CISE Research Infrastructure Grant CDA-9303152
Interactive Accessibility

Department of Computer Science
Virginia Tech

Year - 2 Progress Report
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The Research Program:

Following the CHI '94 workshop on *A Taxonomic Model for Developing High Impact Formative Usability Evaluation Methods* co-organized by Hartson and Hix, with Jakob Nielsen of SunSoft, research continues apace on high impact usability methods. Our efforts are aimed at developing methods for remote evaluation (e.g., via Internet), instrumented evaluation, and specialized evaluation of virtual environments. Both Kodak Corporation and the U. S. Bureau of Land Management are presently interested in the remote evaluation work.

We have also remained active in developing IDEAL, the tool environment for supporting user interaction development activities including task analysis, user class definition, setting of usability specifications, and formative evaluation and analysis. We are integrating video and audio capture from both subject and evaluator. We have also begun to evaluate IDEAL itself. This type of meta-evaluation requires the specialized kind of facilities for which we have specifically designed the Usability Methods Research Lab.

Following the receipt of a planning grant from the National Science Foundation, this has been a year of intensive work with the Montgomery County school system to work toward a system-wide plan for network-based educational reform in the context of the Blacksburg Electronic Village. Despite a system-wide lack of facilities, a group of lead teachers were fully trained as mentors who will drive this reform effort forward. Numerous research projects were initiated with individual teachers and classes to demonstrate how networking capabilities can support collaboration, discussion, and active learning. An instrumented version of the Mosaic WWW browser is being prepared to study how children can work with their peers, families, and schools in an environment of fully networked homes and classrooms. Two major proposals were

prepared, based upon the planning grant, one on educational reform, and one on network-based collaborative technologies. The county school system WWW pages resulting from this project can be found at **http://www.bev.net/education/schools**.

A great deal of effort was directed toward the final design of the Usability Methods Research Laboratory (UMRL) using participatory design techniques. A case study of this design process is being prepared for scientific publication.

Work is continuing on the Educational Initiative and Envision projects, and the massive introduction of network-based materials into our Computer Science curriculum is continuing. Research is now focusing on statistical modeling of network use and the scaling of the project to campus-wide dimensions.

There was a great deal of interest in initiating a virtual reality research group to investigate the human factors of VR and the effect of a number of the design parameters that affect the quality of the illusion of presence in VR systems. Such a group was organized, and core facilities were purchased.

The following are some of the other activities and achievements of the Research Infrastructure program:

- Hartson and Hix co-produced "Usability Specification and Evaluation of ENVISION," a 10-minute video tape illustrating usability engineering methods.
- Continued work on the Task Mapping Model (TMM) for user interface analysis and redesign.
- Continued work on the User Action Notation (UAN), a behavioral technique for interaction design representation.
- Robert Williges and Deborah Hix were faculty co-sponsors for the 3rd Annual Mid-Atlantic Human Factors Conference at Virginia Tech, March 1995
- Carried out formative and classroom studies of the CU-See Me video conferencing system
- Preliminary design was completed for the electronic conference room in the UMRL.
- Mr. Michael P. Snow was awarded support for his doctoral studies under the US Air Force Palace Knight Program directed by his Air Force Mentor, J.R. Reising, in the Pilot-Vehicle Interface Branch, Flight Dynamics Directorate at Wright-Patterson AFB, Ohio. He will complete his dissertation research in the UMRL using virtual reality equipment purchased this year.
- Continued development of GeoSim, our geographic educational system.
- Continued work on SWAN, a data structure visualization tool.

Space and Renovations:

Laboratory renovations are in mid-construction, to be followed immediately with other renovations of most of the Computer Science Department. We expect the laboratories to be completed by the end of 1995.

External Advisory Committee:

An external infrastructure advisory committee has been formed to oversee the progress of the Research Infrastructure program and to help provide insight and direction. The committee is small to simplify expenses and logistics, yet representative of the focus of the program and of both industrial and academic interests. The members are Elizabeth Buie, Computer Sciences Corporation (HCI); Scott Stevens, Software Engineering Institute (Software Engineering and Digital Libraries); and Thomas Hewett, Department of Psychology and Sociology, Drexel University (HCI and social aspects of computing). Plans are to hold one physical meeting each year and others using our evolving electronic conferencing capabilities.

Usability Methods Research Laboratory (Williges):

The UMRL provides a core facility for departmental empirical research in human-computer systems and information access. During laboratory construction in the Computer Science Department the project has been using the facilities in the Industrial Systems Engineering (ISE) Department. This arrangement will continue indefinitely because we expect that activities will keep both laboratories occupied. Major acquisitions this year have been a high resolution projection system and a very powerful digital video system that will satisfy both the need for video editing and for research. This $80,000 system is based upon the new Radius motion JPEG System 100 and has two 18Gbyte disk arrays, CDRom writer, and tape backup. The video subsystem will include Betacam SP, Hi-8, and SVHS decks, DAT tape decks, audio mixing, and switching and monitoring for all devices.

Much effort was invested in the detailed design of the UMRL, culminating with the simulation of the entire facility in our Superscape virtual reality software. We are not aware of any other laboratories of this type that were designed this way, and it turned out to be an excellent way to make design decisions and validate the overall design. Among the design mistakes we caught were:

- wheelchair got caught in too-narrow door once
- wheelchair view through 1-way mirror wasn't right height
- light switch was behind door
- one door opened the wrong way

Most recently we have been conducting design meetings for the electronic conference room that is part of the UMRL and have discovered that this is also a very complicated design problem. We are deferring the purchase of a portion of the audio/video/lighting systems for the laboratory until we have a better understanding of laboratory usage modes and until we have thoroughly assessed the needs of the users of the laboratory and conference facility. We have also had extensive discussions with members of the University's Learning Resources Center who have considerable experience in dealing with such designs.

Interaction Technology Laboratory (Hartson and Hix):

Space for the ITL will not be officially available until a department-wide relocation to be implemented probably late in the Fall of this year. In the meantime equipment already purchased for the ITL, and a few ITL-supported projects already started, have been housed in various temporary locations so some work can proceed before we can move to our permanent space. ITL equipment supports Michael Snow and Dennis Neale in their work on virtual reality environments. Michael's work is funded by the U. S. Air Force. Carolyn Bussi (graduate student in ISE) is using our virtual reality software for work funded by the Federal Highway administration. ITL equipment supports an undergraduate doing development and interface evaluation on a document retrieval system, MADAM IV. We expect to support Karen Baker (graduate student in ISE) and Brian Wentz (undergrad in CS), exploring pen-based computers.

A major project underway in the ITL is development and evaluation of a new interaction technique called pre-screen projection, funded by the Naval Research Laboratory in Washington DC. This technique allows a user to pan and zoom integrally through a scene on a computer screen simply by moving their head relative to the screen. Brian Amento (graduate student in CS) currently is conducting a comparative evaluation of pre-screen projection with other interaction techniques for pan and zoom. This grant would not have been awarded if we had not already had the equipment to support the research, provided by this Research Infrastructure aware.

The ITL, temporarily housed in 102 McBryde, was crucial in enhancing the quality of CS 5714, Human-Computer Interaction, this past Fall (1994). Three new machines, plus a new printer, were used to support HCI team development projects: two Macintosh Quadras (one with a touchscreen) and a Pentium. The lab space also served CS5714 well for demos and in-class evaluations of user interfaces.

Information Access Laboratory (Fox):

The Information Access Laboratory supports the integration of areas such as information retrieval, database systems, hypertext/hypermedia, multimedia, and networked information. This year's acquisitions include video equipment, our first portable high-resolution workstation, and a hierarchical storage system. Finding a suitable storage system was a major effort this year. Smaller systems turn out not to be much more cost-effective than conventional disk systems

($300/Gbyte), while larger systems offer storage costs almost a factor of 10 lower. We are currently requesting bids on a 5Tbyte tape/disk system and will join with the university in purchasing such a system if the cost exceeds our anticipated project allocation of $120,000.

Ongoing research activities include the MARIAN library system project, electronic report and dissertation publishing, digital libraries, the ENVISION education project, retrieval work on the large-scale TREC project. A major focus in the study of digital libraries is the scaling up of the Envision and Educational Initiative projects to create a campus-wide digital library. We are studying World Wide Web network accesses and server architectures and are studying statistical user behavior models for various user classes, such as multimedia, faculty, graduate students, and so forth. We are working on a simulation model that predicts performance in many types of environments. The scope of this work demands the type of storage system we are in the process of purchasing.

Interaction Consulting Service (Ehrich):

The following formal usability evaluations were performed under the auspices of the Interaction Consulting Service:

- Karen Bowen -- KMS, a distributed hypermedia system to support collaborative work
- Jason Moo -- XPRCEDIT, a system for viewing, manipulating, and annotating graphics and video raster images
- Kevin Stringer -- Geo-Sim, an educational system for geography

On-going work through the Interaction Consulting Service includes work on remote evaluation by Jose Castillo, a graduate student in CS, for the Virginia Tech Department of Forestry, the Bureau of Land Management, and the US Forest Service.

Curriculum and Education:

Plans proceed to convert CS5714, presently named Human-Computer Interaction and our only on-going course in HCI, to Usability Methods. We will expand our graduate level HCI course offerings by adding courses in HCI Theory, Complex HCI Applications (e.g., Computer Supported Collaborative Work), and Advanced Topics in HCI. Additionally, a Survey of HCI course will debut at the undergraduate level this fall, expected to draw students from across the university. We also have future plans for an undergraduate course in User Interface Programming. These HCI courses, along with planned cross-listing of graduate courses in Experimental Design for HCI and Ergonomics of Devices from the ISE Department, will boost our curriculum to eight courses specific to HCI!

New Personnel:

- John Kies and Dennis Neale were appointed Research Assistants, funded by this RI grant, beginning August 1, 1994.

Equipment:

The CS Department was fortunate this year to receive additional equipment allocations from the State Council of Higher Education for equipment upgrades (including replacement of much obsolete equipment) and some additional equipment in support of education. This permitted us to shift some funds from computers to specialized equipment we could not otherwise have purchased, such as our virtual reality equipment. To this end we have allocated roughly $50,000 from funds for the Interaction Technology Lab to the purchase of a VR4 head mounted display, Superscape software, and supporting hardware.

Work in the Information Access Laboratory is progressing more rapidly than we had initially thought; since adequate OCR facilities are now available elsewhere in the University, we decided it would be better to add the funds originally allocated to OCR to the purchase of our mass storage system which, as noted earlier, will cost in the neighborhood of $120,000.

Numerous meetings have been held with the University to produce a staged University-wide networking plan for the introduction of ATM into our networking infrastructure, since our servers and video conferencing work will require considerable bandwidth. We expect a major hub to be installed in our building this fall and hope that the University will complete its own plans to increase the bandwidth of its external Internet connection.

Other purchases include the digital video equipment discussed above $80,000, our high resolution display system (Proxima 920 with high intensity projectors) $13,000, the Pentium systems to support the Model Development Environment work of Dr. Balci, several workstations, and a substantial number of smaller expenditures for cameras and video equipment, software, disks, and supporting equipment.

Plans for Next Year:

During the next program year, work will proceed on most of the ongoing research topics; some of the focus will be determined by the grants that are awarded later this year. A noted, there will be considerable emphasis on education and collaborative networking, remote evaluation, virtual reality usability, large-scale digital libraries, and the methodology work represented by the IDEAL environment. Much effort will be made toward the design of our electronic conference room and the acquisition of its facilities. Significant changes in our networking capabilities will begin to appear as we work with the Department and with the University to introduce ATM into our computing infrastructure.

The video equipment currently being ordered will make dramatic improvements to our capabilities. It is sophisticated equipment, and it will take some effort on our part to learn about it in detail and to integrate it into our scientific agenda.

Budget:

There are two main program items for which we wish to request a funds carryover into the second grant year, although most of the carryover funds will be expended in the flexibility period. The total carryover request is **90,390** as detailed below:

1. Programmer salary: As we explained in our previous progress report, our programmer was not available until February last year, and as a result we wish to slide his employment period ahead in time by about 4 months. NSF's share of his salary was to have been expended half way through year 5; this would mean only that the funds would be expended near the end of year 5. However, this requires your permission to carry over roughly 4 months of his salary each year.

2. UMRL instrumentation: We have ordered the video instrumentation we need to carry our current work. However, until we complete our requirements assessment for the electronic conference room and are able to determine the lightning and main instrumentation needs of the Usability Methods Research Laboratory, we thought it prudent to defer these expenditures. Once the physical laboratory is complete and we have met with our advisors, we believe we will be able to do a much better job of specifying this equipment. For this reason we are requesting permission to carry over an estimated $60,532 into the third project year.

There are no programmatic changes aside from the usability work associated with virtual reality that we had not foreseen two years ago. The University cost sharing budget has been almost completely spent as planned, except that we have reserved several thousand dollars for travel expenses for our advisory board. The following table details our request:

Expenditure	**Carryover**
John Kelso, Res. Asst.	15,600
Fringe	4,992
Equipment	60,532
Indirect Costs	9,266
TOTAL	**90,390**

APPENDIX

Infrastructure-Related Publications:

- Alpert, S.R., Singley, M.K., & Carroll, J.M. Multiple mutimodal mentors: Delivering computer-based instruction via specialized anthropomorphic advisors, *Behaviour and Information Technology*, 14, pp. 69-79, 1995.

- Balci, O., Bertelrud, A.I., Esterbrook, C.M., and Nance, R.E., A Picture-Based Object-Oriented Visual Simulation Environment, in *Proceedings of the 1995 Winter Simulation Conference*, December 1995, to appear.

- Belkin, N.J., Kantor, P., Fox, E.A. and Shaw, J.A., Combining the Evidence of Multiple Query Representations for Information Retrieval, *Information Processing and Management*, 31(3), pp. 431-448, May-June 1995.

- Berwick, R.C., Carroll, J.M., Connolly, C., Foley, J., Fox, E.A., Imielinski, T. & Subrahmanian, V.S., Research priorities for the World-Wide Web: *Report of the NSF Workshop Sponsored by the Information, Robotics, and Intelligent Systems Division*, held October 31, 1994 in Arlington, VA, 1995.

- Brock, Derek, Dievendorf, Lynn, and Deborah Hix. Extending the User Action Notation for Research in Individual Differences, in *Proc. Ninth Annual Human Factors Society Conference*, San Diego, CA, October 1995.

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- Carroll, J.M., Redrawing the borders for artifacts in use, *Human-Computer Interaction*, 9, pp. 53-56, 1994.

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- Carroll, J.M., The scenario perspective on system development, *Interactions*, II.2, pp. 79-83.

- Carroll, J.M., History as tool and application: The journey from HCIU91, in *People and Computers X, Proceedings of the HCI'95 Conference*. Cambridge: Cambridge University Press, PAGES, 1995.

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- Carroll, J.M. and Rosson, M.B., Managing evaluation goals for training, *Comm. of the ACM* 38(7), pp. 40-48, July 1995.

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- Gray, W., Atwood, M., Carroll, J.M., Fisher, C., Long, J., and Nielsen, J., Panel on Discount Usability: Discount or Disservice. *CHIU95 Conference on Human Factors in Computing Systems*, (Denver, CO, May 7-11). New York: ACM Press/Addison-Wesley, pp. 176-177, 1995.

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Talks:

- Jack Carroll: *Making History, Giving Reason: Technical Communicators at the Great Divide,* Plenary talk (acceptance of 1994 Rigo Award for career contribution to computer documentation), ACM SIGDOCU94: ACM Conference on Computer Documentation, Banff, Alberta, Canada, October 3-6, 1994.

- Jack Carroll, J.M., Johnson, J., Lund, A. and P. Reed, Panel on HCI and the National Information Infrastructure, *CHIU95 Conference on Human Factors in Computing Systems*, Denver, CO, May 7-11, 1995.

- Jack Carroll: *Making more of Minimalism: Scaling up to complex domains,* Keynote address for Currents 1995, Atlanta, GA, February 25.

- Jack Carroll: *History as tool and application: The Journey from HCIU91*, Invited keynote address for HCIU95 University of Huddersfield, UK, 29 August - 1 September 1995

- Jack Carroll: *TITLE,* Invited keynote address for OZCHIU95: Conference of the Australian Computer Society, Wollongong, Australia. November 1995.

- Roger Ehrich, Andrew Cohill, Doborah Hix, and Andrea Kavanaugh: *Managing the Evolution of a Virtual School in the Blacksburg Electronic Village*, Human-Computer Interaction Consortium Workshop, Fraiser, CO, February 1995.

- Ed Fox: *Images of Digital Libraries*, invited opening keynote address, INFO Conference: Digital transfer of images, Helsinki, Finland, November 10-11, 1994, 2 pg. extended abstract for conference plus longer paper for proceedings.

- Ed Fox: *Multimedia in Education and Digital Libraries*, sole keynote speaker for Multimedia Systems: Technology and Applications, Ottawa, CA, October 12-13, 1994.

- Ed Fox: *How to make intelligent digital libraries*, invited plenary presentation for 8th Int'l Symp. on Methodologies for Intelligent Systems (ISMIS'94), Charlotte, NC, October 16-19, 1994.

- Ed Fox: *Toward a Widely Used Hypermedia Digital Library in Computer Science*, invited plenary presentation for EG-MM '94, First Eurographics Symposium and Workshop on Multimedia: Multimedia/Hypermedia in Open Distributed Environments, Graz, Austria, June 6-9, 1994.

- Ed Fox: *NSF Education Infrastructure Courseware*, Two hour demonstration for Multimedia Expo, Virginia Tech, March 24, 1995.

- Ed Fox and R. Akscyn: *Design and Use of Digital Libraries*, Half day tutorial for ACM SIGIR '94, International Conference on R&D in Information Retrieval, July 3-6, 1994, Dublin, Ireland.

- Ed Fox: *IR is at the Heart of Digital Libraries and the Global Information Infrastructure*, invited presentation for A SMART Celebration, Cornell Univ., Ithaca, NY, April 22, 1995.

- Ed Fox: *Improving CS Education with Digital Libraries*, invited Colloquium for Dept. of Computer Science, SUNY Buffalo, Dec. 2, 1994.

- Ed Fox: *Interactive Accessibility*, invited presentation at MCNC, Research Triangle Park, NC, October 30, 1994.

- Ed Fox: *Requirements for Knowledge Workers and Education*, invited presentation for Digital Library Academy Workshop, sponsored by IBM Academy of Technology, Edith Macy Conference Center, Briarcliff Manor, NY, September 12-13, 1994.

- Deborah Hix: *Ensuring Usability of Interaction Systems*, Invited Presentation by at Siemens Manufacturing, Johnson City, TN, January 1995.

- John Kies: *Video Conferencing Meets the Internet: Current and Future Research,* Seminar presented at the Blacksburg Electronic Village Seminar Series, Virginia Polytechnic Institute and State University, Blacksburg, VA, September 1994.

- Dennis Neale and John Kies: *User-generated Scenarios for Requirements Specification and Design Rationale*, Human-Computer Interaction Consortium Workshop, Fraiser, CO, February 1995.

- Mary Beth Rosson and Jack Carroll: *Introduction to Object-Oriented Design: A Minimalist Approach,* Tutorial, CHIU95 Conference on Human Factors in Computing Systems, Denver, CO, May 7-11, 1995.

- Bob Williges: Seminar at Virginia Tech, Department of Statistics, *Design and Statistical Analysis of Experiments in Human Factors Engineering*, October 1994.

- Bob Williges: *Introduction to Experimental Design,* Electronic lecture for the Engineering Summer Conference, The University of Michigan, August 1994.

- Bob Williges and Bev Williges: *Transportation Systems Viewed from a Wheelchair,* Paper presented at the 1994 Potomac Chapter of the Human Factors and Ergonomics Society Symposium on Special Human Needs in Transportation Systems, Washington, D.C., September 1994.

Infrastructure-Related Workshops and Conference Activities:

- Jack Carroll was a member of the Program Committee of the HCI International '95, Sixth International Conference on Human Computer Interaction, 1993-1995.

- Jack Carroll was a member of the Program Committee of the ACM CHI'95 Conference on Human Factors in Computing Systems, 1994-95.

- Jack Carroll was a member of the Program Committee of the INTERACT'95: IFIP Conference on Human-Computer Interaction, 1994-1995.

- Jack Carroll was a member of the Program Committee of the ESP 6: Sixth Conference on Empirical Studies of Programming, 1994-1995.

- Jack Carroll was a member of the Program Committee of the CIC95: First International Conference on Computing in Context, 1994-1995.

- Jack Carroll was a member of the Program Committee of the DIS'95: ACM Symposium on Designing Interactive Systems.

- Jack Carroll was Discussant, Usability Analysis From Research to Practice Session, CHI'95
- Conference on Human Factors in Computing Systems, Denver, CO, May 7-11.

- Jack Carroll was a member of the Nominating Committee for 1996 (Twelfth) Japan Prize (Science and Technology Foundation of Japan), 1995

- Rex Hartson was member of the Program Committee for the Eurographics Workshop on Design, Specification, Verification of Interactive Systems, Carrara, Italy, 1994.

- Rex Hartson and Deborah Hix attended, chaired sessions, and presented papers at EWHCI'94, the Fourth East-West International Conference on Human-Computer Interaction, August 2-6, 1994, St. Petersburg, Russia.

- Rex Hartson was an Associate Chair for Technical Papers, CHI '95, *ACM SIGCHI Conference on Human Factors in Computing.*

- Rex Hartson was participant in workshop on *HCI Challenges in Government Contracting* at CHI'95, ACM SIGCHI Conference on Human Factors in Computing, May, 1995, Denver.

- Mary Beth Rosson was Technical Papers Chair of CHI '95, *ACM SIGCHI Conference on Human Factors in Computing.*

- Mary Beth Rosson was member of the Program Committee for OOPSLA '95.

- Mary Beth Rosson was member of the Program Committee for UIST '95.

- Mary Beth Rosson was member of the Program Committee for INTERACT '95.

- Mary Beth Rosson was Chair of the Doctoral Symposium for OOPSLA '95.

- Bob Williges and Deborah Hix were faculty co-sponsors for the 3rd Annual Mid-Atlantic Human Factors Conference at Virginia Tech, March 1995.

Television Appearances:

- Deborah Hix and Rex Hartson: a satellite TV presentation, "A Process for Developing Usable Interfaces," in *User Interface Strategies '95: The Information Superhighway*, University of Maryland Instructional Television, December 13, 1994.

- Mary Beth Rosson was elected as Member-at-Large on the Executive Committee of SIGPLAN, and assumed leadership of the Professional Activities Committee.

Awards:

- Jack Carroll: ACM Special Interest Group on Documentation (SIGDOC), Rigo Award (1994)

- Jack Carroll: National Society for Performance and Instruction, Outstanding "Performance Improvement Quarterly" Article of the Year Award (1995)

Editorial Boards:

- Jack Carroll: Handbook of Human-Computer Interaction, North-Holland (new Associate Editor, 1994)

- Jack Carroll: Handbook of User Interface Design, John Wiley and Sons (new since 1994)

- Jack Carroll: Handbook of Computer Science and Engineering, CRC Press (new Editorial Advisor for section on Human-Computer Interaction and Organizational Informatics, 1994)

New Grants and Proposals related to Infrastructure:

- Carroll, John M. and Ehrich, R.W., **Workshop on K-12 Networking** (preproposal), NSF, $23,100 (pending).

- Carroll, J., Hartson, R., and Fox, E.A., **Graduate Research Traineeship in Human Interface Design for Access to Computers and Networked Information at Virginia Tech**, $566,500, NSF (pending).

- Carroll, J., Cohill, A., Fox, E.A., Downey, G., and Rosson, M.B., **Building a History of the Blacksburg ElectronicVillage**, $24,866, NSF (funded).

- Carroll, J., Rosson, M.B., Shaffer, C., and Burton, J., **Leveraging Networks for Collaborative Education in the Blacksburg Electronic Village**, $2,187,888, NSF (pending).

- Carroll, J., Shaffer, C., Campbell, J., Hertel, B., and Hauerstein, N., **Integrating Statistics and Models Across the Social Sciences Curricula**, $376,671, NSF (pending).

- Dodl, N.R., Ehrich, R.W., Hix, D., and Kavanaugh, A.L., **Planning for Schools in Electronic Villages**, NSF, $99,824 (funded).

- Ehrich, R.W., **Collaborative Education in an Interdisciplinary 6-8 Setting**, $1,023,945, Montgomery County Schools/Interagency Technology Task Force (pending).

- Fox, E.A., Moore, J., and Barnett, D., **Creating an Information Highway Assistance Force**, $490,014, SURA/TIIAP (pending).

- Fox, E.A. and Ozsoyoglu, G., **A Usable, Scalable, Sustainable, Active Digital Library**, NSF, $4,800,000 (declined).

- Fox, E. and Rosson, M.B., SURA (for Dept. of Education**)**, **Unlocking Research in Dissertations, Theses and Technical Reports Through Advanced Information Technology**, $101,871 (declined).

- Fox, E., **Hypertext and Automatic Document Indexing**, PRC Inc., $25,308 for 5/16/94-12/31/94 and $27,592 extension to 8/15/95 (funded).

- Hix D., **Developing Evaluation Methods for Pre-Screen Projection**, $70,000 for one year, starting Jan. 1, 1995, Naval Research Laboratories (funded).

- Hix, D. and Hartson, H.R., **Evaluating Evaluation: The Search for High Impact Usability Evaluation Methods**, $500,000, NSF, (declined).

- Rosson. M.B., **Studies of Scenario-Based Design**, $133,833, NSF (declined

- Rosson, M.B., **Studies of Scenario-Based Design**, $2,800, Virginia Tech, College of Arts and Sciences (funded).

- Shaffer, C. and Campbell, J.B, **A Network-Based Scientific Database Browsing System**, NASA, $269,668 (pending).

- Shaffer, C.A. and Barnette, N.D., **The GeoSim Interface Library for Introductory Programming Courses**, NSF, $19,768 (funded).

- Schaffer, C., **A Network-Based Scientific Database Browsing System**, NASA, $269,668 (declined).

- Williges, B.H., Williges, R.C., and Casali, J.G. (Co-Principal Investigators), V**irginia Tech Rehabilitation Engineering Assessment Site**, Department of Rehabilitative Services, $178,000.00 (pending).

- Williges, R.C. and Rosson, M.B., (Co-Principal Investigators), U**sability evaluation of electronic connectivity in the SUCCEED coalition**, NSF, $40,000 (funded).

- Williges, R.C. (Faculty Advisor), **U.S. Air Force Palace Knight Doctoral Program for M.P. Snow**, $80,000.00 (funded).

- Woldstad, J.C. (Principal Investigator), **Intelligent computer-based display for in-vehicle routing and navigation**, Federal Highways Administration, $50,000 (funded).

Service:

- Jack Carroll and Edward Fox: National Science Foundation Workshop on the World-Wide Web in support of Computer Science Research and as a means for NSF to Disseminate Information, sponsored by the IRIS Program Managers, October 31, 1994.

- Edward Fox: Invited participant at the ARPA sponsored HPCC/IITA DigLib Workshop, Tysons Corner, VA, May 18-19, 1995.

- Edward Fox: Organizing Committee, NSF hosted workshop on Computer Science Technical Reports, NSF, Arlington, VA, April 7-8, 1995.

- Edward Fox: Chair, Workshop for Working Group on Theses, Technical Reports, and Dissertations, in Monticello Electronic Library Initiative, sponsored by SURA and SOLINET, Virginia Tech, Blacksburg ,VA, August 12-13, 1994.

- Edward Fox: Session Chair on Architectures, EG-MM '94, Eurographics Symposium and Workshop on Multimedia: Multimedia/Hypermedia in Open Distributed Environments, Graz, Austria. Also, invited workshop participant. June 6-9, 1994.

Infrastructure-Related Degrees Awarded:

Tim Al-Molky, MS, *Feasibility of Disability Guidelines Applied to a Multimedia Workbench*

Michael Bibeau, MS, *A Formative Evaluation of CU-See Me*

Jeffrey Brandenburg, Ph.D., *Timetrees: A Branching-Time Structure for Modeling Activity and State in the Human-Computer Interface*

Kaushal Dalal, MS, *Database Manager and Session Coordinator for Envision*

Sophie Davoine, MS, *Evaluation and Adaptation of a non Single Lens Reflex Camera for Users with Manual Impairment*

R. Austin Hicklin, MS, *A Consignment Library of Reusable Software Components for Use over the World-Wide Web.*

John Kies, MS, *The Effects of System Response Time and Cognitive Loading on Accessing an Automated Telephone Emergency Service: Examining Elderly and Young Users*

Julie Lin, MS, *The Application of a Three-phase Methodology to Design an Accessible Photo CD Player for Older Adults with Mildly Impaired Vision*

David Martin, MS, *Detection of Maximal Repeating Patterns and Limited Length Repeating Patterns*

Robert C. Mohn, MS, *Problems with Integrating Computer Technology into the K-12 Educational Curriculum*

A. Moore, MS, *A Computer-based Training Program for Assessing Material Safety Data Sheet Comprehension*

Dennis Neale, MS, *Spatial Perception in Perspective Displays as a Function of Field-of-view and Virtual Environment Enhancements Based on Visual Momentum Techniques*

Wayne Neale, Ph.D., *An Experimental Test of Dual Coding Theory Using Various Media and Visual Momentum in a Multimedia Environment*

Carlton Petitt, MS, *Simulating User Experiences in Computer-based Multimedia Instruction*

Kevin Stringer, MS, *Evaluation of the GEO-SIM User Interface*

Infrastructure-Related Degrees in Progress:

Ghaleb Abdulla, Ph.D., *A Methodology for Modeling and Design of Hypermedia Digital Libraries for Education*

C. Bussi, Ph.D., *Intelligent Vehicle Highway System Information Display for in-vehicle Routing and Navigation System*

George Chin, Ph.D., *Software Architectures for Collaboration over the World-Wide Web*

Joe Cochran, MS, *Critical Factors in Spatially Displayed Hierarchical Databases*

Susan Keenan, Ph.D., *Using Defect Analysis to Incorporate User Interface Activities into Software Engineering*

Stuart Laughton, Ph.D., *An Ethnographic Study of Internet-Based Applications in Education*

Dennis Neale, Ph.D., *The Effects of Metaphorical Design on 3D Virtual Environment Information Visualization and its Impact on Users' Mental Models During Navigation*

Lucy Nowell, Ph.D., *Psycho-physical Foundations for Information Visualization*

Ray Reaux, Ph.D., *Process for Encapsulating Cognitive, Behavioral, and Constructional Specifications in Human-Computer Interaction Artifacts*

Will Schmidt, MS, *Searching a Multimedia History of the Blacksburg Electronic Village*

Joseph Shaw, MS, *Combining Information for Effective Retrieval*

Michael Snow, Ph.D., *Charting Presence in Virtual Environments and its Effects on Performance*

Yanchun Su, MS, *Hypermedia Support for a Digital Library in Computer Science*

Madhan Subhas, MS, *(Semi-)Automatic Creation of Hypertext Links in Digital Libraries*

Lucio Tinoco, MS, *Animation on the WWW*

William Wake, Ph.D., *Multiple Views of Information*

Visitors:

Rob Jacob, Department of EE and CS, Tufts University (seminar speaker)

Henry Gladney, IBM Almaden Research Laboratory (seminar speaker)

Dan Olsen, Chairman of Computer Science, Brigham Young University (seminar speaker)

Sandra DeLoatch, John Urquhart, Norfolk State University

Henry Gladney, IBM Almaden Research Lab

Prof. Shi, Beijing Information Technology Inst.

Hosted ACM SIGIR'95 program committee meeting

Jennifer Mann, editor, Morgan Kaufmann Publishers

Representatives of SURA, March 16: Dan Van Bellegham, Glen Ricart, ...

Korean delegation interested in Digital Libraries, May 20

March 1995 - Open house in the Human-Computer Interaction Laboratory attended by more than 50 visitors from the third Mid-Atlantic Human Factors Conference held in Blacksburg, Virginia.

External Consulting on User Interface Development Process

Hartson and Hix: Social Security Administration, Baltimore, MD;
PRC, McLean, VA;
Digital Equipment Corporation, several locations.