

Date

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2k22/IT/62 (morning)

BSIT (P-III)

Assignment

Multimedia System &

Design

SUBMITTED TO

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QUESTION : 01

(i) Basis of Multimedia:

Multimedia refers to use of multiple types of content like text, images, audio, video, animation and graphics, combined together to convey information. It is widely used in areas like education, entertainment, advertising, and websites to make content more interactive and engaging.

Discrete Media

- Media made up of individual pieces.
- Text, images, graphics
- Non-time-dependent in nature
- Still visuals or static content

Continuous Media

- Media that flows without break.
- audio, video, animation.
- time-dependent in nature.
- Motion and sound-based content.

(ii)

Typography Etiquette:

It refers to proper way of using text to make it look clean and professional. Key rules include:

Use consistent font: Stick to 1-2 fonts for a neat design.

Proper spacing: Ensure enough space between letters, words and lines.
 Avoid over-styling: Don't use too many effects like bold, italics, or colors.
 Alignment matters: keep text properly aligned.

Typographic Goal:

Goals are:

Readability: Make text easy to read.
 Clarity: Deliver the message without confusion.
 Aesthetic appeal: Make text visually attractive.
 Consistent structure: keep a balanced and organized layout.

(iii)

Hyper text

Definition

Text link to other text.

Hypermedia

Combines text with other media (audio, video, images).

Nature

Text-based only

Multimedia-based.

Examples

Links in wikipedia article.

Youtube, where videos, images, and text are linked.

(IV)

Typefaces:

A typeface is a design style for text, like a font family. It includes variation like bold, italics, or different weights.

Typography:

Typography is the art of arranging text so it looks good and is easy to read. It includes choosing font, size, spacing, and alignment.

Multimedia System Applications:

These are tools or platforms that use multiple types of media (text, audio, video, images) to share information or create experiences.

Examples:

Education: Online courses with videos and text.

Entertainment: Video games and movies.

Advertising: Interactive ads with animations and sounds.

QUESTION : 02

(1)

Color Model and their application

Color models are systems to represent and describe colors. Common ones include:

1. RGB (Red, Green, Blue)

Use: Computer screens, TVs, and digital cameras

How it works: combine all light to create colors.

2. CMYK (Cyan, Magenta, Yellow, Black)

Use: Printing

How it works: uses ink to absorb light and create colors on paper.

3. HSV/HSB (Hue, Saturation, Brightness)

Use: Graphic design and color selection tool

How it works: Represents color by its shade, intensity, and lightness.

4. YUV/YCbCr:

Use: Videos and images compression (e.g. TV, streaming)

How it works: Separates brightness from color information

How Chroma Subsampling Works in Compression:

It reduces file size by compressing color detail more than brightness.

- Why it works: The human eye notices brightness more than small color.

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changes, so color data can be reduced without much visual difference.

How it's done:

- The image/video splits into (Y) for brightness and (CbCr) for colors.
- Color details are sampled at lower resolutions, keeping brightness sharp.

Ex: If 4:2:0 subsampling stores color data for every 4 brightness pixels but only 2 horizontally and none vertically. This saves space while keeping quality acceptable.

(ii)

PNG Compression JPEG Compression

lossless (keeps all original detail)	lossy (removes some data for smaller size).
File Size	

Larger because it preserves detail	Smaller due to data reduction.
Best for	

Images with transparency, sharp edges, or text (logos, screenshots)	Photograph and realistic images with gradient.
Transparency	

Support transparency	Does not support transparency.
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Why is lossy compression preferred?

Smaller file sizes. Save more spaces by discarding unnecessary details.

Faster loading: Compressed file load quickly, especially useful for websites and streaming.

Good Enough Quality: For many uses, the quality loss is barely noticeable.

Why is JPEG is not suitable for

Transparent Image:

JPEG does not transparency in images.

If an image has transparent parts

(e.g. logo), JPEG replaces transparency

with a solid background. (This make it

unsuitable for designs where transparency is essential.

(iii)

(a)

JPEG compression pipeline:

1. Color Space Conversion: Convert RGB to YCbCr to separate brightness and color.
2. Block Spitting: Divide the image into 8×8 blocks.
3. DCT: Convert spatial data to Frequency data.
4. Quantization: Reduce precision of high frequency component, causing most compression.

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Series

- 5 Zigzag Scanning: Group important coefficients together.
- 6 Entropy coding:
 - RLE \rightarrow compresses zero
 - Huffman Coding \rightarrow assigns shorter code to frequent values.

(b) Huffman coding technique

Here is explanation of Huffman coding for 'lossless':

- 1 Count Frequencies:
l: 3, 0: 1, s: 4, e: 1
- 2 Build Tree:
Combine smallest frequencies step by step to form a tree.
 - combine o(1) and e(1) \rightarrow {o, e: 2}
 - combine {o, e: 2} and l(3) \rightarrow {o, e, l: 5}
 - combine {o, e, l: 5} and s(4) \rightarrow Full tree.
- 3 Assign Code:
s: 0, l: 10, o: 110, e: 111.
- 4 Encoded Word:
'lossless' \rightarrow 10 110 0 0 10 111 0 0.

(IV)

a **Dithering**: Dithering is a technique used in digital images to create the illusion of more colors or shades by

arranging pixels of different colors in patterns. It's commonly used to make low-color images look smooth or more detailed.

b GIF File: A GIF (Graphics Interchange format) is a type of image file that supports both static and animated images. It's popular for sharing short animations or simple graphics because it works in many apps and browsers.

c Human Visual Activity: Human visual acuity refers to sharpness or clarity of vision. It measures how well the human eye distinguishes fine details, typically tested by reading letters on an eye chart.

d Steganography: Steganography is the practice of hiding secret messages or information inside regular files, like images, videos, or text, so only the intended recipient knows it's there. It's like a digital form of "invisible ink".

QUESTION #03

(i) Psychoacoustic Phenomena

1. Frequency Masking: Human can't hear some quiet sound if a louder sound at a similar frequency is playing at same time. Audib compression exploits this by removing the quieter, masked sounds, which are unlikely to be noticed.
2. Temporal Masking: A loud sound can "hide" softer sounds that occur shortly before or after it. Compression algorithms discard these softer sound since human ear is less sensitive to them during that time.

File Size and Network

Transfer File:

Step 1 File size calculation:

C-D quality stereo audio track typically has:

Bit depth: 16 bits per sample

Sampling rate 44.1 kHz

Channels: 2 (stereo)

File size (in bits) = Bit depth \times Sampling rate \times Channels \times Duration (in seconds)

For a 10-minute song:

Duration = 10 minutes = 600 seconds

File size (in bits) = $16 \times 44,100 \times 2 \times 600$
 $= 846,720,000$ bits

File size (in MB) = $\frac{846,720,000}{8 \times 1,048,576} \approx 100.94$

Step 2: Network Transfer Time

Using a broadband speed of 15 Mbps

Transfer time (in seconds) = $\frac{\text{File size (in bits)}}{\text{Network Speed}}$
 $= \frac{846,720,000}{15 \times 1,000,000} \approx 56.45$ seconds

File Answer:

File size ~ 100.94 MB

Estimated download time: ~ 56.45 s

(ii)

1 Reverb (Reverberation) :- Reverb is the persistence of sound after original

sound stops: It's caused by the reflection of sound waves bouncing off surfaces like walls or ceilings creating a sense of space.

b Critical Band: A critical band is a range of frequencies that the human ear processes together as a single sound. Sounds within same critical band can interfere with each other, affecting how we hear them.

c Echo: An echo is a sound that you hear again after it reflects off a distant surface, like a mountain or a wall. It is a delayed repetition of the original sound.

d Audio File Types: Audio file types are formats used to store sound digitally, such as MP3, WAV, or AAC. Different types vary in quality, compression, and size.

e Nyquist Theorem: The Nyquist Theorem

states that to accurately digitize a sound, you must sample it at least twice the highest frequency present in the sound. For example, to capture human speech (up to 20 kHz), you need a sampling rate of at least 40 kHz.

QUESTION : 04

(i) Key Differences

1. I-Frame:

- Known as (Intra-coded Frame).
- Full Picture, like a photo.
- Standalone frames that don't rely on others.
- Larger in size but important for starting and resetting the video.

2. P-Frame:

- Known as (Predicted Frames).
- Only store changes compared to the last frame.
- Smaller in size but depend on the previous frames to be understood.

3. B-Frames

- Known as (Bidirectional Frames).

- Use both the previous and next frame to save even more space.
- Store only the difference between these frames.
- The smallest in size but need the most information to decode.

Advantages of B-Frame

Better Compressions: Save space by using information from both directions.

Good Quality at low file Sizes: Help reduce video file size without losing much quality.

Disadvantages of B-Frame

Complex to Process: Need more computing power to encode and decode.

Slower: Add delay because they depend on both earlier and later frames.

Error Sensitive: If one of the related frames is missing, the B-Frame can't be decoded.

(ii)

Steps to Calculate File Size:

1 Understand specification of 4K Video

- Resolution: 3840×2160 pixels
- Frame Rate: Assume 30 frames per second

2 Color Depth: Typically, uncompressed video uses 24 bits per pixel (8 bit per color channel Red, Green, Blue). This means each pixel takes 3 bytes.

3 Calculate Data per frame:

$$\begin{aligned} \text{Data per frame} &= \text{pixels per frame} \times \text{Bytes per pixel} \\ &= 8294400 \times 3 = 24,883,200 \text{ bytes} \end{aligned}$$

4 Calculate data Per Second:

$$\begin{aligned} \text{Data per second} &= \text{Data per frame} \times \text{frames per second} \\ &= 24,883,200 \times 30 = 746,496,000 \text{ bytes} \end{aligned}$$

(iii)

a PAL (Phase Alternating Line): PAL is

a video format used in many countries around the world (mostly in Europe and parts of Asia). It defines the way signals are transmitted to ensure the image quality remains stable and consistent. PAL typically has 25 frames per second and 625 lines of resolution.

Progressive Scan: Progressive Scan is a method for displaying, storing, or transmitting video in which all the lines of each frame are drawn in sequence. This means the image is drawn in one go from top to bottom, creating smoother and clearer video, especially for fast-moving images. This is opposed to interlaced scanning, where lines are drawn in two passes.

c Video Format and Codecs

- **Video Format:** refers to file types used for storing video files, such as MP4, AVI, or MOV. These formats define how video data is packaged.

- **Codecs:** are algorithms used to compress and decompress video data to reduce file sizes while maintaining quality.

Examples include H.264, H.265 and VP9.

d. Motion Compensation: Motion compensation is a technique used in video compression to improve efficiency. It predicts the movement of objects between video frames and stores only difference ("motion vector"). This reduces amount of data needed to represent motion in videos, which helps in compressing video file size without losing much quality.

QUESTION #05

(i) Audio:

- Sampling: Higher rate and bit-depth mean clearer, more detailed sound.
- Quality Impact: Better sound with more detail and less noise.
- Artifacts:
 1. Aliasing: Low sampling rate causes weird, incorrect sounds.
 2. Noise: Low bit-depth leads to fuzzy or hissing sounds.

Graphics:

Sampling: Higher resolution and bit-depth mean sharper images with more colors.
Quality Impact: Clearer, more accurate images and colors.

Artifacts:

Pixelation: low resolution makes images look blocky.

Banding: Low bit-depth causes color transitions.

Images:

Sampling: Higher resolution and bit-depth lead to sharper images and better colors.
Quality Impact: Clearer images and smoother color gradients.

Artifacts:

Compression: low quality compression makes images blurry.

Aliasing: Low resolution creates jagged edges.

Video:

Sampling: Higher resolution and frame rate make video sharper and smoother.
Quality Impact: Clearer, smoother video with less blurring.

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- Aliasing
- Motion Blur: Low frame rate causes blurry fast motion.
- Blockiness: Too much compression creates pixelated video.
- Aliasing: Jagged edges appear in moving scenes.

(ii)

Immersive Reality refers to technologies that create or enhance experiences by immersing users in digitally created environment. These technologies often use special devices, such as headsets, to make experience feel real and interactive.

Virtual Reality is a fully immerse digital experience where users are placed in a completely computer-generated environment. Using VR headsets, users can look around, interact with the environment, and often experience a sense of presence, as if they are truly inside that world.

Augmented Reality overlays digital content onto the real world. Unlike VR, AR does not replace real world; instead, it enhances it by adding graphics,

sounds, or other virtual element. Examples include Pokemon Go or using AR to visualize furniture in your home through your phone.

(iii)

Project Manager: In multimedia is responsible for overseeing the entire multimedia project. They plan the project, set deadlines, coordinate with different teams, and make sure project stays on track and meet its goals. They act as the main point of contact between clients and the team, ensuring everything runs smoothly from start to finish.

Multimedia Programmer: Write code to create interactive media. They design and develop software, websites or application that include graphics, video, animation and sounds. They use programming languages to make these multimedia elements function, ensuring a seamless and interactive user.

Video & Audio Specialist:

reach their destination. This can cause poor quality, like pixelated video.
Bandwidth: The amount of data that can be transmitted at once. Higher bandwidth means better video quality without buffering.

(V)

Processors / GPUs:

- Processor: The CPU is the "brain" of the computer. It handles tasks like processing data and running applications. For multi-media, a powerful CPU helps in editing videos, rendering graphics, and handling large amount of data quickly.
- GPU: The GPU is specialized hardware design to process images and videos. It handles graphic rendering, which is important for things like video games, 3D animation, and video editing. A good GPU ensures smoother visuals and faster rendering.

Input Devices:

Keyboard: Used for typing text or commands.

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- Mouse: Used for pointing, clicking and selecting items on screen.
- Microphone: Capturing audio for voice messages, podcasts, or video call.
- Camera: Used for capturing photos or videos, such as in video conferences or for content creation.
- Graphic Tablet: A device used by digital artists to draw directly on a screen.

Output Devices: These devices display or play data processed by computer.

Monitoring: Displays the video, images, and graphics generated by computer.

Speaker: Play audio, such as music sounds, or voice from videos.

Headphones: Personal audio output devices, used for private listening.

Printer: Produces physical copies of images or text.

(VI)

Mixed Reality: Mixed reality is a technology that blends physical world with digital world. It allows you to interact with both real-world objects.

and virtual objects in real-time. MR combines elements of both AR and VR to create an immersive experience.

Net Neutrality Net neutrality is the principle that internet service providers (ISPs) should treat all data on the internet equally, without discriminating or charging differently based on user, content, website, platform, or application. This ensures free and open access to all online content.

Priority Scheduling Priority scheduling is a method used in computer operating systems to manage the execution of processes. In this method, each process is assigned a priority, and the process with highest priority is executed first. If two processes have the same priority, they may be executed in the order they arrive.

Resource Reservation Protocol:

RSVP

is a network protocol used to reserve resources across a network for a specific application or data flow. It allows an application to request a specified amount

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of bandwidth or network resources, ensuring that data can flow without interruption or delay.

Rapid Spanning Tree Protocol:

RSTP is an improved version of Spanning Tree Protocol used in computer networks to prevent loop in network topologies. It works faster than STP by quickly reconfiguring network to maintain a loop-free environment when changes occur in the network.

Animation Technique:

- Animation Techniques are methods used to create moving images from still pictures or graphics.
- Frame-by-frame animation: Drawing each frame of animation individually.
 - Stop-motion animation: Capturing frame one at a time with physical objects.
 - Computer-generated animation (CGI): Using software to create animation.
 - 2D and 3D animation: Creating animation in two or three dimensions respectively.