

Characteristics of Multimedia Systems

Types of Multimedia

Multimedia	Combination of static and dynamic media
Static Media	Media that do not have time dimension
Dynamic Media	Media that have time dimension

Static Media

- No time dimension - Contents do not change over time
- Images
 - Include: Drawings, Paintings, Photographs etc.
 - Composed of pixels
- Alphanumeric Data
 - Any character (text, white space character, control characters)
 - Information presented clear, logical manner
- Hypertext
 - System for cross linking documents / files
 - Using links

Animation	Images presented in succession at rate pf 25-30 fps
Video	Photography of a continous event - broken up into discrete frames

Dynamic Media

- Audio
 - Played constantly rate (compatible with human speech rate)
 - If played faster or slower with compatible; - distorted
- Video
 - Combines sounds and pictures
 - Continuous events - breaks into frames
 - Must be played constant rate (compatible with human visual frame rate)
 - NTSC - 30fps (525 lines) - American
 - PAL - 25fps (625 lines) - European & Australian
 - MPEG - must be formatted for either.
- Animation
 - Starts: discrete images, presents in rapid progression - impression of movement
 - Each frame called cel

Print Media: Static Media

- Output to hard copy
- Printing to Books, magazines etc.
- Difficult / long time to update

Multimedia: Dynamic Media

Print Media	Hard copy, books, magazines, newspapers etc.
DVD	Digital Video Disk. Capable MPEG-2

- CD ROM or DVD
 - Distributed cheaply
 - Update over internet (Virus scan programs)
 - DVD: single or double sided, each side 1-2 layers
 - CD/DVD offer user interactivity (games, editing programs)
- Internet
 - Content centralised in one virtual location
 - Resources may reside more one location - accessor see's website as single place
 - Offers track request from customers / producers

Differences Between Print Media & Multimedia

- Path followed by use different for each
- Print Media:
 - Print - Static - updates require replacement of whole copy
 - Inform / Entertain through hardcopy
- Multimedia
 - Displayed using screen / projector
 - Stored / backup on digital device
 - Multiple uses simultaneously
 - Interactivity - hypertext / hypermedia
 - Requires hardware and software

Multimedia Hardware Requirements

Primary Storage	Storage are on a memory chip or CPU that the CPU can access
Secondary Storage	Storage external to direct access by the CPU
Caching	Storing of particular data in primary locations, accessible by CPU

Primary Storage

- Random Access Memory (RAM)
 - Read / Write memory
 - Temporary / Volatile Memory
- Read Only Memory (ROM)
 - Fixed in instructions set physical structure
 - Instructions live when power is on
- Cache Memory
 - Halfway between CPU & RAM
 - Caching speeds up access frequent commands
 - Instructions fetched from cache
 - Slower than RAM
 - When Cache & RAM are low - pc caches excess storage requirements onto disk - Disk Swapping
 - Disk Swapping
 - Creates swap file
 - Paging
 - Process of writing excess data
 - As process above required continuously - written to hard drive
 - Whole process slowed by required read / write executions

Secondary Storage

- Floppy Disk
 - Since 70's
 - Store up to 1.44mb
 - Becoming Obsolete
- Hard Disk Drive
 - Increase in capacity
 - Sufficient of multimedia requirements
 - Currently measure in GB
- Tape Drive
 - Alternative to Disk drives
 - Sequential recording / retrieval
 - Large capacity
 - Low Costs
- CD / DVD
- Memory Stick
 - Capacity Limited
 - Capacity also increasing
 - Small form factor

- CD - Compact Disk
- DVD - Digital Video Disk

Calculating Storage Requirements

Bit-Depth	Number of possible colors or shades per pixel, represented by bits per pixel
Resolution	The number of pixels per screen
Sample Rate	Rate at which samples of an event are taken
Sample Size	The size in bits of each sample taken

Still Image Storage

- Variables that determine image file size:

Bit depth (colour depth)	No. bits per pixel
Total File Size	Resolution x bit depth
Resolution	Horizontal pixels x vertical pixel

Audio File Storage

- Audio File Size
 - Time dimension or length of sound piece
 - Number bits per sample or size of the sample
 - Sampling Rate or frequency of sampling

Sampling

- Analog data converted to digital data - sampling
- Process:
 - Take sample time slices of the analog signal
 - Digital quality dependent upon bit size of each slice sample and sampling rate
 - Large sample size greater sampling rate - better digitally converted signal
- Sampling Size:
 - 2^x = sampling rate
 - X in bits
 - E.g.. 8 bits ($2^8 = 256$ colours)
 - E.g.. 16 bits ($2^{16} = 65536$)

- Sampling Rate
 - Sampling occurred rate of one sample slice oer second - three color changes recorded
 - 100 samples per second - 300 color changes would be recorded
 - Quality of conversation to digital data improved determined by sampling rate of conversation proses.

Table 7.1.4 Conversion to digital files: File size determination
Duration of music event: 10 seconds

Sampling size	Sampling rate 1KHz = 1000 samples/second	File size calculation	Total file size
1 byte	1 KHz	$10 * 1000 * 1$	$10\ 000 / 1024 = 10\ Kb$
1 byte	50 KHz	$10 * 50\ 000 * 1$	$500\ 000 / 1024 = 488\ Kb$
2 bytes	1 KHz	$10 * 1000 * 2$	$20\ 000 / 1024 = 195\ Kb$
2 bytes	50 KHz	$10 * 50\ 000 * 2$	$1\ 000\ 000 / 1024 = 977\ Kb$
4 bytes	1 KHz	$10 * 1000 * 4$	$40\ 000 / 1024 = 390\ Kb$
4 bytes	50 KHz	$10 * 50\ 000 * 4$	$4\ 000\ 000 / 1024 = 1954\ Kb$ $= 1954 / 1024$ $= 1.9\ Mb$

Video Data

- Larger than Audio files
- Analogue Video to Digital Video undergo same sampling process as digital audio
- Video at certain speed - human compatibility - smoothness
- National Televisions Standards Committee (NTSC) - America and Japan
- Phase Alternative Line (PAL) - Australia & European Country
- Sequential Couleur a Memoire (SECAM) - France & Greece

Video Frame Rates

Frame	Single image in video or animation sequence. Consists two interlaced patterns
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- Half image on screen every half second.
- Every other time, other half of image is displayed
- PAL & SECAM
 - 625 lines
 - 50 images halves per second
 - 25 fps
- NTSC
 - 525 lines
 - 60 image halves per second
 - 30 fps

<p>Total number of frames = frame rate x running time $= 25 \times (60\ min. \times 60)$ $= 25 \times 3600$ $= 90\ 000\ frames$</p> <p>File size for each frame = horizontal \times vertical \times bit depth $= 1024 \times 768 \times 32$ $= 25\ 165\ 824\ bits$ $= \frac{2\ 516\ 852}{8 \times 1024 \times 1024} = 3Mb$</p> <p>Total movie file size = total number of frames \times individual frame file size $= 90\ 000 \times 3\ Mb = 270\ 000\ Mb$ $= 263.67\ Gb$</p>

- Video / Motion Picture fill speed
 - 24 fps

- Factors to Determine size of video file
 - Frame Rate
 - Running Time in Seconds
 - Horizontal Size of each frame in pixels
 - Vertical size of each frame in pixels
 - Bit depth of each frame

- E.g.. Movie
 - 60 minutes
 - 25 fps
 - 1024 x 768 pixels
 - 32 bits per pixel

Animation Processing

Cel-Based Animation	Animation techniques where each individual frame is stored separately into a memory page
Path-Based Animation	Animation technique in which the only part of the frame that changes is the moving object
Tweening	Generation of in-between scenes by animation software

- Process of displaying series of drawn images in quick succession - effect of movement
- Each drawing is a frame
- Possible at 30 fps
- Computer Animation methods
 - Cel-Based
 - Path-Based

Cel-Based Animation

- Involves drawing and displaying individual frames
- Storing each frame separately into - memory pages
- Each sequential frame slightly different from each previous page
- All frames 30 fps
- Using animation software
- High processing power and memory required

Path-Based Animation

- Preferred over cel based (resource equipment's can be lower)
- Large part of frame remains static
- Only changing part - moving object
- Background may not change
- Original object relocated to another part of frame
- Intermediate Parts between two scenes of moving object generated with software.
- Process called Tweening
- Morphing - image undergoes process of metamorphosis & changes slowly from one image to completely different one
- Warping - image may be stretched and resized

Fields of Expertise Required In the Development of Multimedia Applications

- People Involved in delivering multimedia System
 - Content Providers - provide footage, tracks etc.
 - System Designers - plan & Design System
 - Project Manager - Responsibility, ensuring product delivered to client on time
 - Technical Staff - graphic artist, sound engineers, layout personnel, camera operators, AV editors
 - Technical Support - Skilled in hardware / software
 - Design & Layout - Those who do graphic design for the presentation

Examples Of Multimedia System

Virtual Reality

Virtual Reality	Artificial Sense Impressions, provided by programs that also exclude real;-life perceptions
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- Use of Computers to model and stimulate artificial environment - users immerse them selves in virtual reality
- User may wear Goggles / Head Video display / Body suits
- Sensors on person detect directional movement - simulate in virtual movement
- Use in games:
 - Skiing
 - Flying jets
 - Etc.
- Use in simulations
 - Flight
 - Medical procedures
 - Military training

Education & Training

- Visual displays (subtitles) help children with hearing disabilities etc.
- Capacity to be tailored to individual needs
- Individuals work at own speed and convenience
- Training programs via internet
- Training modules via CD

Leisure & Entertainment

- Greater processing power = Greater range possibilities presented to user
- Graphics more realistic
- Provide people wit =disabilities or limitations, i.e. mobility and or height

Information

- Provide users with information in different media
- Use of touch sensitive screens or actual device to view video, animation, maps etc. Listen to directions
- Used to provide quantities and qualitative data in public areas i.e. Museum, Shops etc.

Developments in Multimedia

World Wide Web

- Use in daily life
- Use in personal financial transactions
- Schools, Universities- Internet Access
- Government Set up Broadband Networks

Compression Technologies

- All multimedia files subject to compression techniques
- Barley noticeable drop in quality
- Common Compression formats:
 - JPEG
 - MPEG

CD & DVD Drives

DVD Drives	Optical Disk drives that read/Burn DVD's
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- DVD's offer greater storage capacity from 4GB - 50GB

Fire wire IEEE - 1394a & IEEE-1394b, USB1, USB2, & USB 3

1394a	Data Transfer of 400Mb/s
1394b	Data Transfer of 800Mb/s
USB 1	Data Transfer of 12Mb/s
USB 2	Data Transfer of 480Mb/s
USB 3	Data Transfer of 680Mb/s

Displaying In Multimedia Systems

Displaying Hardware

Cathode Ray Tube (CRT)

CRT	Uses RGB electron guns to beam electrons onto phosphor-coated screen
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- Consists three electron gun
- Electrons fired at a screen coated in phosphor dots
- To create an image, group of many dots once at once
- Exciting a targeted group of dots and creating an image
- Color images created by each of three electron guns firing primary color.

- Fire beam left to right, top to bottom
- This ^ Constantly repeated - phosphor glows for short time - technique (Raster Scan)
- Interlaced Monitors -
 - use raster scan technique only for every second line
 - Refresh rate not high enough - monitor likely to flicker
- Not Interlaced Monitors -
 - refresh the monitor screens by scanning every line.
 - Screen changing - only changed data transmitted

Liquid Crystal Display

LCD	Screen uses transistors and complex chemical solution to display each pixel
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- Thin, Flat
- Liquid crystal layer is a crystal layer between two polarized glass sheets. Called Substrates
- Current applied to points - light passed through liquid crystal.
- Advances in LCD technology use of different variations of LCD
- Use less Power
- Smaller amounts of electrical radiation

- Problem
 - Size corresponds to number of pixels and transistors in manufacturer able to place the unit
 - Increase in size, increase change of bad resistor
 - 3 Transistors required for each sub pixel (RGB)
- Intensity of pixel controlled by voltage
- Sub pixel produce - 256 shades
- 16.8 Million
- 40% large LCD rejected during quality control

Gas Plasma Displays

Plasma Screen	Screen in which charged electrodes interact with pockets of inert gas to produce images
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- Creates Red, Green, Blue lights in every pixel - reducing need for space
- Charged electrodes sandwiched between two glass panels
- React with tiny pockets of inert Gas
- Gas changes to plasma, production of UV light - reacts with RGB phosphor in each pixel
- No electron beam
- No backlight
- Brighter, Sharper - edge to edge

- Not affected by Magnetic fields
- Free from magnetic interference
- Display unit located close to loudspeaker without disturbance by magnetic forces
- Generate heat
- Lifespan 30,000 Hours

Touch Screens

- Sensing where user touched screen - act as mouse command
- Attached front of notebook, desktop, plasma
- Electronic whiteboards similarly

Projection Devices

- Data Projection Panel
 - Slim line LCD panel fits above standard overhead projector - plugged onto computer
 - Displayed onto light reflective surface for audience

- Data Projector
 - Takes output display from computer projects onto reflective surface
 - Require sources greater than 1000 lumens

- Audio Speakers
 - Require sound card from computer
 - Quality depends on sound file
 - Digital sound - fiber optic cable

Displaying Software

Specialist Multimedia Application Software

- Designed to connect best with broadband communication links
- Dealing with combination of static & Dynamic media in authoring, processing & Displaying capacities

- Authoring Software
 - Allows users to create static & dynamic media
 - Record final product on CD/DVD, HDD, etc.
- Presentation Software
 - Allows users to make automated presentations
- Digital Video editing Packages
 - Create transitions
 - Titles
 - Sounds
- Web Browsers & Editors
 - Assist in creating / editing multimedia for WWW
 - Locating and viewing material on web

Other Information Processes In Multimedia Systems

Compression Methods

- Compression achieved by use of a codec.
- Compression reduces number of bytes consumed by large files and programs
- Viewing - must be decompressed

Compression Methods

- Lossless Compression

Lossless Compression	Algorithms that minimise redundant data and permit no reduction in some of the file data
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- Use - compression computer programs and documents, where no loss allowed i.e.. financial documents
- Only exploit data redundancies
- E.g.. GIF achieves compression ratio 2:1 - compressions: replaces repeating patterns with symbols

- Lossy Compression

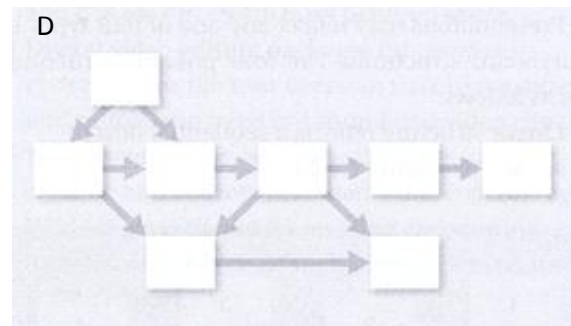
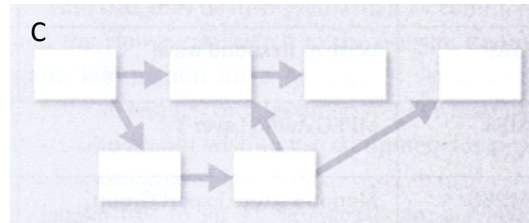
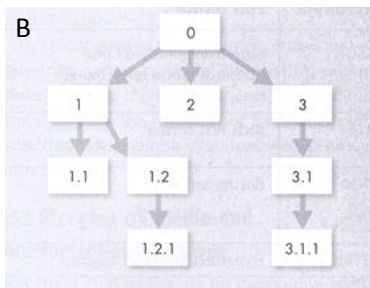
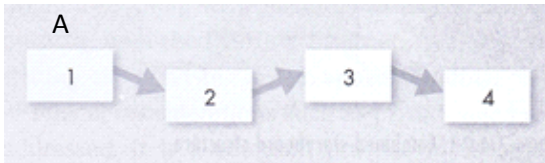
Lossy Compression	Algorithms that minimise redundant data and allow a reduting on some of the file data
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- Produce high compression ratios
- Use bot data redundancies and human perception
- Data lost in compression - might not be noticeable
- Use images on web - fast retrieval
- Quality not near original - still be conveyed to person who has retrieved it
- Unlikely to notice -reeve sound wavelengths out of spectrum
- EG.
 - JPEG (100:1)
 - MPEG 1,2
 - M-3 (11:1)

Organisation of Multimedia Presentations

Compression Methods

- Storyboards
 - Scene by scene illustration
 - Four types of structures
 - A. Linear** - Sequential flow
 - B. Hierarchical** - User chose from multiple options Top down Design
 - C. Nonlinear** - User allows freedom to move up to down direction within any structure
 - D. Combined Structure** - Combination of the three structures



- Identifying Multimedia File formats

Table 7.4.2 File formats

Acronym	Full name	Description
ASCII	American Standard Code for Information Interchange	A standard for text data and numeric data. ASCII code is interchangeable among standard proprietary word and text processors.
RTF	Rich Text Format	ASCII code with additional code for character and paragraph formatting
DOC	document	Word-processed documents. These documents are formatted to proprietary standards and may not transfer to other word processors without the appropriate filters.
HTML	Hypertext Markup Language	Used to create documents for the Web
BMP	Bit map	Each bit's location on the screen is mapped. Bit-mapping creates large files.
JPEG	Joint Photographics Experts Group	Uses lossy compression and is used for storing photographs
GIF	Graphics Interchange Format	Uses lossless compression and is mainly used for storing drawings
TIF(F)	Tagged Image File Format	Used for storing bit-mapped graphics. Problems may occur with this format, as a few variations of the TIF format exist.
WAV	Wave as in sound wave	Non-compressed file format that can store 8- and 16-bit sound files. These can be very large in size.
MP3	MPEG Audio Layer 3	Uses lossy audio compression technology, hence file sizes are much smaller than WAV files
MPEG	Motion Picture Expert Group	Standard for the compression of moving images. Uses lossy compression techniques
AVI	Audio Video Interleaved	Standard format for digital video

Issues Relating to Multimedia Systems

Copyright

Copyright	Ownership of created work, which prohibits others using it as it were their own
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- Multimedia relevant - data stored in digital format (easy to locate copy & Edit)
- As technology consistently innovating around the world - patents consistently arising

Appropriate use of Multimedia

- Includes subset of legal and ethical issues
- Legal ramifications for any work published on the internet - time of writing, publisher has appeal pending
- Privacy
 - Stream and capture live video - without consent of individuals
- Key Logging & Screen obtaining software on PC's - obtain information remotely and display it
- Placement of pornographic images - disturbing materials - place of minors, adults browsing raises legal and ethical issues
- Hyperlinks of indiscriminately tempting internet users to casino websites

Merging All Media and Communications Into One

- Merging of radio, television, other modes of communication
- WEB-TV - aimed at users who do not use computers
- Digital TV - obtain more information from advertisements
- Internet Access - internet service provider - telephone line / digital line
- DSL - simultaneously receive and sends (no need for 2 telephone lines)
- Higher Bandwidth to homes - more accessibility

Data Integrity

Data Integrity	The Reliability, currency & Relevance of data
Publish	Make available by distributing copies of a work as hard copy or by presenting information on the internet

- Refers to reliability of data as factual, current & Relevant
- Source needs to be checked and verified

- Books - formal publishing process - verified prior to publication
- Internet - less formal - requirements are less, adequate knowledge

- Browsers unaware - information on website is out of date
- Data integrity concern - digital signature / (login and password) legitimate / current ??
- Data corrupted or tampered?