CILT99: Ubiquitous Computing Abstracts

Presentations

The Application of Free Open Source Software to Education and Ubiquitous Computing

Stephen Bannasch
http://concord.org/oss

The world of Free Open Source Software has exploded in the last year with the popularization of the GNU/Linux operating system and related applications. GNU/Linux runs on systems as varied as an embedded controller the size of a pack of cigarettes to a parallel cluster of 120 Alpha computers. While GNU/Linux has been used as a server oriented operating system for years only recently have simple to use GUI desktop environments become available. This development is based on a model of intellectual property where the source code is freely available for any programmer to modify and changes are contributed back to the community. There is a huge opportunity here for the educational community as well as for developers of new ubiquitous computing devices to adapt an OS and applications for specific needs. I'll describe our current work and future directions. For more information see: http://concord.org/oss

Beyond Black Boxes: Bringing Transparency and Aesthetics Back to Scientific Investigation

Robbie Berg
http://el.www.media.mit.edu/projects/bbb/

In a project called Beyond Black Boxes, children are using a new generation of tiny programmable bricks called Crickets to design their own instruments for scientific investigations. Students become engaged in scientific inquiry not only through observing and measuring but also through designing and building.

While computational technologies have, in general, contributed to making today's scientific instruments more opaque (that is, less understandable) and less aesthetically-pleasing than their predecessors, I will argue that these same technologies can be used to bring back a sense of transparency and aesthetics to the design of scientific instruments. I will analyze how students, by building their own scientific instruments, can: pursue a broader range of scientific investigations of their own choosing, feel a stronger sense of personal investment in their scientific investigations, and develop deeper critical capacities in evaluating scientific measurements and knowledge. I will also describe the current state of our Cricket technology, highlighting developments in both software and hardware.

Beyond Black Boxes is funded through the National Science Foundation's Collaborative Research on Learning Technologies. The principal investigators are Mitchel Resnick and Sherry Turkle (MIT), Mike Eisenberg (Colorado) and Robbie Berg (Wellesley College). Additional funding has been provided by the LEGO Group, and the MIT Media Laboratory's Things That Think, Digital Life, and Toys of Tomorrow consortia.

Mobile Inquiry Technology

Arthur Camins, Sheldon Berman

The Mobile Inquiry Technology Project is based on four principles:

1. Access: In order to take advantage of the power of technology to enhance students' learning they must have access to the tools. The Mobile Inquiry Technology project will test a classroom implementation model using class sets of 13 computers and sets of scientific probes in each classroom, enabling pairs of students to collaborate on investigations and share the computers for writing purposes. Teachers will have access to the tools as well.
2. Equity: The Mobile Inquiry Technology project is committed to making use of low-cost, durable, and mobile technology.
3. Cognitively powerful solutions: Our goal is to develop activities that support, enhance, and enrich research-based successful learning activities exemplified by NSF-funded, standards-based curriculum projects.
4. Instructional efficiency: We will develop technology-based inquiry activities that can easily be implemented in the classroom.

Design of a Mechanism with Programmable Force-Response Characteristics

Philip FitzSimons

The design of a mechanism to provide programmable Force-Response characteristics for rectilinear motion will be described. A proposed solution to the kernel of the mechanical problem will be stated. The remainder of the presentation will be used to describe the specifics of the electro-mechanical system and software architectures used to implement the solution.

Shared Learning Environments to Enable the Integration of Personal Technologies

Stacey Inkpen

As technology advances and computers become more affordable, more accessible, and increasingly mobile, there will be an increased use of small personal computers, such as handheld devices. As this trend extends to classroom technology, it is important to provide facilities that enable students to work in a shared collaborative environment in order to have a positive impact on student learning. Previous research in the area of Single Display Groupware has shown achievement and motivational benefits when children work together on a shared computer in an educational environment (Inkpen et al. 1995). In addition, enhancing the traditional desktop environment to better support collaborative interactions, such as providing multiple input devices, has shown academic and social benefits (Inkpen et al. 1997, Stewart et al. 1998, and Bricker et al. 1998).

Our research investigates issues related to Single Display Groupware, providing more ubiquitous support to enable seamless collaboration in a face-to-face environment. This includes the ability to integrate personal technologies into a shared learning environment. This approach will allow students to benefit from active discussion and face-to-face

interactions with peers while still promoting individual exploration. Our current research thrusts involve investigating alternative approaches to the traditional one-person/one-computer paradigm, moving beyond current desktop metaphors. Bringing several independent workspaces together (i.e. hand-held computers) means that support must be provided to enable movement between personal and shared spaces. We are also exploring the importance of new shared screen metaphors and multiple input devices to help facilitate face-to-face collaboration. While the promise of low-cost, mobile, personal computing is exciting, we must be careful not to encourage isolation and inhibit collaborative interactions. Our focus needs to provide support for both individual and collaborative activities in learning environments.

Bricker, L. (1998). Cooperatively Controlled Objects in Support of Collaboration. Ph.D. Dissertation, University of Washington, Department of Computer Science and Engineering, Seattle.
Inkpen, K., Booth, K. and Klawe, M. (1995). Playing together beats playing apart, espectially for girls, in Proceedings of CSCL 1995, pp 177-181.
Inkpen, K., McGrenere, J., Booth, K., and Klawe, M. (1997). The effect of turn-taking protocols on children's learning in mouse-driven collaborative environments, in Proceedings of Graphics Interface 1997, pp 138-145.
Myers, B.A., Stiel, H., and Gargiulo, R. (1998). Collaboration Using Multiple PDAs Connected to a PC. Proceedings of ACM CSCW'98 Conference on Computer-Supported Cooperative Work 1998 p.285-294
Stewart, J., Raybourn, E.M., Bederson, B., and Druin, A. (1998). When Two Hands are Better than One: Enhancing Collaboration with Single Display Groupware, in Adjunct Proceedings of CHI 1998, pp287-288.

The Tipping Point

Curtis Lee

South Pasadena USD is a five school district with a demographic snapshot that resembles much of the country. Under the auspices of the Digital High School program, we have embarked on a journey towards redefining the informational space of a large public school campus. The goal is a campus that has total wireless Ethernet coverage at a sufficient density to sustain the eventual one-to-one computer to student/faculty/staff-ratios we seek. Wireless networking combined with small light portable devices (HPC's) is the killer app for public education. They provide a personal information tool to a clientele who are desperate for such autonomy. In New Ideas for a New Economy, Kevin Kelly articulates the phenomena by which a growing number of simple nodes eventually create a critical mass whose impact then ramps up exponentially once this "tipping point" has been reached. This is about the ability and opportunity for everyone to have and use tools that allow for the abstraction, manipulation, and management of information as it moves through and around them all the time, every day.

SPUSD has additionally chosen to use thin-client computing as another essential strategy for maximizing this approach. This technology dramatically lowers Total Cost of Ownership (TCO) for the long-term and alleviates the bandwidth limitations associated with wireless Ethernet. Using Citrix Meta-Frame technology, these devices have network access to the full range of software applications that typically require computers that are much more powerful. We achieve the benefits of a stable, portable

platform without sacrificing the ability to run demanding software applications. Our partners in this solution are NEC, Proxim, Citrix, Microsoft and New Technologies. They are providing both equipment and expertise to make this vision a reality. Thorough testing has been conducted at SPHS in a variety of configurations to assure the viability of this approach.

Adventures in Imaging

Brian Smith
http://www.media.mit.edu/explain/projects/imagemaps.html

Historical photographs are typically used as visual aids to accompany text or lecture-based presentations. We are exploring the use of images as learning tools for understanding historical, architectural, and cultural change. Our focus is on developing tools that allow students to actively investigate how and why their communities over time, using imagery as data for inquiry.

The presentation will describe our pedagogical use of archive photos and our progress in augmenting digital cameras to automatically retrieve historical images using ordinary, tourist photos. We will describe the camera's architecture and mapping tools that we hope will facilitate historical inquiry in classrooms. If time permits, we will also describe our larger agenda concerning imagery and video and tools for active inquiry.

Parallelism and Participatory Modeling in a Classroom Network: A Collaborative Match

Walter Stroup

The new, cross-site, NSF-funded, Participatory Simulations Project brings together two lines of research -- the study of complex dynamic systems and the use of participatory simulations as a powerful way into systems modeling -- both of which can be enabled and advanced through emerging, classroom-based, network technologies. Participatory simulations are activities that allow learners to enact their intuitive modes of reasoning. Students engaged in these participatory simulations act out the roles of the individual system elements and then see how the behavior of the system as a whole can emerge from these individual behaviors. The emergent behavior of the system and its relation to individual participant actions and strategies can then become the object of collective discussion and analysis. These analyses can center on using both aggregate (e.g., STELLA or Model-It) and object-based (e.g., StarLogoT) modeling tools. The hardware for the network of low-cost devices is being developed in close collaboration with a commercial partner, Texas Instruments. There are numerous challenges in the design and implementation of networked participatory activities. Among them is the need to maintain various levels of programming: code on the local device, code to operate the network, code in the form of a scripting language to collect sequences of network actions, and a meta-code for the larger activity design sequence. This presentation will center on the good news that implementing the network functionality in a way that builds on a parallel model of computation Ò something we are calling n-Logo -- solves or makes much more elegant the task of designing various forms of collaborative interaction in the network. Brief examples of working models will be given. It expected that this redesign of network interactivity could make real a range of more-fully collaborative, cost-

effective, group-based learning experiences in schools. The Project sites are Tufts University and The University of Texas at Austin. Uri Wilensky, PI; Walter Stroup, Co-PI.

Posters

Human Interfaces To Knowledge Construction and Transfer Devices: Providing Meaningful Learning Experiences Utilizing Interactive Media

Dane Barse
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As the width of our roads is derived successively from the size of train tracks, the width of the horse and carriage, and the ancient Roman chariot, the interfaces to technology we suffer from today are derived from the handy metaphors of the book and the television. In antiquity, Socrates feared that the written word would cause "forgetfulness" in human minds, yet the book became a powerful paradigm for information transfer, making possible the advances of the modern world, and thus is a pervasive metaphor we must deal with when considering interfaces to knowledge.

Recent consideration of the problems of information delivery and knowledge informed by constructionist theory have led to the concept of creating interactive tools which allow persons to overcome the passive nature of the book and interfaces to electronic knowledge bases. Unfortunately, current interfaces to electronic media generally do not take advantage of the capabilities of the medium, utilizing paradigms left over from earlier technologies such as the book.

The challenge this project will consider derives from attempts to combine the metaphor of the book with new electronic media to create an interface that may facilitate meaningful learning experiences through the construction of interactive knowledge bases, combining the best characteristics of both paradigms. Since this objective is far too large a task for immediate consideration, an attempt will be made instead to provide an overview of the problem to be considered, along with a developmental form of a model for implementation of the concepts.

Multimedia Resources in the Field

Geri Gay

We are studying how learners collaborate and annotate using tablet technology running mobile DL software. This project draws from research into situated learning, CSCL and digital libraries. We view this as a complimentary effort to several CILT projects. Many people in the library, school technology and higher education communities have considered ways to enhance access through portable devices. Others, such as Bob Tinker, have focused more directly on the learning aspects of mobility and ubiquity. Our research portends that the introduction of mobile computers into the field experience can potentially transform the activities of learning and researching in and from the field.

Activity theory provides a theoretical and methodological framework to enable the systematic exploration of these transformations. We examine the use of document annotations, online resources and other tools for group communication and learning in the field.

As students work on projects supported by multimedia resources in the field or at the point of learning, they can bring different perspectives to bear on problems (though whether they in fact do is a matter for investigation). Likewise, multimedia enables the expression and representation of knowledge in different forms. Hence it can augment the acquisition of tacit knowledge that is part and parcel of socialization into a community of practice (i.e., a profession), and provide students with an opportunity to learn in diverse contexts.

Integrating Learning Technologies into the Curriculum

Ann Rivet
http://www.hi-ce.org

This poster presentation will highlight the integration of curricula and learning technologies developed by the Center for Learning Technologies in Urban Schools (LeTUS). LeTUS is a joint effort of the University of Michigan, Northwestern University, the Detroit Public School System, and the Chicago Public School System to systemically bring learning technologies into urban schools through innovative curricula. One of the objectives of LeTUS is to develop innovative project-based curricula that integrate technology seamlessly into the units. The curricular approach is one that combines contextualization through the use of driving questions and anchoring experiences, supported and sustained inquiry, collaboration, and the use of learning technologies to enhance the learning of science content. The goals for technology use in the curriculum projects are twofold: to provide opportunities for learning that could not be afforded otherwise in the curricula, and to make technology use a natural and indispensable part of students' work in the project. One example of this use of technology is the eighth grade project 'Why Do I Need to Wear a Helmet When I Ride My Bike?' developed at the University of Michigan. In this project, students use motion sensors to develop concepts of motion, velocity, and acceleration as they inquire into the driving question and investigate what happens during a collision. The curriculum project is designed and supported so that the technology achieves its appropriate role: the need to use the motion sensors arises as the project naturally turns to asking questions about motion, acceleration, and collisions, and the motion sensor provides the integral link between action and representation that cannot be achieved through more traditional graphing activities. The presentation will include a demonstration of the motion sensor and examples of this and other curriculum projects developed by LeTUS.