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
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/](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: 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

Signal Format

<table>
<thead>
<tr>
<th>Line 1</th>
<th>vertical blanking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 21</td>
<td>Field 1</td>
</tr>
<tr>
<td>Line 263</td>
<td>vertical blanking</td>
</tr>
<tr>
<td>Line 283</td>
<td>Field 2</td>
</tr>
<tr>
<td>Line 525</td>
<td></td>
</tr>
</tbody>
</table>
**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
  - laser disc 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.
- 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)