A Virtual University CS1Course as a Platform for Web-based Education Experimentation

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Abstract

We have developed a version of our CS1 course for Michigan State University's web-based Virtual University. This section was designed as an experimental platform for web-based distance education. We use locally developed Sync-O-Matic 3000 software to deliver a RealVideo streaming video lecture synchronized with PowerPoint slides. The result is a video lecture with slides available over a 28.8 modem which can be watched asynchronously at the student's convenience. An important goal of our research is to humanize asynchronous distance education. That is, insert the human component into a web-delivered course. The RealVideo lectures provided through the Sync-O-Matic 3000 software is an important first step in delivering a human component asynchronously. This paper describes how this course is delivered. The best way to appreciate our approach is to see it in action at http://www.vu.msu.edu/preview/cps230/.

1. Introduction

In the Fall Semester of 1998 we began offering a standard CS1 Introductory Computer Science course[1] on Michigan State University's web-based Virtual University[2]. In addition to making the course available to students who were otherwise unable to take the regular sections, this offering was designed as an experimental platform for web-based distance education. As a regular, required CS1 course in the Computer Science major, this course is a "production" course in the sense that course outcomes are expected to be satisfied for use in all subsequent courses in the major. It is experimental in that innovative technology is used. In the first offering, the course used the Sync-O-Matic 3000[3] delivery software for the lectures. Sync-O-Matic 3000 delivers a RealVideo[4] streaming video lecture synchronized with PowerPoint slides. RealVideo uses a compressed format which can reach a dozen frames per second. The PowerPoint slides are currently delivered as GIF files and share the bandwidth with the RealVideo. The result is a video lecture with slides available over a 28.8 modem which can be watched asynchronously at the student's convenience. Supporting technologies include a WebTalk discussion forum where students and faculty can carry on a discussion, and a *handin* program for submitting projects electronically. Laboratories which meet live in the regular sections are done asynchronously on line by students in the web-based sections. Teaching assistant office hours are handled using a chat room, AOL's Instant Messenger or ICQ.

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through the Sync-O-Matic 3000 software is an important first step in delivering a human component asynchronously.

This paper is organized as follows. We begin by defining where we fit in the spectrum of distance education. Then we describe our goals and our progress toward achieving them. Next we cover the technology we use, and then describe the delivery in more detail. We conclude on where we are headed.

2. Target Audience

Distance education covers a broad range of delivery from hardcopy by mail to live video. Each technique has its advantages. Synchronous live-video delivery, for example, is attractive because it fits our standard notion of educational delivery and it can provide both live video and live response. However, our target is asynchronous delivery to service those people who cannot be in synch with the provider. Students in this target group are in a different time frame from the provider, possibly because of work or maybe because of time zones. Asynchronous delivery will never have all the interactive advantages of live video. The question is whether asynchronous education can be an effective delivery paradigm.

Our view is that video is an essential component of educational delivery–anything else is a glorified textbook. Some people can learn from a textbook, and an interactive textbook greatly enhances that delivery mechanism. However, we are targeting those who prefer to learn from a person rather than a book. That is, we believe that the human component is critical. Live video captures that human component—how can we capture it with asynchronous delivery?

Interaction is another critical component of education. Live video provides an opportunity for an instructor to interact with the class, e.g. respond to questions. If asynchronous distance education is to succeed, it must provide effective interaction.

However, interaction is not limited to instructor-student interaction. Student-student interaction is very important. Significant learning takes place outside of a classroom as students interact with each other. A mechanism must be provided for student-student interaction. Of critical importance is that the mechanism must scale with the class size. A list-server can handle the correspondence of a couple of dozen students, but the volume of a much larger class will overwhelm the students. A long-term goal of our research is to increase interaction.

Video is now feasible over the web, and this technology has increased the attractiveness of asynchronous delivery. The streaming video technology is particularly attractive because it offers a way to provide video over limited bandwidth such as a 28.8 modem. With streaming video we can provide one-way video delivery of lectures or lecture segments. It provides a critical half of live video.

Our target is the student who needs their education delivered asynchronously, and the student who needs to interact with others to learn. We believe that student represents a significant sector of the population.

3. Humanity in Distance Education

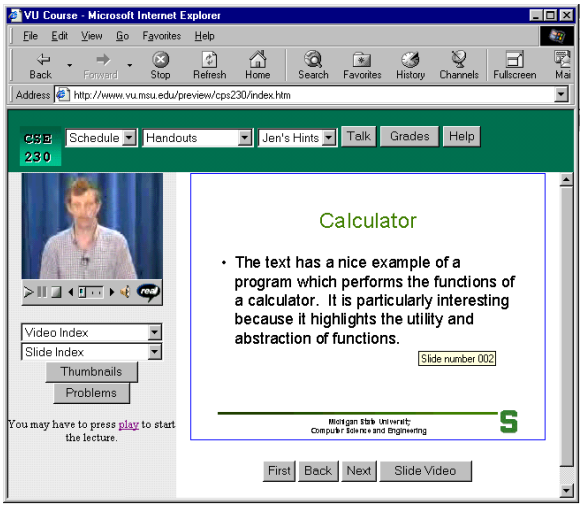
Our research goal is to humanize asynchronous distance education. We would like to bring asynchronous delivery as close as possible to live video. To achieve that goal we need to achieve the following

- Deliver video plus slides to the student.
- Facilitate instructor-student interaction
- Facilitate student-student interaction

A key constraint for our work is that we want techniques which we can use in a production setting now. This course is an experimental vehicle, but it is also a required class for our majors.

Some mechanism which provides a human touch, possibly using visual clues, could enhance interaction. We are experimenting with adding thumbnail pictures to our WebTalk discussion tool so students can "see" who they are communicating with.

4. Technology: Sync-O-Matic 3000



Our current delivery vehicle is Sync-O-Matic 3000 developed by Dr. Charles Severance at MSU, and is illustrated above. The picture is a RealVideo streaming video which displays at about 12 frames per second. The slide on the right is a PowerPoint slide which is synchronized to the video lecture. When the instructor selects the next slide, that slide appears. The video and slides are kept on a server and can be viewed anywhere on the Web at any time. The video and slides are synchronized so that random access in one causes a synchronization with the other: select a slide and the video synchronizes to that point; select somewhere in the video and the slides synchronize to that point. Students can move around at will through the video and slides.

Creation of the on-line lecture is trivial. I go to a recording studio with my PowerPoint slides on a floppy. I deliver my lecture advancing the slides as I go. The studio staff digitize the lecture, and it is ready to view by the time I return to my office. The process is simple enough that lower-quality video can be created using a portable computer and tiny camera. I even filmed a brief segment on an airplane flight.

The streaming concept delivers the video across the web without downloading the whole video before beginning of play. Some small amount of the video is downloaded (e.g. a dozen seconds) before beginning to display the video–called buffering. The rest of the compressed video stream follows as the video is played. By buffering some seconds of video, delays in the web delivery of the video stream can be hidden. If the web delay exceeds the buffered component, the video player will stall from lack of video. We have found that a 28.8 modem provides sufficient bandwidth.

The PowerPoint slides ride on the unused portion of the available bandwidth. On a high-speed network the slides appear instantly. On a slow network they gradually appear as they are being discussed. The timing of the slides can be adjusted, and new slides can be substituted. PowerPoint allows hot links within slides and they are preserved within Sync-O-Matic 3000. Pointers to examples and web sites can be embedded in the slides.

In order to view the lectures a student needs to download and install a free RealVideo player. It is a simple task, but it can be daunting for a novice user.

5. The Course.

Across the top of the web page is a bar with three pull-down boxes for the schedule, handouts, and Jen's hints (Jen was the teaching assistant). The schedule is a selection of 15 weeks. Each week contains two lectures with accompanying code examples. Students can print out code examples before viewing the lecture or select a hot link to the example on the lecture slide. There is also a weekly lab assignment and a programming assignment. The lab is a guided exercise to lead students through some programming or problem solving concept. At the end of the lab students are usually asked to modify a code skeleton to exercise some concept. The labs are not graded, but students need to satisfactorily complete 12 of the 15 in order to pass the course. Students are encouraged to work with each other and the teaching assistant to complete the labs. Programming projects are due ten days after being assigned and require the complete design and

solution of a problem. Both labs and projects are submitted electronically. With electronic copies a program can be run to compare all projects against each other to ensure that students do not copy other's work. We have a home-grown cheat-check program, but there are publicly available programs such as MOSS[5] from Berkeley.

The weekly requirement of lab and project completion forces students to keep on schedule and not fall behind. The discipline is useful for most students, but it does enforce a type of synchronicity which will not be appropriate for all students. However, the weekly schedule keeps students together which enhances interaction among students, and it is more efficient for grading. It also allows synchronization around exams. Currently exams are given at the same time on campus or in satellite sites around the state. More disperse examinations are possible, but proctoring is expected. Other examination models would work, but have not been used.

Jen's hints are a collection of useful programming and system information for novice users. The handouts selector is a central location for all assignments and examples—the same ones which are provided weekly. The grades allows viewing of a student's current points.

The "talk" button accesses WebTalk—a utility provided by MSU's Virtual University. It is a bulletin board for communication. Topics can be specified to organize conversations, e.g. around a particular lecture or programming project. The Virtual University provides other tools and widgets.

The Virtual University sections follow the same schedule, use the same materials, and take the same exams as the regular on-campus sections. In Fall 1998 students were not self-selected since they had no way of knowing that they were enrolling for a virtual section. The virtual sections were offered after the regular sections were full so student simply grabbed these new sections as they became available. A few students dropped out initially due to the startup overhead of the virtual section—little support was available on the initial offering. Otherwise, students performed similarly to those in other sections. Performance was slightly better in the virtual sections, but not significantly so. In a post-course pizza party, students indicated that they would choose a virtual section, if they were given the opportunity to start over again.

6. Observations

As easy as it is to actually produce lectures, there are constraints which complicate the process. Based on my colleague's experience with EGR 124, the first course to be delivered using Sync-O-Matic 3000, a virtual lecture needs to be honed in front of a live audience. I taught this course a number of times before developing the virtual sections. In addition, one cannot simply give the same presentation for the virtual sections. Significant changes in delivery are necessary to accommodate a section which is not live.

Feedback is important for any course, but particularly for an experimental course. Focus groups are particularly effective. In its current instantiation our students are close enough to campus to allow face-to-face focus groups. During this initial offering we had two focus groups catered by a local pizza parlor: one at midsemester; the other after the final exam. Students were enthusiastic about the course, and especially enjoyed the freedom to learn at their convenience.

Extensive time from our teaching assistant was a significant factor in the student's satisfaction. However, the startup was a bit rocky since the course was being developed as it was delivered. Two pieces of feedback were notable. The first was the need for a sense of community to enhance learning. The other was a need to have information delivered in smaller pieces —a notion which fits it well with active learning theory. The latter is easier to address than the former.

7. Conclusion

The first offering of web-based sections of our CS1 course indicates that the approach works. It is not better than a live lecture, but it is also not noticeably worse. A significant number of students prefer the approach, and the requests for seats in the next offering of the virtual sections greatly exceed the number available. The small size of the initial offering provides too small a sample for definitive conclusions on our approach. Also, evaluation of progress through succeeding courses is not yet possible.

Significant progress has been made, but a lot of work is needed to humanize the process—in particular, to facilitate student-student interaction.

Bibliography

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