Design and Development of Distributed e-Education System Based on the Service Oriented Architecture

Parichat Pasatcha
Department of Computer Engineering
Mahanakorn University of Technology, Thailand
e-mail : parichat_noina@hotmail.com

Komrhon Sunat
Department of Computer Engineering
Mahanakorn University of Technology, Thailand
e-mail : komrhon_sunat@yahoo.com

Abstract

Large-scale distributed system, such as educational system, are difficult to develop due to their complex and decentralized nature. Service Oriented Architecture (SOA) is a new form of distributed software architecture. The Service Oriented Architecture facilitates the development of such systems by supporting modular design, application integration and interoperation, and software reuse. With open standards, such as XML, SOAP, WSDL and UDDI, the Service Oriented Architecture supports interoperability between services operating on different platforms and between applications implemented in different programming languages. In this paper, In this paper, we propose software architecture for design and develop for a distributed e-education system in the way of service oriented architecture. We will explain what this e-education system concerns, how it is developed, and what services it provides.

Keyword : *e-education system, Service Oriented Architecture, Web services, XML, Interoperability*

1. Introduction

Currently, World Wide Web is adopted in many areas, such as education, business, government and entertainment [1]. The education area, especially has developed the lessons and presented them on websites. The e-education services system is an instrument of which assists the learners to gain more knowledge by themselves and long to support distance learning. Active education employs a broad range of Internet technologies, such as personalization, simulation, and mobility, to achieve pedagogic scenarios otherwise inaccessible to traditional forms of learning. Thus, today's e-education services must deal with an increasing set of requirements. The demand for modularized and personalizable educational services is growing. But educational services traditional system can't support architectural flexibility due to their monolithic designs. Next generation e-education services will support a wider range of needs by providing interoperability architectures for various existing and emergent services. These needs include federated exchange among services (information and control), various levels of interoperability and service composition.

Several standards and technologies support the interoperability requirements for next generation educational services. Existing and emerging methodologies evolve around modularization and separation of concerns. This, in essence, means that functionality is divided into modules, which can then be combined to provide an integrated educational services. Service Oriented Architecture (SOA) describe an architectural concept that defines the expression of processes and logic as individual services, which in turn publish or expose facets of their functionality in a standardized way, letting other services access and use this functionality in a flexible manner. Hence, an SOA is simultaneously a model for hiding the complexity of distributed services from users and providing a framework for service providers—both characteristics of keen interest in educational circles.

In this paper we describe the design of a distributed e-education services system that uses an SOA as a model for deploying, discovering, integrating, implementing, managing, and invoking e-education service system. Such a model could help the educational area to develop cost efficient and dependable learning services.

The remainder of the paper is structured as follows. Section 2 present areas of education services system as well as Service-oriented architecture. Section 3 propose architecture of distributed e-education services system. Section 4 concludes the paper and suggests further research extension.

2. Services-Oriented Design

The e-education services system that we have developed is based on the Service Oriented Architecture (SOA) and uses Web Services.

Before designing and developing the service-oriented e-education, we have to decide that what technology is the best choice for implement the service-oriented e-education . After comparisons and considerations, XML web services is the best choice under our consideration because of some reasons as follows.

A. Services-Oriented Architecture

The Service Oriented Architecture reinforces basic software architecture principles such as abstraction, encapsulation, modularization and software reuse. It provides well defined interfaces for client applications and separates the interfaces from their implementations. It allows service capabilities and interfaces to be implemented as a collection processes. Each process itself provides a service, one that offers a particular capability. Because each process is exposed through a standard interface, the underlying implementation of the individual service is free to change without affecting how the service is consumed. The Service Oriented Architecture not only encompasses the services from a technology perspective, but also includes the policies and practices by which the services are provided and consumed. Security and privacy are particularly important issues for education. Personal information is confidential, so access to such information must be restricted to authenticated and authorized users. Secure transmission of such information must be complemented with secure storage of the data. The use of the Service Oriented Architecture is critical for enforcing such policies.

B. Web Service

Web service is a technology that has built to provide various types of services over a web. The main advantage of using a web service technology is cross platform communication. Recently (2005) there are two major competitor of web service technology in the market that is Microsoft and Sun. From implementation point of view both using common standards and protocols, such as Simple Object Access Protocol (SOAP), Extensible Markup Language (XML), Web Service Description Language (WSDL) and Universal Discovery Description & Integration (UDDI).

SOAP is an XML-based message exchange protocol that is used to communicate between web services and their clients. With the help of this lightweight protocol we can exchange structured information in a decentralized distributed environment easily. WSDL provides description of a web service. Each web service has WSDL file which is basically an XML file that describes a set of SOAP messages and how the messages are exchanged between web services and clients. UDDI is often called yellow pages of web services. A UDDI is a directory of web services that have XML files describes a business and the services it offers. We will use UDDI in our architecture to expose our educational services so other can take advantages from these services.

3. Propose Architecture

The e-education services of our architecture is based on service-oriented approach. Using web service technology we can provide educational contents in the form of different services such as learning object repository, digital library, LMS, virtual classrooms, virtual labs, authoring services etc. You can add as many as services by adding your web service layer.

Our e-education architecture has two parts; one is for client/devices and other is the education server. Both users are connected through internet with common sets of internet protocols such as HTTP, SOAP and XML.

A. Client/Devices

Various types of computer devices are present in the client that can use diverse platforms. On the other hand server-side uses a single platform that must communicate in this heterogeneous environment using internet standard-based protocols and give services in a scalable and robust manner. In Figure 1, the client-side contains diverse computing devices and platforms. Some users may use desktop PCs or other may use handheld and wireless devices to access learning services. In this case, we have suggested that JAVA™ language is appropriate to develop interface agent so it can be run on any computing device what ever its platform may be. We have categorized computing devices to make different versions of user agent for each category. The category of computing devices may be a desktop PC, PDA, tablet PC and mobile phone etc.

SOAP is used for communication between user agent and web service based agent. A user agent would query information from server-side agent on the basis of user profile and device profile. User profile tells about user age, area of study, interest etc. whereas device profile tells about processing power of computing device, memory, storage etc. User agent also has animation and speech characteristics to interact with the user and maintain user attention during learning.

B. Education Server

The education server of our e-education architecture is composed of several components that include web service, middleware, database, e-learning services and educational services. The main focus of our architecture is on web service that can make our architecture robust, scalable and interoperable. In this paper, we are using SOAP, XML and HTTP to communicate over a network. They can depict their functionality using WSDL just because these are based on web service. Clients are able to call our agents using standard based SOAP messages and take educational services. Here we introduce some important components associating with E-learning Service Bus such as: service provider, service requestor and service registry as follows:

Service Provider

A service provider makes the services of one organization available to others, and vice versa, in a controlled and secure manner. Although the intent of this component is different from the intent of the e-education service, which is to provide a service infrastructure within an organization such as virtual labs,

virtual classrooms, digital library and assessment manager.

Education Service Integration Center is a local SCORM compatible LMS and serves as a learning service broker which obtains the user requests from web client components and subsequently invokes the corresponding services to serve the user requests. This tier is made up of four principle services, namely, the LMS registration, user registration, user profile updating and content discovery services as described below:

(1) Education registration service enables other learning service providers in different remote LMSs to register their learning service information described by Web Service Description Language (WSDL) , such as, service creator, service names, service methods, location of service providers, and input/output parameters, etc. This service information is registered in the metadata-UDDI directory that are subsequently discovered and invoked according to the user requests.

(2) User registration service enables the new web client components register to the Learning Service Integration Center. The user registration service will log the user information (e.g., username, password, registry course, and learning status, etc.) into the user profile. In order to provide the maximal flexibility and loosely connection for users in accessing learning resources from anywhere, the user profile information can be exchanged with other user registration services of different learning service providers. This can be achieved with the help of Web service technology.

(3) User profile updating service is responsible for tracking of user activities and updating the user profile during the learning process.

(4) Content discovery service enables users to search for the required learning courses and search for the user information in the user profile, as well as the prerequisite courses such that the appropriate courses or LOs can be selected and provided to the users. In addition, the content discovery service needs to search for the corresponding service information from metadata-UDDI, as well as initiate SOAP messages for transmitting service request information to the target learning service providers. In the reverse direction, the content discovery service collects and integrates the SOAP response results obtained from each service providers and subsequently forwards to the users, where the presentation format is carried out at the upper web client tier. Upon the presentation of list of available learning courses or LOs, the web clients can register to a desired course locating on a distributed LMS by calling the learning registration service of the corresponding LMS service provider. This can be achieved with the help of service information in metadata-UDDI designs.

Service Requestor

The interface, binding, and service endpoint of a education service are defined in WSDL files. The Requestor can lookup or forward a request through the interface, binding, and service endpoint of a education service defined in WSDL files. The Requestor must support the WS-Inspection specification, and the service requesters can easily locate the WSDL documents of the Web services that are exposed by the Router. The users uses the UDDI registry to obtain WSDL interface definition and implementation definitions of the learning services in virtual organization. The service requesters will obtain the interface definition and implementation definition from the Requestor.

Service Registry

It provides a taxonomy and details of available services to systems that participate in an SOA. In order to perform routing of service interactions, the e-education service obviously requires at least basic routing information, which might be provided by an e-education service namespace registry, or by more simple means such as a service routing table. The role of the learning service directory is to provide details of services that are available to perform learning functions that are identified within a taxonomy. The learning service directory might be an open-standard UDDI directory and TH e-gif (Thailand e-Government Interoperability Framework), or more basic forms might be implemented as a design-time service catalogue, perhaps using collaboration technology. Such catalogues can achieve one of the primary goals of a learning service directory: to publish the availability of services and encourage their reuse across the development activity of an organization.

4. Conclusion and Future work

In this paper we describe the design of a distributed e-education services system that uses an SOA as a model for deploying, discovering, integrating, implementing, managing, and invoking e-education service system. Such a model could help the educational area to develop cost efficient and dependable learning services. Our architecture provides scalable environment where you can grow your services easily without interrupting the core architecture. You can add new educational web service and register your service using UDDI or other directory service. Maintainability of educational services is easier than before because educational services are divided with respect to category and functions. Agents are always flexible as they can move in a network to find information; our web service can communicate with other web services in a network using standard-based protocols such as SOAP.

Our research continues in the field of architecture implementation. Our purpose is to develop a prototype that allows the implementation of the architecture shown.

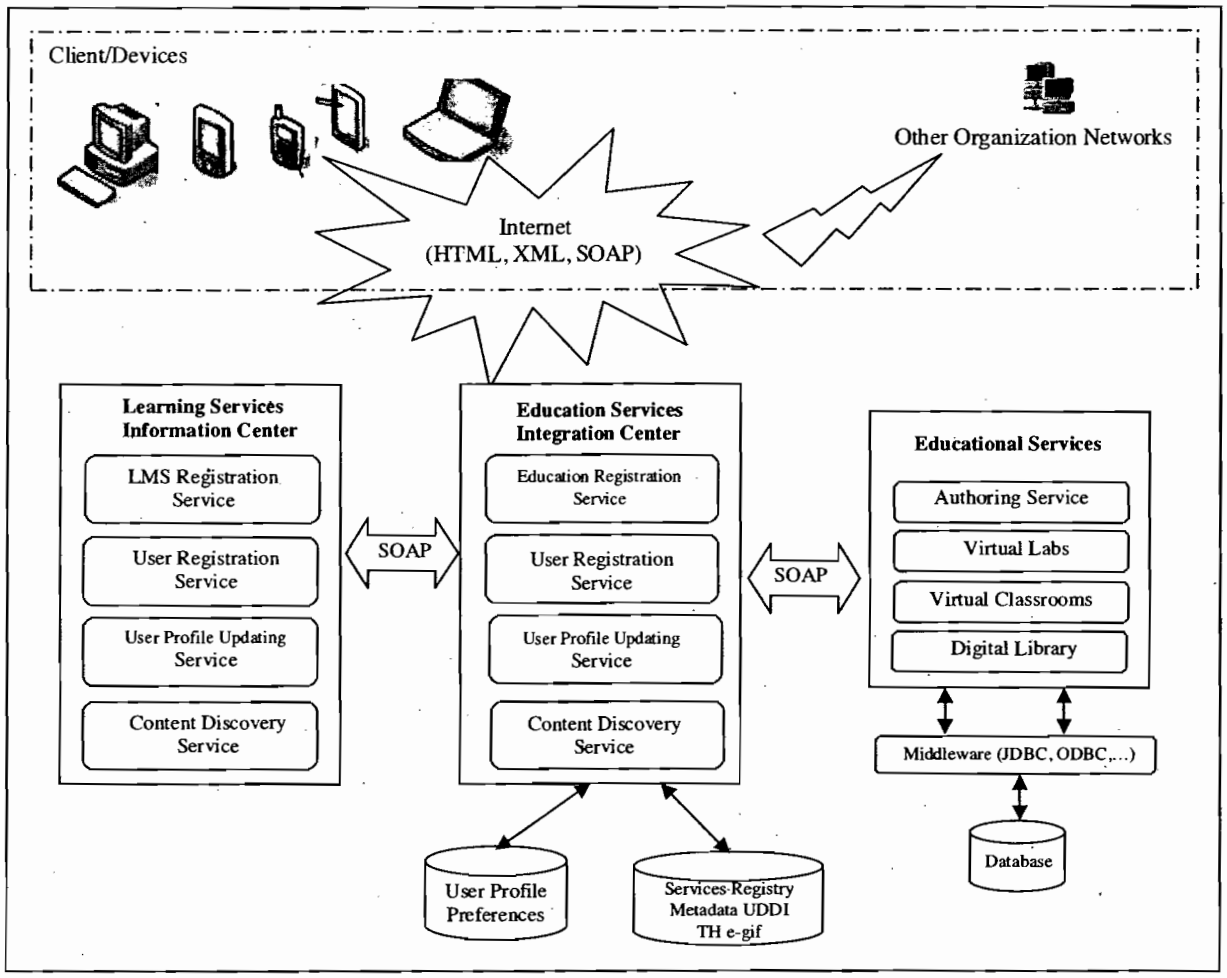

Figure 1. High-level view of e-education architecture

6. References

[1] Nakwichian, Supotchanee and Sunetnanta, Thanwadee, "User-Centric Web Quality Assessment Model", *In proceeding of the National Computer Science and Engineer Conference*, Burapha University, Chonburi, Thailand, 28–30 October 2003.

[2] Declan Dagger and Alexander O]Connor "Service-Oriented E-Learning P;atforms" IEEE Computer Society, 2007.

[3] Gottfried Vossen and Peter Westerkamp, "Towards the Next Generation of E-Learning Standards : SCORM for Service-Oriented Environments", *In proceeding of the Sixth International Conference on Adanced Learning Technologies (ICALT'06)*, 2006.

[4] Westerkamp, P., "Flexible Elearning Platforms: A Service-Oriented Approach", Ph.D. Dissertation, 2006, Logos Verlag Berlin, Germany.

[5] Hoel, T.; Campbell, L.; Arnaud, M.; Pawlowski, J., "A Service Oriented Approach to Learning in Europe - the need for a common framework." Position paper to the CEN/ISSS WS-LT, Oslo meeting of 24-25. January 2005.

[6] Z. Xu, Z. Yin, and A. E. Saddik, "A Web Services Oriented Framework for Dynamic E-Learning Systems," *Proceeding of the IEEE Canadian Conference on Electrical and Computer Engineering (CCECE 20003)*. Montreal, Canada, vol. 1, pp. 943-946, 4-7 May 2003.

[7] Ngamnij Arch-int and Chidchanok, "A Reference Architecture for interoperating existing e-Learning Systems using Metadata and Web Services Model," *Proceeding of the IEEE Canadian Conference on Computational Intelligence for Modelling, Control and Automation, and International Conference on Intelligent Agents, Web Technologies and Internet Commerce (CIMCA-IAWTIC'05)*, 2005.