Integrating Technical Advance in Mobile Devices to Enhance the Information Retrieval in Mobile Learning

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ABSTRACT

It has been a long time since the wireless technologies are used in learning activities to promote the interaction between teacher and learners. The recent advance in the mobile technologies has created new chances improving the flexibility, efficiency, and functionality of the learning interaction systems. This investigation identifies the weakness of the existing systems, and integrates the emerging mobile technologies to establish an open interaction framework to effectively enhance the interaction using students faced mobile devices and public wireless infrastructure. The main work of this investigation contains: (1) a teacher-learner response model for mobile based interaction is proposed and described with state machine logic; (2) a presentation-content retrieval mechanism is designed to efficiently utilise the limited computation resource; (3) device independence and context-aware techniques are integrated to created cross-platform application with mobile device features; (4) an open media framework is built for flexible learning material distribution and question organization. A lightweight mobile oriented Web-based Wireless Response System (mobile-WRS) is implemented as a case study. In-house testing and classroom application of the mobile-WRS in universities demonstrate that the proposed system outperforms the peer works in usability, interface, operational efficiency, learning material distribution, results presentation, and performance assessment, etc.

Keywords: Interactive Learning, Mobile Learning, Wireless Response System (WRS), Context-Aware, Device Independent

1. INTRODUCTION

The past decades have witnessed a fast evolution of utilizing the latest Information and Communication Technologies (ICT) in promoting the flexibility, adaptability, and mobility of Interactive Learning Systems (ILS) (Sabry & AlShawi, 2008). The wireless and mobile technologies are employed due to their spatial and temporal flexibility and their potential in increasing interest and encouraging engagement (Hwang et al., 2011; Álvaro et al., 2013). In the early years, the Infrared based devices and mobile phones or PDAs using Short Message
System (SMS) and Wireless Application Protocol (WAP) were introduced in learning activities (Huang et al., 2008). The interface, speed and functionality of these systems are constrained by the device capability and communication bandwidth. Recently, the continuous progress in smartphone, wireless infrastructure, and mobile computing service converges to facilitate the interaction in learning activities (Sabry & Barker, 2009). The state of art smartphones such as iPhone and Android devices are introduced in learning systems in some research projects (Lu et al., 2010; Pein et al., 2010). Some proprietary and open mobile development platforms such as iPhone SDK, Android SDK, and Qt SDK can create high performance device specific applications. And some Web development technologies such as Ajax, jQuery, and jQTouch can provide the user with mobile oriented Web applications. Moreover, context-aware technology (Martin & Carro, 2009; Clough, 2010; Al-Homouz et al., 2012) and information adaptation technology (Zhang, 2007; Kao et al., 2009; Mahdavi et al., 2010) are used for mobile information retrieval and service provisioning in learning systems.

The remarkable technical advance creates chances to promote the information retrieval in the learning systems. In spite of the remarkable progress, the performance of mobile devices still falls behind desktops and laptops in computation capability, communication capability, and battery life, etc. In addition, heterogeneity in device capability, mobile platform, and runtime environment results in difficulties in creating cross-platform mobile applications for diverse mobile devices (Grace, 2004; Schmohl & Baumgarten, 2008). Therefore, it is a challenging and prospective topic to employ the advanced technologies to overcome limitations of mobile devices while maximizing their strengths.

It is the gap between the functional constraints of the interaction systems and the remarkable advance in mobile technologies that has motivated this study. This investigation aims to integrate the emerging novel techniques in mobile devices and mobile computing paradigm to enhance the information retrieval towards efficient interaction in mobile learning systems. A lightweight Web-based system mobile-WRS is designed and implemented as a case study focusing on the techniques and methods in terms of interoperability, efficient computation resource usage, open media learning content distribution, and efficient user interaction.

The rest of this paper is structured as follows: Section 2 introduces the background and related work, and section 3 states the aim and objectives of this investigation. Section 4 presents teacher-learner response model and characterises the features of the system, followed with the system design and implementation described in section 5. Then, section 6 gives the results, evaluation, and further discussion of the system. Finally, conclusion is drawn and future work is suggested in section 7.

2. BACKGROUND

2.1. Related Work

Previous studies suggest that the interaction between teacher and learners is considered to be a critical component in learning and training activities (Chou, 2003; Draper & Brown, 2004; Siau et al., 2006; Miao, 2012). The utilisation of the WRS can effectively enhance the interaction and increase learning motivation and engagement (Bannan-Ritland, 2002; Zurita & Nussbaum, 2004). Thus, a lot of investigations about the WRS can be found in educational practice and academic studies. These studies may refer to WRS as Classroom Response System (CRS) (Fies & Marshall, 2006), Audience Response System (ARS) (Uhari et al., 2003), Personal Response System (PRS) (d’Inverno et al., 2003; Titman & Lancaster, 2010), Electronics Voting System (EVS) (Saleh et al., 2003; Russell, 2008; Davenport et al., 2009), interactive response system (Slain et al., 2004), or Student Response System (SRS) (Lu, 2010; Pein et al., 2010).

The origin of applying WRS in classroom learning can be traced to more than 60 years ago (Sharples & Roschelle, 2010). The application covers the disciplines of science, statistic, mathematics, psychology, programming lectures,
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