

A model of teaching resources management platform based on XML and Web services

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ABSTRACT: A model of teaching resources management at universities is proposed in this article. Its ambition is to promote the effective use of digital teaching resources in universities and the elimination of duplication of resources. The model is based on XML and Web services, and is designed to carry out services for teaching resources and protecting the resources' property rights at universities. XML is used to describe the data required in the process of resource management, in order to solve the problem of commonality and extensibility of data in resource description. The use of Web services interface in the form of resource management platform achieves a number of public functions, in order to ensure the sharing of data and services between the resources and other platforms.

INTRODUCTION

As information technology applications in the field of education develop, a large number of teaching resources in universities, including high-quality courseware prepared by teachers or teaching media libraries and software at various faculties, are generated and scattered on the teacher's PC or on faculty servers. Unfortunately, this teaching resource utilisation is low [1].

Not only is implementing a large platform with commercial resources highly expensive, but due to the protection of commercial interests, it is difficult to achieve resource sharing between other universities and colleges, thus limiting the large platform's application to one place. In view of the need to use digital teaching resources in universities effectively and to eliminate duplication in the resources, and also to carry out the relevant teaching resources services, while protecting the copyright, it is necessary to design and develop a set of open platform teaching resources [2]. By finding the appropriate balance between often contradictory intellectual property rights and resource sharing, the platform should enable effortless management of resources, make them available for teaching and offer services to the user or support an application that would authorise the right to use.

DESIGN OF FUNCTION

Integration and Convergence of Teaching Resources

Information integration is the merging of information from heterogeneous sources with differing conceptual, contextual and typographical representations. Open management platforms for teaching resources are designed to integrate and collect digital learning resources originating from university units at present or in the future, on the condition that digital resources' rights protection are respected and applied to all kinds of often valuable educational resources that need to be reorganised and filed in the university central database for optimal usage.

With technical assistance to process and integrate the resources, as well as strategy to ensure quality in selection and evaluation, the central resource database will grow quickly and sustainably. Also, a resource data centre of teaching programmes needs to be formed at universities to allow data integration and sharing between educational administrative units or a commercial teaching resource library.

Data Service of Teaching Resources

The value of teaching resources is reflected in their use. The resource platform provides access to services within the platform to authorised users or other learning management systems, such as Blackboard, in the form of Web services [3].

Due to differences in format and size, various qualities, diverse ownership and other issues, it is unrealistic to expect that all teaching resources in a given university will be integrated and stored in the teaching resources data centre at that university.

This article focuses on platforms operating on open service principles for managing resources, whose provider has the right to determine authorisation and access to the data resources centre and decides on the scope, objectives and the way to use the resources. Deciding on the appropriate resource assessment policy is crucial to ensure the quality of resources, their proper integration and promotion for teaching and learning.

Resource Assessment

In resource evaluation, based on a particular strategy, several quality measures need to be considered, including metadata standardisation, resources (software) quality, resource applicability, usage statistics (i.e. number of visits or access to resources).

THE TECHNICAL ROUTE AND KEY TECHNOLOGIES

Microsoft .NET and SQL Server

The Microsoft Windows platform provides a powerful graphical interface and numerous multimedia functions, like free integrated bundled Windows media technology (WMT) and others, which form the current mainstream of the operating system platforms used in Chinese universities. .NET, as the third-generation network platform developed by Microsoft, introduced the new .NET framework on the platform and executes the application through a consistent common language runtime (CLR). The .NET platform stimulates the development mode, reducing a lot of work for programmers, including repeat code, systems maintenance and other aspects [4].

For example, data exchange and message transfer mechanisms based on XML and SOAP and combined with Web services technology, can provide information services across platforms; another example, with the help of access interface of SQL server available internally and the optimised SQL server database: system.data.sqlclient being provided via ADO.NET, programmers can easily carry out operations in the SQL operation server database. Therefore, considering the practices and ease of development, the author of this articles has chosen Microsoft Windows and .NET as the technical line for the resource management platform.

Web Services and XML

The term *Web services* describes a standardised way of integrating Web-based applications using XML (extensible markup language), SOAP (simple object access protocol), WSDL (Web services description language) and UDDI (universal description, discovery and integration) open standards over an Internet protocol backbone. Web services technology has been a new software development model that emerged in recent years, and it is growing strongly based on the object-oriented and component-oriented programming model. Based on innovation, schema, contract and policy, the novel open platform could provide a standard for software module production and exchange. Web services technology aims to fully utilise the capabilities of data access and exchange between different platforms and applications.

The advantages of Web services technology, when implementing the platform of teaching resources management, compared with the traditional B/S Web resource site are as follows [5]:

First, Web services have flexible interoperability. Through the SOAP protocol, any Web services can interact with other Web services on-line. SOAP has been widely adopted by industries as a new standard protocol as it allows problems of converting protocols between different platforms to be avoided, and developers can produce and use Web services when carrying out Web services without changing the existing development environment.

Second, the communications infrastructure of Web services - HTTP and XML is easy to understand and universally applicable in the current Internet environment with the strong usability and popularity [5].

In addition, industry seems to favour and support Web services. Currently, Web services technology has basic support from Sun, IBM, Microsoft and other large companies. Developers can easily build Web services systems and deploy Web platform, realising mutual access between platforms.

The users (application) exist in the form of three roles: resource providers, resource users and resource service agents in the Web services' resources system, in which releasing management and use of resources between them is supported by WSDL and UDDI, and providing cross-platform resource services is based on the agent.

WSDL is an XML format for describing network services based on a standard messaging layer, such as SOAP. Figure 1 explains how to use the service model of teaching resources.

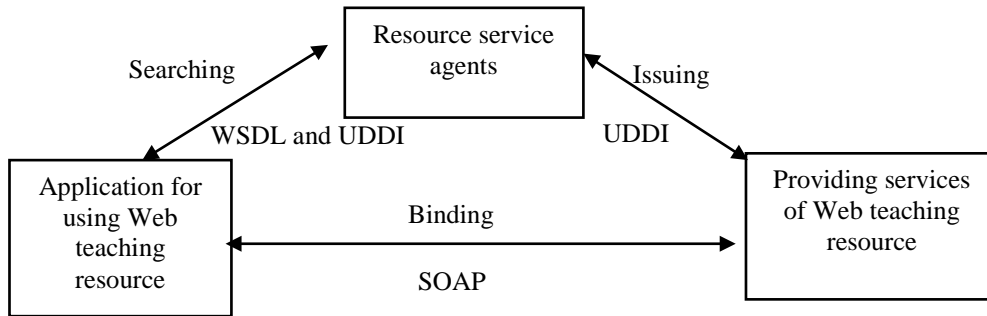


Figure 1: Resource service model based on Web services.

Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format which is both human-readable and machine-readable. It is defined by the W3C's XML 1.0 Specification and by several other related specifications, all of which are free open standards [6].

XML is the basis of the whole Web services system. XML is a language recommended by the World Wide Web Consortium (W3C) that represents data in the Web and provides a way to show complex information. Moreover, it allows developers to customise the vocabulary, thus the language describes the contents of nested nodes relying on the definition. In the end, the XML data stream can be perfectly combined with SOAP news, which is especially appropriate for Web data transmission. The following example is an XML file describing an example of teaching resources:

```

<?XML version="1.0"?>
<!--note: XML describing resource information in the teaching resource platform-->
<Resource>
  <Category>
    <CateName>science&engineering</CateName>
    <SubCategory>
      <SubCateName>computer sience</SubCatename>
      <Curricula >data structure</Curricula >
    </SubCategory>
  </Category>
  <Type>Video</Type>
  <Size>83,466,649</Size>
  <Url>ftp://csu.edu.cn/ResourceCenter/LG/CS/Datastruc
t/Video</Url>
  <Author>Weimin Yan</Author >
  <Publisher>Tsinghua University</Publisher>
  <!--Description of other resources attributes -->
</Resource>

```

In the XML file, the data fields are hierarchically nested. When using a field, the XML data reader comes through the XML tree hierarchy node. Then, it finds the node information to meet the requirements. As the above example demonstrates, the URL position of teaching resources represents a clear indication in node<Url>.... </Url>.

Resource Storage

Resource files usually are stored in two ways: one is stored in a database and the other one is stored in a computer file system. Database retrieval is convenient and easy to manage. Furthermore, its security is relatively high, especially for structured data types. In regard to semi-structured or unstructured documents of teaching resources, the resource entities are transferred into binary data information and, then, stored in the database. When the resource file stored in the database need be searched, the library binary data will be restored to the original file format. The system takes a lot of time to respond. Moreover, its resource ingestion is high. Another way of storing resources is to put the resource file to a computer file system and to place its URL in the database. Querying and managing resources could be achieved through URL resources in the database, in which way it is easy to carry out and ingest system resources slowly. However, security is relatively poor compared with the former. The user may directly access the teaching resources of the file system with the help of obtaining the resource's URL. In the resource management module, it could also happen that the URL database resource is not synchronised with the file system resources [7].

Taking into account these factors, the author used a combination of the database and the file system to achieve the storage of resources. The properties of the resource files and structured data storage like URL location are placed in the database, while the resource entity is stored in the file system. .NET Web services technology has the function to

provide services for resource access in the file system, and securing resources with directory permission management and other methods.

Resource Security Assurance

Interaction within as well as across enterprises must be secured to prevent security attacks of all types, and non-repudiation must be provided for reliable record keeping [8][9]. Setting up security is necessary to ensure the efficiency, convenience and safety for users to access the services of teaching resources. It is also necessary to ensure that the resources are archived in institutional repositories in universities. On the other hand, it is crucial that the outcomes of academic work in the form of teaching resources are protected along with the intellectual property rights of their owners. Considering this, the author utilised the hierarchical user model with the role-based arrangement, in which the resource provider can refer to resource management.

For example, providers who offer a particular resource decide the use tactics for the resource, such as whether the data can be copied to the university resource centre. Another example is that the provider has the right to determine user access to the resource and the scope of IP. The agent model of service access to resources is employed in the whole resource access system. After Web services recognise the access permission of a certain resource according to the user-role (application-role) management model, the XML description and access permission of resources will be sent to the users or application.

SYSTEM DESIGN

The system uses three-layer B/S as the main way to store resources. All resource entities will be stored in the resource data system or file system of the resource that the provider offered. The resource attribute description (including the resource type, author, applicable disciplines, etc) has to correspond to the resources already stored in the repository. In order to ensure synchronisation between resource information, resource entities and access security, management and access to all resources are realised by agent access to the resources on Web B/S services. High-usage resources are stored in the system cache to improve the overall system performance.

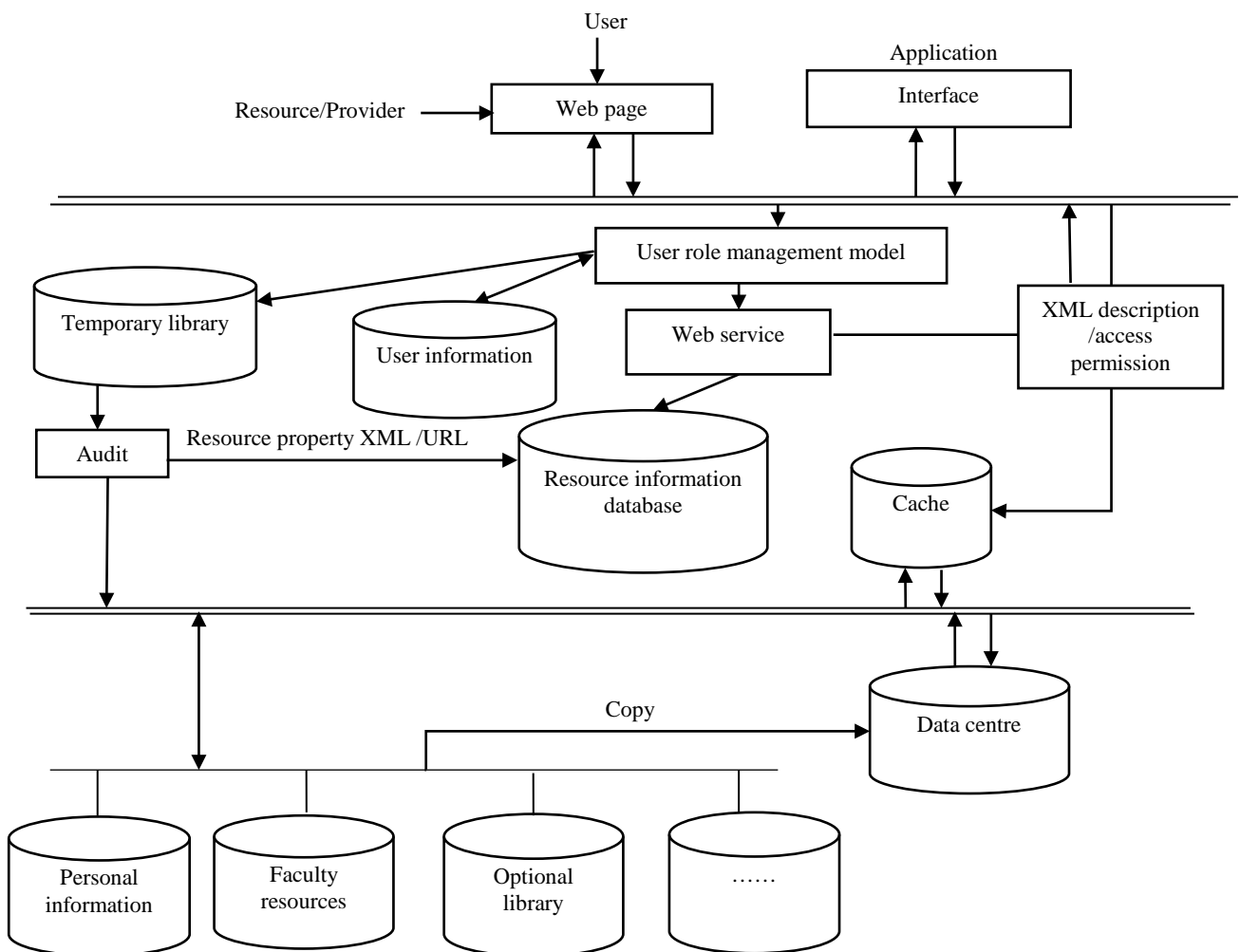


Figure 2: Resource management platform structure.

CONCLUSIONS

This article outlines the current situation in digital teaching resources management in Chinese universities. In the context of the situation, the author proposes an open management model of teaching resources constructed under the Microsoft .NET platform based on XML and Web services technology. Finally, a roadmap for the system and key implementation technologies are analysed and the structural design of the system is established; thus, making this article a reference for digital resource management for universities in China.

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