

REVIEW PAPER

Web Interface in Library Management Software Systems

Shailendra K. and Namrata Rai

University of Delhi, Delhi-110 007

E-mail: shail3@yahoo.com; namrtarai@gmail.com

ABSTRACT

Though a variety of softwares are available in software market, but only few of these are fully compatible with Web. This is a review of the research on library automation software and their compatibility with the recent advancement of Web as an interface used for accessing the software in www environment. It also focuses on the growth and development of library automation software way back to their origin. It also discussed standards, both in terms of library and Web technology. Finally, the topic on Web interface used in library management software system (LMSs) is covered including the technological implication, Web-based technical services, security issue, database used and evaluation of LMSs.

Keywords: Library automation, software, Web, standards, databases, networking architecture

1. INTRODUCTION

The advent of Internet literally opened up a plethora of opportunities for the library professionals, who reacted by seeking to leverage the Web to enable better delivery services to their clients. For libraries, the Web is one of the several networked-based systems to be pressed into service at the same time as the Internet was changing the rules for widespread communications¹.

During 1994, libraries began to show their presence on the Internet setting up their websites. Now Web has become a dynamic platform for information delivery over the Internet and very useful for libraries to provide various types of information. Library management softwares came into existence in all parts of the world, from mid 1970s. These may be broadly divided into four different generations.

Library management softwares of the 'first generation' were 'module-based' with no or very little integration between various modules. Circulation module and cataloguing module were the priority issues for these systems and were developed to run on specific hardware platforms and proprietary operation systems.

The 'second generation' of library management softwares became portable between various platforms with the introduction of UNIX and DOS-based systems. The LMS of this generation offered links between

systems for specific functions and were command-driven or menu-driven systems.

The 'third generation' of LMS were fully integrated library systems based upon relational databases structures. These embodied a range of standards which were a significant step to an open system interconnection (OSI). Colours and graphic user interface (GUI) features such as windows icons, menus, and direct manipulation became standards and norms in this generation of LMS.

The 'fourth generation' of library management softwares are fully Web-centric architecture and facilitate access to other server-over the Internet. These systems allow accessing multiple sources from one multimedia interface². In this paper, a review of the research on the Web interface in LMS system is reported with the aim of identifying the development, standards, technological implication, etc.

2. GROWTH AND DEVELOPMENT OF LIBRARY MANAGEMENT SOFTWARE SYSTEMS

After a long period of gestation, the libraries in India are now in a take-off stage of automation and modernisation. Financial and technical inabilities are the major issues these have to tackle during modernisation.

Though funding appears as the biggest problem faced by the libraries in India, the technical issues of manpower training, procurement of hardware and software, creation and maintenance of databases, etc., also raises serious hindrances in the way of automation. But despite all these hurdles, the growth of library automation softwares in India is increasing day-by-day.

Seneviratne and Amaraweera³ gave the outlines of the historical background about the use of software for library automation, particularly in Srilanka with special reference on the use of CDS/ISIS. They also described the implementation of a prototype low-cost Web-based library automation system. Ebenezer⁴ explained the development of integrated library systems (ILSs) and also identified and evaluated the significant trend in LMSs in relation to library services. Assimilation of Web-based technology in library automation software made the drastic change in earlier module-based ILSs. In Web environment, the scenario is totally changed and all ILS are driven by Internet. The paper also includes the Application Services Provider (APS) and how it subscribes the Internet services in the software. Haravu⁵ described the growth and development of LMSs in libraries for performing various library operations. Library automation was in its infancy during 1954-70. First half of the period saw a trend towards the application designed primarily for the benefits of users. The second half saw a trend towards the applications that used computer for performance of library routine tasks.

The period of 1970-90 is known as the adolescence of library automation. The first phase of automation had helped in the development of technical specification, requirements analysis, and functionalities desired from automated library system. The opening up of the Internet in the late 1980s was responsible for the development of protocols, software and hardware. The standards, which makeup the World Wide Web (WWW), added completely new dimensions to the information world. Now libraries prefer to use fully Web-compatible library software in which all functionalities are based on Web. Mukhopadhyay⁶ gave a different perspective about the development of LMSs. Over the years, open source software solutions for library management have emerged as a viable alternative to commercial close product. The paper discusses the open source and Web-compatible software KOHA and its distinct features.

Bailey⁷ discussed the operational definition of 'Web-hosted software' and 'Browser-based Software' and software applications hosted on a Web server instead of PC or within the organisation. This kind of developments gives emphasis to the third party suppliers like APS. This paper examined the pros and cons for small institutes, e.g., charities of engaging application service providers to Web host their online catalogue. It explains how this form

of outsourcing works and offers lower cost, maintenance and better performance, subscription pricing, data ownership, and interoperability. Haravu⁸ discussed the evolution of library management systems (LMS) and how changes in technology, information environment, user expectations and searching behaviours, competition from related application streams, and the availability of enterprise wide systems particularly in academic and research environments have influenced changes in LMS functionality and design. The drawbacks of current LMS offerings, both commercial and open source, are then described followed by a description of major new initiatives that have taken place in the last two or three years leading to new ways of freeing the LMS from its monolithic nature into one which supports new workflows via services-oriented architectures (SOA) and Web services. These initiatives, particularly that of the OLE Project, eXtensible catalogue, the recommendations of the Digital Library Foundation (DLF) and National Information Standards Organisation (NISO), and the recent proposal of OCLC to move LMS into a Web-spaced platform using cloud computing paradigms have also been discussed. Koneru⁹, Shafique and Mahmood¹⁰, Moorthy¹¹, Lynch¹², and Breeding¹³ have discussed about the growth and development of library automation softwares from their beginning till date.

3. STANDARDS

We live in an increasingly globalised and interconnected world. Globalisation also means increased dependency on one another in various domains. Computers, telecommunication infrastructure and the Internet are not only desirable but indispensable in the world we live today. The library and information world has traditionally been borderless long before others. However, Internet and the WWW have pushed libraries to become even more interdependent than before because of the bewildering array of sources and providers of information from which they draw their information. So, for libraries to maintain interconnectivity to such a diversity of systems and to enable mutual sharing of resources and exchange of data between them requires that all of these follow internationally agreed upon standards.

3.1 Library Automation Software Standards

The one element, in all library automation and networking today that has assumed highest priority, is the use of international standards. Some of these are:

- ✘ Metadata standards: Dublin Core, EAD, LOM, VRA Core Categories, etc.
- ✘ Information exchange standards: AACR, LCSH, ISO10160&10161, ISO2709, etc.

- ✘ Communication Standards: MARC, UNICODE, TCP/IP, Z39.50, Z39.71, OPEN URL, etc.
- ✘ Content representation standards: PDF, HTML, WORD FILE, XML, etc.
- ✘ Interoperability standards: OAI-PMH, etc.

Sherbini and Klim¹⁴ explained the metadata standards, which depend in the large part, on the resources for which they were created. The paper reviews the different kinds of metadata standards and their uses in cataloguing practices and how these standards are applied in libraries. Metadata is basically 'data about data'. This standard is widely used for cataloguing in electronic environment and use of metadata standards with cataloguing provides consistency and exhibits tremendous flexibility. The OHIOLINK electronic theses and dissertation (ETD) are an example how AACR2 (Rev) and MARC21 are used as metadata standards to store, describe and access information resources. Chandraker¹⁵ has discussed how Unicode standard came in to light and what kind of other standards were used place of Unicode. From the start of automation, in the absence of proper standards, professionals tried to romanise documents as computer used to accept only binary digits of Roman script to represent the English language. Later, the development of new technology, ISCII, which is an extended form of ASCII, values from 126 to 255, helped library professionals in developing bilingual databases or bilingual text files on DOS or UNIX-based applications. Gradually, fonts for window-based applications were developed for creating websites or document files. But now with the requirement of different languages in the world, there is a forum available called Unicode Incorporation, which provides a solution to the localisation of problems of world language. Unicode is a multilingual standard and technology for localiation of the Indian language materials.

Z39.50 protocol also promotes centralisation of resources shared by libraries situated worldwide. This protocol is implemented in bibliographic databases in libraries. Nowadays, personal bibliographic managers such as Reference Manager, End Note, Procite, help in accessing bibliographic database via Z39.50 protocol^{16,17}. Wu¹⁸ gave detailed description of Open URL standards. Recently, growth and development of electronic information have progressed rapidly. Therefore, their proper architecture and organisation of electronic information required some standards. The open URL standards solve this problem. Open URL provides a standardised format for transporting bibliographic metadata about objects between information services. The purpose of such research was to define context sensitive linking for ensuring users access to the appropriate copy of materials based on the subscription of

their institution or libraries. This standard is also useful for libraries, because it provides appropriate ways to link across information sources, irrespective of their providers.

Aliprand¹⁹ gave details about the structure of MARC 21. MARC 21 records may be encoded in individual character sets including ASCII and ANSEL or in Unicode. He considered the effect of the use of Unicode without any constraints on the structure and data content of MARC 21. The case of a model where Latin was the preferred script was examined in detail. Haravu²⁰ discussed the need of standardisation in library automation software as well as for establishing networking among the group of libraries so that they can work under similar environment as well as resource sharing can be made possible. Yu²¹ suggested the standards regarding digital archives. Basically, digital libraries stow huge amounts of data, including text, image, map, audio, video and illustrations via electronic formats. Furthermore, digital libraries could be conveniently accessed through the Internet. The traditional library automation systems, applying technologies and protocols, such as MARC, Z39.50 and ISO 2709, could not completely match the requirement of digital archives. The purpose of this study was to find out how to effectively manage and apply the related technology of digital archives to handle the existing operation processes in library and the management requirement of digital archives. This paper discusses an evolution model of the related technology of library automation systems.

3.2 Web Technology Standards used in Library Management Systems

Web services are the set of technologies and standards for interoperability well adapted to exploit the characteristics and potential of the Web environment. Web services refer to a network-addressable software component that can receive a call and provide a given behaviour on behalf of the calling system, application or component. Web technology is being used in LMSs to make these compatible for working in Web environment. Some of these technologies are: HTML, XML, XUL, Open URL, HTTP, SOAP, etc. There have been some studies, which gave the detailed description of Web technology standards now being used in library automation software.

Ryno²² explained the advent of Web and how the system librarians find themselves managing or facilitating a wealth of mainstream technologies. System work revolves around many resources that live outside the library walls, security access for our patrons and pushing access to the desktop users. XML is the Web technology that is tying together the system, applications and formats and the possibilities for component-based applications seems revolutionary. Banerjee²³, Chang,²⁴

and Wusetman²⁵ described the use of XML technology in libraries in different ways like used in OPAC, and suggested a prototype OPAX and XML to manage information in digital environment.

Cordiero²⁶ introduced the main ideas and concepts underlying Web services, and their potential for a new generation of Internet-based distributed applications. A summary of the key standards that are the foundation of Web services technology and its underlying basic model was provided, exploring the potential for interoperability among independently managed systems. This is of special importance for libraries, along with the advantage of reducing the development and deployment costs of distributed applications, and of leveraging the value of IT and data legacy assets. The paper explains developments in Web services technology in the library field and underlines its significance for changes in the library information systems paradigm. Contreras²⁷ has discussed changing needs and expectation of the users and from the example taken from the Penn State University libraries, which are using Web technology in reference service, which included synchronous and asynchronous references, by working with vendors to support services across various system platforms. Jayakanth, Sharada and Minj²⁸ elaborated the OAI-based approaches to build and maintain union catalogues. In this approach, the individual OPACs (data providers) expose their metadata for harvesting. The OAI-based service providers harvest the exposed metadata automatically. The metadata thus harvested is ingested into a centralised database, which serves as an online union catalogue, supporting search, browse, and other value-added functionalities for the end-users. The OAI-based approach eliminates the manual work involved in getting the OAPC updates and also in updating the union catalogues.

4. USABILITY OF WEB INTERFACE IN LIBRARY MANAGEMENT SYSTEMS

This section discusses the use of Web in library automation software, technological developments, which make software compatible with changing demands of users, and Web as a interface used for management modules, etc.

4.1 Databases used in Library Management Systems

In early days computing, data was kept into the data files and programs were written to interact with these data files to produce reports. This type of environment led to a situation in which every new application required the services of an experienced programmer, who usually took a fairly long time to study, design, develop, and test his software. There were some other factors also, which gave

birth to file management systems, in which most of the common file management programmes were incorporated, thereby eliminating the need of writing separate writing programmes for them. So the 'database' concept is a more systematic approach in a database management system.

A database is an organised collection of structured data, unit of information or data records, independent of any application in a computer memory that serves the need of the multiple users. So, the database management system is a collection of programs that enables one to store, modify, and extract information from the database.

Ravindran²⁹ gave the overview of various library management softwares and also described the management of their bibliographic databases. Because the success of any information centre not only lies on their resources but also in identifying and enlisting various information sources and develop the requisite tools for maintaining these information resources. This paper gives the important criteria for selection of library software also. Mishra³⁰ explained the importance of computers in generation of different bibliographic databases at international, national, regional and local levels, and for different levels of exchange formats needed for exchanging information. He also suggested different national and international exchange formats of bibliographic databases such as UKMARC, USMARC, CCF, UNISIST reference manual, etc., and suggested certain national and international standards for the generation of exchange formats. Chandraker³¹ gave detailed description about the character encoding because everything associated with the Web requires character encoding by the developers. Library and information networks of India hold the responsibility to digitise all these valuable resources stored in print media and make them accessible to users through the Web. Chandrakar tried to explain the limitations and the problems being faced in this regard and highlighted the issues involved with multi-script databases creation and the required state-of-the-art technology.

Rhyno²² described relational database management system (RDBMS), as best suited for storing and managing many different forms of digital content and new strategies defined to provide RDBMS solution for XML. Some of the relational databases now offer special mechanism to accommodate XML while several technologies have emerged to facilitate the use of XML representation of data housed within an RDBMS. This paper highlights that XML and XML-enabled technologies may find new application for libraries by combining RDBMS concept with Web-based services. Matoria and Upadhayay³² have discussed about various library automation software packages that are lacking the Web

interfaces and thus do not provide library access databases (e.g., OPAC) through Web. These packages provide less flexibility to the librarians for making desired changes in the existing databases and to publish same on the Web. So, designing in-house databases using common relational database tools like MS-Access, SQL, and DB2, etc., can be a back-end solution. They discussed the merits and demerits of the currently available RDBMS software for library applications as back-end solutions, and the various tools/technologies required/available for publishing the library databases over Web. They also emphasised to use the technologies that are more user-friendly, easy to design, require less programming skill, and thus suitable for librarians to set-up Web-enabled solutions in the libraries.

Sridhara, Makhija, and Pandey³³ discussed the advent of database connectivity to the Web servers and possibilities to generate dynamic webpages using database as the back-end and a Web browser as the front-end. This article focuses on implementation of WINISIS and WWWISIS on Microsoft Windows XP using professional Microsoft's Web server (Internet Information Server 5.1) for generating an information retrieval system for defence science and technology articles database developed by Defence Scientific Documentation and Information Centre (DESIDOC). The database provides an instant access to information on defence-related articles to the scientists of Defence Research and Development Organisation (DRDO).

The paper also focuses about generating a current awareness service, Current Literature in Defence Science and Technology using defence science and technology articles database. Buxton³⁴ suggested a variety of software solutions for putting CDS/ISIS databases on the Internet. He briefly described the origin, history, characteristics, and availability of software packages and identified the type of skills required to implement the packages and the kind of applications that will suit. It covers CDS/ISIS UNIX version, Java ISIS, WWW-ISIS Versions 3 and 5, Genisis, IAH, and Open ISIS. This paper concluded that CDS/ISIS databases provide a range of options to their users for putting their databases on the internet, so that it provides ease to the users who are residing at remote locations. CDS/ISIS provides various options, which are free but the choices may well depend upon the users' capabilities and ease of use with CDS/ISIS, HTML, open source software, and programming.

4.2 Technology Interface in Library and Management Systems

Librarians have a special seat at the table of the 21st century, now that we live in the age of information. Librarians have traditionally been the keepers of

society's knowledge. While the challenges are considerable, the tools that are presently available provide views of information at levels of granularity previously unavailable at any price. That power is not automatically a good thing—we suffer from information overload—but it is a reality that must be managed. There are several technologies that are already or will very soon be impacting the library and may offer advice on how to live in relative harmony with most of them.

There are several technologies being used in library automation software for the ease of staff and users also. Some of these are:

- ✧ *Radio Frequency Identification Device (RFID)*: This technology is used for stock checking, circulation, and security systems, using RFID tags instead of the traditional barcodes and magnetic strips to identify and track items (e.g., VTLS's FASTRAC).
- ✧ *Application Programmer Interface (API)*: API is a feature of several of the new generation ILMSs. These allow systems staff in libraries to modify the vendor's software to fit local requirements, and also faster upgrading of software.
- ✧ *Virtual Reference Service (VRS)*: This is a relatively new component of the ILMS. It can be associated with the Web OPAC when an "Ask a Librarian" link is made available from the OPAC page to a Web form. The most advanced use of VRS is chat room technology, which users can use to interact with a reference librarian in real time.
- ✧ *Personal Digital Assistant (PDA)*: PDA is the computing and storage device which is mobile in the hand-held sense, which means it cannot be carried easily but is designed to be used with the user's bare hands without need of desk, study carrel, etc. (e.g., innovative interface facilitated PDA devices).
- ✧ *Computer Integrated Telephony*: Used for sending reminders and information on reservations to users, and enable them to conduct circulation-related transactions such as book renewals, checking of account status and cancellations or reservations over the telephone (e.g., Dynix's horizon telephone messaging).
- ✧ *Smart Card and Reader*: Smart cards have an intelligent, single-chip microcontroller embedded within the plastic. This facilitates the implementation of a very high level of data security and means that data can be securely updated or written to the card after it has been issued. The key development in recent years has been the integration of reusable memory—Electrically Erasable Programmable Read Only Memory (EEPROM)—onto a single-chip microcontroller.

✧ *Biometric Devices:* These comprise finger print reader, voice recognition, etc.

Lee³⁵ described the cutting-edge hardware and software for multimedia information storage and access. Lee will focused on the NeXT computer as the innovative hardware platform and introduced the VTLS InfoStation as the new generation software that offers user-friendly multimedia information access using expert systems, natural language processing, direct manipulation graphical techniques and retrieval of full text, images, and audio data.

Singh³⁶ discussed the concept of multimedia and its use in library automation software. It also states that compatibility of library software to store, organise and properly displayed multimedia materials. Mc Cullough³⁷ draws attention towards the recent technological changes in library automation software marketplace. So, one of the barometers of the level of demand placed on libraries to evolve their services is the rate at which the library automation vendors release enhancements, new features and entirely new product lines to serve the library marketplace. An area in which new technology and library need intersect is in the area of development for PDAs and other hand-held devices for wireless communication. PDAs in the hands of patrons and staff offer a number of opportunities to improve interactions within the library. PDAs for patron provide all libraries-related information like reminder of due date; checked out item, date and time; information of upcoming events; name and address of branch libraries; etc. Library system vendor demonstrated 'innovative interfaces' at ALA 2000 and their ability to send pertinent information from a library workstation directly to PDA using infrared data transmission. So, this capability used third-party software and hardware on the PC workstation, in particular, an infrared device which would actually transmit the specified information sent to the PC from the library server, to a waiting IR-capable device.

Kern³⁸ gave a detailed description of RFID system and its uses in libraries as well as the standards required for RFID chip. Muir³⁹, Butters⁴⁰, Shahid⁴¹ have highlighted the use of RFID in library for anti-theft, inventory control, etc. Lambrinoudakis⁴² pointed out the continuously increasing need of de-centralised information system offering data to the people who need it, irrespective of their physical location, as well as the requirement for exchanging information between different interoperable systems. The concept of a 'secure portable information file' that can nowadays be easily implemented through the available smart card technology, can significantly ease information management and ensure maximum data protection wrt their integrity, confidentiality and availability. This paper presents the use of smart cards in an educational environment as a case study for

demonstrating the above-mentioned benefits, focusing on the utilisation of the smart card's cryptographic functions for implementing mechanisms capable of providing an extremely secure operational framework in terms of user and application provider authenticity, management of access privileges and data integrity, and confidentiality.

Library automation software incorporates various technologies to facilitate their users and library personnel also. RFID, smart cards, biometric devices, PDAs, etc., are the example of these technological changes, which enable libraries to provide value-added services to its users.

4.3 Implication of Web Interfaces used in Technical Services

Library automation is a generic term used to denote the various activities related to the location, acquisition, storage, update, manipulation, processing, repackaging or reproducing, dissemination or transmission or communication. Libraries that have always been active in the information and knowledge access arena cannot afford to ignore either the threats or opportunities that the evolving Web provides. It would be reasonable to predict that more and more libraries in the near- and medium-term will turn to applications that will be Web-based.

Recently, libraries have started using some Web-based interface in their library automation software systems. The most common areas where Web interfaces used are:

- ✧ Web OPAC
- ✧ Web-based ILL system
- ✧ Online library portals
- ✧ Common user interface
- ✧ Copy cataloguing
- ✧ Digital reference services
- ✧ Web-based document delivery services, etc.

Foo and Lim⁴³ discussed the integrated Web-based ILL system used by the Singapore libraries. They described the system requirements that must be supported to make it a viable and acceptable solution to all participating libraries, and presented the client-server Web-based system architecture, database design and Java development platform that are used to implement the system. The new system exhibits a host of advantages over the manual system including the minimising of human resources by eliminating form filing and other forms of paper work completely, improving the access and

speed of the ILL process by allowing participating libraries to update each others databases directly ensuring data integrity, simplifying status tracking and also provide statistical reporting. Anderson⁴⁴ described the multiple and redundant access to new media in the form of catalogue entries and separately maintained list (prepared by public service librarians). Now the debates have raged which method of access serves users best. This pattern persists as libraries provide access to electronic sources via Web list and the OPAC. Rameshbabu and Brian⁴⁵ enumerated various features of the WebOPACs. Web-based OPACs began to appear in the late 1990s and many libraries are currently considering its implementation. As catalogues, they demonstrate advances on traditional OPACs, especially in terms of remote access by users and their potential to integrate many document types and sources via a single interface. Their paper highlights some of the features and functions of WebOPAC interfaces. But yet, very little evaluation of systems and users has taken place, and until more such literature appears, a general approach to products available will be considered of any value. In other comparative studies about OPAC Joint⁴⁶, Bordeianu, Carter and Dennir⁴⁷; Kapoor and Goyal⁴⁸; and Bernrad⁴⁹ also showed the similar results. Dörner and Curtis⁵⁰ explained the online portals, also called Common User Interface, which replace the multiple interfaces found among individual electronic library resources, reducing the time and efforts spent by the user in both searching and learning to use a range of databases, although the primary purpose of Common User interface is to simplify the search process such as user authentication and site branding. Their paper covered the detailed summary of software that incorporate this feature such as MetaLib, ZPORTAL, Muse Search, Single Search, Meta Find, CPORTAL, WebFeat, etc.

Bandhopadhyay⁵¹ explained the concept of copy cataloging and its benefits and suggested that the national library should take a leading role in organising online copy cataloguing programme in India so that all libraries in the country can use its bibliographical information to prepare their catalogue entries without wasting manpower and money. In online copy cataloguing one may search in the database for the bibliographic record using keywords and then compare with the existing record item, and if it matches then the record may be processed for the local library. Modification facility is also available in this copy cataloguing. OCLC also provided CatExpress used for simple and fast copy cataloguing solution. Cat Express is a fast and easy Web-based copy cataloguing solution. CatExpress also gives access to WorldCat, the world's most comprehensive bibliographic database, and provides the power of Dewey through the Web as an add-on service. Hariharan⁵², *et al.* explained the current awareness

services to meet users' requirements at SERC library. A few libraries and many e-publishers are providing alert services to keep the users informed about the latest additions to their collections and other information relating to the users' areas of interest. This paper described the experiences in using the AutoLib library software and explained the various innovative and useful Web-based library and information services and the alert service being provided at the SERC library. SERC library maintains portal in which different kind of Web-based alert services are provided to the users with the help of AutoLib software where users may create their own profile and post their query to the portal and get updated through new alerts regarding the publications, collections, research activities, etc.

4.4 Security Measures used in Library Automation Software

With the growing dependence on network for smooth communication and increased outputs, information technology industry must become more concerned about the possible security threats that can breach network security resulting in costly damages. A network or Internet work perimeter is a secure boundary of a network that may include some or all of the following:

- ✂ Firewalls
- ✂ Routers
- ✂ Intrusion detection system (IDS)
- ✂ Virtual private network (VPN) mechanism
- ✂ Screened sub-nets

Suman and Lal⁵³ explained the security aspects in computer network environment. In the paper, concept of 'Firewall' came. Firewalls are hardware and software combination built using routers, servers, and a variety of software. Firewall basically used for packet filtering-a screening examines the header of every packet of data travelling between the internet and corporate network. So along with fencing of network and working with firewalls, the paper also described the Worms and Bugs and some recent developments in the area of networking security.

Prevelakis and Keromytis⁵⁴ explained the purpose of drop-in firewalls/VPN gateway, called Sieve, which can be inserted between the mobile workstation and the network to provide individualised security services for the particular station. Sieve is meant to be external modem; the users only need to plug it in. Its existence is transparent to the users, requiring no modification to the workstation configuration. Sieve has been designed to be compact, low cost, requiring little administration or

maintenance. Gupta⁵⁵, *et al.* discussed the demands of networking among the organisations and what kind of security threats they faces while networking. Not only this, paper also discussed the designing of a secure and robust network infrastructure. Secure connectivity also must for the protection of information. For this, digital signatures can be used for encrypted information. Basically 'Encryption Technology' converts network messages into formats that are specially designed to prevent third parties from accessing their contents. This paper explored the process of building and implementing a successful, secure and robust network infrastructure and discussed various techniques to overcome possible security threats. The security process required constant monitoring of the network along with the measurement of staff knowledge and awareness levels to ensure that there is a continuous improvement in their level of security knowledge and awareness. Braid⁵⁶ defined the Digital Right Management (DRM) System and its use in secure document delivery services in libraries. The digital management of rights means the technical protection measures that are added to a piece of content. This usually involves the use of some form of encryption and access control mechanism as well as preventing unauthorised access. The controls can limit various aspects of the use of the contents. Such limitations include the number of copies that can be printed, whether the file can be copied, the length of time file can be accessed, and whether the content can be 'cut and pasted'. At least three major document suppliers, namely British Library (BL), CISTI and Infotrieve, implemented this kind of secure electronic document delivery system. The paper also gave the following reasons for applying this security:

- ✘ Publishers are not in direct control when supply is through a third party,
- ✘ They fear that inappropriate use might result and,
- ✘ They fear erosion of their subscription base.

Although DRM very early made confident predictions but this technology makes system too secure in that it do not permits intermediaries to carry out any form of checking of supplied items before forwarding them to end users. So DRM should help in maintain the stability of scholarly publishing; it may well be the users and not suppliers, who will derive need. Kush and Ram Kumar⁵⁷ discussed the need of the security and gave emphasis on wireless networking which having large bandwidth and a range of several feet. Moreover, multiple wireless access points can be easily installed on same network to cover more areas. So the main challenge is to design these networks is their exposure to security attacks. The paper categorised security measures as logical, organisational, procedural, and physical by tactics which are preventive,

detective, corrective and repressive. As well there is no single standard routing protocol which prevent security attacks.

Roedig and Schmitt⁵⁸ have described about the firewalls. Firewalls are well-established security mechanism to restrict the traffic exchanged between networks to a certain sub-set of users and applications. In order to cope with new applications like multimedia, new firewall architectures are necessary. The performance of these new architectures is a critical factor because Quality of Service (QoS) demands of multimedia applications have to be taken into account. This paper discussed how the performance of firewall architectures for multimedia applications can be determined. It presents a model to describe the performance of multimedia firewall architectures. This model can be used to dimension firewalls for usage with multimedia applications. In addition to this, results of a lab experiment, used to evaluate the performance of distributed firewall architecture and to validate the model was also discussed.

Lekkas and Lambinoukdis⁵⁹ gave detailed description about the digital signatures which are very useful from security point of view. A digital signature preserves basic security characteristics of the digital documents, such as integrity and authenticity of binary data. Digital signatures are only enjoying a gradual and reluctant acceptance, despite the long existence of the relevant legal and technical frameworks. One of the major drawbacks of client-generated digital signatures is the requirement for effective and secure management of the signing keys and the complexity of the cryptographic operations that must be performed by the signer. Outsourcing digital signatures to a trusted third party would be an elegant solution to the key management burden. This paper aims to investigate whether this is legally and technically feasible. It also discussed the weakness and security threat that implies on client side management and compared the basic features of client generated digital signature and outsourcing of digital signature and finally the technical approach for the outsourcing of digital signature.

Hudomalj and Jauk⁶⁰ point out the current state of authentication and authorisation in satisfying the academic library users' mobility and instant access to use of digital information resources and proposed that libraries strongly support effort to establish a global authentication and authorisation infrastructure. A global authentication and authorisation infrastructure will enable users to use a single username and a password for all local and remote library services. It will consist of interconnected authentication/authorisation servers where each institution will be responsible for a local user database. This paper also discussed the practical implication of this global authentication and authorisation

infrastructure because this service can improve services for their user's who are reside at remote places from their institution and enable users to access new services faster. Herzog and Shahmehri⁶¹ discuss about concrete and verified guidelines for enhancing the usability and security of software that delegates security decisions to lay users and captures these user decisions as a security policy. Setting up a security policy or security rules for a personal firewall, for application surveillance on one's computer, or for how one Web browser should interact with the privacy policies of visited Web sites, is a difficult task. So to solve this problem is required to establish at least one security tool for setting up security policies at run time succeeded. Firewalls are used by many users and allow and disallow the network connections. Firewalls are not complex in their run time rule syntax.

4.5 Networking Architecture used in Library Management Softwares

Due to knowledge explosion or enormous growth in volume of published information, it is necessary for libraries to satisfy the diverse need of users and establish network among the group of libraries. Not only this, libraries always faced budgetary constraint, staff pressure and increased cost of printed resources. Networking can help libraries overcome these problems.

A compelling advantage of using Web-based solutions is the possibility to leverage the Web to create an effective network for libraries. The various libraries could be belonging to the same organisation but distributed across the number of locations. So, web-based networking provides solution for establishing effective network among these distributed libraries. Networking among libraries is of the following types:

- ✘ Single-user system
- ✘ Multi-user system
- ✘ Local area network
- ✘ Client- server architecture

Evans⁶² draws the attention of globalisation of library systems. Libraries are using virtual union catalogue enabled by Z39.50 standard which allows libraries a common research purpose. e-lending and MARC databases, etc. are some examples of these technology. Web and various standards compel librarians to 'think locally act globally' so that group of libraries distributed across the world can easily communicate and share their resources. Application service provider is yet another technology which is highly applicable in networking. ASP models look in future in which application runs remotely somewhere in world, it matters not where. Dzuriniko⁶³ elaborated the various features of ASP. Integrated online library system ASP is an Internet-based service, which

allows to rent software or service on per-use or subscription basis. The software sits on the ASP server and the connection is established via Web. All the data stored on ASP server is available for anybody at any part of the world belonging to that firm. The paper also discusses the advantages and disadvantages of ASP.

Kaula⁶⁴ explained the Web architecture, i.e., two-level architecture and three-level architecture. Two-level architecture is a client/server architecture where many computers behave as a client connected to the server computer. In three-level architecture, a database level is added which is DBMS software. The third layer is called the application layer, which manages the interaction of the Web server with the DBMS. The three-level architecture is very useful for the management of RDBMS on Web. Haravu⁵ discussed the technology of client-server architecture. The main difference between client-server architecture and LAN architecture is that client server use a relational database management system on the database server and users query are answered directly. Earlier, file server was used in LAN architecture. The client-server architecture thus reduces network traffic by providing a query response rather than file transfer. It improves multi-users updating through a GUI front end to a shared database. In client server architecture, remote procedure calls (RPCs) or standard query language statements are typically used to communicate between the client and server.

There are two kinds of client server architecture, namely two-tier architecture, and three-tier architecture or n-tier architecture. Earlier two-tier architecture was used in LAN or intranet environment. The two-tier architecture allocates the user system interface exclusively to the client. It places database management on the server and splits the processing management between the client and the server, creating two layers. In n-tier architecture, a middle tier added between a client and a database management server. The middle-tier performs queuing, application execution and database staging. The middle-tier accesses the data and gives answer to client.

Li⁶⁵ described the Web-based library information architecture, outlining the ubiquitous library's most relevant concepts and features tied up with the Internet platform. Utilising successful library projects and applications from the real world, this paper explores primary technical solutions for the ubiquitous library in the digital age, which could be utilised to transform the concept of 'Ubiquitous Library' (ubiquity here define as 'the capacity of being everywhere or in all places at the same time') into a real "dynamic engine for the knowledge and information society.' Also discussed is the future of Web-based ubiquitous library information architecture. This paper intends to draw a clear road map for librarians, instructors, IT specialists, managers,

executives, and other professionals to utilize cutting-edge technologies and emerging technologies to design, develop, integrate, enhance, and implement ubiquitous library services and projects in the 21st century.

4.6 Evaluation of Library Automation Systems

In any endeavour in which we make a substantial investment of money, energy, and time or other resources, we like to know what kind of return we get. The ability to evaluate the return on our investment gives us the basis on which to choose between alternative. So an evaluation is basically a judgment of worth. It is a matter of comparison of actual result with external standard, in the light of existing institutional realities which may be relevant to evaluating the future trajectory of the program or services and provide an objective basis for decision making. Software evaluation is quite a difficult task.

Francis⁶⁶ elaborated important software problems faced by the library professionals in India and points out various compatibility and suitability issues in the selection of library software. The paper also highlighted that these problems have affected the progress of computerisation of libraries. Up-to-date and detailed information on softwares available in India can prevent several issues that may arise in the course of computerisation. An agency/mechanism to continuously evaluate the softwares may be formed to meet this requirement.

Saxena and Srivastava⁶⁷ evaluated important library software packages such as Granthalaya, Libsys, Sanjay, Suchika, Basisplus-Techlibplus, etc. Parameters selected for evaluation of software packages include facilities provided in the software packages, hardware requirements, operating system platforms, language of software development, search facilities, etc. Mukhopadhyay² discussed the development of library management softwares over the past decades, traced out the characteristics and trends of software with special reference to packages available in Indian environment and compares services and facilities incorporated in library automation packages available in India against various checklists and with the help of tables and appendices.

For evaluating number of software, author prepared one checklist, which is broadly divided into following categories: hardware and backend software requirement, intrinsic features of LMS, services and activities, core services, user oriented services, enhanced services, and value-added services. The present study indicates that the SOUL developed by the INFLIBNET has most of the features of a third generation LMS. Goh, *et al.*⁶⁸ described open source software packages available for organisations and individuals to create digital libraries. To

evaluate digital software packages author prepared a 12-point checklist.

Evaluation of library software package is a very complex process. For evaluation, all the packages must be used by the evaluation team under the same conditions, which is not possible practically due to various factors. But with the help of evaluation one can know about the merit and demerits of software and also choose the best software according to the requirement and budget of the library.

5. CONCLUSION

The above studies revealed that information and communications technology plays a very important role in our society. It has influenced the every aspect of human society and libraries as a part of the society are not the exceptional one. The library community is largely made up of not-for-profit, publicly funded agencies, which hardly command a major voice in today's high tech information industry. Libraries today face the challenges of implementing the latest technologies, keeping their data and resources secure and providing their users access to the resources, while coping with shrinking budgets, increased competition and rising demand for more consumer-like-services. With information technology remaining an ever changing landscape, libraries increasingly need to pay more attention to total cost of ownership issues. They must choose the very best, most future proof products for IT investments and developments.

Earlier every task in libraries was performed by the library personnel manually, which used to take lots of time and manpower. But after a long period of gestation, the libraries in India are now in take off stage of automation and modernisation. Now in ICT environment, most of the technical works in libraries are being performed with the help of computers and new technologies without losing much time and efforts. The use of computers for all library operation and services began during the mid 1950s. The advent of Internet in the 1980 was responsible of the protocols, software, hardware and standards that make up the WWW, added a completely new dimensions to the information world. Now libraries prefer using Web-based library automation system rather than using window based automation software. Earlier libraries used window-based softwares for automation but these softwares are not affordable by every library due to financial constraint. Web-based Library Automation Software Systems which use Web as a platform have solved this problem. After seeing the steady growth in library automation drastic changes came, not only in terms of library activities but in terms of increase in the working efficiency of library personals. Now library softwares are hosted on a Web server instead on PC or within the organisation.

Now when the softwares are hosted on Web server, they required certain national and international standards for communication. Certain standards develop by national and international organisation for communication and acceptable to all over world, are Z39.50, AACR-2, ISO2709, ISO10160 and 61, etc. Nowadays we are dependent on networking for smooth communication. Earlier for networking, libraries were using peer-to-peer model but now client-server architecture provides much ease for establishing network among terminals to Web server. Information industry must become more concerned about the possible security threats that can breach network security resulting costly damages. Firewalls, routers, screened subnets etc. provide various options for preventing these kinds of threats. Not only this, content security is also necessary because all content are hosted on Web server. Softwares incorporate various facilities like DRM, water marking, guest right, password authentication, etc. for secure document delivery.

There are several technologies that are already or will very soon be impacting the libraries and provide ease to staff and users like PDA, barcode reader, smart card, biometric devices, etc. Advancements in Web technology have impacted technical services of libraries. Now with the help of copy cataloguing libraries can outsource the information from other libraries as well. Not only this, Web OPAC, ILL, Web-based document delivery accelerated the working efficiency of library staff. Though in India the development of Web-based software is still in its infancy stage but it is already in steady growth. Web-based automation software are the good example of sharing resources worldwide and satisfying the users need ever at remote location.

REFERENCES

1. Rhyno, Arthur. From library system to mainstream software: How web technologies are changing the role of system librarians. *Library Hi-Tech*, 2003, **21**(3), 289-96.
2. Mukhopadhyay, Parthasarthi. Progress of library management softwares: An Indian scenario. *Vidyasagar Univ. J. Lib. Inf. Sci.*, 2002, 1-15.
3. Seneviratane, Gihan P. & Amaraweera, J.P. Automation of library operation in SriLanka: A cost-effective web-based solution. *Information Developments*, 2002, **18**(2), 111-15.
4. Ebenzer, Catherene. Trends in integrated library system. *VINE*, 2002, **32**(4), 19-45.
5. Haravu, L.J. Library automation: Design, principles and Practices. Allied Publishers (P) Ltd, Hyderabad, 2004.
6. Mukhopadhyay, Parthasarthi. Five laws and ten commandments: The open road in library automation in India. *In Proceeding of the National Seminar on Open Source Movement-Asia Perspective*, IIT, Roorkee, 2006. pp. 27-36.
7. Bailey, Penn. Let someone else provide your online catalogue. *Library+ Information Update*, 2006, **5**(10), 39-41.
8. Haravu, L.J. Emerging initiatives in library management systems. *In International Conference on Academic Libraries-Technology, Policy and Innovation*, University of Delhi, Delhi, 2009. pp. 239-48.
9. Koneru, Indra. Integrated library system: Selection and design. *DESIDOC Bull. Inf. Technol.*, 2005, **25**(5&6), 3-9.
10. Shafique, Farzana & Mahmood, Khalid. Integrated library Software: A survey of Lahore. *Library Hi-Tech News*, 2008, **6**, 6-13.
11. Moorthy, A.L. Library automation in India. *In Horizon of information technology: New age, new wage trend and impact of library science. A Festschrift*, Vol. **1**, edited by Suryanath Singh, 2004. pp. 288-300.
12. Lynch, Clifford. From automation to transformation: Forty years of libraries and information technology in higher education. *EDUCASE Review*, 2004, 60-68.
13. Breeding, Marshall. Automation system marketplace 2002: Capturing the migrating customers. *Library Journal*, 2002.
14. Sherbini, Magada El. & Klim, George. Metadata and cataloguing practices. *The Electronic Library*, 2004, **22**(3), 238-48.
15. Chandraker, Rajesh. Unicode as a multilingual standard with reference to Indian languages. *The Electronic Library*, 2004, **22**(5), 422-24.
16. East, John W. Z39.50 and personal bibliographic software. *Library Hi-Tech*, 2003, **21**(1), 34-43.
17. Banka Bihari Chand. Z39.50: The standard for information reterival and its application in libraries. *SRELS J. Inf. Manage.*, 2001, **38**(4), 317-26.
18. Wu, Carol H. Keeping pace with Open URL: A perspective. *The Serials Librarian*, 2004, **47**(1&2), 117-28.
19. Aliprand, John M. The structure and content of MARC 21 records in the UNICODE environment. *Inf. Technol. Lib.*, 2005, **24**(4), 170-79.

20. Haravu, L.J. Standards in library automation and networking, 2006. <https://drtc.isibang.ac.in/bitstream/1849/291/1/Standards%20in%20Library%20Automation%20and%20Networking.pdf>
21. Yu, Shin-Chian. Study on digital archives standards for library automation systems. *In Asia-Pacific Conference on Library and Information Education and Practice*, edited by C. Khoo; D. Singh & A.S. Chaudhary, School of Communication and Information, Nanyang Technological University, Singapore, 2006. pp. 288-93.
22. Rhyno, A. XML and relational databases: Uses and opportunities for libraries. *OCLC Syst. Serv.*, 2002, **18**(2), 97-103.
23. Banerjee, Kyle. How does XML help libraries? *Computers in Libraries*, 2002, **22**(8).
24. Chang, Naicheng. Data manipulation in an XML-based digital image library. *Program: Elect. Lib. Inf. Syst.*, 2005, **39**(1), 62-72.
25. Wusteman, Judith. About XML: From ghostbusters to libraries—the power of XUL. *Library Hi-Tech*, 2005, **23**(1), 118-29.
26. Cordeiro, Maria Ines & Carvalho, Joaquim de. Web services: What they are and their importance for libraries. *VINE*, 2002, **32**(4), 46-62.
27. Contreras, Paula. Expansion of web-based library services in large research libraries: A Penn State case study. <https://www.educase.edu/ir/library/pdf/EDU0370.pdf>
28. Jayakanth, Francis; Sharada, B. & Filbert, Minj. An OAI-based approach to build and maintain union catalogue of OPACs. *In International Conference on Semantic Web and Digital Libraries*, edited by A.R.D. Prasad & Devika P. Madalli, 2007. pp. 451-58.
29. Ravindaran, Sreedevi. Bibliographic databases: Software issues. *DESIDOC Bull. Inf. Technol.*, 1997, **17**(5), 11-16.
30. Mishra, Kamini S. Bibliographic databases and exchange formats. *DESIDOC Bull. Inf. Technol.*, 1997, **17**(5), 17-22.
31. Chandraker, Rajesh. Multiscript bibliographic database: An Indian perspective. *Online Infor. Rev.*, 2002, **26**(4), 246-51.
32. Matoria, Ram Kumar & Upadhyay, P.K. Design and development of Web-enabled databases in libraries with special reference to RDBMS: Selection tools and technologies. *DESIDOC Bull. Inf. Technol.*, 2002, **22**(4&5), 9-15.
33. Sridhara, B.; Makhija, Veena & Pandey, Ajay Kumar. Application of WWWISIS: Web-based CDS/ISIS bibliographic database for journal article. *DESIDOC Bull. Inf. Technol.*, 2006, **26**(4), 17-30.
34. Buxton, Andrew. Opinion for putting CDS/ISIS databases on the Internet. *Program: Electr. Lib. Inf. Syst.*, 2006, **40**(3), 286-95.
35. Lee, Newton S. Infostation: A multimedia access system for library automation. *The Electronic Library*, 1990, **8**(6), 415-21.
36. Singh, Anil. Compatibility of library automation software packages with multimedia. *Herald of Lib. Sci.*, 1998, **37**(3&4), 184-87.
37. McCullough, John. Redesigning library applications for PDAs: ILS vendor perspective. *Library Hi-Tech*, 2003, **21**(4), 393-99.
38. Kern, Christian. Radio-frequency identification for security and media circulation in libraries. *The Electronic Library*, 2007, **25**(4), 430-39.
39. Muir, Scott. RFID security concerns. *Library Hi-Tech*, 2007, **25**(1), 95-107.
40. Butters, Alan. RFID systems, standards and privacy within libraries. *The Electronic Library*, 2007, **25**(4), 430-39.
41. Sahid, Syed Md. Use of RFID technology in Libraries: A new approach to circulation, tracking inventorying and security of library materials. *Lib. Philos. Prac.*, 2005, **8**(1).
42. Lambrinoudakis, Costas. Smart card technology for deploying a secure information management framework. *Inf. Manage. Compu. Secu.*, 2006, **8**(4), 173- 83.
43. Foo, Schubert & Ee-Peng Lim. An integrated Web-based ILL system for Singapore libraries. *OCLC Syst. Serv.*, 1999, **15**(1), 24-34.
44. Anderson, Barbara. Web lists or OPAC: Can we have our cake and eat it too? *Library Computing*, 1999, **18**(4), 312-17.
45. Ramesh Babu, B. & Brian, Ann O'. Web OPAC interfaces: An overview. *The Electronic Library*, 2000, **18**(5), 316-27.

46. Joint, Nicholas. URLs in the OPACs: Comparative reflections on US vs UK practice. *Library Review*, 2007, **56**(3), 182-93.
47. Bordeionu, Sever; Carter, Christina E. & K. Dennis, Nancy. Delivering electronic resources with web OPACs and other web-based tools: Need of reference librarians. *Ref. Serv. Rev.*, 2000, **56**(3), 111-19.
48. Kapoor, Kanta & Goyal, O.P. Web-based OPACs in Indian academic libraries: A functional comparison. *Program: Electr. Lib. Inf. Syst.*, 2007, **41**(3), 291-309.
49. Bernard, Harmsen. Adding value to web OPACs. *The Electronic Library*, 2000, **18**(2), 109-13.
50. Dorner, Dannel G. & Curtis, Anne Marie. A comparative review of common user interface products. *Library Hi-Tech*, 2004, **22**(2), 182-97.
51. Bandhopadhyay, Ratana. Copy cataloguing and national library. *IASLIC Bulletin*, 2005, **50**(2), 69-73.
52. Hariharan, A. *et al.* Customised web-based services at SERC library with special reference to alert services. *DESIDOC Bull. Inf. Technol.*, 2007, **27**(3), 31-38.
53. Yogesh Suman & Banwari Lal. Network and internet security: An overview. *J. Lib. Inf. Sci.*, 2000, **25**(1), 47-58.
54. Prevelakis, Vassilis & Keromytis, Angelas. Drop-in security for distributed and portable computing elements. *Internet Research: Electr. Networking Appli. Policy*, **13**(2), 107-15.
55. Gupta, Vaibhav, *et al.* Networking and Security measures. *DESIDOC Bull. Inf. Technol.*, 2004, **24**(2), 9-16.
56. Braid, Andrew. The use of digital right management systems for document supply services. *Interlending Docu. Supply*, 2004, **32**(3), 189-91.
57. Kush, Ashwini & Ram Kumar. Wireless network security issues. *DESIDOC Bull. Inf. Technol.*, 2005, **25**(1), 13-18.
58. Roedig, Utz & Schmitt, Jen. Multimedia and firewall: A performance perspective. *Multimedia Systems*, 2005, **11**(1), 19-33.
59. Lekkas, Dimitrios & Costas Lambrinouidakis. Outsourcing digital signatures: A solution to key management burden. *Inf. Manage. Compu. Secu.*, 2006, **14**(5), 436-49.
60. Hudomalj, Emil & Avgust, Jauk. Authentication and authorisation infrastructure for the mobility of users of academic libraries: An overview of developments. *Program: Electr. Lib. Infor. Syst.*, 2006, **40**(1), 63-73.
61. Herzog, Almut & Nahid Shahmeri. Usable setup of runtime and security policies. *Inf. Manage. Compu. Secu.*, 2007, **15**(5), 349-407.
62. Evans, Peter. Trends, pressure and realities in the library system marketplace. *American Libraries*, 2000, 50-53.
63. Dzuriniko, Mary K. Application service providers. *Integ. Lib. Syst. Rep.*, 2000.
64. Kaula, Rajeev. Internet and PL/SQL server pages. *INICAE*, 2004, **23**(1), 45-52.
65. Li, LiLi. Building the ubiquitous library in the 21st century. World library and information congress. In 72nd IFLA General Conference and Council, 22-24 August 2006, Seoul, Korea, 2006. pp. 72-84.
66. Fransis, A.T. Software problems in library automation in India. In information management in academic and research libraries, edited by Mahapatra, *et al.* INFLIBNET/UGC, Ahmedabad, 1998. pp. 60-64.
67. Saxena, S.C. & Srivastava, R.K. Evaluation of library software packages available in India. *DESIDOC Bull. Infor. Technol*, 1998, **18**(5), 9-17.
68. Goh, Dion Hoe-Lian, *et al.* A checklist for evaluating open source digital library software. *Online inf. Rev.*, 2006, **30**(4), 360-79.

About the Authors

Dr Shailendra K is Associate Professor in the Department of Library and Information Science, University of Delhi since 2001. Earlier, he worked as Lecturer at Indira Gandhi National Open University and as Faculty at National Institute of Science Communication and Information Resources during 1982 to 1998. He has received Young Information Scientist Award and Fellowship Award of Society for Information Science in 1993 and 2008, respectively.

Ms Namrata Rai is Research Fellow in the Department of Library and Information Science, University of Delhi.