Multimedia System

Media Represntation and Formats

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Bandung
2012

Media

- Media is represented in various forms—text, images, audio, video, and graphics.
- Images are commonly used to capture and represent a static visual snapshot of the world around us.

Digital Images

- When we speak of images, we normally refer to “still” images.
- Images by themselves are used in various forms for a variety of applications. These might be photographs, gray or color, or used with text in documents.
- Furthermore, images form the basic elements of video.

Digital Representation of Images

- All images are represented digitally as pixels. An image is defined by image **width, height, and pixel depth**.
- The image width gives the number of pixels that span the image horizontally and the image height gives the number of lines in the image. Each pixel is further represented by a number of bits, which is commonly called the pixel depth.
- The *pixel* depth is the same for all pixels of a given image. The number of bits used per pixel in an image depends on the color space representation (gray or color) and is typically segregated into channels.
- The total number of bits per pixel is, thus, the sum of the number of bits used in each channel.

An Instance

- the gray-level value is Digital Images 53 encoded on 8 bits for each pixel.
- In color images, each R, G, B channel may be represented by 8 bits each, or 24 bits for a pixel.
- Sometimes a additional fourth channel called the alpha channel is used.
- When the alpha channel is present, it is represented by an additional 8 bits, bringing the total bit depth of each pixel to 32 bits.

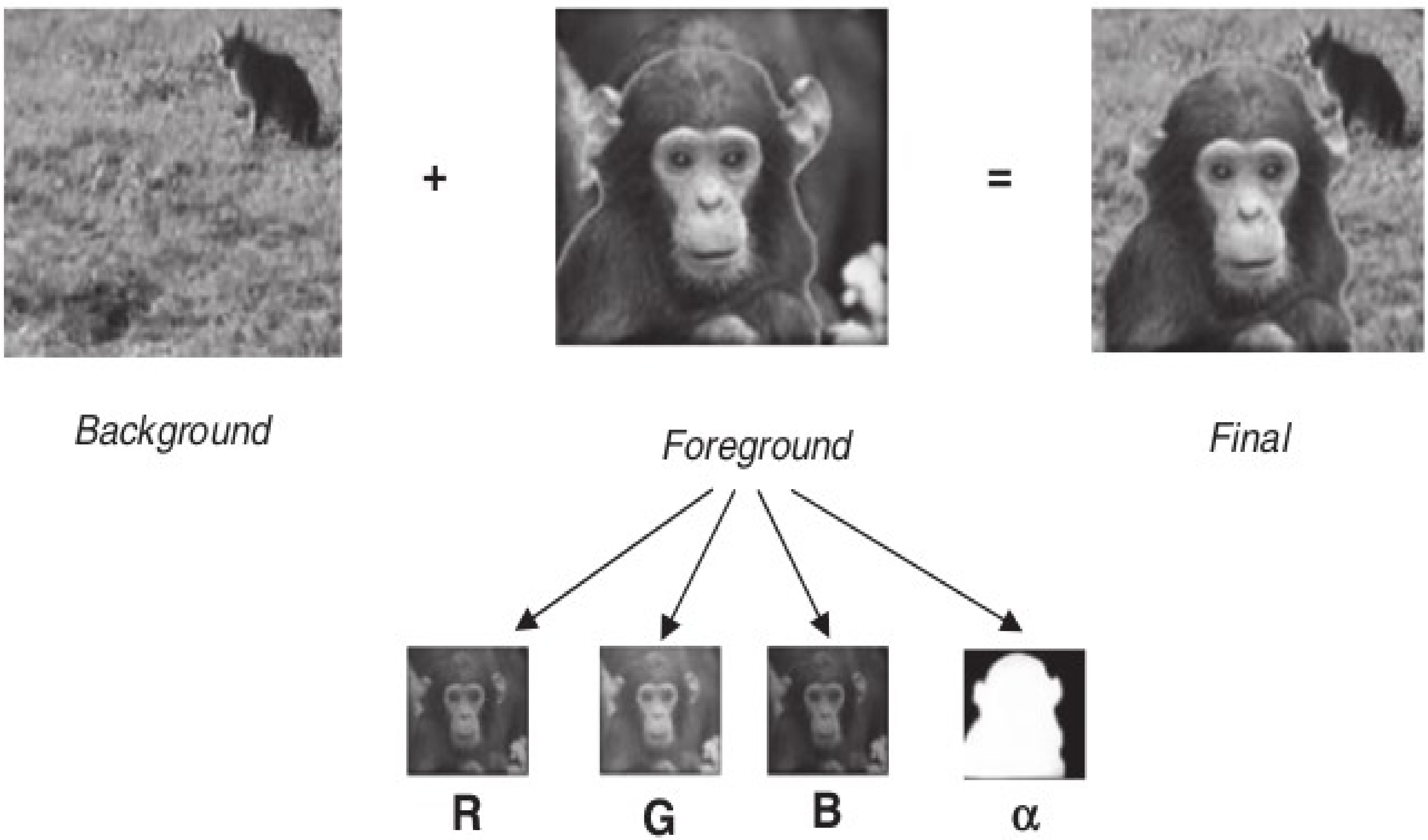
Example

- The size of the image can, thus, vary depending on the representations used.
- For example, a color image has a width of 640 and height of 480.
- If the R, G, B color channels are represented by 8 bits each,
- the size of color image = 640 x 480 x 3 x 8 = 7.37 Mbits (921.6 Kbytes).
- If this were a gray image, its size would be 640 x 480 x 8 = 2.45 Mbits (307.2 Kbytes).

Channel

- The number of channels typically ranges from one to four.
- One channel per pixel produces a grayscale image, and the number of bits in this case gives the possible range of the grayscale values.
- Three channels per pixel produce a color image.
- In the case of a typical color image, three channels represent the red, green, and blue components.
- **Sometimes, an additional channel, called the alpha channel (or α channel, or α matte), is also used.**
- The alpha channel suggests a measure of the transparency for that pixel value and is used in image compositing applications, such as chroma keying or blue screen matting, and in cell animation.

Sample For Alpha Channel



Aspect Ratios

- Image aspect ratio refers to the width/height ratio of the images, and plays an important role in standards
- Some of the commonly used aspect ratios for images are 3:2 (when developing and printing photographs), 4:3 (television images), 16:9 (high-definition images), and 47:20 (anamorphic formats used in cinemas)
- The ability to change image aspect ratios can change the perceived appearance of the pixel sizes, also known as the pixel aspect ratio (PAR) or sample aspect ratio (SAR).

Digital Image Formats

- Images can be acquired by a variety of devices.
- Initially, when images were not large and there was no need for compression, uncompressed formats such as *bmp* (**bitmapped** image) were prevalently used.
- In these cases, images were represented as *bitmaps* and stored in a *binary file*. Files such as these, with no compression, are called raw image files.
- Among the most commonly used compressed storage/transmission file formats are *.jpg for photographic* type images and *.gif* or *.png* for poster-like images. 0 illustrates some of the commonly used *raw/uncompressed* and compressed image formats and their uses.
- The raw and compressed image formats are a result of a *raster representation* of images.

Raster

- Raster images are images stored as row of pixels and have a width and height.

  *more detail in another slide in "Sistem Komputer"

Vector

- Vector graphics files store image data in terms of geometric objects.
- The objects are specified by parameters such as line styles, side lengths, radius, color, gradients, and so on
- This information can be stored in either binary or text form.
- It is possible to create a text-based vector image file by hand with a text editor or even alter an existing one.
- Knowledge of the grammar used and syntax of the object definition is required for this process, along with a lot of attention to detail.
- Vector graphics files are usually not edited by hand because drawing programs give you such powerful higher-level facilities for creating and manipulating vector graphic objects.

Metafile

- Some file formats combine vector graphics with bitmap images. We refer to these as metafiles.
- The term metafile evolved from attempts to create a platform-independent specification for vector graphics.
- The Computer Graphics Metafile (CGM), originally standardized under the International Organization for Standardization (ISO) in 1987, and evolving through several revisions, is an example of a standardized metafile format designed for cross-platform interchange of vector graphics with the optional inclusion of bitmaps.
- CGM files can be encoded in readable ASCII text, or compiled into a binary representation
- World Wide Web Consortium (W3C) has supported the development of WebCGM, which is designed to incorporate the CGM vector format into Web pages using the Extensible Markup Language (XML).
- An alternative to WebCGM for Web vector graphics being developed by W3C is Scalable Vector Graphics (SVG).

Image Formats

File suffix	File name	File type	Features
.bmp	Windows bitmap	Uncompressed raster	Represents from 1 to 24 bits per pixel. Normally uncompressed but can use lossless run length encoding (RLE)
.pcx	Windows Paintbrush	Uncompressed/ compressed raster	Used only on Microsoft Windows platforms. Has similar features to .bmp.
.gif	Graphics Interchange Format	Compressed raster	Predominantly used on the Web. Allows 256 indexed colors and simple animations. Alpha channel supported. Uses LZW compression Proprietary to CompuServe

(Continued)

Image Formats #2

.jpg, .jpeg	Joint Photographic Experts Group	Compressed raster	For continuous tone pictures (photographs). Lossy and lossless compression supported. No alpha channel supported. Level of compression can be specified. Commonly used on the Web
.png	Portable Network Graphics	Compressed raster	Allows 1–48 bits of color. Supports alpha channel. Designed to replace proprietary .gif files. File format approved by W3C
.psd	Adobe Photoshop	Uncompressed layered raster	Used for image editing. Supports a variety of color models. Supports varying pixel bit depths Image can be organized into layers. Commonly used processing file format.
.psp	Paint Shop Pro	Uncompressed layered raster	Similar to .psd
.tif, .tiff	Tagged Image File Format	Uncompressed raster, also compressed raster	Used in traditional print graphics. Can be compressed using lossless and lossy methods of compression, including RLE, JPEG, and LZW. TIFF comes in many flavors

Image Formats #3

.fh	Macromedia Freehand	Compressed vector format	Proprietary to Macromedia, used by Flash Players. Supports animation
.cdr	CorelDRAW	Uncompressed vector format	Proprietary to Corel
.swf	Macromedia Shockwave Flash format	Uncompressed vector format	Proprietary format created by Macromedia (now Adobe). Contains vector representations and animations that can be put on the Web.
.dxf	AutoCAD ASCII Drawing Interchange Format	Uncompressed vector format	ASCII text stores vector data. Used for 2D/3D graphical images.
.ps or .eps	Postscript, or Encapsulated Postscript	Uncompressed metafile	Supports text, fonts, vectors, and images.
.ai	Adobe Illustrator	Metafile format	Proprietary format. Similar to .eps.
.pdf (portable document format)	Adobe PDF document	Compressed metafile	Supports text, fonts, and images. Commonly used document format. Supports hyperlinks. Supports authorized access.
.pict	Macintosh Quickdraw	Compressed metafile	Used predominantly on Macintosh platforms. Can use RLE or JPEG compression. Supports grayscale, RGB, CMYK, or indexed color.

DIGITAL VIDEO

- Video, whether analog or digital, is represented by a sequence of discrete images shown in quick succession.
- Each image in the video is called a frame, which is represented as a matrix of pixels defined by a width, height, and pixel depth.
- The pixel depth is represented in a standardized color space such as RGB.
- Two important properties govern video representation: frame rate and scanning format.

Frame Rate

- The rate at which the images are shown is the frame rate.
- Video standards and applications do not necessarily adhere to the same frame rate.
- Film is displayed at 24 frames per second.
- Television standards use 30 frames per second (NTSC) or 25 frames per-second (PAL).

Digital Video in CRT Monitor

- Although digital video can be considered a three-dimensional signal—a 2D image changing over time—analog video is converted to a 1D signal of scan lines.
- Scan line conversion was introduced to make analog television broadcast technology work, and is central to the manner in which televisions (and all other cathode-ray tubes) display images.
- The electron gun(s) in a television project electrons on the phosphor screen from left to right in a scan line manner and from top to bottom successively for each frame. The phosphor screen glows at each location on a scan line creating a color at all positions on the line.
- The color glow fades quickly, but the frame rate ensures that electron gun(s) recolor the scan line before it fades. Scanning formats, which is an outcome of the analog technology, can be represented as interlaced or progressive.

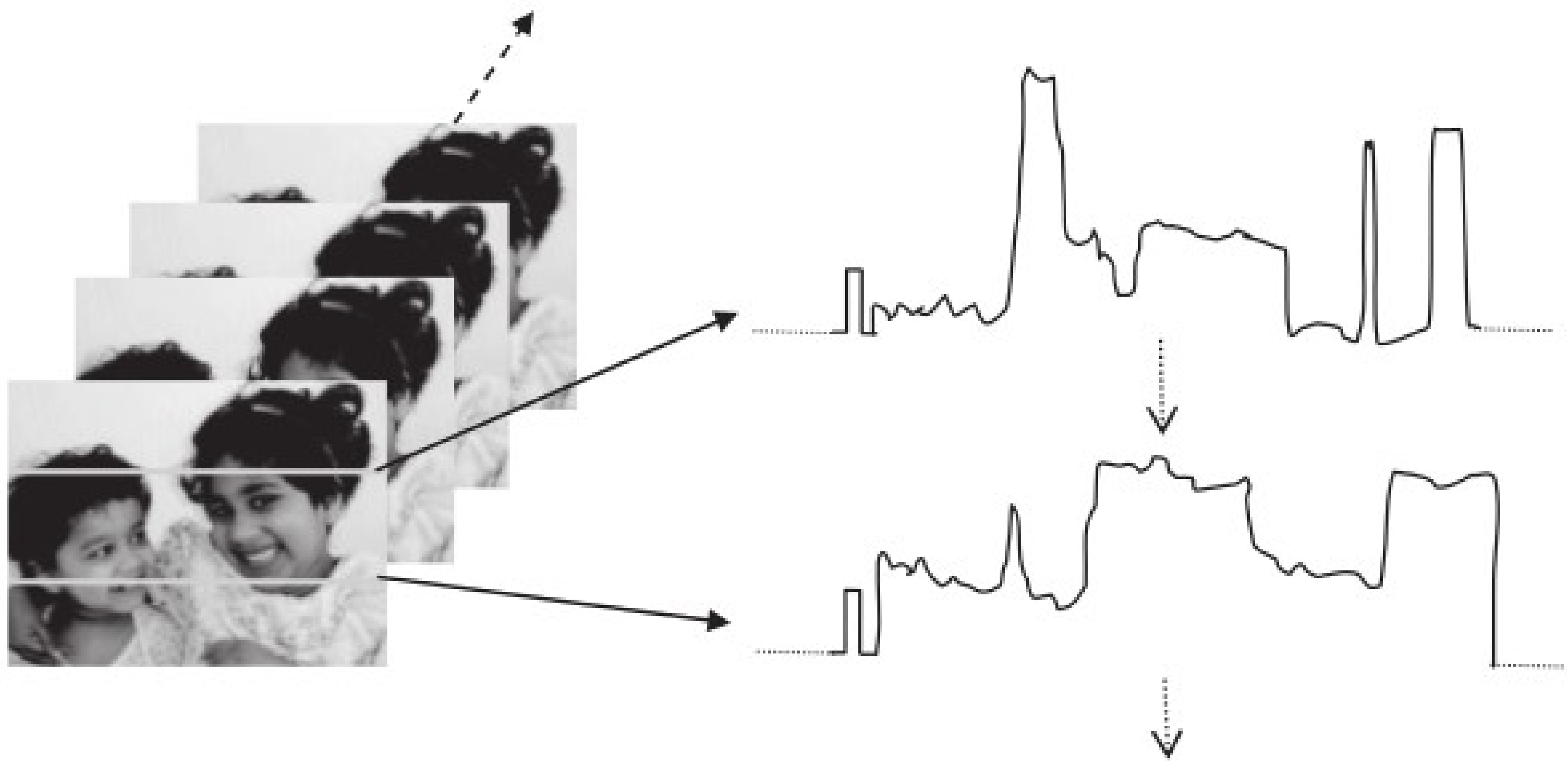


Figure 3-8 Left: Video is represented as a sequence of images. Right: Analog video of one frame scanned as a 1D signal. Each scan line is scanned from left to right as an analog signal separated by horizontal syncs. Two scan lines are shown; each begins with a horizontal sync and traces through the intensity variation on that scan line.

Digital Video in LCD

- Digital video display on these devices, such as LCD or plasma, does not require the scanning mechanism described previously.
- When the technology for digital video started to evolve, the television instruments were still rendering analog signals only.
- The digital video standards have their representations and formats closely tied to analog TV standards—NTSC (developed by the National Television Systems Committee), PAL (Phase Alternating Line), and SECAM (Système Electronique Couleur Avec Mémoire).

Analog Video and Television

- Although digital video is thought of as a three-dimensional signal in space and time, the analog video signal used in broadcast is scanned as a one-dimensional signal in time, where the spatiotemporal information is ordered as a function of time according to a predefined scanning convention.
- This 1D signal captures the time-varying image intensity information only along scanned lines.
- Television requires this analog scanned information to be broadcast from a broadcast station to all users.
- The standardization process implemented in the broadcast of analog video for television mandated a few requirements, which were necessary for making television transmission viable: YUV color space conversion and interlaced scanning.
- These requirements, although not necessary for digital video representation, still need to be supported in the digital world because of the well-entrenched standards for analog television displays.
- Analog displays will gradually transition into digital display devices, but for now, both need to be supported.

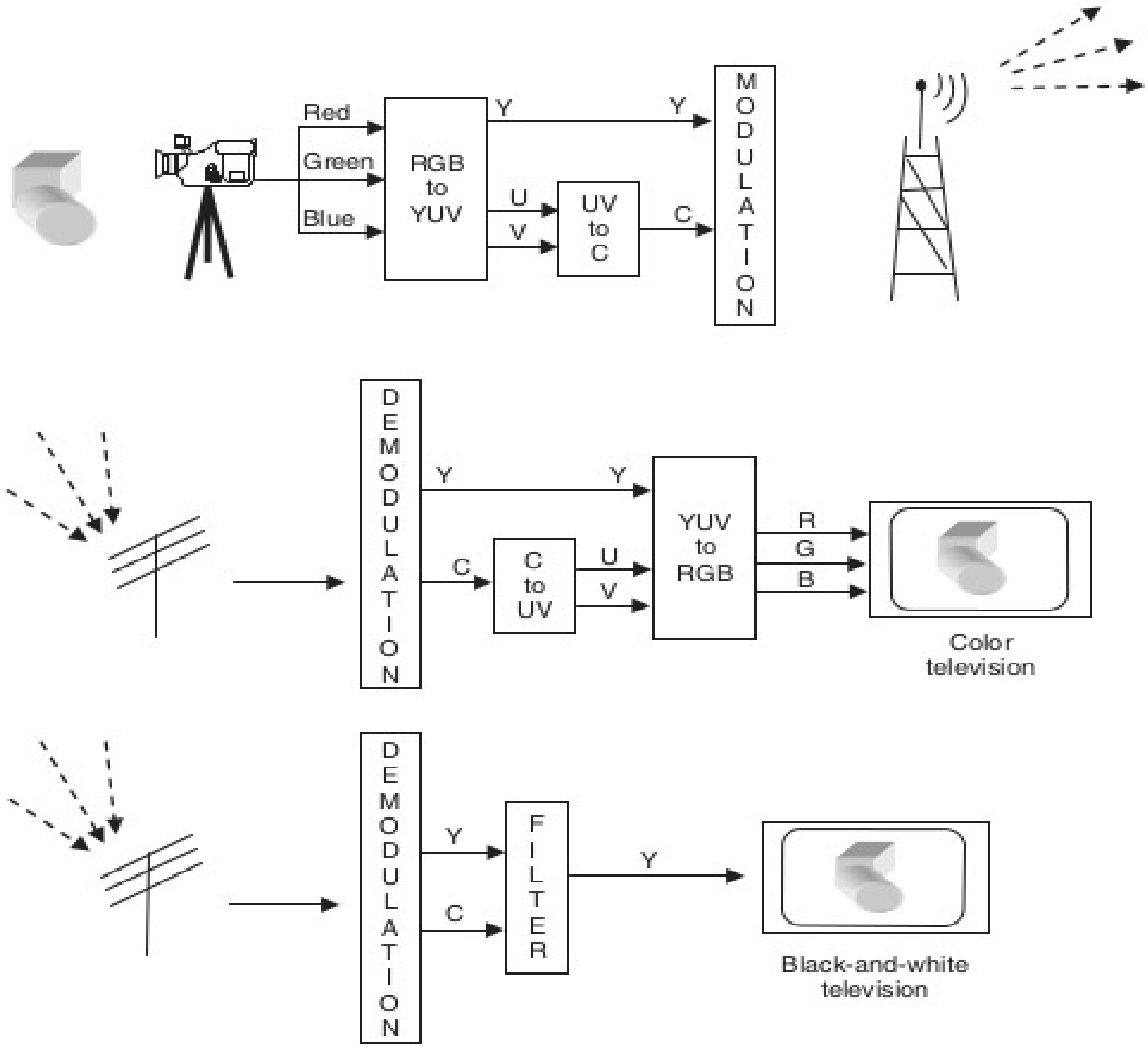


Figure 3-9 Television works by sending scan line information in interlaced YUV format.

Conversion to YU

- Video frames, like images, are represented using a color format, which is normally RGB.
- This RGB color space is used by cathode-ray tube–based display devices, such as the television, to display and render the video signal.
- For transmission purposes, however, the RGB signal is transformed into a YUV signal. The YUV color space aims to decouple the intensity information (Y or luminance) from the color information (UV or chrominance).
- reducing the color resolution does not affect our perception

Analog Video Scanning

- Video is scanned as a 1D signal, as explained in the preceding section, where each raster line is interspaced with horizontal and vertical syncs.
- For synchronization oftransmission purposes, the line-by-line analog raster signal has to be rendered on your television in a corresponding manner, as the data is received.
- This synchronization is carried out by the cycles in the power outlet (60 Hz for NTSC, 50 Hz for PAL).
- Every 1/60th of a second, the electron gun is reset by the vertical sync to draw the beginning of the next frame.

Interlaced

- However, to meet the synchronization needs, each frame is broken down into two fields—an **odd field** and an **even field**.
- The **odd field** consists of the *odd-numbered scan lines* and the **even field** consists of the *even-numbered scan lines.*
- *The electron gun at the back of the TV tube first draws the odd lines of the on-screen image, and then during a second pass, it draws the even-numbered lines.*
- For NTSC signals, this all occurs within 1/30 of a second and each field is drawn at 1/60th of a second. But the resulting video drawn by interlaced scanning techniques might be unacceptable and has occasional flicker and artifacts.
- This is caused because the video is captured at different moments in time as two fields and, hence, interlaced video frames exhibit motion artifacts when both fields are combined and displayed at the same moment.

Interlanced

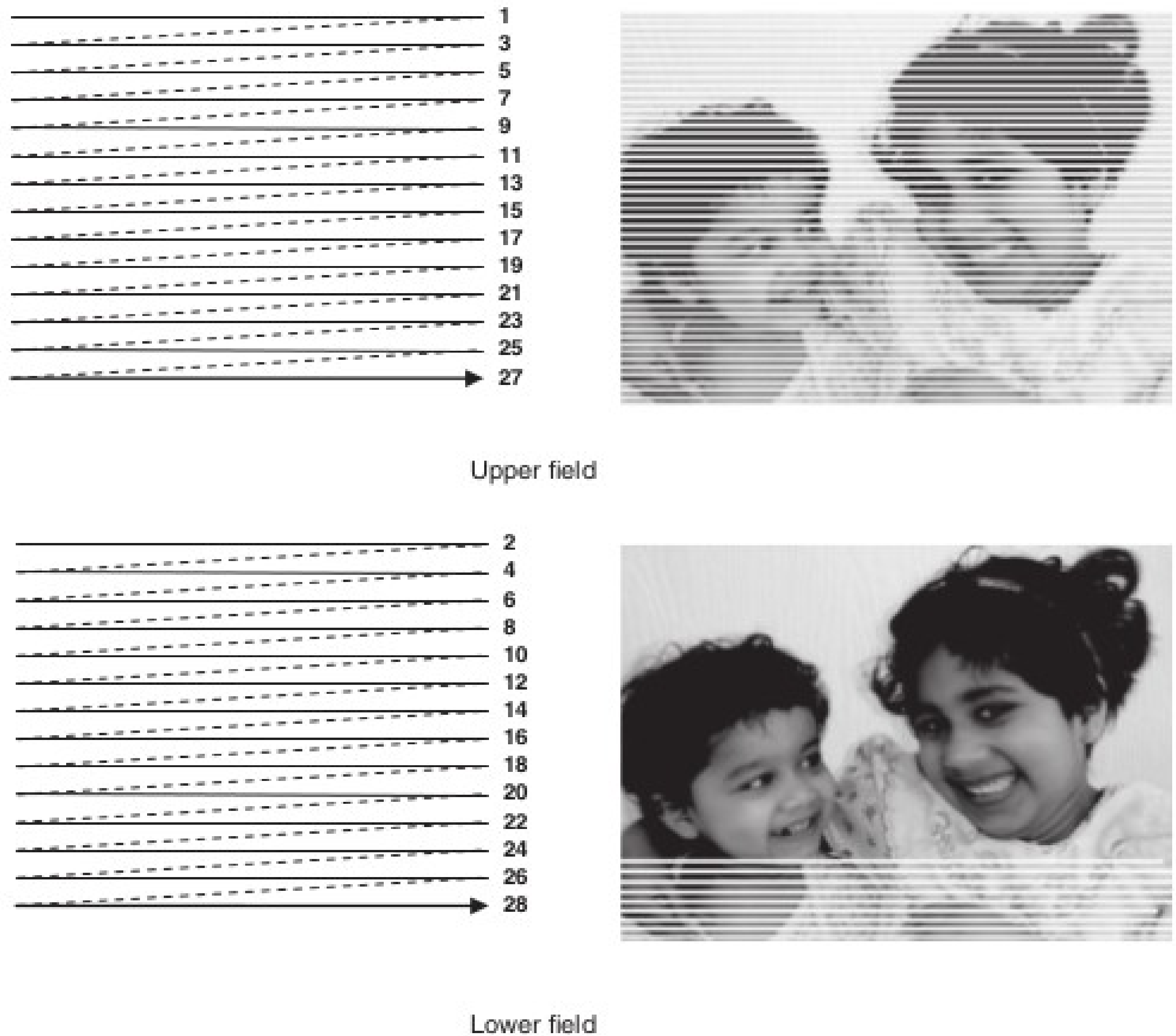


Figure 3-10 Interlaced scanning. The top figure shows the upper "odd" field consisting of odd-numbered lines. The bottom shows a lower "even" field interspersed with the odd field. Both fields are shown in succession to meet the required frame rate.

Progresive

- Video is of better quality when it is captured progressively and drawn progressively, which eliminates the occasional flicker.

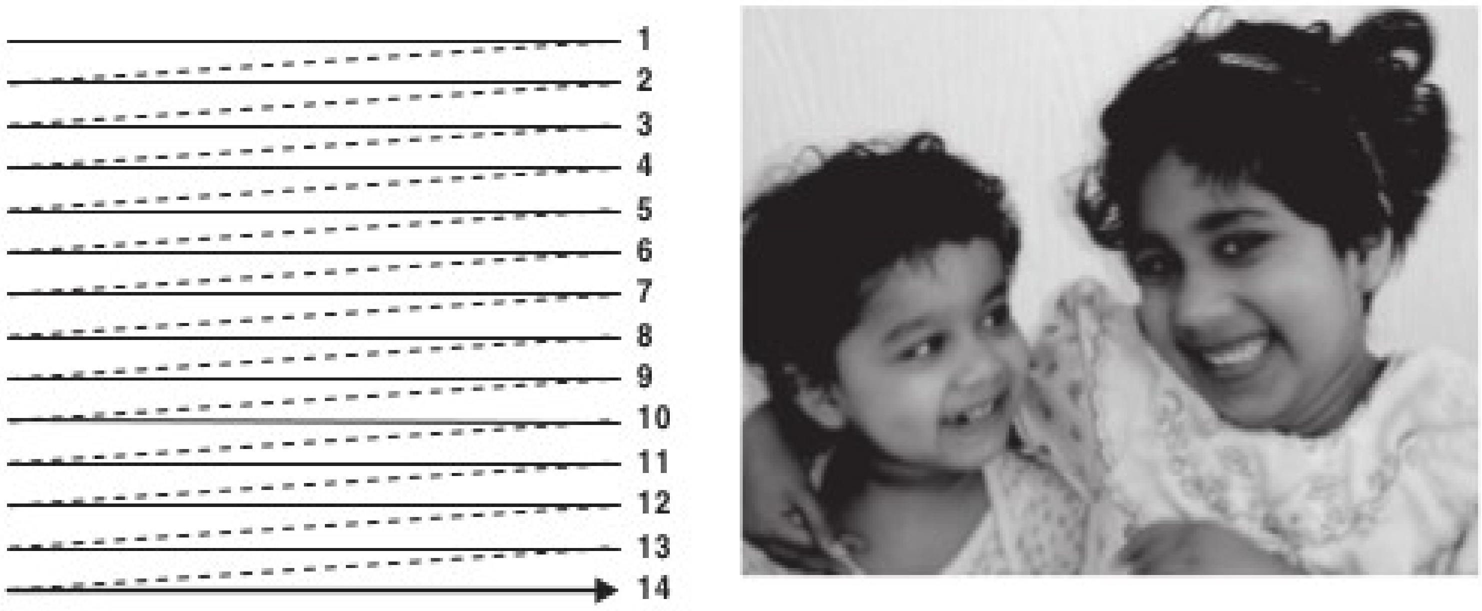


Figure 3-11 Progressive scanning. All the scan lines are drawn in succession, unlike in the interlaced case.

Types of Video Signals

- Video signals have been traditionally transmitted as analog signals for television broadcast.
- Combining all the color and luminance informa tion into one signal called composite video.
- However, with higher digital bandwidths on digital networks, you could transmit them separately—such as S-Video and component video—to get better visual quality.

Composite Video

- Composite video is also called baseband video or RCA video.
- It is the analog waveform that conveys the image data in the conventional NTSC television signal.
- Composite video contains both chrominance (color) and luminance (brightness) information, along with synchronization and blanking pulses, all together in a single signal.
- This was done to reduce bandwidth and achieve real-time transmission.
- However, in composite video, interference between the chrominance and luminance information is inevitable and tends to worsen when the signal is weak.
- This is why fluctuating colors, false colors, and intensity variations are seen when a distant NTSC television station sends signals that are weak and not properly captured at home with old-fashioned “rabbit ears,” or outdoor “aerial” antennae.
- Some DVD players and videocassette recorders (VCRs) accommodate composite video inputs/outputs for the purpose of connecting to standard NTSC televisions, which only accept composite video.

S-Video

- S-Video (Super-Video, sometimes referred to as Y/C Video) is a video signal transmis- sion in which the luminance signal and the chrominance signal are transmitted separately to achieve superior picture clarity.
- The luminance signal (Y) carries brightness information, and the chrominance signal (C) carries color information.
- Here, the chrominance signal (C) is formed by combining the two chrominance signals U and V into one signal along with their respective synchronization data, so at display time, the C signal can be separated into U and V signals.
- This is unlike the traditional composite video where all three channels are combined together into one signal.
- Separating the Y and C channels and sending them separately reduces problems caused by interference between the luminance and chrominance signals and yields a superior visual quality.
- Although the bandwidth required for analog broadcast of S-Video is not available yet, these signals are typically produced by some DVD players and computer monitors.

Digital Video Formats

- The analog TV formats such as NTSC, PAL, and SECAM have been around for a long time and have also made their way into VHS technology.
- The digital video formats have been established for digital video applications.
- The CCIR (Consultative Committee for International Radio) body has established the ITU-R_601 standard that has been adopted by the popular DV video applications.
- For example, the CIF format (Common Interchange Format) was established for a progressive digital broadcast television.
- It consists of VHS quality resolutions whose width and height are divisible by 8—a requirement for digital encoding algorithms. The Quarter Common Interchange Format (QCIF) was established for digital videoconferencing over ISDN lines.

Digital Video Formats

Property	NTSC	PAL	SECAM
Frame rate	30	25	25
Number of scan lines	525	625	625
Number of active lines	480	576	576
Aspect ratio	4:3	4:3	4:3
Color model	YIQ	YUV	YDbDr
Primary area of usage	North America (USA and Canada), Japan	Asia	France and Russia

Figure 3-13 Table illustrating analog video formats and their details

High-Definition Television

- High-definition television (HDTV) has been getting media attention for several years now.
- This section attempts to explain what HDTV is all about and how it differs from the other television standards.
- The usual NTSC analog TV signal in the United States has 525 scan lines, with 480 actually visible.
- The usual TV has an effective picture resolution of about 210,000 pixels. This level of resolution was amazing 50 years ago, but today, consumers are accustomed to better resolutions such as 1024 x 768 and even higher, which are now commonly supported by most graphics hardware that come with computers.
- The standard definition TV technology seems pale when compared with these resolutions. Digital television (DTV) uses the CCIR standards shown in Figure 3-14 for broadcast transmission over the air or via a cable/satellite system.

Format name	Lines per frame	Pixels per line	Frames per second	Support for interlaced format	Subsampling scheme	Image aspect ratio
CIF	288	352		N	4:2:0	4:3
QCIF	144	176		N	4:2:0	4:3
SQCIF	96	128		N	4:2:0	4:3
4CIF	576	704		N	4:2:0	4:3
SIF-525	240	352	30	N	4:2:0	4:3
SIF-625	288	352	25	N	4:2:0	4:3
CCIR 601 NTSC (DV, DVB, DTV)	480	720	29.97	Y	4:2:2	4:3
CCIR 601 PAL/SECAM	576	720	25	Y	4:2:0	4:3
EDTV (576p)	480/576	720	29.97	N	4:2:0	4:3/16:9
HDTV (720p)	720	1280	59.94	N	4:2:0	16:9
HDTV (1080i)	1080	1920	29.97	Y	4:2:0	16:9
HDTV (1080p)	1080	1920	29.97	N	4:2:0	16:9
Digital cinema (2K)	1080	2048	24	N	4:4:4	47:20
Digital cinema (4K)	2160	4096	24	N	4:4:4	47:20

Figure 3-14 Table illustrating digital video formats and their details

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