Abstract

Our interest, development and use of multimedia materials has proceeded mainly along two parallel paths. One has emphasized Computer-animated simulations which are animations controlled by parameters set by the student. This approach enhances student learning by providing realistic, visual feedback of qualitatively correct results. The second path emphasizes virtual instrumentation which uses graphics and video-clip demonstrations via the internet. This approach increases student learning efficiency by providing students with simulated experiences with lab equipment and procedures before, during and after conventional lab activities.

One major obstacle to any kind of materials development, especially multimedia development, is the issue of resources. To most effectively combine our existing materials and leverage limited resources, we have established the framework for a coalition of technology programs with similar goals and interests. A brief interest survey sent to approximately 240 members of the Texas Junior College Teachers Association shows that 30% of respondents are already involved in multimedia development, 54% have internet connectivity, and 77% are interested in participating in our collaborative efforts.

I. Introduction

The introduction of user friendly point-and-click graphical interface(s) to the internet has led to an even more explosive growth rate of the World-Wide Web (WWW) users. Commercial Web applications for some companies include internal communications between departments at the same location and between branch offices at different locations. Other companies are also applying the Web for new outlets of external communications to reach new customer markets world wide. Educational applications include enhancing basic communications between students and instructors. The Web also provides a new medium for communicating different types of multimedia information in ways not previously possible. For example, the Web now gives instructors the possibility of remote multimedia communications for addressing different learning styles and for providing students with asynchronous communications adaptable to different lifestyles. Thus, multimedia Web-based courseware may significantly lower traditional barriers associated with the timing, location, and traditional methods of classroom instruction. This barrier lowering may have an especially positive impact on women, minorities, persons with disabilities and non-traditional students because of the social pressures and peer pressures embedded in the traditional live classroom environment.

Although the Web has been successfully applied for many commercial and educational purposes, multimedia applications on the Web have only recently become feasible. Multimedia ToolbookTM (Assymetrix Inc.) and JavaTM (Sun Microsystems Inc.) are good examples of a multimedia authoring system and of a hardware-independent operating system which hold much promise for multimedia communications via the Web. The following section presents our efforts in multimedia and internet courseware development as well as similar projects and distinguishing characteristics of this collaborative effort. The actual survey and survey results are presented in Section 3 with a brief summary and concluding remarks in Section 4.

II. Project Description

We define Computer-Animated Simulations (CAS) as simulations which allow students to adjust variable values and view the result in a visually oriented yet quantitatively correct animation. We began development of Computer-Assisted Instruction (CAI) emphasizing visual feedback and CAS for basic electricity and electronics topics in the Fall of 1993. Developed modules include Diodes, Diode Rectifiers, Resistors, Ohm's Law, Op-Amps and Relay Devices. Preliminary evaluation of these materials have shown enthusiastic acceptance and definite impact on student performance.

In 1994 we began development of virtual laboratory instrumentation via the WWW using the Hyper-Text Multimedia Language (HTML). These materials provide basic instruction for voltage, current and resistance measurements using the Fluke 45 digital multimeter by
means of text, graphics and short video clips. This approach increases student learning efficiency by providing students with a simulated familiarity with lab equipment and procedures before, during and after scheduled lab activities. Features have steadily advanced to include mechanisms for on-line quizzes and automated, real-time feedback on student performance.

In August 1995, we began to consider ways to merge these two parallel efforts into a joint multimedia, internet-based introductory electronics course. Our presentation of this project[2] in September 1995 provided positive encouragement from representatives of associate degree technology programs, bachelor degree technology programs and the Texas Higher Education Coordinating Board as well. This led to an invitation to present our project at the annual meeting of the Texas Junior College Teachers Association (TJCTA), Electronics Section[3]. Coordinating with the chairman of the TJCTA-Electronics Section, we prepared a survey to determine the interest level of attendants and the feasibility of completing this project. The survey was designed to assess the Internet accessibility, multimedia development experience and general commitment of participants as well as to define what methodology and software tools might be most suitable for the project.

Similar Projects

Similar projects include Multimedia Circuits developed by Robert Murphy at Purdue University, an Electrical Engineering Curriculum developed by N. Al-Holou at the University of Detroit-Mercy; the Institute for Academic Technology (IAT), a national consortium established at the University of North Carolina; and the Southwest Regional Center for Advanced Technological Education, a regional effort whose PI is at the Texas State Technical College (TSTC) in Sweetwater, Texas.

Multimedia Circuits, a commercially available product distributed through Prentice-Hall and the Electrical Engineering Curriculum each contain well-developed multimedia materials on introductory electronics but were not designed for the Web environment.

The IAT project is a model partnership between industry and the academic community dedicated to developing WWW-based resources for distributed learning. Its strengths are based primarily in mathematics and second language acquisition[4]. Two IAT currently available products are WebApp, which automates downloading and running application software from the Web and ExpressAuthor, which works with WebApp provides for developing Toolbook™ multimedia files through the Web environment.

The Southwest Regional Center for Advanced Technological Education (SRCATE) is a relatively new NSF-sponsored program aimed at developing distance learning capabilities for rural areas in the region. Although the role of Web-based multimedia materials in the SRCATE is not clear to us, we intend to maintain close dialogue with this program, as indeed we have already been invited to do[5].

In summary, the multimedia materials on basic electronics are available for single-computers or local-area-networks (LANs) but not for direct use on the Web. Several newer initiatives which target Web-based multimedia materials have recently been formed, but none have developed materials specifically on introductory electronics at the technology level. Several, perhaps many, pockets of ingenuity are necessary to support an evolving technology such as the use of multimedia courseware over the WWW. This collaborative effort may develop significant contributions in this effort.

Distinguishing Characteristics

The distinguishing characteristics of this collaborative development project include its multi-faceted design and its unique set of design and development efficiencies. Our instructional design emphasizes graphical analogies based on common, real-world examples, visual feedback based on quantitatively correct models and video-clips demonstrating how the electronic principles may be verified. The broad-based support of this approach is documented by the survey and by the engaging discussions following the presentation of its ideas[2,3]. We recently distributed 16 copies prototype multimedia modules which provide the framework for this WWW-based project to instructors at 14 different institutions. This distribution also indicates broad-based interest in and support for this multi-faceted approach.

A second distinct characteristic of this project is the potential efficiency of the project's design and development. The design efficiency results from the limited and well-defined boundary of the course content. This allows participants to self-select those parts of the project for which they are particularly interested or well-suited. The accumulated course development expertise and WWW-based expertise of the Engineering Technology Department contribute to the project's development efficiency. We have developed both conventional and multimedia materials for academic, industry and continuing education courses. Examples of Web-based projects recently developed at the Engineering Technology department include a live on-campus video-camera feature, a mechanism for real-time student feedback via the Internet and the ability to control the position of a live video camera remotely via the Internet.
III. Survey

The survey as designed to be as simple as possible for respondents to complete and return. Only the basic information and Question 4 (see below) require free-form responses. A very brief introduction to our project and all survey questions are laid out on one page. The back of the survey is pre-addressed to our department with pre-paid return postage.

The first section of the survey is for basic information such as name, mailing address, institution, phone, fax and e-mail to facilitate subsequent communications. The three subsequent sections of the survey are Technical Resources, Software/Project Development and Internet Workshop. The detailed questions for each section are summarized below:

Technical Resources
1. Internet access (Yes or No)
2. LAN facilities
   (Faculty accessible: Institution, Department, Program and
   Student accessible: Institution, Department, Program)
3. Annual support for computer labs and upgrades (> $20,000, >$10,000, <$10,000)

Software/Project Development
4. Educational products currently used or recommended (No, Yes; please specify)
5. Involvement in Multimedia development (Yes, No; If yes, check all that apply:
   Animation, Video, Graphics, Authoring Tools)
6. Level of participation (Yes, No; If yes, check all that apply: Review Materials, Develop Materials, Design Materials, Evaluate Materials).

Internet Workshop
7. Interest in one-day workshop (Yes or No).

Duplicate responses (only two) were deleted from the total responses leaving a total of 51 distinct, completed surveys from 51 individuals representing 32 educational institutions. The survey results are listed in Table 1.

Table 1. Summary of Survey Results.

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Mail Resp (%)</th>
<th>Mtg Resp (%)</th>
<th>Total Resp. (%)</th>
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<tbody>
<tr>
<td>1. Internet Connection</td>
<td>57</td>
<td>51</td>
<td>54</td>
</tr>
<tr>
<td>2. LAN facilities</td>
<td></td>
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| Faculty access.:
  Institution                    | 67            | 54           | 59              |
| Department                     | 67            | 50           | 62              |
| Program                        | 38            | 34           | 36              |
| Student access.:
  Institution                    | 33            | 24           | 27              |
| Department                     | 19            | 17           | 17              |
| Program                        | 19            | 16           | 15              |
| 3. Computer Support:
  HIGH: > $20,000/yr             | 29            | 26           | 27              |
| MED: > $10,000/yr              | 33            | 46           | 41              |
| LOW: < $10,000/yr              | 29            | 17           | 22              |
| 4. Rec. Educational Products   | 48            | 31           | 36              |
| 5. Multimedia Dev.:
  Animation                      | 29            | 31           | 31              |
| Video                          | 10            | 6            | 7               |
| Graphics                       | 14            | 17           | 16              |
| Authoring Tools                | 19            | 17           | 18              |
| 6. Participation               | 81            | 74           | 77              |
| Review                         | 52            | 49           | 50              |
| Develop                        | 24            | 23           | 23              |
| Design                         | 29            | 14           | 20              |
| Evaluate                       | 67            | 46           | 54              |
| 7. Internet Workshop           | 86            | 89           | 88              |

Among the more significant results from the TOTAL responses is that only 54% of respondents have connection to the Internet. This figure shows that there is still a sizeable audience currently untapped by the Web environment. A second significant TOTAL response is that 77% of respondents indicate a willingness to participate in this project. This indicates a broad-base of support and interest in course development using the Web and in the collaborative approach. Of this 77%, almost half (47%) also indicated no prior multimedia development experience. This may indicate an attraction to and eagerness for learning by doing among technology educators for applying multimedia materials for distance learning.
The TOTAL responses gave an unexpected result to question 5 concerning educational software. We expected responses to vary widely over actual products and to indicate mostly multimedia development software. However, we purposely left the wording of this question not lead the respondents to any particular type of software or development application. Although only 36% of the TOTAL respondents indicated a particular educational software product, a majority (55%) of this 36% endorsed Electronics Workbench™ (Interactive Image Technologies) specifically. This indicates that our collaborative materials should emphasize practical problem-solving tools and should not neglect this particular commercially-available product.

Comparing the Mail-Back responses with the Meeting responses, the Mail-Back respondents were much more likely to indicate more, and more varied, multimedia development experience and more likely to participate in this project. A few Mail-Back respondents voluntarily described details of their multimedia materials. These higher experience and participation indications of the Mail-Back respondents is probably due the greater initiative required in for this group to complete and return the survey. The Meeting respondents had the advantage of visiting with us during several sessions of the TJCTA annual meeting before and after our presentation. We benefited from face to face general discussions and explanations of our project and of our prior multimedia-Web development experiences. The Meeting group also benefited from peer pressure, mostly from the TJCTA-Electronics Chairman, to complete the survey.

IV. Conclusions

With any emerging technology, defining how that technology will be incorporated into existing business practices is usually a major, often fundamental, evolution. This is especially true with the dynamic Internet and World-Wide Web environment. This collaborative project may in some way contribute to the development and definition of multimedia WWW-based courseware.

This project has the potential to significantly impact the infrastructure of technology education. The project's multimedia aspect means that students are exposed to the material in multiple formats. In this way, each student is exposed to the content in ways which best meet that student's particular learning style. The project's WWW aspect means that the content is more available and accessible than ever before. As Internet connections and WWW-based multimedia courseware become more commonplace, women, minorities, persons with disabilities and nontraditional students may benefit the most by the new, more "level" educational playing field.

This project's uniqueness comes from its inclusion of multimedia materials for introductory electronics designed for and implemented in the World-Wide Web. Very recent projects exist which are also developing WWW-based courseware for distance learning applications. These efforts are guideposts for this project and may in fact contribute directly to this project via WWW-based tools for running and developing Multimedia Toolbook™ files. The survey for this collaborative project shows that almost half (54%) of the Texas Junior College Teachers Association member respondents have access to the Internet yet the majority (77%) indicated a willingness to participate in this project. From this survey and related discussions with technology educators at other institutions, we conclude that there is currently a broad base of support and interest in this collaborative effort.

References


