Understanding Multimedia - Basics

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Design and Evaluation of Multimedia Systems

- Lectures
  - video as a medium
  - video technology
  - Design issues
  - Advanced applications & tools
- Multimedia with Video Exercise
  - develop prototype video-based production
  - working both individually and in groups
  - present work at end of course

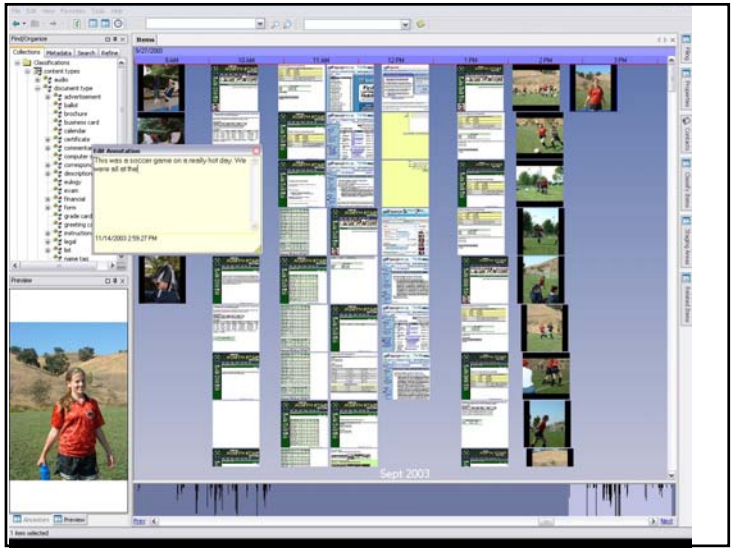
Why is Multimedia Important?

- Our society –
  - *captures* its experience,
  - *records* its accomplishments,
  - *portrays* its past
  - *informs* its masses

  ……in pictures, audio and video
- For many, CNN has become the "publication of record"
- Multimedia Digital libraries are an essential component of
  - formal, informal, and professional learning
  - distance education, telemedicine
- Trends in technology & society
  - Memories for life
  - Capturing lifetime experience- Microsoft
  - Digital diaries - DCU

MyLifeBits Project

- MyLifeBits is a lifetime store of ***everything***.
  - full-text search, text & audio annotations, and hyperlinks.
- There are two parts to MyLifeBits:
  - an experiment in lifetime storage,
    - Gordon Bell, Microsoft Research and
  - a software research effort.
- More details
  - http://research.microsoft.com/barc/mediapresence/MyLifeBits.aspx



SenseCam Images - DCU

- The problem is selecting, from a (large) set of SenseCam images a representative or summary of landmarks, or significant events from a daily, weekly or longer log.
- More details
  - http://www.cdvp.dcu.ie/SenseCam/

FROM:
http://www.cdvp.dcu.ie/SenseCam/

Multimedia Systems: Technology Thrust

- Multimedia workstations with audio and video processing capability
  - Tremendous improvements in CPU processing power
  - Special purpose compression engines for video and audio
- High capacity, high performance storage devices
  - Availability of magnetic disks with several gigabytes capacity, tremendous increase in data transfer rate due to disk array technology
  - Technology for large optical storage servers evolving rapidly
- High speed fibre optic networks and fast packet switching technology

Multimedia Systems: Service Vision and Applications

- Residential services
  - Switched access television, video on demand
  - Video phone/conferencing systems
  - Video advertisement and shopping (e.g., multimedia catalogue classified by category, product demonstrations, real estate sales, …)
  - Self-paced education
- Business services:
  - Corporate education
  - Desktop multimedia conferencing and multimedia email

Multimedia Systems: Service Vision and Applications

- Education
  - Multimedia repository of available classes, videos, books, …
  - Access to digital multimedia library over high speed networks
- Science and technology
  - Computational prototyping and scientific visualisation
  - Astronomy and environmental science studies – efficient access to large number of satellite images
- Medicine:
  - Diagnosis and treatment

Hype vs. Reality

- What is feasible, under what circumstances?
- What is possible?
- What is impossible?
- What is unlikely?
- How to make use of your own "digital assets" effectively?

Intention

- To provide
  - basic understanding of the media "video" and its characteristics
  - to describe system characteristics and standards
- Look at "video" as the process of:
  - Generation ->transmission->perception
  - Generation
    - Both by capturing and synthesis
  - Transmission
    - In the analogue and digital world
  - Perception
    - Which is influenced by output device and human physiology

Course Contents

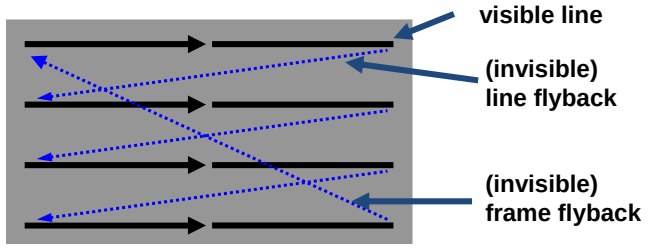
- Basics
  - Image, Audio/Speech, Video processing
  - Standards, Compression
  - Video Streaming
- Multimedia Design Techniques and Issues
- SMIL (Interaction & Interfaces)
- Evaluation of Multimedia Systems with Case Study
- Multimedia Management and Retrieval
- Advanced Topics
  - Multi-Modal Interaction
  - Social media
  - Tagging/Semantic Annotation
  - Music Analysis and Retrieval
  - Multimedia Classification

Video as a Medium:
What's Special About Video?

Video Technology:
raster-based devices

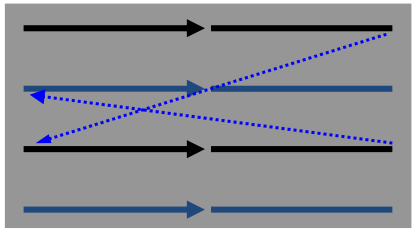
- raster
  - discrete horizontal lines of a frame
  - left to right
  - Voltage level indicate brightness (low dark- high bright)
  - Synchronization signals
- displays
  - CRT = cathode ray tube
  - LCD = liquid crystal display
- printers
  - laser printers
  - inkjet printers

Video Technology:
scan format



Video Technology:
interlaced scan format

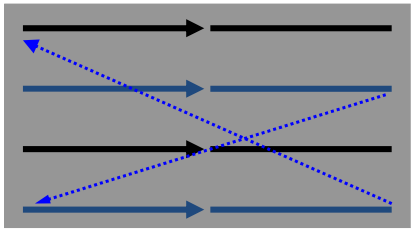
- frame divided into two fields of alternating lines
- fields displayed alternately



1st field flyback

Video Technology:
interlaced scan format

- because phosphor decays over time, interlaced scan doubles effective display rate
- reduces flicker for low refresh rate
- but can introduce judder (up-down)



2nd field flyback

Video Technology:
refresh rate

- television
  - 50 Hz interlaced
  - 60 Hz in US
- monitors
  - approximate 40 - 100 Hz
- flicker is perceivable below ~50 Hz
- Aspect ratio
  - Conventional TV is 4:3 (1.33)
  - HDTV is 16:9 (2.11)
  - Cinema uses 1.85:1 or 2.35:1

Video Technology:
resolution

- DPI
  - dots per inch – size of the colour phosphor dots
  - refers to the density of pixels on the screen or printed page
- resolution as number of pixels
  - sometimes the size of a screen in discrete displayable pixels is referred to as its resolution (e.g. screen resolution = 640x480 or 1024x768)

Device vs. Image Resolution

- Average laser printer has resolution of 300 dots per inch (dpi)
- Average computer display has resolution of 72 or 75 dpi
- Average scanner has 600 dpi resolution
- Photographic film has 1000s of dpi
- Color resolution from 8-bit (256 colors) to 16-bit (65536 colors) to 24-bit (2^24 or ~16.7 million colors, good enough to enable photorealism)
- …and if we focus on Web delivery…

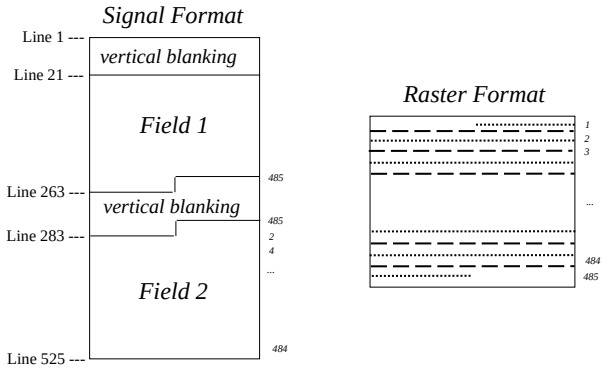
On to Scanning in a Photograph…

- 35 mm photograph requires 20,000,000 pixels
- Scanning in at high resolution of 600 dpi still produces drop in image quality
- 4 inch by 6 inch picture scanned in at 600 dpi would print out as 8 inch by 12 inch picture on 300 dpi laser printer, and would appear as a 33.3 inch by 50 inch image on your 72 dpi monitor (i.e., you would need to scroll many times before seeing each part of the whole image)
- Hence, when scanning for web publication, set scanner for 72 dpi if you wish images to remain same size when presented on the computer display screen

Video Technology: Standards

- Standards are concerned with the technical details of the way colour television pictures are encoded as broadcast signals
- Digital Standards
  - CCIR 601 - standard for sampling
- Analogue standards
  - NTSC= 640 x 480; PAL = 768 x 576
- 40 fps if flickering to be avoided
- Transmitting an entire picture that many times a second requires an amount of bandwidth that was considered impractical at a time of standard was created
- Interlacing
  - divided

Interlaced Fields



NTSC Video

- 525 scan lines repeated 29.97 times per second (i.e.33.37 msec/frame)
- Interlaced scan lines divide frame into 2 fields each 262.5 lines (i.e.16.68 msec/field)
- 20 lines reserved for control information at the beginning of each field
  - so only 485 lines of visible data
  - laserdisc and S-VHS display around 420 lines
  - normal broadcast TV displays around 320 lines
- Each line lasts 63.6 usec(10.9 usec blanked)

(525-lines, 60-fields/sec)

PAL Video

- 625 scan lines repeated 25 times per second (i.e. 40 msec/frame)
- Interlaced scan lines divide frame into 2 fields each 312.5 lines (i.e. 20 msec/field)
- Approximately 20% more lines than NTSC
- NTSC vs. PAL roughly same bandwidth

(625-lines, 60-fields/sec)

Video Technology: Software Support for Video

- multimedia s/w architectures supporting video
- will possess
  - s/w components for creation, storage, and playback
  - standard formats
  - codecs

Video Players for your PC

- To play a movie on your computer, you need a multimedia player
  - e.g. an MPEG player or QuickTime player.
- These players are also called decoders because they decode the MPEG or QuickTime, RealNetworks, etc. compressed codes.
- Some software allow you to both encode and decode multimedia files,
- Some software only allow you to play back multimedia files

QuickTime

- An ISO standard for digital media
- Created by Apple Computer Inc., 1993
- Audio, animation, video, and interactive capabilities for PC
- Allow integration of MPEG technology into QuickTime.
- QuickTime is available for MS Windows/NT as well
- QuickTime movies have file extension .qt and .mov.
- ftp://ftp.intel.com/pub/IAL/multimedia/indeo/utilities/smartv.exe
- converts quicktime to avi and back

Capturing: video cameras

- Intention
  - Transformation of two-dimensional picture into a one-dimensional electrical signal by means of scanning process (e.g., line by line)
  - Principle of operation:
    - Plate of photosensitive material
    - Evolving of a change in material depending on amount of light at each spot
    - Charge read-out:
      - Emitting an electron beam onto the plate
      - Collecting generated signals
    - Alternative: silicon chip (charge coupled devices)