Chapter 14

A Robust and Scalable RESTful Web Service for Collecting Student Responses: Student Response System (SRS)

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ABSTRACT

This paper discusses a model for a RESTful (Representational State Transfer) web service used in education. The “Student Response System” (SRS) has been developed and tested in classrooms for two years within the EduMecca project. The SRS provides a response system, accessible through mobile devices allowing students to submit virtually anonymous responses, i.e., other students are not able to see individual submissions. The system makes strong use of open and flexible standards to allow for external software to control the service with use-case specific interfaces. It is aimed to support as many students using the service in parallel as possible. In this paper, the main performance bottleneck of the system is examined in detail. In order to provide an easy-to-use interface, the mobile devices of the students need to be notified by the service about real-time changes of the data. The benchmark results indicate a high user capacity of the service. It is also a robust approach able to recover quickly after an unusual high request peak.

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INTRODUCTION

Mobile computing in learning environments is getting increasingly popular in recent years (Thornton & Houser, 2004; Roschelle, Sharples, & Chan, 2005; Zhao & Okamoto, 2008). A typical example is that learners and teachers can make conversation through a handy mobile device. This seems to be beneficial, because learning seems to be more efficient, if it includes interaction and dialogue (Laurillard, 1993). Traditionally, lectures with only one teacher are attended by tens of students, leading to unidirectional instruction. The interaction decreases even further, if distance learning technology such as video streaming is used (Stav, 2008).

One approach to improve the learning is the introduction of Electronic Voting Systems (EVS) in lectures (Morris et al., 1999; Draper & Brown, 2004; Drysdale, 2007), which are based on a simple idea. Teachers ask a question and present multiple possible answers. The audience is then requested to answer, not orally or by raising hands, but by submitting a choice electronically. This provides a high anonymity to comfort the audience and also shows the theoretical strengths and weaknesses of this group. If done cleverly, it may also initiate an intended discussion.

In this paper, the model for an implemented RESTful web service used in education is presented. This service - the “Student Response System” (SRS) - has been developed and tested in classrooms for two years within the now finished EduMecca project. It required the use of an anonymous response system (Lu, Pein, Hansen-Nygård, Nielsen, & Stav, 2010). The early software model is described in Pein, Lu, and Stav (2009) with a concept of making the system available even for distance learning environments. The system propagates the use of open and flexible standards to allow adaptive representation of the content to match the constraints of the receiving device. It is assumed that in the near future most students will have a mobile device with a reasonable wireless connectivity and display.

1. BACKGROUND

The focus of this research lies in the development of a fast, robust and easy-to-use web service. During an early development stage of this system, it became clear that the user interface must be intuitive to be non-distracting during lectures. Further, the intended massive use of mobile devices requires a robust concept. Thus, hiding complex concepts and generally simplifying the use of this service, as described by Weiser (1993) are seen to be necessary.

Data sharing and integration in mobile and ubiquitous environments is vital. Ancona, Dodero, Gianuzzi, Locati, and Romagnoli (2001) proposed an architectural model, called Integrated Environment for Scientific Data Entry and Management (IESDEM), that made use of an intermediate data representation layer, where data sharing was made easier with the use of XML. Bellavista, Corradi, Montanari, and Stefanelli (2006) proposed a flexible architecture for the development and implementation of location and context-aware services for heterogeneous data access. The proposed middleware, called “Services with Context awareness and Location awareness for Data Environments” (SCaLaDE), was designed to support Internet data applications for mobile computing. Chen, Yang, and Zhang (2006) presented their context-aware web services, which were designed to enhance web-based e-business, as their first step toward tackling the challenges posed by ubiquitous web services. Unlike e-business solutions, the SRS does not need to provide support for complex session management. In this case, a lightweight solution such as the “Representational State Transfer” (REST) by Fielding (2000) appears to be more appropriate.
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