

Chapter IX

End–User Quality of Experience–Aware Personalized E–Learning

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ABSTRACT

Lately, user quality of experience (QoE) during their interaction with a system is a significant factor in the assessment of most systems. However, user QoE is dependent not only on the content served to the users, but also on the performance of the service provided. This chapter describes a novel QoE layer that extends the features of classic adaptive e-learning systems in order to consider delivery performance in the adaptation process and help in providing good user perceived QoE during the learning process. An experimental study compared a classic adaptive e-learning system with one enhanced with the proposed QoE layer. The result analysis compares learner outcome, learning performance, visual quality and usability of the two systems and shows how the QoE layer brings significant benefits to user satisfaction improving the overall learning process.

INTRODUCTION

It is widely acknowledged that e-learners differ in skills, aptitudes and preferences, may have different perceptions of the same factors and

some of them may have special needs due to disabilities. People also seek different information when accessing Web-based educational systems and may prefer certain learning styles. Therefore, various adaptive and personalized e-learning

systems such as ApeLS (Conlan & Wade, 2004), WINDS (Specht et al., 2002), iClass (O’Keeffe, 2006), INSPIRE (Papanikolaou et al., 2003) and AES-CS (Triantafyllou et al., 2002) were proposed in order to capture and analyze these user-related features, and personalize the educational material thus optimizing users’ learning experience.

With the latest communication-oriented devices like smart phones, PDAs, laptops and network technologies such as 3G, WiFi, IEEE 802.11 family of standards (IEEE802.11, 1999), WiMax, IEEE 802.16 family (IEEE802.16, 2004), e-learners can access personalized information “anytime and anywhere.” However, the network environments allowing this universal access have widely varying performance-related characteristics such as bandwidth, level of congestion, mobility support and cost of transmission.

It is unrealistic to expect that the personalized content delivery quality can be maintained at the same level in this variable environment. Rather an effort must be made to tailor the material served to each person to their operational environment including current network delivery conditions, ensuring high quality of experience (QoE) during the learning process.

QoE focuses on the learner and is considered in (Empirix, 2003) as a collection of all the perception elements of the network and performance relative to users’ expectations. The QoE concept applies to any kind of network interaction such as Web navigation, multimedia streaming, voice over IP, etc. Different QoE metrics that assess user experience with the systems in term of responsiveness and availability have been proposed. QoE metrics may involve subjective elements and may be influenced by any sub-system between the service provider and the end-user.

It should be noted that some adaptive e-learning systems have already taken into consideration performance features such as device capabilities, the type of access to the network, download time, etc. in order to improve learning QoE (Chou et al., 2004; Brady et al., 2004; Smyth & Cotter, 2002;

Apostolopoulos & Kefala, 2003). However, these account for only a limited range of factors affecting QoE. Also, they were considered separately one from another, unlike the real life situation when there is a simultaneous influence on user interaction with the e-learning systems.

In order to address the effect the complex operational environment has on e-learning, a detailed analysis of the key factors that affect learner QoE was conducted. A **QoE adaptation layer** that extends the adaptation features of classic e-learning systems was proposed. It aims to provide high level QoE when users engage in a learning process via network environments with variable connectivity characteristics.

This chapter presents, in details, the proposed QoE layer in the context of a classic architecture for adaptive e-learning systems (AeLS). The most significant AeLS proposed to date are presented in the “Related Work” section that also includes a summarization of the methods most often used in AeLS evaluation. Results of a detailed experimental study that involved a well-known AeLS and a version of the same system enhanced with the proposed QoE layer are then presented. The consequent result analysis compares learner outcome, learning performance, usability and visual quality of the two systems and shows how the QoE layer brings significant benefits to the learning process. The chapter ends with conclusions.

RELATED WORKS

Adaptive E-Learning Systems (AeLS)

Most adaptive e-learning systems are adaptive hypermedia systems (AHS) with applicability in education. In general, AHS aim to help in any application area where the hyperspace is large enough and the system is used by heterogeneous groups of users that have different goals, knowledge, interests, preferences and tasks. Education is one of the major areas of AHS applicability that

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