Adaptive Device Context Based Mobile Learning Systems

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ABSTRACT

Mobile learning is e-learning delivered through mobile computing devices, which represents the next stage of computer-aided, multi-media based learning. Therefore, mobile learning is transforming the way of traditional education. However, as most current e-learning systems and their contents are not suitable for mobile devices, an approach for mobile devices to adapt to e-learning is presented. To provide device-independence mobile learning services, a context-aware mobile learning approach is proposed. Firstly, the formal definitions of contexts and their influence on mobile learning services, including device contexts NCxt, matrix of information transmission parameters S, the degree of influence of the context NCxt on information transmission parameters Q, and adaptation coefficient E, are given. By using this approach, the mobile learning system is constructed. In an example using this approach, the authors detect the contextual environment of mobile computing and adapt the mobile learning services to the learners’ devices automatically.

Keywords: Adaptability, Context, Device Independence, Mobile Learning, Mobile Learning Systems

INTRODUCTION

With rapid development of mobile computing devices having access to Internet capabilities, such as computers, smart phones and handheld devices, people can work or study at any time and any place that is the so-called mobile learning. It is a good complement to the exiting learning models (Motiwalla, 2007). One key benefit of mobile learning is the potential to provide efficient learning anytime and anywhere that is a great extension to the e-learning paradigm. Imagine the power of learning that is truly in time, that is the learner’s access to training is available at a precise time and place for a specific job as it is needed with learning not confined to pre-specified times or places (Sharples, 2002), and is possible at time and places and in the order of topics that the learner wants (Price, 2003).

It is important for mobile learners to get education information and services that meet their needs in an adaptive manner. Two kinds of adaptive manners may be implemented by mobile learning system, one manner is adap-

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tive to the mobile learners, the other is for the mobile devices. It seems that the adaptation to mobile learners is a more essential issue. Recently, many research results about this issue have been proposed (Anastasios, 2006; Diaz, Duque, & Cantero, 2004). While as for the adaptation to mobile devices, few results have been presented (Zhao & Okamoto, 2008). Since mobile learning is a learning process from tutor to learner via mobile devices, the adaptation to mobile devices is also very important. It is a necessary condition to achieve the adaptation to mobile learning. As we all know, there are many different characteristics among all kinds of devices. It greatly restricts the application of mobile learning, because the differences are rarely not taken into account by most of the ubiquitous learning systems (Zhao & Okamoto, 2008). Therefore in this paper, we mainly discuss the mobile learning system with the ability of device independence adaptation.

Context plays a key role in mobile learning. In mobile learning, context is the set of suitable environmental states and settings based on situated roles between learners and tutors. These states and settings are relevant to context-sensitive learning systems that provide services and information adaptively based on defined contexts. Dourish (Tough, 1986) suggests that the notion of context has a dual origin, technical based and social science based. The technical notion relates to the relationships between human actions and computational systems, the social science notion relating to the social settings. Generally speaking, the so called ability of the device independence can be regarded as such technical notions of context. So in this paper, we will define the context with respect to a variety of mobile devices to enhance their adaptive ability. To achieve this goal, a key work is to provide the mobile device contextual content service. The principal motivation for this service is the provision of an intelligent, situation-dependent, customized specific information service to mobile devices based on heterogeneous educational resources. A device contextual service should involve the process of gathering a mobile device’s specific type and parameters once the system’s communication with the engaged device is initiated. The context is then used to select and deliver an appropriate device contextual service to the connected device.

In the mobile learning system, the independent learning is considered an important design issue as we intend to make use of the medium capabilities of wireless communication technologies to make a difference in learning. The independent learning can assist learners in acquiring the knowledge, abilities, skills, values, and motivation that enable them to analyze learning situations and develop appropriate strategies for actions (Tough, 1986; Herber & Nelson-Herber, 1987; McDonald & Ingvarson, 1997; Weasmer & Woods, 2001; Musthafa, 1996; Marsh, 1997; Houston & Lazenbatt, 1996; Sivan, Leung, Woon, & Kember, 2000; Maitland, 2000; Lafferty, 1996; Martens, Valcke, & Portier, 1997; Li, Chen, Shyu, & Furht, 2002). However, many kinds of different characteristics among devices are not taken into account by most ubiquitous learning systems. Therefore, when new devices appear, e-learning system must be modified to adapt.

Based on above discussion, we know that the awareness of learning device context is important. However, context awareness is not easy to achieve. The diversity of mobile and wireless technologies and the nature of dynamics in mobile environments make the context awareness so complicate. Therefore, contextual information, such as display capabilities of mobile devices, is usually predetermined and coded within the system. There have been a few prototype systems utilizing context-awareness to support learning (Abowd, Atkeson, & Feinstein, 1996; Bobick et al., 1998; Iles, Glaser, Kam, & Canny, 2002; Ryokai, Vaucelle, & Cassell, 2002; Nourbakhsh, 2000). These systems’ adaptability is poor. To address this problem there are currently many methods documented in literature which target to improve the system adaptability.

Xinyou Zhao proposed a device-independent architecture for mobile learning, which is composed of one device detector and adapted...
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