

Using Multimedia to Teach Multimedia in Computer Engineering Classes

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Why use technology?

We already use many types of learning technology in our courses (video-based distance learning, software labs, the World Wide Web, e-mail, etc.). However, we saw a niche for developing WebDVD-based modules in the area of multimedia systems, to create a multimedia systems archive that any of our faculty can use in their courses. These modules can also be used as short courses or for distance learning as well.

Our motivation is that multimedia is a new, exciting area that spans many disciplines within computer engineering—it is a computer-based communications system that integrates and delivers a complete package of audio, video, and text to end users. Multimedia is one of the most rapidly growing areas in computer technology, with both hardware and software being redesigned to accommodate it. The design of the systems that enable multimedia should be a primary part of any computer engineering curriculum.

We saw this project as an opportunity to invigorate and update our undergraduate computer engineering curricula, while developing innovative teaching methods and learning technologies. The University of Massachusetts Amherst is located in a somewhat rural location and is still fairly traditional in terms of teaching styles; it is skeptical of much instructional technology, but the College of Engineering sees technology as an important tool. In addition, this is a public university and we have all different types of students, including a growing group of non-traditional students: distance ed students, disabled students, students who are working moms, and transfer students with varying levels of preparation.

The courses

Rather than develop a new course, we felt that we could insert a module of multimedia content into each of our core Computer Engineering Courses: Computer Networks, Computer Architecture, Graphics, Hardware Design, Testing, Programming. These courses are offered at all undergraduate levels to engineering majors, with class sizes varying from large (100 students) to small (10 students). The modules are also used as short course tutorials for distance learning and for self-paced instruction. And I will be teaching a course on multimedia systems as a general education course starting next spring. This will be for non-majors and will require no prerequisites. We felt that multimedia is too important to just leave it to the engineers. This is actually going to be part of an information technology minor program.

The strategy

We chose to develop and deliver the modules using multimedia technology, thus providing a direct example of the technology as part of the curriculum. Our goal was to add new materials to our curriculum and convey the excitement of the content.

The project began in 1998; seven faculty started developing six modules to be used throughout the computer engineering program. The six modules, covering various aspects of multimedia systems, are: Video Coding, Computer Graphics, Multimedia Networking, Multimedia Hardware, Multimedia Architectures, and Multimedia Testing. One or more faculty members are in charge of each module, with assistance from at least one graduate student and one or more undergraduates. We decided on a seven-member team to encourage creativity and to take advantage of a wide variety of teaching styles. It also helped with the critique process—we've actually been much more self-critical as a group. This has prevented us from falling in love with a technology we've developed and then forcing it down students' throats.

We developed a generic module template (interactive video lectures, interactive video demonstrations, links to related design projects), but the modules vary significantly overall because of the different content and teaching styles. We basically had three thrusts in the project, and all of the modules crossed all three thrusts: 1) the presentation format—WebDVD; 2) instructional utilities—hallmark systems, quiz systems, collaboration systems; and 3) design projects—to create an archive of multimedia products.

The latter we felt was very important, to support what we feel is the way most engineers really learn about their discipline: project-based courses. This tends to be very informal, students working together closely with a faculty member, which is much more like real-world engineering. We felt that we could contribute to that process with an archive of materials and descriptions of hardware, of software, of media that would help people. And the “value added” idea was that those projects would leverage our research into multimedia engineering, since we are a research institution.

The learning technology

The six modules are designed to introduce multimedia concepts into traditional computer engineering courses. These modules use a combination of interactive Digital Video Disks (DVDs) and Web technology, providing high-quality audio and video combined with hot-links to the World Wide Web. Besides the Web-links for timely materials, the modules present video lectures and demonstrations. These modules allow for demonstrations of multimedia and hands-on interaction by students that would otherwise require expensive labs. You can explore the entire project by starting at the main URL: <http://www.ecs.umass.edu/ece/dvd>.

For a sample within a module, see <http://www.galois.ecs.umass.edu/dvd/doc/module1/lect41.html>.

Some examples and URLs that visitors can browse:

- In a large freshman networking course, we used a Web-based homework system and demos—this was very successful. The URL: <http://dvd1.ecs.umass.edu/miu/>.
- These last two URLs also show two styles of DVD lectures and demos in a small graduate-level course. Interestingly, this was less successful; here we found that the students preferred a real live professor and more interaction. We realized it was difficult

to re-target static materials to different audiences. We faced the same limitations as with a textbook.

- We used an audio-html RealPlayer format for a module on VLSI design, to create an Internet-based slide show with synchronized audio. We captured the video lecture in our Video Instructional Program professional studios, just like any regular UMass academic or short course. We then digitized the video and combined it with additional course materials before putting in on the DVD. We used MANIC (Multimedia Asynchronous Networked Individualized Courseware) software, developed by the UMass Computer Science Department, which allowed us to integrate slides and video stills with synchronized audio; the software puts the multimedia into an Internet-based format viewable by standard browsers like Explorer or Netscape and the media player RealPlayer. Students can halt the presentation at any point they choose and interact by navigating through the slides; linking to glossaries, other slides, or outside Websites; or searching for keywords in the slides or text. See <http://vsp2.ecs.umass.edu/dvd/pic/Slide/manic-11.jpg>.
- Students can also interact when they're viewing the lectures by choosing examples and demonstrations. These are presented as small applications (Java Applets or CGI programs) that are inserted into html pages like images. For example, an applet can be a demonstration that allows the students to enter their own algorithms onto the page and then see how the outcome changes in the way a piece of video runs.

We also want to customize the homework by tagging the questions by both topic and difficulty—what the researchers call “intelligent tutoring.” If you're having a hard time, you get easier, remedial-type questions. If you're on top of the material, you get harder questions. We're starting to do this with a database of questions, but it's not yet as sophisticated as we want it to be.

The funding

This is a three-year, \$800,000 project, with funds from the National Science Foundation Computer Information Science and Engineering Directorate, Educational Innovations Program; with matching funds from the University of Massachusetts Amherst. To meet the dissemination requirement of the NSF grant, we will be working with and sharing the multimedia products with five institutions: Springfield Technical Community College; Smith College; Pusan National University, South Korea; ENST Paris; and National Technological University.

The results

After our first experiences, we are now shifting a bit to try and get the best aspects of computer technology-based and traditional methods. The students are extremely multimedia literate from the exposure they get from entertainment and such; our technology is still a bit rough, not even matching VHS quality yet. We also found that we needed to pay attention to how static the “talking heads” are in the video lectures. In one, for example, the professor was holding a microphone in one hand and using a mouse pointer with the other, so her hand gestures were severely limited. The students preferred the VHS video format rather than streaming video from the Web; the Web was too slow and unreliable for quality streaming.

You can't just show students a video in class and nothing else; no matter what the subject matter, many of them will just nod off. When I used another instructor's video, I had better results when I stopped it every 10 minutes or so to ask questions and relay some anecdotes to illustrate the material.

Our target is having students run the DVDs off their own machines; they can stop, take the quizzes, be interactive. But this can be lonesome, too. The only solution is to have a fully networked classroom in which students are all sitting at machines and interacting. The University has some fancy classrooms like that but it's extremely expensive to do.

The grand vision is to enable distance education and leverage the distance-ed infrastructure for on-campus students. DVD will allow students to take lectures without scheduling hassles and focus on both face-to-face and Web-based interaction instead. Since it is DVD, students don't require a streaming, high-speed Internet connection; they can study in libraries, cafes, outdoors, just as they do with regular textbooks.

If you have any questions, you can contact me at: burlison@ecs.umass.edu.

LINKS
<i>Multimedia Systems: An Integrated Modular Curriculum:</i> http://vsp2.ecs.umass.edu/dvd/
<i>Sample Module: Video Coding:</i> http://galois.ecs.umass.edu/dvd/doc/module1/module1.html
<i>Sample Topic within a Module: Video Coding Using MPEG:</i> http://galois.ecs.umass.edu/dvd/doc/module1/lect41.html
<i>University of Massachusetts Amherst:</i> http://www.umass.edu/
<i>MANIC:</i> http://manic.cs.umass.edu/