# CHAPTER-1: INTRODUCTION TO MULTIMEDIA

MULTIMEDIA AND IT'S APPLICATION

- The word multi and media are combined to form the word multimedia. The word "multi" signifies "many." Multimedia is a type of medium that allows information to be easily transferred from one location to another.
- Multimedia is an interactive media and provides multiple ways to represent information to the user in a powerful manner.
- Multimedia is the presentation of text, pictures, audio, and video with links and tools that allow the user to navigate, engage, create, and communicate using a computer.
- It provides an interaction between users and digital information. It is a medium of communication. Some of the sectors where multimedia is used extensively are education, training, reference material, business presentations, advertising and documentaries.
- Multimedia refers to the computer-assisted integration of text, drawings, still and moving images (videos) graphics, audio, animation, and any other media in which any type of information can be expressed, stored, communicated, and processed digitally. For examples: E-Mail, Messenger, Video Conferencing, and Multimedia Message Service (MMS).
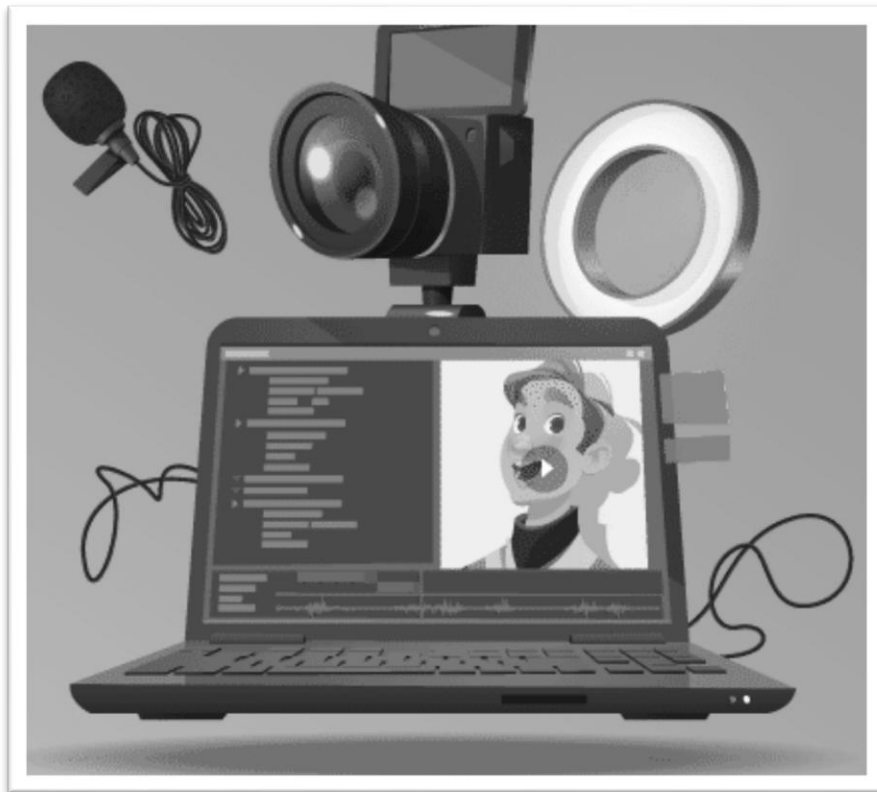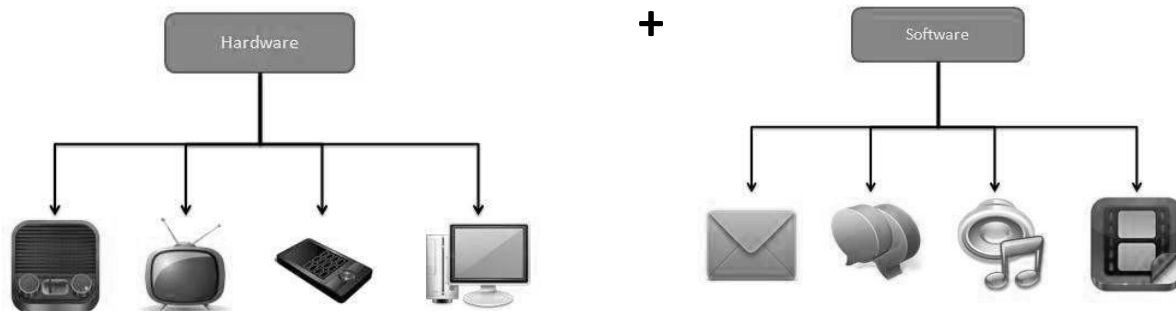
Components of Multimedia

Following are the common components of multimedia:

❖ **Text**

All multimedia productions contain some amount of text. The text can have various types of fonts and sizes to suit the profession presentation of the multimedia software.

❖ **Graphics**

Graphics make the multimedia application attractive. In many cases people do not like reading large amount of textual matter on the screen. Therefore, graphics are used more often than text to explain a concept, present background information etc. There are two types of Graphics:

- *Bitmap Images*

Bitmap images are real images that can be captured from devices such as digital cameras or scanners. Generally bitmap images are not editable. Bitmap images require a large amount of memory. Common file formats: .bmp, .jpg, .png, .gif, .tiff etc.
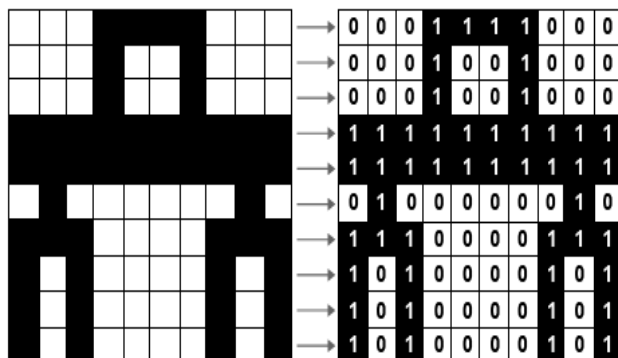
- *Vector Graphics*

  Vector graphics are a way of representing images using **mathematical formulas** instead of pixels. They are especially useful for designs that need to scale cleanly without losing quality.

  Vector graphics are drawn on the computer and only require a small amount of memory. These graphics are editable. Common file formats: .svg, .eps, .pdf, .ai etc.
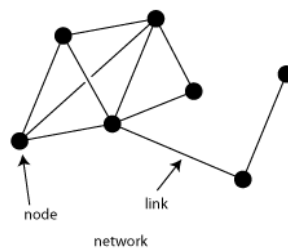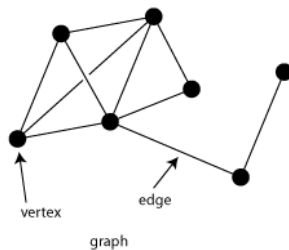
❖ **Audio**

A multimedia application may require the use of speech, music and sound effects. These are called audio or sound element of multimedia. Speech is also a perfect way for teaching. Audio are of analog and digital types. Analog audio or sound refers to the original sound signal. Computer stores the sound in digital form. Therefore, the sound used in multimedia application is digital audio.

❖ **Video**

The term video refers to the moving picture, accompanied by sound such as a picture in television. Video element of multimedia application gives a lot of information in small duration of time. Digital video is useful in multimedia application for showing real life objects. Video have highest performance demand on the computer memory and on the bandwidth if placed on the internet. Digital video files can be stored like any other files in the computer and the quality of the video can still be maintained. The digital video files can be transferred within a computer network. The digital video clips can be edited easily.

❖ **Animation**

Animation is a process of making a static image look like it is moving. An animation is just a continuous series of still images that are displayed in a sequence. The animation can be used effectively for attracting attention. Animation also makes a presentation light and attractive. Animation is very popular in multimedia application

HISTORY OF MULTIMEDIA

A simple example of media communications would be the telegraph, developed in the U.S.A. by Samuel Morse in the mid 1800's. After that the timeline of history of development of multimedia is listed below.

- ✎ The concept of multimedia was sketched by a German citizen Paul Nipkow, who developed the first video disc in 1884.
- ✎ In 1895, Gugliemo Marconi sent his first wireless radio transmission at Pontecchio, Italy.
- ✎ In 1901, Gugliemo Marconi detected radio waves beamed across the Atlantic.
- ✎ In 1927, Electronic television was designed and first successfully demonstrated in San Francisco by Philo Taylor Farmswarth.
- ✎ Thomas Alva Edison commissioned the invention of a motion picture camera in 1887 and Silent feature films appeared from 1910 to 1927.
- ✎ In 1945, Vannevar Bush wrote about Memex a device in which an individual stores all his books, records and communications and which is mechanized so that it may be consulted with exceeding speed and flexibility.
- ✎ In 1960s, Ted Nelson started Xanadu project a kind of deep Hypertext.
- ✎ In 1967, Nicholas Negroponte formed the Architecture Machine Group (A combination lab and think tank responsible for many radically new approaches to the human-computer interface) at Massachusetts Institute of Technology.
- ✎ In 1968, Douglas Engelbart demonstrated Shared-screen collaboration involving two persons at different sites communicating over a network with audio and video.
- ✎ In 1969, The birth of Internet by DARPA
- ✎ In 1971, Email was introduced.
- ✎ In 1976, Architecture Machine Group proposal to DARPA: Multiple Media
- ✎ In 1980, Lippman & Mohl: Aspen Movie Map

- In 1985, Negroponte, Wiesner : opened MIT media Lab Research at the Media Lab comprises interconnected developments in an unusual range of disciplines.
- In 1989, Tim Berners-Lee proposed the World Wide Web to CERN (European Council for Nuclear Research)
- In 1990, K. Hooper Woolsey, Apple Multimedia lab gave education to 100 people
- In 1992, The first M-Bone audio multicast on the net (MBONE- Multicast backbone)
- In 1993, U. Illinois National Center for Supercomputing Applications introduced NCSA Mosaic (a web browser)
- In 1994, Jim Clark and Marc Andersen introduced Netscape Navigator (web browser)
- In 1995, Java for platform independent application development.
- In 1996, DVD video was introduced, high quality, full length movies were distributed on a single disk. The DVD format promised to transform the music, gaming and computer industries. 1998, XML 1.0 was announced as a W3C Recommendation.
- In 1998, Handheld MP3 devices first made inroads into consumer tastes in the fall, with the introduction of devices holding 32 MB of flash memory.
- In 2000, World Wide Web (www) size was estimated at over 1 billion pages.

TYPES OF MULTIMEDIA

- The most common types of multimedia are as follows:
    1. Linear / Sequential Multimedia
    2. Non-linear (Interactive) Multimedia
    3. Hyperactive Multimedia

1. Linear / Sequential Multimedia
- This type of multimedia also known as sequential multimedia is a type of multimedia that runs linearly or in a straight line.
- It moves only in the same direction as we often encounter in all types of video tutorial films.
- In contrast to interactive multimedia, there is an interaction between the user and the multimedia by using computers, mice and keyboards.

✎ At the same time, linear multimedia in its use must be scheduled and sequentially from start to finish. For example, music and television station broadcasts.
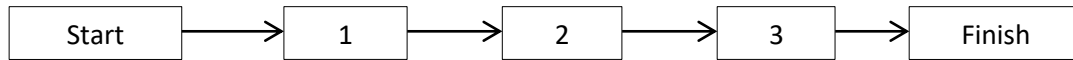
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│  Start  │ ───> │  1  │ ───> │  2  │ ───> │  3  │ ───> │  Finish  │
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Fig: Linear Multimedia

2. Non-linear (Interactive) Multimedia

✎ The non-linear or interactive multimedia is a form of multimedia that the user can have some control what and when the multimedia is displayed or run.

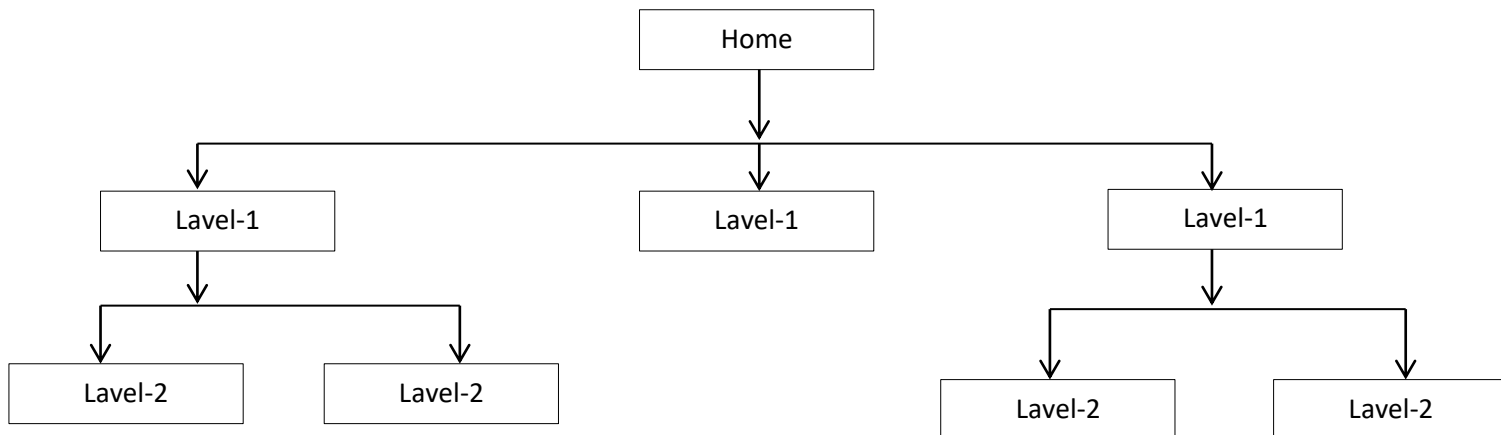✎ Some popular examples of this type of multimedia are games and virtual reality.

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Fig: Nonlinear Multimedia

3. Hyperactive Multimedia

✎ This type of multimedia has a structure of various related elements that the user can control.

✎ Although it is not like interactive multimedia, this type of hyperactive multimedia also has certain functions. For example, websites and online games.

Multimedia File System

- ✎ The multimedia file system must be efficient to meet the requirements of continuous media.
- ✎ These media files require very high-disk bandwidth rates.
- ✎ Disks usually have low transfer rates and high latency rates.
- ✎ To satisfy the requirements for multimedia data, disk schedulers must reduce the latency time to ensure high bandwidth.
- ❖ **File formats that support multimedia**
    - ✎ Multimedia data consists of a variety of media formats or file representation including, JPEG, MPEG, AVI(Audio Video Interleave), MID(Musical Instrument Digital), WAV(Waveform Audio File Format), DOC, GIF(Graphics Interchange Forma), PNG etc.
    - ✎ AVI files can contain both audio and video data in a file container that allows synchronous audio-with video playback.
    - ✎ Like the DVD video format, AVI files support multiple streaming audio and video.
    - ✎ Because of restrictions on the conversion form one format to the other, the use of the data in a specific format has been limited as well.

Network Support

- ✎ It includes internet, intranet, LAN, WAN, ATM, Mobile telephony and others.
- ✎ In recent years, there has been a tremendous growth of multimedia applications on the internet like streaming video, IP telephony, interactive games, teleconferencing, virtual world, distance learning and so on.
- ✎ These multimedia networking applications are referred as continuous-media applications and require high communication latency.
- ✎ Communication Latency is the time it takes for a data packet to be received by the remote computer.

Multimedia Software Tools

- ✍ For the development of multimedia applications, the various software tools like programming languages, graphics software, multimedia editing software scripting language: authoring tools, design software etc. are required.
- ✍ In addition to these the device drivers are required for interfacing the multimedia peripherals. Some of them are listed below:
  - ❖ **Music sequencing and notation tools:** Cakewalk, Cubase, Macromedia etc.
  - ❖ **Digital audio tools:** Cool Edit, Sound Forge, Pro Tools etc.
  - ❖ **Graphics and image editing tools:** Adobe Illustrator, Adobe Photoshop, Macromedia Freehand etc.
  - ❖ **Video editing tools:** Adobe Premiere, Adobe After Effects, Final Cut Pro
  - ❖ **Multimedia APIs :** Java 3D, DirectX, OpenGL
  - ❖ **Rendering Tools:** 3D Studio Max, Maya animation, GIF Animation
  - ❖ **Multimedia authoring tools:** Author ware, Quest
  - ❖ **Presentation tools:** PowerPoint, Keynotes, Google slides etc.

Media Types

- ✍ Media types are categories into two broad classes:
  - ❖ Static, time-independent discrete media:(Text, graphics, images) Information in these media consist exclusively of a sequence of individual elements without a time component.
  - ❖ Dynamic, time-dependent continuous media:(Sound, video) Information is expressed as not only of its individual value, but also by the time of its occurrence.

APPLICATIONS OF MULTIMEDIA

Multimedia indicates that, in addition to text, graphics/drawings, and photographs, computer information can be represented using audio, video, and animation. Multimedia is used in:

1. **Education**

In the subject of education, multimedia is becoming increasingly popular. It is often used to produce study materials for pupils and to ensure that they have a thorough comprehension of various disciplines. Edutainment, which combines education and entertainment, has become highly popular in recent years. This system gives learning in the form of enjoyment to the user.

2. Entertainment

The usage of multimedia in films creates a unique auditory and video impression. Today, multimedia has completely transformed the art of filmmaking around the world. Multimedia is the only way to achieve difficult effects and actions.

The entertainment sector makes extensive use of multimedia. It's particularly useful for creating special effects in films and video games. The most visible illustration of the emergence of multimedia in entertainment is music and video apps. Interactive games become possible thanks to the use of multimedia in the gaming business. Video games are more interesting because of the integrated audio and visual effects.

3. Business

Marketing, advertising, product demos, presentation, training, networked communication, etc. are applications of multimedia that are helpful in many businesses. The audience can quickly understand an idea when multimedia presentations are used. It gives a simple and effective technique to attract visitors' attention and effectively conveys information about numerous products. It's also utilized to encourage clients to buy things in business marketing.

4. Technology & Science

In the sphere of science and technology, multimedia has a wide range of applications. It can communicate audio, films, and other multimedia documents in a variety of formats. Only multimedia can make live broadcasting from one location to another possible.

It is beneficial to surgeons because they can rehearse intricate procedures such as brain removal and reconstructive surgery using images made from imaging scans of the human body. Plans can be produced more efficiently to cut expenses and problems.

5. Fine Arts

Multimedia artists work in the fine arts, combining approaches employing many media and incorporating viewer involvement in some form. For example, a variety of digital mediums can be used to combine movies and operas.

Digital artist is a new word for these types of artists. Digital painters make digital paintings, matte paintings, and vector graphics of many varieties using computer applications.

6. Engineering

Multimedia is frequently used by software engineers in computer simulations for military or industrial training. It's also used for software interfaces created by creative experts and software engineers in partnership. Only multimedia is used to perform all the minute calculations.

GLOBAL STRUCTURE OF MULTIMEDIA

The global structure of multimedia refers to the organized way in which different types of media (such as text, audio, images, video, and animations) are integrated, processed, and delivered in digital systems.

Some major components that make up the global structure of multimedia:

1. Multimedia Content Types

- **Text** – Basic content component; includes titles, subtitles, descriptions.
- **Images/Graphics –** Static visual elements.
- **Audio –** Sound, music, speech.
- **Video –** Moving visuals; may include synchronized audio.
- **Animation –** Frame-by-frame visual movement (2D/3D).
- **Interactivity –** User control via buttons, hyperlinks, etc.

2. Multimedia System Architecture

- **Input Devices** – Keyboard, microphone, camera, scanner.
- **Storage Media –** Hard drives, SSDs, cloud storage, CDs/DVDs.
- **Processing Units –** CPUs and GPUs handle rendering, encoding, decoding.
- **Output Devices –** Screens, speakers, printers, VR headsets.

3. Software and Tools

- **Authoring Tools** – Adobe Animate, Unity, Flash, etc.
- **Editing Tools –** Photoshop (images), Audacity (audio), Premiere Pro (video).
- **Compression Tools –** Codecs like MPEG, JPEG, MP3, H.264.
- **Players –** VLC, Windows Media Player, web browsers.

4. Delivery Platforms

- **Offline –** CD/DVD, USB, local installations.
- **Online –** Websites, streaming services (YouTube, Spotify), cloud apps.
- **Mobile –** Apps on Android/iOS.
- **Broadcast –** TV, radio.

5. Network Infrastructure

- **Protocols –** TCP/IP, HTTP, RTP, RTSP.
- **Streaming Technologies –** Adaptive bitrate streaming (e.g., HLS, DASH).
- **Content Delivery Networks (CDNs)** – Distribute content globally with low latency.

6. User Interface (UI) and User Experience (UX)

- **Design Elements –** Layout, navigation, interactivity.
- **Feedback Mechanisms –** Visual, auditory, haptic responses.
- **Accessibility Features –** Subtitles, screen readers, high-contrast modes.

7. Applications of Multimedia

- **Education –** E-learning platforms, interactive tutorials.
- **Entertainment** – Games, movies, music streaming.
- **Business –** Presentations, marketing videos.
- **Healthcare –** Simulations, training tools.
- **Communication –** Video calls, social media.
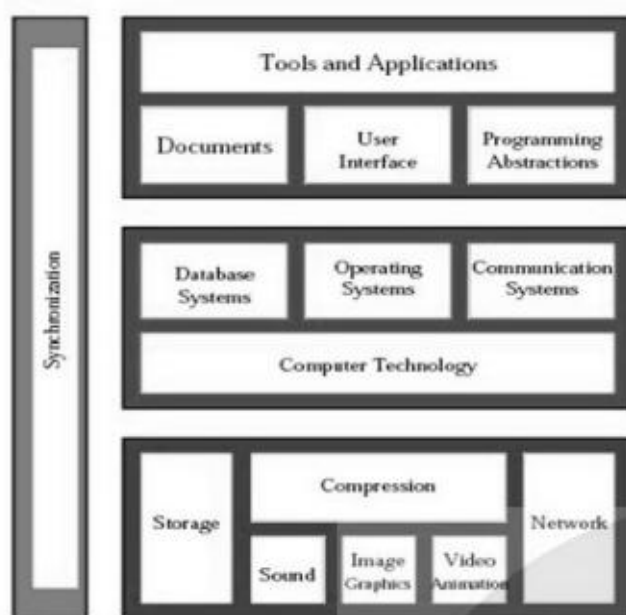
Application domain — provides functions to the user to develop and present multimedia projects. This includes *Software tools*, and multimedia projects *development methodology*.

System domain — including all supports for using the functions of the device domain, e.g., operating systems, communication systems (networking) and database systems.

Device domain — basic concepts and skill for processing various multimedia elements and for handling physical device.

Fig: Global Structure of Multimedia

MEDIUM IN MULTIMEDIA

In multimedia medium refers to the individual elements or formats of communication used to convey information, such as text, images, audio, video, or animation. Multimedia combines two or more of these media types to create an interactive presentation.

The media are classified consistent with the given mediums:

1. Perception medium

2. Representation medium

3. Presentation medium

4. data-storage medium

5. Transmission medium

6. Information exchange medium

1. Perception medium:

The perception of data occurs mostly to seeing or hearing the knowledge. For the perception of knowledge through seeing the virtual media like text, image and video are use. Whereas for perception of knowledge through hearing auditory media like music, noise and speech.

2. Representation medium:

It is a medium which provides the thought about how the knowledge are represented internally within the computer. i.e. how it's coded there are various formats accustomed represent media information in an exceedingly computer. For example:

a) Text characters are coded in ASCII or EBCDIC (extended code for decimal interchange code).

b) An audio stream will be represented using simple PCM (pulse coding method) with a linear quantization of 16 bits per sample.

c) A picture may be coded in JPEG (joint photographic expert group) format.

d) A combine audio, video sequence may be coded in computer in MPEG (moving picture expert group) format.

3. Presentation medium:

It refers to the tools and devices for the input and output of knowledge for instance paper, screen and speaker for computer are output media, where as keyboard, mouse, camera, and microphone are input media. Using this media the knowledge are presented before of the audience or from one system to a different system.

4. Storage medium:

Where the data is preserved for stored for future used as an example micro film, disk, hard disk, CD, and even paper also.

5. Transmission medium:

Different information carried that enable continuous data transmission media. The data is transmitted over networks, which uses wire, cable transmission like co-axial and fiber optics likewise as free air space (wireless) transmission.

6. Information exchange medium:

Which information carries are visiting be used for information exchange between different places. Information can flow through intermediate storage media, where the medium is transported outside of system to the destination, through mechanism using network, or to through the combine, usages of storage and transmission media.

MULTIMEDIA SYSTEM AND PROPERTIES

Multimedia Systems:

- ✎ A multimedia system is responsible for developing a multimedia application. A multimedia application is a bundle of different kinds of data. A multimedia computer system is one that can create, integrate, store, retrieve delete two or more types of media materials in digital form, such as audio, image, video, and text information.

Characteristics of Multimedia System

- ✎ Following are some major characteristics or features of a Multimedia System:
- ❖ **Very High Processing Power:**
- ✎ To deal with large amount of data, very high processing power is used.
- ❖ **File System:**
- ✎ File system must be efficient to meet the requirements of continuous media. These media files requires very high-disk bandwidth rates. Disks usually have low transfer rates and high latency rates. To satisfy the requirements for multimedia data, disk schedulers must reduce the latency time to ensure high bandwidth.
- ❖ **File formats that support multimedia:**
- ✎ Multimedia data consists of a variety of media formats or file representation including ,JPEG, MPEG, AVI, MID, WAV, DOC, GIF,PNG, etc. AVI files can contain both audio and video data in a file container that allows synchronous audio-with-video playback. Like the DVD video format, AVI files support multiple streaming audio and video. Because of restrictions on the conversion from one format to the other, the use of the data in a specific format has been limited as well.
- ❖ **Input/Output:**
- ✎ In multimedia applications, the input and output should be continuous and fast. Real-time recording as well as playback of data are common in most of the multimedia applications which need efficient I/O.

❖ **Operating System:**

✎ The operating system must provide a fast response time for interactive applications. High throughput for batch applications, and real-time scheduling.

❖ **Storage and Memory:**

✎ Multimedia systems require storage for large capacity objects such as video, audio, animation and images. Depending on the compression scheme and reliability video and audio require large amount of memory.

❖ **Network Support:**

✎ It includes internet, intranet, LAN, WAN, ATM, Mobile telephony and others. In recent years, there has been a tremendous growth of multimedia applications on the internet like streaming video, IP telephony, interactive games, teleconferencing, virtual world, distance learning and so on. These multimedia networking applications are referred as continuous-media applications and require high communication latency. Communication Latency is the time it takes for a data packet to be received by the remote computer.

❖ **Software Tools:**

✎ For the development of multimedia applications, the various software tools like programming languages, graphics software's, multimedia editing software's scripting languages: authoring tools, design software's etc are required. In addition to these the device drivers are required for interfacing the multimedia peripherals.

CHALLENGES FOR MULTIMEDIA SYSTE

✎ There are several challenges occur while building multimedia system.

✎ One of the principal challenges in building a multi-media system lies in balancing the platform's resources against the demands of the presentation.

✎ One of the major issue and challenge is a temporal relationship between many forms of media such as video and audio.

✎ There are also other forms of problems known as challenges which exist in multimedia. They are as follows:

1. **Sequencing**

   ✎ Sequencing the components of multimedia in multimedia one of the key challenges while developing multimedia.

- ✍ Sequencing is the process of translating timed data into correctly timed presentation.
- ✍ Though sequencing logic is a central part of all multimedia applications, it tends to be tightly integrated with specific media formats, authoring models, timing/control primitives and predefined UI elements.
- ✍ Within the media which occurs by playing frames in correct order / time frame in a video.

2. Synchronization
- ✍ Synchronization is another challenge while producing multimedia content.
- ✍ Multimedia synchronization refers to the coordination of multimedia information along three axes: content, space and time.
- ✍ The media streams must be highly synchronized, so that speech remains lip synchronized and the whiteboard updates are synchronized with audio references to them.

3. Inter-media scheduling
- ✍ The next challenge of multimedia system is an inter-media scheduling which is concerned with maintaining the requirements of the temporal relationships between two or more media.
- ✍ Lip scheduling between video and audio is an example of inter media scheduling where the display of video must synchronize with audio.

4. Distributed network
- ✍ Multimedia systems in distributed network consist of multimedia databases, proxy, information servers, clients and several hardware and software application which are intended to for the distribution of multimedia content over the networks.
- ✍ This is also an important challenge in multimedia system since the multimedia systems should support multiuser system and run smoothly.