Tablet PC-Based Indexed Captioned Searchable Videos for STEM Coursework

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Background

Tablet PCs allow free mixing of prepared viewgraphs and on-the-fly annotations for teaching. PC Video lectures are widely used for STEM education.

Objectives

- Development of “ICS Videos” Framework for quick access to video content with:
  - Index Snapshots
  - Keyword Search
  - Text Captions

Evaluation of ICS Videos for STEM Coursework with extensive deployment and assessment with student surveys and instructor interviews.

Indexing

- Summary: Videos are automatically divided into logical segments, each represented by a visual index snapshot. User can start video playback from any index point.
- Automatic indexing: 1) Identify all “Transition points” where the picture on the video changes significantly and 2) Select “Index points” as a subset of transition points that are roughly evenly distributed.
- Status: Deployed since Summer 10.

Search

- Summary: User types a keyword; all video segments that match the keyword are presented.
- OCR: Off the shelf OCR tools to extract text from video frames. Enhanced with a suite of preprocessing image transformations. Accuracy significantly enhanced with image transformations – from ~91% to ~97%.
- Status: Evaluated Since Fall 10, Deployed form Spring 11.

Captioning

- Summary: Scrolling text for the audio. Main purpose is to make mainstream lectures available to deaf students.
- Speech Recognition can be employed, but exhibits high error rates. Extensive instructor-specific training needed for acceptability.
- Status: Captioning is supported by the ICS video player but manual transcription of audio text is currently employed. Design influenced by the Texas School for the Deaf. Wider availability of captions from Spring 11.

Conclusions

- Videos of Tablet PC based lectures proved to be a versatile academic resource beyond expectations. Videos have special value for students striving for life balance with, e.g., jobs, long commutes, or caring for children or the elderly.
- Key shortcoming of ordinary videos is the difficulty of locating content of interest. Indexing is shown to help significantly in this. Users of Indexing perceived videos to have a greater value.
- We expect to establish that keyword search has impact similar to indexing. Captioning is being deployed to make the videos accessible to deaf students.
- Automatic methods were effective in driving indexing and keyword search. Speech recognition for captioning is a challenge -- hybrid approaches found to be most practical.

Deployment

Integrated with VNET Course management system at University of Houston for extensive deployment and usage. Current use by over 20 courses. Main usage centers:

- UH Biology, Computer Science, Geology, Mathematics, and Physics
- University of Houston Downtown Campus Computer Science
- Testing and feedback from the Texas School for the Deaf
- Freely available to all interested educational institutions

Evaluation

The evaluation is based on student surveys from Fall 2009, Spring 2009, and Spring 2010, totaling 1,839 usable surveys.

Profile of UH Students Surveyed:

- Very diverse
- Long commutes, avg 40 mins
- 60% work part time
- Only 66% native English speakers
- 90% used videos when available, yet almost all believe it is important to go to class

What Students are Saying: Representative Comments

On Video Usage: “To review dense or quickly presented material that I could not take adequate notes on in class, I listened to it on my iPod whenever I get stuck in traffic coming or to leaving campus”

On Indexing: “it enabled me to jump directly to my trouble spots” “I didn’t have to wade through the rest of lecture just to answer one question” “Well, sometimes I would have to pause the lecture to take care of other responsibilities that I had to attend too, and when I was ready to come back to the lecture I’d pick up exactly where I was at, it was great!”

Contributors