▼ Journal of Research (Science), Bahauddin Zakariya University, Multan, Pakistan.
Vol. 17, No. 2, April 2006, pp. 97-102 ISSN 1021-1012

DEVELOPMENT OF DIGITAL LIBRARY FOR WEB BASED EDUCATION

Fawad Baig
Qauid-e-Azam Institute of Computer Sciences,
3-Shara-e-Aiwan-e-Tijart, Lahore.
email: fawadbaig123@yahoo.com

Abstract
Digital Library is an electronic information storage system to fulfill the pedagogical requirements of distance learners in web based education. The basic components of digital library are Learning modules, Metadata or cue cards and Users' profiles. Development of digital library includes following phases**:** Identification of Requirements and Funding, Hiring of Better Human Resource, Hardware Installment, Development of Learning Modules, Storage of Components, Interface Development and Security Issues.

Keywords: Digital library, Web based education, Learning modules, Metadata, Users' profiles.

INTRODUCTION
Knowledge management is the key area to promote knowledge economy through energetic and fast resources to maximize learning. In this regard digital libraries are playing a vital role. "A Digital Library is an electronic information storage system focused on meeting the information seeking needs of its users" [Suleman 2002]. The basic functionalities of any Digital Library are quite similar to that of traditional libraries. Books and other resources, as in a traditional library, are collected and after cataloging, are finally made available to its patrons. However the similarities end there. To support such activities, the architecture of digital libraries is quite different from those of traditional libraries. The brick-and-mortar buildings are replaced with databases, content servers and web-portals, etc. The common element among them is their ability to provide knowledge or education.
Usually, electronic educational systems are built for those students who are adult or busy in their businesses and jobs. Such types of students have not enough time to go to public or private libraries. Similarly, many e-learners are living in remote areas far away from big cities where better educational resources are not easily available. But, such types of students require same educational material like journals, magazines and books, which are in the access of students studying in the class room based environment. In Digital Library all such type of material is available in digital format through internet to fulfill the pedagogical requirements of distance learners.
Some examples of Digital Library systems are: Computer Science Teaching Center [Grissom *et al***.** 1998], Computing and Information Technology Interactive

Digital Educational Library [Fox *et al*. 2002], Los Alamos e-Print archive [Halper 2000], The American Memory Project [Library of Congress 2001] and The National Science, Technology, Engineering, and Mathematics Education Digital Library [Zia 2002].

BASIC COMPONENTS OF DIGITAL LIBRARY

Leaving the technical aspects, if we only focus on the basic structure then there are three major components of Digital Library.

LEARNING MODULES IN ELECTRONIC FORM

Learning modules can be electronic books, exercises, lessons, lectures and tutorials etc. Since the Digital Library exists in the virtual medium, the learning modules are maintained in digital format. In almost all the fields of arts, sciences, engineering, technology and others, the knowledge providing contents that come in varying sizes and formats can be presented as text, graphics, animated graphics, audio, video, or a combination of these.

METADATA

In a traditional library, the cue cards hold information about a book in order for easy discovery and locating. Moreover the cue cards in themselves are arranged in some intuitive order for convenience of browsing and subsequent retrieval. Its electronic counterpart – the metadata, performs a similar function in Digital Libraries. Metadata is data about data [Adriaans and Zantinge 1996] that holds information to assist a user in quickly locating the learning modules of interest. A limited list of metadata elements of interest to any audience is given in Table 1. The first row of metadata is related to “ownership” or “copyright” aspect of the information. This is generic information like the author(s)’s or publisher’s name, affiliations and contact information. Besides providing copyright value, this kind of data can also be used to identify the content.

Table 1: Metadata Elements for Cataloging

Category	Metadata Element
Information about the Contributor	• Author Name • Email Address • Department • Organization
Basic Metadata	• Title • Language • Description • Keywords • Date of Creation • Format • Classification

More common identifiers of information are “title”, “description”, “classification” and related items as listed in the second row of the table. Since the content in a digital library can be of various forms, the “format” metadata element is further useful to identify the relevant learning modules for the user. The accuracy and richness of this kind of data is highly valued as it is the most commonly sort

identifier used by the patrons to browse or select content for further investigation. Since each learning module has a "cue card" associated with it, one of the simplest ways to arrange and catalog the cards is through the classification element. "Classification" element utilizes the fact that different disciplines of study can be divided into many subject areas, which can be further branched into associated sub-topics. In a digital library users may browse through their specific areas of interest, to see a comprehensive set of learning material available in those sub-topics. Additionally, "keywords" and mixed phrases can also be used to seek and isolate the content of interest. The information within the metadata reflects on the quality of the resources and hence the credibility of the library. It is hence a very essential component within a Digital Library.

USERS' PROFILES

Besides Metadata, the profile of the library subscriber is another essential component of indexing. In a traditional library, this helps in tasks of checking the books issued, renewed or overdue with the patron. Hence, the user profile can be used to store additional information like the correlation between the various types of "books" downloaded, track knowledge (if any) gained via these modules, inform or initiate actions based upon user's history, maintain security and privacy, etc. In a commercial setting, they can be further used for billing such as pay-per-use or to track royalty for authors etc. Thus, in Digital Libraries, the user's profile or "library card" is far more critical and central in providing a "learner-centric" pedagogy.

DEVELOPMENT OF DIGITAL LIBRARY

Developing a Digital Library may become a quite expensive process. However, there are some general development phases which can be followed to develop a better digital library.

IDENTIFICATION OF REQUIREMENTS AND FUNDING

First the aims and objectives of Digital Library should be made clear that "what information the library will contain, how that information will be generated, what audience the information is intended for, and how the data will be accessed" [Richvalsky and Watkins 1998]. Then high level requirements are identified at the base of such goals in which financial requirements are also included related to hardware, software and hiring of employees etc. Full picture should be clear that what we have to do and what are the strengths and weaknesses we have. Sometimes we have to work from scratch, and sometimes we have readymade digital contents and sufficient hardware so in this situation, less working and funding are required.

HIRING OF BETTER HUMAN RESOURCE

Skilled professionals are always the key players in all type of projects. In this case the team should include experts of library science and computer science. Where librarians can perform work related to cataloging and indexing etc. They should also be familiar with current information regarding users or students. Computer experts are concerned with technology [McCray and Gallagher 2001]. For example, development and maintenance of system which is comprised of

database, website and networks etc. Higher management should care about financial issues and team management. They are also responsible for staff training to deal with emerging technologies [Creth 1996].

HARDWARE INSTALLMENT

High speed web servers with high speed internet connection are basic requirements to give better access of Digital Library to its users. Storage devices with better capacity are also required for both storage and backup purposes. Within the educational institute or research organization, network based access can also be given to the users to enhance searching or downloading speed with the help of coaxial cables or fiber-optic.

DEVELOPMENT OF LEARNING MODULES

We have already mentioned before that Learning Modules include: Books, Journals and learning materials in text or video formats. Their development is the major process. If we keep some points in our mind during the electronic publishing of these modules then we can preserve ourselves from so many ambiguities and hard working. For example, if the video material is saved in only one or two formats then same number of software will be required to watch them. Otherwise, we have to purchase so many softwares to maintain them. On the other side, student will also gain same benefit.

Standardization may also become beneficial for us, for example, if we save images or text files in standard file formats, such as TIFF and open ASCII or Unicode simultaneously, then these images or files will be easily accessible in future than those files saved in non-standard formats. Standardization also helps to port our system to other plate form [McCray and Gallagher 2001]. If we want to change our operating system, and our files are not saved in standard file formats then it would be very difficult for us to do so.

Sometimes, material of one particular type is available on other Digital Libraries. Through collaboration with them, we can use their already being published material. Some libraries also offer their technical or human resources in the development of libraries [Creth 1996]. In this way, not only we can save our time but funding as well.

STORAGE OF COMPONENTS

After development of learning modules, it is needed to save information regarding such modules or metadata and profiles of users for which different databases are available, for example, Oracle, MSQL and Microsoft Access. Similarly, instead of using a database, we can also create our own special directory and file structure [Richvalsky and Watkins 1998]. Anyhow, selection of database is based upon needs and financial situation. If any body needs more security in the system then Oracle is suitable but its package is quite expensive. Microsoft databases are comparatively less expensive but lack in security. Moreover, MS Access has less capability to store huge amount of data as compare to Oracle. Along with these, such databases are also available which are totally free to host on the web like My SQL.

INTERFACE DEVELOPMENT

Interface of the web based Digital Library should be attractive because so many websites become famous just because of their beautiful interfaces. Catalog along with detailed search options can be beneficial for searching something within the library. Links of useful educational websites and other Digital Libraries about particular topics can also be given there. If you have added some thing new to your library then announcement banner may be good to inform users. Similarly, personalization option which is more student intensive, can also be provided to allow the user to design the website according to his/her own needs. Search engine can be another feature, but the development of search engine is just like to develop another project, so any other free search engine can be added to interface.

SECURITY ISSUES

If we want to allow only those users or students to access the digitized contents that have the membership of the library then we need a proper registration system. Similarly, if we want to make the whole digital library secure then safety measures should be taken. Firewall can be installed to protect the digital library because firewall has capability to examine and filter all information entering or leaving the system to ensure its appropriateness. It helps to confirm that information received from an outside source does not contain viruses.

CONCLUSIONS

Digital Libraries are just like a pool of educational material, so we can not keep our distant learners deprived from this facility. In comparison with physically existing libraries, it is very easy to find educational material from such libraries by just writing some words related to our topic of interest, any time and from any where in the world. The development of such libraries is related to conversion of material into digital format and then maintenance of the whole system, but no need to buy a lot of land and then construct huge building for that. However, still there is a need to think that how we can reduce overall cost.

References

Adriaans, P. and Zantinge, D. (**1996**) “Data Mining”, Addison Wesley Longman Limited, Harlow, England.

Creth, S.D. (**1996**) “The Electronic Library**:** Slouching Toward the Future or Creating a New Information Environment”, *Follett Lecture Series*, Retrieved December 13, 2004, from http://www.ukoln.ac.uk/services/papers/follett/creth/paper.html.

Fox, E.A., Suleman, H. and Luo, M. (**2002**) “Building Digital Libraries Made Easy: Toward Open Digital Libraries”, *Proceedings of 5th International Conference on Asian Digital Libraries,* December 11-14, Singapore, 14-24.

Grissom, S., Knox, D., Copperman, E., Dann, W., Goldweber, M., Hartman, J., Kuittinen, M., Mutchler, D. and Parlante, N. (**1998**) “Developing a digital library of computer science teaching resources”, *ACM SIGCUE Outlook*, **26** (4), 1 - 13.

Halper, J.Y. (**2000**) “CoRR: a computing research repository”, *ACM Journal of Computer Documentation (JCD)*, **24** (2), 41-48.

Library of Congress (**2001**) “Five Million Items Online: National Digital Library program reaches goal”, *Library of Congress Information Bulletin*, **60** (1), 3.

Mahadevan, S. (**2002**) “A Learning Object Model for Electronic Learning”, M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA.

McCray, A.T. and Gallagher, M.E. (**2001**) “Principles for digital library development”, *Communications of the ACM*, **44** (5), 48-54.

Richvalsky, J. and Watkins, D. (**1998**) “Design and Implementation of a Digital Library”, *ACM Crossroads*, **5** (2), 15–19.

Suleman, H. (**2002**) “Open Digital Libraries”, Ph.D. Dissertation, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA.

Zia, L.L. (**2002**) “The NSF National Science, Mathematics, Engineering and Technology Education Digital Library (NSDL) Program: New Projects in Fiscal Year 2002”, *D-Lib Magazine*, **8** (11). Retrieved December 13, 2004, from http://www.dlib.org/dlib/november02/zia/11zia.htm