Application of Information & Communication Technology (ICT) in Information Management

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Abstract

Information and Communication Technology (ICT) has a very vast meaning and it has been dominating each and every aspect of this universe. Due to ICT only whole world has been become a global village and the other side ICT is accelerating information explosion, which leads to the problem of bibliographical control. But there are some tools, which can help us to manage these digital contents in a systematic order for use. The concept of digital library is very much suitable for information management. Here, we have Greenstone and DSpace Open Source Software for content creation, which are being used for maintaining an institutional repository. After content creations, the objective should be accessing these contents globally, for this purpose we need some broadband networks. In India, UGC-Infonet is the example for such kind of country-wide network which is being responsible for improving the higher educational system in the country with state-of-the-art technology. Now contents and infrastructure with strong network are with us, UGC-Infonet: E-Journals Consortium is one of the good examples which show that how we can facilitate the educational system across the country through this kind of ICT system.

Keywords : Information Management, Library Network, INFLIBNET, Digital Library, ICT, UGC-Infonet

0.   Introduction

Information Communication and Technology shortly known as ICT is not a single technology only, it is the complete system of technologies. Time to time this term has been defined by many scholars, learners and learned societies in different ways, but literary meanings of comprised terms are giving more appropriate and authentic idea about ICT. It is comprises with two strong technologies, one is *information technology* which usually deals with the hardware and software elements that allow us to access, store, organize, and manipulate the information by electronic means. The second is *communication technology,* which deals with the equipment, infrastructure and software through which information can be received, accessed and disseminates, for example phones, faxes, modems, networks, etc.

Today, we all are dealing with information and it is the strength of each nation, now status of any nation can be determined by its information resources rather than economic resources. It is not an exaggeration to say that due to ICT only we are talking about globalization. Not in library and information profession but all the professions are dominated by ICT, now we can hear about e-governance, e-banking, e-learning, e-business, e-education, e-publishing, e-documents, e-journals, etc.

1.   Consequences of ICT

ICT is playing a pivotal role for the emergence of information explosion theme. This information explosion leads to the problem of bibliographical control, which is the major and one of the biggest problem in front of all the library and information professionals. Their job is becoming more complex and tougher day by day. ICT is a very wide term and most specific and accurate example of ICT is Internet and this is a collection of millions and millions of documents but the problem is that all the documents are in scattered or unorganized form and information contained by many of them has not any durability or permanent significance. Many times Internet leads us to the misleading information or information pollution, e.g. If

someone is looking for "apple" fruit, the result out put will show information on apple (earlier computer's name) with apple fruit and will give millions of records, which leads us to wastage of precious time. In this case one should not get the exact information and Internet can take s/he far away from the needed information. At this juncture, being a library and information professional this is our responsibility to manage all the scattered information in such a way that it will fulfill the diversified needs of information society.

Information management is key element to catch up the 'mantra' of knowledge management. The motive of information management is *'right information to the right user at right time'.* Therefore, in this digital world of information we need some tools to manage the digital information with systematic order. Here, for managing important information on the terms of durability and permanency we have the concept of "digital library".

2.   Digital Library

The ICT innovation in the area of e-journals and e-books and mounting popularity of Internet gave birth to the concept of digital library. Although the term digital library has gained popularity in recent years. The digital library has material stored in a computer system in a form that allows it to be manipulated and delivered. "A digital library is a structured collection of digital objects and resources for universal access to the end users including interoperability, irrespective of platform and languages".

Michael Lesk (1997) defined digital library as "It is an organized collections of digital information. They combine the structuring and gathering of information, which libraries and archives have always done, with the digital representation that computers have made possible. Digital information can be accessed rapidly around the world, copies for preservation without error, stored compactly, and searched very quickly. A true digital library also provides the principles governing what is included and how the collection in organized".

Several infrastructural components are required for setting up a digital library. "Here meaning of the Infrastructure is the general functionality upon which other applications can be built" (Tim DiLauro, 2004). It is the set of systems and services that should not have to be recreated for each application in a digital library. The infrastructure of a digital library has to support mechanisms to import, export, identify, store, and retrieve digital objects and metadata. Generally in digital library we have to deal with many steps of different kinds to make it virtual system. These steps can be known as different phases of digital library, are:

1.   Collection Infrastructure phase
2.   Access/search phase
3.   Network phase
4.   Global Access phase

2.1   Phase - 1

Collection Infrastructure Phase : It mainly based on two components, i.e. metadata and digital objects. The metadata provides bibliographic or the index information for the digital objects and digital object is the document which holds the primary or full information. The main element of this is conversion of content from physical to digital form. It can be two types Born digital HTML, TXT, TEXT, XML, DOC, PDF, MPEG, JPEG, etc. and Print documents which contains physical library collection. Digitization of Legacy resources is very much important and large amount has been investing on this and this is fulfilling the target of preservation and conservation of important and rare documents.

	Original	Digital Image	Digital Information
Physical Form	Physical object (book, video)	Computer File	Computer File
Format	Varied (English text, etc.)	Comp. graphics program	Computer text, video or databases program
Readability	Human or special equipment	Comp. graphics program	Computer text, video or database program
Reproduction	Physically duplicate original (Photocopy, duplicate)	Copy file and print any no. of exact duplication	Produce original information in different form (re-print book in large italic type, play video with different sound track)
Manipulation	Physically modify (write in margins, cut and splice tape)	Mark electronically and manipulate graphically (add user specific notes, reduce/enlarge, re-sequence change colors, paste alternate images.	Edit the original information, produce derivative work, copy and distribute endlessly

* Table from *"the digital library tool kit"* by Dr. Peter Noerr

Apart from this, digital library is providing integrated access to its sources through single inter-phase. Here we need many image capturing devices, like- scanners, digital cameras, video cameras and photoCD systems, etc.

2.2   Phase - 2

Access/Search Phase : This component is dealing with the search and browsing facilities. In simple words, after collection digital library has to provide the simple and useful interface for users to search, browse and navigate the needed information which has stored in the form of metadata or in digital object. For content creation and providing access points to retrieve the information we need some tools. Software is a key component or tool to manage the information systematically. There are many options to choose the needed software. It can be developed by our own and can be purchased from commercial developer. Firstly, commercial softwares are so costly to afford, especially relates to developing countries, secondly, due to the information explosion and day by day intense changes are taking place in the area of ICT software needs updation regularly. This needs recurring grant of money. Therefore, the Open Source Software (OSS) is the right choice to manage the diversified information. We have many Open Source Software which are available free of cost, e.g. Greenstone, DSpace, Fedora etc.

2.2.1 Greenstone Digital Library

Greenstone is a suite of software which has the ability to serve digital library collections and build new collections. It provides a new way of organizing information and publishing it on the Internet or on CD-ROM. Greenstone is produced by the New Zealand Digital Library Project at the University of Waikato, and

distributed in cooperation with UNESCO and the Human Info NGO. It is open-source software and can be downloaded from its main website. The aim of the software is to allow users to build their own digital libraries. Languages in which Greenstone is available are: English, French, Spanish, Russian, Kazakh and Vietnamese. Greenstone runs on Windows, UNIX and Mac OS X and it can be customized. It can be installed in two ways, for a local library it requires Greenston software and Java virtual environment and for Web Library it requires Greenstone Software, Java virtual environment and Apache or IIS Web server running. Greenstone digital library software provides a flexible way of organizing information and publishing it on the Internet or removable media such as CD-ROM.

The workflow of greenstone based on four options:

The Collector	:	Collector helps us for creating new collection and modify and add to the exiting collection and delete the existing one.
Administration	:	Administration allows us to add new users, summarizes the collection in the system, and gives technical information on the greenstone installation.
Greenstone	:	It tells us about the Greenstone software.
Documentation	:	It contains the Greenstone manuals.

At the time of adding the new collection and adding in the exiting one the information undergoes a "building" process. Searching is based on various indexed, while browsing is based on various metadata because in ICT environment every digital object contains metadata. It can manage the downloaded articles in four steps, these are:

|		
Collection Information	:	Here we have to write the name of the collection.
Source Data	:	Select the downloaded article which we want to add.
Configure Collection	:	It gives configure information of the collection.
Build Collection	:	It builds collection automatically for the selected articles.

* Search with in the collection of individual.

2.2.2 DSpace

DSpace is a joint project of the MIT (Massachusetts Institute of Technology's libraries) and Hewlett-Packard (HP) Labs and it is freely available to research institutions word-wide as an open source system that can be customized and extended. DSpace is being considered as an institutional repository digital library system. It has been organized to accommodate the multidisciplinary and organizational needs of a large institution/university. It provides access to the digital work of the whole institution/university through one interface. It accepts any type of digital content, including: text, images, audio, video, scanned version of documents such as articles, preprints, working papers, technical reports, conference papers, books, theses, data sets, computer programs, visual simulations and models, and gives the flexibility to the institution to determine its own list of supported formats according to its needs and resources. One of the primary goals of DSpace is to preserve digital information, for this purpose it provides long-term physical storage and management of digital items and assigns a persistent identifier to each contributed item to ensure its irretrievability in the future.

Overview: **Data model**
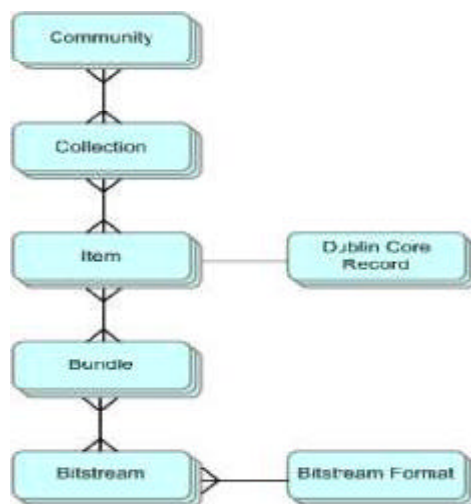
Data Model Diagram

The way data is organized in DSpace is intended to reflect the structure of the organization using the DSpace system. Each DSpace site is divided into *communities*; these typically correspond to a laboratory, research center or department. Communities contain *collections*, which are groupings of related content. Each collection is composed of *items*, which are the basic archival elements of the archive. Items are further subdivided into *bundles* of *bitstreams*. Bitstreams are, as the name suggests, streams of bits, usually ordinary computer files. Bitstreams that are somehow closely related, for example HTML files and images that compose a single HTML document, are organised into bundles. Each bitstream is associated with one *Bitstream Format*. Because preservation services may be an important aspect of the DSpace service, it is important to capture the specific formats of files that users submit. In DSpace, a bitstream format is a unique and consistent way to refer to a particular file format.

DSpace Technical Architecture

DSpace architecture is straight forward three-layer architecture, including storage layer, business logic layer and application layer.

Storage layer	It is responsible for physical storage of metadata and content file. It is managed by Postgre SQL database tables.
Business logic layer	It deals with managing the content of the archive, users of the archive, authorization and workflow, content management and search and browse module. Here each module has an API to allow DSpace adopters to replace or enhance the functions according to the need.
Application layer	This layer contains the interfaces to the system.

In this era of information explosion, with the help of DSpace one can easily handle the pressure of information explosion and this has been working as a tool for information management. Information and Library Network (INFLIBNET) Centre, Ahmedabad is also using the DSpace with new interface for the purpose of institutional repository.

* Screen shot of first interface of customized DSpace at INFLIBNET Centre.

2.3   Phase - 3

Network Phase: This component is giving the importance to network system for the digital library. Mostly digital libraries are based on the concept of server and cliental network system. What should be the configuration for the server and client, here, in this part we have to decide.

By using the digital library technology and Open Source Software for content creation, management and distribution, as described earlier, the ultimate goal of ICT applications can be achieved. Now challenge is to make these contents accessible at geographically separated locations. To achieve this objective latest development in networking technology using broadband networks, like Wi-Fi, Wi-Max, etc. can be of great help. UGC-Infonet is state-of-art example of such network, which has been fulfilling the different needs of academic community in India.

2.3.1 UGC-Infonet

UGC-Infonet is one of the biggest and ambitious programs has initiated by UGC for the development and improvement of the higher educational system in India. This is the Wide Area Network (WAN) connecting more than 170 universities and R&D Institutes etc. The main objective of this program is to share the library resources, qualitative and collaborative research, distance learning, multimedia application and accessibility of Intranet and Internet to the member institutions. The program is a joint venture of University Grants Commistion (UGC), Information and Library Network (INFLIBNET) and, Education and Research Network (ERNET). Here UGC is the main funding body, ERNET India is responsible for infrastructural part and, INFLIBNET is the nodal agency to manage, supervise and execute the whole program.

UGC-INFONET Network : ERNET has entrusted for connecting member institutions with state-of-the-art technology. On the recommendation of INFLIBNET different kind of connectivities are selected for this program, some of these are:

Radio Link Connectivity : Universities which are located up to 35 kms from the POPs (Point of presence is usually a location where a network can be connected) can be provided Radio Link Connectivity. The speed of data transfer in this is 64 Kbps to 2Mbps.

Leased Line Connectivity : Universities which are located more than 35 Kms to 100 Kms from the POP can be connected with this connectivity. Here a line from user's premises to ISP is leased from a basic telephone operator (BSNL or other basic service provider). Fiber Optical Cables are used for this connectivity. VSAT (Very Small Aperture Terminal) Connectivity: This is provided through satellite links. VSAT is a small earth station used for transmitting signals to and receiving signals from satellites. Two VSATs communicate with each other via a satellite. UGC-Infonet network have a two types of VSATs, one is TDM A (Time Division Multiple Access), it also called Broadband VSATs. Here, each VSAT transmits signals in the time bound basis. Due to small antennae size and low transmit power, these VSATs cannot communicate with each other directly. For their easy communication a big central earth station called Hub will be placed. The second one is SCPC (Single Channel Per Carrier) VSATs, in this case each VSAT allotted a specific frequency to transmit and because of larger diameter and higher power two VSATs can communicate directly without the Hub.

2.4   Phase - 4

Global Access Phase: Digital library may include digital contents in different formats and these needs to be organized and made accessible to the users. To get approached by the users on the web it has to follow the addressing protocols of the Internet, e.g. URL (Uniform Resource Locator), PURL (Persistent Uniform Resource Locator), URN (Uniform Resource Name) and, Digital Object Identifier (DOI).

Now, this network can be used in information management or content creation and all the universities must be benefited with this network. Universities can share their resources between each other, improve the distance learning, e-learning and e-education.   One of the biggest example of sharing the contents through network is UGC-Infonet: E-journals consortium through which all the universities of India have been accessing packages of scholarly literature.

2.4.1 Access to E-resources under UGC-Infonet

After ensuring proper connectivity, universities can access the E-resources provided by INFLIBNET under this program. The charisma of this e-journals consortium is that we are getting 60% to 90% off on the subscription of these e-resources under the consortium purchasing model, within that we are not only able to access current issues of the journals but able to get access for 5 to 10 years back volumes and

publishers like IOP and ACS are providing access to whole archive. The access to scholarly literature has been made available from January 1 st, 2004 to 50 universities start with as a first phase and second phase of another 50 universities have also been accessing these e-resources. Addition in the numbers of universities and resources are on increasing mode. Presently, 3000+ scholarly full-text e-journals with 8 databases and 2 portals are being provided under this program. After getting such an enormous amount of scholarly literature, it is important for the user to utilize these resources in systematic and exhaustive manner. Therefore, the training, orientation and awareness programs are very much important to inform the user. To keep proper usage of these e-resources INFLIBNET Centre has already been conducting one day user awareness program at various universities across the country. The same way access to Chemical Abstract through STN needs specialized training and it has been also carried out by INFLIBNET in different places. Enhancement and systematic approach, proper utilization of e-resources is the main objective of these user awareness programs. INFLIBNET has also been providing training to a person (mainly from the library side) who is nominated by the Vice-Chancellor of that particular university to carry out and co-ordinate the UGC-Infonet project into his or her university. Library and information professionals from more than 110 universities have already been trained at INFLIBNET Centre, Ahmedabad. The same kind of training for computer science professionals to understand or look after the network within the university is also carried out by ERNET, New Delhi.

3.   Conclusion

The innovations in ICT have brought revolutionary changes in creation, handling, processing, storage, and dissemination of digital information through communication network. Millions of millions digital information products are coming up day by day. Inability in bibliographical control is not a small problem but this is going to be a serious one due to the information explosion. The described Phases are not merely the phases of one system but each phase is unique system in itself. Each Phase needs systematic approach, planning and execution for accomplishment. Therefore, this is the right time to all the library and information professionals to woke-up and gear up to meet the challenges of digital environment. Now, complete systematic layout of a information management system is with us and its on the library and information professionals to take maximum use of it, for achieving this purpose training, orientation and awareness programs are most important to cope with the challenges of information explosion.

4.   Acknowledgement

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