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Ajaz R. Rana

New Jersey Institute of Technology, rana@cis.njit.edu

James C. Wooster

New Jersey Institute of Technology, wooster@helios.njit.edu

James Whitescarver

New Jersey Institute of Technology, jim@helios.njit.edu

Starr Roxanne Hiltz

New Jersey Institute of Technology, roxanne@eies.njit.edu

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From Virtual Classroom to Hypermedia Virtual Classroom

[Ajaz R. Rana](mailto:rana@cis.njit.edu) (rana@cis.njit.edu)

[James C. Wooster](mailto:wooster@helios.njit.edu) (wooster@helios.njit.edu)

[James Whitescarver](mailto:jim@helios.njit.edu) (jim@helios.njit.edu)

[Starr Roxanne Hiltz](mailto:roxanne@eies.njit.edu) (roxanne@eies.njit.edu)

New Jersey Institute of Technology

1. Introduction: The Virtual Classroom® (VC) is a teaching and learning environment constructed as enhancements to a computer-mediated communication system called EIES (the Electronic Information Exchange System), designed to support asynchronous learning networks engaged in collaborative learning activities (Hiltz, 1986, 1994; Harasim et. al., 1995; Turoff and Hiltz, 1995). Participants connect to the VC via the Internet at whatever times are most convenient for them. New Jersey Institute of Technology (NJIT) currently offers a full B.A. in Information Systems via a combination of the VC, plus videotaped lectures and also uses the VC as an adjunct to traditional, Face-to-Face courses. Evaluations have been favorable, with students doing as well or better in VC courses as in traditional sections, and giving subjective ratings that tend to be more favorable than those for traditional sections (Hiltz, 1994, 1995).

Until recently, the VC provided only a VT100 full screen interface navigated via menu choices or commands. Currently, it has been upgraded to a graphical interface accessible through the World Wide Web and popular browsers such as Netscape®. In this paper, we provide a brief description of the current system design, and describe a prototype system that extends VC functionality.

2. Current System Design and Delivery Mechanism: The heart of the system architecture is a Smalltalk-80 byte-code interpreter with a distributed persistent object store which provides a scalable groupware environment where the location of objects on the network is transparent to the application. A framework of Communication Objects including Users, Items, Discussions, and User-Views create an access hierarchy of waiting items and Activities (items incorporating special structures or programs) with User Privileges mediated by Roles defined as sets of Permissions. The User-Agent determines interface selection, information filtering and other automated actions to be done on the behalf of the user. The system utilizes HTML support and a built-in HTTP daemon which supports messaging objects over the Web. The Web based VC is accessible at <http://www.njit.edu/CCCC>.

The current mode of delivery consists of a combination of video taped lectures and on-line VC activities (VC+Video). The lectures for all remote courses are available on video and delivered via cable TV, satellite transmission, or tapes that are sent by conventional mail. Professors set up shared discussion spaces (called conferences) for their students. The online discussion items (called comments) may contain anchors to HTML ready course notes, slide shows, or other material on the WWW. Professors make use of various built in modules (called Activities) to create communication structures (e.g., Question/Response, Gradebook, Exams, etc.) to engage students in on-line collaborative learning activities and support course administration (Turoff & Hiltz, 1995).

3. Hypermedia Virtual Classroom®: Often cited critical reports of ineffective higher education and recent advances in computer technologies provide an impetus for use and evaluation of such technologies for learning and instructional purposes (Alavi, 1994). The recent trend in classroom teaching at all levels is to move beyond traditional Computer Aided Instruction towards more active/interactive hypermedia, where computing and communication technology are combined to make flexible connections among formerly distinct media such as writing, photographs, video, sound, graphics, and computing (Bork, 1986; Norman, 1990). Commonly noted benefits of hyper/multimedia-based instruction, if done properly, include: higher level of student involvement (Kearsley, 1988); greater interactivity and hence better learning experience (Nelson & Polombo, 1992); flexibility along with a combination of media having positive impacts on learning (Kozma, 1991), learning that is constructive or generative in nature through anchored or situated instruction (Cognition and Technology Group at Vanderbilt, 1991), and improved learning through the development of concrete and abstract projections of one's mental images (Lennon & Mauer, 1994).

Recent advances in computer technologies, especially ones related to the World Wide Web, provide exciting, low cost, and viable opportunities for integrating interactive hyper/multimedia components into the VC, making it possible for remote learners to enjoy the benefits of multimedia technologies. Our goal is

to develop a domain independent generalized framework/support mechanism for creating hyper/multimedia instructional material suited for distance learning (CITE, 1996). Besides HTML text, the course content may consist of clickable links to multimedia objects, such as animations, graphics, virtual reality models, and audio/video clips of instructors' comments anchored on topics needing verbal instructions, explanations, and/or emphasis. Students will be able to share and manipulate multimedia objects as part of online discussions and learning activities on VC.

Work on the development of interactive multimedia courseware is already underway at NJIT (Bengu, 1995). As part of a systematic program, under the advisement of faculty at NJIT, both undergraduate and graduate level students will be undertaking projects involving JAVA applets and VRML models. The present technology to conduct media rich interactive dialogue and share multimedia objects over the Internet provides a basis for both synchronous and asynchronous modes of communication. Some examples include: Cu-SeeMe from Cornell University (Koch, 1995) for live interaction, Multi-User Dungeons (MUDs) and Object-Oriented Multi-User Domain (MOO) software (Newberg, et al, 1995) for same-time different-place collaboration, live video broadcast using high bandwidth ISDN (Integrated Services digital Network) lines and MBONE (Multicast Backbone) technology (Watanabe, et al, 1995), and compressed video broadcast using low bandwidth streaming and reflector technology (e.g., Xing Streamworks' MPEG1 and VDonet's VDOLive). The technology is evolving rapidly and new and better tools are being introduced every day.

One of our objectives is to provide a platform for integrating small clips (2 - 3 minutes) of instructors' videos anchored to relevant course material. Short clips of instructor's live video will provide for prompting. Prompting- clips will involve antecedent stimuli (e.g., reflexive elicitation, attention getting, instructions, etc..) to generate a desired response from remote learners. It is believed that such prompts would accelerate behavioral occurrences with reinforcing consequences (Ray, 1995). Our preference is for asynchronous (on-demand), low-cost availability of course material to students via the Web. (Although the EIES system architecture enables synchronous interaction, we believe that asynchronous [different times/ different places] communication is better suited for the majority of educational goals-- see Hiltz & Turoff, 1993, Ocker, 1995). Therefore, we chose compression technology for incorporating video instructional component into the VC.

At present, we are in the process of developing a prototype system that uses stream compression technology. As part of this project we will be evaluating various streaming compression products, such as, VDO, Xing, Apple, and others, as new merging products become available. Hardware/software requirements for asynchronous stream video servers are low cost. A stream server could run on a 100MH Pentium with 32MB RAM Windows-NT machine. The viewing clients (e.g., a Netscape plug-in) are readily available at Internet sites. The hardware requirements for viewing clients are not very taxing either, a multimedia ready 486 or above PC with modem connection would suffice. Using some of the most recent compression technologies (such as VDonet's VDOLive server and its companion Netscape plug-in), remote learners can receive reasonable video quality at 14.4 or 28.8kbs baud rate. It is hoped that, the low bandwidth streaming requirements would make Hypermedia Virtual classroom a broad reach support mechanism for distance learning. Remote students will be able to read HTML ready course notes, invoke instructor's video clips, and manipulate JAVA applets or VRML models, by simply pointing and clicking on the anchors embedded in a comment written by the instructor in the Hypermedia VC system.

We plan to assess the effectiveness of the prototype system by using it for one of the BAIS courses. We will collect various objective and behavioral/subjective data and compare them with the data already being collected on VC+Video courses. We believe that the incorporation of hypermedia functionality will make the VC an even more attractive, effective, and broad reach learning support environment.

4. Conclusion: A combination of full length video lectures and continuous (asynchronous) media rich online activity in the Hypermedia Virtual Classroom should provide a sound foundation for self- paced collaborative learning. We believe that a hypermedia Virtual Classroom would provide for more active engagement on part of the remote learners. Even though our current focus is on improving the asynchronous distance learning infrastructure, continuous evolution of computer and communication technology demands vigilance, and hence, we remain open to evaluating and embracing alternative technologies. Finally, we close this discussion by highlighting the common wisdom that technological enhancements on their own cannot ensure improved achievement of educational objectives. The real challenge lies in effective adoption of these tools by faculty.

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