

MULTIMEDIA SYSTEMS

Characteristics of Multimedia Systems

MULTIMEDIA SYSTEMS – INFO SYSTEM THAT INCLUDE COMBINATIONS OF THE FOLLOWING MEDIA:

- **Text and numbers** – Text and number are **displayed as images** using fonts.
 - **Text** – Text is digitally represented by **ASCII** and **EBCDIC** with **seven bit** per character. **Unicode**, the extension of ASCII, is the standard for representing text.
 - **Fonts** – How a character is rendered for display. Includes **outline font (TrueType)** and **raster font**, and **serif** and **san serif**. It is vital the font is available on the end-user's computer.
 - **Numbers** – Numbers have **magnitude and place value**. This includes **integer, real number, currency, Boolean and date & times**. It is often represented as text when displayed.
- **Audio** – Audio is **sound digitalised**. Two main components of audio are **frequency (Hz)** and **amplitude (db)**.
 - **Sampling** – Converts **analogue sounds to digital** by taking **samples of the sound** at **certain intervals**. The points are joined to form an **approximate shape**. The quality is determined by **no. of channels, bits per sample** and **sample rate**. File formats include **MP3, WAV** and **WMA**.
 - **Individual notes** – Digital audio is made with individual notes (pitch and duration). **MIDI** file format.
- **Images and/or animation**
 - **Images** – Images are used to **represent data visually**. They are all **made of pixels** (smallest part of a computer that can be controlled). The **resolution** is the total number of pixels of the image.
 - **Bitmap images** – Bitmaps are a **2D array of pixels** represented individually using binary to describe the colour. The total of number of colour present determines the size of binary representation. E.g. 256 colours = 8 bits.
 - **JPEG, GIF, PNG and BMP**
 - *Bit depth* – number of bits per pixel
 - **Horizontal pixels x vertical pixels x bit depth = file size**
 - **Vector images** – Each shape is represented with a **mathematical description**, allowing them to resize without loss of clarity/quality and increase of storage size. Each shape is a separate object. It requires less storage size but more processing than bitmaps.
 - **SVG, WMF and EMF**
 - **Animation** – Animation is made of a **sequence of image (cells)**. The cells are played quickly to perceive continuous movement.
 - **Cell based** – **Sequence of images** where each image is slightly different to the previous one.
 - **Path based** – The character follows a **long line drawn across the screen**. It can rotate, flip and transform. The character itself can be cell based.
- **Video** – Video **combines images and sound (optional) that are synched together**. Each image is a frame (bitmap). Buffering prevents delays in the video.
 - **Calculate total frames** – frames/sec x number of seconds
 - **Calculate size of each frame** – horizontal pixels x vertical pixels x bit depth
 - **Calculate total file size** – frames x size of each frame = ___ bits
- **Hyperlinks** – Hyperlinks are a graphic or piece of text that **connects users to another page** or portion of the document. The organisation of hypertext and hypermedia is based on hyperlinks. It is based on **HTML (tags)**.
 - `Google`

THE DIFFERENCES BETWEEN PRINT AND MULTIMEDIA

- **Different modes of display** – Prints have a **higher resolution** than multimedia (screen displays).
- **Interactivity and involvement of participants in multimedia systems** – Prints are **static**. But, multimedia systems can be **easily edited**, while **print can't be altered** or **requires money to change** and reprint.

- **Ease of distribution** – Print is **harder** and **more expensive to distribute**. Multimedia systems simply require the **internet, hardware, software** and **basic skills**. Print requires printers, ink, paper and publisher.
- **Authority of document** – Professionally printed books are more readily trusted than multimedia.

THE DEMANDS PLACED ON HARDWARE BY MULTIMEDIA SYSTEMS

- **RAM** – Temporarily holds data and instructions, is volatile and relies on power to maintain its content.
- **ROM** – Fixed in instructions that live when power is on.
- **Cache** – In between CPU and RAM, it speeds up access to commands.
- **Secondary Storage** – It is non-volatile and includes magnetic disk, USB, hard disk, CD/DVD and tape drives.
- **Primary and secondary storage requirements as a result of:**
 - **Bit depth and the representation of colour data** – Higher bit depth = larger RAM (frame buffer – section of memory that temporarily stores the current image displayed) and hard disk required.
 - **Sampling rates of audio data** – Higher sample rate = larger RAM and hard disk required
- **Processing as a result of:**
 - **Video data and frame rates** – Videos are large files (thousands of frames and high quality audio). So a separate processor chip or video card is needed to reduce processing strain on CPU when viewing.
 - **Image processing, including morphing and distorting** – Morphing (smoothly changing from one image to another) and distorting (changing original image by twisting, bending and stretching).
 - **Animation processing, including tweening** – Tweening is the generation of intermediate scenes between key frames created by animators. For cell based, it requires a fast processor and large RAM
- **Display devices as a result of:**
 - **Pixels and resolution** – High resolution = more pixels = higher resolution screens.

VARIETY OF FIELDS OF EXPERTISE REQUIRED IN THE DEVELOPMENT OF MULTIMEDIA APPLICATIONS

- **Content providers** – Supply ready to use content by acting on behalf of copyright holders, to negotiate fees.
- **System designers and project managers**
 - **System designers** – They identify the **purpose**, decide **feasibility**, **choose** and **design the solution**. Leadership skills are needed.
 - **Project managers** – They develop the **project plan** and ensure it is followed. They **schedule** and **monitor** each of the development tasks. **Communication skills** are needed.
- **Those skilled in the collection and editing of each of the media types**
 - **Text** – Writers produce **textual content** and create **storylines**.
 - **Image** – Illustrators and animators draw **figures** and **scenes** with software (vector graphic software).
 - **Audio** – Audio production personnel **record and edit audio** (music, voice and special effects). They **adjust levels and mix audio clips**. This requires creativity, artistic and technical skills.
 - **Video** – Video production personnel includes a crew of at least a **director, camera operator, sound engineer and perhaps actors and editors**. Directors direct other personnel, and **approve of set designs, costumes, camera angle, lighting and delivery of lines**. They also over the **final editing**.
- **Those skilled in design and layout** – Graphic designers improve multimedia systems by **enhancing visual appeal**. They organise **layout of screens, colour, typography** and **size**, and develop **consistent layouts**.
- **Those with technical skills to support the use of the information technology being used** – Technical personnel **ensure the system will operate on user's machines**. They need to consider **hardware configuration** and the typical **communication speeds**.
 - **Multimedia delivered over the internet is reliant on the speed of the user's internet connection** – With different levels of compression, lower resolution and streaming, technicians ensure it will be delivered in timely fashion over slower internet.
 - **CD-ROM** – As the physical space limits the size of presentation, images, audio and video need to be compressed. Technicians ensure the required codecs are available at end user's machine.

Examples of Multimedia Systems

THE MAJOR AREAS OF MULTIMEDIA USES:

- **Education and training** – This allows users to **learn new skills, distribution of multimedia and training staff** in OHS, customer support, communications, sales and computer skills. Users can learn at their own pace.
 - **Participants** – Infants, students (schools & universities), parents and training organisations
 - **Data/info** – Text (info), videos (online classes), icons and other menu path-based animations
 - **Info tech** – Adobe flash, mouse, keyboard, OS, speakers (any basic computer), touch screen, CD-ROM, sufficient RAM and fast processor.
- **Leisure and entertainment** – This includes **action (3D games), role playing, and MMO, platform and simulation games**. The **high level of graphics, animations and audio increase interactivity**. The introduction of more platforms (PC, consoles, Wii) has led the video gaming industry to grow in profit and audience.
 - **Participants** – Anyone with technological skills (all ages and abilities)
 - **Data/info** – text (dialogue/instructions), images, video (fighting scenes) and audio (sound effects)
 - **Info tech** – keyboard, mouse, OS, graphic card, sufficient RAM and fast processor (good computer)
- **Information provisions, such as information kiosk** – **Different multimedia types are integrated to provide info to users**, advertise products and promote services. This includes information kiosks, multimedia brochures, reports, and encyclopaedias.
 - **Participants** – Anyone (not much skilled is required)
 - **Data/info** – Text (instructions to route), images (maps/icons/keys) and audio (optional)
 - **Info tech** – Touch screen (reducing technology literacy requirements and removing need for keyboards and mouses), secured personal computer, magnetic swipe card readers, printers and internet connection.
- **Virtual realities and simulations such as flight simulator** – VR is a **computer generated artificial reality that projects the user into a 3D space**. It is used where training would normally be impractical. This includes flight simulators, medical schools (surgeons), military, virtual tours, architectural and overcoming phobias.
 - **Participants** – Restricted to certain ages and professions [e.g. pilots (trainees)]
 - **Data/info** – Text (instructions, info related to pilots), images/videos (scene created), audio
 - **Info tech** – VR headset, microphones, speakers, VR program/software, PC
- **Combined areas such as educational games** – Computer games can be created to have an educational twist. (Participants, data/info and info tech is similar to ‘education and training’ and ‘leisure and entertainment’)

ADVANCES IN TECHNOLOGY WHICH ARE INFLUENCING MULTIMEDIA DEVELOPMENT

- **Increased storage capacity allowing multimedia products to be stored at high resolutions** – This allows for more realistic and high quality images (particularly in VR).
- **Improved bandwidth allowing transmission of higher quality multimedia** – These speeds allows larger and more detailed multimedia products to be distributed faster and more easily for users.
- **Improved resolution of capturing devices**
- **Increases in processing power of CPUs** – Large high quality videos and music can be handled. Simulations (games) requiring high resolution can be supported. Larger files can be processed.
- **Improved resolution of displays** – Displays can view higher resolution images (more detailed and realistic)
- **New codecs for handling compression of media while improving quality** – Highly interactive multimedia can be distributed on the web. For video, the most commonly used standard is MPEG.

HARDWARE FOR CREATING AND DISPLAYING MULTIMEDIA

- **Screens including CRT displays, LCD displays, plasma displays and touch screens**
 - **VGA** =Video graphics array and **DVI** = Digital visual interface
 - **CRT displays** (Cathode-Ray tubes – VGA connector) – **Electron guns** are fired onto the inside of the **phosphor-coated screen**, causing it to glow. **RGB beams** are fired at different intensities at the pixels (three phosphor dots – RGB). **Refresh rate** is the no. of times/sec the beam traverses the screen.
 - CRTs are **heavier**, take up more **desk space**, use more **power**, emit **EM radiation** and require a **DAC**. But, they have **larger viewing angles**, **multiple resolutions** and **unlimited colours**.
 - **LCD displays** (liquid crystal display – DVI connector) – An array of **liquid crystals** is placed between **polarised glass panels**, which direct light to display RGB. **Transparent electrodes** electrify the crystals to change its directions. Light shines through to the pixels (RGB). A **separate transistor** controls the light allowed to pass through for each colour of each pixel by varying the voltage.
 - LCDs are **smaller, lighter**, has **unlimited colours**, **native resolution**, uses **less power**, doesn't emit **EM radiation** and accepts **digital signal**. However, it has a **smaller viewing angle**.
 - **Plasma displays** (DVI connector) – Cells, between glass panels, are made of **neon and xenon**, and coated in RGB. **Electric currents excite the gas**, forming plasma. **Plasma releases UV light**, reacting to the phosphor colours. Varying the current alters the colour intensity.
 - **Wide screened** and **thin** with **same colour intensity**, **good brightness** and **contrast**. It allows for **true black** but needs **more power**, **heavier** and **more fragile** than LCD.
 - **Touch screens** – It is made up of a **sensor panel** overlaying the screen. When the **electric current** flowing through is disrupted, the **change is detected** and determines the location of the touch. It includes **resistive, surface wave** and **capacitive**.
 - **Eliminates keyboard** and **mouse**. It's less likely to **damage** and the interface is **easier to use**.
- **Digital projection devices** – It uses the **data output info from the computer** and **projects it at a reflective surface**. Light is directed through a **small transparent image** or **reflected off a small image**, and then at a **small focusing lens** onto a **large screen**. It uses **LCD technology**.
- **Speakers, sound systems**
 - **Sound card** – A sound card is either embedded on the **motherboard** or on a **separate card** that attaches to a PCI bus. It has an **ADC and DAC**, and contains their own **RAM**, which acts as a buffer. The **DSP** decompresses and smooths the sound samples, which is then sent to the DAC.
 - **Speakers/sound systems** – Speakers are **analogue devices** that convert currents into sound waves. The **electromagnet** (a **coil** around a magnet) performs the conversion into soundwaves. **The coil vibrates in time with the alternating current**. The coil is attached to a **diaphragm**, which compresses and decompresses the air, forming the sound waves.
- **CD, DVD and video tape players** – A **laser beam** reads/write data on the **spiral tracks**. A **sensor** detects the **pits and lands**, translating it into binary. Quality is maintained after copying.
 - **CD** (Compact discs) – CDs store data on a single track, holding up to 680 MB.
 - **DVD** (Digital video disc) – Double sided and dual layered (17 GB). **Ideal for distributing multimedia**.
 - **Video tape players** – Stores data on long strip of magnetic tape. Quality reduces after copying.
- **Head-up displays and head-sets**
 - **Head up displays** – Information is **superimposed** on a **transparent screen** and won't interfere with the user's normal view. It is used in military and aircraft.
 - **Headsets** – It is an **integration of microphone and speakers** into a device worn on the head. It used by users who spend extended periods on the phone. **Lower quality microphones** can be used, while **speakers are eliminated**. It allows users to **listen without distracting others**.
 - **Virtual Reality headsets** – VR uses **head-up displays, goggles, gloves or body suits**. These devices contain sensors that monitor movement. This allows the displayed image to move with the user.

SOFTWARE FOR CREATING AND DISPLAYING MULTIMEDIA, INCLUDING:

- **Presentation software** – It creates **high quality multimedia presentations** with **graphics and date/info** from other software tools. It also provides templates, themes and transitions to use. E.g. Powerpoint.
- **Software for video processing** – This allows **video to be captured, imported and edited** (special effects, text overlays, transitions). It compresses the original video size to be more suitable.
- **Authoring software** – It **combines many standalone application software products** to simplify the user's involvement when creating multimedia. It allows users to easily select text, images, video and audio.
- **Animation software** – It takes **multiple images and plays them in quick succession**. It creates 2D (cell/path based) and 3D (mathematical models) animations.
- **Web browsers and HTML editors**
 - **Web browsers** – It provides a **human interface**, allowing **users to explore the web** while ignorant of the underlying processes.
 - **HTML editors** – Plain text editors that create **and edit websites**. May have a **WYSIWYG** environment.

Other Information Processes in Multimedia Systems

PROCESSING

- **The integration of text and/or number, audio, image and/or video** – **Interleaving** – data from different sources are stored on storage media to reduce retrieval delays. This integration result in the need for **increase in storage and compression**. This increases interactivity.
- **Compression and decompression of audio, video and images**
 - **Audio** – high or low **frequencies that are barely notices are removed**. This results to fewer bits to store the remaining frequencies.
 - **Video** – Codecs are used to encode/decode files. **MPEG** is the most common standard. Repetitive data and data that the human eye can't perceive are removed. E.g. **block based encoding**.
 - **Images** – **lossless** and **lossy** **Pg. 6 MS**
- **Hypermedia – the linking of different media to one another**
 - **Existing content is imported** into the app. A library/collection of media files is created by the app.
 - **Screens are created**, content is added and formatted and hyperlinks created
 - **The file is then created** (authoring packages – integrated package) for distribution and display

ORGANISING PRESENTATIONS USING STORYBOARD LAYOUTS – linear, hierarchal, non-linear, combination

STORING AND RETRIEVING

- **The different file formats used to store different types of data**

<u>Images</u>		<u>Video and Animations</u>	
<u>File Format</u>	<u>Compression</u>	<u>Film Format</u>	<u>Compression</u>
Joint Photographics Expert Group (JPEG/JPG)	Lossy	Motion Picture Experts Group (MPG)	Lossy
Graphics Interchange format (GIF)	Lossless	Quicktime (MOV, QT)	Usually lossy
Portable Network Graphics (PNG)	Lossless	Audio Video Interleave (AVI)	Usually lossy
Windows Bitmap (BMP)	Lossless	Windows Media Video (WMV)	Lossy
<u>Audio</u>		<u>Animations</u>	
MPEG-1 Audio Layer 3 (MP3)	Lossy	Shockwave Format (SWF)	None
Waveform Audio Format (WAV)	Lossy, Lossless, none		
Windows Media Audio (WMA)	Lossy		
Music Instrument Digital Interface (MIDI)	Lossless, none		

- **Compression and decompression**
 - **Compression** – It is the **reduction of the size needed to store the file**. The amount the file has been compressed is **compression ratio**.
 - **Lossy** – **Permanently removes** a number of data bytes from the file, leaving reduced quality and smaller file size. Usually the quality reduction is unnoticeable.
 - **Lossless** – **Temporarily replaces** repeated data with something that requires less space. It recovers the original data when opened.
 - There is **no compression in vector images** (PDF, SWF, WMF, etc).
 - **Decompression** – **Reconversion of compressed data** to its original form so it can be heard, read and seen as normal.

COLLECTING

- **Text and number in digital format**
 - **Keyboard** (In digital form)
 - **OCR scanner** – Allows conversion of scanned images of printed text into machine-encoded text.
- **Audio, video and images in analog form**
 - **Images**
 - **Flatbed scanner, handheld scanner, Overhead scanner** (from **analogue form**) – **Sensors the intensity of the light** (raw analogue data) reflected off the image. In response to the amount of light detected, sensors will **emit varying currents**. The current is converted into binary.
 - **TWAIN** – Protocol that controls communication among software and digital imaging devices
 - **Digital camera** (also audio and in **digital form**) – It works similarly to scanners. They are either based on CCD or CMOS (complementary metal oxide semiconductors).
 - **Video**
 - **Video camera** – It captures **light and converts it** into binary signals. There are **two sensors**. The **front sensor** collects light and transfers the electrical current to the lower sensor. The **lower sensor** reads it, while the upper lens is still collecting. Data passes through an ADC.
 - **Audio**
 - **Microphone** (from **analogue form**) – Sound hits the **diaphragm**, which transfers the waves via the **coil** to an **electromagnet**. The electromagnet then converts the **vibrations** into audio.
 - **Sound card** – When the analogue sound reached the soundcard, it is fed into an **ADC** to the **DSP** (digital signal processor). The DSP filters and compresses sound samples to better represent the original sound. The samples then give to the **CPU** to be placed in **storage**.
- **Describe the process of analog to digital conversion** – ADCs repeatedly **sample the magnitude of the incoming electrical current** and converts the samples into binary. DAC conversion is much simpler.
- **Methods for digitising data** –ADC are used (audio, video, images).

Issues Related to Multimedia Systems

COPYRIGHT: THE ACKNOWLEDGMENT OF SOURCE DATA AND THE EASE WITH WHICH DIGITAL DATA CAN

BE MODIFIED – **Infringement** to copy/adapt someone else's multimedia product without the author's consent.

Copyright **encourages creativity** by providing an **incentive** by limiting distribution. After receiving permission, the copyright owners should be acknowledged.

- **Copyright Act 1968**

APPROPRIATE USE OF THE INTERNET AND THE WIDESPREAD APPLICATION OF NEW DEVELOPMENTS

–All software created must **stay in line with today's ethics**. Introducing **living streaming** is effective, but raises privacy issues. There is also distribution of **disturbing material**, and misuse and abusing efficient **online transactions**.

THE MERGING OF RADIO, TELEVISION, COMMUNICATIONS AND THE INTERNET WITH THE INCREASE AND IMPROVEMENTS IN DIGITISATION

– Advances and cost reduction in processing speeds, storage, codec and speed of electrical components have made the use of digital data more affordable.

- ***Digital convergence*** (store data as digital than analogue) has allowed multimedia types to be combined with computer technology. This includes **VoIP, streaming of desktop digital internet radio and WEB-TV.**

THE INTEGRITY OF THE ORIGINAL SOURCE DATA IN EDUCATIONAL AND OTHER MULTIMEDIA SYSTEMS –

Data integrity is concerned with the data being **accurate, consistent and up-to-date.** The **increase of info and unknown authors** has made data integrity a bigger issue. Multimedia systems usually derive from **various sources,** thus making it important to **reference sources.** All source data should be **cross referenced.**

CURRENT AND EMERGING TRENDS IN MULTIMEDIA SYSTEMS, SUCH AS:

- ***Virtual worlds*** – VWs are **online simulated environments with another persona through an avatar.** It is mostly for entertainment but others are emerging (e.g. business meetings). It allows users to overcome their disabilities or trial new products with creating a physical sample.
 - VW are now available on **PC, laptop, iPhones and Android smart phones.** Smartphones also have a large availability to different apps.
 - **Ethical issues** – anonymous people in VW can pose problems of privacy and identity theft.

Other: Increase in usage of computers

- Faster CPU
- Faster transmission speeds
- Better codecs
- Higher quality sound/graphics card and displays
- Cheaper storage devices
- Higher monitor resolution