Statement of Research, Teaching, and Service

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I have spent the last two years developing a research and teaching agenda that focuses on evaluation tools and techniques for the domains of assistive technology and ubiquitous computing. As part of my research, I also have a strong focus on undergraduate research, and one of the applications I am developing is being created by an undergraduate-only research group [7]. My research includes collaborations with other members of Berkeley's Group for User Interface Research [3], faculty in Mechanical Engineering [9], faculty member at Georgia State [8] and University of Washington [4], and researchers at HP [1].

Research

My work during the last two years has focused on the development of tools and techniques for evaluation of interfaces designed for universal access. This encompasses the domains of assistive technology (AT) for people with disabilities, and ubiquitous computing (Ubicomp), the study of technology embedded throughout the environment. Together, they represent the dual goals of making interfaces accessible to a wide variety of people doing varying tasks in many different types of locations using an assortment of technologies.

Assistive technology and ubiquitous computing have a unique and symbiotic relationship that has the potential to support a rich and interesting set of research problems. Ubicomp can be a source of solutions for people with disabilities because of its use of a variety of modalities, its mobility, and its pervasiveness. Because of the varied contexts in which Ubicomp is applied, Ubicomp interfaces do not typically conform to the traditional GUI model, may lack any graphics, include recognition errors, and so on. Thus AT research can inform the design of such systems because it deals with equivalent human impairments such as lack of vision or unreliable motor skills.

Both AT and Ubicomp systems also share the problem on which my research focuses: They can be difficult to evaluate. In both cases, applications may be hard to build, subjects familiar with the domain may be difficult to find, and the developer herself may have limited intuition about what will work and what will fail. In both cases, traditional techniques that focus on a single user, a GUI application, and traditional input devices, fail to address a large proportion of the typical systems being designed. Because of these issues evaluation is a challenge.

I am approaching these problems from three directions, discussed in more depth below: First, I and my students are building and evaluating applications. Second, we are developing new evaluation techniques. Third, we are developing tools to support evaluation.

Evaluating applications

We have two goals in evaluating applications. First, by using a variety of techniques, we can begin to introspect and report on the difficulties that arise with particular techniques. Secondly, we can begin to test out the evaluation tools and techniques that we ourselves develop.

To date, we have built and evaluated a variety of applications including a cognitive assessment tool [11], a display of ambient audio for the deaf [3], a system for managing end-user privacy [5], a community awareness system [1], and a system for supporting the tracking of consumer food purchases and nutrition [7]. In building these and other applications, we have used a combination of interviews, surveys, culture probes, rapid ethnography, lab studies, and field studies.

Additionally, we are currently conducting a study comparing a range of laboratory and field studies intended to determine the limitations and benefits of each technique, when applied to a subset of ubiquitous computing known as peripheral displays. We plan to expand this work to include a wider variety of techniques.

Developing new evaluation techniques

Our major goal here is to address the difficulties discovered in using existing techniques. Our work focuses on developing techniques that can be applied to a variety of applications. Our goal is to show that this can lead to better application design, and help developers to find real problems.

To date, we have developed a modified version of heuristic evaluation for ambient displays [6], and we are working on a modified version of expert review for accessible website design. In the first case, we developed a new set of heuristics appropriate to ambient displays and compared them to standard heuristic evaluation. In the second, we are comparing the efficacy of simulating visual impairments (using a screen reader commonly used by the blind). This technique was designed for people who do not have expertise in assistive technology. Because the majority of designers fall into this category, evaluation techniques that help them address the needs of people with disabilities have the potential to have the greatest impact on the accessibility of today's interfaces.

We plan to expand this work to include a wider variety of vision and motor impairments, as well as other types of disability. We also plan to expand the range of Ubicomp applications to which our techniques apply, and to increase the number and variety of techniques available. Lastly, we have extended our work to the area of gender and design [9].

Developing new tools

Given our experience with existing techniques and in developing new techniques, we believe that software infrastructure is essential to supporting evaluation of *actual prototypes*. While existing techniques are sufficient for formative inquiries, and for testing complete working systems with real users, they are inadequate for providing rapid feedback on prototype designs during an iterative design cycle. One major difficulty here is the problem of creating prototypes rapidly. Another lies in the lack of realistic surroundings (a true Ubicomp environment, access to people with disabilities, and so on). Lastly, existing prototyping tools often do not have built-in support for iterative evaluation. Thus our goals are to investigate the type of support that existing prototyping tools should provide for evaluation, and also to develop a tool specific to evaluation.

To date, we have developed a tool for simulating motor impairments [2] and shown that it can be used to get baseline results similar to studies with motor-impaired participants.

In future work, we plan to develop a tool for rapidly prototyping and testing incomplete interfaces. This tool will need to handle issues of scale including input streams from many sensors and output to multiple, potentially remote devices. Additionally, it will need to allow multiple wizards to work together when necessary. It will need to handle simulation of errors, allow a developer to play pre-recorded input and output, and make use of sketches, audio recordings, and video recordings to fake the look and feel of an application. Our goal is to avoid the problems inherent in building multiple copies of complex physical components.

Lastly, we haved begun work on two toolkits (a toolkit for developing peripheral displays, and a toolkit that can support the process of transparently mapping any input device to the input event stream expected by an application [10]). We plan to expand these tools by adding support for evaluation.

Funding

Funding for these projects comes from two NSF ITR grants, one solo NSF grant, and industry money with matching state funds. The first ITR grant provides funding for investigations in context-aware computing, while the second focuses on computing in developing countries, specifically with a small, handheld, inexpensive computing device. The solo NSF grant provides funding for work in assistive technology with a particular focus on motor impairments and web access. Industry funding focuses on the design and evaluation of ubiquitous computing systems, as does the state matching money.

Teaching

My main educational goals are (1) to increase the relevance and diversity of the classes I teach and (2) to increase the participation of undergraduates in research.

To date, four of the five classes I have taught or co-taught have included a service-learning component. Service-learning is an approach to teaching that involves the students in community issues or community service. These classes have covered topics including assistive technology (grad), disability mentoring (undergrad), designing technology for girls and women (first/second year undergrad), and human computer interaction (grad, undergrad): In a recent course on assistive technology for people with disabilities, I experimented with volunteer work in local disability organizations as a way of introducing students to their user population as participants instead of observers. The response of the students in the class to this experiment was unanimously positive. I had similar results when I asked students in an undergraduate Human Computer Interaction course to work in a Soup Kitchen and focus their projects on the needs of local non-profit organizations. The groups worked with: Two after school tutoring programs, a pet adoption program, a nursing home, two student co-ops, the Jewish Family and Children's Services, the Berkeley Free Clinic, the Youth Support Program, and the Student Learning Center. In an end-of-semester survey, 50 of 54 students felt that the service work should be repeated in future semesters. This semester, I recruited project sponsors for the same class from among local non-profit organizations in the community.

One hallmark of these classes has been their diversity. For example, the assistive technology class included community members, students with disabilities, and both undergraduate and graduate students of policy, education, cognitive science and computer science. Similarly, at least a fourth of the students in the undergraduate HCI class major in something besides computer science (often cognitive science). The disability mentoring class I was involved in brought together Berkeley students from all backgrounds with community college students with disabilities.

Including other projects, and graduate students, my research group consists of over 60% women. In addition to recruiting women and minorities early to help increase retention, I participate in several programs that aim to help women succeed in computer science, including Berkeley's Virtual Development Center (sponsored by the Institute for Women and Technology), the Computing Research Association (CRA)'s undergraduate summer intern program, and a CRA program that supports women-only undergraduate research.

In terms of undergraduate research, in addition to asking all of my graduate students to mentor undergraduates, I have begun and undergraduate-only research group, the nutrition project. The nutrition project, in particular, is part of an ongoing experiment in undergraduate research in which I recruit students early (first and second year), and involve them in peer learning and research on a long-term basis. Early recruitment is made particularly feasible by the fact that evaluation research does not require programming skills, since students can help gather, enter, and analyze data. Currently, the six-student undergraduate nutrition researchers are all non-Caucasian and half female. My goal is to develop a sustainable model for long-term, undergraduate research opportunities.

Service

I am an active member of the human computer interaction community. I have been on the ACM User Interface Systems and Technology program committee for three the past four years, and on the CHI program committee once. I have been a reviewer for CHI, UIST, CSCW, GI, and major journals in the field (CACM, HCI).

I have been actively working to forge bonds with disability organizations in and around campus and beyond. I am on the campus disability studies advisory board, have active relationships with organizations such as the Center for Assistive Technology and PANGEA and I am on the conference committee for the ACM Assistive Technology conference.

At Berkeley, I have served as a member of the graduate admissions committee, and on Ph.D. qualifying committees. I helped to create a Repetitive Strain Injury equipment lending library and organized lectures for staff, graduate students, and undergraduate students on the topic. Finally, at a broader level, I helped to created the safe.millennium.berkeley.edu website to help people find out if friends and family were safe in the aftermath of September 11th, 2001.

Selected Publications

[1] S. Carter, J. Mankoff, and P. Goddi. hebb: An infrastructure for conveying shared interests. Technical Report UCB-CSD-03-1259, Computer Science Division, University of California, Berkeley, July 2003.

[2] H. Fait and J. Mankoff. Ease: A simulation tool for accessible design. Technical Report UCB-CS-03-1260, Computer Science Division, UC Berkeley, 2003.

[3] W.-L. Ho-Ching, J. Mankoff, and J. Landay. Can you see what i hear? the design and evaluation of a peripheral sound display for the deaf. *Proceedings of the ACM CHI'03 Conference on Human Factors in Computing Systems, CHI Letters*, 5(1):161–168, April 05–10 2003.

[4] M. Y. Ivory, J. Mankoff, and A. Le. Using automated tools to improve web site usage by users withe diverse abilities. *Information Technology and Society*, 3(1):195–236, 2003.

[5] S. Lederer, A. K. Dey, and J. Mankoff. A conceptual model and a metaphor of everyday privacy in ubiquitous computing environments. Technical Report UCB-CSD-02-1188 and IRB-TR-02-017, Computer Science Division, University of California, Berkeley and Intel Research Berkeley, July 2002.

[6] J. Mankoff, A. K. Dey, G. Hsieh, J. Kientz, M. Ames, and S. Lederer. Heuristic evaluation of ambient displays. *Proceedings of the ACM CHI'03 Conference on Human Factors in Computing Systems, CHI Letters*, 5(1):169–176, April 05–10 2003.

[7] J. Mankoff, G. Hsieh, H. C. Hung, S. Lee, and E. Nitao. Using low-cost sensing to support nutritional awareness. In *Proceedings of Ubicomp 2002*, volume 2498 of *Lecture Notes in Computer Science*. Springer-Verlag, October 2002. pp. 371–378.

[8] M. Moore, E. Mynatt, P. Kennedy, and J. Mankoff. Nudge and shove: Frequency thresholding for navigation in direct brain-computer interfaces. In *Proceedings of CHI 2001 Conference Companion, Technical Notes*, pages 361–62. ACM, March 2001.

[9] C. Newman, M. Bauer, A. M. Agogino, and J. Mankoff. Perceptions of the design process: An examination of gendered aspects of new product development. *International Journal of Engineering Education*, 20(2), 2004. Designing Engineering Education (Proceedings of the Mudd Design Workshop IV), 2003.

[10] J. Wang and J. Mankoff. Theoretical and architectural support for input device adaptation. In *Conference on Universal Usability*, pages pp. 85–92, 2003.

[11] R. Wylie. The effects of computers on cognitive assessment. Undergraduate Honors Thesis, UC Berkeley, 2003.