On a Design of SCORM-Compliant SMIL-Enabled Multimedia Streaming E-Learning System

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ABSTRACT

E-learning plays a key enabling role in knowledge management for individuals, schools, and enterprises. Nevertheless, the lack of standards in content and learning management systems (LMSs) makes the reusability and interoperability of learning resources infeasible. The emergence of the SCORM specification has shed light on the standardization of e-learning. Unfortunately, the existing SCORM-compliant asset model is simplified; only a few asset types are allowed. On the other hand, W3C’s declarative-style SMIL (Synchronized Multimedia Integration Language) is becoming prevalent in designing Web-based instructions with the consideration of temporality and spatiality of presentations. In addition, advances in real-time multimedia technologies can vitalize further these instructions. In this study, we propose an SMIL-enabled asset model with the enhancement of multimedia streaming. To render SCORM-compliant SMIL-enabled streaming contents, a Java applet-based SMIL RTP/RTSP LMS system is designed. We develop the proposed system in the Java EJB environment to tackle the issue of platform interoperability. The resulting system demonstrates an encouraging direction towards a more vivid and interactive SCORM-compliant e-learning.

Keywords: electronic learning (e-learning); Java EJB; LMS; multimedia streaming; SCORM; SMIL

INTRODUCTION

The rapid expansion of the Internet has had a dramatic impact on both our lives and our education. The major feature that differentiates e-learning from traditional learning is its ability to train anyone; anytime; and anywhere, which is attributed to the openness of the Internet. Without temporal and spatial limitations, a person can have an independent and individual learning space. Universities first realized the advantages of e-learning and actively built up the so-called cyber universities that offered diverse asynchronous or synchronous distance learning in regular, professional, and/or continued educations. Next, business companies also recognized the significant market benefits of e-learning. Analysts predicted that corporate spending on e-learning programs would reach US $23 billion by 2004. Yet, some innovative enterprises...
have moved beyond training to focus on e-learning in the context of knowledge management and found that e-learning is a vital step in the development of knowledge management systems (Ismail, 2002).

The major feature of e-learning is digitized courseware, which is managed by the so-called Learning Management System (LMS). In addition, LMS helps learners to learn the coursewares and keep track of their learning behaviors. But coursewares in different LMS platforms cannot be interoperable directly, so the attempt to share learning resources is impeded. The most critical issue for this is whether the process of designing the coursewares follows some kind of standards. Besides, the heterogeneity existing in the different LMSs is another impediment. There is no way to monitor and evaluate the learner’s behavior from one platform to another. All these hinder the sharing of learning resources, including platforms and contents. Although it has been recognized that developing reusable and shareable content objects is of great importance (Anido et al., 2001a, 2001b; Muzio et al., 2002; Rifon et al., 2001), not all of the aforementioned issues have been addressed. To overcome these hurdles, a variety of e-learning standards have been developed, such as IMS, IEEE LTSC, AICC CMI, LMML, ARIDANE, and ULF, and so forth. Recently, Advanced Distributed Learning (ADL) organization, supported by the U.S. Department of Defense, and major e-learning vendors, established one specification called Sharable Content Object Reference Model (SCORM) toward standardizing e-learning (SCORM, 2003). SCORM integrates and refers to the aforesaid standards from AICC, IMS, IEEE, and several e-learning factories. The objective of the specification is to facilitate the interoperability between SCORM-compliant contents and SCORM-compliant LMS, and to make the valuable resources become durable, interoperable, accessible, and reusable.

On the other hand, recent progress in multimedia technologies is greatly changing people’s life-styles. The marriage of the Web and multimedia technologies results in the Web-based multimedia presentations, so people can read multimedia lectures via general browsers. However, designing multimedia presentations is not a trivial task. Synchronized Multimedia Integration Language (SMIL) (SMIL, 2004) built on XML and proposed by W3C, provides a simple way to design multimedia presentations in a manner similar to HTML documents. The SMIL specification meets three requirements of multimedia document models: temporal, spatial, and interaction.

Furthermore, the demand for real-time and robust multimedia applications is rising dramatically, as Internet connection speeds improve. Various protocols for supporting networked multimedia services have been proposed. Two of the representatives are Real-Time Transport Protocol (RTP) and Real-Time Streaming Protocol (RTSP). RTP is designed specifically to transmit real-time media data and enables client applications to play media over the Internet without having to download the entire file at once. RTSP, a state-oriented protocol, provides VCR-like functionality to allow more interaction between users and media sources.

Multimedia presentations can attract learners’ attentions because of the vivid video images and sound effects. According to the SCORM specification, multimedia materials, such as images, are defined as assets in the content. Currently, however, the samples in this specification or mostly SCORM-complaint LMSs that only handle simple assets like pictures. To vital-
An Ontology Infrastructure for an E-Learning Scenario
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