Advanced Mobile Lecture Viewing: Summarization and Two-Way Navigation

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ABSTRACT

In this work, the authors present a fully automated recorded lecture summarization tool and an innovative mobile iPad visualization tool. Summarization works for blackboard-based lectures by robustly extracting blackboard edits with great accuracy and high performance. Analysis output is then presented with overview and visual timelines along the original video to allow discovering lecture passages based on time. A second option allows students navigating contents in space by allowing revisiting blackboard elements directly by touching regions in the video. Proposed summarization, temporal and spatial navigation along with interactive visual annotations bring to recorded lectures the benefits that other digital learning material has long enjoyed and entice a younger generation of learners.

Keywords: Blackboard Analysis, iOS, iPad, Mobile Learning, Recorded Lectures, Video Skimming, Video Summarization

INTRODUCTION

For years video has been used to record lectures for distance learning and reviewing (Brofferio, 1998). Indeed video has the power to capture and reproduce more lecture and presentation features than any other widely available media like text transcriptions or audio recordings: in addition to presenting text, illustrations and speech, video also conveys lecturer’s gestures, interactions with the audience and the classroom scene in general.

Recording and sharing lectures has also got a lot easier in recent years as there is no longer need for dedicated recording crews, invasive capture devices or specially tailored classroom environments. In sum, any lecturer can now setup a tripod-mounted camera and record his entire presentation without assistance (Soong, Chan, Cheers, & Hu, 2006). Resulting videos can then be shared using free Internet lecture and educational videos’ repositories such as iTunes U (Apple Inc., 2007) and YouTube EDU (Google Inc., 2009) among others.

Going All Digital, and Mobile

The enthusiast way our education community embraced new technologies can be first explained by the effectiveness for creating and de-
delivering digital learning material. Additionally, with the advent of mobile platforms, reaching learners has never been this straightforward (Ormond, 2008).

A second reason why eLearning has been received so warmly is the fact that most learning material has been significantly enhanced when going digital. For example textbooks and printed material have gained in interactivity and navigability allowing students to browse text and image-based material in small chunks and in the order that best suits their learning path, all while skipping unneeded content with unprecedented ease.

Notable exceptions to such digital enhancements are recorded lecture videos. Although producing recorded lectures is more accessible and popular than ever, we cannot help wondering if at the other end students will be genuinely interested in resulting videos and their inherent media shortcomings.

**Video’s Media Limitations**

Ever since becoming mainstream video has largely remained unchanged: from videotape recordings to high definition broadcasts—all conceived with entertainment content in mind—video is still a rigid and linear medium. While general entertainment videos can be watched from beginning to end sequentially, and knowledge about the actual contents and their structure is not critical, recorded lectures are not suitable for such passive viewing. After all a typical lecture repository consists of hefty video files with dozens of recorded hours of overwhelmingly indistinguishable content.

A typical video player, such as the one illustrated in Figure 1, doesn’t provide navigation cues other than an inexpressive timeline without any real useful information besides the current playing position and duration of the recording while lecture contents remain obscure. In most cases users have no other option than blindly jumping around the video, or even worse, skipping recorded lectures altogether because of frustration.

With our research we intend to provide a complete solution for learners with intuitive information of recorded lecture contents to enable them to precisely find sections of interest and browse recordings without guesswork. At the same time we aim to leverage videos’ interactivity and navigation features by providing several visual cues and annotations features.

In the next section we first describe an automated summarization tool that we have developed for blackboard-based recorded lectures. Later on we present our mobile visualization tool that combines source lecture videos with our summarization analysis output to provide a novel lecture viewing experience.

**SUMMARIZING LECTURES**

Summarization consists in discarding highly similar video sections while retaining only the most significant elements to succinctly describe the contents of a recording. Automated summarization is a hot research topic (Money & Agius, 2008) and lots of work has been done towards characterizing general videos where edition cuts, different camera angles, recording locations and multiple individuals clearly mark shot boundaries greatly simplifying automated scene’s feature extraction (Ciocca & Schettini, 2006a; Smith & Kanade, 1998). Summarizing documentary educational videos (Luo, Gao, Xue, Peng, & Fan, 2008; Song, Marchionini, & Oh, 2010) shares many aspects of general videos’ summarization techniques with visually recognizable passages and cinematography elements. As for digital slides-based presentations and lectures they are commonly summarized based on their already structured source files in PowerPoint or PDF file formats (Mittal, Pagalthivarthi, & Altman, 2006; Mukhopadhyay & Smith, 1999; Repp & Meinel, 2006).

On the other hand, blackboard-based recorded lecture lack dramatic scene changes with mostly static shots: all the action takes place in an immutable indoor classroom and the main character, the lecturer, is by far the central character. Resulting recording passages seem all too
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