

**SUDDHANANDA SCHOOL OF MANAGEMENT & COMPUTER  
SCIENCE**

**LECTURE NOTES ON  
MULTIMEDIA TECHNOLOGY (MCPE2020)**

**UNIT – I**

**INTRODUCTION TO MULTIMEDIA:**

The term **Multimedia** is derived from two words:

- **Multi** = Many
- **Media** = Means of Communication

Multimedia refers to the integration of multiple forms of media such as text, graphics, audio, video, animation, and interactivity into a single application for effective communication and presentation of information.

Multimedia has become an important part of education, entertainment, business, medicine, advertising, and communication systems.

**DEFINITION OF MULTIMEDIA**

Multimedia is the computer-controlled integration of text, graphics, audio, video, animation, and interactive elements to present information effectively.

**CHARACTERISTICS OF MULTIMEDIA**

**1. Integration**

Combines various media elements into one system.

**2. Interactivity**

Allows users to interact with the application.

**3. Digital Representation**

All media elements are stored digitally.

**4. Communication**

Improves information sharing and understanding.

**5. User-Friendly**

Provides attractive and engaging presentations.

**ELEMENTS OF MULTIMEDIA**

The major elements of multimedia are:

1. Text
2. Graphics

3. Audio
4. Video
5. Animation
6. Interactivity

## **1. TEXT**

Text is the most basic and widely used multimedia element.

It is used to provide information, explanations, titles, labels, and instructions.

### **Examples**

- Books
- Web Pages
- Presentations
- Reports

### **Advantages**

- Easy to create
- Easy to understand
- Requires less storage

### **Disadvantages**

- Less attractive alone
- Limited visual appeal

## **TYPES OF TEXT**

### **Plain Text**

Contains only characters.

Example:

Welcome to Multimedia Technology

### **Formatted Text**

Includes styles such as:

- Bold
- Italic
- Underline
- Colors

## **2. GRAPHICS**

Graphics are visual representations of information.

They improve the appearance and understanding of multimedia applications.

## **TYPES OF GRAPHICS**

## **Raster Graphics**

Made up of pixels.

Examples:

- JPEG
- PNG
- BMP
- GIF

### **Advantages**

- Realistic images
- Rich colors

### **Disadvantages**

- Large file size
- Quality loss during resizing

## **Vector Graphics**

Created using mathematical formulas.

Examples:

- SVG
- AI

### **Advantages**

- Scalable without quality loss
- Small file size

### **Disadvantages**

- Less suitable for complex photographs

## **APPLICATIONS OF GRAPHICS**

1. Website Design
2. Advertising
3. Gaming
4. Education
5. Medical Imaging

## **IMAGE RESOLUTION**

Resolution refers to the number of pixels in an image.

Example:

1920 × 1080

Higher resolution provides better image quality.

## **COLOR MODELS**

A color model defines how colors are represented.

### **RGB Model**

RGB stands for:

Red

Green

Blue

Used in:

- Computer Monitors
- Mobile Screens
- Television Displays

### **CMYK Model**

CMYK stands for:

Cyan

Magenta

Yellow

Black

Used in printing.

## **3. AUDIO**

Audio refers to sound information used in multimedia systems.

Audio enhances user experience and improves communication.

### **TYPES OF AUDIO**

#### **Speech**

Human voice recordings.

#### **Music**

Songs and instrumental sounds.

#### **Sound Effects**

Artificial sounds used in games and movies.

## **AUDIO FILE FORMATS**

### **Format Description**

MP3	Compressed audio
WAV	High quality audio
AAC	Advanced audio coding
WMA	Windows audio format

## **AUDIO CHARACTERISTICS**

### **Sampling**

Converting analog sound into digital form.

### **Sampling Rate**

Number of samples taken per second.

Example:

44.1 kHz

Used in CDs.

### **BIT RATE**

Bit rate determines audio quality.

Example:

128 kbps

320 kbps

Higher bit rate gives better quality.

## **4. VIDEO**

Video is a sequence of images displayed rapidly to create motion.

Video combines:

- Images
- Audio
- Animation

## **VIDEO CHARACTERISTICS**

### **Frame**

A single image in a video.

### **Frame Rate**

Number of frames displayed per second.

Examples:

24 fps

30 fps

60 fps

## **VIDEO FORMATS**

### **Format Usage**

MP4 Most popular

AVI High quality

MOV Apple devices

MKV High-definition video

## **APPLICATIONS OF VIDEO**

1. Online Learning
2. Movies
3. Video Conferencing
4. Advertising
5. Entertainment

## **5. ANIMATION**

Animation is the process of creating the illusion of motion by displaying a sequence of images rapidly.

### **TYPES OF ANIMATION**

#### **Traditional Animation**

Hand-drawn animation.

#### **2D Animation**

Flat two-dimensional graphics.

#### **3D Animation**

Three-dimensional graphics.

#### **Motion Graphics**

Animated text and graphics.

## **APPLICATIONS OF ANIMATION**

1. Movies
2. Games

3. Advertisements
4. Education
5. Simulations

## **6. INTERACTIVITY**

Interactivity allows users to control multimedia content.

Examples:

- Clicking buttons
- Filling forms
- Playing games
- Navigating websites

## **ADVANTAGES OF INTERACTIVITY**

1. Better user engagement.
2. Improved learning.
3. Personalized experience.

## **MULTIMEDIA SYSTEM**

A Multimedia System is a computer system capable of creating, processing, storing, and presenting multimedia information.

## **COMPONENTS OF MULTIMEDIA SYSTEM**

### **Hardware Components**

#### **Input Devices**

- Keyboard
- Mouse
- Scanner
- Microphone
- Camera

#### **Output Devices**

- Monitor
- Printer
- Speakers
- Projector

#### **Storage Devices**

- Hard Disk
- SSD
- DVD
- Pen Drive

## **SOFTWARE COMPONENTS**

### **System Software**

- Operating System

### **Application Software**

- Photoshop
- Video Editors
- Audio Editors

## **MULTIMEDIA HARDWARE REQUIREMENTS**

### **Processor**

High-speed CPU

### **RAM**

Adequate memory for processing

### **Graphics Card**

For image and video rendering

### **Sound Card**

For audio processing

### **Storage**

Large capacity storage devices

## **MULTIMEDIA SOFTWARE TOOLS**

### **Image Editing Tools**

- Adobe Photoshop
- GIMP

### **Audio Editing Tools**

- Audacity

### **Video Editing Tools**

- Adobe Premiere Pro

### **Animation Tools**

- Blender

- Adobe Animate

## **MULTIMEDIA APPLICATIONS**

### **Education**

- E-learning
- Smart Classes
- Virtual Labs

### **Entertainment**

- Movies
- Music
- Video Games

### **Business**

- Product Demonstrations
- Advertising
- Presentations

### **Medicine**

- Medical Imaging
- Surgery Simulations

### **Communication**

- Video Conferencing
- Social Media

## **ADVANTAGES OF MULTIMEDIA**

1. Attractive presentation.
2. Improved understanding.
3. Better communication.
4. Increased user engagement.
5. Interactive learning.

## **DISADVANTAGES OF MULTIMEDIA**

1. High development cost.
2. Large storage requirements.
3. Requires specialized hardware.
4. Time-consuming development.

## **MULTIMEDIA PROJECT DEVELOPMENT STAGES**

### **Planning**

Define objectives.

### **Designing**

Create layout and structure.

### **Development**

Develop multimedia content.

### **Testing**

Check functionality.

### **Deployment**

Release application.

## **FUTURE OF MULTIMEDIA**

The future of multimedia includes:

- Virtual Reality (VR)
- Augmented Reality (AR)
- Artificial Intelligence (AI)
- Interactive Learning Systems
- 3D Simulations
- Metaverse Applications

## UNIT – II

### DIGITAL AUDIO, SOUND SYSTEMS, AUDIO COMPRESSION, MIDI, DIGITAL VIDEO, VIDEO COMPRESSION, MULTIMEDIA FILE FORMATS AND STREAMING MEDIA

#### **INTRODUCTION TO DIGITAL AUDIO**

Audio is one of the most important components of multimedia. Digital audio is the representation of sound in digital form so that computers can store, process, and transmit it efficiently.

Sound in the real world is analog in nature. Computers cannot understand analog signals directly, so they convert them into digital signals through a process called digitization.

#### **ANALOG AND DIGITAL AUDIO**

##### **Analog Audio**

Analog audio consists of continuous sound waves.

Examples:

- Human voice
- Musical instruments
- Radio signals

##### **Characteristics**

- Continuous signal
- Affected by noise
- Difficult to store and process

##### **Digital Audio**

Digital audio is represented by binary numbers (0s and 1s).

### **Characteristics**

- Easy to store
- Easy to edit
- Less affected by noise
- Suitable for multimedia applications

### **SOUND WAVE**

Sound is produced when an object vibrates.

These vibrations travel through air as sound waves and reach our ears.

### **CHARACTERISTICS OF SOUND**

#### **1. Frequency**

Frequency refers to the number of vibrations per second.

Unit:

Hertz (Hz)

Example:

1000 Hz = 1000 vibrations per second

Higher frequency produces higher pitch.

#### **2. Amplitude**

Amplitude refers to the height of the sound wave.

It determines loudness.

Higher amplitude means louder sound.

#### **3. Wavelength**

Distance between two consecutive wave peaks.

Unit:

Meter (m)

#### **4. Pitch**

Pitch determines whether a sound is high or low.

Example:

- Whistle → High Pitch
- Drum → Low Pitch

## DIGITAL AUDIO PROCESS

Conversion of analog sound into digital form involves:

Analog Sound



Sampling



Quantization



Encoding



Digital Audio

## SAMPLING

Sampling is the process of measuring the amplitude of an analog signal at regular intervals.

### SAMPLING RATE

Sampling rate indicates the number of samples taken per second.

Unit:

Samples per Second

or

kHz

Example:

44.1 kHz

Used in Audio CDs.

## NYQUIST THEOREM

According to Nyquist Theorem:

The sampling frequency must be at least twice the highest frequency present in the signal.

Formula:

$$f_s \geq 2f_{\max}$$

Where:

- $f_s$  = Sampling Frequency
- $f_{\max}$  = Maximum Signal Frequency

## QUANTIZATION

Quantization converts sampled values into discrete digital values.

It assigns numerical values to sampled amplitudes.

## **ENCODING**

Encoding converts quantized values into binary form for storage and transmission.

## **AUDIO QUALITY FACTORS**

Audio quality depends on:

1. Sampling Rate
2. Bit Depth
3. Bit Rate

## **BIT DEPTH**

Bit depth indicates the number of bits used to represent each sample.

Common values:

8-bit

16-bit

24-bit

32-bit

Higher bit depth gives better audio quality.

## **BIT RATE**

Bit rate represents the amount of audio data transmitted per second.

Formula:

$$\text{Bit Rate} = \text{Sampling Rate} \times \text{Bit Depth} \times \text{Channels}$$

Unit:

kbps

Examples:

128 kbps

256 kbps

320 kbps

## **AUDIO FILE FORMATS**

Different audio formats are used for storage and transmission.

Characteristics:

- High quality
- Uncompressed
- Large file size

Applications:

- Audio recording
- Professional editing

### **MP3 (MPEG Audio Layer-3)**

Characteristics:

- Compressed format
- Small file size
- Popular worldwide

Advantages:

- Easy sharing
- Reduced storage requirements

### **AAC (Advanced Audio Coding)**

Characteristics:

- Better quality than MP3
- Efficient compression

Applications:

- Mobile devices
- Streaming services

### **WMA (Windows Media Audio)**

Developed by Microsoft.

Used in Windows applications.

### **AUDIO COMPRESSION**

Audio compression reduces file size while maintaining acceptable quality.

### **NEED FOR AUDIO COMPRESSION**

1. Saves storage space.

2. Faster transmission.
3. Reduced bandwidth usage.
4. Efficient streaming.

## **TYPES OF AUDIO COMPRESSION**

### **Lossless Compression**

Original data can be perfectly recovered.

Examples:

- FLAC
- ALAC

Advantages:

- No quality loss

Disadvantages:

- Larger file size

### **Lossy Compression**

Some data is permanently removed.

Examples:

- MP3
- AAC

Advantages:

- Small file size

Disadvantages:

- Slight quality loss

## **MIDI**

MIDI stands for:

### **Musical Instrument Digital Interface**

MIDI is a communication standard used to connect electronic musical instruments and computers.

### **FEATURES OF MIDI**

1. Small file size.
2. Easy editing.
3. Supports multiple instruments.
4. Efficient music generation.

## **WORKING OF MIDI**

Instead of storing actual sound, MIDI stores instructions about:

- Which note to play
- Duration
- Volume
- Instrument type

## **ADVANTAGES OF MIDI**

1. Very small storage requirement.
2. Easy modification.
3. Supports music composition.

## **DISADVANTAGES OF MIDI**

1. Cannot store human voice.
2. Depends on playback device quality.

## **DIGITAL VIDEO**

Digital video is a sequence of digital images displayed rapidly to create motion.

Video combines:

- Images
- Audio
- Animation

## **BASIC COMPONENTS OF VIDEO**

### **Frame**

A single image in a video.

### **Frame Rate**

Number of frames displayed per second.

Examples:

24 FPS

30 FPS

60 FPS

Higher frame rates produce smoother motion.

## **VIDEO RESOLUTION**

Resolution refers to the number of pixels displayed in a frame.

Examples:

### **Resolution Quality**

640×480 Standard Definition

1280×720 HD

1920×1080 Full HD

3840×2160 4K UHD

### **VIDEO COMPRESSION**

Video compression reduces video file size.

Since videos contain huge amounts of data, compression is essential.

### **NEED FOR VIDEO COMPRESSION**

1. Reduced storage requirements.
2. Faster transmission.
3. Efficient streaming.
4. Lower bandwidth consumption.

### **TYPES OF VIDEO COMPRESSION**

#### **Lossless Compression**

No information is lost.

Advantages:

- Original quality preserved.

Disadvantages:

- Large file size.

#### **Lossy Compression**

Removes unnecessary data.

Advantages:

- Significant reduction in file size.

Disadvantages:

- Slight reduction in quality.

### **VIDEO COMPRESSION STANDARDS**

## **MPEG**

MPEG stands for:

### **Moving Picture Experts Group**

Popular standards:

#### **MPEG-1**

Used in VCDs.

#### **MPEG-2**

Used in DVDs.

#### **MPEG-4**

Used in modern multimedia applications.

## **H.264**

Widely used video compression standard.

Applications:

- YouTube
- Video conferencing
- Online streaming

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

High Efficiency Video Coding.

Provides better compression than H.264.

## **MULTIMEDIA FILE FORMATS**

A file format specifies how multimedia data is stored.

### **IMAGE FORMATS**

#### **Format Features**

JPEG    Compressed photographs

PNG    Supports transparency

GIF    Animated images

BMP    Uncompressed images

### **AUDIO FORMATS**

### **Format Features**

MP3 Popular compressed audio

WAV High quality audio

AAC Efficient compression

FLAC Lossless audio

### **VIDEO FORMATS**

#### **Format Features**

MP4 Most popular

AVI High quality

MOV Apple format

MKV HD videos

### **STREAMING MEDIA**

Streaming is the process of playing audio or video directly from the Internet without downloading the entire file.

#### **WORKING OF STREAMING**

Media Server



Internet



Buffer



Playback

#### **BUFFERING**

Buffering temporarily stores data before playback.

It ensures smooth streaming even when network speed fluctuates.

#### **TYPES OF STREAMING**

##### **Live Streaming**

Content is broadcast in real time.

Examples:

- Online classes
- Live sports

- News broadcasts

### **On-Demand Streaming**

Previously recorded content is available anytime.

Examples:

- Movies
- Educational videos

### **ADVANTAGES OF STREAMING**

1. Instant playback.
2. No full download required.
3. Efficient bandwidth usage.
4. Convenient access.

### **DISADVANTAGES OF STREAMING**

1. Internet dependency.
2. Buffering issues.
3. Network congestion.

### **APPLICATIONS OF DIGITAL AUDIO AND VIDEO**

#### **Education**

- Online lectures
- Virtual classrooms

#### **Entertainment**

- Movies
- Music Streaming

#### **Communication**

- Video Conferencing
- Voice Calls

#### **Business**

- Online Meetings
- Product Demonstrations

#### **Healthcare**

- Telemedicine
- Medical Training

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### **UNIT – III**

**IMAGE PROCESSING, GRAPHICS, COLOR MODELS, IMAGE COMPRESSION, ANIMATION, 2D & 3D GRAPHICS, VIRTUAL REALITY (VR) AND AUGMENTED REALITY (AR)**

#### **INTRODUCTION TO IMAGE PROCESSING**

Image Processing is the technique of manipulating, analyzing, enhancing, and transforming digital images using computer algorithms.

It is used to improve image quality, extract information, and prepare images for various applications.

Image processing plays an important role in:

- Medical Imaging
- Satellite Imaging
- Computer Vision
- Multimedia Applications
- Security Systems

### **DEFINITION OF IMAGE PROCESSING**

Image Processing is the process of performing operations on digital images to enhance their quality or extract useful information.

### **OBJECTIVES OF IMAGE PROCESSING**

1. Improve image quality.
2. Remove noise.
3. Enhance visual appearance.
4. Extract useful information.
5. Prepare images for analysis.

### **DIGITAL IMAGE**

A digital image is a two-dimensional representation of a picture stored in digital form.

A digital image consists of small picture elements called **Pixels**.

### **PIXEL**

Pixel stands for:

Picture Element

It is the smallest unit of a digital image.

Each pixel contains color and brightness information.

### **IMAGE RESOLUTION**

Resolution refers to the number of pixels present in an image.

Example:

1920 × 1080 Pixels

Higher resolution provides:

- Better quality
- More details
- Larger file size

## **TYPES OF DIGITAL IMAGES**

### **Binary Image**

Contains only:

Black and White

Pixel values:

0 and 1

Applications:

- Document scanning
- OCR systems

### **Grayscale Image**

Contains shades of gray.

Pixel values:

0 to 255

Where:

- 0 = Black
- 255 = White

Applications:

- Medical imaging
- X-ray analysis

### **Color Image**

Contains multiple colors.

Uses RGB color model.

Applications:

- Photography
- Multimedia
- Web Design

## **IMAGE ACQUISITION**

Image acquisition is the process of capturing images using devices.

Devices include:

- Digital Cameras

- Scanners
- Mobile Phones
- Satellite Sensors

## **IMAGE ENHANCEMENT**

Image enhancement improves image quality.

### **TECHNIQUES OF IMAGE ENHANCEMENT**

#### **Brightness Adjustment**

Improves visibility.

#### **Contrast Enhancement**

Makes image details clearer.

#### **Noise Removal**

Removes unwanted disturbances.

#### **Sharpening**

Improves edge visibility.

### **IMAGE PROCESSING STEPS**

Image Acquisition



Preprocessing



Enhancement



Compression



Storage/Transmission

### **COMPUTER GRAPHICS**

Computer Graphics refers to the creation, storage, and manipulation of images using computers.

Graphics are used extensively in multimedia systems.

## **APPLICATIONS OF COMPUTER GRAPHICS**

1. Video Games
2. Animation Movies
3. CAD Systems
4. Scientific Visualization
5. Advertising
6. Education

## **TYPES OF COMPUTER GRAPHICS**

### **Raster Graphics**

Made up of pixels.

Examples:

- JPEG
- PNG
- BMP

### **Advantages**

- Realistic images
- Rich color representation

### **Disadvantages**

- Large storage
- Quality loss when enlarged

### **Vector Graphics**

Created using mathematical formulas.

Examples:

- SVG
- CorelDraw Images

### **Advantages**

- Scalable
- Small file size

### **Disadvantages**

- Less suitable for photographs

## **COLOR MODELS**

A Color Model is a method of representing colors digitally.

## **RGB COLOR MODEL**

RGB stands for:

Red

Green

Blue

Used in:

- Computer Monitors
- Television Screens
- Mobile Displays

## **WORKING OF RGB**

Different colors are created by combining Red, Green, and Blue in different proportions.

Example:

<b>Color</b>	<b>R</b>	<b>G</b>	<b>B</b>
--------------	----------	----------	----------

Red	255	0	0
-----	-----	---	---

Green	0	255	0
-------	---	-----	---

Blue	0	0	255
------	---	---	-----

White	255	255	255
-------	-----	-----	-----

Black	0	0	0
-------	---	---	---

## **CMYK COLOR MODEL**

CMYK stands for:

Cyan

Magenta

Yellow

Black

Used mainly in printing industries.

## **ADVANTAGES OF CMYK**

1. Better printing quality.
2. Accurate color reproduction.
3. Suitable for publishing.

**RGB****CMYK**

Screen display    Printing

Additive model    Subtractive model

Uses light        Uses ink

Brighter colors    Print-friendly colors

**HSI COLOR MODEL**

HSI stands for:

Hue

Saturation

Intensity

**Hue**

Represents actual color.

**Saturation**

Represents color purity.

**Intensity**

Represents brightness.

**IMAGE COMPRESSION**

Image Compression reduces image file size while maintaining acceptable quality.

**NEED FOR IMAGE COMPRESSION**

1. Save storage space.
2. Faster transmission.
3. Reduced bandwidth usage.
4. Efficient multimedia delivery.

**TYPES OF IMAGE COMPRESSION****LOSSLESS COMPRESSION**

Original image can be completely recovered.

Examples:

- PNG
- GIF

#### **Advantages**

- No quality loss.

#### **Disadvantages**

- Larger file size.

### **LOSSY COMPRESSION**

Some information is permanently removed.

Examples:

- JPEG

#### **Advantages**

- Smaller file size.

#### **Disadvantages**

- Slight quality loss.

### **JPEG COMPRESSION**

JPEG stands for:

Joint Photographic Experts Group

Most widely used image compression technique.

Applications:

- Digital Photography
- Websites
- Social Media

### **GIF FORMAT**

GIF stands for:

Graphics Interchange Format

Features:

- Supports animation.
- Supports 256 colors.

Applications:

- Animated images.
- Web graphics.

## **PNG FORMAT**

PNG stands for:

Portable Network Graphics

Features:

- Lossless compression.
- Transparency support.

Applications:

- Web design.
- Logos.

## **ANIMATION**

Animation is the process of creating the illusion of movement by displaying a sequence of images rapidly.

### **PRINCIPLE OF ANIMATION**

Human eyes perceive continuous movement when images are displayed quickly.

### **TYPES OF ANIMATION**

#### **Traditional Animation**

Hand-drawn frame-by-frame animation.

Example:

Classic cartoons.

#### **2D Animation**

Two-dimensional animation.

Examples:

- Educational videos
- Cartoon shows

#### **3D Animation**

Three-dimensional animation.

Examples:

- Movies
- Games

## **Motion Graphics**

Animated text and graphical elements.

Applications:

- Advertisements
- Presentations

## **ANIMATION PROCESS**

Storyboarding



Design



Modeling



Animation



Rendering



Final Output

## **2D GRAPHICS**

2D Graphics represent objects using two dimensions:

Width

Height

Applications:

- Logos
- Drawings
- Diagrams
- Cartoons

## **CHARACTERISTICS OF 2D GRAPHICS**

1. Flat appearance.
2. Easy development.
3. Less computational power required.

## **3D GRAPHICS**

3D Graphics represent objects using:

Width

Height

Depth

### **CHARACTERISTICS OF 3D GRAPHICS**

1. Realistic appearance.
2. Better visualization.
3. Complex rendering process.

### **COMPONENTS OF 3D GRAPHICS**

#### **Modeling**

Creating object structure.

#### **Texturing**

Applying surface details.

#### **Lighting**

Adding light effects.

#### **Rendering**

Generating final image.

### **APPLICATIONS OF 3D GRAPHICS**

1. Games
2. Movies
3. Architecture
4. Medical Visualization
5. Engineering Design

### **VIRTUAL REALITY (VR)**

Virtual Reality is a computer-generated simulated environment that allows users to interact with a virtual world.

VR creates an immersive experience.

### **COMPONENTS OF VR SYSTEM**

1. VR Headset
2. Sensors
3. Controllers
4. Computer System

### **FEATURES OF VR**

1. Immersive environment.
2. Real-time interaction.
3. 3D visualization.
4. User engagement.

### **APPLICATIONS OF VR**

#### **Education**

Virtual classrooms.

#### **Medicine**

Surgical training.

#### **Gaming**

Immersive games.

#### **Military**

Combat simulations.

#### **Architecture**

Building visualization.

### **ADVANTAGES OF VR**

1. Realistic experience.
2. Safe training environment.
3. Improved learning.

### **DISADVANTAGES OF VR**

1. Expensive equipment.
2. Motion sickness.
3. High computational requirements.

### **AUGMENTED REALITY (AR)**

Augmented Reality overlays digital information onto the real-world environment.

Unlike VR, AR does not replace reality; it enhances it.

## **WORKING OF AR**

Real World

+

Digital Objects

=

Augmented Reality

## **EXAMPLES OF AR**

1. Mobile Camera Filters
2. Navigation Systems
3. Interactive Learning Apps
4. Furniture Placement Apps

## **APPLICATIONS OF AR**

### **Education**

Interactive learning.

### **Healthcare**

Medical visualization.

### **Retail**

Virtual product testing.

### **Entertainment**

AR games.

## **ADVANTAGES OF AR**

1. Real-world interaction.
2. Better learning experience.
3. Increased user engagement.

## **DIFFERENCE BETWEEN VR AND AR**

### **Virtual Reality (VR)    Augmented Reality (AR)**

Creates virtual world    Enhances real world

Requires headset    Can work on mobile devices

Fully immersive    Partially immersive

**Virtual Reality (VR) Augmented Reality (AR)**

Replaces reality

Adds digital content to reality

**MULTIMEDIA APPLICATIONS OF GRAPHICS AND ANIMATION**

1. Web Design
2. Film Production
3. Game Development
4. Medical Imaging
5. Scientific Visualization
6. E-Learning Systems
7. Advertising

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## UNIT – IV

### MULTIMEDIA AUTHORING TOOLS, MULTIMEDIA DESIGN PROCESS, HYPERMEDIA, MULTIMEDIA NETWORKING, MULTIMEDIA DATABASES, MULTIMEDIA COMMUNICATION AND APPLICATIONS:

#### **INTRODUCTION TO MULTIMEDIA AUTHORING**

Multimedia Authoring is the process of combining various multimedia elements such as text, graphics, audio, video, animation, and interactivity into a single multimedia application.

Authoring tools help developers create multimedia projects without writing extensive programming code.

These tools provide a user-friendly environment for designing interactive multimedia applications.

#### **DEFINITION OF MULTIMEDIA AUTHORING**

Multimedia Authoring is the process of organizing and integrating multimedia elements into a structured and interactive presentation using specialized software tools.

#### **OBJECTIVES OF MULTIMEDIA AUTHORING**

1. Create interactive applications.
2. Integrate multiple media elements.
3. Improve user experience.
4. Simplify multimedia development.
5. Support educational and commercial applications.

#### **FEATURES OF AUTHORING TOOLS**

1. User-friendly interface.
2. Supports multimedia integration.
3. Interactive content creation.
4. Easy navigation design.
5. Event handling capability.
6. Multimedia synchronization.

#### **TYPES OF AUTHORING TOOLS**

##### **1. CARD-BASED AUTHORING TOOLS**

Information is organized in the form of cards or pages.

Users navigate between cards using buttons and hyperlinks.

##### **Examples**

- HyperCard
- ToolBook

##### **Advantages**

1. Easy navigation.
2. Simple design.
3. Suitable for educational applications.

#### **Disadvantages**

1. Limited flexibility.
2. Not suitable for complex projects.

### **2. ICON-BASED AUTHORING TOOLS**

Applications are created using icons representing multimedia functions.

Icons are connected to define application flow.

#### **Examples**

- Authorware

#### **Advantages**

1. Visual programming.
2. Easy development.
3. Reduced coding requirements.

### **3. TIME-BASED AUTHORING TOOLS**

Media elements are organized according to a timeline.

Widely used in animation and video production.

#### **Examples**

- Adobe Animate
- Adobe Flash

#### **Advantages**

1. Excellent synchronization.
2. Suitable for animations.
3. Supports multimedia presentations.

### **COMPARISON OF AUTHORING TOOLS**

<b>Tool Type</b>	<b>Organization Method</b>
------------------	----------------------------

Card-Based	Pages/Cards
------------	-------------

Icon-Based	Icons
------------	-------

Time-Based	Timeline
------------	----------

## MULTIMEDIA DESIGN PROCESS

Multimedia development follows a systematic process.

### PHASES OF MULTIMEDIA DESIGN

Planning



Analysis



Design



Development



Testing



Implementation



Maintenance

### 1. PLANNING

Planning is the first stage of multimedia development.

Activities:

- Define objectives.
- Identify audience.
- Determine requirements.
- Estimate budget.

### 2. ANALYSIS

Analyze project requirements.

Activities:

- Study user needs.
- Determine hardware requirements.
- Determine software requirements.

### 3. DESIGN

Design the structure of multimedia application.

Activities:

- Storyboarding
- Interface design
- Navigation design

## **STORYBOARDING**

A storyboard is a visual representation of multimedia content before actual development.

It shows:

- Screen layout
- Navigation flow
- Multimedia elements

## **ADVANTAGES OF STORYBOARDING**

1. Better planning.
2. Easy visualization.
3. Reduces development errors.

## **4. DEVELOPMENT**

Actual creation of multimedia content.

Activities:

- Image creation
- Audio recording
- Video editing
- Animation development

## **5. TESTING**

Testing ensures proper functionality.

Types:

### **Functional Testing**

Checks application functions.

### **Performance Testing**

Measures speed and efficiency.

### **User Testing**

Evaluates user satisfaction.

## **6. IMPLEMENTATION**

Final deployment of multimedia application.

Example:

- Website launch
- Educational software release

## **7. MAINTENANCE**

Regular updates and improvements after deployment.

### **HYPertext**

Hypertext refers to text containing links to other information.

Users can navigate between documents using hyperlinks.

### **CHARACTERISTICS OF HYPertext**

1. Non-linear navigation.
2. User-controlled access.
3. Easy information retrieval.

### **EXAMPLE OF HYPertext**

```
<a href="chapter2.html">
```

Next Chapter

```
</a>
```

### **HYPERMEDIA**

Hypermedia is an extension of hypertext that includes multimedia elements.

It combines:

- Text
- Graphics
- Audio
- Video
- Animation
- Hyperlinks

### **FEATURES OF HYPERMEDIA**

1. Interactive navigation.
2. Multimedia integration.
3. Non-linear structure.
4. Improved user engagement.

## APPLICATIONS OF HYPERMEDIA

1. Websites
2. E-Learning Systems
3. Digital Libraries
4. Online Encyclopedias

## DIFFERENCE BETWEEN HYPERTEXT AND HYPERMEDIA

<b>Hypertext</b>	<b>Hypermedia</b>
Contains text links	Contains multimedia links
Text-oriented	Multimedia-oriented
Limited media support	Rich media support

## MULTIMEDIA NETWORKING

Multimedia Networking refers to transmission of multimedia data through communication networks.

Examples:

- Audio Streaming
- Video Streaming
- Video Conferencing

## REQUIREMENTS OF MULTIMEDIA NETWORKING

1. High bandwidth.
2. Low delay.
3. Reliable transmission.
4. Quality of Service (QoS).

## QUALITY OF SERVICE (QoS)

QoS refers to the network's ability to provide guaranteed performance.

Parameters include:

### **Bandwidth**

Amount of data transmitted per second.

### **Delay**

Time required for data transmission.

### **Jitter**

Variation in packet arrival time.

### **Packet Loss**

Loss of data packets during transmission.

## **MULTIMEDIA COMMUNICATION**

Multimedia Communication involves transmitting multimedia information between users.

### **TYPES OF MULTIMEDIA COMMUNICATION**

#### **Audio Communication**

Examples:

- Voice Calls
- Internet Telephony

#### **Video Communication**

Examples:

- Video Conferencing
- Online Meetings

#### **Interactive Communication**

Examples:

- Online Gaming
- Virtual Classrooms

## **VIDEO CONFERENCING**

Video conferencing allows users in different locations to communicate through audio and video.

### **COMPONENTS OF VIDEO CONFERENCING**

1. Camera
2. Microphone
3. Speakers
4. Network Connection
5. Video Conferencing Software

### **ADVANTAGES OF VIDEO CONFERENCING**

1. Reduced travel costs.

2. Faster communication.
3. Remote collaboration.
4. Distance learning support.

## **MULTIMEDIA DATABASE**

A Multimedia Database stores multimedia objects such as:

- Images
- Audio
- Video
- Graphics
- Animation

along with traditional data.

## **NEED FOR MULTIMEDIA DATABASES**

1. Efficient storage.
2. Easy retrieval.
3. Multimedia management.
4. Large data handling.

## **COMPONENTS OF MULTIMEDIA DATABASE**

### **Multimedia Objects**

Images, audio, video.

### **Metadata**

Information describing multimedia content.

### **Database Management System**

Manages storage and retrieval.

## **TYPES OF MULTIMEDIA DATABASES**

### **Image Database**

Stores image collections.

Examples:

- Medical image databases.

### **Audio Database**

Stores sound files.

Examples:

- Music libraries.

### **Video Database**

Stores video collections.

Examples:

- Streaming platforms.

### **MULTIMEDIA DATA RETRIEVAL**

Retrieval refers to searching multimedia content.

Methods:

#### **Keyword-Based Retrieval**

Search using text descriptions.

#### **Content-Based Retrieval**

Search based on multimedia characteristics.

Example:

Searching similar images.

### **CHALLENGES IN MULTIMEDIA DATABASES**

1. Large storage requirements.
2. High processing cost.
3. Complex indexing.
4. Efficient retrieval challenges.

### **DISTRIBUTED MULTIMEDIA SYSTEM**

A Distributed Multimedia System stores and processes multimedia content across multiple computers connected through a network.

### **ADVANTAGES OF DISTRIBUTED MULTIMEDIA SYSTEMS**

1. Better scalability.
2. Improved performance.
3. Resource sharing.
4. Fault tolerance.

### **MULTIMEDIA APPLICATIONS**

## **EDUCATION**

Applications:

- E-learning
- Virtual Classrooms
- Digital Libraries

Benefits:

- Interactive learning.
- Better understanding.

## **ENTERTAINMENT**

Applications:

- Movies
- Music Streaming
- Online Games

Benefits:

- User engagement.
- Rich media experience.

## **BUSINESS**

Applications:

- Product Demonstrations
- Advertisements
- Corporate Presentations

Benefits:

- Effective communication.
- Better marketing.

## **MEDICINE**

Applications:

- Medical Imaging
- Surgical Simulations
- Telemedicine

Benefits:

- Improved diagnosis.

- Better training.

## **SCIENTIFIC RESEARCH**

Applications:

- Data Visualization
- Simulation Systems

Benefits:

- Improved analysis.
- Better decision making.

## **E-COMMERCE**

Applications:

- Product Catalogs
- Online Shopping Systems

Benefits:

- Better product presentation.
- Enhanced customer experience.

## **SOCIAL MEDIA**

Applications:

- Image Sharing
- Video Sharing
- Live Streaming

Benefits:

- Global communication.
- Content sharing.

## **FUTURE TRENDS IN MULTIMEDIA**

### **Artificial Intelligence (AI)**

Intelligent multimedia systems.

### **Virtual Reality (VR)**

Immersive experiences.

### **Augmented Reality (AR)**

Enhanced real-world interaction.

### **Cloud Multimedia**

Cloud-based content storage and delivery.

### **5G Technology**

High-speed multimedia communication.

### **ADVANTAGES OF MULTIMEDIA SYSTEMS**

1. Interactive communication.
2. Better understanding.
3. Attractive presentation.
4. Enhanced learning.
5. Global accessibility.

### **LIMITATIONS OF MULTIMEDIA SYSTEMS**

1. High development cost.
2. Large storage requirements.
3. Complex implementation.
4. Hardware dependency.

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## UNIT – V

### MULTIMEDIA STANDARDS, COMPRESSION STANDARDS, MULTIMEDIA SECURITY, COPYRIGHT ISSUES, DIGITAL WATERMARKING, MULTIMEDIA PROJECT MANAGEMENT, EMERGING MULTIMEDIA TECHNOLOGIES AND FUTURE TRENDS:

#### **INTRODUCTION TO MULTIMEDIA STANDARDS**

Multimedia standards are a set of rules, specifications, and guidelines used to ensure compatibility, interoperability, and efficient communication among multimedia systems.

Standards allow multimedia content to be created, stored, transmitted, and displayed consistently across different devices and platforms.

Without standards, multimedia files created on one system may not work properly on another system.

#### **NEED FOR MULTIMEDIA STANDARDS**

1. Ensure compatibility among devices.
2. Facilitate data exchange.
3. Improve multimedia quality.
4. Reduce development complexity.
5. Enable global communication.

#### **TYPES OF MULTIMEDIA STANDARDS**

##### **Audio Standards**

Used for storing and transmitting audio.

Examples:

- MP3
- AAC
- WAV

## **Image Standards**

Used for storing images.

Examples:

- JPEG
- PNG
- GIF

## **Video Standards**

Used for storing and transmitting videos.

Examples:

- MPEG
- H.264
- H.265

## **Communication Standards**

Used for multimedia communication.

Examples:

- HTTP
- RTP
- RTSP

## **IMAGE COMPRESSION STANDARDS**

Image compression reduces image size while maintaining acceptable quality.

### **JPEG STANDARD**

JPEG stands for:

Joint Photographic Experts Group

JPEG is the most widely used image compression standard.

### **FEATURES OF JPEG**

1. Lossy compression.
2. High compression ratio.
3. Good image quality.
4. Small file size.

## **WORKING OF JPEG**

Image



Color Conversion



Compression



Storage

## **ADVANTAGES OF JPEG**

1. Reduced storage requirements.
2. Faster transmission.
3. Suitable for photographs.

## **LIMITATIONS OF JPEG**

1. Quality loss after compression.
2. Not suitable for repeated editing.

## **PNG STANDARD**

PNG stands for:

Portable Network Graphics

## **FEATURES OF PNG**

1. Lossless compression.
2. Transparency support.
3. High image quality.

## **APPLICATIONS OF PNG**

- Web design
- Logos
- Graphics

## **GIF STANDARD**

GIF stands for:

Graphics Interchange Format

### **FEATURES OF GIF**

1. Supports animation.
2. Small file size.
3. Limited to 256 colors.

### **VIDEO COMPRESSION STANDARDS**

Video files require large storage space; therefore compression standards are necessary.

### **MPEG STANDARD**

MPEG stands for:

Moving Picture Experts Group

It is the most popular video compression standard.

### **MPEG-1**

Applications:

- Video CDs (VCD)

Features:

- Good video quality.
- Moderate compression.

### **MPEG-2**

Applications:

- DVDs
- Digital Television

Features:

- Higher quality than MPEG-1.

### **MPEG-4**

Applications:

- Internet Streaming
- Mobile Devices

Features:

- High compression efficiency.
- Better quality.

## **H.264 STANDARD**

H.264 is one of the most widely used video compression standards.

Applications:

- YouTube
- Video Conferencing
- Online Streaming

Advantages:

1. High-quality video.
2. Reduced bandwidth usage.
3. Efficient compression.

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

HEVC stands for:

High Efficiency Video Coding

Features:

1. Better compression than H.264.
2. Supports 4K and 8K videos.
3. Lower bandwidth requirements.

## **AUDIO COMPRESSION STANDARDS**

Audio compression reduces audio file size.

### **MP3**

MP3 stands for:

MPEG Audio Layer III

Features:

1. Lossy compression.
2. Small file size.

3. Popular worldwide.

### **AAC**

AAC stands for:

Advanced Audio Coding

Advantages:

1. Better quality than MP3.
2. Efficient compression.

### **FLAC**

FLAC stands for:

Free Lossless Audio Codec

Features:

1. Lossless compression.
2. High-quality audio.

### **MULTIMEDIA SECURITY**

Multimedia Security protects multimedia content from unauthorized access, modification, copying, and distribution.

#### **OBJECTIVES OF MULTIMEDIA SECURITY**

##### **Confidentiality**

Only authorized users can access data.

##### **Integrity**

Content remains unchanged.

##### **Authentication**

Verifies user identity.

##### **Availability**

Data remains accessible.

#### **THREATS TO MULTIMEDIA CONTENT**

##### **Unauthorized Access**

Access without permission.

##### **Data Modification**

Altering multimedia files.

## **Piracy**

Illegal copying and distribution.

## **Malware Attacks**

Viruses and malicious software.

## **SECURITY TECHNIQUES**

### **ENCRYPTION**

Encryption converts readable information into unreadable form.

#### **TYPES OF ENCRYPTION**

##### **Symmetric Encryption**

Uses the same key for encryption and decryption.

Advantages:

- Fast processing.

Disadvantages:

- Key distribution issues.

##### **Asymmetric Encryption**

Uses two keys:

- Public Key
- Private Key

Advantages:

- Better security.

Disadvantages:

- Slower performance.

### **DIGITAL SIGNATURE**

Digital signatures verify:

1. Authenticity.
2. Integrity.
3. Non-repudiation.

## **COPYRIGHT ISSUES IN MULTIMEDIA**

Copyright is a legal protection granted to creators of original works.

It prevents unauthorized copying and distribution.

### **IMPORTANCE OF COPYRIGHT**

1. Protects intellectual property.
2. Encourages innovation.

3. Provides legal rights.

### **COPYRIGHTED MULTIMEDIA CONTENT**

Examples:

- Music
- Videos
- Photographs
- Software
- Animations

### **COPYRIGHT VIOLATIONS**

Examples:

1. Illegal downloading.
2. Unauthorized copying.
3. Piracy.
4. Content redistribution.

### **CONSEQUENCES OF COPYRIGHT VIOLATION**

1. Legal penalties.
2. Financial loss.
3. Reputation damage.

### **DIGITAL RIGHTS MANAGEMENT (DRM)**

DRM is a technology used to control access to digital content.

#### **FUNCTIONS OF DRM**

1. Prevent unauthorized copying.
2. Restrict distribution.
3. Protect copyright owners.

### **DIGITAL WATERMARKING**

Digital Watermarking is the process of embedding hidden information into multimedia content for ownership verification.

#### **PURPOSE OF DIGITAL WATERMARKING**

1. Copyright protection.
2. Ownership verification.
3. Content authentication.
4. Piracy prevention.

## **TYPES OF DIGITAL WATERMARKING**

### **Visible Watermark**

Clearly visible on content.

Example:

Company logo on image.

### **Invisible Watermark**

Embedded secretly within multimedia content.

Not visible to users.

## **WATERMARKING PROCESS**

Original Media



Watermark Embedding



Watermarked Media



Verification

## **APPLICATIONS OF WATERMARKING**

1. Copyright protection.
2. Digital media authentication.
3. Content tracking.

## **MULTIMEDIA PROJECT MANAGEMENT**

Multimedia Project Management involves planning, organizing, controlling, and monitoring multimedia projects.

### **OBJECTIVES OF PROJECT MANAGEMENT**

1. Complete project on time.
2. Maintain quality.
3. Control cost.
4. Achieve project goals.

## **PHASES OF MULTIMEDIA PROJECT MANAGEMENT**

### **Project Planning**

Define objectives and requirements.

### **Project Design**

Create storyboards and interface designs.

### **Project Development**

Develop multimedia content.

### **Testing**

Evaluate functionality and quality.

### **Deployment**

Release final product.

### **Maintenance**

Update and improve project.

## **ROLE OF PROJECT MANAGER**

1. Team coordination.
2. Resource management.
3. Budget control.
4. Risk management.
5. Quality assurance.

## **PROJECT MANAGEMENT CHALLENGES**

1. Time constraints.
2. Budget limitations.
3. Technology changes.
4. Team coordination.

## **EMERGING MULTIMEDIA TECHNOLOGIES**

Emerging technologies are transforming multimedia applications.

### **ARTIFICIAL INTELLIGENCE (AI)**

AI enables intelligent multimedia systems.

Applications:

- Chatbots
- Image Recognition
- Voice Assistants

Machine Learning allows systems to learn from data.

Applications:

- Recommendation Systems
- Face Recognition

### **VIRTUAL REALITY (VR)**

Creates immersive virtual environments.

Applications:

- Gaming
- Medical Training
- Education

### **AUGMENTED REALITY (AR)**

Adds digital content to the real world.

Applications:

- Interactive Learning
- Navigation Systems

### **MIXED REALITY (MR)**

Combines VR and AR technologies.

Applications:

- Industrial Training
- Product Design

### **CLOUD MULTIMEDIA**

Cloud Multimedia stores and delivers multimedia content through cloud platforms.

Advantages:

1. Remote access.
2. Scalability.
3. Reduced infrastructure cost.

### **5G TECHNOLOGY**

5G provides high-speed communication for multimedia applications.

Benefits:

1. Faster streaming.
2. Lower latency.
3. Better video quality.

### **INTERNET OF THINGS (IoT)**

IoT enables communication among smart devices.

Applications:

- Smart Homes
- Smart Healthcare
- Smart Cities

### **FUTURE TRENDS IN MULTIMEDIA**

#### **IMMERSIVE MEDIA**

Provides realistic experiences through VR and AR.

#### **HOLOGRAPHIC DISPLAYS**

3D visual representation without special glasses.

#### **AI-BASED CONTENT CREATION**

Automatic generation of images, videos, and animations.

#### **SMART MULTIMEDIA SYSTEMS**

Systems capable of adapting to user preferences.

#### **ULTRA HIGH-DEFINITION CONTENT**

Future multimedia will increasingly use:

- 4K
- 8K
- 16K resolutions

### **APPLICATIONS OF ADVANCED MULTIMEDIA TECHNOLOGIES**

#### **Education**

Virtual classrooms and simulations.

#### **Healthcare**

Medical visualization and telemedicine.

#### **Entertainment**

Movies, gaming, and streaming.

#### **Business**

Product demonstrations and training.

## **Research**

Scientific simulations and visualization.

### **ADVANTAGES OF MODERN MULTIMEDIA SYSTEMS**

1. Better communication.
2. Enhanced user experience.
3. Interactive learning.
4. Improved collaboration.
5. Global accessibility.

### **LIMITATIONS OF MODERN MULTIMEDIA SYSTEMS**

1. High development cost.
2. Large storage requirements.
3. Security concerns.
4. Complex implementation.

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