Listen to Me!

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ABSTRACT

Podcasting has recently seen rapid expansion as a means of delivering audio content to listeners. In this paper we report our own experience with its use in the delivery of online recorded audio of classroom lectures to enhance course materials. We believe podcasting will see rapid adoption in the higher education sector. Our experience sharing is intended to provide an example of how this new technology can be adopted in teaching and learning. Then, we present ReCap, a tool for automated capture and creation of synchronized audio, PowerPoint and digital ink presentation in Real media format. ReCap creates the presentation based on the capture of a classroom lecture in real-time. Recorded presentations are then made available through a podcast which students can subscribe to, using any podcast receiver. A slide level and pen stroke level indexed presentation is also supported on any browser supporting Active X, like Internet Explorer. By avoiding full-fledged video capture, file sizes are significantly reduced, typically requiring only about 10 Mb for a one-hour lecture. Another salient feature of our tool is that it requires no post-processing to create the synchronized media, thus saving significant post-production effort.

Keywords

Podcasting, eLearning, education, Web 2.0, tablet PC, digital ink

INTRODUCTION

Podcasting has emerged as the premier push technology for delivering online audio content to listeners interested in automatically receiving updated content. Whenever new content becomes available, it is unobtrusively delivered to the users without their explicit involvement. By podcasting, we do not mean just putting audio content online. The advantage of podcasting is in its ability to automatically deliver content to listeners without their explicit intervention. Increasing availability of sophisticated and inexpensive audio recording and processing technologies has made it easy for individuals to produce and make audio content available online. The ubiquitous PC with its ability to capture audio makes this process very convenient. In addition, the increasing prevalence of audio (MP3) players with audio recording capability makes this process even more convenient. Once the content is captured, it can easily be made available online for download in a few simple steps. This has contributed significantly to the growth of individuals making a large amount of audio content available through podcasts. In this paper we describe our experience with the use of podcasting as a means of delivering the recorded audio of course lectures.

As pointed out in Muppala (2006), a non-indexed recording of a classroom lecture in a format that hinders the location of specific parts of the presentation is not very popular among students. As they say, a straightforward recording of a classroom lecture audio narration and then making it available as a podcast does not satisfy the students' needs. Instead most students prefer the presentation in a format where they can locate specific content with ease. This brings forth the need to provide some form of indexing within the presentation, for example a PowerPoint slide level index, through which students can quickly get to that part of the recorded presentation in which they are interested.

In this paper, we present a software tool named ReCap that is designed to capture all the dynamics of a classroom lecture. Its features include 1) non-intrusive integration with PowerPoint, 2) recording of presentations including Powerpoint slide transitions, voice, and digital ink stroke dynamics either on a Tablet PC or on a regular PC, 3) production of a synchronized audio, PowerPoint and digital ink presentation with small file size in Real media format, and 4) creation of an indexed presentation for viewing online using Internet Explorer web browser. We focused on supporting PowerPoint because this is the most widely used presentation software.

The main advantages of ReCap over existing tools include: 1) It integrates non-intrusively with PowerPoint and requires minimal effort to learn and use, 2) Unlike other tools, ours does not require the users to convert their presentations from PowerPoint to any other specific format to make use of the tool's features, 3) It incurs minimal post-production cost, 4) It provides indexed presentation so students can easily locate the specific content that they are interested in, 5) All key dynamics of a lecture are transparently captured, and 6) The storage requirements for the presentation are small compared to full-fledged video because of the use of Real media format.

PODCASTING IN OUR COURSE

For many years our students have been requesting us that our course lecture recordings (either audio or video) be made available for their use when revising and reviewing the course materials. So far we refrained from providing this mainly due to technological constraints and the prohibitive cost of providing such a service. With the advent of digital audio/video, the cost factor became less significant. However there still existed technological constraints in terms of efficiently and cost-effectively capturing and processing the audio/video and making it available online. The growing availability of inexpensive MP3 players with recording capability made it quite simple to capture, process and make the audio available through the Internet. In addition, podcasting provided us with a simple mechanism for delivering the content to users through subscription.

The course lectures were recorded while being delivered in the traditional classroom setting. We used a simple MP3 player (a Samsung Yepp YP-T6 MP3 player) to record the audio during the lecture. Its quality was quite clear and acceptable to the students. This player records the audio in WAV format (32 Kbps mono audio) which was then converted to MP3 format. The typical MP3 file size was about 15 Mb for one hour of audio. The audio files were made available online either for download directly from a website, or through a podcast that students could subscribe to using their favorite podcatcher software like iTunes. This enables them to automatically download the lecture audio and listen to the lectures at their convenience, either using an MP3 player or a PC. Post-processing of the recorded audio and

making it available online took about 15 minutes.

For podcasting the audio files, our department web server which hosts our course web pages was sufficient. No additional infrastructure to support podcasting was needed. Podcasting required the setting up and editing of a simple XML (extended markup language) file containing the podcast information. Because we were familiar with XML syntax, we accomplished this by directly editing the file. Whenever a new audio file was uploaded, the podcast XML file was edited to add in the information pertaining to the audio file. For those unfamiliar with XML, several free podcasting tools are available which can be used to set up and manage a podcast. A review of the steps involved in arranging the podcast is shown in Fig. 1 below.

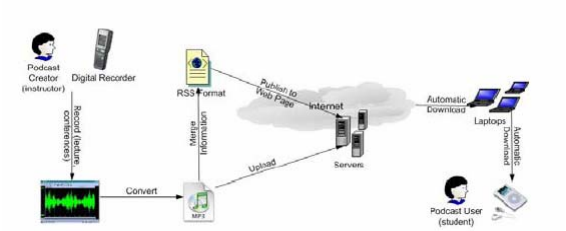


Figure 1. Podcast Framework.

EXPERIENCE AND REFLECTIONS

Podcasting provided us with an excellent cost-effective and scalable method to deliver the lecture audio to the students. We found it quite convenient to use a simple MP3 player to record the lecture audio. This freed us from the necessity to install special hardware in the lecture room. The quality of the audio recordings was clear and acceptable to the students.

We found that for podcasting the only infrastructure we needed was the standard web server. Since we were familiar with XML, we were able to do a podcast by creating an XML file and manually editing it rather than going through the whole process of setting up podcasting software. However, we recommend this option only if instructors are familiar with XML and the RSS format.

We used student surveys as a method of understanding the students' response to the use of new technologies in education. In particular we were interested in better understanding how they used the lecture audio available through podcast in their own learning process. A survey was conducted at the beginning of the course to better understand students' familiarity with podcasting and the availability and usage of portable media players among them. An end-of-semester survey was carried out to better understand the students' experience.

Student response was very encouraging. Podcast audio of lectures was enthusiastically received. Several interesting patterns and observations were made based on the students' surveys. We summarize some of these below:

- Close to 70% of the students downloaded and listened to the lecture audio. Most of the time they listened to each recording once.

- Typically the lecture audio was about 1.25 hours long. Most students downloaded and listened to only about 5-20 minutes of the audio. They often listened to only the portion

of the audio that was specifically of interest to them, rather than the whole lecture. This seems to be mainly to review the hard-to-follow parts and the material itself.

- Surprisingly most students listened to the lecture audio on their personal computers (80%) rather than portable audio devices. This is in contrast to observations in other places where portable devices seem to be the favored listening option. Our surveys did indicate the prevalence of portable media players, especially MP3 players, among the students. However most considered them as entertainment devices and did not envisage them as being useful in education.

- The above point leads to an interesting related observation. Many students found that listening to the complete lecture audio was not useful. Instead they wished to review only a part of it. On a portable audio device, fast forwarding and rewinding functions are not supported, and so they are not conducive to this mode of listening. A PC, on the other hand, enables us to select and listen to only a portion of it. This seems to support the reason for students favoring the PC as the listening device.

- Another related observation was that students found it difficult to find the specific location within the audio file which corresponds to a particular slide used in the lecture presentation. Thus they preferred some kind of indexing or synchronization of the audio file with the PowerPoint presentation. This kind of synchronization cannot be provided on a portable media player. But, this is possible on a PC and students' expectations are higher because of its capabilities. In addition some students preferred video recording rather than audio, again seemingly related to the use of PC. We are not sure whether this is related to the fact that the students in our class were computer science/engineering majors and hence spent a significantly higher time in front of a computer. This is an issue that we will investigate further.

- Many students prefer to listen to the lecture as a way of reviewing the materials covered in the class. This provided them with additional reinforcement of their understanding of concepts as they could always revisit our lectures and review the materials that they found difficult to understand the first time around. Students found this to be very useful especially when they were reviewing the materials for examinations. Further evidence corroborating this fact is that most students mentioned that more often they listened to the audio just before examinations.

- Students also said the availability of the recorded audio gave them the confidence that they can always review a difficult concept again just in case they did not understand it first time. This also takes the pressure off them caused by having to take detailed notes during the lecture which might distract their attention.

- Opinions have been expressed by many educators that the availability of lecture audio or video may encourage students to skip classes. In our own experience, this effect was not that perceptible. There was an insignificant drop in class attendance. Students seem to say that the availability of lecture audio does not have a major impact on their decision to attend or skip lectures. While the availability of the lecture audio does take the pressure off of them especially if they occasionally miss a lecture, it does not seem to promote absenteeism. Students seem to value the in-class interaction and classroom dynamics a lot more and see it as a valuable component of their learning experience.

- One of the major points in favour of podcasting and making available lecture audio is the fact that non-native English speakers find it beneficial. They may not be able to keep up with the pace of the lecturer's teaching in English. Our university offers an excellent experimenting ground for this theory. Tertiary (university) education is taught exclusively in English. However most students entering the university here have received their schooling mostly in their mother tongue. They do find some difficulty in adjusting to being taught in English. Very often the students' command of English is not very good. Added to this, they are now faced with being taught in English by faculty members who hail from all over the world, some of whom are not necessarily native English speakers. With recorded audio, they get to listen to the lectures again to fill in the parts they found difficult to follow in the first place.

- Morales and Moses (2006) make the interesting point that many visual elements of the in-class lecture cannot be captured. Indeed this was clearly observed in our own experience. This point was brought home by some interesting student comments in our surveys which we quote here: "Avoid using 'this' words when describing something. A listener does not know what you are talking about", "As instructor may draw or write something on the white board, which might not be found in the lecture notes. The instructor can include some description of the item in the recording", "It may be better if we can always refer to diagrams drawn on the board, which part of the recorded MP3 refers to it. We suggest taking photos of the diagram and making it available online." Indeed these bring out the limitations of the audio format. However, all is not lost as long as we can provide the supplementary material in a form that students can print and use in conjunction with the audio. When we make the lecture notes available online, we can make references to the specific page numbers within these notes while delivering the lecture. While this requires some adaptation on part of the instructor, it will be a beneficial change.

Our survey of the students' opinions, attitudes and listening habits helped us to better understand their needs and gave us suggestions about possible improvements. Many of these observations lend additional validity to similar observations by educators elsewhere. Some of our findings however were quite surprising and not necessarily in conformance with observations elsewhere.

RECAP

As stated earlier, our major goal was to design a tool that seamlessly and non-intrusively integrated with PowerPoint and enabled the capture of the lecture dynamics in a format with small file sizes and with minimal post-production overheads. We succeeded in meeting these expectations well, resulting in our easy-to-use tool named ReCap. In this section we review the salient features of ReCap and the technologies and techniques used in implementing the tool.

ReCap requires the use of a Microsoft Windows based PC with .NET framework 1.1 support. For best results in using Digital Ink capabilities, a Tablet PC is recommended. However, the tool will support Digital Ink capability on any standard Windows PC equipped with a mouse, albeit with less satisfactory Digital Ink writing experience. For audio recording the PC must be equipped with a microphone. The authors used an IBM Thinkpad X41 Tablet PC with Bluetooth support, and a Bluetooth mobile headset (Plantronics Voyager 510) equipped with a microphone for audio recording. The Bluetooth headset provided the lecturer with the

flexibility to move about in the classroom without being tied down in front of a standard PC microphone for audio recording.

Recorded presentations are produced in RealPix and SMIL format, which can then be hosted on a standard Web server to be streamed to any PC with Real player. Indexed presentations are supported using a PHP script, and requiring a Web server with PHP support. The indexed presentations can be viewed on any browser like Internet Explorer which has Active X control support.

Features Overview of ReCap

Figure 2 depicts ReCap's operation from the beginning of a classroom lecture capture to the dissemination of the presentation using a Web server, and the access of the presentation using either podcast, Real player or a Web browser. Before starting their presentations in the class, the instructors will start our tool. We can also set up ReCap to automatic startup whenever the PC is powered up or rebooted, and run in the background. Instructors then give a presentation using PowerPoint just as they normally do using the PC. Whenever an instructor starts a PowerPoint slideshow our tool will be triggered to begin capturing the lecture. It will continue until the user exits the slideshow. The tool creates a special directory in the "My Documents" folder named with the PowerPoint file's name appended with the date and time of the start of the presentation. This way each slideshow is captured as a separate lecture presentation. If the instructor is not interested in using Digital Ink for annotation, they need only to invoke a PowerPoint slideshow as usual. No further action by the user is required.

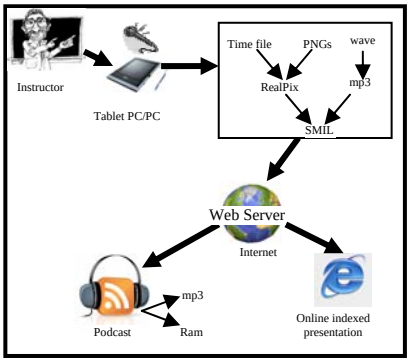
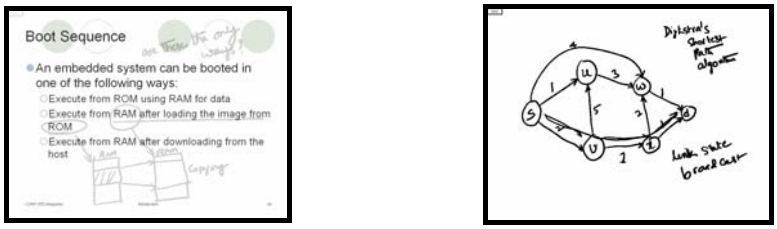


Figure2: ReCap System



(a) Transparent Overlay (b) Whiteboard

Figure 3: Digital Ink Annotation

If the instructor wishes to make Digital Ink annotations during a presentation, we support this in two ways, either using a transparent overlay screen or a blank whiteboard. These can be invoked either through our tool's menu or using keyboard shortcuts (F2 (F3) to bring up a transparent screen (a white board) for digital Ink annotations (see Figure 3 below)). When no longer required, they can be hidden again by using the same procedure. These should be (can

be) invoked without exiting the PowerPoint slideshow, so they can be incorporated into the synchronized presentation produced by the tool.

The transparent overlay screen brings up a transparent overlay right on top of the PowerPoint slideshow and enables the user to make Digital Ink annotations on the screen on top of the PowerPoint slideshow underneath. This is similar to putting a transparency on top of an existing transparency and writing using a pen. The annotations are captured and incorporated into the synchronized presentation produced by our tool. The ink annotations are captured at the pen stroke level, and thus would appear as if being directly written on the screen when the synchronized presentation is viewed. The blank whiteboard brings up a blank white screen on top of which the user can write using the digital pen just as if writing on a standard white board. This writing will be incorporated into the synchronized presentation at the appropriate location.

Next, we will consider how ReCap produces the synchronized audio, PowerPoint and Digital Ink presentation. Capturing a video recording of the activities on a desktop requires continually taking snapshots of the screen at regular intervals. When we use PowerPoint to make a slideshow presentation most snapshots will be repeated and redundant, because the screen does not change very often. Typically screen changes are triggered by PowerPoint events invoked by the user by clicking the mouse button or hitting keys on the keyboard. ReCap takes advantage of this knowledge to reduce the space requirements by taking a snapshot only when certain events occur such as changing a slide or when a pen stroke is made on a slide. The corresponding time of occurrence of such events is recorded in a "timeline file", which is a standard text file. ReCap records the slide transition and every pen stroke written on the screen as image files in portable network graphics (PNG) format. Simultaneously ReCap also records the audio narration of the instructor in WAV format in a sound file.

At the end of the PowerPoint slideshow, ReCap makes use of the timeline file and the PNG screen image files to produce a RealPix presentation using graphics files and a simple mark-up language to specify visual effects. RealPix, which is part of the RealSystem approach to making synchronized presentations, lets you stream images across the Internet. By combining images with media such as audio and text, we can create compelling presentations for many purposes. ReCap then combines the audio file and the RealPix file to form a synchronized presentation in SMIL (Synchronized Multimedia Integration Language) format. The WAV audio file can be used as is, or converted to MP3 format by our tool before being incorporated into the SMIL presentation.

The recorded presentation can then be uploaded to a Web server and made available for download or viewing over the Internet. At the moment the upload is done manually. However, ReCap does have the facility to automatically upload the files to a Web Server. To take full advantage of this feature, we need to develop a customized hosting service on a Web server. We are developing one using Apache Web server and PHP scripts. Once the presentation is uploaded, we need to create a Real Player presentation file (RAM metafile) on the server which includes the url of the SMIL file. This process will be automated once we have the hosting service ready. All that is now left is to make the presentations available for users to view. This can be done by putting links to the RAM file on a website. We make both the lecture audio, and synchronized presentation available through podcast.

Once the presentation is uploaded to the Web server, we also make available an indexed

presentation which the students can access online using a Web browser like Internet Explorer. This requires the browser to support ActiveX controls. The indexed presentation is generated automatically using a PHP script which makes use of the timeline file generated by ReCap to provide slide level indexing.

User Experience and Feedback

ReCap has been under development for about a year. Starting earlier this year, the authors have used it extensively in the classroom to capture the lectures. Through regular usage of the system, several improvements and new features were identified as desirable and the system has been continuously modified. In particular this tool has been used in two classes, one undergraduate class on Embedded Software, and a graduate class on Computer Networks.

Based on our experience, we find that this tool is very useful in capturing many of the classroom lecture dynamics and nuances of the in-class presentation and interaction among the participants. In particular many of the off-the-cuff remarks prompted by discussions in the classroom can easily be captured and preserved in audio form. Furthermore, a PowerPoint slideshow is often supplemented by writings on the whiteboard when further explanation is deemed appropriate during the lecture. Often these are lost after the class. Since ReCap provides an electronic whiteboard and annotation facility, they can be permanently preserved for the benefit of the students. Indeed the author finds this to be very useful, especially in teaching Computer Science courses.

Students' opinions and reactions to the system were gathered using opinion surveys conducted in the classroom, and through informal discussions with students. In our experience, more than 90% of them accessed the recorded presentation for reviewing the lectures. Among these, over 80% found it helpful when reviewing class materials.

Of MP3 audio, synchronized presentation, online indexed presentation, and class notes in PDF format, over 50% of the students preferred viewing the online indexed presentation. Of the students who preferred indexed presentation, more than 30% made the choice because they learn better when they can see and hear the lecture, and over 30% did so because they are able to see the digital ink annotations in the context of the lecture. We will have more data available by the end of this semester and more detailed analysis of the students' reactions will be incorporated into the final version of the paper.

CONCLUSIONS

We reviewed the use of podcasting as a means of delivering recorded lecture audio to our students. Several interesting observations regarding our own experiences and the students' opinions on the use of the new technologies are presented in the paper. We plan to continue our investigations into their use on a larger scale in the future to gather more experience and evidence to advocate their widespread adoption. We then described our tool, ReCap, including its features, technologies used in implementing the tool and user feedback from the classroom.

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