LEARNING PORTFOLIO AS A SERVICE – A RESTFUL STYLE

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ABSTRACT

Learning portfolios play a critical role in fostering learning and assessing learning achievement. For easy access and more efficient processing, various electronic portfolio systems have being developed and receiving widespread adoption. Contemporary electronic portfolio systems are designed and developed proprietarily, such that the limited functionalities of each system are available to particular users only, and it is difficult to integrate them due to diverse access interfaces. However, just like other pedagogy support systems, e-portfolio systems must be renovated continuously to make them adapt to the ever-changing learning contexts and meet diverse requirements from teachers, educators, and administrators. Besides, to facilitate sharing and consolidating resources from different e-portfolio systems, it is of great importance to build easy-accessible as well as open e-portfolio systems. In consideration of the necessary agility, versatility, and accessibility, the present work proposed the concept of learning portfolio as a service and realized it with a restful styled approach. This article describes the design rationales and implementation of the learning portfolio as a service system, and analyze its impact on educational facets.

1. INTRODUCTION

Learning portfolios have being widely used to record all kinds of relevant data during the course of teaching and learning activities, and insightful information that can improve learning performance could be further distilled from these records. For the sake of efficiency and easy access in the age of Internet, many Web-based learning platforms take in e-portfolio systems to fulfill the task of tracking learning activities and documenting the corresponding artifacts. However, to adapt to ever-changing learning environments and meet diverse requirements from students, teachers, administrators, e-portfolio systems need to be agile and versatile. Furthermore, because cross-institute integration of portfolio resources enables cooperative analysis, planning, and management among different education institutes, administrative and accreditation agencies, functionalities of ideal e-portfolio systems need to be accessible.

Just like other Web-based learning management and contents systems, most currently-deployed e-portfolio systems have two major drawbacks, which include (1) proprietary design and implementation make each e-portfolio system be available to limited users who teach or learn in particular environment; (2) non-common application programming interface leading to difficulty in integration of distributed but complementary resources. Fortunately, the service-based approach, to certain extent, is able to resolve these shortages (Hu and Chen, 2008).

Among many advantages of service-based pedagogical resources, the most attractive one to both content consumers and providers is the open access method that are based on existing standardized techniques including HTTP, XML, etc. Not only being able to couple distributed and heterogeneous resources easily, the standardization, the derived openness and interoperability also facilitate the access to service-based resources and ease the composition of them.

In view of the importance of an agile, versatile, and accessible learning portfolio system, the present research work aimed to develop a system that realizes the concept of "learning portfolio as a service" (LEPORAAS) according to the restful style. Besides the fundamental functionality of a typical e-portfolio system, the LEPORAAS will enable prompt assessment of learning, pervasive assessment in diverse instructional and learning situations, efficient cross-institute cooperation, and macro administrative works and decision making.

2. PRIOR RESEARCH WORKS AND RELATED TECHNIQUES

2.1 Requirements of an Ideal E-Portfolio System

In general, education institutes use portfolios to document students' learning activities, progress, and concrete artifacts. The original and main purpose of learning portfolios is providing educators and administrators an alternative tool to assess students' learning (Ryan, 2011, Cavaller, 2011) from not only result-oriented, but process-oriented viewpoints. Portfolios support summative and formative assessment (Gans, 2009), which usually need reflection of artifacts that were developed during the course of learning and thus is more difficult to conduct than conducting quantitative and summative assessments, such as standardized tests. The electronic version of learning portfolios offer extra merits including storage of multimedia contents, easy access, fast index and search, efficient and precise analysis in depth.

Beyond its typical application to assessment, functionality of e-portfolios has been proved to be multi-facet. Many prior research works indicated that, main effects of portfolio also include improving students' knowledge and understanding, creating greater self-awareness and encouragement to reflection (Inácio and Salema, 2011), and nourishing the ability to learn independently (Buckley et al., 2009, Hays, 2004, Zembal-Saul et al., 2002). Additionally, along with Websites and Facebook, e-portfolios have been applied to aid pre-service teachers in understanding how to integrate technology into their instruction (Shaltry et al., 2013). The study conducted by Lambe et al. shows that e-portfolio can assess aspects of pre-service teacher education program within the specific context of special needs education, and can demonstrate a range of teaching competencies (2013). E-portfolio also can serve as an effective tool to facilitate the communications among students, teachers, and parents who can keep track of children's classroom learning through the corresponding e-portfolios (McLeod and Vasinda, 2009). Not surprisingly, career placement could be more suitable and precise by referencing long-term portfolios (Brennan and Lennie, 2010) of job seekers, rather than relying on the result of a single placement test. The reason is that contents in e-portfolio reflects a student's strength, weakness, interests, and particular the progress in specific domains.

In recent years, ICTs facilitate new learning approaches such as collaborative learning and edutainment. In addition, situations for learning have been broadened by wireless and broadband communication networks, which realized the concept of mobile or pervasive learning. In summary, all new aspects of teaching and learning activities correspondingly induce new requirements for e-portfolio systems. That means e-portfolio systems need to be adaptive and versatile, in order to meet emergence of ceaseless new requirements. Besides, they need to be accessible for easy consolidation of portfolio resources from multiple institutes (Ritzhaupt et al., 2008).

In addition to the aforementioned aspects, the widespread necessity for e-portfolio systems by institutes leads to two more requirements of an ideal e-portfolio system: a cost-efficient delivery mode and an elastic usage/payment scheme. The cost-efficient delivery mode reduces burden on preparing and maintaining software, while the elastic payment scheme makes cost be proportional to actual usage. Both of these two aspects are valuable to educational institutes due to their great deal of variety in demand for e-portfolios functionality and financial strength. Taking all of these advantageous aspects into account simultaneously, provisioning learning portfolios as a service is a reasonable and promising option.

2.2 Software as a Service and Restful Styled Web Service

As one of the service model in cloud computing, software as a service (SaaS) (Liu et al., 2010, Goth, 2008) should be the one which most end users of software can benefit from. SaaS reshaped the paradigm through which software deliver its functions to users. Unlike traditional software that need to pre-acquired and installed on particular host(s), SaaS deliver user functions that were wrapped in Web-based interfaces through the Internet, or more specifically, the Web service techniques (Petrie, 2009, Yi and Blake, 2010). Because the corresponding program and configuration files are controlled and maintained by service providers on remote sites, users of SaaS are able to access the latest updated functions of software without installation and maintenance by themselves.

The most valuable advantage of SaaS is that SaaS enables a fairer consumption/payment scheme: pay-per-use in software industry. The advantages of SaaS already attracted volume of users who want to use software functionality and pay for it fairly, but are reluctant to manage and maintain software.

When Web service techniques were applied in the provision of e-learning functionalities and materials, its platform-neutrality characteristic means no matter which implementation techniques and operating platforms were chose, once an instructional resource was developed or just wrapped as a service, all clients on the Internet can send compliant request to access it. Obviously, that will leverage the reusability and sharing of educational resources beyond the current level.

To resolve the overhead issue by the SOAP based Web service, the representational state transfer (REST) architectural style (Fielding, 2000) offers a promising approach. The restful Web applications (Vinoski, 2008) emerged as an lightweight alternative for realizing the concept of SaaS, which is one of the major service models in cloud computing (Dillon et al., 2010) environment. In a restful Web application, everything that could be accessed or operated are treated as resources, and resources must be identifiable via an uniform naming scheme, or practically, the uniform resource identifier (URI). In contrast with its heavyweight counterpart: the SOAP-based Web service, the restful Web service associates standard HTTP methods with operations that intended to be performed on resources.

Due to the uniform identifying scheme and access (operation) interface, the restful approach significantly reduces the complexity that are caused by processing of SOAP-encoded messages, such reduction offers users and bystanders a lightweight option for adopting Web services. Moreover, the plain HTTP-based access interface eases the integration of popular and lightweight techniques such as asynchronous JavaScript and XML (AJAX) into client side of restful Web applications, which further makes more service consumers using devices with various form factors to access online resources pervasively.

In general, the restful style have being applied to develop Web applications with diverse purposes (Belimpasakis and Moloney, 2009, Rissanen et al., 2010, Gao et al., 2010, Qian and Xianglong, 2010). Considering the advantages of restful Web applications, this research work proposed the learning portfolio as a service and realized it with the restful style and the supported techniques. The implementation work embodies merits including lightweight, pervasive access, scalability, and flexibility.

3.   REALIZATION OF A RESTFUL LEARNING PORTFOLIO SERVICE

This section explains the design rationales of the restful learning portfolio service system, as well as describes how the design concepts were realized accordingly.

3.1 Design Rationales

To embody the concept of learning portfolio as a service, a corresponding system was designed and implemented. The system consisting of major components is illustrated in figure 1. The design of the interface for accessing this e-portfolios service system complied with the following constraints: first, all types of resources will be organized in hierarchical style. For example, a user's portfolio consists several of sub-portfolios that in turn comprising different types of records and artifacts associated with a specific user. Second, identifiers of all resources follow a common URI pattern, and thus could be represented hierarchically. For example, to identify a particular (say, with ID =10) certificate in a sub-portfolio recording a user's all certificates, we can use *http://www.eportfolio.org/username/certificate/10*.
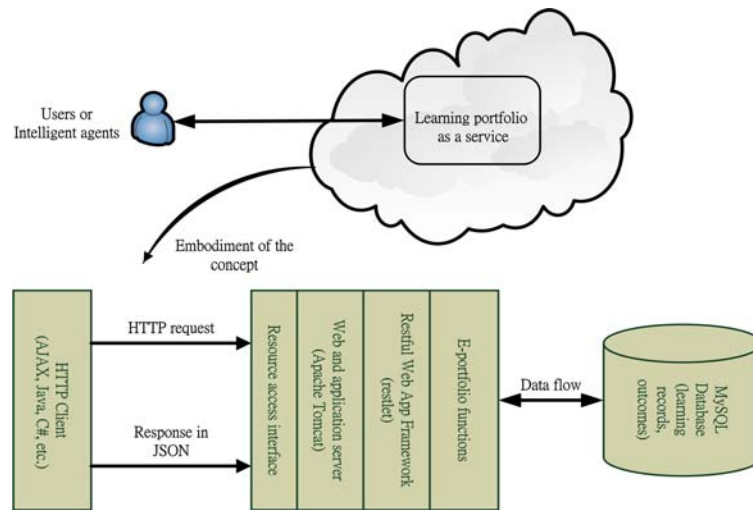
Figure 1. Architecture of The Restful Learning Portfolio Service System

Third, the four basic HTTP methods: POST, GET, PUT, and DELETE are uniformly used to map the CRUD (Create, Read, Update, Delete) operations on a resource, respectively. Accordingly, to create a new instance of the certificate record for a particular user, a POST request including the HTTP verb along with the request contents (input data) would be sent to *http://www.eportfolio.org/username/certificate/new/*.

3.2 Implementation

To realize the design concept, the Apache Tomcat was used to serve as the Web and application server, the restlet was used for frameworking the restful Web application with Java servlet and JSP techniques. To persist all data records regarding contents in users' portfolios, mySQL was the choice. On the client side of the proof-of-concept system, the AJAX was applied to send the four basic HTTP requests, as well as to receive and handle the response messages from the service provider. Typical restful applications allows that resources have different formats, e.g. plain text, XML, and JSON (JavaScript Object Notation), etc.

4. ADVANTAGES AND IMPACTS

The advantages of the learning portfolio as a service and the corresponding impact on multiple facets are discussed in this section.

4.1 Agility and Versatility

With adoption of the SaaS concept, consumers of e-portfolio services can always use the latest functionality but do not need to install and maintain various software any more, instead, they pay for what they actually used. Doubtless, this flexibility of payment scheme will reduce waste that are caused by pre-licensed but under-utilized software. Moreover, the pay-per-use scheme enables a finer-grained budget allocation.

By inheriting the most valuable merit of the service-oriented architecture (SOA) (Yau et al., 2009, Joseph, 2006) for building up software systems, innovative functionalities of e-portfolio service system could be developed in shorter time frame by mashing up available services, rather than developing everything from scratch. An most importantly, the useful services could be within or outside of the present system. This versatility keeps moving the e-portfolio service system forward to meet new requirements of emerging educational methodologies and circumstances.

4.2 Pervasiveness

Fundamentally, the restful e-portfolio services need to be accessed through basic HTTP methods. Consequently, the widely support of HTTP client makes it feasible to perform e-portfolio functions diversely and pervasively. This is a critical feature making the e-portfolio service system be adaptive to the ever-changing learning approaches and contexts.

Besides the pervasiveness, the simple application interface utilizing URI and HTTP methods also reduces work load of service provider significantly because of the lower time complexity of algorithms that are responsible for composing and decomposing large volume of messages between service clients and providers. Obviously, the simplicity of the restful e-portfolio service benefit users of mobile devices in particular due to the inferior computing power and communication bandwidth embedded within constrained space.

4.3 Accessibility

Many kinds of teaching, learning, and administrative works need seamless collaboration among multiple participants using e-portfolio services. For example, both assessment of a collaborative learning activity and nation-wide evaluation or comparison of students' achievements need to consolidate contents of e-portfolios that are owned by multiple institutes and located on different sites. Fortunately, the common and standardized interface of restful Web services make it easier to consolidate resources from multiple e-portfolio and/or other pedagogical services. Actually, it is straightforward to access resources from multiple service providers and integrate them directly within any type of HTTP client, including the application of AJAX technique in most Web browsers.

5. CONCLUSIONS

Electronic learning portfolio systems play a significant role in tracking learning activities and assessing learners' achievement, and have been widely adopted by many institutes to fulfill other purposes. To meet diverse pedagogic and administrative requirements, as well as adapt to ever-changing learning contexts, ideal electronic learning portfolio systems must be agile, versatile, and accessible. However, most currently-deployed e-portfolio systems that originally aimed to serve specific clients only, thus were built with monolithic and proprietary approach, which make these e-portfolio systems cannot meet the requirement of being agile, versatile, and accessible.

The present work proposed the concept of learning portfolio as a service, which actually is an extension of the generic software as a service (SaaS) concept. The most significant advantages brought to users by SaaS include the lower preparation and maintenance cost, and the fairer payment (pay-per-use) scheme. The restful styled embodiment of a SaaS is relatively favorable in terms of performance, comparing with its SOAP-based counterpart. The present work designed and implemented the proof-of-concept with restful style.

Looking into the future, the design patterns and experiences learned in this work could be applied to develop other online pedagogical services. Although the feasibility of a restful learning portfolio service has been confirmed, the widely acceptance of it needs further works on session management and security. For the sake of scalability, restful services supposed to be completely stateless. In other words, using widely accepted server-side session mechanism violates the constraints of the restful design. However, it is obvious that access control and session management mechanisms are vital to practical pedagogical services.

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