Introduction to Multimedia

Basic Concepts:-

Multimedia means, from the user's perspective, that computer information can be represented through audio or video, in addition to text, image, graphics and animation.

For example, using audio and video, a variety of dynamic situations in different areas can often be presented better than just using text and image alone.

One of the first and best known institutes working on different aspects of multimedia is the MIT [Media Lab in Boston].

Definition:-

One way of defining multimedia can be found in the meaning of the composed word.
Multi ----------> [Latin word: much] or multiple.
Medium ----------> [Lat: Middle]

This description is desired from the common forms of human interaction. It is not a very exact definition. Proper definition is ----------

"A multimedia system is characterized by computer controlled, integrated production, manipulation, presentation, storage and communication of independent information, which is encoded at least through a continuous (time dependent) and a discrete (time independent) medium."

Different Types of Medium:-

"Medium" means for distribution and presentation of information examples of medium are text, graphics, speech, and music.
Media can be clarified according to ----------

- Perception
- Representation
- Presentation
- Storage
- Transmission and information exchange

1. ***Perception:*** - Perception media help humans to sense their environment. The perception of information occurs mostly through seeing or hearing the information.
   - Perception of information through seeing
     ---→ (visual media) e.g. text, image & video
   - Through hearing (auditory media)
     ----→ e.g. music, noise, speech.
2. ***Representation Media: -*** It is a computer representation of information.

   i) A text character is coded in ASCII or EBCDIC
   ii) An image can be coded in JPEG format.
   iii) A combine audio/ video can be coded in MPEG format.

3. ***Presentation media :-*** It refers to the tools and devices for the input and output of information.

The media, e.g. paper, screen and speaker (output media) keyboard, mouse, camera and microphone use the input media.

4. ***Storage Media :-*** Floppy disk, hard disk and CD

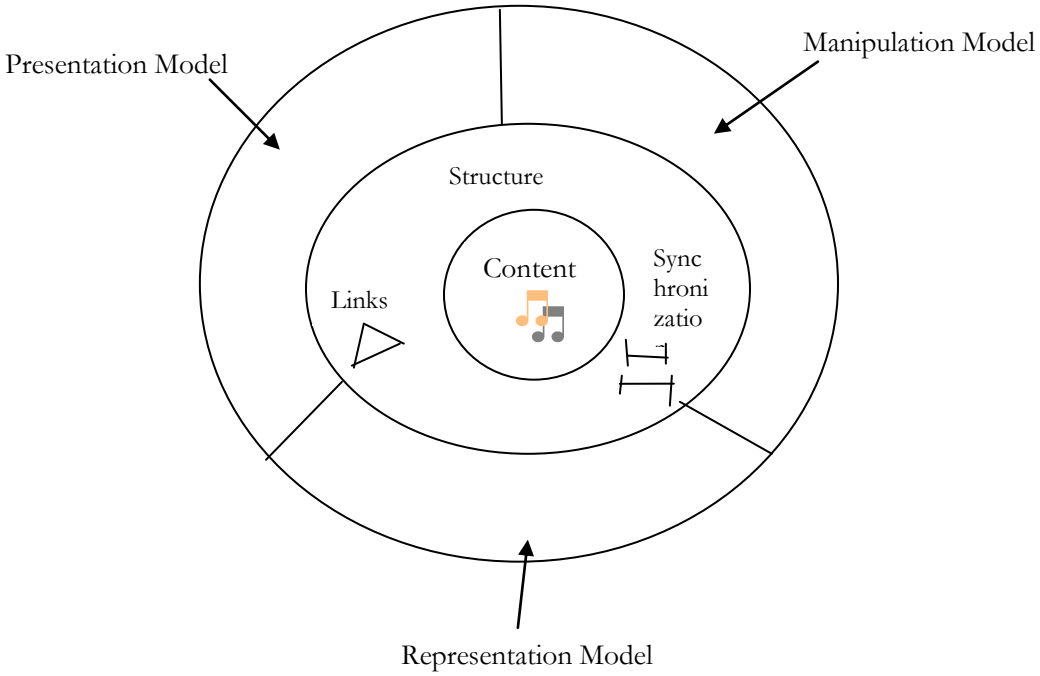
5. ***transmission Media:-*** The transmission media characterizes different information carries, that enable continuous data transmission.
Information is transmitted over networks, which use wire and cable transmission.(Coaxial cable, twisted pair, fiber optics).

Main Properties of Multimedia System:-

1> A multimedia system is any system which supports more than a single kind of media. This characteristic is insufficient, because it only deals with a quantitative evaluation of the system. We understand multimedia more in qualitative than a quantitative way.

2> Not every arbitrary combination of media justifies the usage of the term multimedia. A simple text processing program with incorporate images is often called a multimedia application because two media are processed through one program. But one should talk about multimedia only when both continuous and discrete media are utilized.

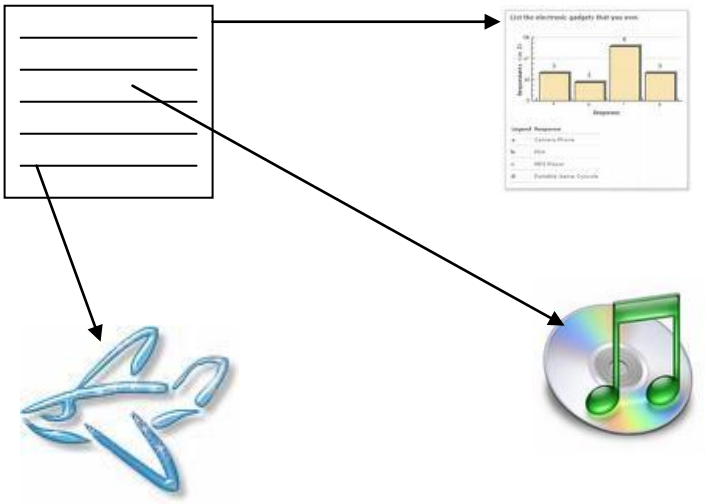
3> Multimedia may require served several levels of independence. One had computer controlled video recorder stores audio and video information, but there is an inherently tight connection between the two types of media. Both media are coupled together through the common storage medium of tape. (DAT {Digital Audio Tape} recorder).



Multimedia Document Architecture

Short Note: - Hypertext, Hypermedia, Multimedia

>> A book or an article on a paper has a given structure and is represented in a sequential form. Although it is possible to read individual paragraphs without reading previous paragraph, author mostly assumes a sequential reading. Novels, as well as movies, for example, always assume a pure sequential representation. Technical documentation (e.g. manuals). Consists of a collection of relatively independent information units. In a reference of a book, which is generated by several authors, there also exist many cross references in such documentation which lead to multiple searches at different places for the reader.



Hypertext data, an example of linking of information of different media.

>> NON LINEAR INFORMATION CHAIN

Hypertext and hypermedia have a major property a non-linear information link. These exists not only a reading sequence, but also the reader decides on his/her reading path. One example let us consider our subject (i.e. multimedia) multimedia system. Actually the first part of this paper (i.e. introduction part) is very much important. This includes our fundamental concepts, which can help our reader further. All other chapter are relatively independent and the reader can determines his/ her own path. A hypertext structure is a graph consisting of nodes and edges.

>> HYPERTEXT SYSTEM

A hypertext system is mainly determined through non-linear links of information pointers connect the nodes. The data of different nodes can be represented with one or several media types. In a pure text system, only text parts can connect. We under stand hypertext as an information object which includes links to several media.

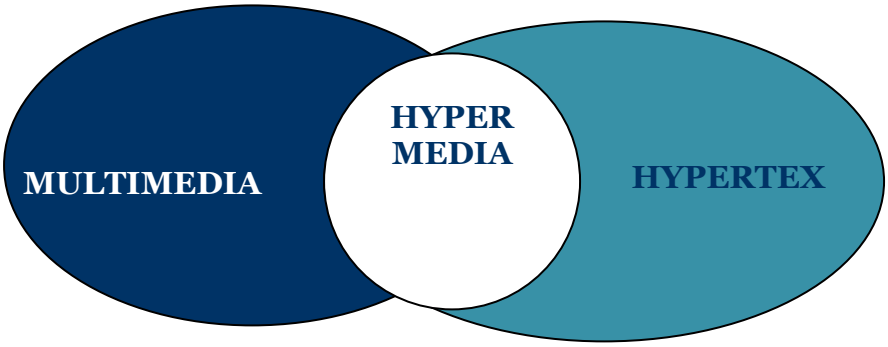
>> Multimedia System

A multimedia system consist of information which is coded at least in a continuous and discrete medium.

e.g. – A video conference , with simultaneous transmission of text and graphics, generated by a document processing program, is a multimedia presentation.

>> HYPERMEDIA SYSTEM

Hypermedia system includes the non-linear information links of hyper-text system and the continuous and discrete media of multimedia system.



Relationship

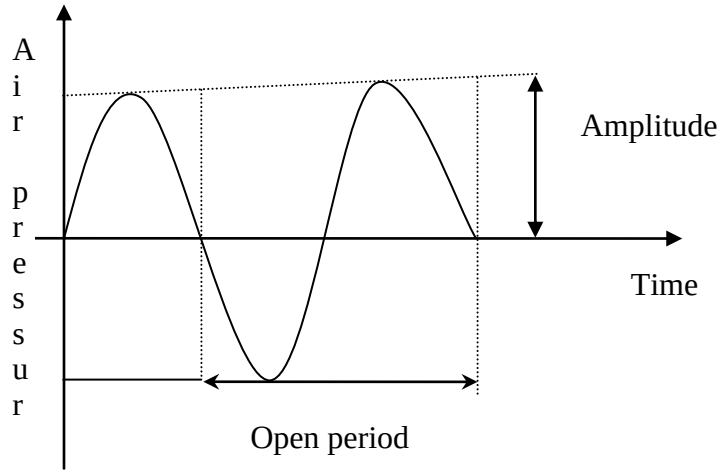
Sound / Audio

Introduction:-

Sound is a physical phenomenon produced by the vibration of matter, such as a violin string, or a block of wood. As the matter vibrates, pressure vibrations are created in the air surrounding it. This alteration of high and low pressure is propagated through the air in a wave – like motion. When a wave reaches the human ear, a sound is heard.

Basic sound concept:-

Sound is produced by the vibration of the matter. During the vibration, pressure variations are created in the air surrounding it. The pattern of the oscillation is called a waveform.



Oscillation of an air pressure wave.

The wave form repeats the same shape at regular intervals and this portion is called a period. Since sound waves occur naturally, they are never perfectly smooth or uniformly periodic. Periodic sounds are more musical compare to non-periodic sounds.

Example of periodic sound sources → musical instrument, bird song

Example of non-periodic sound sources → rushing water

Frequency:-

The frequency of a sound is the reciprocal value of the period. It represents the no. of periods in a second.

- Measured in hertz (Hz) or cycle / sec (cps)

- The frequency range is divided into:-

Infra-sound	→	form 0 – 20 Hz
Human- hearing frequency	→	form 20 Hz – 20 KHz
Ultra-sound	→	form 20 KHz– 1 GHz
Hyper-sound	→	form 1GHz – 10 THz

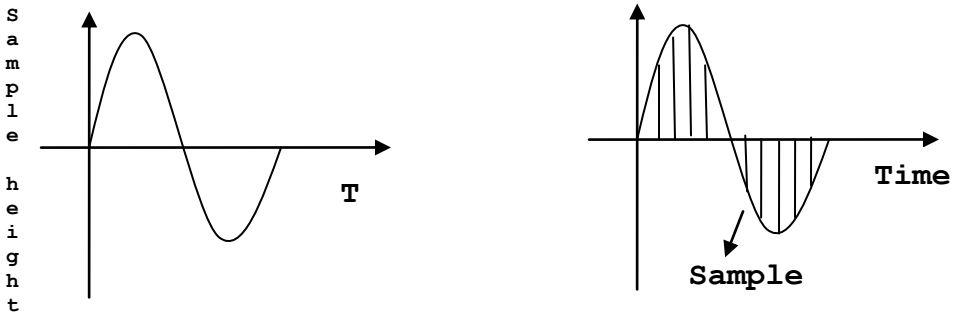
Multimedia systems typically make use of sound only within the frequency range of human hearing.
We will call sound within the human hearing range audio and the waves in this frequency range acoustic signals.

Amplitude:-

A sound also has an amplitude, a property subjectively heard as loudness.

Digitizing and computer representation of sound

The smooth, continuous curve of a sound waveform is not directly represented in a computer. A computer measures the amplitude of the waveform at regular time intervals to produce a series of numbers. Each of these measurements is a sample.



Audio signal **Digital sample**

The mechanism that conrots an audio signal into digital sample is the → Analog–to–Digital converter (ADC)

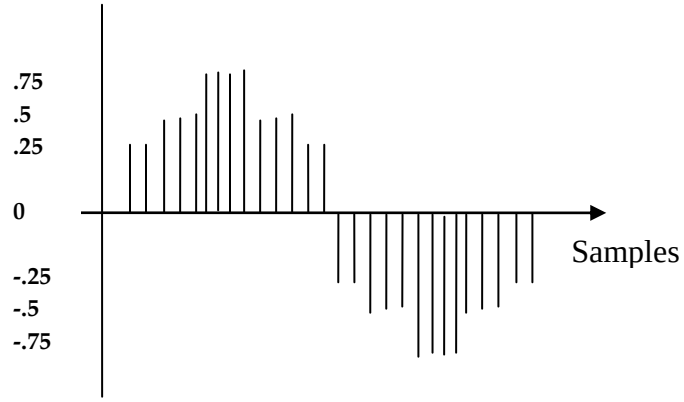
And the reverse conversion is performed by a Digital-to-Analog converter (DAC).

Sampling Rate:-

The rate at which a continuous waveform is sampled is called the sampling rate.
Like frequency sampling rates are measured in Hz.
The CD standard sampling rate of 44100 Hz means that the waveform is sampled 44100 times per sec.

Quantization:-

The resolution or quantization of a sample value depends on the number of bits used in measuring the heights of the waveform. A 8 bit quantization yields 256 possible value, 16- bit CD quality quantization results in over 65536 values.



◊ 3 bit quantization results in only 8 possible values (.75, .5, .25, 0, -.25, -.5, -.75 and -1)

◊ Lower the quantization, the quality of the sound is also lower. (result might be a buzzing sound).

Sound Hardware:-

Before sound can be processed, a computer needs input / output devices.

Devices → Microphone jacks, built in speakers are connected to an ADC and DAC.

MIDI (Musical Instrument Digital Interface)

☐ The relationship between music and computer has become more and more important, specially considering the development of MIDI and it's important contribution in the music industry today.

☐ The MIDI interface between electronic musical instruments and computers is a small piece of equipment that plug directly into the computer serial part and allows the transmission of musical signals

☐ MIDI is a standard that manufacturer of musical instruments have agreed upon. It is a set of specifications they use in building their instrument so that the instruments of different manufacturers, can without difficulty, communicate musical information between one another.

MIDI components:-

It has two different components ----------

1) Hardware connects the equipment. It specifies the physical connection between musical instruments. MIDI port, MIDI cable that deals with electronic signal are the H/W components.
2) A data format encodes the information traveling through the hardware. The MIDI data format is digital; the data are grouped into MIDI message. Each MIDI message communicate one musical event between machines.

Example of MIDI message creation:-

When a musician presses a piano key, the MIDI interface creates a MIDI message where the beginning of the note with its stroke intensity is encoded. This message is transmitted to another machine. In the moment they key is released, a corresponding signal (MIDI message) is transmitted again.

For 10 minutes of music, this process creates about 200 kb of MIDI data.

☐ If a musical instrument satisfies both components of the MIDI standard, the instrument is a MIDI device (e.g. synthesizer)

☐ Capable of communicating with other MIDI devices through channel.

☐ The MIDI standard specifies 16 channels.

☐ The MIDI standard specifies 128 instruments, including noise effects (e.g. telephone, air craft), with unique nos. Ex →

0 ----------> Acoustic Grad Piano
12 ----------> Marimba
40 ----------> Violin

73 ----------> Flute

□ MIDI have 4 reception modes →

i) Mode1: Omni On / Poly;
ii) Mode2: Omni On/ Mono;
iii) Mode3: Omni Off/ Poly;
iv) Mode4: Omni Off/ Mono;

TEXT

There are three types of text that are produce pages of document :

1) Unformatted text:-

This is also known as plain text and enable pages to be created which comprise strings of fixed size characters from a limited character set. In unformatted text set of character can be represent in ASCII (American Standard Code for Information Interchange). This is one of the most widely used character sets and the table includes the binary codeword used to represent each character. As we see each characters is represented by a unique 7-bit binary codeword. The use of 7 bits means that there are 128(2^7) alternative characters and the codeword used to identify each character is obtained by combining the corresponding column (bits 7-5) and row (bits 4 – 1). Bit 7 is the most significant bit and hence the codeword for uppercase M, for ex. Is 1001101.

In addition to all the normal alphabetic, numeric and punctuation characters collectively referred to as printable characters.

The total ASCII character set also includes a number of control characters. These are --------

a) **Format control characters:-**
BS (backspace), LF (linefeed), CR (carriage return), SP (space), DEL (delete), ESC (escape).

b) **Information separators :-**
FS (file separator), RS (record separator)

c) **Transmission control character :-**
SOH (start of Heading), SOT (start of text), ETX (End of Text), ACK (acknowledgement), NAK (negative acknowledgement) etc.

The characters in columns 010 / 011 and 110 / 111 are replaced with the set of mosaic characters. These are used to create relatively simple graphical images. An example, application of this particular character set is in Videotext and Teletext which are general broadcast information service available through a standard television set.

2) Formatted Text:-

This is also known as rich text and enables pages and complete documents to be created which comprise of string of characters of different styles, size and shape with tables, graphics and images inserted at appropriate points.

Example of formatted text is word processing system.

a) An example of formatted text string:-

<B> <Font size = 4> Formatted Text </B. </Font>
 Hello SIT
 <I> Italics </I> <B> Bold </B> <U> Underline </U> </P>

b) Printable version of the string:-

Formatted Text
Hello SIT
Italics **Bold** Underline

3) Hypertext:-

This enables an integrated set of documents (each comprising formatted text) to be created which have defined linkages between them – referred to as hyperlinks between each other.

For example, most of universities describe their structure and the courses and support services they offer. Hypertext can be used to create an electronic version of such documents with index, descriptions of departments, courses on offer, library and other facilities all written in hypertext as pages with various defined hyperlinks between them to enable a person to browse through its contents in a user- friendly way.

An example of hypertext language is HTML.

JPEG [Joint Photographic Experts Group]

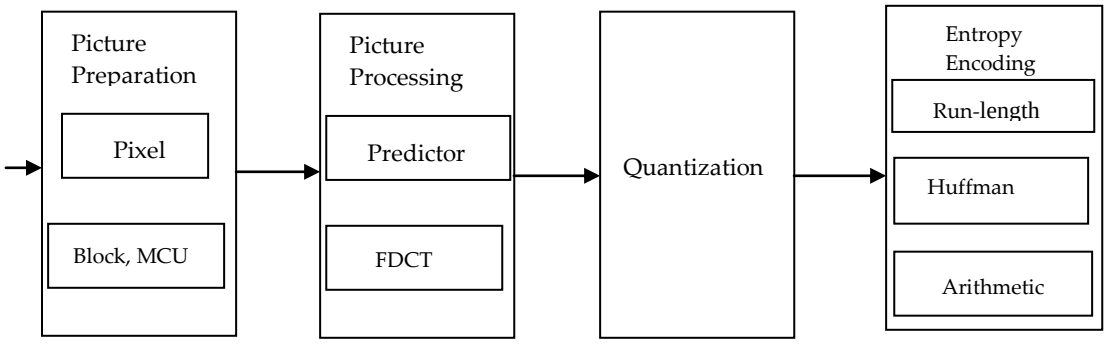
JPEG is a standard, developed by ISO for image compression (lossy compression) purpose. JPEG applies to color and gray-scaled still images. Images may contain 24 bits of color depth (millions of colors). JPEG uses a powerful but lossy compression technique that produce files as much as ten times more compressed than GIF (Graphic Interchange File) lossy means that information in the original image is lost in the compression process and cannot be retrieved.

JPEG compression scheme compresses about 20: 1 before visible image degradation occurs. To compress an image into JPEG, the image is divided into 8 x 8 pixel blocks (called a "search range"), so more information can be transmitted in less time. JPEG compress slowly, about one to three seconds for a 1 MB image depending upon computer speed.

>> Advantage of using JPEG Compression:-

i) JPEG implementation should be independent of image size.
ii) JPEG implementation should be acceptable to any image and pixel aspect ratio.
iii) Color representation itself should be independent of the special implementation.
iv) Image content may be of any complexity.
v) Processing complexity must permit a software solution to run on as many available standard processors as possible. Additionally the use of specialization hardware should substantially enhance image quality.
vi) Sequentially decoding (line-by-line) and progressive decoding (refinement of the whole image) should possible.

Q. Explain the different steps of JPEG compression.



Steps of the JPEG Compression Process

Image / block preparation:-

Source image / picture are made up of one or more 2D matrices of values. In case of a continuous monochrome image, just a single 2-D matrix is required to store the set of 8 bits gray level values. That represents the image. If the image is represented in an R, G, B quantized values, three matrices are required one of each for the R, G and B. for color image the alternative way is Y, C_b, Cr can optionally be used. This done to exploit the fact two chrominance signals, C_b and Cr require half the bandwidth of the luminance signal Y.

Once the source image format has been selected and prepared, the set of values in each matrix are compressed separately using the DCT (Discrete Cosine Transformation). This step is known as ***block preparation***.

It would be too time consuming to complete the DCT of the total matrix in single steps, so each matrix is divided into smaller 8 x 8 sub matrices. Each is known as block.

Forward DCT

In discrete cosine Transformation law frequency define the average color, and the information of high frequency contains the sharp edges. Hence low frequency is much more important than the higher ones, which is a key feature used in DCT based compression.

Normally, each pixel value is quantized using 8 bits which produces a value in the range 0 to 255. For intensity / luminance values R, G, B or Y and a value in the range of -128 to 127 for the two Chrominance values C_b and Cr.

In order to compute the (forward) DCT, however, all the values are first centered on zero, by subtracting 128 from each intensity luminance value.

Then, if the input 2-D matrix is represented by: P[x,y] and the transformed matrix by F[i,j], the DCT of each 8 x 8 block of value is computed using the expression :

F[i,j] = ¼ C(i) C(j) ∑ Σ∑

Where C (i) and C (j) = $1/\sqrt{2}$ for i, j = 0
= 1 for all other values of i and j

And x, y, i and j all very from 0 through 7

i =	0	1	2	3	4	5	6	7
0		0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0

- All 64 values in the input matrix, P[x, y] contribute to each entry in the transformed matrix, F [i, j]
- For i = j = 0, the two cosine terms (and hence horizontal and vertical frequency coefficients) are both 0. Also, since COS (0) = 1, the value in location F(0,0) of the transformed matrix is simply a function of the summation of all the values in the input matrix. Essentially, it is the mean of all 64 values in the matrix and is known as the DC coefficient.

P[x, y]

Y=

x =	0	1	2	3	4	5	6	7
0								
1								
2								
3								
4								
5								
6								
7								

F [i, j]

j =

DCT

- Since the value in all the other location of the transformed matrix have a frequency coefficient associated with them, either horizontal (x = 1 to 7 for y = 0), vertical (x = 0 for y = 0 to 7) or both (x = 1 to 7 for y = 1 to 7) --- they are known as AC coefficients.
- For j = 0, only horizontal frequency coefficient are present which increase in frequency for i = 1 to 7
- For i = 0, only vertical frequency coefficient are present which increase in frequency for j = 1 to 7

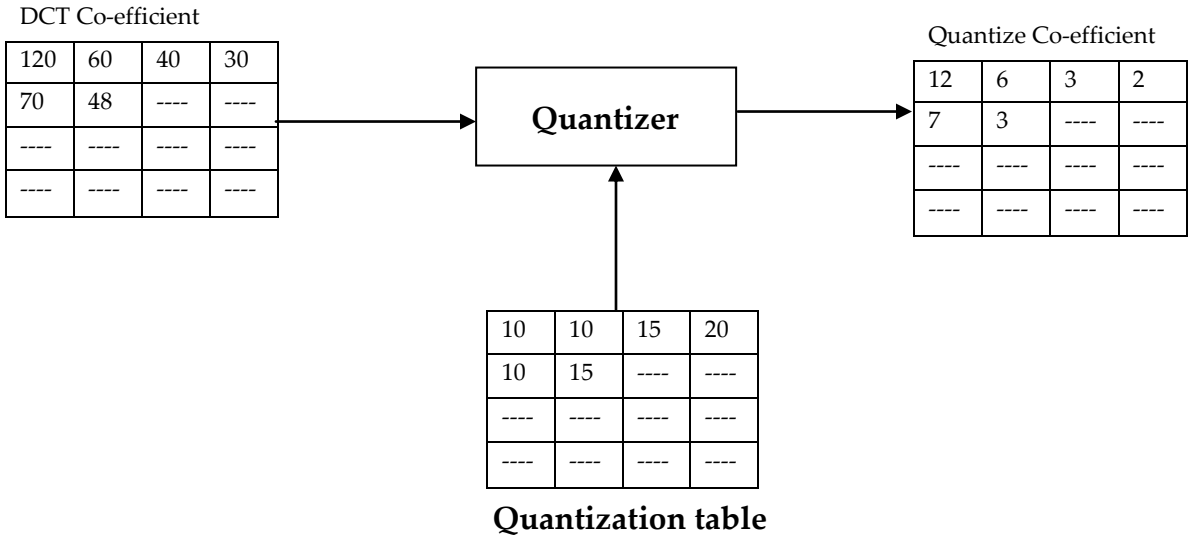
Quantization:-

There is very little loss of information during the DCT phase. The main source of information loss occurs during the quantization and entropy encoding stage, where the compressions take place.
Quantization is a process that attempts to determine what information can be safely discarded without a significant loss in visual fidelity. It uses DCT co-efficient and provides many to one mapping. The quantization process is fundamentally lossy.
The DCT output matrix is quantized to reduce the precision of co-efficient, there by increasing the compression.
The JPEG compression includes a set of quantization tables.

Quantization co-efficient (i, j)
= DCT (i, j) / Quantum (i, j)

e.g. Assuming a quantization threshold value of 16, desire the resulting quantization error for each of the following DCT co-efficient.

Co-efficient	Quantized value	Rounded value	De-Quantized value	Error
127	127/16 = 7.93	8	8 * 16 = 128	1
72	72 / 16 = 4.5	5	5 * 16 = 80	+ 8



Quantization table

Entropy encoding:-

Entropy encoding stage comprise four steps →

i) Vectoring
ii) Differential encoding
iii) Run length encoding
iv) Huffman encoding

Vectoring: -

Before we can apply any entropy encoding to the set of values in the matrix, we must first represent the values in the form of a single – dimension vector. This operation is known as vectoring. A zig-zag scan of the matrix is used in vectoring process.

Different encoding:-

This encoder encodes only the difference between each pair of values in a string rather than their absolute value. Hence in this application, only the difference in magnitude of the DC co-efficient in a quantized block relative to the value in the preceding block is encoded. In this way, number of bits required to encode the relatively. Large magnitudes of the DC co-efficient are reduce.

e.g. If the sequence of DC co-efficient
12, 13, 11, 11, 10, - - - - - -

The corresponding difference value would be -----
12, 1, -2, 0, -1, - - - - - -

Video

The human eye has the properly that when an image is flashed on retina, it is retained for some milliseconds before decaying. If a sequence of image is flashed at 30 – 50 image / sec, then the eye does not notice that it is looking at discrete images. All video exploit this principal to produce the moving picture.

Three main properties of a color source that eye makes use of are:-

- **Brightness: -** This represents the amount of energy that stimulates the eye and varies on a gray scale from black (lowest) through to white (height). It is thus independent of color of source.

- **Hue: -** This represents the actual color of the source, each color has a different frequency / wavelength and the eye determine the color from this.

- **Saturation: -** This represents the strength of the color, a pastel color has lower level of saturation than a color such as red.

Luminance & Chrominance:-

The term Luminance is used to refer brightness of the source.
The term Chrominance is used to refer to the hue & saturation of the source.

As we know that range of that range of color can be produce by mixing of three primary colors R, G and B. A range of color can be produce on a television display screen by varying the magnitude of the electrical signal that energizes the red, blue and green phosphors.

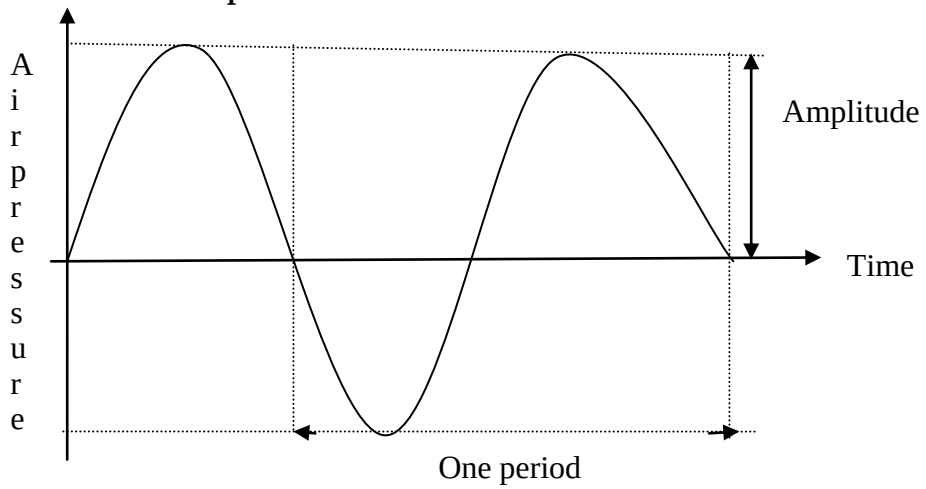
When the magnitude of the three signals has been proportions ---------
i.e.

R + G + B = 1 (white).

Sound / Audio

Sound is a physical phenomenon produced by the vibration of matter, such as violin string. As the matter vibrates, pressure variations are created in the air surrounding it. This alteration of high and low pressure is propagated through the air in a wave like motion. When a wave reaches the human ear, a second is heard.

Basic sound concept:-



Oscillation of an air pressure wave

Sound is produced by the vibration of matter. The pattern of the oscillation is called a wave form. The waveform repeats the same shape at regular intervals and this portion is called a period. Sounds are generally two type's periodic and non-periodic sound. Sounds that display a recognizable periodicity tend to be more musical than those are non-periodic. Examples of periodic sound sources are musical instrument, vowel sound, whistling wind and bird songs. Non-periodic sound sources include unpitched precaussion instruments.

Frequency:-

The frequency of a sound is the reciprocal value of the period. It represents the number of cycles per seconds (CPS).
The frequency range is divided into :-

Infra sound	From 0 to 20 Hz
Human hearing frequency range	From 20Hz to 20 KHz
Ultra sound	From 20 KHz to 1 GHz
Hyper sound	From 1 GHz to 10 THz

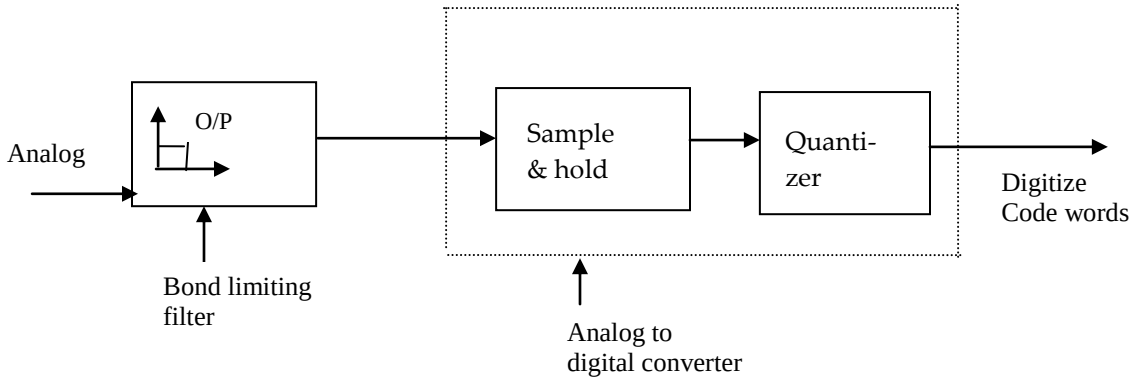
Multimedia systems typically make use of sound only within the frequency range of human hearing. The wave in this frequency range is called acoustic signal.

Amplitude:-

The amplitude of a sound is the measurer of the displacement of the air pressure wave from its mean, or quiescent state. An amplitude is a properly subjectively heard as loudness.

Computer Representation of Sound:-

A sound wave is nothing but an analog signal. But computer is only familiar to the digital data. So, our main objective is to convert analog signal into digital form. The following circuit is followed for performing this –



Analog signal is first passing through a Bandwidth filter for removing selected higher frequency components from the source signal. Whenever we discuss with audio signal the wave from which have frequency less than or greater than the audible frequency range (20 Hz – 20 KHz) that will be treated as a noise and will be filtered in this step. Now the audible waveform passing through ADC (analog to digital converter) and will be transformed into Digital form. ADC has two steps sample & hold and Quantizer. In quantization process we convert value of amplitude into digital from (combination of 0 & 1).

Sample:-

A computer measures the amplitude of the waveform at regular time intervals to produce a series of numbers. Each of these measurements is a sample.

Nyquist Sampling Theorem:-

In order to obtain an accurate representation of time varying analog signal, its amplitude must be sampled at a minimum rate that that is equal to or greater than twice the highest sinusoidal frequency component that is present in the signal.

MDBMS
[Multimedia Database Management System]

Multimedia database systems are database system where, beside text and other discrete data, audio and video information will also be stored, manipulated and retrieved. To provide this functionality, multimedia database systems require a proper storage technology and file system.

Multimedia application often addresses file management interfaces at different levels of abstraction. Consider the following these applications: a hypertext application can manipulate nodes and edges; an audio editor can read, write and manipulate audio data (sentences); an audio-video distribution service can distribute stored video information.

At first, it appears that these three applications do not have much in common, but in all three their functions can uniformly be performed using MDBMS. The reason is that in general, the main task of a DBMS is to abstract from the details of the storage access and its management. MDBMS is embedded in the multimedia system domain, located between the application domain (application, documents) and the device domain (storage, compression). The MDBMS is integrated into the system domain through operating system and communication components. Therefore, all three applications can be put on the same abstraction level with respect to DBMS.

Properties of DBMS in addition to storage abstraction

1. **Persistence of Data:-**
   This implies that a DBMS should be able to manipulate data even after the changes of the surrounding programs. e.g. → Insurance companies must keep data in databases for several decades. During this time, computer technology advances and with these changes operating system and other programs advance.

2. **Consistent view of Data:-**
   In multi-user system it is important to provide a consistent view of data during processing database requests at certain points. This property is achieved using time synchronization protocol.

3. **Security of Data:-**
   Security of data and integrity protection in case of system failure is one of the most important requirements of DBMS. This property is provided using transaction concept.

4. **Query and Retrieval of Data:-**
   Different information (entries) is stored in database, which later can be retrieved through database queries. Database queries are formulated with query languages such as SQL.

Characteristics of a MDBMS:-

1. **Corresponding Storage Media:-**
   Multimedia data must be stored and managed according to the specific characteristic of the available storage media. Here, the storage media can be both computer integrated components and external devices.
2. **Descriptive Search Methods:-**
   During a search in a database, an entry given in the form of text or a graphical image is found using different queries and the corresponding search methods. A query of multimedia data should be based on a descriptive, content oriented such e.g. – "The picture of a woman with a red scarf". This kind of search relates to all media, including video and audio.

Compact Disc Technology [CD]

A Compact disc, or CD, is a thin water of clear polycarbonate plastic and metal measuring 4.75 inches (120

nm) in diameter, with a small hole, or hub in its center. The mental layer is usually pure aluminum. A laser beam of approximately 780 nm wave length can be focused at approximately 1μm.

Pits on the CD, where the information is stored are 1 to 3 microns long, about ½ micron wide and 1/10 micron deep. (By comparison, a human here is about 18 micron in diameter). A CD can contain as many as 3 miles of this tiny pit in a spiral pattern from the hub to the edge. The area between this pits are called Lands.

Cross Sectional View of CD

As a CD or DVD disc spin, laser light is beamed along a grove or track of lands (high points) and pits (low points).

Compact Disk Consist of:-

i> The label
ii> The protective layer
iii> The reflective layer
iv> The subtractive layer

In contrast of floppy disks and other connectional secondary storage media, the entire optical disk information is stored in one track. Thus, the stored information can be easily played back at a continuous data rate. This has advantages for audio and video data, as they are continuous data streams.

The track is spiral. In the case of CD, the distance between tracks is 1.6μm. The track width of each pit is 0.6μm. The pits themselves have different lengths.

The main advantage of the optical disk is comparison to magnetic disk is that on the former 1.66 data bits/μm can be stored. This result in a data density of 1,000,000 bits/mm², which implies 16,000 tracks per inch. In comparison, a floppy disk has 96 tracks / inch. The source light source of the laser can be positioned at a distance of approximately one millimeter from the disk surface, and hence, it does not have to be positioned directly on the disk. This approach reduces friction and increases the life span of the involved components.

Compact Disk Standards:-

In 1979, Philips and Sony together launched CD technology as a digital method of delivering sound and music (audio) to consumers. This collaboration resulted in the Red Book standard (named for the color of the document's jacket), officially called the compact Disk Digital Audio Standard (CD-DA).

The Red Book standard defines the audio format for CD's, which is available in music stores today.

The Yellow Book for CD-ROM
The Green Book for CD-I (Interactive)
The Orange Book for write-once, read only (WORM)
The White Book for video CD (Karaoke CD)

Q. What is Yellow book in case of CD?

Philips and Sony developed the Yellow Book to provide an establish standard for data storage and retrieval. Yellow Book adds another layer for error checking to accommodate the greater reliability required of computer data. And it provides two nodes:

One for computer data and other
For compressed audio / video picture data.

The most common standard currently used for CD ROM production evolved from the Yellow Book, with Microsoft joining the collaboration and it was approved by the ISO.

Red Book Standard:-

Red book remains the basis for recent standards that define move elaborate digital data formats for computers and other digital devices. Audio CDs can provide up to 76 minutes of playing time, which is enough for a slow-tempo. This was reported to be Philip's and Sony's actual criterion during research and development for determining the size of sectors and ultimately the physical size of the CD itself.

A CD may contain one or move tracks. These are areas normally allocated for storing a single song in the Red Book format. CDs also contain lead in information and a table of contains. Each track on the CD may use a different format; this allows you to create a mixed-mode disc that combines.

Color Models

Several color models have been develop over the years -----

1. **Chromacity model:-**
   The chromacity model is one of the earliest models. It is one of the earliest models. It is 3-D model, with 2-D x and y, defining the color and the third direction defining luminance.

   It is an additive model, since x and y are added to generate different colors.

2. **RGB Model:-**
   The television monitor, and camera hardware manufactures developed the RGB model, to be used in design of image capturing devices, television and color monitors. The model is additive in that different intensities of red, green, blue (RGB) are added to generate various colors.
   This model has not proved suitable for image processing.

3. **HIS Model:-**
   The Hue Saturation and Intensity (HIS) represents an artist's impression of tint, shade, and tone.
   This model is used for image processing for filtering and smoothing images. This model is required high level of computation.

4. **CMYK Model:-**
   The Cyan, Magenta, Yellow and Black (CMYK) color model is used in desktop publishing printing devices.

5. **YUV presentation:-**
   YUV is 3-D colors model. Y is the luminance component (or Signal), UV is the chrominance components.

   Luminance component contains the black and white or gray-scale information.
   Chrominance component contains color information where ------

U = R (red) – C (cyan)
V = M (magenta) – G (green)

So, UV model is a subtractive model.

Case study on RGB and CMYK:-

The color range of the printer and the display do not match since monitors use the RGB color model and printers use the CMYK color model. The printer driver makes the best attempt to achieve the closet match for printing colors. The RGB color model is best suited for monitors, since screen phosphors generate color by additive mixing. On the other hand, the CMYK color model is best suited for printers. Since Cyan, Magenta, Yellow & Black are use subtracting mixing to create colors on paper.