline etc.

Styles such as **Bold**, Underlined, and *Italics* can be applied to most fonts.

- **Font weight:** the thickness of the characters' strokes within a font.
- **Font size:** the number of points or pixels (digitally) of a font, representing its height. The size of a text is usually measured in points. One point is approximately 1/72 of an inch i.e. 0.0138. The size of a font does not exactly describe the height or width of its characters. This is because the x-height (the height of lower case character x) of two fonts may differ.

**The size of the font** also can be altered through software commands.

### **FILE FORMATS**

Text created on a computer is stored as a file on a hard disk or floppy disk. The ASCII file format, aka plain text, is universally understood by all computer systems.

A more complex standard called Rich Text Format (RTF) was developed by Microsoft to allow for the exchange of word processing files that include formatting such as text alignment, font styles, and font sizes.

A quickly-emerging replacement for RTF, however, is HTML (HyperText Markup Language) which is used for creating web pages. Many word processors today are also equipped to interpret HTML.

Various Text file formats are-

.txt, .doc, .pdf, .rtf, .html.

### **SELECTING TEXT FONTS**

It is a very difficult process to choose the fonts to be used in a multimedia presentation. Following are a few guidelines which help to choose a font in a multimedia presentation.

- Use Appropriate Fonts - Fonts are useful in focusing attention on certain text on the screen, enhancing readability, setting a tone (serious, lighthearted), and projecting an image (progressive, conservative). When choosing a font, always consider the objectives and the audience.

- Make it Readable - Although it may be tempting and certainly easy to use various typefaces, sizes, and styles, it is important to

exercise restraint. Be careful to avoid a busy and difficult to read design resulting from too many fonts and type styles on one screen. In addition, try to maintain consistency in the use of text.

Suggested guidelines are as follows :

Headings-14 to 48 point

Subheadings-Half the heading size

Text blocks 10 to 12 point

- For small type, it is advisable to use the most easily read and clear font.
- In large size headlines, the kerning (spacing between the letters) can be adjusted.
- In text blocks, the leading for the most pleasing line can be adjusted.
- Drop caps and initial caps can be used to accent the words.
- The different effects and colors of a font can be chosen in order to make the text look in a distinct manner.
- Anti aliased can be used to make text look gentle and blended.
- For special attention to the text the words can be wrapped onto a sphere or bent like a wave.
- Meaningful words and phrases can be used for links and menu items.

### **PARAGRAPH ALIGNMENT**

The arrangement of text relative to a margin.

**Four types of alignment: –**

1. **Flush left** – The text is aligned along the left margin, also known as ragged right.
2. **Flush right** – The text is aligned along the right margin.

3. **Centered** – Text is aligned to neither the left nor right margin; there is an even gap at the end of each line.

4. **Justified** - Text is aligned along the left margin, and letter- and word-spacing is adjusted so that the text falls flush with the right margin, also known as full justification.

### **TYPOGRAPHY**

Typography is the art and/or technique behind arranging type, where type means the letters and characters that you see in printed material. It's about the science behind laying out said letters and characters, which affects readability and legibility. Without effective typography, design fails to communicate its central message.

### **Kerning**

Kerning is the procedure of altering the spaces in between the letters in a font, but only among specific and individual letters. In other words, kerning allows for varying degrees of spaces between different letters in the same word, as long as the end result is visually attractive.

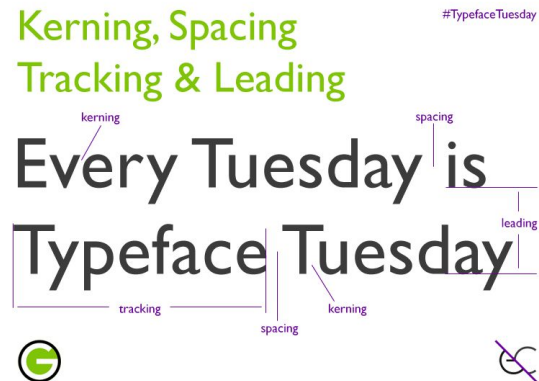
### **Tracking**

Tracking is the typographer's term for simple letter spacing. The crucial difference between it and kerning is that tracking makes uniform adjustments consistently among all the spaces in the same word, whereas kerning only makes adjustments to the spaces between words on a case-by-case basis.

### **Leading**

Another essential term in typography, leading relates to the spacing in between any successive lines of type. Originally used in the olden days of

typesetting by hand, this term has survived today even in digital printing, with such programs as Adobe InDesign and QuarkXPress both utilizing it.



Microsoft office and Wordpad are commonly used text editing and word-processing softwares.

### **TEXT EDITING TOOLS :**

These tools are used to write a letter, invoice, user manual for a project and other documents. These tools are most often tools for any multimedia project. e.g. Word pad, MS Word, Open Office Word.

### **• Features of Text editing editing tools:**

1. Opening Existing Files, creating new files, saving it on some storage device and printing.
2. Find or replace replace the text from a document document of multiple multiple pages, cut, copy, paste of a selected document or whole file.
3. Insert page numbers on top, bottom or centre of the page.
4. Format the font of the text, making columns in the document, changing changing background background color.
5. Checking the document for spelling and grammar, protect the document.

6. Making tables with variable variable numbers numbers of columns columns and rows, sort the table and change the style of the table.

## 5.2 Audio:

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Sound is perhaps the most important element of multimedia. It can provide the listening pleasure of music, the startling accent of special effects or the ambience of a mood-setting background.

Acoustics is the branch of physics that studies sound.

Sound pressure levels are measured in decibels (db).

Sound can enhance your website design and social media platforms. In multimedia, application of sound happens in form of dialogue, recorded narration, music and sound effects. These are called the audio or sound elements.

The integration of audio sound into a multimedia application can provide the user with information not possible through any other method of communication. Some types of information can't be conveyed effectively without using sound. It is nearly impossible, for example, to provide an accurate textual description of the beat of a heart or the sound of the ocean.

Most of the time, audio files are deployed using plug-in media players. A few audio formats include MIDI, Wave, WMA, and MP3. The developer will compress the format to shorten the time.

## DIGITAL AUDIO

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### AUDIO FILE FORMATS EXTENSION

There are many different types of audio files, and each have their distinct advantages.

#### .MP2/.MP3

Motion Picture Expert Group

The most ubiquitous audio file is the MP3. MP3's have become the standard audio files on most devices and on most websites. The advantage of MP3 file over different formats is their small size. MP3 files can be compressed, as they do not contain the inaudible sections of an audio track. While this results in good quality audio, while taking up a small amount of space, in certain situations, audio quality can suffer. Mp3 files use a lossy compression.

#### .WAV

Waveform Extension

Windows-based PC's use WAV files to store audio files. These files are uncompressed, so they take up a large amount of space, but they are of better quality than most MP3 files. The Windows wav file , can be played only on PCs running the Windows operating environment. Wave files can store any type of sound that can be recorded by a microphone. A WAV audio file is an example of an uncompressed audio file. Lossless compression.

#### . WMA

Another file type common on windows computers is WMA. This format is optimized for use by Windows Media Player. Its primary advantage is that is copyright protected, but it can only be used on Windows Media Player. The WMA audio file format uses lossless compression.

### **.MID**

MIDI (Musical Instrument Digital Interface)

Another type of audio sound that may be used is known as the Musical Instrument Digital Interface, or MIDI for short. The MIDI format is actually a specification invented by musical instrument manufacturers. The MIDI specification cannot store anything except in the form of musical notes. MIDI music can be created with a sequencer. These files are supported in many browsers. Very small file size for a lengthy selection. The files are instrumental only. The files can not be recorded. They must be synthesized on a computer with special hardware and software.

### **.AIF**

Audio Interchange Format

Very good sound quality. Widely supported in many browsers with no need for a plugin. You can record your own .aif files from a CD, tape, microphone, etc. The very large file sizes severely limit the length of the sound clips that you can use on your Web pages.

### **.RA/.RAM/.RPM**

Real Audio

Very high degree of compression with smaller file sizes than .mp2 or .mp3. Whole songs files are reasonable to download. The files can be "streamed" from a normal Web server without any special software so that the audience can begin listening to the sound before the file has completely downloaded. Real Audio files use a lossy compression.

### **Software used for Audio**

There are several tools available for recording audio. Following is the list of different software that can be used for recording and editing audio:

- Sound recorder from Microsoft
- Apple's QuickTime Player pro
- Sonic Foundry's SoundForge for Windows
- Sound edit Adobe Audition
- Sound Edit pro, Audio edit deluxe, Audio Editor Pro, Goldwave digital audio editor.

### **SOUND EDITING TOOLS**

Sound editing tools for both digitized and MIDI sound let's hear music as well as create it. By drawing a representation of a sound in fine increments, it is possible to cut, copy, paste and otherwise edit segments of it with great precision.

For ordinary sound there are varieties of software such as Soundedit, MP3cutter, Wavestudio.

### **Preparing Digital Audio Files**

Preparing digital audio files is fairly straight forward. If you have analog source materials – music or sound effects that you have recorded on analog media such as cassette tapes.

- The first step is to digitize the analog material and recording it onto a computer readable digital media.

It is necessary to focus on two crucial aspects of preparing digital audio files:

- Balancing the need for sound quality against your available RAM and Hard disk resources.
- Setting proper recording levels to get a good, clean recording.

### **Editing Digital Recordings**

Once a recording has been made, it will almost certainly need to be edited.

The basic sound editing operations that most multimedia procedures need are



1. Multiple Tasks: Able to edit and combine multiple tracks and then merge the tracks and export them in a final mix to a single audio file.
2. Trimming: Removing dead air or blank space from the front of a recording and an unnecessary extra time off the end is your first sound editing task.
3. Splicing and Assembly: Using the same tools mentioned for trimming, you will probably want to remove the extraneous noises that inevitably creep into recording.
4. Volume Adjustments: If you are trying to assemble ten different recordings into a single track there is little chance that all the segments have the same volume. Editing software provides various options of adjusting the volume level of audio.
5. Conversion from one format to another.
6. Resampling or downsampling: If you have recorded and edited your sounds at 16 bit sampling rates but are using lower rates you must resample or downsample the file.
7. Equalization: Some programs offer digital equalization capabilities that allow you to modify a recording frequency content so that it sounds brighter or darker.
8. Digital Signal Processing: Some programs allow you to process the signal with reverberation, multitap delay, and other special effects using DSP routines.
9. Reversing Sounds: Another simple manipulation is to reverse all or a portion of a digital audio recording. Sounds can produce a surreal, other wordly effect when played backward.
10. Time Stretching: Advanced programs let you alter the length of a sound file without changing its pitch. This feature can be very

useful but watch out: most time stretching algorithms will severely degrade the audio quality.

### **AUDIO QUALITY**

It is the accuracy and enjoyability of the audio which the user can listen from an electronic device. Audio quality depends upon the bit rate, sample rate, file format and encoded method. It also depends on the ability of the encoder to get the important bits right.

### **BIT DEPTH**

The **bit depth** refers to the number of bits in each sample. It describes the resolution of the sound data that is captured and stored in an audio file. A higher audio bit depth indicates a more detailed sound recording. It is an important integer that determines how good a recording sounds.

The bit depth may be 16-bit, 24-bit, 32-bit. Bit depth is sometimes referred to as the sample format or audio resolution. The unit of measure for bit depth is binary digits (bits); for every 1-bit increase, the accuracy doubles.

### **Bit Rate**

refers to the audio quality of the stream. It is measured in Kilobits per sec (kbps or k). Bit rate is the number of bits (data) encoded per second or the number of bits transmitted or received per second. Higher the bit rate with more sampling rate, requires high bandwidth and produces good audio quality. Low bit rates refer to smaller file sizes and less bandwidth with a drop in audio quality. For good quality music usually 64–128kbps bit rate is preferred.

### **SAMPLE RATE**

In developing an audio sound for computers or telecommunication, the **sample rate** is the number of samples of a sound that are taken per second to represent the event digitally. A sample is a measurement of signal amplitude and it contains the information of the amplitude value of the signal waveform over a period of time. The sample rate is measured in hertz (Hz).

The more samples taken per second, the more accurate the digital representation of the sound can be. For example, the current sample rate for CD-quality audio is 44,100 samples per second. This sample rate can accurately reproduce the audio frequencies up to 20,500 hertz, covering the full range of human hearing.

### **AUDIO COMPRESSION**

Audio compression is the process of reducing a signal's dynamic range. Dynamic range is the difference between the loudest and quietest parts of an audio signal.

You need to reduce the dynamic range of most audio signals for them to sound natural on a recording. Compression is useful to smooth out a vocal track that pitches from very loud to incomprehensibly soft. Think of it as heightening the soft signals and reducing the loud signals to average out the overall volume.

Compressors, meanwhile, average out both the high and low end of a sound within a designated range.

For example: Imagine a whisper and a scream on the same audio track. If they were the same difference in loudness as they are in real life, it would be very distracting!

Compressors fix it by attenuating the loudest

parts of your signal and boosting the result so the quieter parts are more apparent.

### **Compression Controls**

The compression device itself has many different controls that can have an effect on the sound you're processing. The main controls that are commonly found:

#### **Input Gain**

This controls the level of the signal going into the audio compressor.

#### **Threshold**

By setting the threshold, the compressor compresses the loudest signal of the audio, e.g, if you set your threshold at -20 dB, everything below this level will not be affected by the compressor. But everything louder than this level (-20 dB) will be compressed.

#### **Ratio**

The ratio controls the amount of signal to compress once it's gone over the threshold level. The higher the ratio, the more compression there is. e.g; If the ratio is set at 2:1, for every 2 dB of sound that goes over the threshold, you get 1 dB of output above the threshold.

#### **Attack**

This is the time that the compressor takes to act on the input, once the sound level has gone over the threshold level. It's usually measured in milliseconds (ms).

#### **Release**

This is the time that the compressor takes to let the signal return to normal once it has fallen below the threshold level. Again, usually measured in ms.

### **Output Gain (Make-up Gain)**

If the audio signal has been compressed, the overall level of the signal will be reduced. Increasing the output gain raises the level coming out of the compressor, so the volume can be more easily matched to the levels of the rest of your tracks in your mix.

### **Knee**

Soft-knee compression is gentler on the sound as it goes through the audio compressor – the change from uncompressed to compressed sound is smoother. Hard-knee compression is a more immediate and obvious effect.

### **MONO VS STEREO**

**Stereo (or Stereophonic sound)** is the reproduction of sound using two or more independent audio channels in a way that creates the impression of sound heard from various directions, as in natural hearing. Home or personal audio systems create stereophonic sound by transmitting two independent signals through two separate channels into a pair of speakers. Stereo systems are best used to replicate the sensation of hearing a band or orchestra performing live. As the independent signals emphasize different instruments or sounds in the right and left channels, stereo sound is considered to have more "depth," recreating the sound of individual instruments located in different areas. For the best experience, the listener must place himself directly in the middle of the two speakers, which creates a sensation referred to as "audio imaging" by some listeners. Stereo sound has almost completely replaced mono because of the improved audio quality that stereo provides.

Movies, Television, Music players, FM radio stations

**Mono (Monaural or monophonic sound reproduction)** has audio in a single channel, often centered in the "sound field". Amplifiers produce monophonic or "mono" sound by transmitting a single signal channel to one or more speakers. Even if two speakers are used, a mono signal will produce the exact same sound levels in each speaker. Therefore, mono conveys no sensation of depth or location, unlike stereo speakers. Even through headphones, monophonic sound will produce a single "cluster" of music, without the sensation of audio imaging. Mono or monophonic describes a system where all the audio signals are mixed together and routed through a single audio channel.

Public address system, radio talk shows, hearing aids, telephone and mobile communication, some AM radio stations are examples of mono systems.

### **SOUND CARD**

A sound card is an expansion component used in computers to receive and send audio. Sound cards are configured and utilized with the help of a software application and a device driver. The input device attached to receive audio data is usually a microphone, while the device used to output audio data is generally speakers or headphones.

The sound card converts incoming digital audio data into analog audio so that the speakers can play it. In the reverse case, the sound card can convert analog audio data from the microphone into digital data that can be stored on the computer and altered using audio software.

Sound cards are also known as **audio adapters, audio output device, sound board, or audio card**. They are included on every computer in one form

or another, either in an expansion slot or built into the motherboard (onboard).

Sound Blaster is considered to be the pioneer of digital audio sound cards.

### Uses of a computer sound card

Below are all of the different areas where a computer sound card can be used.

- Games.
- Audio CDs and listening to music.
- Watch movies.
- Audio and video conferencing.
- Creating and playing MIDI.
- Educational software.
- Business presentations.
- Record dictations.
- Voice recognition.

### Sound card connections

The picture is an example of a sound card audio ports or audio jacks on the back of your computer, associated colors, and the connector symbols.

- Digital or Digital Out (white or yellow; - Used with loudspeakers.
- Sound in or line in (blue; Arrow pointing into waves) - Connection for external audio sources, (e.g., tape recorder, record player, or CD player.)
- Microphone or Mic (pink) - The connection for a microphone or headphones.
- Sound out or line out (green; Arrow pointing out of waves) - The primary

Back of Sound Card



<http://www.computerhope.com>

sound connection for your speakers or headphones. This sound card also has a second (black) and third (orange) sound out connector.

- MIDI or joystick (15 pin yellow connector)  
- Used with earlier sound cards to connect MIDI keyboard or joystick.

## 5.3 IMAGES:

An image, digital image or still image is a binary representation of visual information, such as drawings, pictures, graphs, logos, or individual video frames. Digital images can be saved electronically on any storage device. An image catches the viewers' attention much more quickly than just plain, old text. Almost every multimedia application contains images and graphics.

Images whether represented analog or digital plays a vital role in a multimedia. Images or Graphics include photographs taken from digital camera (like bitmaps), paintings, illustrations, vector-based drawings, clip art, icons, 3D renderings or any other non-text elements on a website or in social media. There is no movement in these types of pictures. Still/static pictures typically accompany text to illustrate the point or ideas the text makes.

The most common image formats are JPEGs and PNGs. Adobe Photoshop and Paint.NET create high tech visual effects which are common with images.

In multimedia context, graphics may consist of slide shows or galleries that a website or social media visitor can view. They may have clickability that leads the viewer to another element, such as audio or video.

### **PIXEL**

The unit of measurement used for computer graphics is the pixel. The term "pixel" is a contraction for "picture element". It is the smallest particle of a bitmap image. Pixels are the points at which an image is sampled.

### **RESOLUTION**

The term resolution describes the number of dots, or pixels, that an image contains or that can be displayed on a computer monitor, television, or other display device. These dots number in the thousands or millions, and the higher their number, the greater the image's clarity and quality.

#### **Resolution in Computer Monitors**

A computer monitor's resolution refers to the approximate number of pixels the device is capable of displaying. It's expressed as the number of horizontal dots by the number of vertical dots; for example, an 800 x 600 resolution means the device can show 800 pixels across by 600 pixels down. In total, this screen displays 480,000 pixels.

Common computer monitor resolutions include:

1366 x 768

1600 x 900

1920 x 1080

2560 x 1440

3840 x 2160 (often referred to as 4k resolution)

#### **Resolution in TVs**

For televisions, resolution is similar but is expressed a bit differently. TV picture quality focuses more on pixel density than it does the

gross number of pixels. In other words, the number of pixels per unit of area (generally an inch) dictates the picture's quality, rather than the total number of pixels. Thus, a TV's resolution is expressed in pixels per inch (PPI or P). The most common TV resolutions are 720p, 1080p, and 2160p, all of which are considered high definition.

#### **Resolution in Images**

The resolution of an electronic image (photo, graphic, etc.) refers to the number of pixels it contains, usually expressed as millions of pixels, or megapixels (MP). Digital cameras and smartphone cameras are usually rated by the number of megapixels in the images they capture.

The greater an image's resolution, the better its quality. As with computer monitors, the measurement is expressed as width by height, multiplied to yield a number in megapixels. For example, an image that is 2048 pixels across by 1536 pixels down (2048 x 1536) contains 3,145,728 pixels; in other words, it's a 3.1-megapixel (3MP) image.

Resolution is a measure of pixel density, usually measured in dots per inch (dpi). Images on websites usually have a resolution of 72 dpi. This means that a 1-inch square contains a grid of pixels that is 72 pixels wide by 72 pixels high.  $72 \times 72 = 5184$  pixels per square inch.

High quality printed images in books and magazines have a higher resolution than computer screens. Magazines often use either 300 dpi or even 600 dpi.

#### **WHAT IS COLOR DEPTH?**

Color "depth" is defined by the number of bits per pixel that can be displayed on a computer screen. Data is stored in bits. Each bit represents two

colors because it has a value of 0 or 1. The more bits per pixel, the more colors that can be displayed. Color depth is sometimes referred to as bit depth because it is directly related to the number of bits used for each pixel. A 24-bit video adapter, for example, has a color depth of 2 to the 24th power (about 16.7 million) colors. One would say that its color depth is 24 bits. Color depth is also referred to as bits per pixel (bpp). The number of bits indicates how many colours are available for each pixel. In the black and white image, only two colours are needed. This means it has a colour depth of 1 bit.

A 2-bit colour depth would allow four different values: 00, 01, 10, 11. This would allow for a range of colours such as:

BINARY CODE	COLOUR
00	White
01	Light grey
10	Dark grey
11	Black

The greater the colour depth (bits per pixel), the more colours are available. In general, the higher the color depth you choose, the better your screen will appear when looking at things with lots of color like photos and videos.

Examples of color depth are shown in the following table:

COLOUR DEPTH	AVAILABLE COLOURS
1-bit	$2^1 = 2$
2-bit	$2^2 = 4$
4-bit	$2^4 = 16$
8-bit	$2^8 = 256$

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24-bit  $2^{24} = 16,777,216$

### Raster & Vector graphics

An image can be described in terms of **vector graphics** or **raster graphics**. An image stored in raster form is sometimes called a bitmap.

Bitmap (or raster) images are stored as a series of tiny dots called pixels. Each pixel is actually a very small square that is assigned a color, and then arranged in a pattern to form the image. When you zoom in on a bitmap image you can see the individual pixels that make up that image. Bitmap is an image format suited for creation of:

1. Photo-realistic images, Complex drawings, Images that require fine detail
2. Bitmapped images are known as paint graphics. Bitmapped images can have varying bit and color depths.

More bits provide more color depth, hence more photo-realism, but require more memory and processing power. Bitmap graphics can be edited by erasing or changing the color of individual pixels using a program such as Adobe Photoshop. Bitmap formats are best for images that need to have a wide range of color gradations, such as most photographs. Because raster images are constructed using a fixed number of colored pixels, they can't be dramatically resized without compromising their resolution. When stretched to fit a space they weren't designed to fill, their pixels become visibly grainy and the image distorts.

Unlike bitmaps, vector images are not based on pixel patterns, but instead use mathematical formulas to draw lines and curves that can be combined to create an image from geometric objects such as circles and polygons. Vector

images are edited by manipulating the lines and curves that make up the image using a program such as Adobe Illustrator.

Vector images have some important advantages over bitmap images. Vector images tend to be smaller than bitmap images. That's because a bitmap image has to store color information for each individual pixel that forms the image. A vector image just has to store the mathematical formulas that make up the image, which take up less space.

Vector images are also more scalable than bitmap images. When a bitmap image is scaled up you begin to see the individual pixels that make up the image. This is most noticeable in the edges of the image. There are ways of making these jagged edges less noticeable but this often results in making the image blurry as well. When a vector image is scaled up, the image is redrawn using the mathematical formula, so the resulting image is just as smooth as the original.

The three most popular image formats used on the Web (PNG, JPEG, SVG and GIF) are bitmap formats.

Vector formats are better for images that consist of a few areas of solid color. Examples of images that are well suited for the vector format include logos and type.

Constructed using mathematical formulas rather than individual colored blocks, vector file types such as EPS, AI and PDF are excellent for creating graphics that frequently require resizing. A PDF is generally a vector file. However, depending how a PDF is originally created, it can be either a vector or a raster file.

### **DIFFERENT IMAGE FILE EXTENSION TYPES AND THE BEST USE FOR EACH (IMAGE FILE FORMATS)**

Once created (or acquired through scanning) images can be stored in electronic files on a computer's hard disk, floppy disk, or other electronic storage mechanism. Contemporary graphics software allows the user to save image files in a variety of file formats.

There are 5 main formats in which to store images.

#### **TIFF, file types ending in .tif**

TIFF stands for Tagged Image File Format. TIFF images create very large file sizes. TIFF images are uncompressed and thus contain a lot of detailed image data (which is why the files are so big). TIFFs are also extremely flexible in terms of color (they can be grayscale, or CMYK for print, or RGB for web) and content (layers, image tags).

TIFF is the most common file type used in photo software (such as Photoshop), as well as page layout software (such as Quark and InDesign), again because a TIFF file contains a lot of image data.

Since, it has no loss in quality and therefore is primarily used for images used in printing.

#### **JPEG (also known as JPG), file types ending in .jpg**

JPEG stands for Joint Photographic Experts Group. JPEG files are raster images that have been compressed to store a lot of information in a small-size file. Most digital cameras store photos in JPEG format, because then you can take more photos on one camera card than you can with other formats.

A JPEG is compressed in a way that loses some of the image detail during the compression in order

to make the file small (and thus called “lossy” compression).

JPEG files are usually used for photographs on the web, because they create a small file that is easily loaded on a web page and also looks good.

JPEG files are bad for line drawings or logos or graphics, as the compression makes them look “bitmappy” (jagged lines instead of straight ones).

A JPG can’t have a transparent background so they are always in the shape of a rectangle or square with a solid background.

#### **GIF, file types ending in .gif**

GIF stands for Graphic Interchange Format. It is a raster file format. A GIF is formed from up to 256 colors from the RGB colorspace. This format compresses images but, as different from JPEG, the compression is lossless (no detail is lost in the compression, but the file can’t be made as small as a JPEG).

GIFs also have an extremely limited color range suitable for the web but not for printing. This format is never used for photography, because of the limited number of colors. GIFs can also be used for animations.

#### **PNG, file types ending in .png**

PNG stands for Portable Network Graphics. It was created as an open format to replace GIF. The main difference to understand between PNG and JPG is that a PNG can have a transparent background and is generally larger and higher quality. It also allows for a full range of color and better compression. Therefore a PNG is ideal for saving logo files for websites because they can be placed over a colored background.

It’s used almost exclusively for web images, never for print images. For photographs, PNG is not as

good as JPEG, because it creates a larger file. But for images with some text, or line art, it’s better, because the images look less “bitmappy.”

When you take a screenshot on your PC, the resulting image is a PNG—probably because most screenshots are a mix of images and text.

**RAW** - Found in many DSLRs, and keeps all the light data received from the camera’s sensor. The files are called raw because they haven’t been processed and therefore can’t be edited or printed yet. Raw files usually contain a vast amount of data that is uncompressed. Therefore, these files types tend to be quite large in size. Additionally, there are different versions of RAW, and you may need certain software to edit the files. Usually they are converted to TIFF before editing and color-correcting.

#### **EPS**

An EPS file is a vector file of a graphic, text or illustration. Because it is vector it can easily be resized to any size it needs to be. An EPS file can be reopened and edited.

It is best used for creating master logo files and graphics and print designs.

#### **AI**

An AI file is a proprietary, vector file type created by Adobe that can only be created or edited with Adobe Illustrator. It is most commonly used for creating logos, illustrations and print layouts.

It is best used for creating logos, graphics, illustrations.

#### **Editing vector files and saving “in outlines”**

Vector files such as AI and EPS can remain editable so you can open them back up in Illustrator and edit any text or other elements within the graphic. With images that contain text



that are saved as a JPEG, PNG or GIF, you would not be able to reopen and edit the text.

### **IMAGE COMPRESSION**

Image compression is a type of data compression applied to digital images, to reduce their cost for storage or transmission. It is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages.

There are several different ways in which image files can be compressed. For Internet use, the two most common compressed graphic image formats are the JPEG format and the GIF format. The JPEG method is more often used for photographs, while the GIF method is commonly used for line art and other images in which geometric shapes are relatively simple.

Here are a few reasons.

- For website optimization. Sites with uncompressed images can take longer to load, and can cause your visitors to bounce because of this.
- For sending and uploading images. Uploading an uncompressed image can take a while, and some email servers have a file size limit.
- For reducing the storage impact on your hard drive.

There are two kinds of image compression methods - lossless vs lossy.

### **Lossless Compression**

Lossless compression refers to compression in which the image size is reduced without any quality loss. RAW, BMP, GIF, and PNG are all lossless image formats.

For example, in a DSLR camera, you probably have the option to save photos as either RAW or JPEG. RAW files have no compression and are great if you're a professional photo editor. But they take up more space. JPEG, on the other hand, won't fill up your hard drive as fast, but some of the data is lost in the conversion.

The big benefit to lossless compression is that you can retain the quality of your image and still achieve a smaller file size.

### **Lossy Compression**

Lossy compression refers to compression in which some of the data from the original file (JPEG) is lost. The process is irreversible, once you convert to lossy, you can't go back. And the more you compress it, the more degradation occurs. JPEGs and GIFs are both lossy image formats. In order to give the photo an even smaller size, lossy compression discards some parts of a photo. One of the biggest obvious benefits to using lossy compression is that it results in a significantly reduced file size (smaller than lossless compression method), but it also means there is quality loss. Most tools, plugins, and software out there will let you choose the degree of compression you want to use. However, this doesn't mean the photo will look bad. Converting a lossy photo back to lossless won't restore the photo's data.

### **MULTIMEDIA GRAPHIC TOOLS**

**Image Editing Tools:** An image is a spatial representation of an object. Image editing tools are required to reshape the existing images. The

image editing tools can be used to create an image from scratch as well as image from scanner, digital cameras cameras, files or from other painting and drawing tools.

### **Painting and Drawing Tools**

- Painting software, such as Photoshop, Fireworks, and Painter, is dedicated to producing crafted bitmap images.
- Drawing software, such as CorelDraw, FreeHand, Illustrator, Designer, and Canvas, is dedicated to producing vector-based line art easily printed to paper at high resolution.

### **Image-Editing Tools**

Here are some features typical of image-editing applications and of interest to multimedia developers:

- Image-editing application is specialized and powerful tools for enhancing and retouching existing bitmapped images.
- Conversion of major image-data types and industry-standard file formats
- Direct inputs of images from scanner and video sources
- Capable selection tools, such as rectangles, lassos, and magic wands, to select portions of a bitmap
- Image and balance controls for brightness, contrast, and color balance
- Good masking features
- Multiple undo and redo features
- Anti-aliasing capability, and sharpening and smoothing controls
- Adjustment of color balance
- Tools for retouching, blurring, sharpening, lightening, darkening, smudging, and tinting

- Geometric transformation such as flip, skew, rotate, and distort, and perspective changes
- Ability to resample and resize an image
- Ability to create images from scratch, using line, rectangle, square, circle, ellipse, polygon, airbrush, paintbrush, pencil, and eraser tools, with customizable brush shapes and user-definable bucket and gradient fills
- Multiple typefaces, styles, and sizes, and type manipulation and masking routines.
- Filters for special effects, such as crystallize, dry brush, emboss, facet, fresco, graphic pen, mosaic, pixelize, poster, ripple, smooth, splatter, stucco, twirl, watercolor, wave, and wind
- Ability to design in layers that can be combined, hidden, and reordered
- Zooming, for magnified pixel editing

## 5.4 ANIMATION:

Animation is a simulation of movement created by displaying a series of pictures, or frames. It is a series of images put together to give the illusion of movement. Animations are the most creative and fun multimedia element. It has the power of injecting energy and emotions into the most seemingly inanimate objects. Animation draws in the younger crowd. AdobeFlash is the most common tool for creating these animations.

Computer-assisted animation (2D) and computer-generated animation (3D) are two categories of computer animation. It can be presented via film or video.

Animation is used to add visual interest or bring attention to important information or links. It can illustrate how things work or present information in entertaining ways. Animation can also include interactive effects allowing visitors to engage with the animation action using their mouse and keyboard. Animation is a dynamic and media-rich content that stays within one container on a page – a very powerful form of communication.

A **keyframe** in animation and filmmaking is a drawing that defines the starting and ending points of any smooth transition. The drawings are called "**frames**" because their position in time is measured in frames on a strip of film. A sequence of keyframes defines which movement the viewer will see, whereas the position of the keyframes on the film, video, or animation defines the timing of the movement. Because only two or three keyframes over the span of a second do not create the illusion of movement, the remaining frames are filled with inbetweens. An animation starts with frames and converts it into a video.

Animation can be used in many areas like entertainment, computer aided-design, scientific visualization, training, education, e-commerce, and computer art. **Some common uses of animation include:**

- **Advertising**  
Example: Website advertisements that are animated to attract attention
- **Information**  
Example: Kiosk for directions or information
- **Education**  
Example: Tutorials using animated graphics for demonstration
- **Games**  
Example: Games using animation to simulate action
- **Websites**  
Example: Animated navigation button that changes when the cursor passes over it (rollover).



### TYPES/CATEGORIES OF ANIMATION:

1. Traditional animation
2. 2D Vector-based animation
3. 3D computer animation
4. Motion graphics
5. Stop motion

### TRADITIONAL ANIMATION

Traditional animation, sometimes referred to as **cel animation**, is one of the older forms of animation. All the frames in an animation had to be drawn by hand. Sequential drawings screened quickly one after another create the illusion of movement.

The animation process of traditional animation can be lengthy and costly. Since each second of animation requires 24 frames (film), the amount

of effort required to create even the shortest of movies can be tremendous.

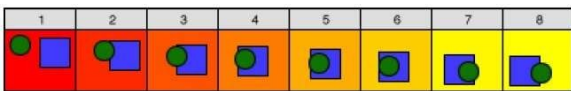
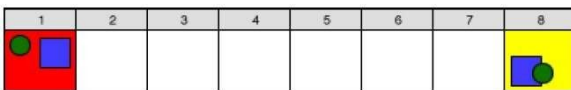
Today, traditional animation can be done on a computer using a tablet, and does not require actual photography of individual frames.

### **VECTOR-BASED 2D ANIMATION**

2D animation is the term often used when referring to traditional hand-drawn animation, but it can also refer to computer vector animations that adopts the techniques of traditional animation.

Vector-based animations, meaning computer generated 2D animations, uses the exact same techniques as traditional animation, but benefits from the lack of physical objects needed to make traditional 2D animations, as well as the ability to use computer interpolation to same time.

**Keyframing** is used in this technique. A storyboard is laid out and then the artists draw the major frames of the animation. Major frames are the ones in which prominent changes take place. They are the key points of animation. The computer then figures out all the in-between frames and saves an extreme amount of time for the animator.



**Animation exists in two dimensions, i.e, objects have x and y dimensions.**

Example: Cartoons such as Scooby Doo, The Simpsons or Family Guy

### **3D ANIMATION**

3D animation, also referred to as CGI, or just CG, is made by generating images using computers. That series of images are the frames of an animated shot.

3D animation deal with animating and posing models. It is a lot more controllable than 2D animation, since it's in a digital work-space.

Instead of drawn or constructed with clay, characters in 3D animation are digitally modeled in the program, and then fitted with a 'skeleton' that allows animators to move the models.

Animation is done by posing the models on certain key frames, after which the computer will calculate and perform an interpolation between those frames to create movement.

When the modeling and/or animation is complete, the computer will render each frame individually, which can be very time-consuming, depending on the quality of the images and the quantity of polygons in the scene.

**Animation exists in three dimensions, i.e, objects have x,y and z dimensions.**

-Has depth, and more realistic in appearance  
-Example: Video games like Halo or Madden or 3D movies

### **MOTION GRAPHICS**

Think animated logos, explainer videos, app commercials, television promos or even film opening titles.

The skills for motion graphics don't necessarily translate to the other types of animation, since they don't require knowledge of body mechanics or acting, but they do have some attributes in common such as understanding good

composition and the all important camera motion.

The process of creating Motion Graphics depends on the programs used, since video editing software often have different UI or settings, but the idea is the same. Motion Graphics usually involves animating images, texts or video clips using key framing that are tweened to make a smooth motion between frames.

### **STOP MOTION**

Stop-Motion animation can be referred to any animation that uses objects that are photographed in a sequence to create the illusion of movement.

The process of stop-motion animation is very long, as each object has to be carefully moved inch by inch, while it's being photographed every frame, to create a fluid sequence of animation.

Here are the different types of stop-motion animation:

#### **Claymation**

One of the most popular stop-motion form is Claymation. Working with clay or play-doh characters that can easily be manipulated for animation. Advanced claymation (such as The Neverhood or Armikrog) uses metal skeletons on which the clay is then molded for more sturdy rigs.

#### **Puppets**

Some animators use regular Puppets instead of clay ones, usually also built with some sort of skeleton rig. The faces of the characters can be replaced based on the expression, or controlled within the rig.

#### **Pixelation**

Pixelation is a form of stop motion that uses real people and real environments to create unreal videos. It uses the stop motion method of taking a still photo, moving things around, and then taking another photo, but the subject matter is usually real people instead of puppets.

#### **COMMON ANIMATION FORMATS:**

Animated GIF

SWF

MOV

AVI

#### **ANIMATION TOOLS**

A computer based animation is performed by a computer with various software and animation tools.

e.g. Adobe After effects, Autodesk Maya, Autodesk 3DS Max, Cinema 4D, 2D and 3D Animator, Adobe Flash, Toon Boom Harmony, Adobe Animate, Blender, iStopMotion, Image Forge.

#### **Adobe Flash**

This is a vector-based software mainly used for delivering high-impact, rich designs, animation and application user interfaces (UI). For creating animations Macromedia Flash or Adobe Flash are the industry standard. A file created in Flash is called a movie. A movie in Flash occupies very less file size, and hence is more popular for the Web. You can also create presentations and 2D Animations using Flash.

#### **Adobe After Effects**

It is mainly used for creating motion graphics and visual effects. You can use this software to animate, alter and composite media in 2-D and 3-D space with various built-in tools. It allows you

to add various effects like fire, explosions and noise.

### **Autodesk Maya**

This comprehensive 3-D animation software can be used for 3-D computer animation, modelling, simulation, rendering and compositing to generate interactive 3-D applications, including video games, animated film, TV series or visual effects.

### **Autodesk 3ds Max**

This 3-D computer graphics software can be used for 3-D modelling, animation, rendering and compositing by games, film and motion graphics artists.

### **AutoDesk Mudbox**

This is a digital painting and digital sculpting software that can create highly realistic 3-D characters, engaging environments, detailed props and compelling concept designs.

## **5.5 VIDEO:**

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### **Meaning**

Video provides a powerful impact in a multimedia program. Video is a sequence of images captured by camcorder or any other video recording device of live actions. In the context of video these images are called frames. We measure the rate at which frames are displayed in frames per second (FPS). Videos usually have audio components that correspond with the pictures being shown on the screen. It starts with continuous event and breaks it up to frames. Generally there are 15 to 25 frames per second so that the movement is smooth.

The video clips may contain some dialogues or sound effects and moving pictures. These video clips can be combined with the audio, text and graphics for multimedia presentation.

Mostly the video available are in analog format. To make it usable by computer, the video clips are needed to be converted into computer understandable format, i.e., digital format. Both combinations of software and hardware make it possible to convert the analog video clips into digital format.

## **DIGITAL VIDEO**

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### **ANALOG TV STANDARDS**

Four broadcast and video standards and recording formats are commonly in use around the world: NTSC, PAL, SECAM, and HDTV.

### **PAL**

- PAL is an abbreviation for Phase Alternate Line.
- PAL is the television standard used in the UK, Australia, South Africa and most of Europe.
- It specifies a frame rate of 25fps and a frame size of 720x576 pixels (non-square pixels).
- For a 4:3 frame aspect ratio, a pixel aspect ratio of 1.07 is used.
- For a 16:9 frame aspect ratio, a pixel aspect ratio of 1.42 is used.
- DV-PAL is a DV video format that conforms to the PAL specification.
- PAL is an integrated method of adding color to a black-and-white television signal

that paints 625 lines at a frame rate of 25 frames per second.

### **NTSC**

- NTSC is an abbreviation for National Television Standards Committee,
- NTSC is the television standard used in USA & Japan.
- It specifies a frame rate of 29.97fps or 30fps and a frame size of 720x480 pixels (non-square pixels).
- An NTSC picture is made up of 525 interlaced lines and is displayed at a rate of 29.97 frames per second.
- For a 4:3 frame aspect ratio, a pixel aspect ratio of 0.9 is used.
- For a 16:9 frame aspect ratio, a pixel aspect ratio of 1.2 is used.
- DV-NTSC is a DV video format that conforms to the NTSC specification.

### **SECAM**

**SECAM** is an abbreviation for Sequential Color and Memory.

This video format is used in many Eastern countries such as the USSR, China, Pakistan, France, and a few others.

Like PAL, SECAM picture is also made up of 625 interlaced lines and is displayed at a rate of 25 frames per second.

However, the way SECAM processes the color information, it is not compatible with the PAL video format standard.

### **HDTV**

- High Definition Television (HDTV) provides high resolution in a 16:9 aspect ratio (see following Figure).
- This aspect ratio allows the viewing of Cinemascope and Panavision movies.
- There is contention between the broadcast and computer industries about whether to use interlacing or progressive-scan technologies.
- HD refers to multiple video formats which use different frame sizes, frame rates and scanning methods.
- Typical HD frame sizes are:
  - 1280x720 pixels (used for HD television and HD web video)
  - 1920x1080 pixels (referred to as full-HD or full-raster)
  - 1440x1080 pixels (full-HD with non-square pixels)

## **VIDEO STANDARDS**

### **Digital TV Resolution Standards**

The three resolution formats used in digital and HDTV are:

- **480p** - Represented by 720 pixels running across the screen and 480 pixels running from top to bottom. Each row of pixels is displayed progressively. The total number of pixels displayed on the screen is 345,600.
- **720p** - Represented by 1280 pixels running across the screen and 720 pixels running from top to bottom. Each row of pixels is displayed progressively. The total number

of pixels displayed on the screen is 921,600.

- **1080i** - Represented by 1,920 pixels running across the screen and 1,080 pixels running from top to bottom. Each row of pixels is displayed in an interlaced fashion (all odd-numbered rows, followed by all even-numbered rows). The total number of pixels displayed on the screen is 2,073,600 (half the pixels displayed at a time).

### **BITRATE**

Bitrate is the number of bits per second. The symbol is bit/s. It generally determines the size and quality of video and audio files: the higher the bitrate, the better the quality and the larger the file size because File size = bitrate (kilobits per second) x duration. In most cases, 1 byte per second (1 B/s) corresponds to 8 bit/s. Bitrates should be expected to go up whenever the resolution goes up, as more data is being processed.

### **FRAME RATE**

- A frame rate is simply the frequency at which independent still images appear on the screen. This means that you can choose the number of stills that are displayed in one second. If you increase the number of frames per second the figures in the shot will appear to be moving slower, while if you decrease the frame rate the characters in the shot will move faster, like in the early Charlie Chaplin movies.

### **Most Commonly Used Frame Rates**

- Video cameras in Europe use 25 frames per second (fps). In USA & Japan 29.97fps or 30fps is used.
- Animation works by recording each frame individually (e.g. with a stills camera) and then playing them back at a frame rate.
- Animators often work with a lower frame rate (e.g. 12fps) so less frames are needed for the same length video clip.
- A large majority of DSLR and movie cameras offer only three different frame rates, the standard 24fps, 30fps for those who want to produce videos in the style of TV shows, and 60fps for sports and all other scenes that involve rapid motion.

### **WHAT IS TIMECODE?**

- Timecode is how the duration of video is measured, and is divided into hours, minutes, seconds and frames, like so: HH:MM:SS:FF.
- An example: 00:01:22:06 means 1 minute, 22 seconds and 6 frames.
- It is recorded by the video camera as part of the video signal, and is used to navigate and locate video when editing.

### **WHAT IS FRAME SIZE?**

- Frame Size describes the size of a single video frame: width x height, measured in pixels.
- The width of the frame can vary depending on whether the pixels in the frame are square pixels or non-square pixels.
- An example: a DV-PAL 4:3 frame is 768 pixels wide (square pixels) or 720 pixels wide (non-square pixels). This is because a



smaller number of pixels are required to create the same size frame on screen if each individual pixel is wider.

- Computer graphics use square pixels, whereas video cameras use non-square pixels. Therefore if creating graphics for video, use the square pixel frame size.
- A square pixel aspect ratio can be written as 1.0 (width÷height). All other values indicate non-square pixels.

### ASPECT RATIO

The term Aspect Ratio refers to the width of a picture (or screen) in relation to its height. Ratios are expressed in the form "width x height". Video is landscape, so the width of a frame is greater than the height. For example, a 4x3 ratio means the picture is 4 units wide by 3 units high. Alternatively a colon may be used (e.g. 4:3 or 16:9) or a ratio to the number 1 (e.g. 1.33:1 or 1.78:1).

Note that the actual physical size of the picture is irrelevant - aspect ratio refers only to the relationship between width and height.

The three most common aspect ratios are shown below. There are many variations in addition to these but most video and film production uses one of these formats.

#### **4x3**

This is the standard television format used throughout the second half of the 20th Century. Sometimes referred to as 12x9.

#### **16x9**

This format has gained acceptance as the new standard for widescreen TV, DVD and high-definition video.

#### **21x9 (Cinemascope)**

A very wide screen format used for theatrical release movies.

### Converting Between Aspect Ratios



Conversions almost always involve compromise and often annoy the end user, the film director, or both.

For example, if we take the 21x9 image above and convert it to a narrower format, we will have to lose quite a large part of the picture. The blue lines show where the picture will be cropped at 16x9, and the red lines show a 4x3 version.

### VIDEO RESOLUTION

In digital video, resolution means the number of pixels displayed on the screen. Technically speaking there are two types of resolution:

1. **Spatial resolution** means the width and height of the displayed image, measured in pixels. In other words, the total number of pixels contained in each individual frame.
2. **Temporal resolution** means the frame rate (number of frames shown per second), i.e. "resolution over time".

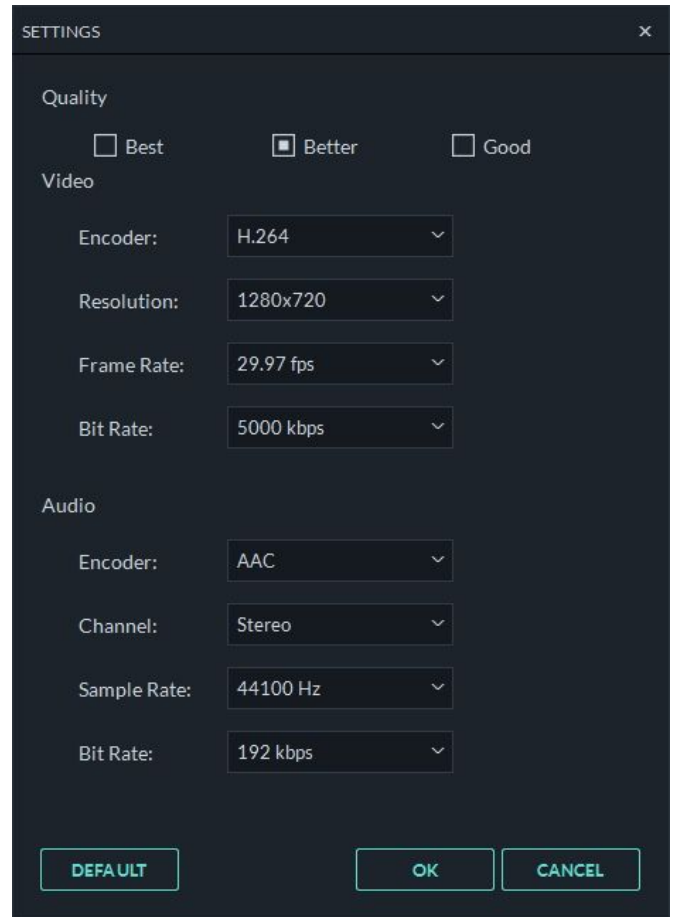
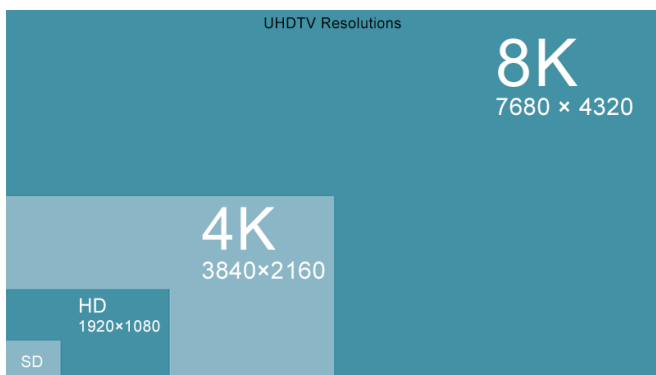
Unless otherwise stated, it's safe to assume that the term resolution by itself means spatial resolution.

### Common resolutions

There are many different resolutions available for video, television and cinemas—the table below shows some of them.

- "i" refers to a TV standard that uses interlaced frames. "p" means progressive frames.
- In some older systems, some pixels are reserved for technical display information and are not part of the visible image.
- Digital cinema formats have variations for archiving and other purposes.

The image below shows some of these resolutions in relation to each other. Remember that higher resolution doesn't necessarily mean a "bigger picture", it just means more pixels in the displayed image—whatever size that happens to be. Of course higher resolutions are generally suited to larger displays.



### VIDEO COMPRESSION

- Video compression is used to reduce the size of the file because videos take up a lot of space and bandwidth is limited. Video compression is the process of encoding a video file in such a way that it consumes less space than the original file and is easier to transmit over the network/Internet. It involves packing the file's information into a smaller space.
- Usually video compression is done by removing repetitive images, sounds and/or scenes from a video.
- Once a video is compressed, its original format is changed into a different format (depending on the codec used). The video player must support that video format or

be integrated with the compressing codec to play the video file.

- This works through two different kinds of compression: lossy and lossless.

### Lossy Compression Formats

- Lossy compression means that the compressed file has less data in it than the original file. Images and sounds that repeat throughout the video might be removed to effectively cut out parts of the video that are seen as unneeded. In some cases, this translates to lower-quality files because information has been lost, hence the designation "lossy."
- Lossy compression makes up for the loss in quality by producing comparatively small files. For example, DVDs are compressed using the MPEG-2 format, which can make files 15 to 30 times smaller than the originals, but viewers still perceive DVDs as having high-quality pictures.
- Most video files uploaded to the internet use lossy compression to keep the file size small while delivering a relatively high-quality product.
- If a video were to remain at its (in some cases) extremely high-quality file size, not only would it take forever to upload the content, but users with slow internet connections would have an awful time streaming video or downloading it to their computers.

### Lossless Compression Formats

- Lossless compression is exactly what it sounds like: the original and the compressed versions are nearly identical. None of the data is lost in the compression

process. Lossless compression formats are not nearly as useful as lossy compression in many cases because files often end up being the same size as they were before compression.

- If the file size is not an issue, using lossless compression results in a perfect-quality picture.
- For example, a video editor transferring files from one computer to another using an external hard drive might choose to use lossless compression to preserve quality while he's working.
- Lossless compression formats include Free Lossless Audio Codec (FLAC), Apple Lossless Audio Codec (ALAC), and Windows Media Audio Lossless (WMAL), among others.

### WHAT IS VIDEO CODEC?

- Codec is a set of instructions that identifies the method used to compress data into fewer bytes, as well as doing just the opposite when a video file is played back, decompressing it.
- File Formats include things like AVI and Quicktime.
- Codecs include things like MJPEG, Sorenson, Cinepak, and DivX. Some Codecs are also formats (or have specific formats attached to them), such as MPEG and ASF.
- The "codec" can be divided into 2 parts: encode and decode. The **encoder** performs the compression (encoding) function and the **decoder** performs the decompression (decoding) function. Some codecs include both of these components and some codecs only include one of them.

- For example, when you rip a song from an audio CD to your computer, the Player uses the Windows Media Audio codec by default to compress the song into a compact WMA file. When you play that WMA file (or any WMA file that might be streamed from a website), the Player uses the Windows Media Audio codec to decompress the file so the music can be played through your speakers.
- Transcoding is the process of converting from one codec to another.
- Codecs can be Lossless, which means that they do not throw away any data, or Lossy, which means that data is lost during encoding.
- Lossless codecs are higher quality than lossy codecs, but produce larger file sizes.

### **Common Video Codecs**

There are common video codecs that will meet most of your needs:

- H.264
- MPEG-4
- DivX
- MPEG-2
- HEVC (H.265)

### **H.264**

Probably the most common, particularly for HD, is H.264. It's one of the more efficient codecs, allowing smaller file sizes while retaining high quality as well as offering options for either lossless or lossy compression. It's compatible with the .MP4 container and can be played on many different players and streaming services.

### **MPEG-4**

Another very common codec for online streaming is the MPEG-4 codec. Newer standards within MPEG-4 are identical to H.264, while the older MPEG-4 Part 2 is somewhat different. MPEG-4 has a very wide range of compatibility.

### **DivX**

DivX, along with the open source version XviD, is a somewhat older codec that is designed to maximize video quality at the expense of having significantly larger file sizes. It's commonly used in a variety of commercial settings where there is less concern over file size.

### **MPEG-2**

A predecessor to MPEG-4, MPEG-2 was the standard codec for use on DVDs and Blu-ray discs. It's not commonly used for streaming video. Professional camera codecs which use MPEG-2 are HDV and XDCAM.

### **HEVC (H.265)**

New video codecs are constantly evolving to keep up with modern technology. HEVC, also called H.265, is one such codec designed to offer more efficient compression for 4K video and Blu-ray. It's the video compression standard widely used by GoPro to capture their level of video content at half the size.

### **FILE FORMATS (VIDEO CONTAINERS)**

Video containers bundle and store all elements of a video into one package. Elements include the video and audio streams, subtitles, video metadata, codec and more. These are referred as Video File Formats.

Each video container type is compatible with certain video codecs.

Like video codecs, there are common video formats:

- MP4
- AVI
- MOV
- FLV
- WMV

#### **MP4**

The .MP4 container is probably the closest thing to a universal standard that currently exists. It can be used in all versions of MPEG-4 and H.264 and is compatible with a huge range of players. Videos using the .MP4 container can have relatively small file sizes while retaining high quality. Many of the largest streaming services, including YouTube and Vimeo, prefer .MP4.

#### **AVI**

One of the oldest and most universally accepted video file formats is .AVI. It can use an enormous range of codecs, resulting in a large variety of different file settings. While .AVI videos can be played on a wide range of players, file sizes tend to be large making it less ideal for streaming or downloading. It's a great option for videos you plan to store on a computer.

#### **MOV (Quicktime)**

Apple developed the .MOV container to use with its Quicktime player. Videos using .MOV generally have very high quality but also fairly large file sizes. Quicktime videos don't have as much compatibility with non-Quicktime players, though there are third party players that will read them.

#### **FLV (Flash)**

Made for Adobe's Flash player, .FLV videos were extremely common for a number of years thanks to their very small file size and a wide range of browser plugins and third party Flash video

players. There has been a significant decline in Flash videos recently.

#### **WMV (Windows Media)**

Windows Media videos tend to have the smallest file size, which makes them a good option if you need to send through email or other methods with file size limits. However, this comes with the tradeoff of having a significant drop in quality. A common use for .WMV is emailing video previews to clients.

#### **CAPTURE CARD**

- A video capture card is an expansion board that converts video signals into digital data compatible with your computer. Unlike a video adapter card, which sends images to your computer screen, a capture card takes video in and records it as data.
- Capture cards accept video from sources such as cable television, DVD players and video cameras.
- Video capture cards work in conjunction with PC software that displays the video on the computer screen and enables you to save the resulting data to a media file.
- Video capture cards come in two main types: internal circuit boards you install inside your computer and external boxes that connect via USB or another interface. Internal cards plug into standard PCI and PCI Express slots on a desktop computer's motherboard. Both types of video capture devices have one or more input jacks that accept analog or digital video.
- **Input and Tuning**  
The video capture card's input jacks take in video from a variety of sources. Depending on the card, it may be digital-only or it may have inputs for older

analog sources such as DVD players. Some cards have tuner circuits that select channels from an antenna or broadband cable TV signal. Using a video capture card with a tuner, you can watch TV shows in one window on your computer screen while checking your email in another window.

- **Conversion**

A specialized high-speed chip on the capture card analyzes the incoming video signal, turning it into a stream of digital images. The source largely determines the quality of the image and frame rate; generally, digital sources produce higher-resolution images at faster rates.

- **Buffering**

Once the video is converted into data, the processor chip on the capture card stores the video images into a memory area called a buffer. The buffer acts as a reservoir, keeping a certain amount of video data ready to send to the PC.

- **Drivers and Editing Software**

The video capture card manufacturer provides software called drivers along with the card itself. When you install the capture card, Windows automatically loads the drivers, which become part of the computer's operating system. The drivers enable Windows to recognize the card and handle the data coming from it. To use the card, you connect it to a video source and start a video editing program. The program displays the video on your computer screen and helps you add, remove or rearrange scenes and then save the results to a file on the hard drive.



A PCIe 2-port video capture card (Datapath VisionRGB-E2s)



A Mini PCIe card that simultaneously captures 8 video and 8 audio signals (Sensoray 1012)

### VIDEO EDITING TOOLS

In this collection of video material is either compiled and altered from its original form to create a new version.

Video editing tools enable us to edit and assemble video clips captured from camera, animations and other sources. The completed clip with added transition and visual effects could be played back. Adobe Premiere and Media Shop Pro are two good examples of these tools.

**Adobe Premiere** is a powerful tool for professional digital video editing. It is primarily used to produce broadcast quality movies. It has excellent editing tools that enable the programmer to work with complete flexibility. This software first digitizes the sound and video and then allows the programmer to edit them to preserve picture quality. It can edit video and multimedia movies in AVI as well as MPEG format. It can create titles and graphics and then add them to the multimedia project. It uses digital filtering for incorporating special effects. This

software has applications in film editing and movie making.

**Final Cut Pro** is a sophisticated video editing program made by Apple. It is the editing software of choice for multimedia journalists using Apple computers, and is comparable to Adobe's Premiere video editing program.

**Media Studio Pro** also gives the most complete set of advanced video editing tools. It can capture the video from VCR, TV or camcorders. It is capable of capturing a batch of scenes. It brings all the components of a multimedia project like video, sound, animation and titles together. One can add effects and transitions and finally save the video in the desired format. It can retouch videos by painting directly over any frame in a video sequence. It has an audio editor, which can remove background noise and add another sound to your video.

## INTERACTIVE AND NEW MEDIA

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- "Interactivity" in new media is "allowing a two-way flow of information between a computer or other electronic device and a user."
- Multimedia is any combination of text, graphic, sound, video and animation. When the user is allowed to control what and when these elements are delivered, it become an interactive multimedia. Interactive multimedia can be called hypermedia. This happened when a user is provided with a structure of linked elements for the use of navigation.

The most common view of interactivity involves "cause and effect" relationships with the user; the user performs an action with some sort of input device and as a result another action occurs. The

following are common examples of some cause and effect levels of interactivity:

- **Rollovers**- the user rolls their mouse over a certain web-based object (button) and that object (button) responds in a certain way.
- **Flash websites**- the user can "interact" in a variety of different ways with the content of the website; the user has a cause and effect relationship with the content on the page.
- **Video games**- the player can control an on-screen character's actions through the input of a keyboard or game control.
- **Hypertext**- the user clicks on a bit of text and as a result is taken to a different location on the web.
- **Input devices** (keyboard, mouse etc.)- the most obvious form of interactivity, the user's actions towards the input objects are directly mirrored in the program the user is using.

Another type of interactivity in respect to new media, is that of communication. The ability to communicate with another person over the internet instantly through instant messenger applications or telephone applications is another aspect of new media interactivity.

## 6 APPLICATION IN EDUCATION

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Multimedia applications play a crucial role in education which range from preschool education to postgraduate students and corporate training packages.

In Education, multimedia is used to produce computer-based training courses (popularly called CBTs) and reference books like encyclopedia and almanacs. A CBT lets the user go through a series

of presentations, text about a particular topic, and associated illustrations in various information formats. Edutainment is an informal term used to describe combining education with entertainment, especially multimedia entertainment.

- Multimedia applications in education are used to improve the learning process and increase the interaction between students and teachers. It also allows users to interact with the information quickly and accurately. These enable students to get information in various formats. Examples of multimedia applications are World Wide Web, courseware, interactive TV, computer games, and virtual reality.
- Teachers or lecturers discover ways to boost students' interest and motivate them by using educational multimedia applications. Students can also actively involve in the learning process by using multimedia applications such as CD-ROM based textbooks, tutorials and laboratory experiments.
- Multimedia applications increase the learning effectiveness and are more attractive than traditional-based learning methods. This new learning environment definitely influence the way of teachers or lecturers teach and the way students learn.

### **APPLICATION IN EDUCATION**

A multimedia learning environment involves numbers of elements in order to enable learning process taking places. There are six main elements in multimedia applications for educational purposes which are texts, images, audio, video, animations and user control.

1. Firstly, text is an important element in multimedia applications; it can be used to provide information and emphasize specific point by using different styles, fonts, and colours.
2. Secondly, image is an object that has more significant impact than merely reading about text in an educational session. Image can be added to multimedia applications by using colour scanner or digital camera. Examples of image are photographs, artworks, drawings.
3. Thirdly, audio can be used to emphasize certain points and enables teachers to presents a lot of information at once rather than use printed learning resources. Audio allows students to use their imagination without being biased, so it will greatly increase the learning outcome. Audio also ease the students by conducting live online discussions via audio tools and platform. There are a few widely used software that can be used for this, such as, Wechat, Whatapps, Line and Skype. Such apps are frequently used for long distance learning. Learning by using audio also can help disabled people such as blind people to learn.
4. Fourthly, video can be used to present the information beyond the scope of the ordinary lecture room such as medical operations. The use of video to deliver information can be very powerful and immediately, it allows teachers or lecturers to highlight certain key points or tell the students what are going to do next and understand the real life situation.

This type of multimedia elements are used because it can provide visual stimulation for students so that they can have a better understanding in learning. This proves to be helpful in surgical training where students cannot just understand the procedure for surgery just by reading. So, a video of a surgery in action is needed so



that the students can understand. It also can help to enhance their practical skills.

5. Fifthly, animation is used to demonstrate an idea or illustrate a concept; an object that appears blurry in video can be presented clearly in animation because it can view the changes of the object over time.

Animation can help students to learn faster and easier. This is because they can help teacher to explain a difficult topic. For example, the flow of blood throughout the body cannot be seen. The flow of blood in and out of the heart are difficult for students to understand in the beginning. By providing a structural animation of our blood circulatory system and the heart, students can clearly see how it work. This can help provide a better understanding about the topic to students. With the help of computer animation, learning and teaching can be much more easier, faster and amusing.

6. Lastly, user control (interactive media) uses to provide students with the option to skip particular parts of the multimedia application and allow them to navigate other areas of that program. Students are able to navigate and retrieve the information quickly because they have the ability to interact with the multimedia applications.

Navigation feature can enhance learning outcome and make an interactive multimedia applications easy to use by the students. Navigation provides students some control over the events and allows them to jump into new sections or revisit the information from earlier screen. Students can also learn and understand more when they can control multimedia applications such as slow down, start and stop at certain information as they want. Students can learn more when they can control the pace of the presentation such

as slow down, start and stop at certain information as they want.

All of the elements are combined to provide a platform for students to maximize the effectiveness of educational purposes.