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ITP4247

Presentation Recording as a Means to go Virtual for Campus-Based Universities

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INTRODUCTION

Distance education is no longer a monopoly for specialized Open Universities, such as the OU [1] in the UK or the FU Hagen [2] in Germany anymore. Traditional universities have also begun to virtualize parts of their curricula by offering Web-based courses. In particular in computer-related fields such as Computer Science, Information Technology and parts of Business Administration the use of computers in daily work is so common that it is quite natural to use this instrument also for knowledge mediation in these fields. Traditional universities, however, have little or no experience in distance education. In this paper we start with an analysis of the reasons why it is difficult for campus-based universities to virtualize parts of their curricula. Then, we propose a technological solution to overcome many of the difficulties, known as presentation recording or electronic note-taking. Our arguments are based on experiences gained over the last couple of years in several large-scale joint projects which have the ambitious goal of allowing students enrolled in a campus-based university to study Computer and Information Science as a mixture between traditional on-site and Web-based distance education.

INHERENT PROBLEMS IN E-LEARNING PROJECTS

Several years of effort and the expense of hundreds of millions of Euros have not been not enough to achieve a breakthrough in virtualizing parts of the educational offers of campus-based universities. What are the reasons for this phenomenon?

Cost-value ratio: In projects, such as VIROR [3], vhb [4], SVC [5], which may be considered as fairly representative for Europe, several hundred thousands of Euros per course are spent just for content development. This requires the amortization of these costs by using the course material for teaching large numbers of students. It is, however, highly questionable whether the expected or required numbers will ever be achieved. Furthermore, running a Web course will require additional expenses for tutorial guidance and the course content has to be continuously revised and updated. This observation strongly supports the idea of decreasing the production costs drastically by increasing the degree of automation in the production process of multimedia documents as explained below.

Added value: The intention when introducing networked multimedia is often a didactical revolution among other aspects. We believe that beyond that there is still a wide spectrum of possibilities of improving the teaching and learning by using the new technology. Our students appreciate already that they can find all relevant information for a traditional course offered on campus in the Web, such as syllabus, slides, lecture notes, literature hints, assignments etc. Well-done presentation recordings in particular provide a clear added value, as has been shown in [6].

Research vs. production: In most e-learning projects carried out at European universities the course material is actually produced by graduate students qualifying themselves for a Ph.D. Fortunately, in computer-related disciplines it is possible to combine the two conflicting objectives, research and development, in e-learning projects. Therefore, technology-driven projects dominate with a clear research focus. Psychology, pedagogy, and cognitive science have also many possibilities of combining media project work with research interests. In most other disciplines the production of media-rich content is left to a few enthusiasts who are willing to ignore the common research-oriented incentives ruling classical universities.

Acceptance conflicts: It is difficult to share e-learning modules between different institutions. Curricula at universities are planned and developed beforehand over a long period of time. Therefore it is rather accidental if a course offered by one university fits exactly into the curriculum, let alone in the same subject of another. Acceptance conflicts can be avoided if e-learning offers are additional: both students and faculty appreciate when a speciality not present at one institution can be imported from another. In this way, the spectrum of possibilities of studying can be broadened by technological means. This is the idea underlying the joint effort of a dozen Computer Science departments in Germany called ULI (University Teaching Cooperation in Computer Science, [7]) including the FU Hagen.

Profiling: The structure of curricula and the mode of teaching form an essential part of the characteristic profile of a university and, therefore, are in conflict with the goal of sharing and reusing e-learning modules. This is clearly understood by the leading educational institutions all over the world: MIT, Stanford, ETH Zurich, and many others develop their own brand name for their e-learning offers and aggressively try to market them world-wide. This is a further argument for traditional universities to invest in the development of highly topical specialities for rather small target groups taught by leading experts in one field instead of producing standard courses for mass education. It requires, however, to decrease drastically the effort and costs of producing the specialities.

Organisation and sustainability: Most e-learning projects currently carried out at universities are still concentrated on the preparation of appropriate (adaptive) media-rich course content. Except the Open Universities, that have the explicit mission to offer distance education, only a very few traditional universities have gained first experiences in courses taught in a distance mode. These experiences show that it is seldom sufficient to make the content accessible over the Internet. It is necessary to provide a full service including registration, administration, course management, assessment, accreditation, tutoring, communication, etc., a service which is not easily scalable. Moreover, the service must be offered beyond the end of the short-term projects. This requires the allocation of permanent resources (staff and investment), a well-known difficult matter regarding the budget restrictions of universities.

SYNCHRONOUS VERSUS ASYNCHRONOUS MODE OF LECTURING

We may distinguish two different e-learning scenarios, the synchronous and the asynchronous mode. In the synchronous mode different classrooms are connected via the Internet. Tools for audio and video communication, shared whiteboards and applications comprise the technical basis for the synchronous scenario. In the project VIROR we have gained a lot of experience with this scenario. There is, however, the common experience that the available tools are still insuffi-

This paper appears in *Issues and Trends of Information Technology Management in Contemporary Organizations,* the proceedings of the Information Resources Management Association International Conference.

cient. Some of the deficiencies also apply to the other scenario, the asynchronous mode: A lecturer who wants to transmit a computer presentation to remote locations or who wants to record a live lecture for later offline use has to use an electronic whiteboard as a substitute for the blackboard or slide projector. The available tools nowadays in widespread use for this task do not provide a convenient user interface for the lecturer nor do they support the fully automated transformation and access of the presentation recording as a Web-course. This is especially true, if a traditional blackboard and chalk lecture is recorded. Nevertheless, we will propose presentation recording as a very pragmatic approach for partially virtualizing education offered by campus-based universities which may overcome many of the above mentioned difficulties in current e-learning projects.

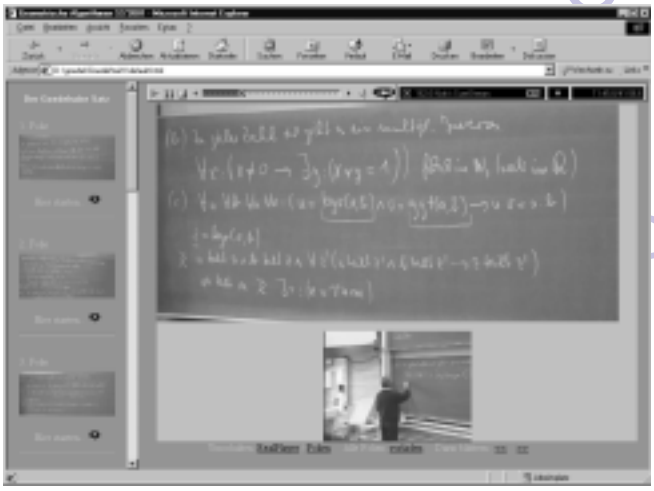
RECORDING A BLACKBOARD-AND-CHALK LECTURE

In this scenario the lecturer does not use any technical equipment at all, no digital whiteboard, no special pen, no pointing device, but just a blackboard and chalk. He can stay with his usual way of lecturing and he is not diverted by technology. In particular, mathematicians and theoretical computer scientists are keen to teach in this traditional mode, because it allows them to develop complicated lines of thought step by step in real-time on the blackboard. In a recent experiment, we have made such a live lecture offline accessible: The video of the lecturer is combined with digital high-resolution images taken from the blackboard whenever the lecturer had filled it with his handwriting. These digital images are necessary, because it is well known that video recordings alone do not lead to well readable material; furthermore, the lecture can be naturally structured by the blackboard shots, similar to structuring a lecture by the sequence of presented slides. The digital static images of the blackboard, the video and audio streams of the lecturer, and occasional camera swings into the audience were then transformed into an integrated RealMedia document for offline access. In our experiment all of these tasks have been carried out by hand and took about three times the time of the live lecture. But even if this mode of presentation recording is further automated including the post-processing steps, it will never become fully automatic.

PRESENTATION TOOLS

It is nowadays common to support teaching in class by slides or direct computer output. The advantage of using slides is that they can be taken from books. They can be prepared either by hand or by using an arbitrary text-processing tool. They are fairly "low tech" in the sense that the lecturer has not to fear any technical problems when presenting the slides. Slides can easily be annotated by handwritten notes during the live lecture. A disadvantage is that everything (except the annotations) remains purely static: You can not start an animation or simulation on a slide projector, though some lectures try this by overlaying series of slides. Direct computer output avoids unnecessary digital analogue conversions and supports a direct integration of arbitrary application programs into a computer presentation. However, it is usually not easy to annotate a computer presentation by handwritten notes or, simply, to use a pointing or highlighting device. The reason is that current presentation software, such as the widely used PowerPoint, still applies the desktop paradigm for interaction with keyboard and (tele-)mouse. In a lecture setting it is often much more natural to use an interactive screen or whiteboard with pen input in order to interact with the presentation software. We have gained a lot of experience with different devices of this kind ranging from a large rear-screen or on-screen, interactive whiteboards, such as the SmartBoard or the Intelliboard, and a high-resolution interactive LCD display, such as the WacomBoard. All of these boards allow pen input (beyond keyboard and mouse). None of them, however, achieve the "look and feel" of a real blackboard and chalk input (SmartBoard and Intelliboard), or of writing with pencil on paper (WacomBoard) yet. Currently, using the WacomBoard seems to offer the best compromise.

Figure 1: Recording of a blackboard and chalk lecture



THE "AUTHORING ON THE FLY" SYSTEM

Beyond the presentation and annotation of a series of prepared slides the presentation software should facilitate the recording of the presentation. In a series of projects we are pursuing this idea and combine the two apparently different tasks of teaching in class and of automatically creating multimedia documents for offline use. We have developed a new electronic note-taking system, the AOF system (Authoring on the Fly) for presentation recording and have routinely used it to record a large number of lectures, mainly in Computer Science. We will not describe the technical details of the AOF system in detail here, but refer instead to the following papers (Springer/ACM [12], ACM Multimedia [8], JUCS1 [9], JUCS2 [10]). From the user's point of view the most significant feature is the so-called unrestricted random access facility of the resulting AOF Documents. This allows a very convenient navigation during replay and provides a flexible mechanism to integrate AOF Documents into Web-based courses. So far nine complete courses have already been recorded as part of the above mentioned joint projects VIROR and ULI; they are available on local servers and have also been exported on CDROM for individual offline use by students.

Because many lecturers use PowerPoint to prepare their slides, we have developed an import filter. In contrast to simply importing PowerPoint slides as GIF images and importing them into the AOF whiteboard, our method extracts enough information from the source, and rebuilds the objects for the target system. Thus, not only the visual appearance of both the source and the destination documents are almost the same, but also the editing capability is preserved. Unfortunately, some objects and features like media clips, embedded objects, and integrated applications can not be converted. In JUCS1 [9] we discuss the problem of annotating, capturing and replaying arbitrary applications in a computer presentation in more detail.

OTHER APPROACHES TO PRESENTATION RECORDING

In this section we sketch other approaches that provide solutions of more or less automated presentation recording and replay. Some of them try to cover the full production process (from preparation over verification and test to presentation and recording, and post processing), some try to provide complete but customizable solutions including the synchronous scenario, integration of external applications, content server, assignment handling, and subject matter expert mechanisms. Others focus on offering large databases filled with contents of famous subject experts together with their recording and replay technology.

A survey covering the existing solutions for presentation recording and replay in the research area can be found in [11]. [12] includes a more recent and more complete description of the research or university solutions.

AREL is one of the newer players in the eLearning community and aims at providing full eLearning service mostly for major customers in the industrial sector. Their integrated system *AREL Spotlight* seems to provide everything from a learning management system over synchronous satellite downstream technology to presentation recording and replay tools. Nevertheless, the system seems to be more focused on the synchronous scenario, since even synchronous elements in presentations, such as tests, quizzes, embedded applications and questionnaires remain interactive during the replay.

Boxmind is a new startup company founded by a group at Oxford University, UK in 2001. The major aim is to act as a production service provider as well as content provider mainly for universities. They already offer a database of recorded presentations across almost all subject areas, partially given by experts famous in their areas. Colleges and universities can subscribe to this presentation database. It remains unclear what kinds of features their production service provides and whether their tools are available for individual production. The complete textual transcript offered during replay implies a fairly low degree of automation during the recording process.

The **Camtasia** suite of tools is based on a new Codec designed for screen capturing. It allows to add audio to the produced video clips and to export the recording in AVI format or as a streaming media file. For the playback of the Camtasia recordings either the stand-alone Camtasia player or Windows Media Player as well as the Real Player can be used.

Centra and **Interwise** are both full service providers mostly focused on the industrial sector. Centra tries to supply all customer needs regarding the complete eLearning spectrum with their tools and services, whereas Interwise is more concentrated on the presentation scenario – transmission, recording and replay. Both seem to offer a streaming replay including recorded applications and video over low-bandwidth connections. Despite the overwhelming information and documentation on their Web-sites and, maybe, due to missing suitable demonstrations, it is difficult to estimate what functionality in what coverage, complexity and quality their systems and services really provide. Regardless, it remains very questionable whether understandable audio, recognizable video in reasonable resolutions and complete recorded applications in whatever format can be simultaneously transmitted over ISDN or modem lines in real-time and with regard to synchronization aspects.

Eloquent provides with *LaunchForce* an environment which is predominantly focused on product presentations within the industrial area. The time-synchronous transmission, especially over company firewalls, as well as the asynchronous replay of recorded presentations seems to be supported. It remains unclear how scalable these transmissions are with regard to the number of participants. It appears that the company's emphasis is more on the authoring aspect than on the ad-hoc production of educational documents taken from presentations not especially prepared for recording.

The system of **HorizonLive** offers very similar features as LaunchForce from Eloquent. However, their intention is to provide an environment to realize a virtual classroom and is definitely directed into the educational sector. Their transmission technology is very scalable. The system's application sharing mechanism is realized through desktop grabbing (sequences of static images) and the replay is based on RealMedia technology.

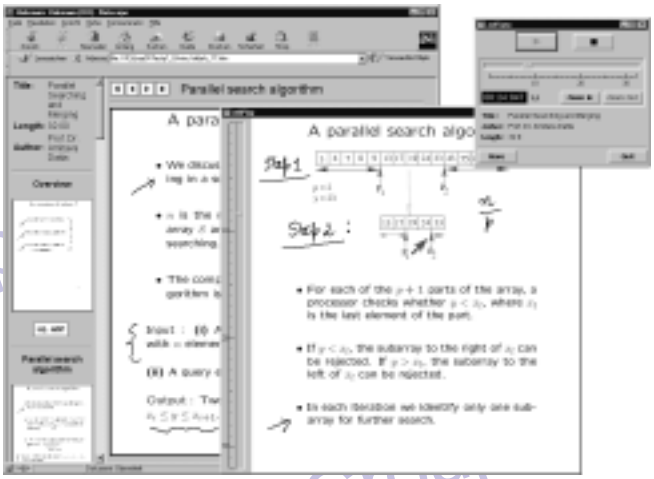
Recently also Microsoft offers a synchronization tool, **Microsoft Producer**, as an add-on for Microsoft PowerPoint 2002. It provides an easy way to capture and synchronize audio and video together with PowerPoint presentations and then to publish the captured document as a streaming media file.

Real Networks offers with *Real Presenter* a system to broadcast and record PowerPoint presentations as a sequence of static images together with audio and video. Dynamic effects, such as slide transition or animations, and graphical annotations on the slides are not supported. The result of a recording is a RealMedia document, where the different streams are synchronized over SMIL.

Another company providing a recording tool for PowerPoint presentations is *Cyberlink* from Taiwan, which is otherwise specialized on streaming video solutions for the consumer domain.

Other companies not discussed in detail but providing solutions for presentation transmission or recording are *Tegrity*, *NZEdSoft* and *TutorsEdge*. *Lotus* provides with *LearningSpace* and *Sametime* a groupware system also intented to session sharing and recording. *Groove* is another example for such a system.

Figure 2: Automatically generated Web version of a whiteboard lecture using the AOF system



FROM PRESENTATION RECORDINGS TO WEB-BASED COURSEWARE

In the traditional university teaching scenario one can clearly distinguish different phases in the learning cycle: Ex-cathedra lectures constitute the first phase in the learning cycle, the *presentation phase*. In most science studies (such as Math, Computer Science, Physics, etc.) the first phase alternates with the *dialog phase* in which the student has to submit assignments once a week or every other week. In Web-based courses the two phases are usually interlaced in a fine granular manner. Presentation recordings can be combined with tests and assignment parts in a similar manner, if the content has been appropriately modularised into small, self-contained parts. In this way we have produced a number of educational documents with presentation recordings as their core components, many of them containing also animations, simulations, tests, and assignments. We mention in particular a highly specialized, well-structured course given by a guest lecturer at the University of Freiburg in the summer term 2001 which was successfully transformed into a Web course by minimal additional effort [10]. The multimedia document generated in this course contains all the usual parts CS lecturers usually put on the Web for their students, such as syllabus, slides, assignments, solutions, further readings etc. These were combined with the automatically recorded live presentations given by the lecturer. They were made accessible both on the Web immediately at the end of each lecture and exported on CDROM at the end of the term. For assignment submission and correction the WebAssign system [13] developed at the FU Hagen was used. It is a Web-based tool that supports the electronic submission, correction and management of assignments for a large number of students in the same way as in a traditional on-site course. In this way, a complete Web course on Parallel Algorithms and Applications has

been produced almost automatically and in parallel to teaching it in the standard way on campus. This course can now be used for pure offline teaching. The development costs are negligible compared to what is necessary for the nowadays usual way of producing Web courses (WBTs). Of course, in order to run courses in pure distance mode, tutorial guidance over the Web and a learning management system (LMS) are necessary in order to handle all the administrative tasks beyond content delivery.

CONCLUSION

Usually, campus-based universities organize their teaching under the assumption that all of their students are full-time students. They do not react properly to the increasing demand for education of part-time students who cannot fully subject themselves under the time and space constraints of teaching and learning of traditional campus-based universities. Most of these students do not want to study in pure distance mode (at one of the Open Universities), because they prefer to be embedded into the social network of their classmates on campus. However, these students would appreciate, if they could take at least some of their courses in distance mode. Our experience shows that the (almost) fully automated generation of Web-courses emanating from traditional lectures can serve this purpose. Presentation recording plays a crucial role in this endeavour. At the same time, presentation recordings of renowned members of a university can further contribute to sharpen their profile and become an important advantage on the world-wide market for higher education.

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