**ABSTRACT**

In this paper, the authors describe X-System, a general digital library platform which is capable of handling large-scale digital contents with flexible, extensible management features. The development of X-System achieves several important goals of modern digital library systems, including fully functional system, neutral and portable architecture, stackable modules, data exchange, and universal access. Several open source digital library systems are selected as a comparison of platform features. The model and architecture of X-System are also discussed in this paper. Moreover, several extension case studies of X-System are demonstrated to show the extensibility of their system. In addition to act as a basic digital archive/library system, the X-System has been adopted as various different usages, including E-learning platform, knowledge management platform, library circulation system, and embedded metadata framework.

**Keywords:** Content Management, Digital Library, Embedded Metadata, Handle System, Stackable Service

**INTRODUCTION**

Advances in computer network and storage technologies have inspired the design of digital libraries in recent years. The emergence of digital libraries has introduced a number of important issues (Chen, Chen, Chen & Hsiang, 2002; Chen, Chen, Chen, 2001; Dempsey & Winkler, n.d.). One issue that has not attracted much attention but is essential to digital library development is the flexible design of digital library systems. After the construction of a digital library, it is natural for the digital library to push the content circulation and application as much as possible in order to show its maximum effect. Based on this point of view, it is...
important to design an architecture to support flexible contents management and fast service development. For flexible contents management aspect, it is known that if a closed data storage system is adopted, the circulation of digital library contents decreases. So the data model and storage with high portability is necessary for easy data access and manipulation. For fast service development aspect, it is more competitive for a system architecture with stackable service feature to develop digital library services according to different information needs. If a digital library system meets the requirements of both flexible contents management and fast service development, it is more likely to create many kinds of information service based on it. In this chapter, we introduce X-System (Yeh & Chen, 2003), a general digital library platform which is capable of handling large-scale digital contents with flexible, extensible management features.

DESIGN ISSUES OF DIGITAL LIBRARY SYSTEMS

As mentioned earlier, the most important features of a modern digital library system are flexibility and generality. Since 2003, the year of X-System’s announcement, several extensions and applications have been developed and deployed. The aim of our research team is to create a powerful digital library system which meets the following important design issues:

1. **Fully-Functional Digital Library System**: The design of X-System aims at handling multiple metadata formats which meets the needs of various digital content applications. For example, digital archive systems, knowledge management systems, and e-learning systems all require various kinds of metadata co-existent in a repository system. So the ability of handling various metadata formats becomes a fundamental need of digital library systems. This is also one of the basic features of function design in X-System.

2. **Platform-Neutral, Fully Portable System Architecture**: The development of X-System is totally based on platform-independent technologies, including Java programming language, Java application servers, XML data presentation, XSL/XPath data transformation, and so on. Also we use a Java-based, native XML database server as the metadata storage, which means the whole system is fully portable. Currently the X-System has many deployment experiences, including Windows-based systems, Linux-based systems, and Solaris-based systems. Any platform which supports Java virtual machine will run our system.

3. **Stackable Information Service Modules**: In addition to the modular and object-oriented design concepts, the X-System introduces the layered function design concept, which makes services of X-System stackable. Any newly extended service may use basic services (we call them “upper-layer services”) provided by the system, and the extended services will also be usable by future extended services. The layered architecture makes X-System very extensible, and there will be several extension case studies of X-System demonstrated in the later section.

4. **Portable Data Exchange**: The XML data flow between service modules is a basic design of the X-System. In the layered architecture of X-System, the data between services is XML-encapsulated, and the data rendering to end users is also XML-based, plus XSL transformation as the way of HTML rendering. This feature makes data exchange very easy to be customized for user needs. Also the extension of any X-System service is easy since the XML-based data semantics is all a service programmer should know.

5. **Universal Data Access**: X-System is a web-based digital library system, so the data accessibility is a major concern of the system design. We introduce the handle system, which behaves similar to CNRI
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