

# USE OF WIRELESS COMPUTERS IN THE UNDERGRADUATE AND GRADUATE CLASSROOM

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**Abstract** *¾ Laptop and handheld computers are increasingly available for use in educational environments for a variety of applications, from taking classroom notes to providing access to electronic presentations and "paperless" coursework. In this work in progress, we are building an experimental system to explore how mobile devices with wireless internet connectivity may be effectively used in a classroom setting. The experimental testbed consists of a wireless local area network in the School of Information Sciences at the University of Pittsburgh connected to the university's wired network. A variety of user (student) devices are being tested with a goal to minimize the cost of an useful classroom system.*

## INTRODUCTION

Most teaching institutions recognize the need to incorporate computers connected to the Internet into their students educational experience [1]. Unfortunately hardwired desktop computers limit students to information access only inside wired classrooms and even there, the space requirements and fixed wiring prevent students from organizing into groups. Consequently, making simultaneous interaction with information sources and other students becomes difficult. However, the quickly decreasing price of handheld computers combined with wireless connectivity can alleviate both problems and allow student access to information in a much richer set of educational situations.

Mobile handheld or laptop computers with wireless connectivity to the Internet introduce the opportunity of mobility for students and the challenge of effectively using the tools for educators. Our testbed will allow students to attend a lecture or discussion class "virtually". Currently students can move through various locations in a university building to access resources such as printed material in the library, high performance workstations, and laboratory equipment while still remaining in contact with an instructor and classmates through wireless data communications. Today the communications are in the form of email, web pages and text messaging. Future enhancements to this system will include developing multimedia (voice, video) and electronic whiteboard capabilities. Conversely, students in a classroom are able to access distributed resources (such as electronic libraries, internet databases, personal file and database collections, real time data and laboratory equipment outside the classroom) all while a lecture,

discussion or group meeting is in progress. As part of this project we are investigating classroom dynamics and how traditional lecture and discussion classes may change with access to these resources.

Within the classroom, this project is investigating two instructional modalities: unidirectional and bidirectional. By unidirectional, we mean no electronic feedback from the student to the instructor. For this, we are studying pen based systems to address the human I/O issue. The ease and comfort for students to annotate lecture presentations and take notes using a variety of pen based, mouse based and text based interfaces is being evaluated. To support students, their notes will be stored in a secure, high availability repository that provides a much greater storage space than available on the handheld computers. The repository will also allow students to access their notes via the web and to share their notes as they see fit. Students may also access online tools and the Internet for information sources to support their learning.

In the bidirectional setting, we are studying the ability of students to present information to the class or instructor without standing at a blackboard, thus allowing more interactivity in the classroom. We are testing network protocols, user interface design and support technologies such as projection systems.

The metrics for evaluating this work includes cost considerations, network performance issues and effectiveness of instructional tools and settings based on student feedback and instructor experience.

## PROTOTYPE SYSTEM

We are constructing the prototype system based on a small set of core technologies. The wireless infrastructure is a IEEE 802.11 11 Mbps wireless local area network. Our prototype design places ten wireless access points (APs) throughout the building to obtain full coverage with a minimum number of APs over nine levels.

The handheld technologies meeting the requirements of having a pen based user interface and a PC card slot for an 802.11 wireless network interface card are minimal. The devices selected for the prototype system are the Vadem Clío and the HP Jornada 690. A Linux server functions as the data repository. Additionally we are supporting laptop devices for use in the development of course material.

[1] Ratnesar, R., "Learning by Laptop", *Time*, vol.151, 82., 2 March 1998.

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