Chapter 4.11
Internet-Enabled User Interfaces for Distance Learning

Wei Liu
National University of Singapore, Singapore

Keng Soon Teh
National University of Singapore, Singapore

Roshan Peiris
National University of Singapore, Singapore

Yongsoon Choi
National University of Singapore, Singapore

Adrian David Cheok
National University of Singapore, Singapore

Charissa Lim Mei-Ling
Nanyang Technological University, Singapore

Yin-Leng Theng
Nanyang Technological University, Singapore

Ta Huynh Duy Nguyen
National University of Singapore, Singapore

Tran Cong Thien Qui
National University of Singapore, Singapore

Athanasios V. Vasilakos
University of Peloponnese, Greece

ABSTRACT

The advent of Internet technologies since decades ago has propelled distance learning drastically. In this modern world, knowledge develops so fast that the amount of intellectual information that needs to be learnt before it becomes obsolete again is so huge. Distance learning through the use of Internet technologies has the advantage of being able to get across the information to the students remotely and effortlessly. The other advantage, which is the main focus of this paper, is that students are able to learn from their instructors on an entirely new media platform - the Internet-enabled and tangible user interface. This paper discusses how to use two main new media: multi-modal Internet technologies, namely remote physical interface and remote augmented reality technology in distance learning.

INTRODUCTION

In an attempt to provide increased educational opportunities to their present students and to attract new students who are working or have other constraints on their time or mobility, many colleges and universities (Hentea, Shea, & Pennington, 2003) are developing distance education programs. Distance education before the Internet age was

painstakingly ineffective. First of all, there was the lack of interaction between the instructors and the students. Then there was the issue of delay in communications. Today the distance learning is supposed to provide a rich, ``almost classroom experience'' to distance students. It is a big challenge. Distance education offers freedom from space and time constraints, increased interactivity, improved delivery of multimedia, broadened curricula, and personalized learning (Hentea et al., 2003). Many tools have been developed to facilitate distance learning since its inception, such as traditional mails of printed material, videotape, CD-ROM, DVD, and the more recent web-based methods, which includes live video streaming, video conferencing and interactive graphical user interface.

The advantage of distance learning has been mentioned briefly. There are far more disadvantages that needs to be discussed here. We would discuss how our proposed Internet technologies could help overcome these shortcomings in later sections.

One of the major concerns is that students who are learning at a distance from the instructor and other fellow students may suffer from lack of interaction. Situated learning theory (Lave & Wenger, 1991) describes the process of learning as highly social, embedded in the lives of learners. Much of the theory of situated learning centers on the notion of communities of practice, dynamic groups that are present throughout our lives in which we participate in various ways. Such groups exist in schools, workplaces, social organization and families. With the pervasive of internet and those online social networks such as ``facebook'', social groups on internet become a new form of dynamic groups that people communicate using online chat, voice phone etc. technologies. However, usually students have little or no means of communicating with each other; even those who have the means of communicating with others in their class via online chats or email may not receive any encouragement to do so. Both students and instructors are affected if they do not have enough effective communication with each other. The instructor is unable to judge a student's progress and is unable to adapt the learning to successfully meet the needs of the learners. The students are more likely to feel confused or angered by assignments when they do not understand their significance. In addition, if communication between student and instructor is not timely, much of the value of feedback on assignments and tests is lost (Hentea et al., 2003). We need to consider how to encourage students to communicate with the instructor and other students when developing a distance learning system.

The other major concern of distance learning is that, often there is a loss of visual and physical experience. In other words, students sometimes could not visualize the physical objects or models as illustrated by the instructor. This shortfall is much real when it comes to subjects, which are best taught using physical artifacts. Instructors believe that visual enhancement helps students learn (Naps et al., 2003). Moreover, the feel of physical presence in front of the instructor or in the classroom also enhances the learning process.

So the current distance learning suffers from, but not limited to, lack of interaction, lack of active learning group, loss of visual experience and absence of physical presence. In this article we address the use of Internet-enabled tangible user interfaces, which encompasses augmented reality and remote physical interaction to handle these problems. A few enabling systems which we envisage will enhance the distance learning process which has been developed with the end users involved in the development process. We hope that practical tools using these enabling technologies can enhance the students' experience in remote learning. The tools, which will be described in later sections, are the 3D Live Technology (Nguyen et al., 2005), Mixed Reality Classroom-based Education Systems, and Internet Haptic System. The end users are involved in the development process of these tools and