Research on the E-Learning Application of Web Service *

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Abstract  This thesis introduces the e-learning system and Web Service technology. Then, it proposes how to apply Web Service technology to the e-learning system, and how to improve systematic flexibility and dependability. Finally it provides the basic framework of the system and a simple realization according to related specification.

Key words  e-learning;  Web Service;  learning object;  meta-data

The e-learning has attracted a popular attention as a kind of teaching mode. It links up teachers and learners at different places by offering study contents and intercommunications on the network.

Teacher and learner are the two main roles in E-learning. Teachers or other trainers produce their own contents of courses through certain tools and manage these contents by the learning management system (LMS), and then learner can choose and study. These contents of courses are transmitted between teachers and students. They usually are stored in a large-scale database, and can be revised and duplicated. The teacher, learner and contents of courses form three most basic parts in network teaching.

As a platform for common use, the e-learning is not customized for a particular user, but it can change according to users’ special demands in the form and appearance. In an e-learning system there are some different extents to be considered such as learning style, study schedule, study time because of learner’s habit, ability and goal. In this way learners are naturally divided into different kinds. As a perfect system, the e-learning must offer qualified content service for all users (most users at least).

The course contents in an e-learning system are usually shown as learning objects (LOs). LOs are basic units that can be studied, practiced and tested in a session. They are shown as the units stored in transmitting medium and can be reused. The typical LOs include contents of the multimedia, teaching goal, teaching software and tool, author, organization, etc. LOs can be exchanged between different LMS and put together to realize a special purpose. Meanwhile, LOs are context-free in the sense that they have to carry useful descriptive information of the type and context. For example, an LO based on schema can be used in software engineering, database management and data modeling.

With courseware and object increasing constantly, the object’s meta-data becomes a key factor, including LO’s name, the language, life cycle, edition, content and character bunch used for visiting this LO, etc. In order to offer simple and reusable study contents based on web, a lot of corresponding standards have been set now, such as Learning Object Meta-data (LOM) and Advanced Distributed Learning[1].

LOs always are stored in a database, with which objects are correlated, and divided into different sets according to attributes. Other related information about e-learning can be mapped as the structure of database, not only this make it possible to work in coordination, but also the processes that e-learning supports can interact with the underlying database. The e-learning is made up of various kinds of complicated behaviors. These behaviors can be modeled as processes and can be attributed to and associated with the various components of a learning platform.

If a process view is accepted as fundamental modeling and enactment paradigm, we can change this kind of study into web service offering content of courses.

1 Web Service’s Current Situation

We need to understand the knowledge of web services before we sum up the characteristics and components of e-learning as a set of web services.

Outwardly, a web service is an application program, and it exposes APIs that can be used through web to other functions. In other words, it is an online application that is published by enterprises to provide their commercial services. Users can visit and use this application service through the Internet. The web

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service is a software package, which has the one only the uniform resource identifier (URI) in essence [1]. The package can be operated through the network.

Generally, an e-learning system has three roles: service provider, UDDI and service users. The service provider supplies its service functions and responds to the requests of users; the UDDI registers and classifies the web services announced already, offers the searching services, and enables potential users to find the web services; the users utilize UDDI to look for and use the necessary services. The web service system must have at least one of these roles.

Clearly, the web services need to be interoperable. Moreover, they have to be independent of the operating system they are running on, they should be usable on every web service engine regardless of their programming language, and they should be able to interact with each other. There are some relevant standards of Web Service such as SOAP [1, 2] based on XML [3], UDDI, and WSDL, etc.

The UDDI catalogue keeps all meta-data and relevant information of web service, but does not keep service itself. These meta-data include author’s information, service type, technical specification, etc. The UDDI further defines a query language, an authoring authorization and a replication strategy. This ensures that a service can efficiently be found in response to a request that is answered by delivering information on how to use and call the service at the server of provider. The exchange norms of the customer and web service are defined in a WSDL file, which is a set of information obtained from the UDDI catalogue. The WSDL document is used to generate a proxy to communicate with the actual web service via SOAP messages.

Now the research and realization of web services are setting up in business application, for instance, B2B, B2C, etc. In future, the applications that have already established can be moved and served to web more and more.

2 System Design

An e-learning system consists of the content provider, the learner (or client) and the rules. We will discuss each part separately below.

In an e-learning system, all kinds of respects, characters and components are realized as web services. The system functions are separated into independent behaviors. They can be modeled as processes to provide as services. In this way, the initial functions are be made up by suitable reconfigured services. Fig.1 shows the sub-systems that we will discuss.

2.1 Provider Side

The providers of e-learning web services can be divided into different groups as individual services: authors who create LOs [1, 4, 5], authors who create courses or lessons composed of existing LOs, teachers or trainers who communicate with learners. The first step to create a learning material is to create the LOs that can be configured into classes and courses later. The author decides the important degree of different attributes in the content of a concrete LO according to the needs. The content of a LO can be set up through conceiving and channeling from other sources, even generate from other systems. So the author can choose the most suitable services for his content from different services. At the end of a content creation, the author should register the new content in a service directory, on the other hand; the LOs that have been created can be stored on any servers.

Fig.2 shows the process of a content creation. After the author has locally prepared what he wants to do, he can choose a service for the content creation by searching through a UDDI directory. This service may comprise a commercial authoring system. The authoring system calls the service that has found. The author can create the content using the chosen modules. He needs to register the new LO in the central directory and store the LO on a server when he finishes the creation of material. Then, the author can choose to create other LOs or do some other things. This process
can be divided into LO creation and LO publication.

![Diagram of process of creating a teaching object]

Other people who are not the content authors can do the classes and courses creations. They can combine the LOs into classes or courses. New classes and courses are also stored on a server and registered in the central directory as services.

Providers should offer some services to ensure the dependability of the behaviors, such as courses arrangement, user authorization, certification of classes for exams, or storage of user profiles. The tracking of a user during his work can be handled by corresponding services. A tracking service can be designed to check for the completions of assignments, the degrees that a learner has finished, etc. One important characteristic of these services is they are realized as web services.

### 2.2 User Side

Different learners visit and use one E-learning with different purposes and attitudes. A personal login ensures that a profile can be created for each user, in order to adapt the system to user’s preferences.

Usually a learner is linked to a course or a class. Learners search the contents catalogue and book LOs, classes or courses according to their needs. This search depends on several conditions, including personal conditions, meta-data, client software and hardware, age of material, authors or providers, etc. After they get the result that they need, learners can choose or book the contents that they want to use. If a learner does not want to book all contents of a course, he can combine several topics into his own course. Supposing the choice is a class, which is generally composed of several LOs. The LOs will be presented one after the other to the learner. The learner needs to study these objects one by one according to the order. Learners can find LOs that they need through the WSDL file with a simple description of web services. Web service looks for LOs that belong to a topic through the theme. The result collection that has been searched is a set of information includes authors, establishing dates, prices and content descriptions. Fig.3 shows a learner uses a basic course of system to study.

![Diagram of learning process]

In the use of LOs, the system determines whether a learner has already passed the test of this part. If a learner fails in test, system need to determine whether he needs to study one different but similar LO or he has to study and test the LO that he did not pass just now again. The choice of similar object finishes by a web service that bases on contents, demands and the learner’s personal situation. The platform only needs to choose the next LO of this course for the learner if he has passed the test of the LO.

Learners usually need to ask teachers or find some materials to solve the problems that they meet in learning process. The teachers’ help can through such as E-mail, broadcast information, network meeting, white board or BBS, etc. All these functions can also be included in the E-learning system as web services.

### 3 Prototype and Realization

We need to integrate different services to provide satisfying functions. From a technical perspective, complex web services consist of atomic ones that call each other by using the URI of a follow-up service when the service is needed. If a web service is not available at the moment of call, the entire process fails. We choose a dynamic form of service selection to avoid service failure. At this time, the service is not called directly as statically but requested a technical description of the service. System searches the UDDI directory by the description to find the proper service. System will provide the service if the service is
reachable. We use tModel to finish the task\cite{5}, which can be used in a UDDI environment both as a technical fingerprint of a service and as a name space identifier.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{fig4}
\caption{Dynamic services Call}
\end{figure}

Fig.4 show the dynamic call of the creation process, which is described in Fig.2. We divide the whole process into two parts to simplify the matter, the course creation and course publication. These two actions complete as basic web services. The UDDI uses the same tModels for services with the same semantics. As a result, services Authoring Content 1 and Authoring Content 2 are assigned to the same tModel Authoring. The web service building content is just called tModel Authoring, and the service platform calls the related web services to build up contents.

In the system, we follow Web Service standard and use the extensible markup language (XML) as the basic form showing the data. At the same time we use SOAP to transfer web services through standard RPC methods. SOAP messages transmit through POST method or M-POST method that HTTP protocol defines. Search result returns to client in a WSDL file when the service needed was found. Users can choose services that follow their need or request to use.

There are several similar results when users choose web services and LOs. System chooses the most suitable or reachable services or objects for users through dynamic services.

4 Conclusions

In this paper, we try to realize an e-learning system via Web Service. On one hand we want to overcome the disadvantage that some existing e-learning systems are difficult to transplant and put in other positions. Even it is because the applications based on web become a kind of trend on the other hand. This system utilizes the existing Web Service standards and combine the characteristics of the e-learning system to design the prototype, using XML language, SOAP protocol, WSDL file, UDDI, etc.

There is much work for us to do to completely realize the system, such as the tools that are used to create course contents, validation service, test service, interface realization, etc. How to raise the efficiency, optimize services among several servers are the works that we can launch on later stage.

References


Brief Introduction to Author(s)

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