Interaction Techniques for Mobile E-Lectures

Jochen Huber
Technische Universität Darmstadt
Hochschulstraße 10
Darmstadt, 64289 Germany
jhuber@tk.informatik.tu-darmstadt.de

Jürgen Steimle
Technische Universität Darmstadt
Hochschulstraße 10
Darmstadt, 64289 Germany
steimle@tk.informatik.tu-darmstadt.de

Max Mühlhäuser
Technische Universität Darmstadt
Hochschulstraße 10
Darmstadt, 64289 Germany
max@tk.informatik.tu-darmstadt.de

CHI 2010, April 10–15, 2010, Atlanta, Georgia, USA.
ACM 978-1-60558-930-5/10/04.

Abstract
With the advent of increasingly powerful mobile devices like Apple's iPhone, e-lectures can be used in mobile learning scenarios virtually anywhere and anytime. However, state of the art mobile video browsers do not support learners in getting an overview on and navigating between the large amounts of semantically related e-lectures, which are available in various digital libraries. We contribute a novel user interface for the mobile navigation of large e-lecture libraries comprising two novel spatial interaction techniques for the mobile, nonlinear interaction with multiple e-lectures. Evaluation results show that our solution leads to significantly higher efficiency and user satisfaction.

Keywords
Multimedia, mobile devices, video browsing, e-lectures

ACM Classification Keywords
H5.2. Information interfaces and presentation: User Interfaces.

Motivation and Position
The ubiquitous availability of multimedia learning material through digital libraries like for instance iTunes U [4] has paved the way for groundbreaking changes in mobile learning. Increasingly capable mobile devices

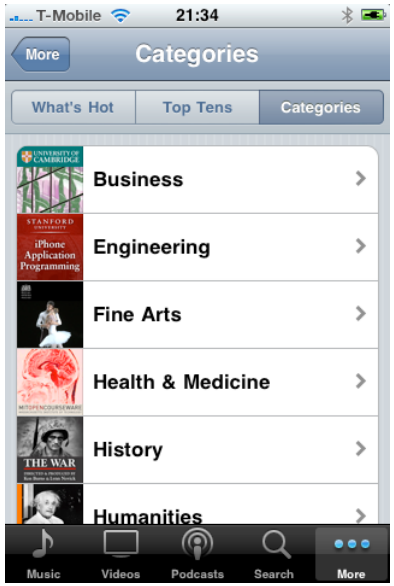

Figure 1. iTunes U digital library browser on the iPhone OS. Users can either search for lectures using the search button at the bottom or select appropriate lectures from various categories. However, lectures can only be watched as an ordinary movie. It is impossible to either access slides directly or navigate between semantically related e-lectures.

like Apple's iPhone, empower learners to access recorded classroom lectures (so-called *e-lectures*) almost anytime and anywhere. E-Lectures consist of various, synchronous multimedia streams, typically an audio recording of the lecturer's talk (*audio stream*) and (probably annotated) presentation slides (*whiteboard stream*). A video of the lecturer (*video stream*) is not necessarily presented due to its low information content [3]. A recent study [2] found a shift in the usage habits of students towards using the mobile version of e-lectures.

Fostering a good learning process should not only comprise the usage of individual e-lectures. Like it is common practice with textbooks or web pages, various topically related lectures from different institutes or lecturers should be included. Hence, learners are able to for instance receive elaborate explanations for a certain problem, e.g. an alternative description of an algorithm. Furthermore, several topically related lectures can be used to gain deeper insight into a specific problem domain from a slightly different point of view.

This practice is possible nowadays due to the vast amount of e-lectures available online from various universities. However, state of the art mobile video browsers do not support the user sufficiently in these tasks which involve the use of multiple e-lectures. A learner would have to (1) identify potential lectures in the digital library browser (see Fig. 1), (2) scan each lecture sequentially to check whether it really covers the right topic and (3) note down or memorize the occurrences and correct positions within the lecture recording. Hence, it is impossible for learners to complete this task in a reasonable amount of time in a mobile setting.

These observations let us formulate two key requirements for mobile e-lectures:

1. Mobile video browsers shall not only support learners when watching a *single* e-lecture but shall highlight the very relationships *between various* e-lectures. Hence, users will be able to learn within an interwoven web of e-lectures. As a direct consequence, browsers shall support learners in *getting an overview on* and navigating *between* topically overlapping e-lectures.

2. Learners shall be able to use this interwoven web of e-lectures efficiently on mobile devices, overcoming their limited device characteristics like small form factors and displays.

Based on these requirements, we have developed an interface concept for the mobile navigation of large e-lecture libraries, which is to the best of our knowledge the first approach. This comprises two novel, spatial interaction techniques for the mobile, nonlinear interaction with e-lectures. In the remainder of this paper, we first present our concept before reporting on evaluation results. Finally, we outline open research questions which should be addressed within the community as future work.

Concept

The main goal for our interface concept can be deducted from the requirements for mobile e-lectures formulated above. The interface shall allow for an intuitive interaction *within* and *between* e-lectures.

Moreover, it shall foster awareness of e-lecture interrelationships, despite the mobile device's small screen. Due to these facts, we have utilized a simple but powerful spatial, two-dimensional metaphor. The horizontal dimension is used to browse within a lecture recording. The vertical dimension is used to navigate between topically related e-lectures. Topical relationships are expressed as hyperlinks between the lecture slides. We assume that these links are created automatically. Furthermore, it is also possible to enhance the user interface to allow users the manual creation of links between slides.

The arrow up indicates that other e-lectures contain content, which is similar to the currently viewed slide. By flicking downwards, the user interface moves up and reveals the related lectures (see Fig. 3).

Users can navigate directly through the multimedia streams by flicking horizontally. Flicking from right to left switches to the next slide and vice versa.

The lecture slides are aligned in a grid. Slides can be switched by simply tapping onto the miniaturized versions. It is also possible to zoom in by double tapping the grid. The current slide is highlighted in the grid.

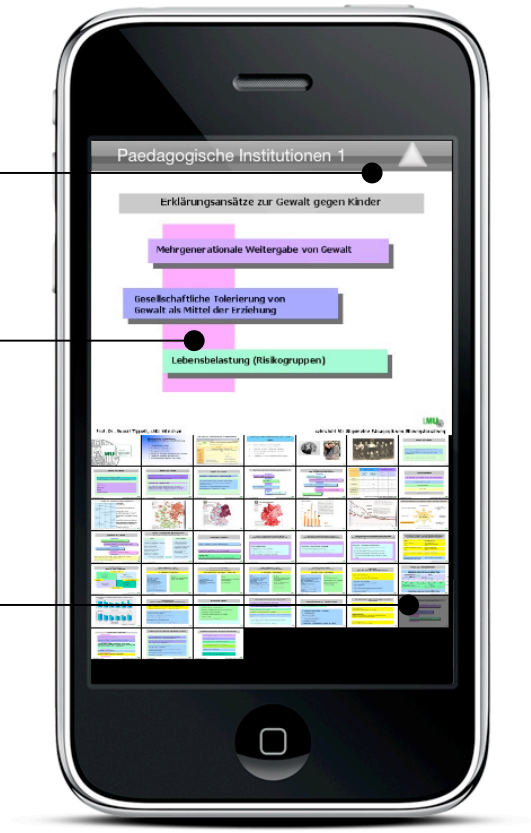

Figure 2. User interface screenshot of our mobile e-lecture browser.

Horizontal Navigation: Within an E-Lecture
Figure 2 shows a user interface screenshot of our e-lecture browser. The user interface is subdivided into two areas. The upper part shows the current slide in detail, whereas the lower part shows an overview over all slides, which are available in the whiteboard stream of the current lecture. Users can navigate through the multimedia stream by simply flicking horizontally through the upper part of the user interface. Playback of the lecture can be started by either simply rotating the device into landscape mode or double tapping the current slide in the upper part.

Vertical Navigation: Between E-Lectures
Whenever an e-lecture overlaps topically with other e-lectures in the digital library (e.g. two slides cover the same topic), available relationships are indicated by a small arrow in the upper right corner of the user interface (see Fig. 2). When the user flicks downwards, the interface is being scrolled downwards, revealing related e-lectures as shown at the bottom of Figure 3. In this case, two interlinked e-lectures (visualized using grey boxes) contain relevant material. By tapping one of the lectures, the interface is being scrolled down further, thereby displaying the whiteboard- and video-stream of the interlinked segments of the lecture (see Fig. 3 top). These can also contain topical relations to other e-lectures, which are thence visualized again with a small arrow in the upper right corner.

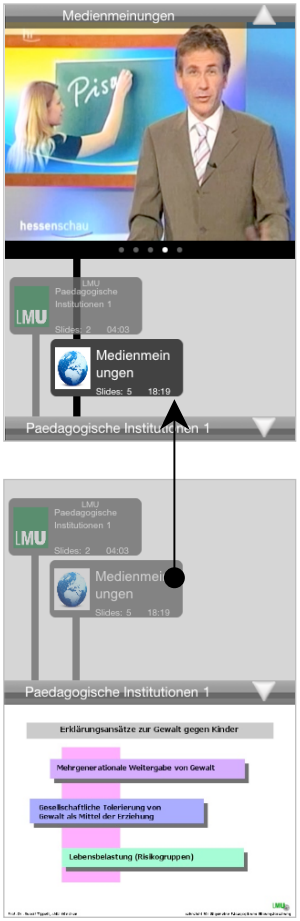

Figure 3. Browsing topically related recordings.

By aligning semantically related e-lectures vertically, the browsing history results in a vertical stack, which can be navigated by simply flicking vertically up and down respectively.

Evaluation

We have evaluated our prototypical implementation for the iPhone OS in a controlled experiment with 44 participants (30 male, 14 female) with different backgrounds. Each single-user session lasted about 2 hours. The overall goal was to evaluate the effectiveness, efficiency, learnability and attractiveness [1] of the e-lecture browser, as well as user satisfaction. The tasks of the participants comprised simple fact finding tasks as well as advanced knowledge integration tasks, each relying on multiple e-lectures. The sessions were video-recorded. Moreover, semi-structured interviews were conducted and quantitative feedback was gathered using the system usability scale (SUS) questionnaire.

In our experiments, we found that users completed the tasks about 56% faster and committed about 65% less usability errors using our spatial metaphor than with an enhanced standard iPhone media player. We enhanced the iPhone media player by adding the possibility to switch forth and back between slides and integrated topical relationships which are being displayed as textual hyperlinks on the slides. Evaluation results furthermore show that our user interface supports the user's orientation when navigating multiple e-lectures. Moreover, statements in the interviews showed that the two dimensional browsing metaphor fosters the learners' awareness of interrelated e-lectures. The average SUS score for our e-lecture browser is 83.07, whereas the enhanced iPhone player scored 58.98.

Finally, our e-lecture browser was perceived as far more attractive (with an average score of 6) than the enhanced iPhone media player (with an average score of 2.5 on a 7-point Likert scale).

Future Work

This user interface concept is a first step towards supporting learners when browsing multiple, topically related e-lectures in mobile learning scenarios. Although we addressed the physical limitations of mobile devices by employing a spatial navigation metaphor, the qualitative evaluation of our study shows evidence that users demand more screen real estate in order to e.g. grasp further visual details of the content. Further screen space may be for instance available through interactive surfaces in urban pervasive environments or dynamically created using pico projectors in arbitrary mobile settings. Hence, it is of major interest how we can leverage the unique affordances of these new technologies and therefore extend the user interface beyond the device to further enlarge our spatial navigation metaphor.

References

[1] Hassenzahl, M., Platz, A., Burmester, M., and Lehner, K. Hedonic and ergonomic quality aspects determine a software's appeal. In Proc. CHI 2000, ACM Press (2000), 201–208.

[2] Hürst, W., Welte, M., and Jung, S. An evaluation of the mobile usage of e-lecture podcasts. In Proc. Mobility 2007, ACM Press (2007), 16–23.

[3] Lauer, T., Müller, R., and Trahasch, S. Learning with lecture recordings: Key issues for end-users. In Proc. ICALT 2004, IEEE (2004), 741–743.

[4] iTunes U. http://www.apple.com/education/mobile-learning/.