Unit 4

Introduction to Multimedia

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Historical perspective of multimedia

- The word multimedia was coined in the beginning of the 1990s by Tay Vaughan.
- After the success of the digital audio recording industry, and the distribution of digital audio in the form of compact discs (CDs), the next anticipated step was to create digital content involving images, text, and video along with audio and distribute it in a similar fashion.
- Outcomes of this were multimedia CD-ROMs, which included informational content as well as games.
- Examples of these include, Encyclopedia Britannica and interactive CD-ROM games with simple graphics, animations, and audio

Multimedia data and multimedia

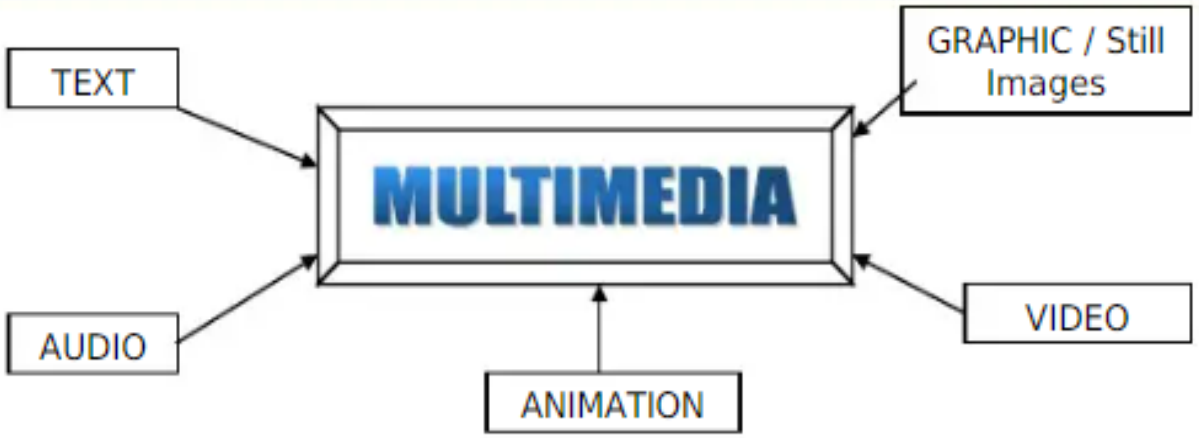
- **Definition:**

  Multimedia is any combination of text, graphics, animation, audio and video that is delivered interactively to the user by electronic and digitally manipulated means.

- **Elements of multimedia:**

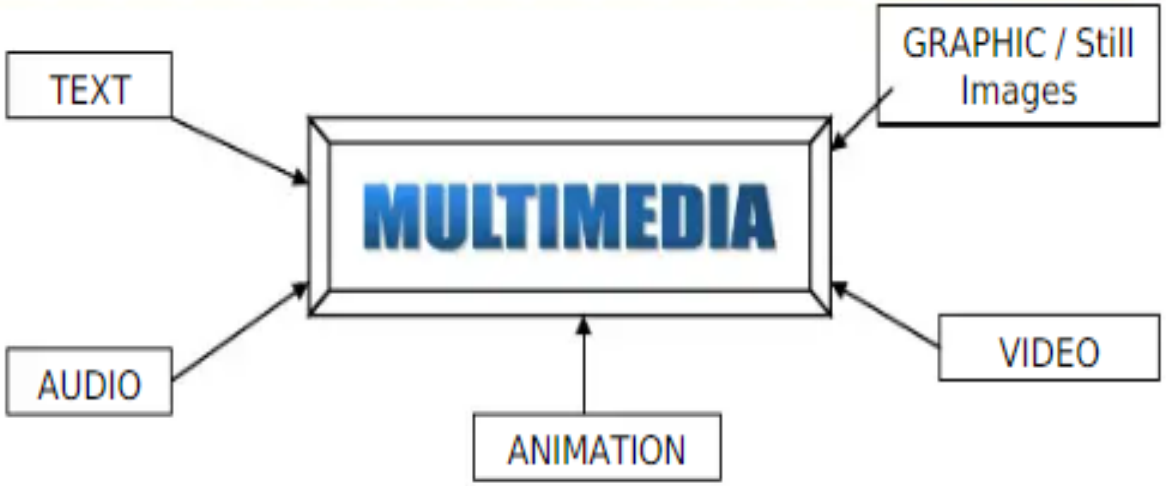
  Text, Graphics, Audio, Animation, Video

TEXT



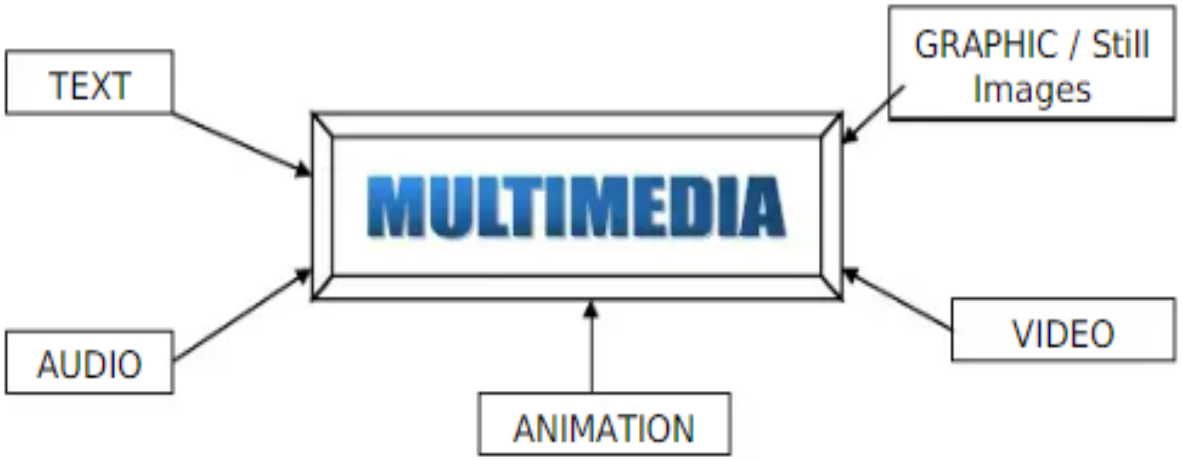
- A broad term for something that contains words to express something.
- Text is the most basic element of multimedia.
- A good choice of words could help convey the intended message to the users (keywords).
- Used in contents, menus, navigational buttons

GRAPHIC



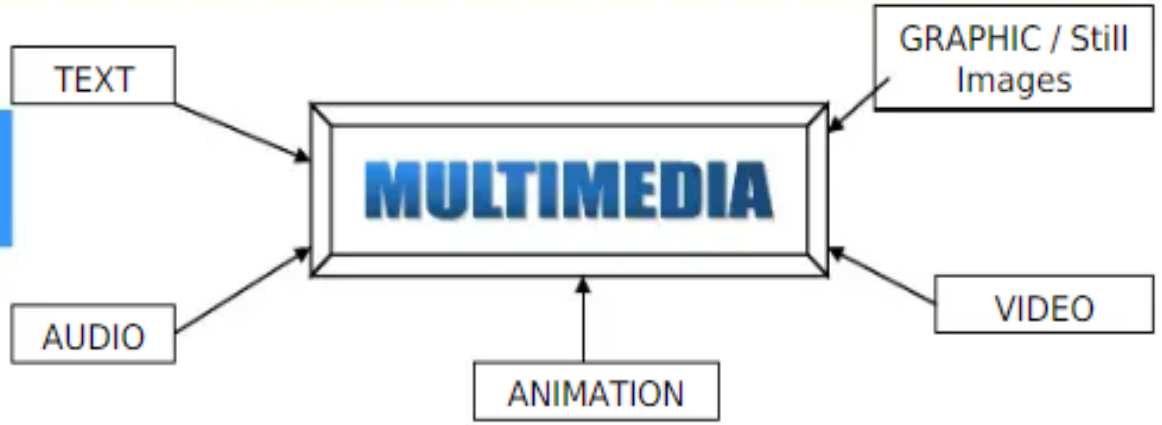
- Two-dimensional figure or illustration
- Could be produced manually (by drawing, painting, carving, etc.) or by computer graphics technology.
- Used in multimedia to show more clearly what a particular information is all about (diagrams, picture).

AUDIO



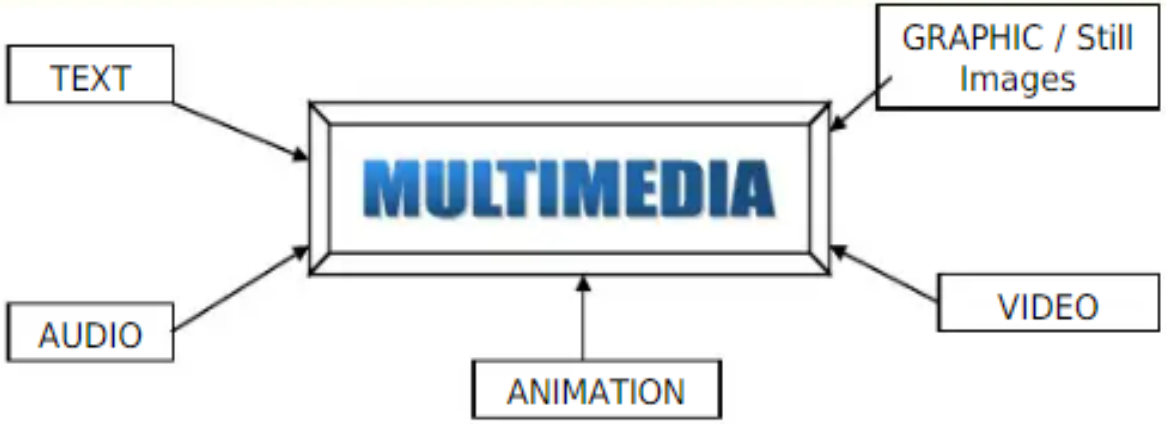
- Produced by vibration, as perceived by the sense of hearing.
- In multimedia, audio could come in the form of speech, sound effects and also music score.

ANIMATION



- The illusion of motion created by the consecutive display of images of static elements.
- In multimedia, animation is used to further enhance / enriched the experience of the user to further understand the information conveyed to them.

VIDEO



- Is the technology of capturing, recording, processing, transmitting, and reconstructing moving pictures.
- Video is more towards photo realistic image sequence / live recording as in comparison to animation.
- Video also takes a lot of storage space. So plan carefully before you are going to use it.

Multimedia system today

Multimedia systems can be logically grouped into three parts whose primary functionalities are

(1) content production,

(2) compression and storage, and

(3) distribution to various end users and platforms

- **Multimedia content creation or multimedia authoring**—This process involves digitizing media (audio, images, video) using capture devices and assembling/processing them using smart software and hardware.
- **Storage and compression**—Multimedia content created today has significant memory requirements and has to be engineered so as to minimize necessities for Multimedia: Historical Perspective 3 storage and distribution. The process mostly involves state-of-the-art compression algorithms and standards for audio, video, images, and graphics.
- **Distribution**—Distribution involves how multimedia content is distributed via various media, such as wired cables, optical networks, satellite, wireless networks, or any combination thereof, to specific platforms ranging from television, computers, personal digital assistants (PDAs), and so on.

Types of Multimedia

- **Linear Multimedia:**

  Projects that are not interactive. Users have very little control over the presentation.

- **Nonlinear Multimedia:**

  Projects that are user-interactive, where users are given navigational control.

- Linear Multimedia
  - The users sit back and watches the presentation
  - The presentation normally plays from the start to end or even loops continually to present the information.
  - A movie is a common type of linear multimedia.
  - Demo show, non interactive lecture

- Non linear (interactive) multimedia
  - Users have the ability to move around or follow different path through the information presentation.
  - Advantage: complex domain of information can be presented.
  - Disadvantage: users might lost in the massive “information highway”.
  - Useful for: information archive (encyclopedia), education, training and entertainment.

Multimedia systems involve three major components: multimedia content creation, compression/storage of multimedia content, and delivery or distribution of multimedia content.

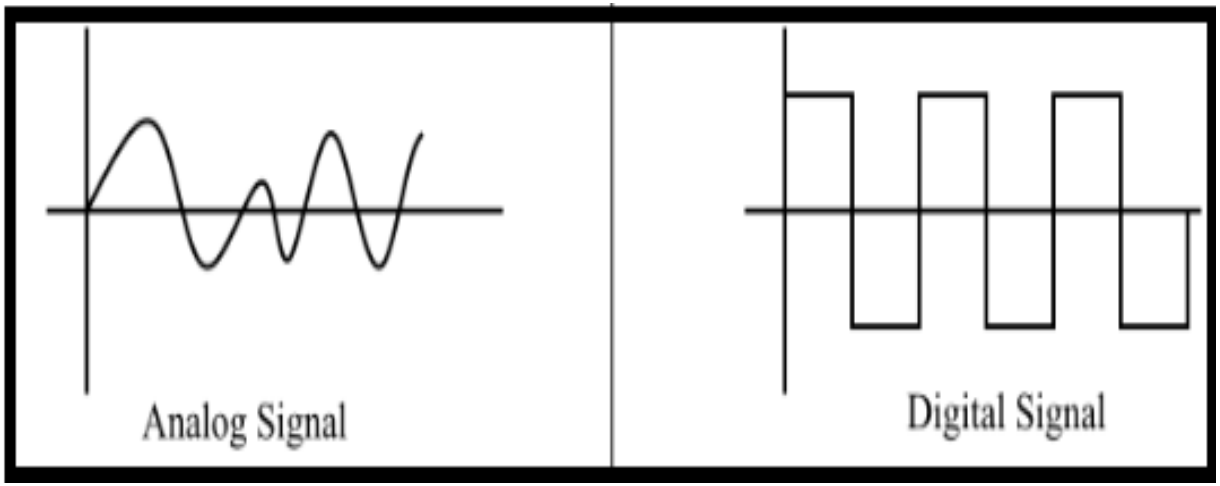
Multimedia information is digital, interactive, and voluminous. One of the first tasks in creating multimedia content using text, audio, video, and images is to record these individual media types into a digital form, making it is easy to combine and assemble these heterogeneous entities.

The conversion and recording of information into a digital medium is important. It brings forth issues involved in digitizing one-dimensional (such as audio), two-dimensional (such as images), and three-dimensional (such as video) signals

Analog & Digital Signals

An electrical or electromagnetic quantity that carries data or information from one system (or network) to another is called a **signal**. Two basic types of signals are used for carrying data, viz. analog signal and digital signal.

Analog signal and **digital signal** are different from each other in many aspects. One major difference between the two signals is that an analog signal is a continuous function of time, whereas a digital signal is a discrete function of time.



Analog Signal:

- A signal which is a continuous function of time and used to carry the information is known as an analog signal.
- An **analog signal** represents a quantity analogous to another quantity, for example, in case of an analog audio signal, the instantaneous value of signal voltage represents the pressure of the sound wave.
- Analog signals utilize the properties of medium to convey the information.
- All the natural signals are the examples of analog signals. However, the analog signals are more susceptible to the electronic noise and distortion which can degrade the quality of the signal.

Digital Signal:

- A signal that is discrete function of time, i.e. which is not a continuous signal, is known as a **digital signal**.
- The digital signals are represented in the binary form and consist of different values of voltage at discrete instants of time.
- Basically, a digital signal represents the data and information as a sequence of separate values at any given time. The digital signal can only take on one of a finite number of values.

Analog & Digital Signals

Analog signals are captured by a recording device, which attempts to record a physical signal. A signal is analog if it can be represented by a continuous function. For instance, it might encode the changing amplitude with respect to an input dimension(s).

Digital signals, on the other hand, are represented by a discrete set of values defined at specific (and most often regular) instances of the input domain, which might be time, space, or both. An example of a one-dimensional digital signal is shown in Figure , where the analog signal is sensed at regular, fixed time intervals.

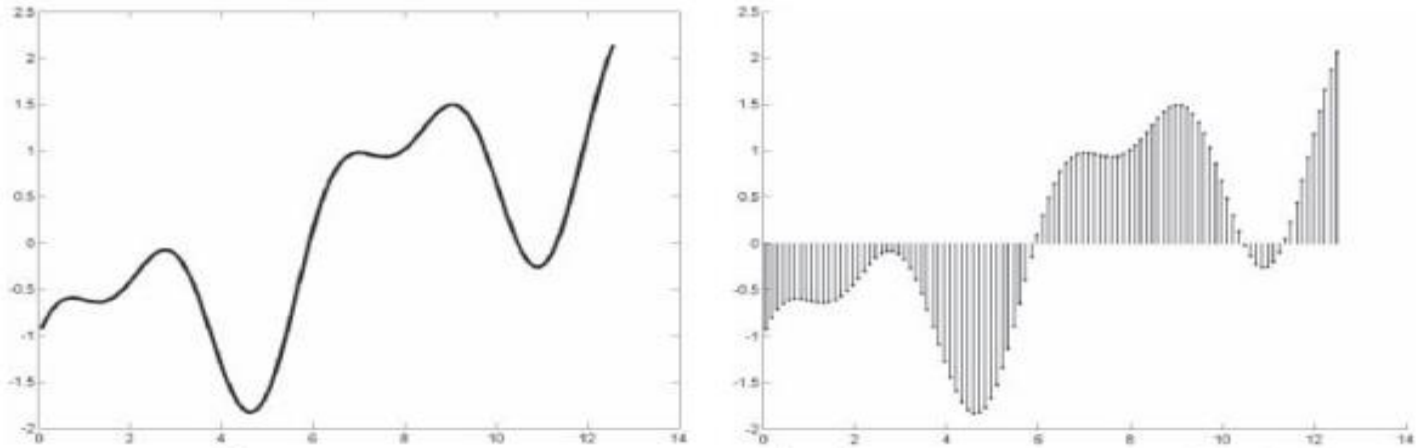


Figure: Example of an analog signal (left) and a digital signal (right) in one dimension

Comparison of Analog Signal and Digital Signal

Sr. No.	Parameter	Analog Signal	Digital Signal
1	Definition	A signal for conveying information which is a continuous function of time is known as analog signal.	A signal which is a discrete function of time, i.e. non-continuous signal, is known as digital signal.
2	Typical representation	An analog signal is typically represented by a sine wave function. There are many more representations for the analog signals also.	The typical representation of a signal is given by a square wave function.
3	Signal values	Analog signals use a continuous range of values to represent the data and information.	Digital signals use discrete values (or discontinuous values), i.e. discrete 0 and 1, to represent the data and information.
4	Signal bandwidth	The bandwidth of an analog signal is low.	The bandwidth of a digital signal is relatively high.

Continued…

Sr. No.	Parameter	Analog Signal	Digital Signal
5	Suitability	The analog signals are more suitable for transmission of audio, video and other information through the communication channels.	The digital signals are suitable for computing and digital electronic operations such as data storage, etc.
6	Effect of electronic noise	Analog signals get affected by the electronic noise easily.	The digital signals are more stable and less susceptible to noise than the analog signals.
7	Accuracy	Due to more susceptibility to the noise, the accuracy of analog signals is less.	The digital signals have high accuracy because they are immune from the noise.
8	Power consumption	Analog signals use more power for data transmission.	Digital signals use less power than analog signals for conveying the same amount of information.

Continued…

Sr. No.	Parameter	Analog Signal	Digital Signal
9	Circuit components	Analog signals are processed by analog circuits whose major components are resistors, capacitors, inductors, etc.	Digital circuits are required for processing of digital signals whose main circuit components are transistors, logic gates, ICs, etc.
10	Observational errors	The analog signals give observational errors.	The digital signals do not given observational errors.
11	Examples	The common examples of analog signals are temperature, current, voltage, voice, pressure, speed, etc.	The common example of digital signal is the data store in a computer memory.
12	Applications	The analog signals are used in land line phones, thermometer, electric fan, volume knob of a radio, etc.	The digital signals are used in computers, keyboards, digital watches, smartphones, etc.

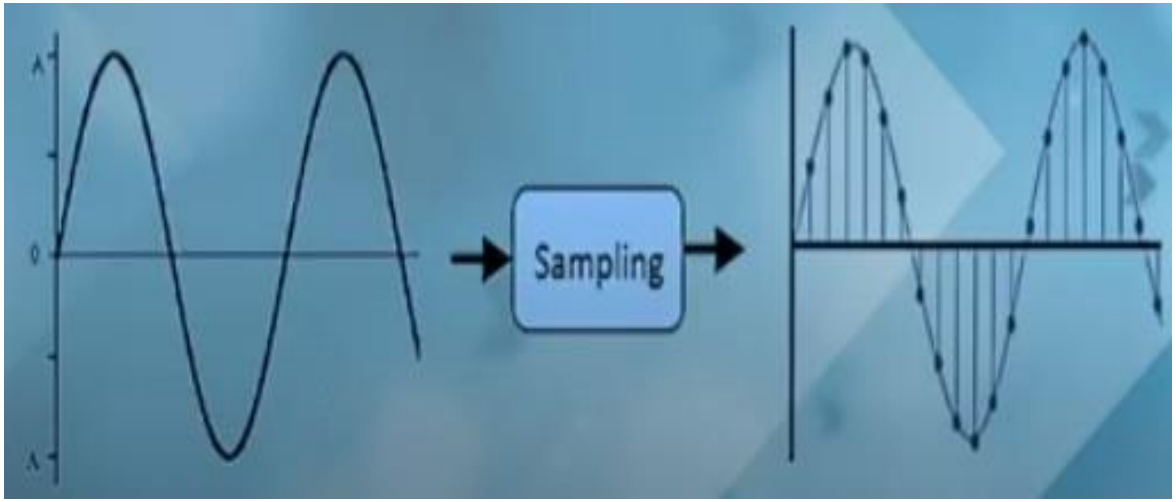
Analog to Digital Conversion

- **Analog to Digital Conversion** is the process by which analog signals are converted to their digitized forms.

- ADC occurs via three steps:
  - Sampling.
  - Quantization.
  - Encoding.

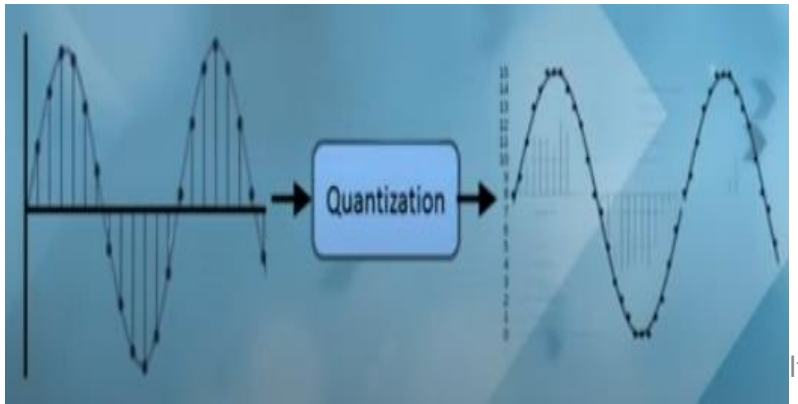
Sampling

- The analog input signal which is a continuous function in time has to be held constant for a period of time to convert the instantaneous value to digital form. This process is done by the sampling & holding
- Sampling is a process of measuring the amplitude of a continuous time signal at discrete instants, converts the continuous signal into a discrete signal.
- Sampling takes the samples of a continuously varying analog signal & holds its value at a constant level for a specified period of time
- The rate at which samples are collected is called the sampling rate
- The sampling rate is measured in the number of samples captured per second (samples/sec)



Quantization

- The digitization of analog signals involves the rounding off of the values which are approximately equal to the analog values.
- The method of sampling chooses a few points on the analog signal and then these points are joined to round off the value to a near stabilized value. Such a process is called as Quantization.
- The quantizing of an analog signal is done by discretizing the signal with a number of quantization levels.
- Quantization is representing the sampled values of the amplitude by a finite set of levels, which means converting a continuous-amplitude sample into a discrete time signal
- Quantization is the process of mapping continuous infinite values to a smaller set of discrete finite values.
- Quantization error is the difference between actual analog value & quantized digital value



Sampled Value	Quantized Value	Sampled Value	Quantized Value
6.5 - 7.5	7	14.5 - 15.5	15
5.5 - 6.5	6	13.5 - 14.5	14
4.5 - 5.5	5	12.5 - 13.5	13
3.5 - 4.5	4	11.5 - 12.5	12
2.5 - 3.5	3	10.5 - 11.5	11
1.5 - 2.5	2	9.5 - 10.5	10
0.5 -1.5	1	8.5 -9.5	9
0 - 0.5	0	7.5-8.5	8

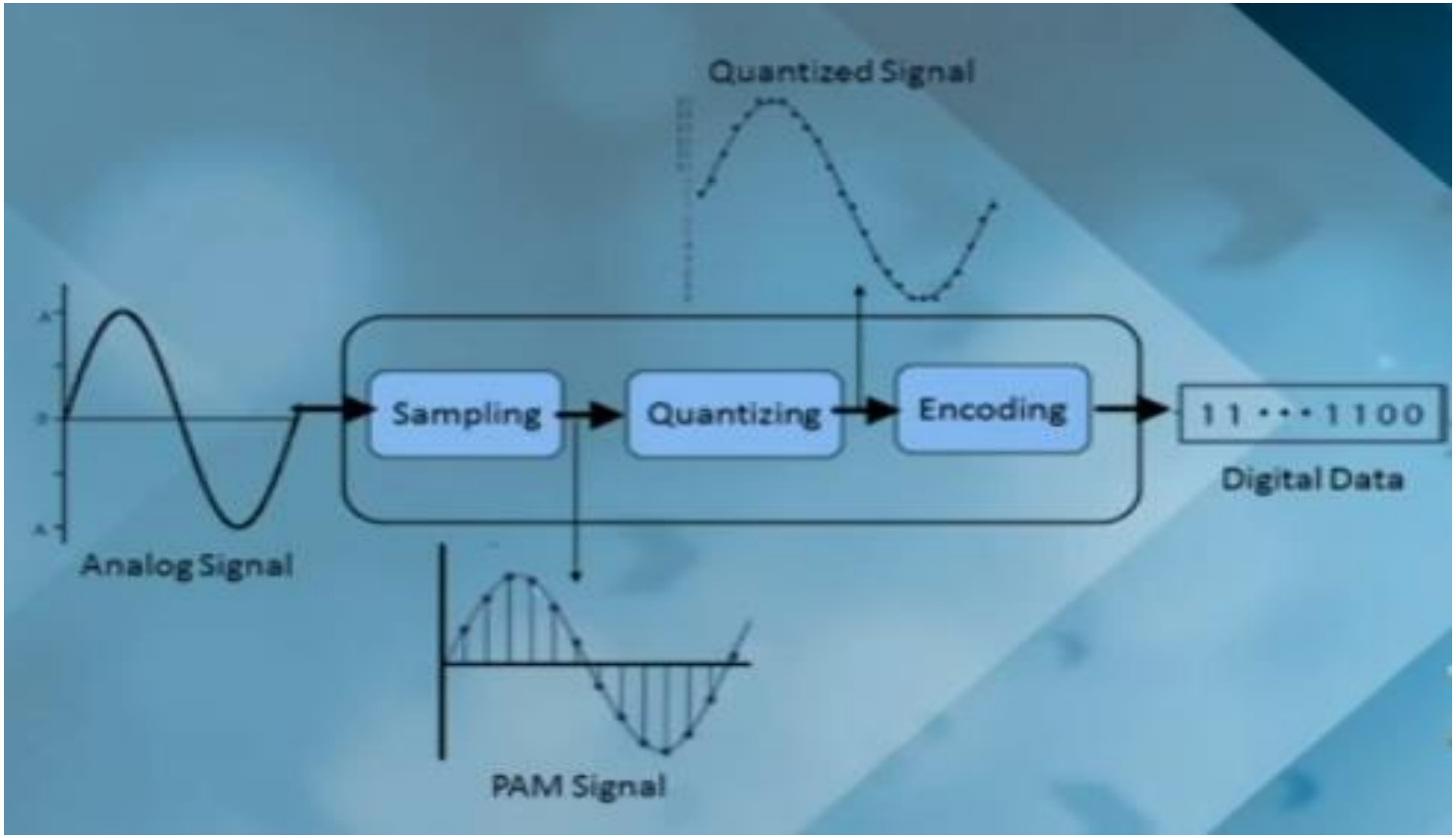
Encoding

- Encoding is the process of converting the quantized signals into a digital representation i.e. Encoding is the process which assigns ones and zeros (stream of bits) for every quantization level.
- After identifying the closest value, a numerical value is assigned to it and it is encoded in the form of a binary number.
- A unique digital code will be assigned and after that the input is allocated with a digital code.

Sampled Value	Quantized Value	Digital Output
6.5 - 7.5	7	0111
5.5 - 6.5	6	0110
4.5 - 5.5	5	0101
3.5 - 4.5	4	0100
2.5 - 3.5	3	0011
1.5 - 2.5	2	0010
0.5 -1.5	1	0001
0 - 0.5	0	0000

Sampled Value	Quantized Value	Digital Output
14.5 - 15.5	15	1111
13.5 - 14.5	14	1110
12.5 - 13.5	13	1101
11.5 - 12.5	12	1100
10.5 - 11.5	11	1011
9.5 - 10.5	10	1010
8.5 -9.5	9	1001
7.5-8.5	8	1000

A/D Converter



Media Representation and Media Formats

- Media is represented in various forms—text, images, audio, video, and graphics.
- Images are commonly used to capture and represent a static visual snapshot of the world around us.
- The world is not static, but continuously changes in time. To record this change, we need to capture the time evolution of changing images (video) and sound (audio).
- Graphical illustrations and animation help to visually convey the changing information.
- The digital media forms need to be represented and stored so that they can be viewed, exchanged, edited, and transmitted in a standard manner.

Digital Images

- Images by themselves are used in various forms for a variety of applications. These might be:
  - photographs, gray or color
  - used with text in documents
  - fax is another image representation used in communication
- Images are combined to create an interesting application using different methods
- Images are also basic element of video

Digital representation of images

- Images are digitally represented as pixels
- Images is defined by
  - Width
  - Height and
  - Pixel depth (number of bits per pixels)
- Pixel depth is same for all pixels of a given image
- Number of bits per pixels used in an image is depends on the color representation **grey or color**

Continued…

- For instance
  - in a grey scale image the pixel depth is 8bits per pixel
  - In color image each R, G, B channel may be presented by 8 bits. So the depth for color image would be 8+8+8= 24bits
- An additional channel alpha is used to composite the pixels of the foreground with the background image, producing the final image on the far right.
- In this case the pixel depth would be 32 bits
- So the number of channels typically ranges from 1 to 4 and accordingly pixel depth changes.
- Image size can be calculated as:
  - ➔ Resolution * depth = image size
  - ➔ (width * height) * depth = image size
- For example image size of a grey scale image having resolution of 640*480 pixels using 4 bits per pixels is:
  - ➔ Image size = resolution * depth
  - ➔ Image size = 640*480* 4
  - ➔ Image size = 1228800 bits

Continued…

- **Digital image formats** depends on the software and hardware used for the image.
- Some commonly used formats are:
  - Bmp
  - Pcx
  - Gif
  - Jpg, jpeg
  - Png
  - Psd,
  - etc

Digital Video

* Throughout twentieth century motion pictures were stored on films
* Then medium changed to tapes and provide public direct access to movies
* Digital videos further altered the field by making available precedent level of:
  * Visual quality
  * Distribution
  * Interaction

Representation of digital video

* Video, whether analog or digital, is represented by a sequence of discrete images shown in quick succession.
* Each image in the video is called a frame, which is represented as a matrix of pixels defined by a width, height, and pixel depth. The pixel depth is represented in a standardized color space such as RGB.
* These image attributes remain constant for all the images in the length of the video.
* Thus, video has the same properties such as width, height, and aspect ratio.
* In addition, two important properties govern video representation: frame rate and scanning format.
* The rate at which the images are shown is the frame rate.
* Film is displayed at 24 frames per second.
* Television standards use 30 frames per second (NTSC) or 25 frames per second (PAL).National Television Systems Committee & Phase Alternating Line
* If the frame rate is too slow, the human eye perceives an unevenness of motion called flicker.

Digital Video file formats

Whenever a video file is saved it contains two file in it. One is the container and other is codecs. Container defines the structure of the video file and which codecs will be used. Codecs is used to compress and decompress video file.

Some of common container format are:

- **Flash Video Format (.flv)**
- **AVI format (.avi) (Audio Video Interleave)**
- **MP4 (.mp4) (Moving Picture Experts Group (MPEG))**
- **WMV (Windows Media Video)**
- **QuickTime Format (.mov)**
- **3GP (.3gp)**

Digital audio

* Sound is a form of energy transmitted in form of pressure waves
* Captured by electromechanical devices such as microphone
* The first sound capturing/reproducing equipment appeared in the late 1800s in the form of a phonograph created by Thomas Alva Edison and a gramophone by Emile Berliner.

Digital Representation of audio

* Digitizing an analog audio signal requires sampling and quantization. The process of conversion to digital sound is known as pulse code modulation (PCM).
* The analog sound is sensed at evenly spaced time intervals, producing digital audio samples. The number of samples per time unit (sampling rate) must be specified during the digitization process.
* All samples are represented by the same number of quantization bits.

Continued…

- The sampling rate and the quantization bits per sample are the main properties of the PCM signal and need to be carefully chosen so that it is possible to reconstruct the analog equivalent.
- In addition to sampling rate and quantization, another characteristic commonly used to describe audio signals is the number of channels, which may be:
  - one (mono),
  - two (stereo),
  - or multichannel (surround sound)

Digital audio Format

- **Audio format defines the quality and loss of audio data. Based on application different type of audio format are used. Audio formats are broadly divided into three parts:**
- **Uncompressed Format**
  - **PCM(Pulse-Code Modulation)**
  - **WAV(Waveform Audio)**
  - **AIFF(Audio Interchange File Format)**
- **Lossy Compressed format**
  - **MP3(MPEG-1 Audio Layer 3)**
  - **AAC(Advanced Audio Coding)**
  - **WMA(Windows Media Audio)**
- **Lossless Compressed Format**
  - **FLAC(Free Lossless Audio Codec)**
  - **ALAC(Apple Lossless Audio Codec)**

Applications of Multimedia

- **Multimedia in Business**
- **Multimedia in Marketing and advertising**
- **Multimedia in Entertainment**
- **Multimedia in Education**
- **Multimedia in Bank**
- **Multimedia in Hospital**
- **Multimedia in Pedagogues**
- **Communication Technology & Multimedia Services**

Thank you