Interactive Student Engagement Using Wireless Handheld Devices

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Abstract

This paper presents an experimental wireless *Classroom Communication System* (CCS) used for continuous and interactive engagement of students aiming at enhancing student critical thinking, extending attention span and enabling better student assessment.

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The paper describes the main infrastructure upon which this CCS structure is based as well as some of its most important features. The system is designed mostly for engineering students it is designed to be used during lectures, tutorials or laboratory. The design enables students to use, amongst other software, standard engineering packages such as MATLAB, PSpice, or Electronic WorkBench to construct designs, perform simulations and obtain answers to design problems using just wireless handheld pocket PCs. The system can be used anytime during lectures or tutorials and may involve the guidance and personal intervention of a lecturer or tutor. It is designed to support several modes and allows group or one-to-one personal tutoring. The paper also describes how the system may serve as a means of assessing individual student performance and in assisting lecturing staff with other tasks. A partial assessment of the current limitations and experiences are also presented in this paper.

1.0 Introduction

The advantages of interactive communications in classrooms have successfully been demonstrated, over a number of years in several educational institutions. Amongst the innovators in this area are the University of Massachusetts, Amherst with their Classroom Response System [7] and Harvard [8].

Lectures usually have two important aims: to increase student understanding of the presented concepts, and to do so in ways that demands attention by the audience and even provides enjoyment to that audience. Past studies have cast doubt on whether traditional lecture delivery accomplishes the first, finding that passive observation of demonstrations does not significantly improve student understanding of the associated concepts.

Lecture presentation is directly linked to the effectiveness of the presented lecture – a good presentation tends to induce further discussion and promote active thinking as

well as further exploration into the subject area thus giving rise to students to discover inconsistencies or weaknesses in their own thinking or knowledge.
With universities currently being the main vehicle for mass higher education, student numbers are increasing and so are the ranges of skills and motivation that these students have. At the same time, secondary education is sometimes being driven by success in examinations (e.g. in UK) – an approach which is at risk of promoting an attitude amongst students that the most important issue in their education is assessment rather than learning. It is for these reasons that there is now, more than ever before, a need for universities to focus on more effective and less laborious means of learning.

In response to this need a system was developed at the University of Strathclyde in Glasgow known as NATALIE [2]. The philosophy was to re-emphasize the role of critical thinking by moving away from the traditional lecture format. NATALIE allows tutors to present information to large classrooms and obtain responses from the students through a "voting" process using infrared transmitters and receivers. Useful as this system has shown to be, it has several limitations due to the technology involved:

a) Only multiple choice questions may be asked during lectures,
b) It can only be used in specially designed classrooms,
c) It evaluates student knowledge but it is not thorough enough to provide a broader view of student ability,
d) It can be used in most lecturing courses but it provides little assistance in subjects where the use of engineering packages is essential.

Our intention with the work presented in this paper was to build upon the positive aspects of interactive Classroom Communication Systems (CSS). To do so it was felt necessary to attempt to remove the aforementioned limitations and provide an fully Interactive Classroom Learning Environment (ICLE). Our attempt to achieve this is based on a modified version of our Computer Supported Collaborative System (CSCW) which is capable of sharing all types of software across several computer platforms including wireless handheld PCs. Our intention was to develop a support system which would permit the engagement of students at any time, in any environment and for any course modules.

The idea to use handheld PCs partially derived from the work carried out in the Pebbles project and reported in [5] and [6]. This is an initiative which has been supported over a number of years by organizations such as Microsoft, Hewlett Packard, the National Science Foundation and DARPA and it aims to evaluate the use of handheld PCs in classroom environments, for people with disabilities, as the command post of the future, as a personal universal controller, etc. The experiments carried out in classroom environments amounted to using PDAs as a "voting" device (i.e. much in the same way NATALIE used custom-made IR devices). Further details on this development are reported in [1].

A more sophisticated system known as "Classtalk" is reported in [9]. This was a classroom communication system which was developed in collaboration with Texas Instruments using graphic calculators. Classtalk was relatively expensive but very sophisticated allowing questions other than multiple choice and with bi-directional feedback. Because of the growing choice in tools for interactive teaching, it was decided at the end of 2000, that “Classtalk” was no longer a system in demand.

2. Motivation and Objectives

In the more general context of engineering education, it is believed that handheld PCs and PDAs can be used much in the same way as ordinary PCs but with the added advantages which could enhanced student experience, continuous, better and faster evaluation of student ability and performance, flexibility and mobility, as well as substantial cost benefits.

The development presented here was inspired partially by the work presented in [5] and [6], partially by the sophistication of Classtalk, and partially by a small scale survey carried out amongst our student population.

As our intention for this project was to provide a comprehensive interactive classroom environment where the use of standard engineering software packages would be possible and where multiple interactions could take place amongst students and tutors on a group or individual basis. Classtalk’s capabilities appeared to answer most of the requirements but we were looking for a considerably less expensive system and one that could be easily transportable to any lecturing, laboratory or tutorial class. Handheld tablet PCs and wireless connections appear to be the obvious answer but there were two main constraints – cost and size of tablet PCs. Our student survey indicated that current tablet PC prices were outside the range of most students. More importantly however, it appeared that it was the size of tablet PCs which was the largest obstacle with nearly 80% of students indicating unwillingness to carry the device – preferring PDAs instead. The reported results and experience of the Pebbles project indicated that this could potentially provide a solution to our requirements.

The system presented here has a different approach to that presented in [5] and [6] and hence different objectives. It is primarily aimed at engineering courses and the aim is to permit use of standard engineering software packages whilst, at the same time, provide a means for continuous, rigorous and automated assessment of student performance. The experimental system, which is still under development, described in this paper was set up to evaluate the following:

a) establish best possible routes of delivering material and engaging students using handheld devices,
b) evaluate the technological constraints associated with the use of these devices particularly pertaining to graphic intensive packages used in engineering,
c) examine the additional overhead involved in preparing material to be delivered in his way,
d) evaluate user response to the system,
e) examine best possible methods to assess student performance

2. System Architecture

To achieve this, we have expanded our resource sharing software structure to allow multiple connections of handheld clients to application servers. Students, using thin handheld clients and wireless connection points, log on to the system and access applications (e.g Matlab, PSpice, etc) in designated servers. Tutors can share with students (individually or collectively), guide them or oversee their work, take control of applications if needed, assign questions, exercises or tests and generally interact with students collectively or individually in a wireless intranet environment.

On the server side the system cycles through users, obtains their responses to questions, tests or exercises, runs through their answers in the appropriate application, stores the information for analysis, evaluates performance and returns general and individual statistics and results. The subsequent analysis of the responses can result in fast performance evaluation and allow lecturing staff to provide timely assistance to students who need it most.

There are two main ways to achieve this functionality. One has been implemented and discussed in this paper, the other is still under investigation but it is also covered in this paper for completion.

The system may also be used to automatically obtain and process class registers and, if interfaced with existing software such as WebCT, provide early warnings of absenteeism, low student performance and other related issues. The technology can be applied to existing classroom environments, laboratories or indeed anywhere within an Intranet environment.

References

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