CS 414 – Multimedia Systems Design

Lecture 11 – MPEG-4 Video (Part 6)

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Administrative

- MP2 was posted on Monday, February 9th and deadline will be Monday, March 2nd
  - Please, start early – we will have two discussion sections for MP2
  - The first discussion section will be on next Monday

Interact With Visual Content

MPEG-1/MPEG-2

- Pixel-based representations of content
  - takes place at the encoder
- Lack support for content manipulation
  - e.g., remove a date stamp from a video
  - turn off “current score” visual in a live game
- Support manipulation and interaction if the video is aware of its own content

Original MPEG-4

- Conceived in 1992 to address very low bit rate audio and video (64 Kbps)
- Required quantum leaps in compression
  - beyond statistical- and DCT-based techniques
  - committee felt it was possible within 5 years
- Quantum leap did not happen

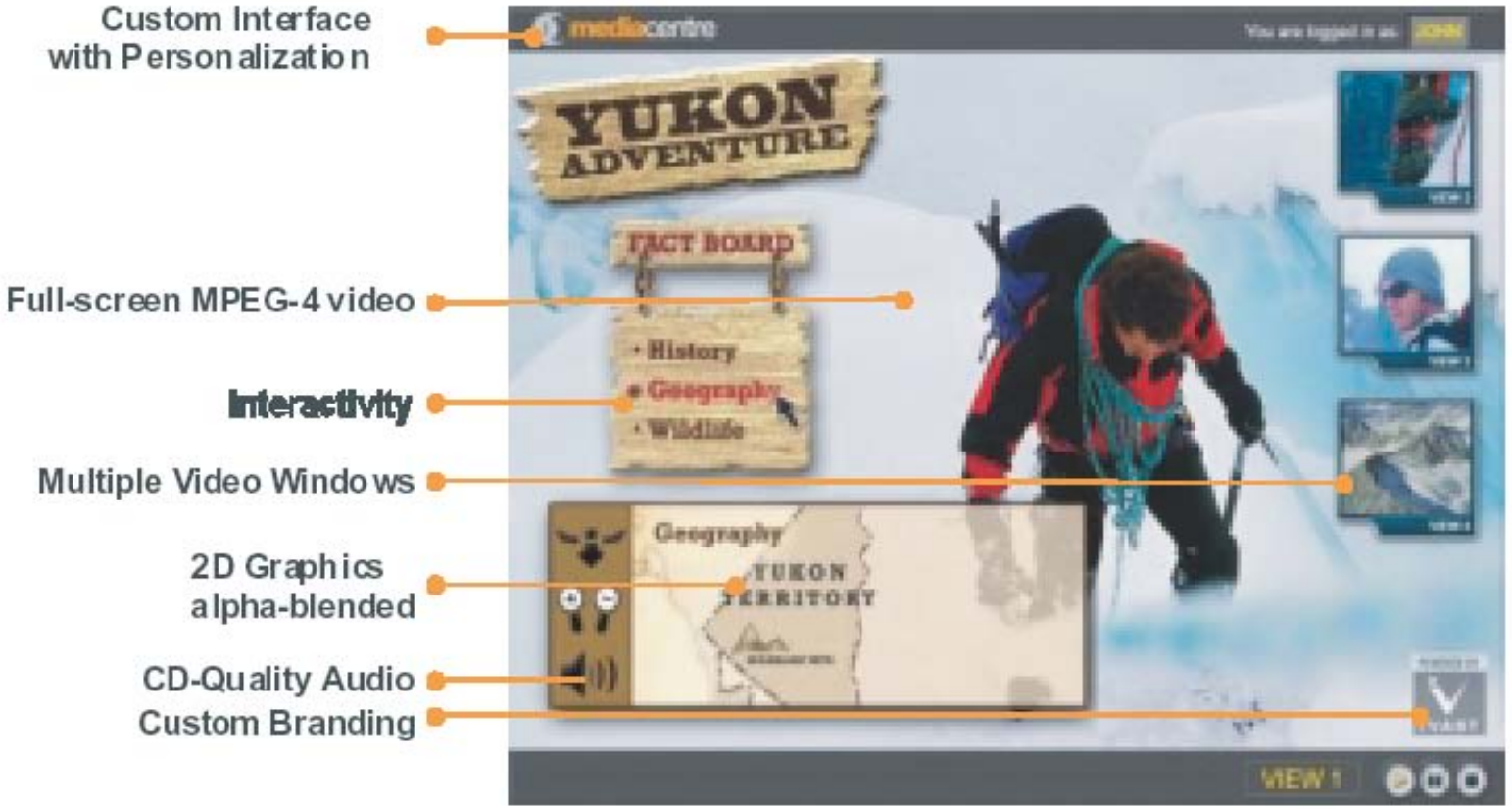
The “New” MPEG-4

- Support object-based features for content
- Enable dynamic rendering of content
  - defer composition until decoding
- Support convergence among digital video, synthetic environments, and the Internet

MPEG-4 Components

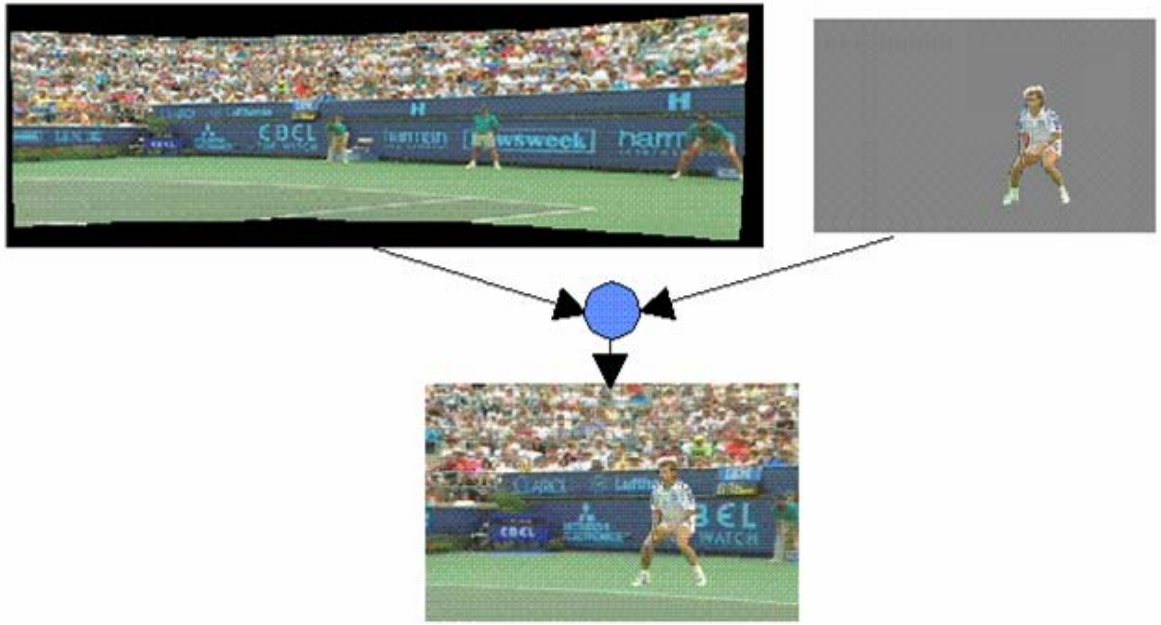
- Systems – defines architecture, multiplexing structure, syntax
- Video – defines video coding algorithms for animation of synthetic and natural hybrid video (Synthetic/Natural Hybrid Coding)
- Audio – defines audio/speech coding, Synthetic/Natural Hybrid Coding such as MIDI and text-to-speech synthesis integration
- Conformance Testing – defines compliance requirements for MPEG-4 bitstream and decoders
- Technical report
- DSM-CC Multimedia Integration Framework – defines Digital Storage Media – Command&Control Multimedia Integration Format; specifies merging of broadcast, interactive and conversational multimedia for set-top-boxes and mobile stations

MPEG-4 Example



ISO N3536 MPEG4

MPEG-4 Example



ISO N3536 MPEG4

MPEG-4 Example

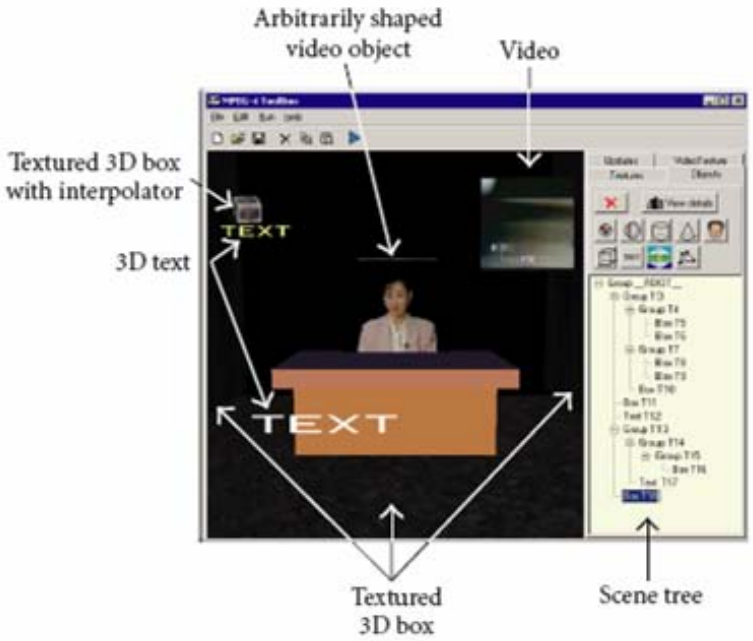
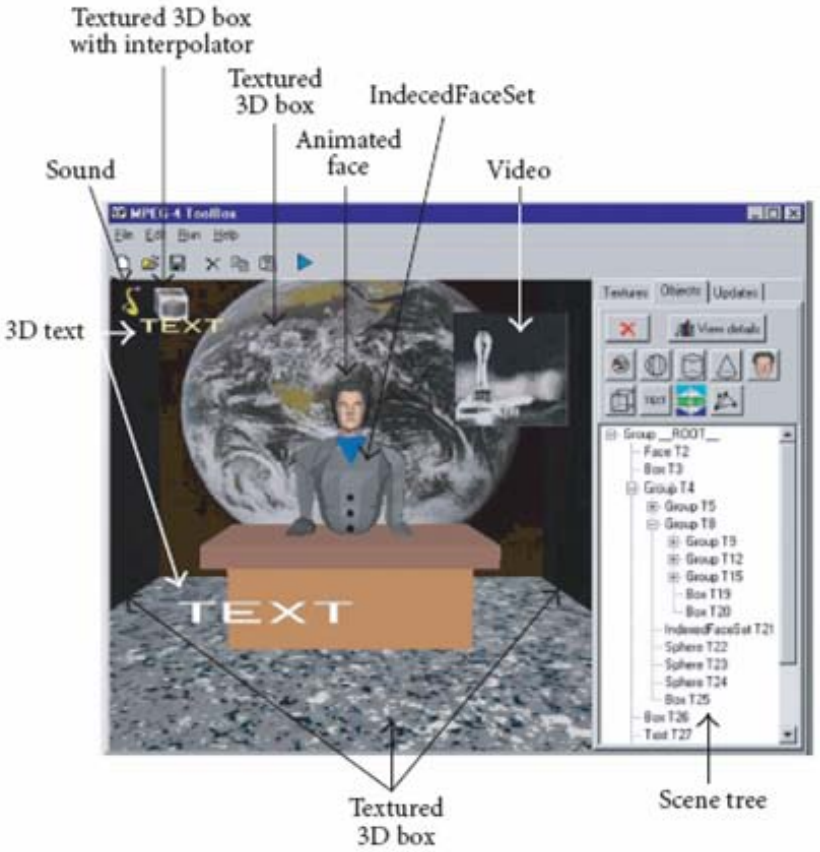


FIGURE 20: The virtual studio scene using arbitrarily shaped video objects in the Authoring tool.

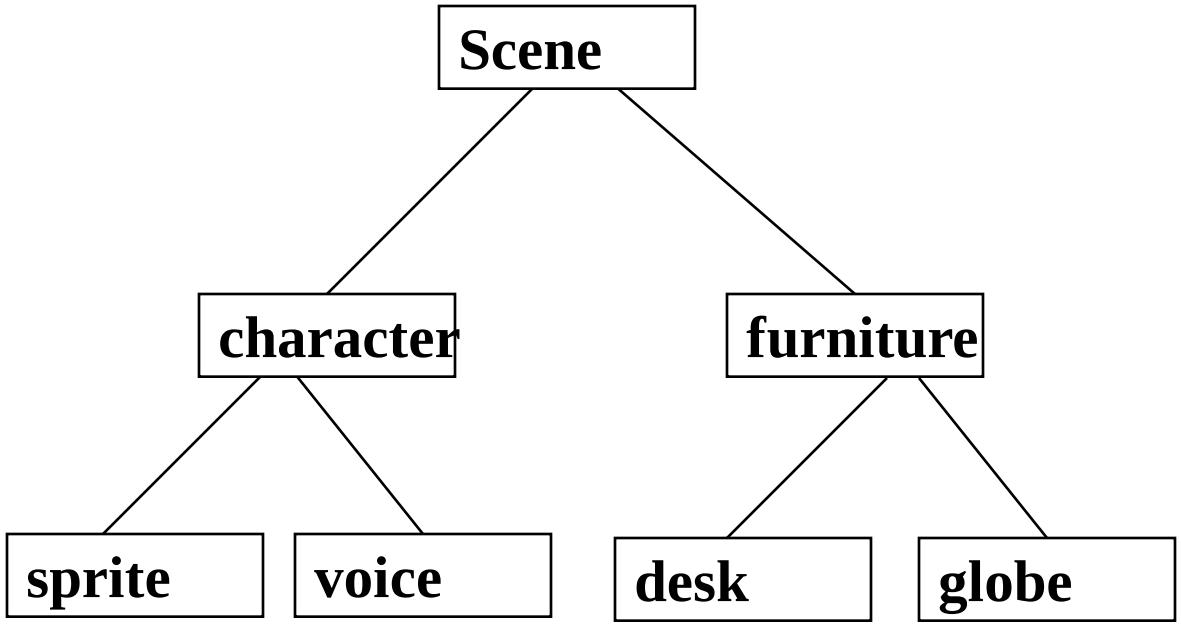


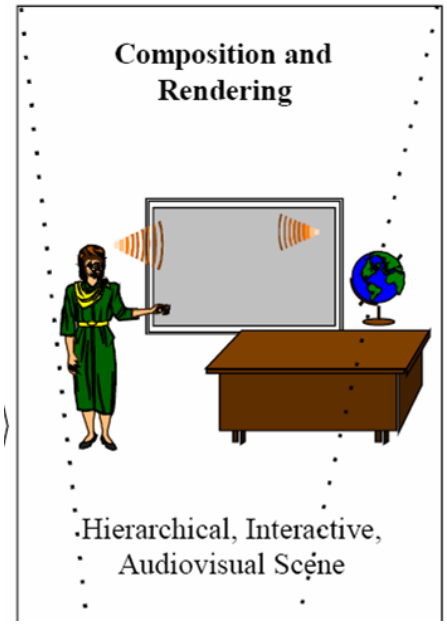
Daras, P. MPEG-4 Authoring Tool, *J. Applied Signal Processing*, 9, 1-18, 2003

Media Objects

- An object is called a *media object*
  - real and synthetic images; analog and synthetic audio; animated faces; interaction
- Compose media objects into a hierarchical representation
  - form compound, dynamic scenes

Composition



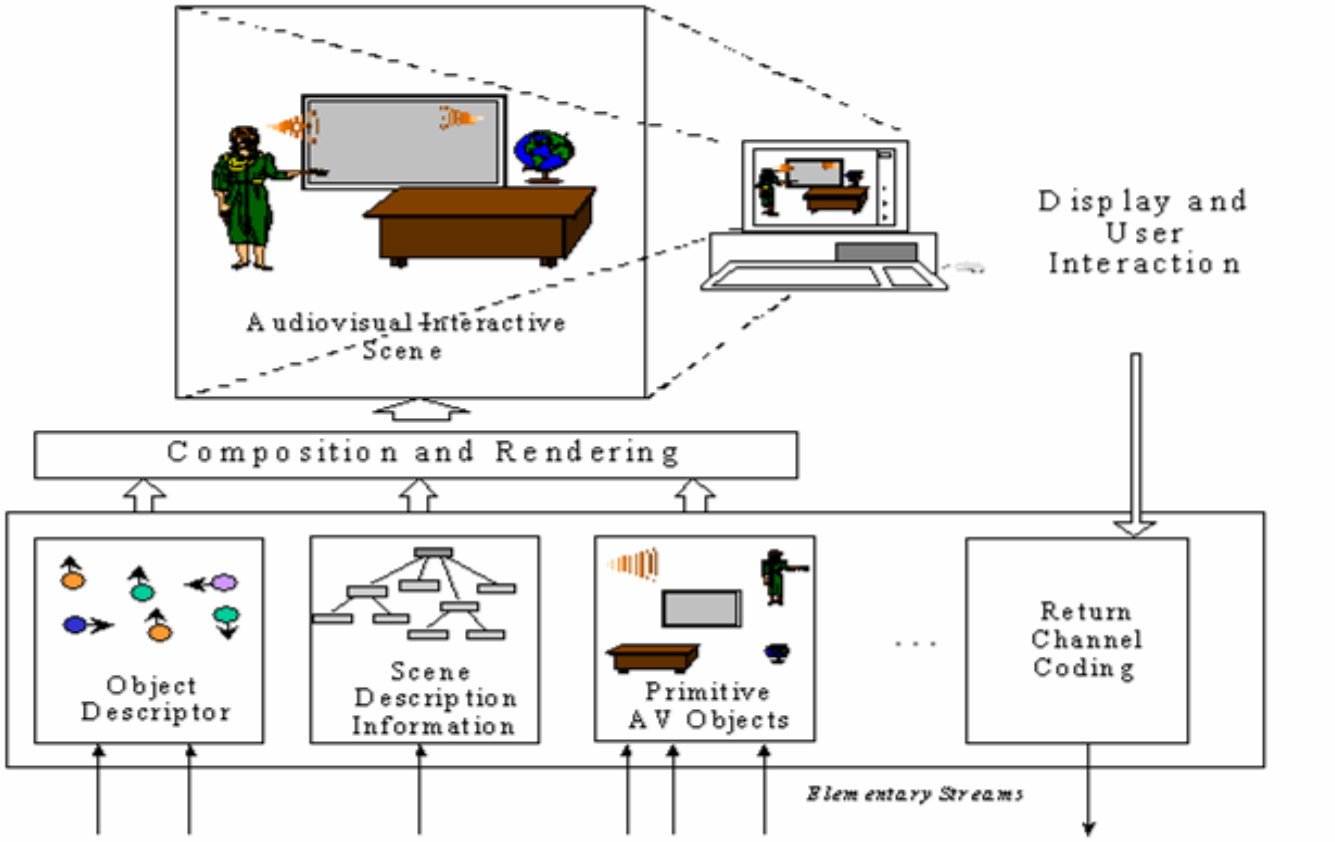


ISO N3536 MPEG4

Composition (cont.)

- Encode objects in separate channels
  - encode using most efficient mechanism
  - transmit each object in a separate *stream*
- Composition takes place at the decoder, rather than at the encoder
  - requires a binary scene description (BIFS)
- BIFS is low-level language for describing:
  - hierarchical, spatial, and temporal relations

MPEG-4 Rendering



ISO N3536 MPEG4

Interaction as Objects

- Change colors of objects
- Toggle visibility of objects
- Navigate to different content sections
- Select from multiple camera views
  - change current camera angle

- Standardizes content and interaction
  - e.g., broadcast HDTV and stored DVD

Hierarchical Model

- Each MP4 movie composed of tracks
  - each track composed of media elements (one reserved for BIFS information)
  - each media element is an object
  - each object is a audio, video, sprite, etc.
- Each object specifies its:
  - spatial information relative to a parent
  - temporal information relative to global timeline

Synchronization

- Global timeline (high-resolution units)
  - e.g., 600 units/sec
- Each continuous track specifies relation
  - e.g., if a video is 30 fps, then a frame should be displayed every 20 units
- Others specify start/end time

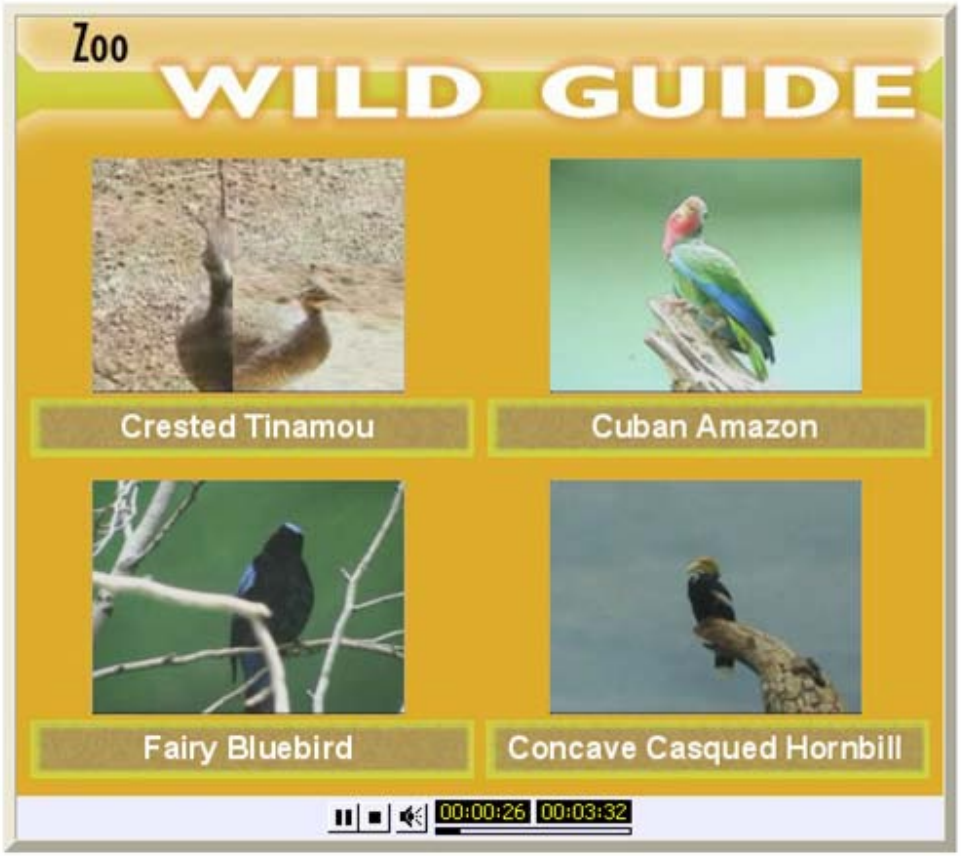
MPEG-4 Audio

- Bit-rate 2-320kbps
- Sampling up to 96Khz
- Scalable for variable rates
- MPEG-4 defines set of coders
  - Parametric Coding Techniques: low bit-rate 2-6kbps, 8kHz sampling frequency
  - Code Excited Linear Prediction: medium bit-rates 6-24 kbps, 8 and 16 kHz sampling rate
  - Time Frequency Techniques: high quality audio 16 kbps and higher bit-rates, sampling rate > 7 kHz

Conclusion

- A lot of MPEG-4 examples with interactive capabilities
- Content-based Interactivity
  - Scalability
    - Spatial Scalability
    - Temporal Scalability
  - Sprite Coding
- Improved Compression Efficiency (Improved Quantization)
- Universal Accessibility
  - re-synchronization
  - data recovery
  - error concealment

Another Interaction



Interactive Drama

http://www.interactivestory.net