

Overview of an Industry/Academia Partnership for Furthering the Advancement of Pen-based Technology in Research and Education

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Abstract

Microsoft Research understands the vital role academia plays in the future of computing. We continually seek to collaborate with leading schools to enhance the teaching and learning experience. In support of this vision, we have identified and supported research in pen based technologies since the early 2000's. During this time we developed 4 primary programs: 1) Academic Summits, Workshops and Symposiums, including the "Tablet PCs in Higher Education & Research Workshop" being offered at this event; 2) Request for Proposals to explore new idea; 3) Direct support for individual projects such as for development of Classroom Presenter at the University of Washington, and 4) Center & Institutes to accelerate research in a specific domain, [e.g.,] the Microsoft Center for Research on Pen-Centric Computing at Brown University and the Microsoft/MIT alliance on Information Technology in Higher Education;

This paper provides a brief overview of all of the Tablet/pen enabled activities and examples of the results of the collaborations.

1. Introduction

To create the next generation of scientists and engineers, education institutions need access to significant resources to help them deliver a rich education experience. Resources like faculty, information technology infrastructure, and training are not only hard to find but are very expensive to develop and acquire. To compound the problem, institutions today are increasingly faced with budget constraints that have limited their abilities to develop and deploy these resources. To meet some of these challenges, schools are turning to corporate America for partnerships to accomplish their goal of driving the next wave of innovation in education. The partnerships can vary in scope, objective and goals based on the collaboration partners.

The External Research & Programs and University Relations groups (1) within Microsoft Research (MSR) are dedicated to building these types of collaborations with leading universities to advance research, enhance the teaching and learning experience, inspire technological innovation and cultivate the next generation of thought leaders. In support of this vision, MSR each year uses a multi-tier collaboration model to invest in external research



Figure 1 Microsoft Research Collaboration Opportunities

in the academic ecosystem. Each year MSR hosts academic summits, workshop and symposiums to bring together leaders of academic communities. MSR annually publishes request for proposals (RFPs) to explore the breath of innovation in specific research areas and award software, technical resources and funding. Once projects are completed and research findings are published, a selected few are sponsored through directed funding to continue to validate the research direction and build communities of liked minded researchers. The deepest levels of collaboration are multi-year joint research institutes and centers to accelerate the research in a specific research area.

This paper provides an overview of the collaboration research in the Tablet PC and Pen-Computing research domain and highlights examples of specific collaborations.

2. Workshops, Summits and Symposium

Microsoft Research hosts workshops to identify and build a community of practitioners with respect to tablet technology in the classroom and to explore how to best take advantage of these new communication and collaboration resources. In 2004 (2) and 2005 (3) MSR partnered with the Computer Science Department at the University of Washington (UW) in to organize the Tablet PC in Higher Education Workshop which generated a whitepaper that summarized the discussions at the event.

In April 2006, MSR partnered with Brown University on the Workshop on Pen-based Computing Research (4). This workshop was dedicated to investing research advances in pen-based computing. The goal was to bring together like-minded researchers and industry experts to share their current research activities in pen-centric computing and to identify future pen research directions. The descriptions of the demonstrations as well as a workshop whitepaper are available on the web (4).

We also co-sponsor WIPTE – the Workshop on the Impact of Pen-based Technology on Education. A selection of papers from the first WIPTE resulted in the 2006 Monograph was published [ISBN 1-55753-434-9]. The 2007 WIPTE will also produce a Monograph.

3. Request for Proposals

Microsoft Research has just completed the third year of Request for Proposals for the tablet technology in higher education initiative. In 2004, we issued a RFP for projects to develop computing curriculum and made a total of 11 awards ranging from algorithms, grading tools, and platforms (5). In 2005 we shifted our focus to include an emphasis on classroom assessment and opened the project domain to include all academic disciplines. In this round of RFPs we awarded a total of 14 projects (6). This year's RFP results were just recently announced, where we received over 130 proposals and were able to fund 6 new projects and continue support for 8 previous RFP winners (7).

Preliminary results are encouraging that the incorporation of tablet technology into classroom pedagogy can help improve student learning. We encourage the community to contact the project PIs directly for more information.

4. Direct Fund Engagement

The second level of engagement is of direct funding. Again, the number of these types of

engagements is limited and is for a limited period of time. Currently we have three such engagements: University of Washington (8), University of Massachusetts Amherst and Virginia Tech (9).

The University of Washington project involves the development and deployment of the Classroom Presenter Application This classroom technology supports teaching through the use of examples and active learning techniques. Classroom Presenter provides instructors with increased flexibility in delivering a presentation and facilitates interaction with the audience. Because it is a distributed system, synchronized versions of the presentation are shared across instructor, public, and student machines, allowing for high quality ink annotations. The digital ink can then be sent from student tablets to the instructor for review or public display.

Classroom Presenter (8) allows the integration of activities into a lecture scenario -- students are able to actively participate in working problems rather than sitting, listening, watching. In addition, the instructor can collect and review student work in real time, identifying common misconceptions, illustrating multiple correct solutions developed by students, better engaging students in the classroom.

The engagement with Virginia Tech is in support of their large-scale deployment of tablets to all of the students and faculty in the College of Engineering (COE) (9). To improve the effective use of technology in teaching and learning, beginning in Fall 2006, the COE began requiring all incoming students to own a Tablet PC. A Tablet PC deployment of this magnitude had not been attempted before in a college of engineering, making this a potentially arduous task for the 300 faculty members who will be charged with the responsibility to implement the broad-based curriculum modification required across the entire college of engineering.

5. Centers and Institutes

Microsoft joint research institutes and centers are the highest level of collaboration partnerships sponsored by Microsoft Research. Each center is a multi-year partnership where Microsoft awards software, technical resources and direct funding to the institutions. In the research domain of Pen based Learning and Teaching Microsoft has supported two distinct centers, the Microsoft/MIT alliance for Information Technology in Education (iCampus) and the Microsoft Center for Pen-Centric Computing at Brown University.

5.1 Microsoft/MIT alliance for IT in Education

Started in 1999 iCampus was an alliance forged between MIT and Microsoft Research with the goal of enhancing university education through information technology. Over 50 projects (10) in science, mathematics, and engineering – some led by faculty principal investigators and others lead by students – focused on three key areas. Active Learning and Classroom Transformations projects emphasized project-based curriculum development and activities that brought concepts to life in the classroom. Another group of projects focused on Learning Services, the educational utilities needed to better manage classrooms, evaluate student understanding, move course content online, and facilitate distance learning. Emerging Technologies projects innovatively drew up technology to enhance the everyday lives of students on the MIT campus, but also ranged from global robotics competitions to HIV/AIDS patient tracking in Africa.

“iCampus shows what we can achieve when researchers from Microsoft and academia work together to use technology to transform higher education. Investments like this that focus on the future of education are more important than ever.” – Bill Gates, Chairman, Microsoft Corporation (11).

When the Microsoft Tablet PC was released in 2002 it attracted the attention of researchers at MIT and the following pen based projects, Magic Paper (12), Classroom Learning Partner (13), Robot World (14) and iLabnotbook (15) were started by iCampus that effected students in the Computer Science and Artificial Intelligence Laboratory, Electrical and Computer Sciences Department, Mechanical Engineering Department, and the Bioinstrumentation Laboratory.

The project Magic Paper allows a person to sketch a simple mechanical system - a collection of balls, springs, containers, and inclined planes and the computer can understand the drawing, “clean it up,” and animate it according to the laws of physics. This application is now being distributed by Microsoft as a power toy for Tablet PCs under the name “Physics Illustrator” (16).

5.2 Pen-Centric Computing Center

In 2006, the Microsoft Center for Research on Pen Centric Computing at Brown University (17) launched, which promotes research aimed at improving pen-based operation of the Tablet PCs, PDA, electronic whiteboards and touch displays. The center is the first academic research program in the US dedicated to pen-

centric computing innovation. With the goal of driving innovation that will serve the academic community as a whole, Microsoft Research and Brown University researchers investigate new ways for computers to recognize and interpret handwritten input. Faculty, students and research staff create and test new software that recognizes notations in mathematics, chemistry, music, art and design, as well as other fields that have well developed notational styles.

The following projects are currently underway at the center: Math Error Correction Project (18), Diagramming (19) and *Pad (20). The *Pad project the overarching vision is a pen-centric application that students and professionals would use to conceive, explore, and archive solutions to a broad range of predominantly science, technology, engineering, and math (STEM) problems. The intent of *Pad is to augment the intuitive interaction processes already used for sketching out a problem, often on a piece of paper. The barriers to this vision are twofold: we need to develop an software architecture that allows a domain-specific modules to co-exist and, when appropriate, inter-operate, and we need to develop a range of compelling domain-specific modules that operate on hand-drawn ink to provide a range of computational and visualization assistance. Consequently, our research project is to develop a framework, *Pad Software Development Kit (SDK), that support the development of *Pad and other similar pad-like application.

6. Conclusions

In this paper we have discussed the structure and organization of Microsoft Research Tablet PC and Pen Computing collaboration partnerships with academic institutions. Microsoft understands the vital role academia plays in the future of computing and we are continually seeking to collaborate with leading schools to enhance the teaching and learning experience. We believe our engagements provide value to the whole academic ecosystem, individual institutions and students as well as advancing the state of art in Pen-based learning technologies.

The use of tablet technology in education is just beginning – instructors are learning and thinking about how the ability to use ink and a stylus can provide different ways of teaching and learning. We expect that this community and the ideas for tools, applications and pedagogies will continue to grow.

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