What difference does ***digital*** make?

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Digital vs Analogue

- I could provide a detailed description of the differences in signal coding
  - and in the effects these have
    - from a technical / engineering viewpoint

Or

- I could talk about it from the user's point of view.

- In fact, I'll start with the second, and occasionally drop into engineering mode
  - And if that gets too technical, tell me!
- There's other viewpoints too

Example 1: Digital text (Computer scientists viewpoint)

- Text has been around a long time.
  - More than 5000 years.
- Text was the first type of media to be digitized
  - Relatively low volume of data
    - Originally 1 byte/character (ASCII code)
    - Later 2 bytes/character (UNICODE)
    - Later still further information implementing
      - Font family, font size, tabs, headers, footers, …
  - Straightforward conversion
    - Text ⇔ digital internal format ⇔ Text
- Display format, internal format, printed format

Text and digital text

- Mass production of text started in the 18th/19th centuries.
  - By the mid 20th century typescript was absolutely commonplace in commerce
    - And handwritten documents relatively rare
- Digitised text extended this
  - Digital text-based communication arrived in the 1990's
    - Email, text messaging
  - Sending large volumes of fully formatted text became commonplace in the very late 1990's/early 2000's
- Now more and more text-based material is entirely electronic
  - With no physical "hard copy"

Critical technical advances

- Computer hardware
  - Cheap electronics, large-scale storage on disc
- Interface hardware
  - Better and more precise (high resolution) displays
    - Cheap CRTs, then cheap flat screens
  - Portable displays
    - Flat screens
  - High resolution printers
    - Laser and ink jet printers, permitting professional quality printing
  - Optical character reading scanners
    - Not quite here yet
- Communications systems
  - The internet, the web: allowing digital text to be exchanged easily
- Standardisation
  - A critical requirement for the sharing of digital text

Digital vs Physical text

- Physical:
  - Portable (but can be heavy), readable anywhere,
  - Annotatable easily
  - Can be copied with a photocopier (costs for toner and paper)
  - Not searchable

  Other comparisons?
- Digital:
  - Needs a reader, which might be portable, but no issue with weight
  - Needs software for annotation
  - Can be copied digitally (perfectly), for free
  - Searchable

What difference has digital made?

- We still have books and newspapers
- We still have magazines and journals
- People still send letters
  - Has there been any effect?

- Many newspapers are now available on-line
- A few books and magazines are available on-line
- Far fewer business letters are sent that previously
  - Mostly sent by email: or information placed on web.
- Technical manuals, and many academic journals are now primarily accessed on-line

- Change has been relatively gradual.

Example 2: digital images

- Once upon a time …
  - Artists created images
    - One at a time
    - Copying meant literally copying
  - Then various mechanisms for making multiple copies were developed
    - Wood-cuts, copper plates
- Then (analogue) photography came along
  - And had a major effect on image art!
  - Mass analogue photography spawned industries
    - Camera manufacture
      - Camera, lens, etc
    - Reproduction manufacture
      - Film, development shops, …
- And now digital photography is here

Digital vs analogue images

- Analogue:
  - Take photo on a reel of film: 24/36/48 images
  - Choose film to suit light conditions
  - Get film developed
  - Discard unwanted images
- Digital
  - Take digital photo: camera can hold hundreds
  - Camera adjusts to suit light levels
  - Either examine on camera, or transfer to computer
  - Modify/adjust/zoom in on images
  - Delete unwanted images
    - Perhaps print some, or place on WWW (etc.) for others to use
- Not surprisingly, analog photography is virtually dead.

Critical advances

- Cheap and high quality graphical displays
  - CRT, flat screen
  - Small flat screen
- Electronic digital imagers
  - Used in digital image acquisition
  - Cameras
- Cheap memory
  - Cheap flash memory
- Standardisation
  - Allows sharing of digital images

What difference has digital made?

- Digital images are
  - Much easier to work with
  - Much easier to share/copy
  - Much easier to adjust (photoshop/GIMP vs airbrush)
  - Able to be incorporated into larger digital objects
    - Like digital documents/papers/books etc.
- Analogue techniques are still used by creative artists
  - But not in commercial contexts!

Digital audio

- Sound recording
  - Started in 1877
  - Commercially about 1900 (analogue format)
  - Digital CDs introduced in 1982
    - Well defined format
  - Compressed memory-based formats from about 2000
    - Apple iPod 2001
  - (longer discussion in a later lecture)
- Primarily used for music initially
  - Digital media also used for voice now (podcasts, re-play of radio programmes))

Critical advances

- Signal processing
  - Critical for real-time playing of digital signals
- Memory price
  - Both semiconductor memory (ROM, specifically Flash memory)
  - And disk memory
- Memory size
  - portability

What difference does digital make

- Ability to make perfect copies
  - Issues for the music industry
- Ability to make relatively cheap but high quality recordings
  - Digital audio mixing can be carried out perfectly on a desktop (or even a laptop) computer
- Sound quality vs. price
  - Can purchase very high quality equipment cheaply

Film vs digital video

–Film has been around for rather more than 100 years

– as a mass media for a little less

–Though usually associated with H(B)ollywood, it was also used by ordinary people

– super 8 etc.

–Analog video cameras

–(video-tape recorders)

–Became popular about from the early 1970's

Analog and digital video

- Analog video (and basic consumer film) suffered from difficulties in editing
  - Virtually impossible to to create a finished article in one "take"
  - Analog or film video editing stations are very complex and expensive
- Digital video recorders came in in the 1990's
  - But digital video editing software for the mass market had to wait until the computers were fast enough
    - Really the early 2000's.

Critical advances

- As for digital images, plus
  - Portable mass storage
  - Advances in compression software and technology
  - High speed real-time digital signal processing
    - Critical for allowing the playback of compressed digital video in real-time
  - Styandardisation
    - Allows sharing of digital video
    - Not quite as advanced as for images and sound and text.

What difference does digital make

- Editing is easier
  - Cut and paste (literally)
  - Digital editing
- In-betweening (or tweening) in cartoons
  - Drawing vs digital calculation
- Addition of special effects
  - Others?

Digital mass media

- Digital newspapers, digital radio and digital TV
- All newspapers are now created digitally
  - Hot type is long dead (I believe!)
- Radio and TV are initially analogue
  - The actual sounds and images and videos are analogue
- and are viewed in an analog fashion
  - Loudspeakers, screens.

Newspapers

- Still largely distributed as physical objects
  - Why?
  - Will this continue?
  - How do you use newspapers?
- What critical advances would be needed to make purely digital distribution work?

Radio

- Oldest purely electronic mass medium
  - Early 20th century
  - Analogue originally
    - And still mostly analogue
- But digital radio broadcasting has been coming in in the last decade
  - Allows accompanying text to be displayed
  - Allows customisation of content locally
  - Allows many stations to be heard at (reasonably) high quality
- Catching on, but not as fast as expected.
  - Why?

Television

- Started in 1930's, then restarted after 2nd world war in 1950's
- Originally analogue.
- Initial digital addition: teletext (1970s, 1980's)
  - Allowed accompanying interactive text
  - But the interaction was slow, and restricted to navigation through a set of pages
  - Early precursor of web?

Digital television

- Two standards (at least)
  - Various image aspect ratios
    - 4:4, 16:10, etc.
  - Normal and high resolution
- Allows much better image quality
  - But many people don't care!
- Allows more stations to share the same area of the electromagnetic spectrum

What difference has digital made?

- Additional channels
- Ability to watch channels intended for quite different geographical areas
- Advent of some channels intended for a truly international audience
  - MusicChannel,BBC World, Al Jazeera

Digital telephony

- Telephony was originally static, and digital
  - But digital communication outpaced analogue in quality and price/performance
  - Leading to digitisation of much of the trunk network
    - And to the switching stations (exchanges)
- Initially mobile telephony was also analogue
- But:
    - Analogue mobile telephony was
      - Insecure
      - Liable to very serious problems with noise
      - Limited in how it could use the bandwidth
      - Leading to difficulties in mass usage

Current situation

- Static telephony is analogue only at the customer's premises
  - Exchanges are virtually all digital (in UK)
- Mobile telephony is all digital
  - Very sophisticated transmission techniques makes the calls secure
  - And uses the electromagnetic spectrum more efficiently

What difference has digital made?

- Static:
  - Little to actual direct usage
  - Additional facilities
    - Caller ID, ringback, alarm calls, …
  - Capability to use telephone network as a computer/data network
    - Broadband internet services to the home
- Mobile
  - Usability
  - Additional services
    - Most notably SMS
  - Capability to use for internet access
    - Still relatively slow and expensive in UK
      - (but not elsewhere – specifically Japan!)

Convergence

- Digitization of media has permitted mixed media to be created
  - Text and sound
  - Images and sound, etc.
- Possibilities of new media
  - And particularly new interactive media
  - Using the information processing power of the media player
    - (which is simply a computer anyway)
- There are huge possibilities here …
  - Interactive Multimedia
  - Interactive Games