BASICS OF VIDEO

GROUP-12

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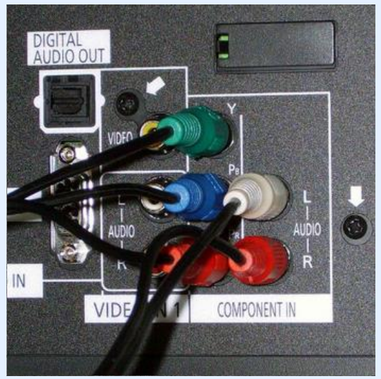
INTRODUCTION

- Video is a visual and audio medium for recording, displaying, and broadcasting moving images.
- Video signals are used to transmit visual information from one source to a display device, such as a television, computer monitor, or projector.

TYPES OF VIDEO SIGNALS

01 Component Video

- Separates the video signal into three distinct component. Y, Pb, Pr



02 Composite Video

- Combines all video information into a single channel

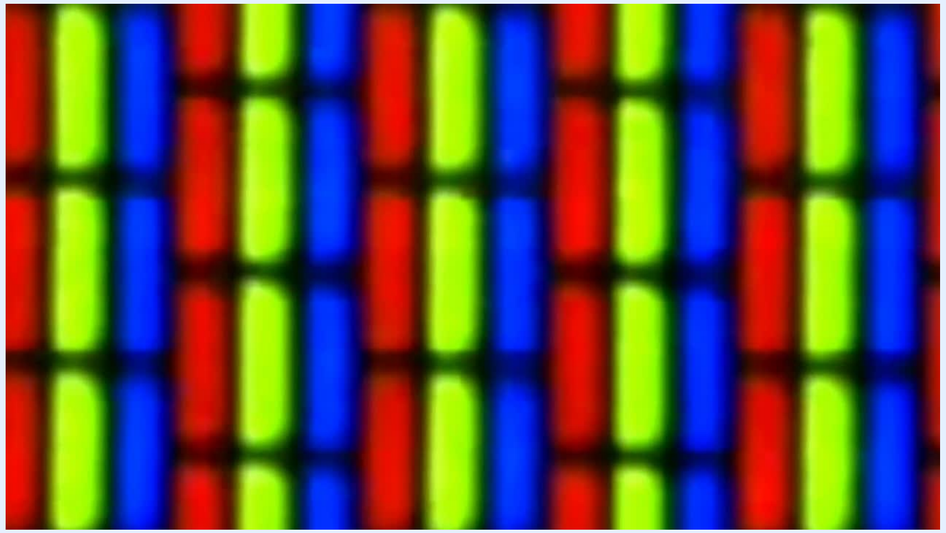
TYPES OF VIDEO SIGNALS

03 S-Video

- separation of video information results in better image quality compared to composite video, where the brightness and color information are combined into a single signal.

ANALOG VIDEO

Analog video is a method of transmitting and displaying video signals by representing the visual information as continuously varying electrical signals.



PAL(SECAM)

Resolution

625 lines per frame (576 visible lines)

Frame Rate

25 frames per second

Aspect Ratio

Originally designed for a 4:3 aspect ratio

CSF

4.43 MHz.

NTSC

Resolution

525 lines per frame (480 visible lines)

Frame Rate

29.97 frames per second

Aspect Ratio

Originally designed for a 4:3 aspect ratio

CSF

3.58 MHz.

FRAME RATE AND INTERLACING

- Number of individual frames displayed per second in a video .
- Splitting each frame into two fields and displaying them alternately.

01

Frame Rate vs Interlacing

Images displayed in a single vs split alternative frame

03

Applications

Broadcasts, Cinematic Films, Gaming, Real-Time Video Processing

04

Optimal Selections

The choice of frame rate and interlacing method depend on the specific application

ADVANTAGES OVER ANALOG

High Quality

Sharper images, better color accuracy, and clearer audio

Ease of Editing

Easy to edit and manipulate video files without generation loss.

Versatility

Converted into different formats and resolutions to suit various devices and display sizes.

Compression

video can be compressed without significant loss of quality.

Nonlinear Playback

Can be jump to specific scenes or chapters, rewind, fast forward, and even skip sections.

CHROMA SUB-SAMPLING

A METHOD OF REDUCING THE AMOUNT OF COLOR INFORMATION WITHOUT CHANGE IN BRIGHTNESS INFORMATION

Necessity

Optimizing data less storage uses, transmission efficiency

How it works

Color values are reduced while keeping brightness values intact

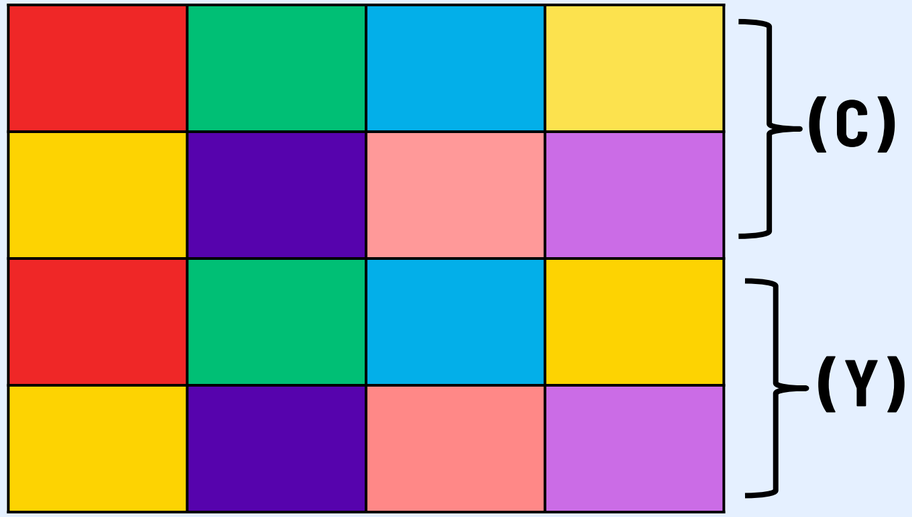
Advantages

Reduced file size, lower bandwidth requirement, less cost

Applications

Video streaming, Video frame analysis, broadcasting graphics

TECHNICAL ASPECTS



Original pixel (4x4)
(4:4:4)

Luminance (Y)

Y1	Y2	Y3	Y4
Y5	Y6	Y7	Y8

Chrominance (Cr & Cb)

C1	C2	C3	C4
C4	C5	C6	C7

Subsampled pixel (4:2:2)

C1	C2	C3	C4
C1	C2	C3	C4

Subsampled pixel(4:2:0)

- **Luminance (Y):** Brightness
- **Chrominance (C) :** Color

CHROMA SUB-SAMPLING

4:4:4 : Better pixel information but Higher Quality, that needs more bandwidth

4:2:2 : Still better quality but smaller file sizes

4:2:0 : Lowest pixel information , smallest file sizes

HDTV

HDTV vs. SDTV

It provides a more immersive viewing experience, in terms of resolution, aspect ratio, and audio quality

Benefits of HDTV

provides a crystal-clear picture quality and more cinematic view

HDTV Technologies

technologies like LCD, LED, OLED, and plasma displays to bring images to life

Challenges and Limitations

Faces challenges like bandwidth requirements, compatibility issues, and cost considerations

HDTV

Name	Lines	Aspect Ratio	Opt. View dist	P/I	Freq. MHz
HDTV USA, ana	1050	16:9	2.5H	P	8
HDTV Eur, ana	1250	16:9	2.4	P	9
HDTV NHK	1125	16:9	3.3	I	20

- Horizontal lines of resolution that make up the HDTV image
- Aspect ratio, indicates that the screen is X units wide for every Y units in height.
- Optical view distance specifies the ideal viewing distance from the screen to achieve the best visual experience
- "Progressive" (P) means all lines are drawn in each frame. "Interlaced" (I) alternates between drawing even and odd lines in successive frames.

COMPUTER VIDEO FORMAT

MP4	AVI	MKV	MOV
More flexible	Old format	flexible container	macOS and iOS
online streaming, youtube	less efficient	high-quality content	professional and high content
Efficient compression	larger file size limitations	files are larger	less Compatibility
a single frame 80-150 KB.	a single frame 150-250 KB	a single frame 80-150 KB	a single frame 80-150 KB.

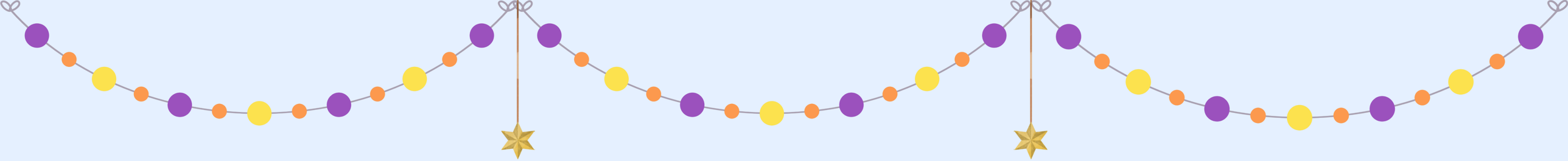
COMPUTER VIDEO FORMAT

MP4: 59MB

AVI:

40.6MB

MKV: 55MB



THANK YOU

- Multimedia Systems
- Section: A, Group – 9
- Presented to Rani Ellen V. Ramos

MULTIMEDIA ARCHITECTURE

PREPARED BY

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- Components of multimedia systems
- Data Processing and Compression
- 4-level Hierarchy
- Explanation of all levels
- Why compression?
- Redundancy
- Lossless vs. Loss compression
- Data compression with Huffman coding
- Shannon-Fano Encoding Algorithm
- Huffman Algorithm
- Conclusion

INTRODUCTION

Multimedia architecture refers to the structure or framework that underlies the design and organization of multimedia systems, applications, or platforms.

Multimedia architecture is essential in ensuring that multimedia systems deliver a seamless and effective user experience.

COMPONENTS

A Multimedia System comprises of several components:

- Input Devices
- Data Storage and Management
- Data Processing and Compression
- Data Communication and Transmission
- Data Representation and Encoding
- Data Retrieval and User Interaction
- Output Devices and Presentation

DATA PROCESSING AND COMPRESSION

Data Processing:

- Data processing in multimedia involves various tasks to prepare content for storage, transmission, and presentation.
- It includes tasks like encoding, decoding, transcoding, and manipulation.

Compression:

- Multimedia content can be large and data-intensive, making efficient storage and transmission essential.
- Compression reduces the size of multimedia files, making them easier to manage and transmit.

DATA PROCESSING AND COMPRESSION CONT.

Lossless Compression:

- This technique reduces file size without any loss of quality.
- It's used for text, graphics, and some multimedia data.

Lossy Compression:

- This technique sacrifices some data to achieve higher compression ratios.
- It's commonly used for audio and video, where minor quality loss may not be noticeable.

Examples of codecs: MP3 (lossy audio), JPEG (lossy image), and H.264 (lossy video).

4-LEVEL HIERARCHY

In a multimedia architecture, a typical hierarchy may consist of four levels, each serving a specific purpose and function in the multimedia system. These levels are:

- Network Subsystem (Layer 1)
- End-to-End QoS Control (Layer 2)
- Media Management (Layer 3)
- Application (Layer 4)

NETWORK SUBSYSTEM (INTRODUCTION)

The Network Subsystem layer in a multimedia architecture is a crucial component that focuses on the networking and communication aspects of multimedia systems.

It deals with how multimedia content is transmitted, distributed, and shared over networks to reach end-users.

NETWORK SUBSYSTEM (KEY FUNCTIONS)

Data Transmission:

- The primary function of this layer is to facilitate the transmission of multimedia data over various network types.

Bandwidth Management:

- It ensures that data is transmitted smoothly and without interruptions, especially in real-time applications.

Network Protocols:

- Network protocols are vital for ensuring that multimedia data is packaged, transmitted, and received correctly.

END-TO-END QOS CONTROL (INTRODUCTION)

The End-to-End QoS Control layer is a vital part of multimedia architecture, focusing on the quality of multimedia content and user experience.

It plays a central role in guaranteeing that multimedia content is delivered smoothly and with the desired quality to end-users.

END-TO-END QOS CONTROL (KEY FUNCTIONS)

Quality Assurance:

- The primary function of this layer is to ensure that multimedia content meets defined quality standards.

Traffic Management:

- The layer manages network traffic to prioritize multimedia data, giving it the necessary resources to maintain quality.

Error Handling and Recovery:

- Dealing with network issues and ensuring error-free delivery is a critical function.

Buffering and Synchronization:

- Managing buffers to prevent jitter and synchronizing audio and video streams are crucial for delivering a seamless multimedia experience.

MEDIA MANAGEMENT (INTRODUCTION)

The Media Management layer is an essential part of multimedia architecture, focusing on the efficient organization, storage, and management of multimedia content.

It plays a central role in ensuring that multimedia assets are accessible, searchable, and ready for distribution.

MEDIA MANAGEMENT (KEY FUNCTIONS)

Media Storage and Retrieval:

- The primary function of this layer is to store multimedia content securely and efficiently.

Metadata Management:

- Metadata includes information like file names, tags, descriptions, and attributes, making it easier to search and categorize media.

Content Versioning:

- Content versioning allows tracking changes and maintaining access to previous versions of multimedia assets.

Search and Retrieval Systems:

- This layer incorporates search engines and retrieval systems to enable users to quickly find and access multimedia content.

APPLICATION (INTRODUCTION)

The Application Layer is a critical part of network communication, providing services and interfaces that directly interact with end-users and applications.

In multimedia architecture, this layer is responsible for various multimedia applications and services.

APPLICATION (KEY FUNCTIONS)

User Services:

- The primary function of this layer is to provide network services and interfaces to end-users.

Data Exchange:

- The Application Layer enables the exchange of data between different devices and platforms.

Interoperability:

- Ensuring that diverse software and applications can communicate and work together is a key role.

Presentation Services:

- Data formatting and translation for presentation to users are part of this layer.

WHY COMPRESSION?

Reduced Storage Requirements:

- Compression reduces the file size, allowing you to store more data efficiently.

Faster Data Transmission:

- Smaller file sizes result in faster data transmission.

Bandwidth Efficiency:

- Data compression minimizes the amount of bandwidth required to transmit multimedia content.

Improved User Experience:

- Compressed multimedia content can load more quickly, play smoothly, and be more responsive.

Real-Time Communication:

- In real-time multimedia communication, such as video conferencing, data compression helps reduce latency and ensures a more responsive and interactive experience.

Resource Conservation:

- Smaller data sizes require fewer resources, which is important for mobile devices with limited storage capacity, battery life, and processing power.

Archiving and Backup:

- Compression can make it more practical to archive and back up multimedia content. It saves both storage space and time during data transfer.

REDUNDANCY

Redundancy is a critical aspect of compression because it offers opportunities to reduce the size of data without losing essential information.

Types of Redundancy:

Spatial Redundancy:

- Spatial redundancy exists when the same or very similar data values occur in proximity within the data.

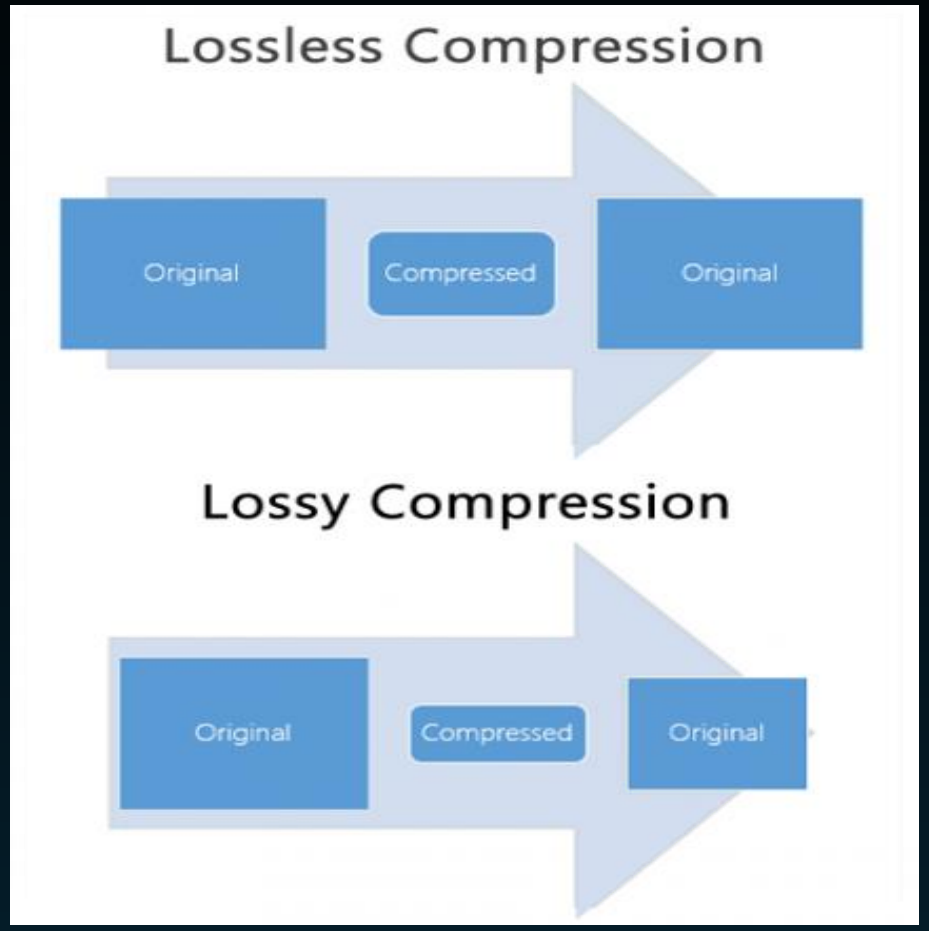
Temporal Redundancy:

- Temporal redundancy refers to redundancy over time, where data values in a sequence of frames or data samples exhibit similarity.

Statistical Redundancy:

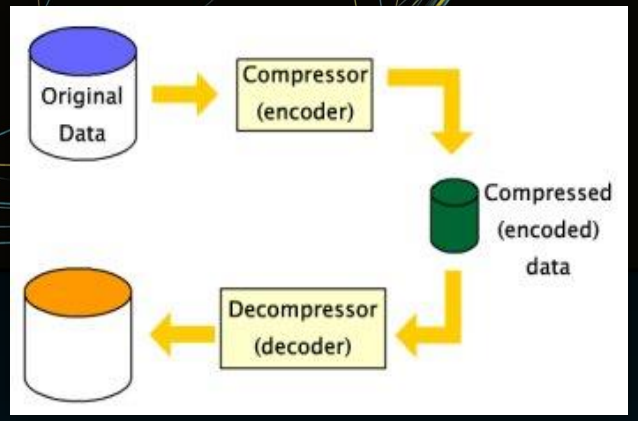
- Statistical redundancy arises from the non-uniform distribution of data values.
- Some data values occur more frequently than others, leading to inefficiencies in data representation.

LOSSLESS VS. LOSSY COMPRESSION



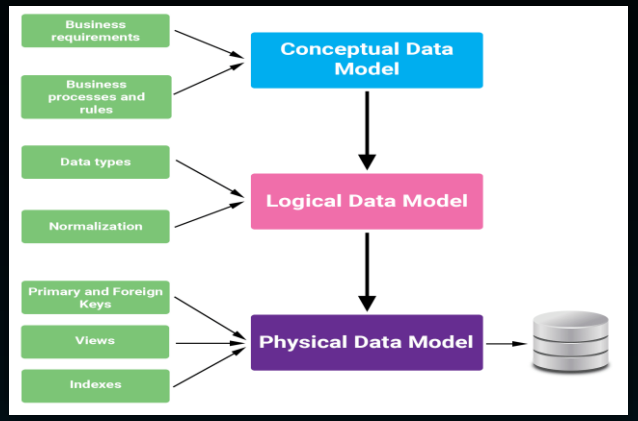
Features	Lossy	Lossless
Image reconstruction	Quality degraded compare to original image source	Quality remain the same with original image
Compression size rate	High compression up to 50% of original data file size	2:1 , the most is 3:1 ratio

INTRODUCTION TO DATA COMPRESSION, MODELING, CODING



Data Compression

- Data compression is the process of reducing the size of data without losing essential information.
- Modeling and coding are two essential steps in data compression.
- Huffman coding is a widely used compression algorithm.



Data Modeling

- The first step in data compression is to model the data
- Modeling involves identifying data types and their relationships.
- Example: Text file with letters, numbers, and punctuation.
- Modeling can be done using grammars or rule-based systems.

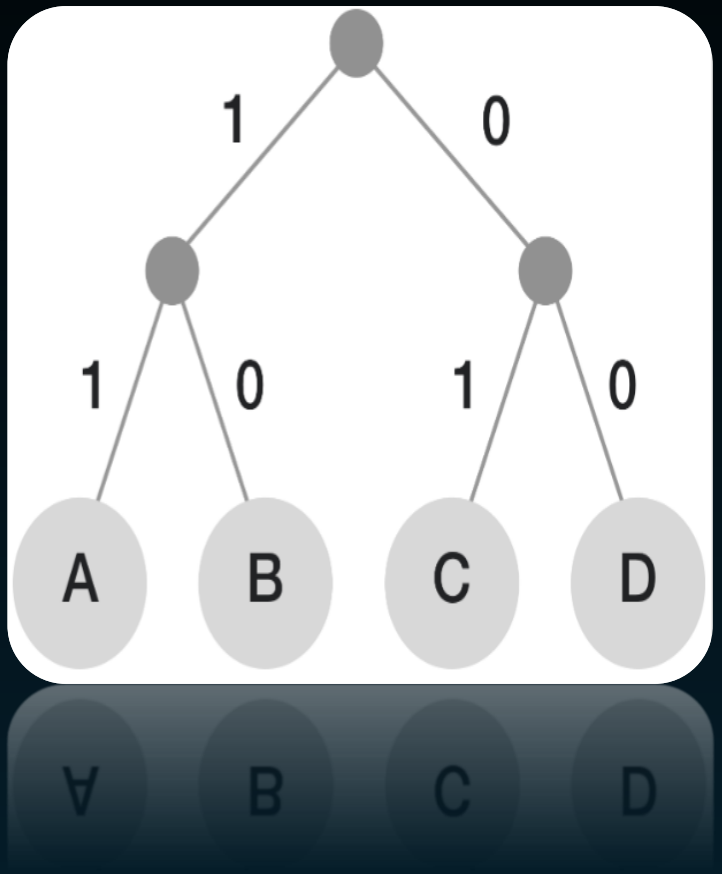
Data Coding

- Coding translates data into a compressed form based on the model.
- It uses variable-length codes based on symbol frequencies.
- More frequent elements are assigned shorter codes, while less frequent elements are assigned longer codes resultant a compressed data.

INTRODUCTION TO HUFFMAN CODING

Huffman Coding

- Huffman coding creates a code table based on symbol frequencies.
- Frequent symbols get shorter codes for efficient compression.
- No loss of information during compression.



USE HUFFMAN CODING TO DEMONSTRATE THE DISTINCTION

Modeling

- Huffman coding relies on modeling symbol frequencies.
- The algorithm constructs a model of how often symbols appear.
- Symbol frequencies are used to create an optimal code table.

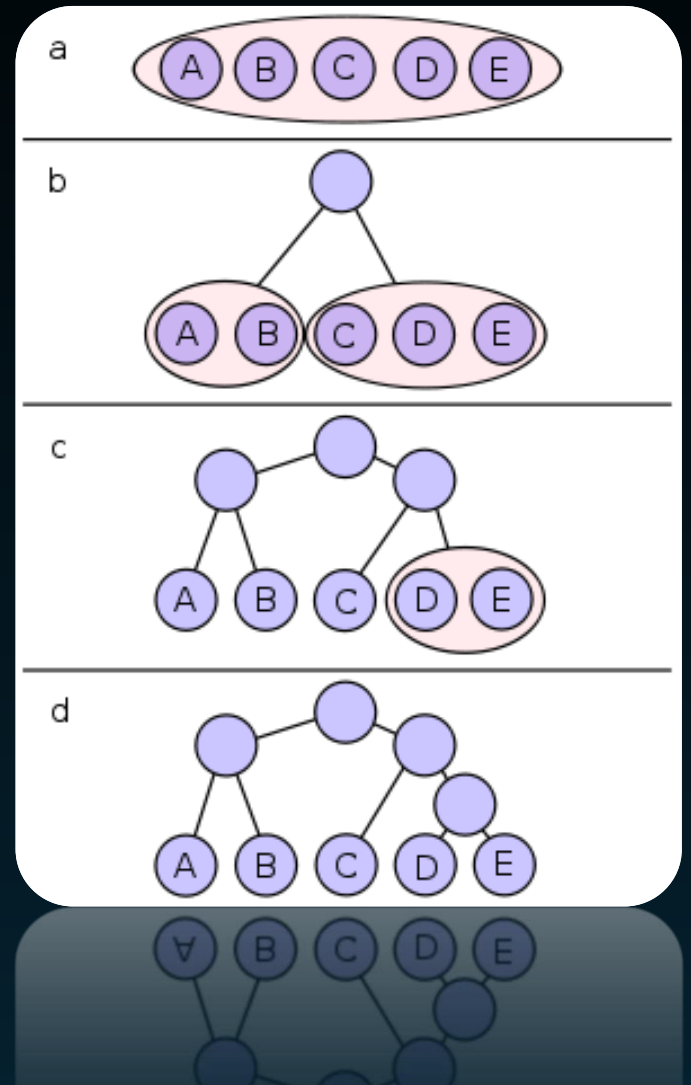
Coding

- Huffman coding assigns shorter codes to more frequent symbols.
- The code table is a crucial part of the modeling process.
- Code is efficient representation of data is achieved through this modeling.

INTRODUCTION TO SHANNON-FANO ENCODING ALGORITHM

Shannon-Fano Encoding Algorithm

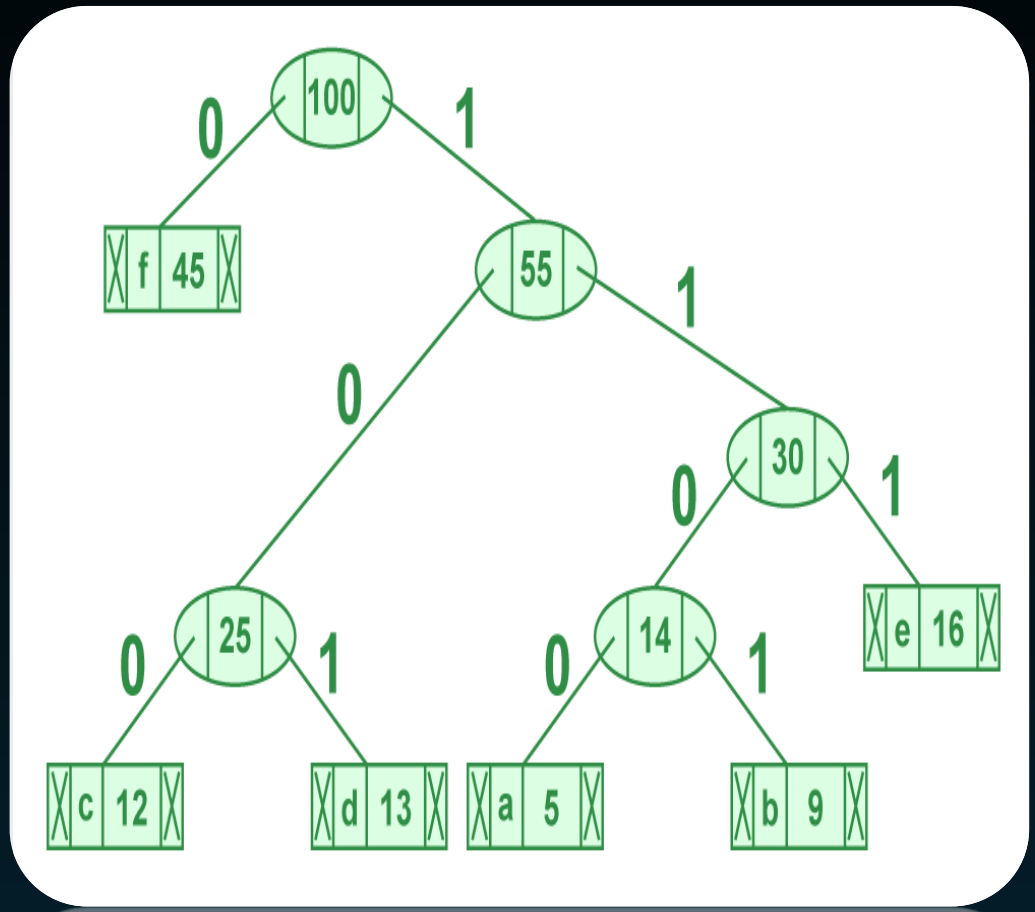
- Shannon-Fano is a lossless data compression algorithm.
- Variable-length code table: The code table is created based on symbol frequency.
- Recursively divided data: Symbols are divided into two halves based on frequency.
- Left and right assignments: More frequent symbols are on the left, less frequent on the right.
- Unique code assignment: This process is repeated until each symbol has a unique code.



INTRODUCTION TO HUFFMAN ALGORITHM

Huffman Algorithm

- More efficient than Shannon-Fano: Huffman is an improved version.
- Huffman tree: It's a binary tree with leaves representing symbols and internal nodes representing codewords.
- Tree construction: The tree is built by merging least frequent symbols.
- Codeword assignment: Symbols get codewords by traversing the tree, starting at the root and using 0 for the left branch and 1 for the right branch.



CONCLUSION

- Multimedia architecture serves as the backbone for systems that handle multimedia content.
- It enables the creation, processing, and delivery of multimedia in an efficient and user-friendly manner.
- By understanding the various components and concepts discussed today, you are better equipped to appreciate the complex, yet essential, world of multimedia architecture.
- As we continue to embrace digital media, the importance of well-designed multimedia architecture will only grow, ensuring that we can enjoy rich, interactive, and seamless multimedia experiences across various platforms.

THANK YOU

Distributed Systems

Group: 8

Name: Tazuddin Ahmad & Shake Mahmud Alve

What is a distributed system?

- A distributed system is a network of computers that work together over a distance. They share tasks, data, and services. These systems are known for being concurrent, transparent, scalable, reliable, and able to handle failures. They communicate through networks, deal with heterogeneous components, and often prioritize consistency and security. Examples include cloud computing, peer-to-peer networks, and distributed databases.

Distributed Multimedia

- Distributed multimedia involves sharing images, videos, and audio across networks. It enables streaming, synchronization, and efficient content delivery using technologies like CDNs. Security and quality of service are vital for a seamless user experience. Examples include video streaming services like Netflix and online gaming platforms.

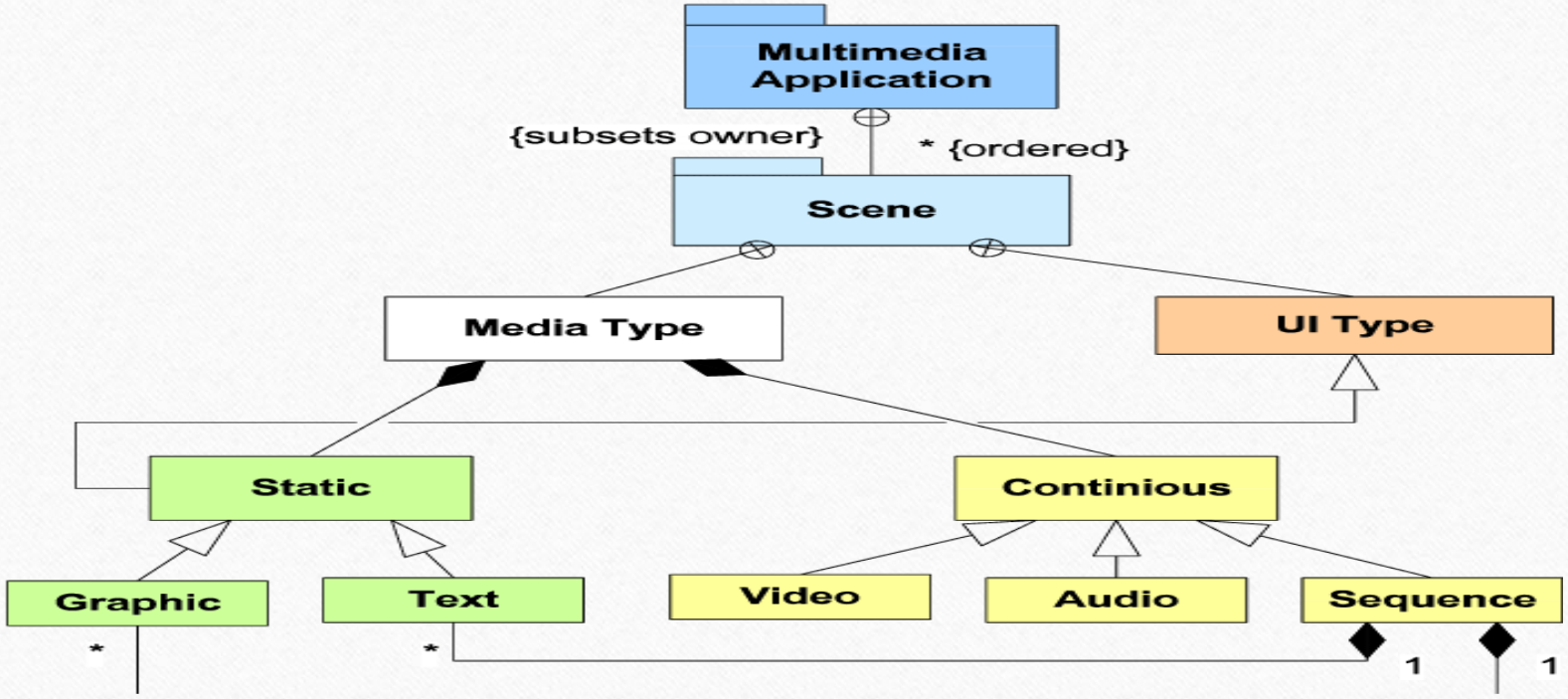
Systems (DMMS)

Characteristics of of distributed multimedia systems

1. **Content Variety:** They handle various media types, such as images, videos, and audio.
2. **Content Distribution:** Multimedia content is shared across a network.
3. **Real-Time Streaming:** Content can be streamed in real-time for immediate access.
4. **Synchronization:** Systems manage synchronization of multiple media elements.
5. **Quality of Service (QoS):** QoS considerations are crucial for maintaining media quality.
6. **Content Delivery Networks (CDNs):** CDNs are often used for efficient content distribution.
7. **Security:** Multimedia content is protected from unauthorized access and tampering.

Examples of the many issues that concern distributed computing research complimentary to multimedia systems

Example of a multimedia



Systems Architecture

1. **External Environment:** The external environment of a system can significantly influence it. Factors like changes in market conditions, regulations, technological advancements, and economic shifts can affect how a system operates and its performance.
2. **Internal Design and Architecture:** The way a system is designed and its architecture can have a substantial impact. Poorly designed systems may be less efficient, less scalable, and more prone to errors.
3. **User Behavior and Requirements:** User behavior and changing user requirements can affect a system. User feedback, evolving needs, and user adoption or resistance to the system can all impact its success.
4. **Technological Changes:** Advances in technology can both positively and negatively affect a system. New technologies may enhance a system's capabilities, while obsolete technologies may lead to compatibility issues and the need for updates or migrations.

Approaches in DMMS

- Promp-based
- Parallel or clustered servers
- Cachinghas context menu

Differences between a Multimedia Application and a typical Computer Application

1. **Content Type:**
    1. Multimedia: Rich media content (images, videos, audio).
    2. Computer: Text-based or numerical data.
2. **User Interaction:**
    1. Multimedia: Interactive multimedia elements.
    2. Computer: Graphical or command-line interfaces.
3. **Media Handling:**
    1. Multimedia: Specialized media processing.
    2. Computer: Data processing and calculations.
4. **User Experience:**
    1. Multimedia: Visually engaging.
    2. Computer: Functionality and efficiency.

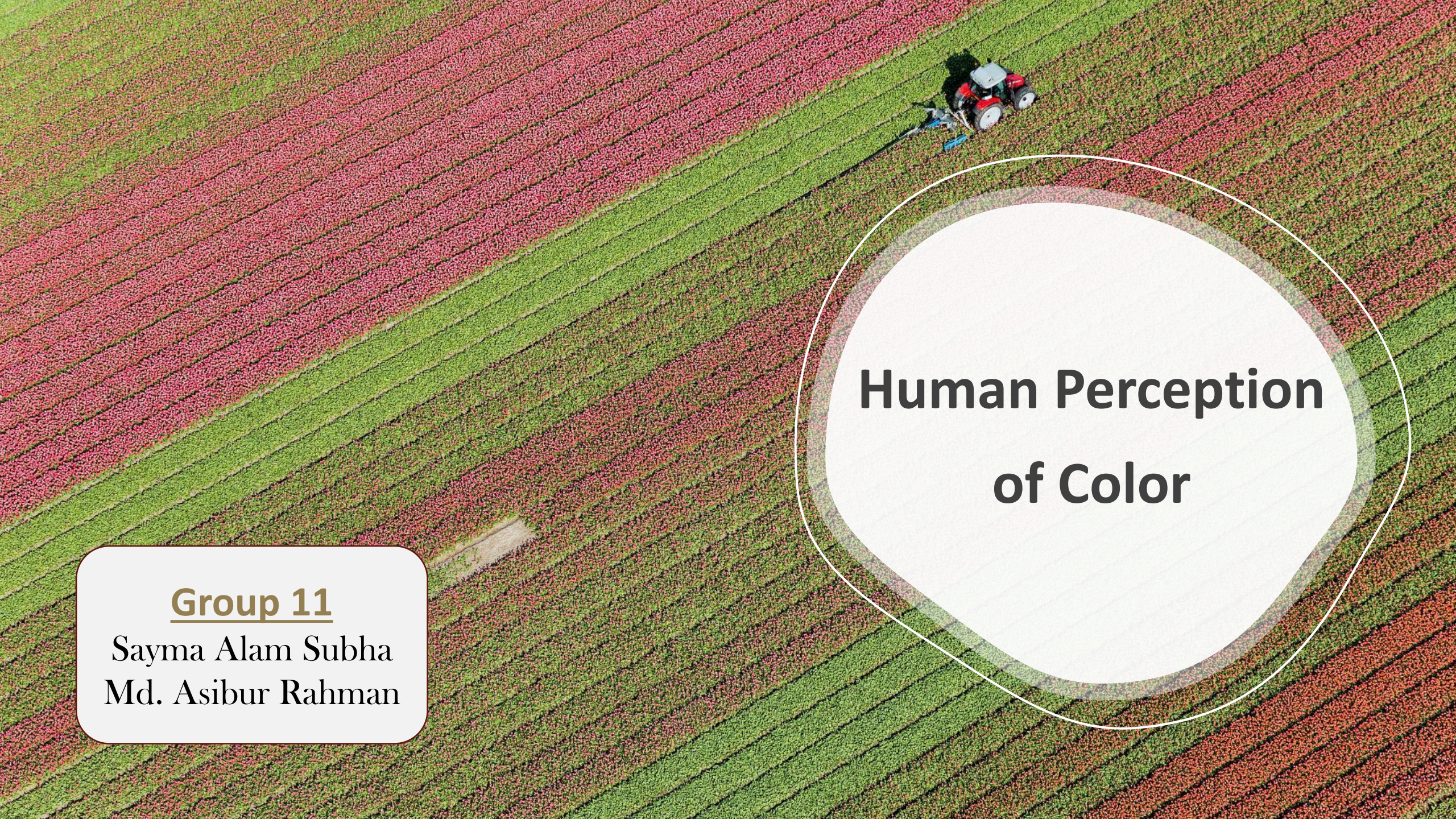
Ways to achieve QoS

1. Prioritize critical traffic.
2. Manage and shape bandwidth.
3. Define QoS policies.
4. Use advanced queuing and buffer management.
5. Monitor, optimize, and adapt to network conditions.
6. Implement error handling and correction.
7. Ensure low latency and jitter for real-time applications.
8. Optimize the network infrastructure and use CDNs.
9. Consider security measures to protect QoS.

Congestion control

1. **Traffic Monitoring:** Continuously observe network traffic to identify congestion points and issues.
2. **Traffic Policing:** Enforce traffic rate limits to prevent individual users or applications from overloading the network.
3. **Traffic Shaping:** Smooth out bursts of traffic to avoid congestion, typically by adding delays or buffering.
4. **Queue Management:** Implement various queuing mechanisms to prioritize and manage the order of packet transmission.
5. **Flow Control:** Use feedback mechanisms to slow down or stop sending data when congestion is detected


THANKS FOR
YOUR ATTENTION
ANY QUESTION
SEARCH IN GOOGLE



Human Perception of Color

Group 11

Sayma Alam Subha

Md. Asibur Rahman

Outline

Basics of Color

The Human Retina

Cones and Color

Color Composition

Color Models for Image

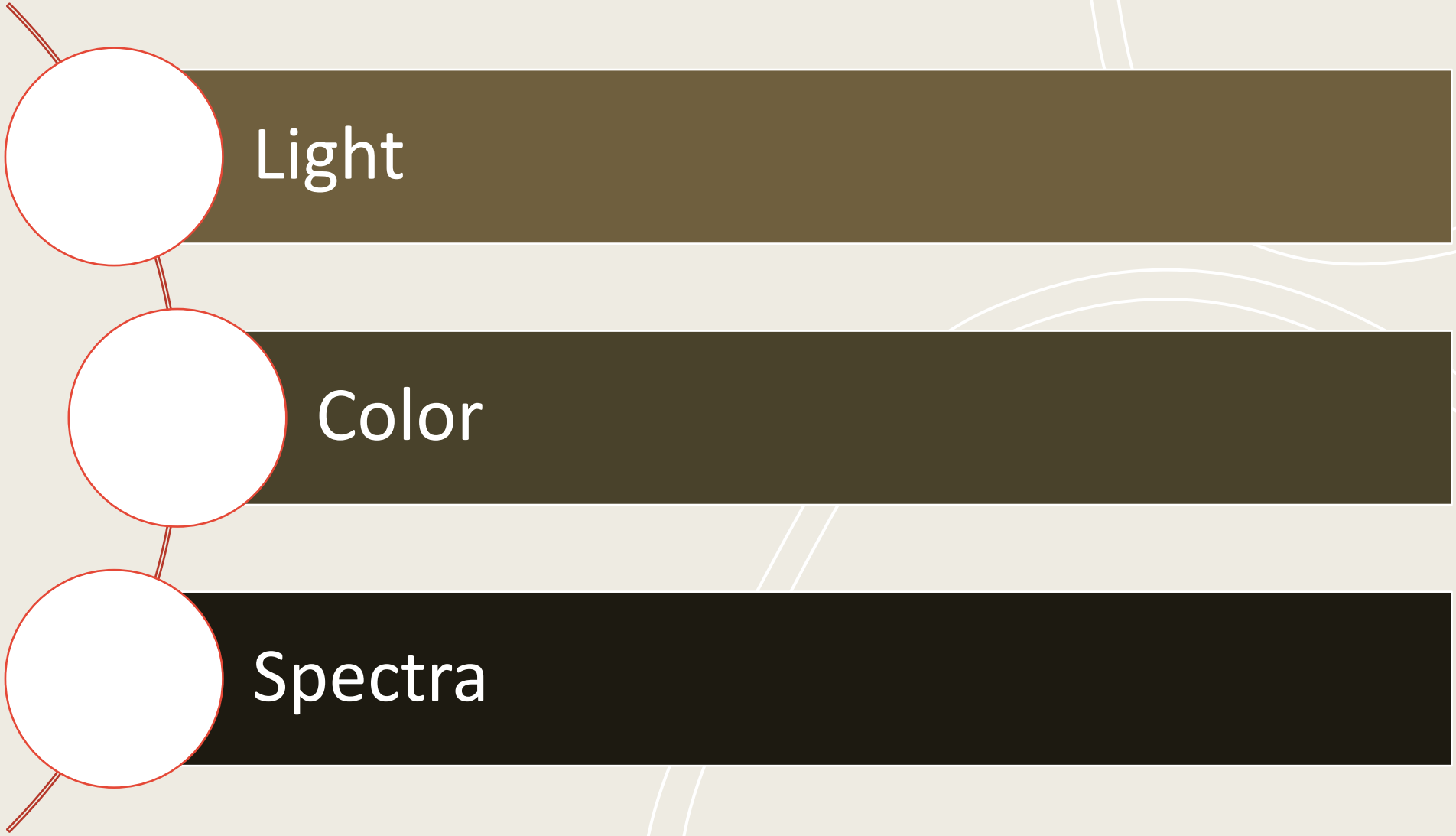
Color Models for Video

Summary

Human Perception of Color

Color is all around us, influencing our emotions, choices, and experiences. In this presentation, we delve into the captivating world of human color perception, uncovering the science and artistry that shape our colorful reality. Welcome to the journey of color and vision.

Basics of Color



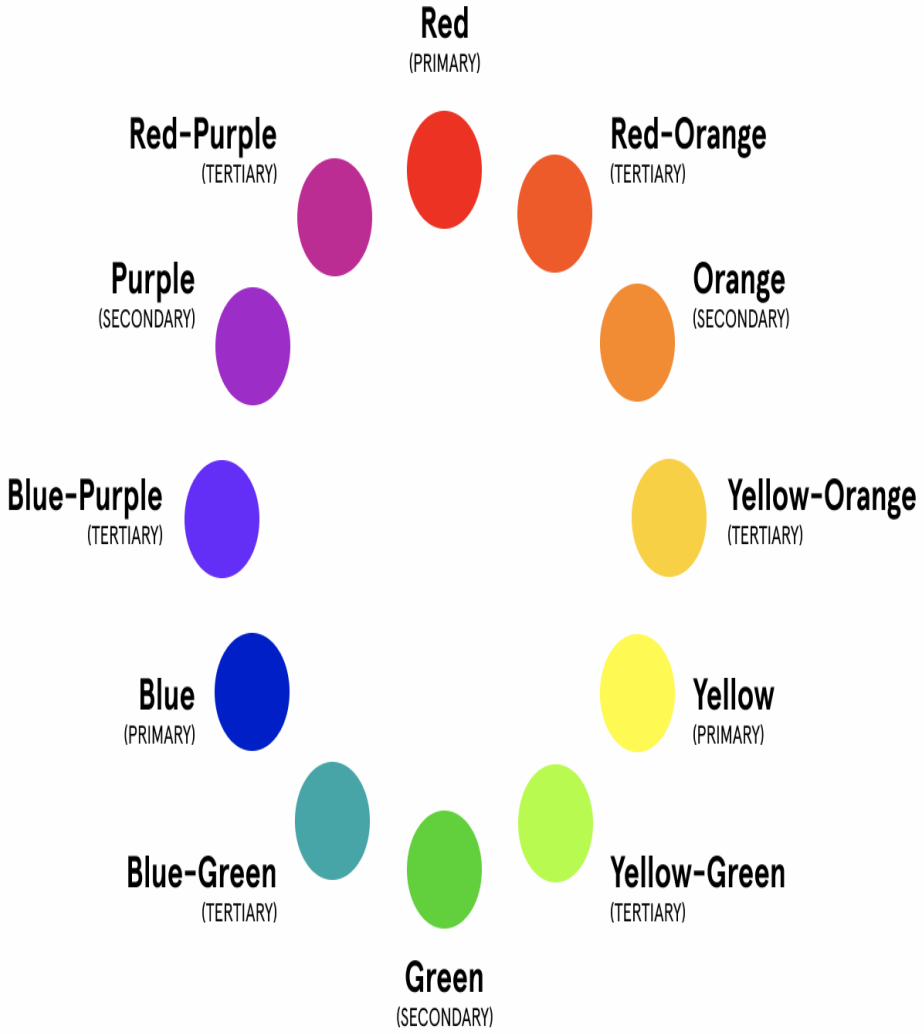
What is Light?

Light is a form of electromagnetic radiation that our eyes can perceive. It's composed of tiny particles called photons that travel in waves, carrying energy.

Visible light, which helps us see, falls within a specific range of frequencies within the electromagnetic spectrum. It ranges from approximately 400 to 700 nanometers..

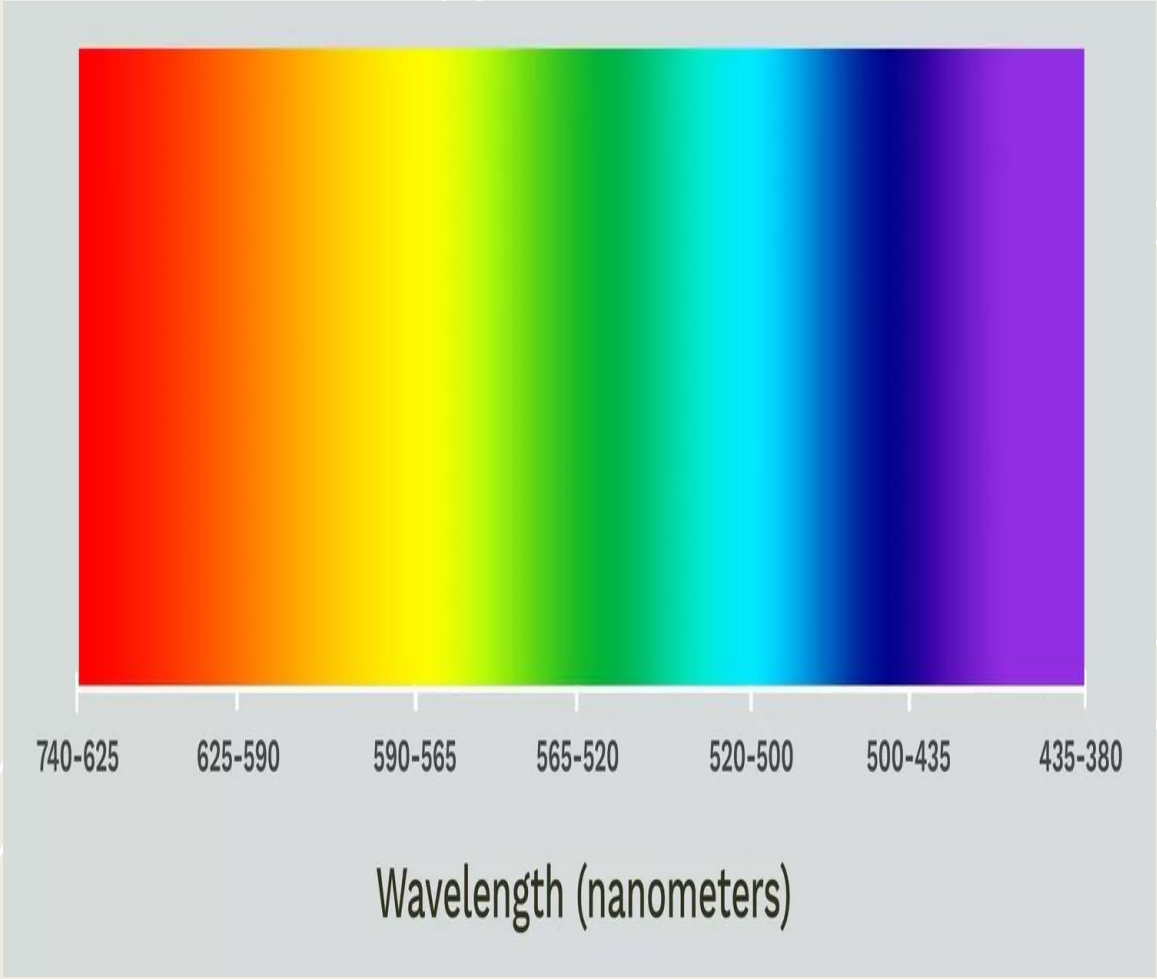
Introduction To Color

Color is an extremely important part of most visualizations. Choosing good colors for your visualizations involves understanding their properties and the perceptual characteristics of human vision.It is also important to understand how computer software assigns colors and various hardware devices interpret those assignments.



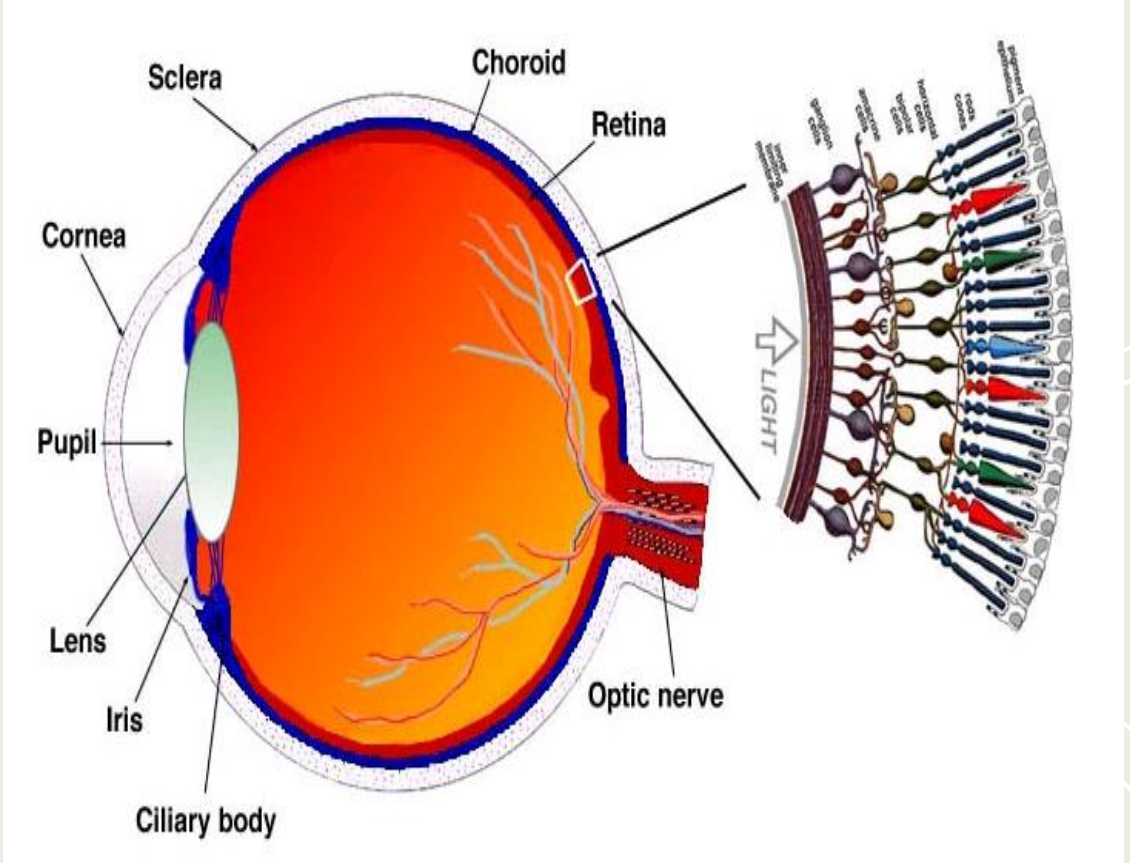
The Spectral Basis for Color

- Visible light, ultraviolet light, x-rays, TV and radio waves etc are all forms of electromagnetic energy which travels in waves.
- The wavelength of these waves is measured in a tiny unit called the Angstrom, equal to 1 ten billionth of a meter.
- Another unit sometimes used to measure wavelength of light waves is nanometers (nm) which are equal to 1 billionth of a meter.
- Visible light is an electromagnetic wave in the 700 nm (infrared) and 400 nm (ultraviolet) range



The Human Retina

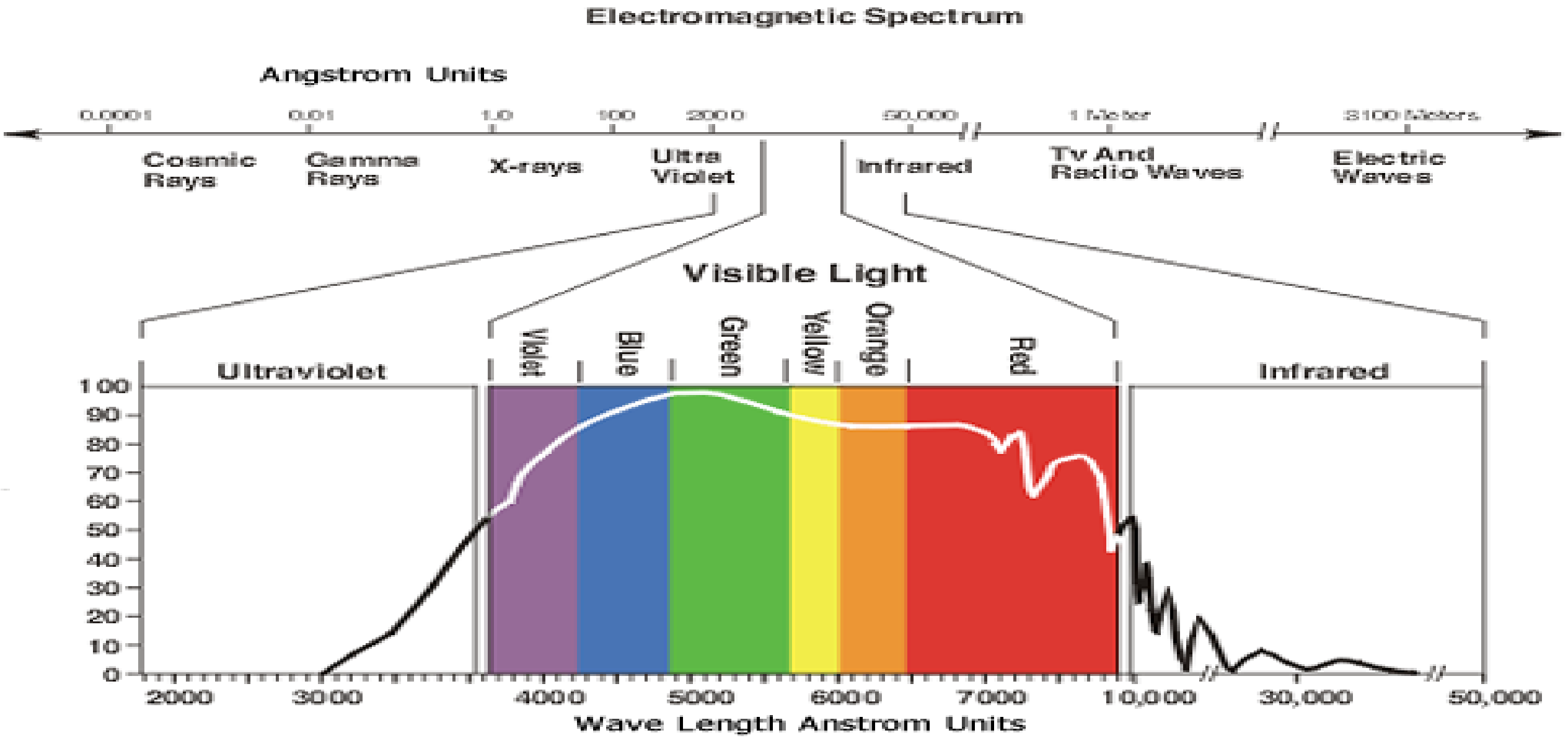
The human retina contains specialized light-sensitive cells called photoreceptors (rods and cones) that are responsible for detecting colors. The cone cells are sensitive to different parts of the color spectrum, with each type of cone sensitive to a different range of colors. The combination of these cone cell responses allows humans to perceive a wide range of colors, including red, green, and blue.



The Human Visual System

- ✓ Visible light corresponds to an electromagnetic wave that falls into the wavelength range of 380 to 825 nanometers
- ✓ Human cannot see whatever that is outside this range (the spectrum)
- ✓ The spectrum is divided into various spectral bands, each band is defined by a range of the wavelengths (or frequency)

The Human Visual System



Cones and Color

Cone Function

The cones in the retina are specialized photoreceptor cells responsible for color vision. vision. Cones contain pigments that are sensitive to sensitive to specific wavelengths of light, primarily in primarily in the red, green, and blue parts of the the spectrum.

Stimulus and Color Perception Perception

When light enters the eye and activates the cones, it cones, it triggers a response. The color we perceive is perceive is determined by which type of cone is most is most stimulated. For example, if the long-wavelength (red-sensitive) cones are most active, we active, we see the color red. If the medium-wavelength (green-sensitive) cones dominate, we we perceive green

Color Composition

Color composition is the art of arranging and combining colors to create visually appealing and meaningful designs. It involves considering elements like harmony, contrast, balance, and the emotional and cultural significance of colors to convey messages effectively in various fields, including art, design, fashion, and marketing.

Color Composition Essentials

1 Additive Color Mixing

In color theory, additive mixing combines red, green, and blue light to create white light, widely used in digital displays.

2 Subtractive Color Mixing

By blending cyan, magenta, and yellow pigments, a spectrum of of colors is created, while while an equal mix results results in black.

3 Color Harmonies

Vital for pleasing compositions, harmonies harmonies include complementary, analogous, and triadic color schemes in art, design, and fashion.

4 Color in Psychology Psychology

Colors influence emotions emotions and moods; red red symbolizes passion, passion, while blue conveys calm and stability.

5 Cultural & Symbolic Symbolic Aspects

Colors hold diverse cultural meanings; white white represents purity in purity in the West but signifies mourning in some Asian cultures.

6 Color in Marketing & Marketing & Design Design

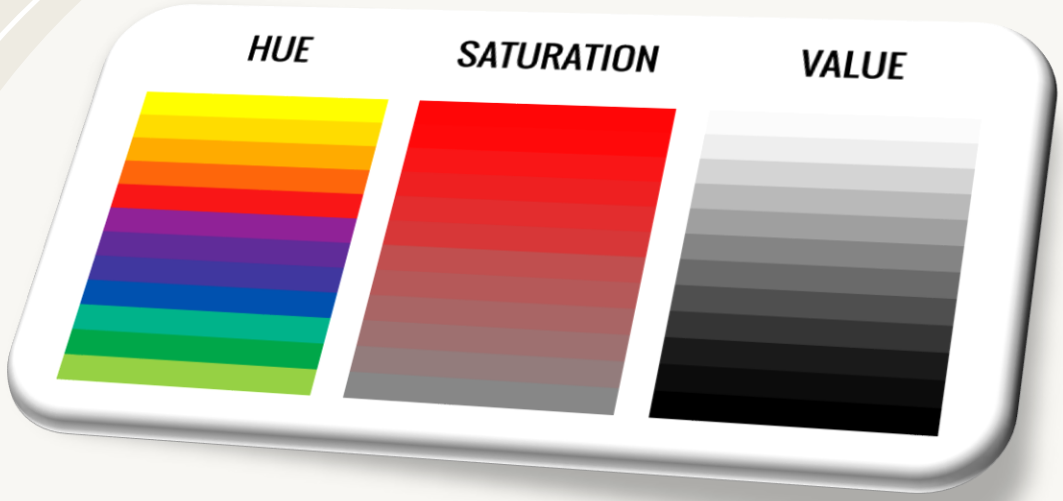
Businesses strategically strategically use colors to to evoke emotions, shape shape brand identities, identities, and influence influence consumer behavior.

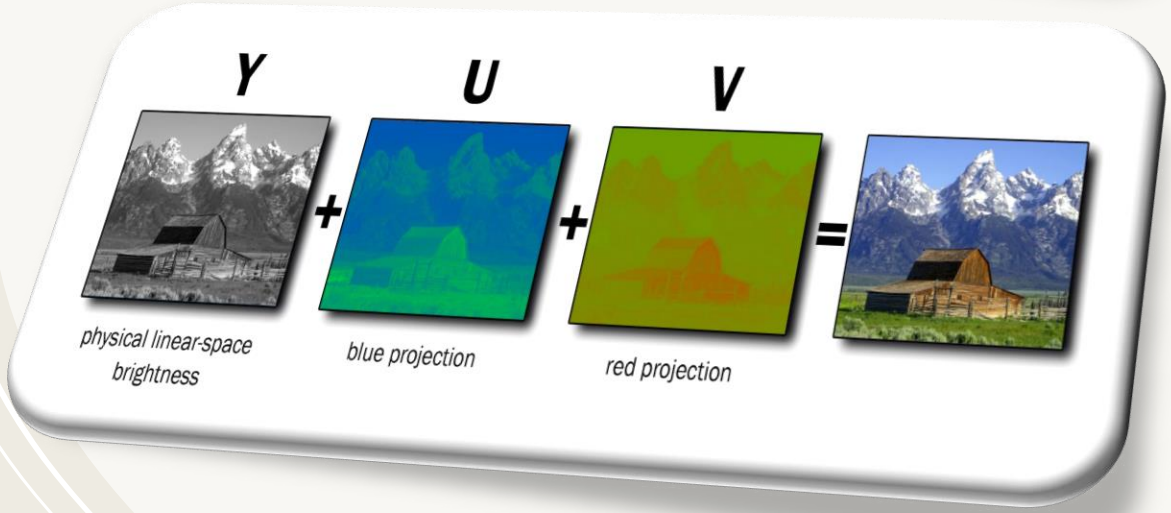
7 Color Perception Variations

Not all perceive colors the same; color blindness, especially red-green, impacts how individuals see the individuals see the world.

Various color models

1. RGB Color Model
2. CMY and CMYK Color Models
3. YUV and YCbCr Color Models
4. HSL and HSV Color Models
5. Lab (CIELAB) Color Model
6. Pantone Color System
7. CMC and ΔE Color Difference Formulas





Various color models

RGB COLOR MODEL

Based on additive color mixing, where different intensities of red, green, and blue light combine to create various colors. Common in digital displays and photography

CMY AND CMYK COLOR MODELS

Subtractive color models used in color printing. Mixing cyan, magenta, and yellow pigments subtracts wavelengths to create colors. Adding black (K) improves contrast and color accuracy.

YUV AND YCBCR COLOR MODELS

Separate luminance (brightness) from chrominance (color information) for efficient video encoding and transmission. Takes into account the human eye's sensitivity to brightness.

Various color models

HSL AND HSV COLOR MODELS

Intuitive for artists and designers. Describe colors by hue, saturation, and lightness/value. Used for color selection and adjustment in design.

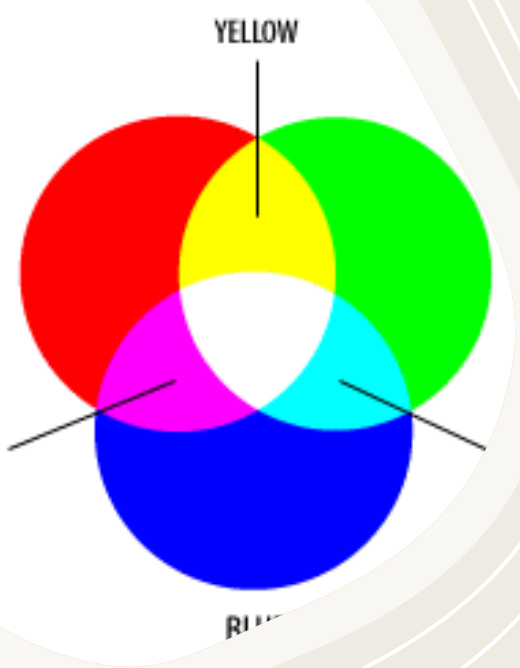
LAB (CIELAB) COLOR MODEL

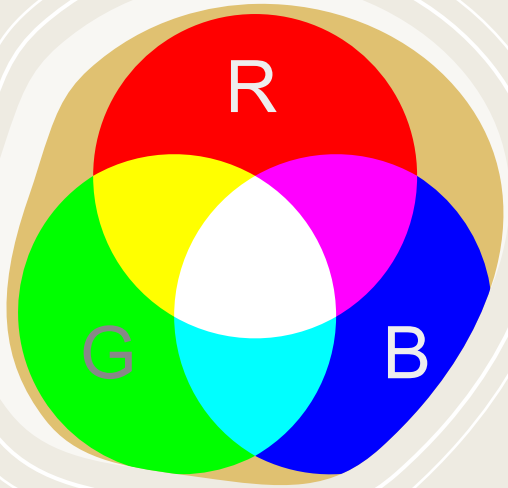
A device-independent color model that defines colors based on perceptual similarity. Separates color and luminance, useful for color calibration and matching.

PANTONE COLOR SYSTEM

Proprietary color matching system for design and printing. Assigns unique codes to ensure consistent color reproduction across media and materials.

Color Models for Images





- ❑RGB Additive Model
- ❑CMYK Subtractive Model

RGB Additive Model

The RGB color model is an additive model used in digital displays and photography. It defines colors based on the combination of red (R), green (G), and blue (B) light at varying intensities.

Applications:

Commonly used in computer monitors, TVs, and digital image processing, where different intensities of these primary colors create a wide spectrum of colors.

Advantages:

Produces vibrant, bright colors and is suitable for displays and digital media.

CMYK Subtractive Model

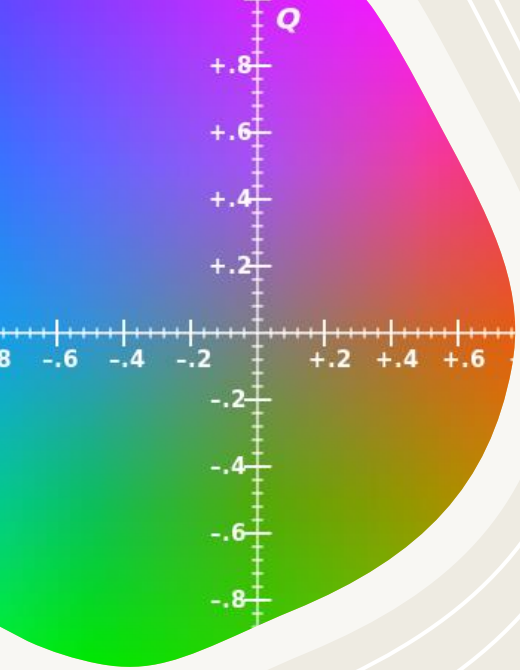
The CMYK color model is a subtractive model used primarily in print and graphic design. It is based on the subtractive color mixing of cyan (C), magenta (M), yellow (Y), and black (K) inks.

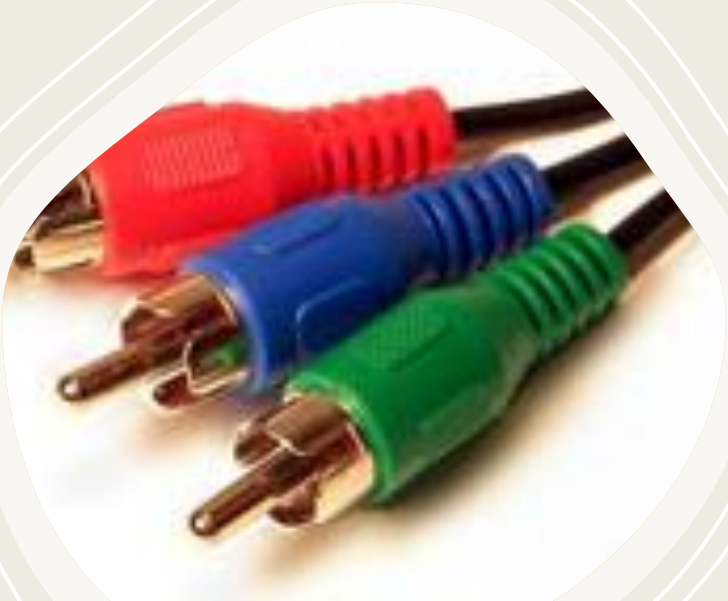
ADVANTAGES

Ideal for printing and reproducing a wide range of colors with good accuracy.

Application:

Widely used in color printing, including magazines, brochures, and posters, where inks are layered to absorb colors, resulting in the desired hues.





Color Model For Video

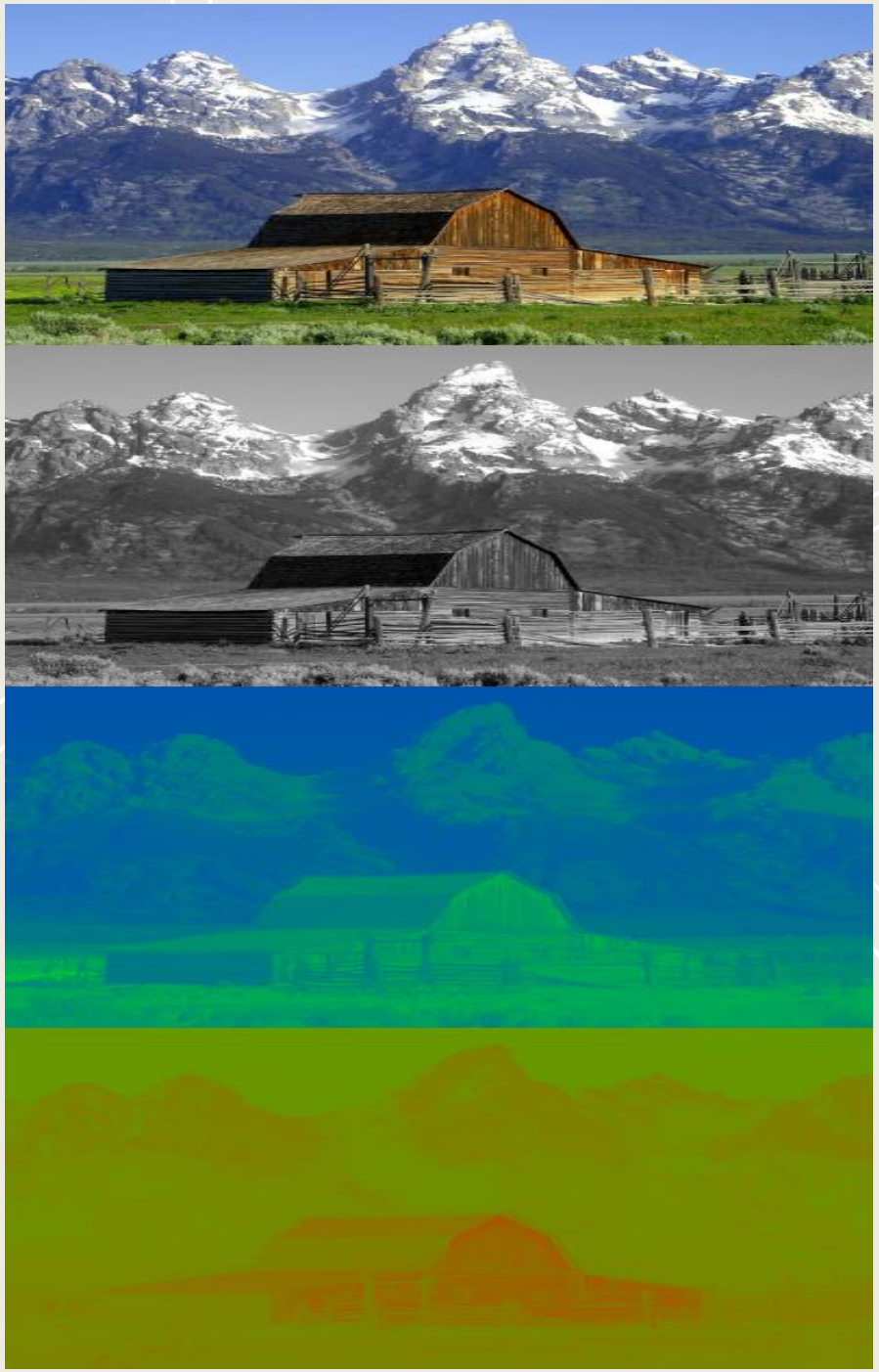
Color models for video are similar to those used for images, but they are designed to handle the dynamic nature of video content. These color models are used to represent and process colors in video and ensure accurate and consistent color reproduction. The two most common color models for video are:

- YUV Model
- YIQ Model

YUV Model

The YUV video model separates video or image data into three channels:

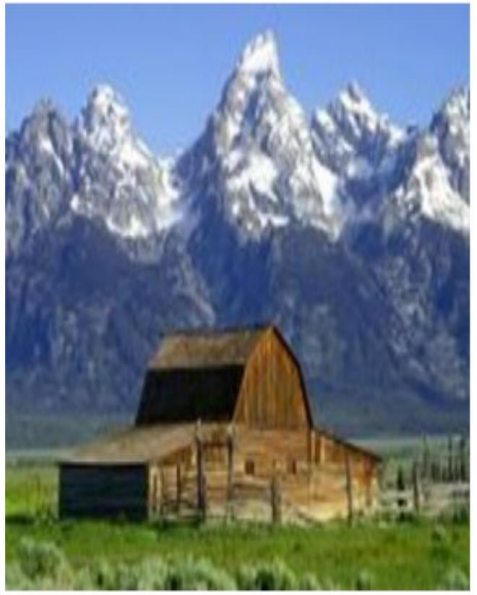
1. Y (Luma): Represents brightness or grayscale.
2. U and V (Chroma): Hold color information.



YIQ Model

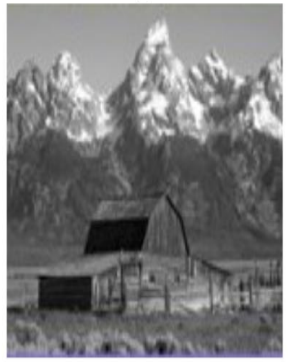
The YIQ video model is used in analog television, primarily in North America and Japan. It separates video data into three components:

- Y (Luma): Represents brightness.
- I (In-phase): Indicates the position on the color wheel, leaning toward red or green.
- Q (Quadrature): Indicates the position on the color wheel, leaning toward violet or yellow.



Luminance

Y



I

Q

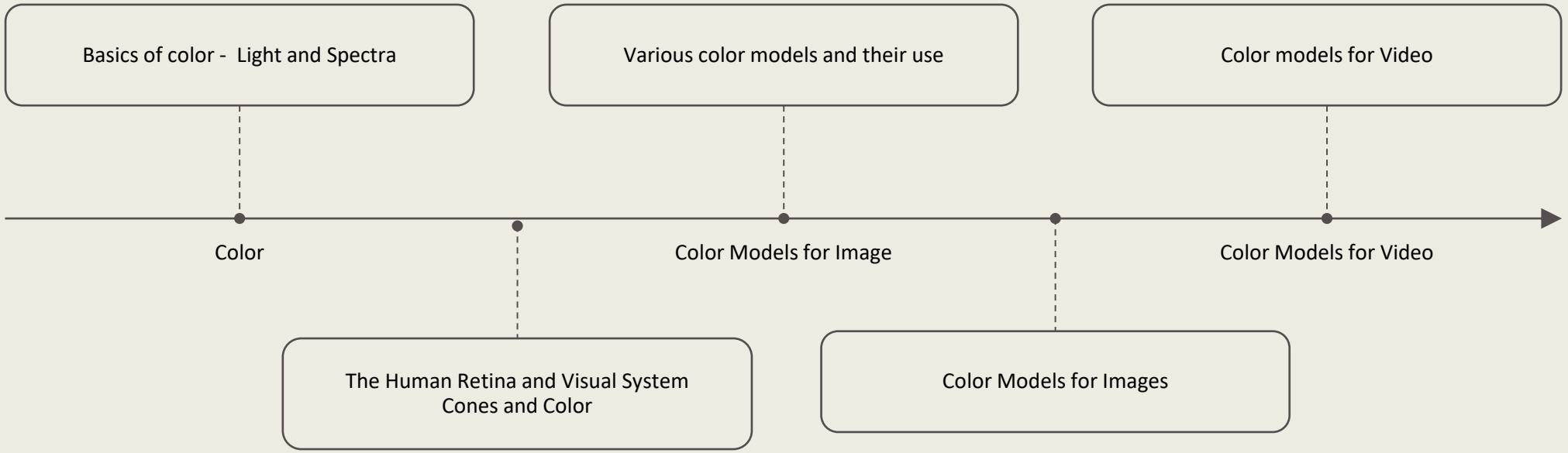
Summary

- Color images are encoded as triplets of values
- RGB is an additive color model that is used for light- emitting devices (e.g., CRT displays)
- CMYK is a subtractive color model that is used often for printers
- Two common color models in imaging are RGB and CMYK, two common color models in video are YUV and YIQ.
- Besides the hardware-oriented color models (i.e., RGB, CMYK, YUV, YIQ), others, such as HSB (Hue, Saturation, and Brightness) and HLS (Hue, Lightness, and Saturation) are also used commonly and can be adjusted using software

"Color is a power that directly influences the soul.

-Wassily Kandinsky

Timeline


Basics of color - Light and Spectra
Various color models and their use
Color models for Video
Color
Color Models for Image
Color Models for Video
The Human Retina and Visual System
Cones and Color
Color Models for Images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IMAGES & COLOR

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- Dithering
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- System Dependent Formats
- PNG: The Future

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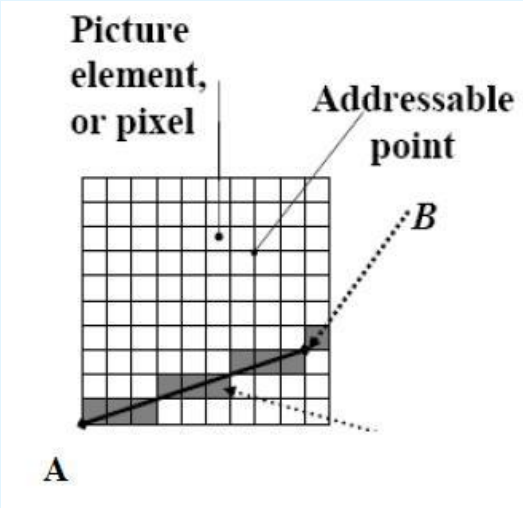
Part A:

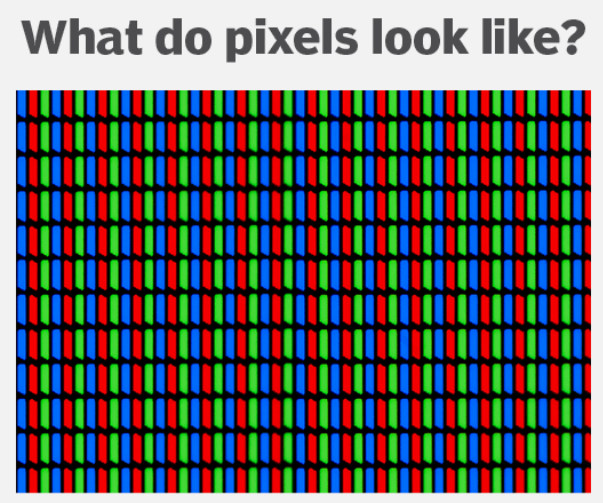
Basic Concepts Underlying Images

Graphics: Terminology

01 Pixels

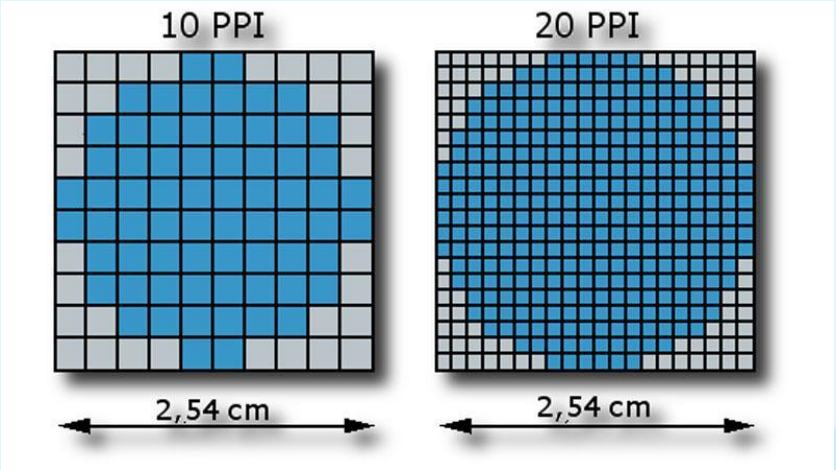
- Tiny dot, smallest bit of an image
- Many pixels together make up an image
- Every pixel has a specific value





02 Image Resolution

- The level of detail in an image is defined as its resolution
- Typically expressed as a horizontal x vertical measurement, for example if we multiply 4000 x 3000 = 12 megapixels (MP)
- Higher resolution means that there are more pixels per inch (PPI), resulting in a more detailed and crisper image



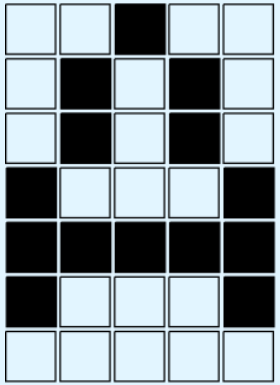
02 Image Resolution (contd.)

Image created at a low resolution of 72 dpi.

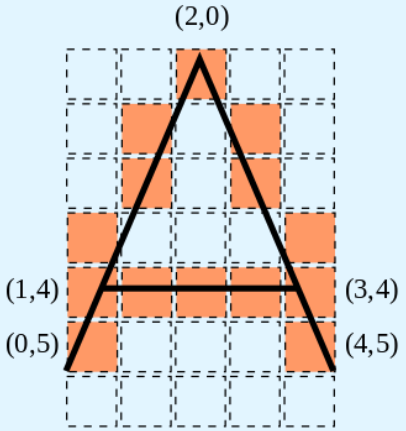
Image created at a high resolution of 350 dpi.

03 Bit-map

- Bitmap (BMP) is an image file format for creating and storing computer graphics also known as raster graphics
- These graphics consist of pixels, which are small blocks of color
- It carries the extension .BMP



Bitmap-depiction of the letter “A”



Vector depiction of the letter “A” (underlayed with bitmap-depiction)

04 Bits/Pixel

- The amount of information in each pixel of a digital image is measured in bits per pixel (BPP)
- It measures an image's color depth, showing the number of bits utilized to describe the color of a single pixel
- Higher bits per pixel allow for more colors or shades, leading to better color accuracy and more realistic images
- Images with higher bpp contain more data per pixel, requiring more storage space

Common Color Depths

1-bit color:
Represents 2 colors (e.g., black, and white)

Common Color Depths

1-bit color:
Represents 2 colors (e.g., black, and white)

8-bit color:
Represents 256 different colors

Common Color Depths

1-bit color:
Represents 2 colors (e.g., black, and white)

8-bit color:
Represents 256 different colors

24-bit color:
Represents over 16 million different colors

Monochrome vs Grayscale

Monochrome

- Monochrome refers to images or displays that use a single color or shades of a single color
- Monochrome pictures are often created using a 1-bit color depth, in which each pixel is represented by a single binary number (0 for black, 1 for white)

Grayscale

- Grayscale photos feature shades of grey ranging from pure black to pure white, as well as every grey level in between.
- Grayscale photographs, as opposed to monochrome photos, may show a broad range of tones and features.
- Grayscale graphics generally employ an 8-bit color depth, which allows for 256 distinct shades of grey.

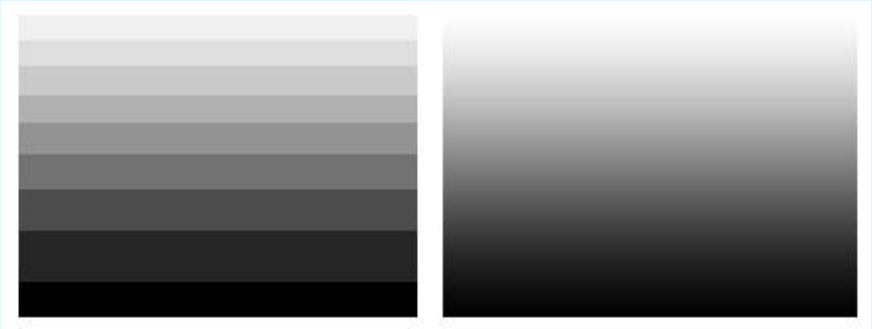
What is Dithering?

What is Dithering?

- Dithering is a digital imaging and graphics method that creates the illusion of more colors and shades by combining pixels of obtainable colors in specified patterns.
- Benefits:

  Improved Visual Quality: Makes pictures and gradients look smoother.

  Perceptual Enhancement: Improves the sense of color depth and detail.



Color Images: 24-bit vs 8-bit

Color Images: 24-bit

- Each pixel in a 24-bit color picture is represented by 24 bits. These bits are separated into three 8-bit channels: red, green, and blue (RGB color model).
- There are 256 potential shades of red, green, and blue with 8 bits in each channel, resulting in nearly 16 million possible colors (256 x 256 x 256 = 16,777,216 colors).
- 24-bit color pictures provide high color accuracy and realism. They can represent realistic visuals with smooth gradients, brilliant colors, and a variety of tones.
- Use: 24-bit color is extensively used in digital photography, online graphics, and any other application requiring high color accuracy and detail.

Color Images: 8-bit

- 8-bits are used to represent each pixel in an 8-bit color picture, allowing for 256 distinct colors.
- An 8-bit picture has 256 indexed colors drawn from a broader palette. The color of each pixel is represented by an index number (from 0 to 255) that points to a specific color in the palette.
- Due of the low number of colors available, 8-bit photographs may exhibit apparent color banding in gradients and lack the color fidelity of 24-bit images.
- 8-bit color is commonly utilized on older computer systems, some graphics files, and specific programs with limited memory or computing capability. It is also employed for creative reasons in some artistic and retro-style designs.

Part B:

Popular Image File Formats

System Independent Formats

System Independent Formats

01 GIF (Graphics Interchange Format)

- Supports simple animations with multiple frames
- Ideal for images with limited color palettes
- Often used for logos and icons

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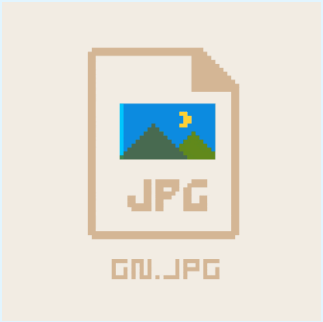
System Independent Formats

02 JPEG (Joint Photographic Experts Group)

- Suitable for photographs and complex images
- Uses lossy compression for smaller file sizes
- Commonly used for digital photos



System Independent Formats

03 TIFF (Tagged Image File Format)

- Versatile format for professional image editing
- Supports both lossless and lossy compression
- Used for high-quality images, printing, and layered graphics

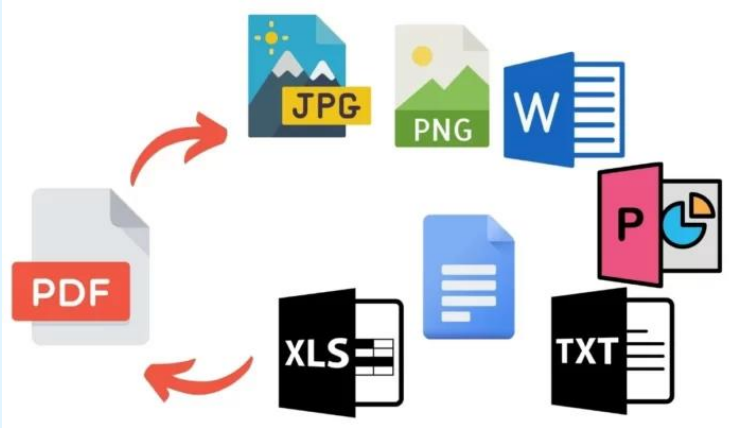
04 Graphics Animation Files

- Includes formats like APNG and MNG for advanced animations
- Offer better compression and features than GIFs
- Used for interactive and dynamic graphics

System Independent Formats

05 PostScript/PDF (Portable Document Format)

- Primarily used for documents but can embed images
- PDF is a versatile format for text, images, and vector graphics
- Ideal for digital documents, presentations, and publications



System Dependent Formats

System Dependent Formats

01 Windows (BMP)

- Standard Windows format for basic graphics
- Simple and uncompressed, resulting in larger files

02 Macintosh (Paint; PICT)

- Mac-specific formats for images and illustrations
- PICT is versatile for storing images and graphics
- Paint is typically used for simple drawings on Mac computers

03 X-Windows (XBM)

- Used in Unix-based systems for black-and-white graphics
- Efficient for graphical elements in X applications

PNG: The Future

PNG: The Future

- PNG (Portable Network Graphics) is emerging as the future of image formats
- Offers lossless compression for quality preservation
- Supports transparency, ideal for web design and graphics
- Compatible with all major browsers
- Open standard, no proprietary restrictions
- Preferred choice for graphic designers due to lossless editing
- Balances image quality with efficient file sizes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