mLab: handheld assisted laboratory

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Abstract

This paper explores the potential of an m-learning environment by introducing the concept of mLab, a remote laboratory environment accessible through the use of handheld devices.

We are aiming to enhance the existing e-learning platform and internet-assisted laboratory settings, where students are offered in-depth tutoring, by providing compact tuition and tools for controlling simulations that are made available to learners via handheld devices. In this way, students are empowered by having access to their simulations from any place and at any time.

Keywords
blended learning, m-learning, remote laboratory

1 Introduction

The recognition of the role that mobile devices are likely to play in the future of learning (Keegan 2002) has led us to seek for learning materials and feasible applications for mobile devices in higher education. To the best of our knowledge, there has not been any similar initiative, offering remote laboratory access over the mobile device.

The starting point for this project was the Guided Wave Theory engineering course at our university, which consists of learning sessions that involve a blend of technologies. The course content material is presented via traditional classroom lectures and an interactive online learning environment. Additionally, a vital part of this lecture course is the remote, online laboratory setting (iSign), a self-learning environment where students can practise transferring theoretical knowledge into practical experiments (Christ 2002) in the area of electromagnetic fields calculation.

Since the launch of the iSign online laboratory in September 2001, experience has shown that the students are very motivated to use this blended approach that allows them to organise and pace their learning in the way that best suits their preferences and goals.

The use of mobile devices within iSign started with Short Message System (SMS) notification on the successful completion of the simulation. During the last few years, we have witnessed the rapid development of wireless technologies and mobile devices, as well as the release of new and powerful Java technology for creating applications for mobile devices – Java 2 Platform, Micro Edition (J2ME). All this made the concept of the handheld-assisted laboratory model a feasible project.

2 mLab: the handheld-assisted laboratory model

The input and display capabilities of wireless devices are cumbersome and limited. Consequently, the learning content for those devices needs to be carefully designed and selected. Furthermore, these very restrictions can be exploited to give the learner easier access to the most important and relevant learning material (Li 2003).

In our project, learning content within the mLab application is designed to be a brief summary of the classroom course with a focus on necessary instructions and formulae to accomplish the laboratory tasks. In addition, the students are able to test their knowledge with the multiple-choice questionnaire.

Using a wireless device, the student can log in to the remote server where the simulation is carried out, and start and stop the simulation. The simulation run can take anything from several minutes to several hours. During this time, the student is able to check the progress of the simulation via the mobile device. Finally, the student is provided with the evaluation of his or her results, where they are compared with the reference results set by the teacher.

The overall structure is presented in **Figure 1**. The web- and mobile-based applications are completely developed in Java. Use of the same technology, both on the client and the server side, simplifies infrastructure integration and allows the use of existing knowledge, tools and code through the network (Mitic 2003).

The iSign platform is the application server that provides access for different types of client through different connectors. It connects to the database where all user settings and simulation data are stored. The simulation server deploys the actual software for the electromagnetic fields calculation.

The mLab application is not a stand-alone application; it provides a limited learning material and simulation functionality compared to a web application. Therefore, the use of a web-based and mobile-based laboratory is seen to be complementary, in the way that it provides unconstrained and continuous access to the laboratory settings.

3 Current state of play and further work

In the current stage of the project, we are implementing the application to be used by students on the Guided Wave Theory course in order to evaluate their motivation and expectation when using the mLab platform. The application has been tested on different devices to assure portability and the same 'look and feel'. The plan is to make it available to students from the winter semester of 2004. We expect to get valuable knowledge that will help us to improve the mobile learning content and the student experience. The goal is to offer students an efficient and innovative laboratory environment that is accessible at any time and from any place.

References

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Figure 1 Overall architecture of the web-based and mobile learning platform