

# Using Research and Projects to Develop Tablet PC Applications for Enhanced Undergraduate Learning

## Project Overview

We propose a research and project-development-infrastructure approach to facilitate the use and effective integration of the Tablet PC into undergraduate courses, primarily CIS 101 (Introduction to Computing), a core course of the Pace University Curriculum taken by all undergraduate students. An earlier funded project [1] to integrate the Tablet PC into CIS 101 was only partially successful mainly because we lacked appropriate and interesting ways of having the students use the Tablet PC. Because the CIS 101 students cover all majors it is important to provide them with interesting pen-centric computing applications in their various disciplines. Pen-based interfaces, not just paper and pencil, have a proper place alongside keyboard and mouse interfaces for students of all disciplines. It is important, therefore, to create pen-based computer interfaces into the workflow of students of music, art, mathematics, and the sciences. For example, we could provide pen-based interfaces for sketching 3D models, writing music, for creating mathematical formulas, and for drawing molecules. If applications are properly developed for the various disciplines, we believe that pen-based computing can positively affect the way students learn.

Our Seidenberg School of CSIS at Pace University has had considerable success with the interplay of research and team projects – that is, having research students serve as customers of team projects and having the project teams develop the supporting computer system infrastructure for the research [2, 3]. Since some of this infrastructure and research has involved and continues to involve pen computing due to our faculty expertise in this area, we believe we can extend this approach to facilitate the integration of the Tablet PC into undergraduate courses. The project's goals are to enhance the learning experience of CIS 101 undergraduate students by initially utilizing pen-centric applications that are currently available for several disciplines (e.g., <http://pen.cs.brown.edu/home.html>), using the research-project-interplay approach to develop new appropriate and interesting pen-centric applications, and finally testing the benefits of conducting discipline-specific team projects with these applications in CIS 101. The project will have an important immediate impact on the CIS 101 course, and, more broadly,

on the CSIS curriculum. This proposal further details the dissemination of the findings of this research initiative, and the promotion of the use of the Tablet PC at Pace University. Upon completion of the project, the use of discipline-specific pen-centric team projects will have been evaluated and possibly incorporated into the CIS 101 curriculum. We will develop a set of educational material including Tablet PC-specific curriculum, a set of best practices for faculty, examples of students work, and a detailed evaluation of our project.

## **Pen-Centric Research and Team Projects**

Our School of CSIS has had considerable success in having student teams develop real-world computing systems to serve the community – the internal university community, the greater university community, and the external non-profit local community [2, 3]. Many of these systems further student and faculty research and we have observed an interplay between the research and the team projects – that is, having research students serve as customers of team projects and having the project teams develop the supporting computer system infrastructure for student and faculty research. Since some of this infrastructure and research has involved and continues to involve pen computing due to our faculty expertise in this area, we believe we can extend this approach to facilitate the integration of the Tablet PC into undergraduate courses. We have had five pen-computing projects, mostly in the handwriting area, and several related M.S. and doctoral dissertations [4, 5, 6, 7]. Research is conducted by faculty and by students in our Doctor of Professional Studies (DPS) in Computing and M.S. programs. Our DPS program allows working professionals with five years of work experience in the computing profession to obtain a doctorate in three years interacting primarily online and meeting face-to-face five weekends a semester. In September 2006 we started a second DPS program for K-12 teachers, and we anticipate that some of these students may be interested in exploring the use of pen-centric applications for their K-12 students (e.g., a previous project partially developed a handwriting interface to help children learn to write by matching the alphabet letters they draw against idealized letters).

In developing the in-house pen-centric, discipline-specific applications we will contact and seek the assistance of Pace faculty in the related disciplines. The research will be conducted by faculty and by

DPS and M.S. students. The project work will be conducted mostly by M.S. students taking such courses as Software Engineering, Pattern Recognition, Artificial Intelligence, and Computer Information System Projects. We anticipate that some of these projects will simply provide pen-centric interfaces to existing discipline-specific software, such as mathematics software like Mathematica (<http://www.wolfram.com/>) or Maple (<http://www.maplesoft.com/>).

## **CIS 101 (Introduction to Computing)**

CIS 101 is a survey course in the uses and applications of computing technology that is required by all undergraduate students at Pace University. In the 2004-2005 academic year, for example, more than 2400 students in 88 sections took CIS 101. Because CIS 101 is the CSIS School's ambassador to the University community, we strive to provide the students with an interesting computing experience, emphasizing the value of computing in all disciplines. We anticipate that for many disciplines pen-centric computing will allow us to demonstrate the value of computing better than we can with conventional keyboard/mouse interfaces. CIS 101 provides students with an understanding of hardware, software, and computing applications necessary to understand how computing functions in academia, business, and society. The curriculum blends in-class lecture for two hours a week, asynchronous or synchronous online discussions conducted via the Blackboard course management tool, and significant hands-on lab exercises on computer applications (Excel), Internet technology (HTML), and programming (JavaScript), that allow the students to develop a 'tool kit' of skills that will enable their success at Pace and in their future careers. During class time students also discuss with their professor current topics and emerging trends in technology, e.g. security and the future of mobile computing. Online discussions are fueled by course readings taken from textbooks, newspapers and IT magazines. Individual students' work is evaluated on online quizzes and on Excel, HTML, and JavaScript assignments. With the funding from this proposal we will add a team project in which each team creates a simple application in their respective discipline, e.g. draw math equations through a provided pen-centric interface to prove a theorem, draw molecular structures to clarify an issue, etc. As a service and core course at the University, CIS 101 provides an

excellent place to begin the introduction of the Tablet PC and its possible future adoption at Pace University.

## **Project Description**

**Cost Breakdown** The proposed budget for this one-year effort is \$80K: \$8K to purchase 5 Tablet PCs (increasing the available Tablet PCs to 10 since we purchased 5 Tablet PCs in our earlier study [1]), \$4K to purchase discipline-specific, pen-centric and supporting software, \$28K for graduate assistantships and partial assistantships supporting this effort, and the remaining \$40K to support the curriculum design/execution and for faculty and students' travel to conferences. Five Tablet PCs will be used in the research-project development and five (one per student team) in CIS 101.

**Audience and Scenarios** This pilot targets one section of CIS 101 taught in the Pace New York campus (approximately 25 freshman and sophomore students) in semester 1. Another section will be incorporated in semester 2. In the Tablet PC section, the instructor will utilize a Tablet PC, and students will be organized into teams, each using a Tablet PC. Each of the student teams will create and demonstrate an application using discipline-specific application software in a specific discipline like music, art, mathematics, or forensic science.

**Team Projects** Team projects offer a particular benefit to the study of the impact of pen-centric computing on technology education. We anticipate that student teams in the Tablet PC section of CIS 101 will create interesting pen-centric applications for a variety of disciplines, such as sketching 3D models, writing music, for creating mathematical formulas, and for drawing molecules. For business-oriented students a team technology-centered product development exercise might be employed where the student group sketches and mocks-up a technical product (such as a satellite radio playing clip-on for an MP3 player or a new hand-held computing device). Conducted over the complete semester, these projects will provide the students and faculty with real examples of applications in a variety of disciplines.

**Promotion of the use of the Tablet PC at Pace University** CIS 101 is a service core course at Pace University and enhancements to its curriculum will be widely noted on campus.

## Assessment Plan and Measurement of Outcomes

The main goal of our assessment plan will be to evaluate the effect of the Tablet PC in CIS 101 on students and on faculty. We will focus on the following questions in CIS 101:

- What are the initial and evolving perceptions of the Tablet PC by students and faculty?
- How quickly do the students and faculty adapt to using the Tablet PC?
- In what disciplines is the Tablet PC more empowering than standard PCs and laptops?

**Faculty and student surveys** We will develop questionnaires, and survey the faculty and students on their perception, use, and satisfaction of use of the Tablet PC in the team project activities. We will also interview students and faculty to get more detailed responses.

## Dissemination Plan

**Use of Internet** This project will be advertised on the Web sites of the CSIS School at Pace University (<http://www.csis.pace.edu>), and on a project-specific Web site that we will develop.

**MSDNAA Curriculum Repository** We will develop lecture notes (in PDF, PowerPoint, and HTML), laboratory material (in PDF, Word, and HTML), and multimedia material using Microsoft Produced (e.g. tutorials to use Classroom Presenter and DENIM by CIS 101 students), and distribute and share them in the MSDNAA Curriculum Repository.

**Conference and Publications** The proposed project and related results will be summarized in articles and submitted for publication to major conferences such as ACM SIGCSE, ACM ITICSE, ASEE/IEEE FIE and the Tablet PC Computing Curriculum Workshop.

**Adoption of the Model** We expect our project and related results to be of interest to instructors of Introduction to Computing courses, and to encourage the adoption of our discipline-specific project-oriented model of learning and teaching using the Tablet PC.

## Milestones

### Semester 1 (either Spring 2007 or Fall 2007)

- We will use available commercial discipline-specific, pen-centric software for student team projects in one CIS 101 section.

- New discipline-specific, pen-centric software will be developed using our research-and-project-developed-infrastructure approach.
- Ongoing Assessment for Semester 1.
- Progress reports will be sent to Microsoft Research.
- Participation in the 2007 Invited Workshop on Pen-Centric Computing Research, Brown University, March 26-28, 2007.
- Participation in the Tablet PC Computing Curriculum Workshop.

### **Semester 2 (Fall 2007 or Spring 2008)**

- We will add some of our home-grown discipline-specific, pen-centric software to the commercially-available ones for student team projects in one CIS 101 section.
- Ongoing Assessment for Semester 2.
- Further training and a sharing of best practices with the Tablet PCs will be offered to Pace University faculty.
- Papers will be submitted to conferences.
- Progress report will be sent to Microsoft Research.

### **Institutional Background**

The CSIS School at Pace University is part of the MSDNAA program. Pace University has many wireless access points installed around its campuses.

### **Institutional and Other Supports**

The leadership of Pace University fully supports this project as essential to the mission to use new approaches and technologies that support more effective learning and teaching, and extend educational opportunities as part of the University Strategic Plan. One of the PIs of this proposal is the coordinator of CIS 101, and this guarantees the implementation of the project.

### **Qualification of the team and Responsibilities in the Project**

**Dr. Charles Tappert (PI)** is a Professor of Computer Science with extensive expertise in pen-centric computing who will lead the development of new pen-centric, discipline-specific applications. As a member of the IBM Handwriting Recognition and Pen Computing Group from 1978 to 1993, he spearheaded the development of IBM's ThinkWrite handwriting recognition software in the IBM Pen-Enabled ThinkPad product marketed in the early 1990s.

**Dr. Sung-Hyuk Cha (co-PI)** is an Assistant Professor of Computer Science with extensive expertise in pen-centric computing who will co-lead the development of new pen-centric, discipline-specific applications. His Ph.D. dissertation, "Use of Distance Measures in Handwriting Analysis," was under the supervision of Dr. Srihari, Director, Center of Excellence for Document Analysis and Recognition (CEDAR), University at Buffalo, SUNY.

**Prof. Jonathan Hill (co-PI)** coordinates the CIS 101 program at Pace University (2400 students/88 sections in 2004-2005). He has private sector managerial experience with companies such as the Hertz Corporation and Travelocity.com, and spent 15 years on the faculty of the City University of New York. He was PI for the Higher Education Mobile Technology Grant in 2004 by Hewlett Packard. He will teach the pen-centric section of CIS 101 in semester 1.

**Dr. Allen Stix (co-PI)**, Dr. Allen Stix (co-PI), Associate Professor of Computer Science, has served as the Seidenberg School's Director of Assessment for over eight years. During this time he has worked through two ABET accreditation cycles for the BS in CS program, led the five year assessment of the DPS in computing (which resulted in a published report in the SIGCSE Bulletin), and created much of the prose on the Web page for the University-wide Assessment Committee (e.g. the FAQs). He has taught a section of CIS101 once a year for the past ten years.

## References

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- [3] C.C. Tappert and S. Cha, [Security-Related Research and Projects in Computing Promote Student Awareness of Security Issues](#), *Information Systems Education Journal (ISEDJ)*, Volume 4, Number 82, September 2006.
- [4] W. Huber, V. Hanson, S. Cha, C.C. Tappert, "Common Chatroom Abbreviations Speed Pen Computing," *Proc. 11th International conference on Human-Computer Interaction*, Las Vegas, NV, July 2005. (summary of M.S. dissertation)
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- [6] H.-C. Chen, S.-H. Cha, Y.-M. Chee, and C.C. Tappert, "The Detection of Forged Handwriting Using a Fractal Number Estimate of Wrinkliness," *Proc. 11th Int. Graphonomics Soc. Conf. (IGS 2003)*, Scottsdale, AZ, November 2003, pp. 312-315. (summary of M.S. dissertation)
- [7] S. Sok and A. Apelbaum, "TabletERD: A Tablet PC Application for Database Design," *Proc. CSIS Research Day 2006*, Pace University, May 2006.