CHAPTER
8. Video

COM 205
MULTIMEDIA APPLICATIONS

CHAPTER HIGHLIGHTS

- Moving Pictures
- Analog video
  - Formats
  - Standards
- Digital video
  - Quality factors:
    - Screen resolution
    - Frame rate
  - Compression strategies
  - File formats

- Digital video sources
  - Convert analog source
  - Create original video.
    - Shooting
    - Editing
    - Rendering
- Digital video camera considerations
- Guidelines for video in multimedia

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VIDEO COLOR SIGNALS

- Composite color signal.
  - Combines two signals:
    - Luminance or amount of brightness in the image.
    - Chrominance or color hue in the image.
  - Inexpensive to create and transmit.
- Component color signal.
  - Colors are represented separately.
    - Red, Green, Blue light signals combine to create color range.
  - Better color quality.

> Video captured in component color.
> NTSC standard = composite color.
> Computer monitors = component color.

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VIDEO IMAGE

- Video image is created by an electron gun in the CRT.

- The electronic signal illuminates lines of phosphorus dots on the screen.

- Methods to illuminate or scan the image:
  - Interlaced scan alternates the scanning between odd numbered lines in the frame and even numbered lines in the frame (NTSC).
  - Progressive scan scans each line of the image sequentially (computer monitor).

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ANALOG TAPE STANDARDS

- Tape provides another mode for creating and distributing analog video.

- VCR tape formats:
  - VHS: low resolution(240 lines), hi-fi audio, composite color.
  - S-VHS: better resolution(400 lines), hi-fi audio, Y/C color.
  - 8mm: smaller tape, low resolution(230 lines), near-CD quality sound.
  - Hi8: increased resolution(400 lines), Y/C color.

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DIGITAL TO ANALOG VIDEO

- Video frequently is created in digital format and converted to analog broadcast format.

- Considerations in this conversion include:
  - Aspect ratio
    - Both analog TV and many computers use 4:3 ratio.
  - Raster scan.
    - TV uses interlaced scanning.
    - Computers use progressive scanning.

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DIGITAL TO ANALOG VIDEO

- Other considerations for conversion.

  - Display Area

    - TV does not display full image it receives.

    - Computers do display full image.

  - Color gamut

    - NTSC has smaller range of colors.

    - Computer RGB color is richer.

      - Computer colors that cannot be displayed on NTSC are "illegal colors."

- Digital TV resolves the differences.

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DIGITAL TELEVISION

- DTV standard for U.S. (2009)

  - Video is created and delivered as digital.

    - Result: higher screen resolutions, richer colors, better video.

- DTV features include:

  - New aspect ratio for television screen (16:9).

  - Screen resolution choices:

    - SDTV - 704 X 480 pixels (480i or 480p)

    - HDTV - 1280 X 720 pixels (720p) OR 1920 X 1080 pixels (1080i or 1080p).

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DIGITAL VIDEO

MOVING PICTURES IN DIGITAL FORMAT.

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DIGITAL VIDEO CHALLENGES

- Large file sizes
  - Every second of uncompressed digital video requires 30MB of storage.

- Hardware performance
  - Computer processors, memory and bus size must deliver digital video to the screen at full motion frame rates.

- Distribution methods

  Digital video made possible by:
  • Compression algorithms
  • Fast computer hardware
  • DVD storage
  • Gigabit bandwidth.

  - DVD players.
  - High speed network bandwidth.

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DIGITAL VIDEO QUALITY

- Three factors contribute to quality.
  - Screen resolution
    - Number of horizontal and vertical pixels used to present the video image.
  - Frame rate
    - Number of individual video frames displayed per second.
  - Compression method
    - Algorithm used to compress and decompress the video.
- Developers can adjust these factors to optimize delivery of digital video

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SCREEN RESOLUTION

- Screen resolution (or output resolution) impacts processing, storage, and transmission requirements.
- High quality digital video (DV) format is 720 X 480 (or 350,000 pixels at rates of 30fps).
  - CD-Rom and Internet are too slow to deliver that much data.
  - Solution: reduce the display size, which reduces the number of pixels/second to output.

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FRAME RATE

- Standard frame rate for NTSC video is 29.97 frames per second (fps).

- Reducing the frame rate reduces the data to be transferred.

  – Video on Internet is often delivered at 15fps.

- Cautions:

  – Lowering frame rate will slow delivery of individual images and drop out frames of video.

  – Result could be "jerky" motion.

  > 15 fps is a threshold for smooth motion video.

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COMPRESS THE VIDEO

- Compression is key to successful delivery of digital video.

- Three strategies for compressing video:

  – Intra-frame: re-encodes within the frame.

  – Inter-frame: eliminates intervening frames saving only changes between the frames.

  – Variable bit rate (VBR)

    - CBR (constant bit rate) assigns same number of bits per second to all parts of the video.

    - VBR assigns more bits to complex scenes and fewer bits to simpler scenes.
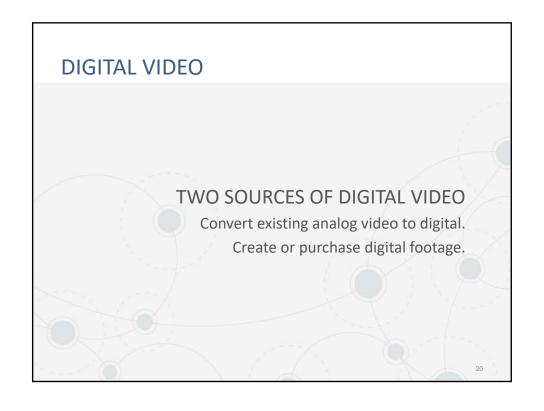
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COMPRESS THE VIDEO

- Choosing compression depends on:
  - Output destination
    - DVD
    - Internet
  - Editing capability
    - Detailed editing tasks
    - Limited editing tasks
  - Type of images in video
    - Complex scenes
    - Similar scenes

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COMMON VIDEO CODECS

- MPEG
  - MPEG-1(short videos on Video CD—optical disc format).
  - MPEG-2 (transmission of video for television).
  - MPEG-4 (video over the web).
- M-JPEG (less-compressed higher quality files without inter-frame loss)
- RealVideo (proprietary codec for streaming video on web)
- DV (uses M-JPEG, suitable for authoring or archiving)

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DIGITAL FILE FORMATS

- Developers use these formats to render the final project in a form suitable for delivery:
  - D1
  - D2 and D3
  - DV
  - CD Video
  - DVD video
  - Quicktime
  - Video for Windows
  - Real Video.

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DIGITAL VIDEO

TWO SOURCES OF DIGITAL VIDEO

Convert existing analog video to digital.

Create or purchase digital footage.

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MAKING DIGITAL FROM ANALOG

- Sampling from existing analog sources.
  - VCR
  - Laserdisc
- Requires digitizing boards on computers.
  - Sample the electrical currents produced by playing the analog image and sound source.
  - Store the resulting voltage levels as digital values.
- Video cameras can "record" directly from an analog source to make a digital video.

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FACTORS THAT AFFECT SAMPLED VIDEO QUALITY

- Format of analog source.
  - S-VHS and Hi8 produce better digital video.
- Connector from the analog playback device to the digitizing device.
  - Composite RCA jacks mix the Y/C signal into a composite signal.
  - S-Video cable transmits luminance and chrominance data through separate wires for better quality capture.

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ORIGINAL DIGITAL VIDEO

- Three main steps in creating original digital video:
  - Shooting
  - Editing
  - Rendering.

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STEP ONE: SHOOTING

- Requires planning for:
  - Intended uses of video
  - List of shots required
  - Weather and lighting conditions
  - Availability of personnel
  - How the video will be integrated in the project

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STEP ONE: SHOOTING

- Shooting to record.
  - Captures ultimate form of video as shooting is done.
  - Used to capture event and share immediately with others.
- Shooting to edit.
  - Captures source video with editing in mind.
  - Acquire a variety of video clips that will later be trimmed, re-ordered, and blended into a single message.

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DIGITAL VIDEO CAMERA CONSIDERATIONS

- CCD (Charge-Coupled Device).
  - Generates levels of electrical voltage based on variations in light intensity striking the surface.
  - Converts voltages into digital values to store data about each pixel in the image.
  - Size varies from 1/16 to 1/2 inch.
    - Larger CCDs are more expensive.

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DIGITAL VIDEO CAMERA CONSIDERATIONS

- Number of CCDs

  - One CCD: Light is filtered and level of each filtered color is recorded.

  - Three CCDs: Light is split into three channels and each CCD records separate levels of RGB.

    - Produce clearer, more accurate color.

- Resolution of CCD

  - Higher resolution delivers more accurate images.

  - Motion capture 720 X 480 is desired for DV.

  Camera selection should always be based on resolution of CCD, not digital enlargement ratings.

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DIGITAL VIDEO CAMERA CONSIDERATIONS

- Lens

  - Look for high quality lens from better vendors.

  - Ignore software zoom capabilities.

- Light sensitivity

  - Lower lux ratings indicate the camera can operate in lower light conditions.

  - DV camcorders vary from 2 to 8 lux.

  - Supplemental lighting may be needed for dimly lit conditions.

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DIGITAL VIDEO CAMERA CONSIDERATIONS

- Microphones: placement, type, and quality.

  - Omni-directional: optimized for broad range of background sound.

  - Unidirectional: record from narrowly defined location.

  - Placement on handle toward front of camera is preferred to avoid sound from camera itself.

  - Headphones give direct feedback of microphone effectiveness.

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DIGITAL VIDEO CAMERA CONSIDERATIONS

- File format

  - Source video footage should be captured at highest resolution possible and not be highly compressed.

  - DV format:

    - Limits compression to 5:1

    - Has relatively high resolution

    - Uses M-JPEG compression.

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SHOOTING BASICS

- Framing a Shot

  - Rule of thirds—widely embraced guideline for framing a video shot.

    - Preserves its interest.

    - Meaningfully relates it to action taking place.

    - Helps ensure adequate side and headroom.

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SHOOTING BASICS

- Minimize camera motion.

  - Use tripod or steady surface to support camera.

  - Keep the camera still at all times.

- Camera controls for generating motion:

  - Pan—moving side to side.

  - Zoom—enlarge camera lens.

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SHOOTING BASICS

- Take care of time code.
  - Format of hours, minutes, seconds, frames.
  - Time code becomes the frame address.
  - Editing software uses time code for splits, trims, transitions.
  - Camera records the code but
    - Code can be lost if user shifts to VCR mode to view video and advances to new location to continue shooting.
    - Look for camera's "End Search" control to restart code.

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SHOOTING BASICS

- Get the right shots.
  - Source video needs to cover all the important elements of the subject.
  - Videographer can use a variety of shots to tell the story.

- Close up shot (CU)
- Medium shot (MS)
- Wide shot (WS)
- Establishing shot
- Cutaway
- Point of view shot
- Reverse angle shot
- Over-the-shoulder shot

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STEP TWO: EDITING

- Editing software options:
  - Consumer packages.
  - Prosumer applications.
  - Specialized video and film production.
- Features include:
  - Capture video from external source.
  - Arrange separate video clips.
  - Split and trim clips.
  - Add transitions and special effects.

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EDITING OPERATIONS

- Splitting: dividing clip into multiple parts.

- Trimming: removing unwanted frames from clips.

- Transitions: effects to move into or out of a clip. These include:
  - Cut
  - Fades
  - Dissolve
  - Wipe.

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STEP THREE: RENDERING

- Process of applying the editing operations specified by the master video to produce a new, independent video file.
  - Can be processor intensive and time consuming process.
  - Output options are based on video's intended use. These include:
    - Video compression method
    - Resolution or screen size
    - Frame rate and video data rate
    - Audio data rate and audio format

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RENDERING DECISIONS

- Choice of a codec.
  - All video must be compressed.
  - Choice will determine quality of resulting video.
    - Variable bit rate encoding better than constant bit rate.
- Choice of screen resolution.
  - Vary depending on mode of delivery:
    - DVDs = 720X480
    - CD media = 320X240
    - Web = 240X180

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RENDERING DECISIONS

- Choice of frame rate.
  - Impacts size of video file.
  - Web video must be significantly reduced for a wide viewing audience.
- Choice of video data rate.
  - Low quality streaming web video = 20 - 30Kbps.
  - DVD high quality video = 9Mbps.
  - Typically set in the codec software preferences.

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RENDERING DECISIONS

- Choice of audio compression and data rate.
  - If file size is not critical, use PCM format.
  - Also widely used are MP3 and Dolby Digital AC-3 formats.
- Choice of computer hardware.
  - Video complexity could make render time over 1 hour per minute of video.
  - CPU speed, amount of RAM, size of hard drive can save you time.
    - Multi-core processors and distributed processing can also reduce the time for rendering.

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GUIDELINES FOR VIDEO

- Shooting

  - Choose camera carefully.
  - Steady the camera.
  - White balance prior to shooting.
  - Avoid shooting into light and backlit scenes.
  - Limit pans and zooms.
  - Frame the subject.
  - Make inventory of required shots.

  - Use highest resolution available.
  - Add external microphones.
  - Use headphones to monitor sound quality.
  - Record background sound for use in editing.
  - Don't break the time code.

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GUIDELINES FOR VIDEO

- Editing

  – Protect source video.

  – Save a copy of the master video prior to rendering.

- Rendering

  – Match codec, resolution, frame rate, and data rate to intended use and delivery medium.

  – Use variable bit rate encoding when available.

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