

The Application of Open Source Software Technology in Electronic Information Management in Digital Libraries: The Case of DSpace

Mbah Relean-Jeans¹, Egbe Isu Michael²

¹Ph.D. in Information Science, University of Calabar, Cross River State, Nigeria

¹Lecturer of Library, Archival, Museum and Information Science, University of Buea, South West Region, Cameroon

²Ph.D. in Digital Librarianship, University of Calabar, Cross River State, Nigeria

²Lecturer in Department of Library and Information Science, University of Calabar, Cross River State, Nigeria

ABSTRACT

With the introduction of open source software and particularly DSpace in the broad and ever-growing world of information science, it is incumbent on information scientists and digital librarians to stimulate and ensure a sustained understanding, utilisation and optimisation of this new arm of technology. On the one hand, this research article is an investigation into what this new arm of technology called DSpace of open source software is all about. On the other hand, it acts as a gateway into the application of this new arm of technology within the precision of virtual information institutions such as digital libraries. It is within the competence of this research article to demonstrate that through a virtual platform called integrated library system, the timely introduction as well as adequate absorption of DSpace into librarianship is of enduring nature which leads to long-lasting significance in information acquisition, management and consultation. In perspective, therefore, the organisation of digital information resources through acquisition and circulation for instance are quite eminent when it comes to the application of this new technology in librarianship. In this scientific write-up therefore, there are explorations and presentations of fundamental aspects of open source software technology which contradict those of proprietary software technology. It is recommended that information institutions such as university libraries, archives, museums, etc. should solicit the services, procurement and institutionalisation of DSpace. Finally, a glossary is built at the end of this scientific write-up, and through this initiative, meanings are accorded to seemingly challenging terms and concepts which are generally frequent and unavoidable in this branch of information science.

How to cite this paper: Mbah Relean-Jeans | Egbe Isu Michael "The Application of Open Source Software Technology in Electronic Information Management in Digital Libraries: The Case of DSpace" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-8 | Issue-4, August 2024, pp.618-627, URL: www.ijtsrd.com/papers/ijtsrd67208.pdf



Copyright © 2024 by author (s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0>)



KEYWORDS: *Open source software, Electronic information, Digital library, DSpace*

1. INTRODUCTION

With the advent of software technology in library and information science a lot has changed in the methods which information professionals previously used in assembling and systematising information for public consumption. In the past few decades it is undoubtedly visible that software technology has brought a sea change in the conceptualisation and arrangement of information in libraries, archives, museums and other related information institutions. Software therefore, has flagged information scientists' as well as digital librarians' gateway to information widely opened towards the organisation

and management of relevant information in this new era of information globalisation. DSpace is an *open source software* technology that has particularly stood the test of time in digital information management in modern librarianship.

The philosophy behind open source software defines a free method in which software development, distribution and use, allow for peer review and transparency of progress. This technique has greatly contributed to the provision of qualitative information assemblage and management especially as it is capable of propagating salient elements such as

reliability, flexibility and lower cost. Consequently, open source software technology has proven beyond every reasonable doubt that it is an unavoidable end to the traditional or stereotypic reasoning which stipulates that financial remuneration must accompany goods and services. Open source software is an indication that information which is representative of the so-called 'goods and services' is free. In accordance with the aforementioned, therefore, it is encouraging to note that in open source software the source code and rights that could have been normally reserved for copyright holders are rather provided to all and sundry under a free software license that permits developers and users to study, change, improve and at times also distribute the software.

According to Lochhaas and Moore (2010) open source software is software that provides access to source code. This opinion or fact simply means that users are free to see how this production or product is constituted. Additionally, users possess the right and potentiality to adjust and/or adapt the product by offering a slight alteration to its code based on their liking, thought, experience and experiment with different versions. This is interestingly important because these acts of freedom and right are prerequisites of profound marketing. By the endorsement of these characteristics this product stands a great chance to be properly advertised, marketed and sold even at a giveaway price. However, it should be understood here that based on what is commonly stated as the principle of freely received freely given, it is highly expected of modifiers of this product to give it away or resell the new product with the guarantee that they must also provide free access to its altered source code. Modification and redistribution of the product are the two main components of open source software.

Kogut and Metiu (2001) posited that the ideology behind open source software is the promotion of information use and intellectual freedom. However, when it is said that open source software is free, many people misunderstand the meaning of this statement. Here, it is cautioned that information scientists, digital librarians, virtual archivists, electronic curators and anyone else who is deeply involved in the profession of digital information management, should think of "free" as in freedom, and not necessarily "free" as in price, although it often is. Founded in 1985 by Richard Mathew Stallman, Free Software Foundation (FSF) or Movement has a *raison d'être* which differs slightly from open source software ideology (Corrado, Sandy & Mitchell, 2018). This difference comes on the heels of the fact that in free

software there is freedom which promotes liberty in software technology which is more preferable to a situation in which there exists ownership in technology. This is a situation in which proprietary software is indeed abhorred (Lochhaas & Moore, 2010).

Based on GNU Operating System, Free Software Foundation promotes the *Four Essential Freedoms* of using free software:

- The freedom to run the programme, for any purpose (freedom 0).
- The freedom to study how the programme works so as to be able to change it and enable it to do what someone wishes (freedom 1). Access to the source code is a precondition for this specific freedom.
- The freedom to redistribute copies so that someone who is already in possession can be able to assist his/her neighbour or partner i.e. someone else who wishes to be in possession later on (freedom 2).
- The freedom which someone possesses to distribute copies of his/her modified versions to someone else or other people (freedom 3). By carrying out this specific freedom a primary user of this commodity can eventually distribute and redistribute it to an entire community of users who will have the opportunity of benefiting from the changes made by the primary user. Access to the source code is a precondition for this particular freedom.

2. BRIEF HISTORY OF OPEN SOURCE SOFTWARE

As far back as early 1960s there was the production and distribution of commercial computers which had a rather surprising element of freely distributed software accompanied by source code. This production and distribution was on a large-scale basis and was hosted by IBM. In the 1970s this promising trend unfortunately subsided in preference of proprietary software which operated under very restrictive licensing conditions. Then came the magical 1980s when things returned to where they previously were in the 1960s. By mid 1980s and under the auspices of Richard Mathew Stallman popularly known by the initials RMS, a movement was launched known as Free Software Movement.

In 1998 and under what was termed Mozilla Project, Netscape made a rather surprising announcement that it was going to release the source code for its web browser. This somewhat amazing announcement, was the main reason why a conference held in Palo Alto, California to discuss the strategic process for this

extraordinary event. In this conference, the term "open source" software was born. According to Neary (2018) this was the very first time that this term was coined; and its coinage was thanks to Christine Peterson. Although Christine Peterson is apparently projected as the first person to use the term open source, it is argued that RMS remains the father of open source technology.

Before this juicy advocacy brought forth by Richard Stallman's movement what dominated the existence of software technology in the 1960s was the first UNIX (or UNICS) operating system which was designed and implemented at Bell Laboratories by Thomson. Stallman's GNU was an alternative to Thomson's UNIX. Stallman licensed his project under what he termed *Copyleft* which is a direct opposite of what is normally known as copyright.

Soon afterward, Open Source Initiative was founded by Eric Raymond, another attendee at the conference who continued to promote open source education and community building. Open Source Initiative adhered to the responsibility of creating awareness towards the benefits of open source software (Lochhaas & Moore, 2010). These authors further revealed that GNU General Public License (GPL), created by Richard Stallman is an example of free software license, cleverly nicknamed copyleft license. Effectively, copyleft license uses copyright law to request and obtain works that have to be available for modification and distribution under the general philosophy of free and open source software. Obtaining a GPL is another form of copyleft which stands out as a technical assurance of the fact that open source rights are legally enforced ironically in its freedom.

3. INTEGRATED LIBRARY SYSTEM (ILS)

It is imperative to have a good understanding of ILS because open source software used in information institutions such as libraries are generally or commonly used when such libraries are adequately endowed with integrated library system. Adamson and Veronica (2008) are of the opinion that integrated library system which equally goes by the appellation Library Management System (LMS) is a reference made to what they term Enterprise Resource Planning System (ERPS) for a library. In an attempt to elaborate and substantiate this, it is clear that integrated library system or library management system or enterprise resource planning system is a complete electronic setup or platform which is designed to incorporate all the essential elements and components of librarianship which are considered as prerequisites for effective and efficient functioning of libraries. Nowadays, it is somehow mandatory for

institutions, establishments, organisations, companies or agencies of information such as libraries, archives, etc. which are modern in their operations and functioning to adopt ILS.

Within an integrated library system a couple of issues are mandatorily addressed and several activities are effectively and efficiently realised. For instance a software built to this capacity and capability should ensure that used or borrowed items are traced or tracked, needed resources are ordered for acquisition, salaries of workforce are programmed and paid, resources are organised through classification, cataloguing, indexing, etc. just to mention these few. Furthermore, Tennant (2008) is quick and efficient at illustrating how an integrated library system is a complex presentation of a typical *relational database* comprising two principal components technically called *graphical user interfaces*. In the architecture of an ILS its software is designed to offer possibility for two principal actors in the field of librarianship to interact primarily between themselves and secondarily among themselves and the things or issues of the library. These two principal actors are no other than library workforce also called library staff and library patrons who equally go by the name information seekers and/or users.

Information scientists and digital librarians who double as software engineers have found effective and efficient ways in which library staff who receive training as librarians can be productive in their activities, output and performances. In the architectural design or programming of an ILS which fulfils all the necessary parameters that can permit it to be implemented and integrated in librarianship in order to enhance the functioning of the library, there is what is known as modulation. Modulation is a situation in which an ILS which is non-proprietary in nature is originally designed by its manufacturer to divide and separate library chores or activities into discrete programmes called modules. According to Kochtanek and Mathews (2002) in ILS, software functions are separated with each being integrated with a unified interface. In a typical ILS galvanised by an open source software technology such as DSpace, this division and separation have led to the existence and availability of some fundamental modules for the coordination of library functioning. These fundamentally sustainable modules include the following:

- *Acquisition module* which is made to entertain and facilitate principal collection development activities such as selection, subscription, ordering, invoicing, etc.

- *Organisational module* which is designed to incorporate organisational activities such as classification, cataloguing, indexing, abstracting, etc.
- *Circulation module* which is built to enhance and facilitate the distribution of resources or materials to library users. It facilitates the implementation of two major circulation processes known as charging and discharging which are interpreted as lending of materials and reception of loans respectively.
- *Serial module* which is made to enhance, promote and coordinate activities that have to do with the manner and rate at which serial publications such as journals, newspapers, magazines, etc. are treated in the library by workforce and circulated to patrons.
- *OPAC module* which is a special designation for library users. This is the reason for which it is rather known as public interface for users.

In an integrated library system it is possible for every duly registered user to have all his/her activities and interactions monitored. This is because every bona fide member of a library community is awarded a unique identification commonly known as ID which can be used for reference, hence, tracking. Equally, it is quite possible for every workforce to have his/her actions, involvements, interactions or activities assessed and monitored. This is because the assignment of unique ID is not limited to information seekers and users. It is a generous award which is highly extended to the whims and caprices of all those who are involved in librarianship. These include workforce and users. In conclusion, it is fascinating to note that all materials which are processed in all institutions of information such as libraries are equally given unique IDs.

4. ELECTRONIC INFORMATION

Electronic information refers to an awareness-creating entity (or a collection that constitutes information resources) which is accessible through electronic devices such as computers, laptops, radios, televisions, etc. as well as handheld devices such as mobile phones, Kindles, Nooks, etc. which offer personal digital assistance to individuals. Electronic information refers to facts or knowledge that can be acquired and/or disseminated via electronic devices which either operate on an independent or standalone basis, or operate in conjunction and integration with factors and facilities which have the propensity to influence or enhance automation and to a reasonable extent digitisation which is equally known as digitalisation.

For electronic information to be made realistically available, a combination of fundamental components of what is generally known as Information and Communication Technology (ICT) must be brought together and connected to function in a union or as a system. For this to be a reality, fundamental components of ICT that must be incorporated include hardware, software and network. In reality, electronic information is simply the electronic version of intellectual contents of physical books, photographs, newspapers, magazines, paintings, etc. all of which are physically owned by a traditional library. This is the reason for which there is the existence of e-books, e-photographs, e-newspapers, e-magazines, e-paintings, etc. The letter “e” is used to represent the word “electronic.”

Open source electronic information software presents a system for the construction (assembling) and presentation (dissemination) of facts or knowledge which is present as information in either a singular arrangement or in a collection or collections. This has helped in building collections with metadata-based browsing facilities and searching. Moreover, this system can easily be maintained, augmented and rebuilt automatically with the help of various components of Information and Communication Technology. With many open source software applications now available for library and information management, information organisations and institutions currently have new options for acquiring, organizing and disseminating information. DSpace presents such illustrated capabilities. Therefore, the open source software application for library and information management that is researched and discussed in this article is no other than DSpace.

5. ELECTRONIC INFORMATION AND DIGITAL LIBRARY MANAGEMENT SYSTEMS

More often than not, a digital library is considered as a complex system. However, while Ferilli et al. (2010) simply view a digital library as any library in which collections are preserved in digital format and accessible through computers or computing devices, Waters (1998) considers digital libraries as:

“Organisations that provide the resources, including the specialised staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities.”

Das and Krishnamurthy (2014) view a digital library as an integrated system that allows the gathering,

cataloguing, storage, preservation, protection and retrieval of information at a right time to the right user. These authors are upbeat that a digital library gives service like a physical library does although in the form of digital media. Digital libraries provide users with soft copies of documents in a systematic way. They focus on collections of digital objects that can include texts, videos, audio recordings, still images and other digital documents. The uniqueness of a digital library stems from the fact that all its information resources which are available for patrons to use are stored and presented as digital media or in digital media format.

The concept and practicability of digital library services have greatly advanced during the past few decades throughout the world. Before now, digital libraries were merely understood to be the digital counter part of physical libraries and other information centres (or information institutions) among which include museums and archives. But currently, digital libraries are intricate networked systems capable of supporting communication and collaboration among different, worldwide distributed user communities (Tramboo, Humma, Shafi & Gul, 2012). Premium functionality as implemented by digital library management system is the conceptual and practical digitising of all possible information resources wherever and whenever they are available irrespective of their types or forms. Therefore, the major anticipated achievement of digital libraries is thoughtfully going to be the dissemination of digital and electronic information universally without boundaries. This is definitely a dream which has practically come true today.

An outstanding property of digital library management system is that the system makes allocation for a suitable framework that allows the incorporation of in-coming digital and/or electronic resources and providing for their integration within the system. With regards to electronic information management in a digital library what is of outmost importance is the fundamental functionality essential to the permutation of additional software that provides more refined and advanced application. This is absolutely factual because a digital library primarily offers and manages electronic information given that all digital information is primarily or basically electronic although this situation is not vice versa. While all digital information is electronic in nature only a portion of electronic information is digital in constitution. The practical institutionalisation of digital library can thus be realised by setting up and deploying a digital management system and then uploading a content

unto it which is largely composed of electronic and digital information. It is only when this methodology is exhaustively used (i.e. used to its last stage) that open source software technology can then be recommended for acquisition, installation and use.

6. OPEN SOURCE AND PROPRIETARY SOFTWARE

There are two major categories or types of software with respect to acquisition, organisation, dissemination and use of soft or virtual information. Since a digital library is a 'home' for soft or virtual information, it is mandatorily important to underscore the presence or availability as well as use of these two categories of software in a typical digital library. It should equally be understood that there are several types of libraries which deal in the management of soft information. In one of his leading research publications titled *School library: School and educational library media centre*, Relean-Jeans (2024) clearly differentiates among digital library, electronic library, virtual library, automated library and hybrid library.

In perspective, the two major categories of software technologies that are generally deployed in digital libraries include fee-based or commercial software and free or open source software technologies. Some major distinguishing features that differentiate these two categories include the class of functionality offered, the type of object model for information being supported, and the openness of their architecture. By implication, open source software is normally used to run an open source digital library management system. An open source digital library management system is an information system purely characterised by a series of unique factors or elements. It is a system which provides extensible features to system administrators and allows information-providing organisations or institutions to showcase their digital achievements to users or viewers all over the world with the possibility of causing some sort of restructuring or modification of existing source code which has the propensity to alter, adjust, revise and regulate certain contents of this system or software. Haven underscored the fact that digital library management system is available on commercial as well as open source software, it is now imperative to state that open source software and precisely DSpace is the one researched or investigated and reported hereafter in this article.

7. BRIEF HISTORY OF DSPACE TECHNOLOGY

As a word of caution, DSpace should not be confused with 1988 dSPACE of Herbert Hanselmann who served at Institute of Mechatronics which was based

in Germany especially in University of Paderborn. This other dSPACE is an acronym for Digital Signal Processing and Control Engineering. This research article is on DSpace and not dSPACE. Initially released in November 2002, Dura Space or DSpace in short is a remarkable digital repository system which captures, stores, indexes, preserves and redistributes an organisation's research material in digital form and formats. This software was launched in the year 2000 and its first version known as DSpace 1.0 was only released two years later i.e. precisely on the 4th of November 2002. However, in 2009 Dspace merged with Fedora Commons and this merge went a long way to ensure that as a software manufacturing company DSpace was actually counted among the world's largest, greatest and leading providers of open source digital repository software. In the year 2011, DSpace launched what is known as Dura Cloud. In reality, Dura Cloud is nothing other than open source digital preservation software service. This giant digital information-providing company known as Dura Space lastly witnessed a merge as late as 2019. This merge was with Lyrisis.

8. THE MEANING OF DSPACE TECHNOLOGY

DSpace stands for Dura Space and represents open source digital repository software currently being used in giant information-providing institutions such as libraries, archives and museums just to name only these few. Dura Space or DSpace in short has gradually become formidable especially for tertiary institutions which are involved in research and dissemination of soft information through library practices across the globe. To solicit the services of DSpace for a variety of digital preservation or archiving is a warranty for needs which include learning object preservation, institutional preservation as well as electronic records archiving. One good thing with DSpace is that as open source software, it is freely available for acquisition and use.

Furthermore, active communities of talented software engineers, researchers and users throughout the world who can contribute their own quota to the development and advancement of this technology, keep updating it with their latest expertise knowledge. Mellon (2004) corroborated by Morris (2019) is of the opinion that DSpace is a representation of open source repository software package. The main purpose of DSpace is associated with creation, control and management of open access information repository which is host to scholarly published intellectual contents. This repository software typically serves as a digital archiving system, focusing on the long-term storage, access and

preservation of digital content in general and digital intellectual content in particular.

9. DSPACE AS USED IN ELECTRONIC INFORMATION MANAGEMENT

A. MIT Libraries and HP labs

DSpace open source software technology is a product of mutual partnership between two world's leading giants in digital technology sector. MIT Libraries and HP labs are the initiators and developers of this lifelong joint project. According to Trambo et al. (2012 p.12), "DSpace is a digital asset management system which allows institutions such as libraries to collect, archive, index, and disseminate scholarly and intellectual efforts of a community." Written with a combination of technologies by MIT and HP, "it is primarily used to capture bibliographic information describing articles, papers, theses, and dissertations" (Trambo et al., 2012 p.12). Electronic information management is simple with Dspace because it uses such quick metadata access points like title, creator, subject, description, publisher, contributor, date, type, format, identifier, source, language, relation, coverage and rights. In this technology there is built-in interoperability between systems which adheres them to international standards for metadata format.

B. General characteristic functions of Dspace

It is important to underscore that DSpace is built on a highly flexible and accommodating disposition which consequently enables it to easily adapt to different information needs of a community of information users. Since DSpace is an open source technology platform, it can be customised to extend its capabilities. Some of its characteristics are as follows:

- a. It is an open source software technology whose design purposely target open access information management.
- b. Information management and archiving of digital contents or preservation of soft documents via DSpace are accorded with great flexibility and above all, a high tendency to cause modification within the system.
- c. It is used in creating open access repository for digital contents in general and soft documents in particular which are representatives of intellectual contents.
- d. As a relational database, it is in possession of many features that demonstrate overlapping and crossover functionalities.
- e. As information management system, it operates on the overall functionality of information management which is specifically attainable in information acquisition, information processing and information dissemination.

- f. Its digital archiving system is designed to operate on a long-term basis and ensures that content storage and preservation are digitalised.
- g. It is a turnkey digital repository application for durable access to digital resources.
- h. It provides a platform through which institutional repositories and/or collections are searchable and retrievable, and these activities or operations can be realised via the Web.
- i. It helps to make available institution-based scholarly materials in digital form and other related formats. These materials will be open and available to everyone who is in need and comes for inquiry, accessibility, location and retrieval.

C. Data organisation into bundles

The manner in which data (which cumulatively yield digital information and subsequently digital information resource) is controlled and arranged in DSpace is intended to reflect the structure of the organisation using the DSpace. Each DSpace site is divided into communities, which can be further divided into sub-communities reflecting the typical university structure of faculty, department and unit. Communities are composed of collections while collections are composed of groups or sets of related content. An important dynamism in this systematic arrangement is the fact that one collection may appear in more than one community. However, every collection is composed of items, which are the basic archival elements of the collection.

At an initial stage of data input (comprising data structuring and organizing), every item has just a single 'parental' ownership. But after the input stage, or in other words during the retrieval stage, despite the fact that an item originally has a single ownership, it may additionally appear in other collections. Items are further subdivided into bundles named bitstreams. Bitstreams are, as the name suggests, streams of bits, usually ordinary computer files. Trambo et al. (2012 p.8) stated that Bitstreams that are somehow closely related "for example HTML files and images that compose a single HTML document are organised into bundles." Similarly, Tansley, Bass, Branschofsky, Carpenter, McClellan, and Stuve (2005) stated that the bundles most items tend to have, always showcase originality, thumbnail, text, license and CC license. Consequently, there is a need to scrupulously examine these qualities.

D. General characteristics of bundles

Bundles which in other words are the smallest identifiable aspects of DSpace sites are characterised by some features. It is worth noting that a progressive breakdown of each DSpace site will result in

communities, collections, items (which are archival elements, bitstreams and bundles in this decreasing order of magnitude. The general features of bundles are as follows:

- a. *Originality*: The bundle content is original i.e. it contains the originally deposited bitstreams.
- b. *Thumbnails*: Thumbnails of any image bitstreams are constantly available.
- c. *Text*: It includes extracted full-text from bitstreams. This happens due to the originality which bundles have (i.e. due to the fact that bundles have original content).
- d. *Deposit license*: Every bundle most especially those in open source software contains a general license called *deposit license* which is usually an official permission of a submitter tolerating the host organisation to have right over his submissions or deposits.
- e. *CC-license*: This is a rather common license which a bundle has in order to legally support the promotion of its free distribution. This license specifies what end users can do with the downloaded content.

E. Interpretation of bitstream and its relationship with Dublin Core

One of the fundamental services which is so important to the functioning of DSpace open source software package is preservation service which traces the format of files submitted by users. It is important to capture the specific formats of files that users submit. The nature of a bitstream is unique and provides a coherent way to sort out a particular file format. Trambo et al. (2012) opined that the implicit or explicit notion of a bitstream format is the provision of means on how material in that format can be interpreted; for example the bitstream interpretation for still images compression encoded in the JPEG standard is defined explicitly in the Standard ISO/IEC10918-1. In DSpace each item in data organogram (or data organisational chart) has one qualified Dublin Core metadata record. An item may have other metadata stored in as serialised bitstream but all the time, Dublin Core is used to provide interoperability and ease of discovery. The Dublin Core may be entered by end-users as they submit content, or it might be derived from other metadata as part of an ingest process.

F. Expulsion of item from DSpace

Whenever an item is deemed necessary for expulsion from DSpace, it is done in two ways. Firstly, the said item could simply be 'withdrawn'. Withdrawal of items from DSpace is an act which makes items completely hidden from view but enables them to

remain in the archives. Item withdrawal therefore implies that whenever end users make an effort to access withdrawn items, an indication appear to them explaining that the item has been taken away and therefore no longer exists. Secondly, there is a complete removal or delete of an item from the entire system. For some peculiar or pertinent reasons, an item may be 'erased' totally from the system if absolutely necessary. In this case, all traces of it are removed from the archive.

G. The features of DSpace as Digital Management Software

As digital management software, DSpace primarily has two outstanding features which are authentication and authorisation. In Information Security Control (ISC), authentication and authorisation are basically *access control* to the content of digital information. Beside access control, there is physical control and communication control making all together three major types of controls in information security control. Unfortunately, physical and communication controls are not directly linked to this discussion. Consequently, only access control which is divided into authentication and authorisation is discussed in this information science article as follows:

A. Authentication

This is a process of ensuring that the 'digital signature' i.e. password of a contributor or user is valid. DSpace allows contributors or users to limit the access they have to items in a DSpace site at both the collection and the individual item levels. Authentication is therefore, the mechanism used by the system to securely identify its users. According to Sprague (2013) authentication is about: something the user is, something the user has, something the user does and something the user knows. In a simpler way, this author concluded that authentication is about password. There are basically three ways through which authentication can be provided in DSpace and these include user passwords, X509 certificates and LDAP. It is not every information user that has the privilege or potential to administer access control. In fact access control can only be administered by authorised users and this logically explains why authorisation is of utmost importance.

B. Authorisation

This is the mechanism by which DSpace determines what level of access a particular authenticated user should have to secure resources. Access control is always instituted in consonance with access control policies. So these two (i.e. access control and access control policies) always work together enabling a user to know the type of credentials that may be needed to

undertake particular actions when it comes to particular resources.

10. CONCLUSION AND RECOMMENDATION

DSpace open source software technology presents an easy to use, customisable architecture to create and manage electronic information. In organisations or institutions such as universities, use of this technology can greatly help to disseminate lecturers' as well as students' research works, manuscripts, publications, or other digital media which require preservation in digital form or format. As recommendation, information institutions and organisations such as university libraries, university archives, university museums and other libraries, archives and museums, are highly encouraged to solicit the services, procurement and institutionalisation of DSpace. Open source software technology generally presents different services and architectures. In as much as it is difficult to propose a specific open source software as the best, it is undoubtedly clear that DSpace is one of the most suitable in all cases.

GLOSSARY

Bell Laboratories is a long-time American research based corporation operating in the form of a laboratory. This corporation has left a bold mark in the world of technological and/or scientific innovation which is typically driven by research.

Creative Commons (CC) license is one of several public copyright licenses that enable the free distribution of an otherwise copyrighted work. A CC license is used when an author wants to give people the right to share, use, and build upon a work that he/she has created.

Digital library is a library in which all its information resources are in digital format. These resources can include text, visual material, audio material, video material, etc. stored as digital media. This is contrary to other media, forms, formats, etc. such as print, microform, etc. in which information is available, contained and served in a physical or traditional library.

Dublin Core Schema is a small set of vocabularies or terms that can be used to describe web resources for instance web pages, images, video, etc. It is also applicable to the description of physical resources such as books, compact disks, etc.

GNU which stands for *Gnu's Not Unix* is an operating system whose origin and development can be traced to an announcement made in 1983 by Richard Stallman. GNU is pronounced as "g-noo." As an operating system GNU plays a fundamental role in the open source software movement or free software

advocacy discussed in this article. GNU is often associated with General Public License (GPL).

GNU General Public License (GPL) refers to a license advocated by Stallman whose prerogative was to ensure the free utilisation, free sharing and free modification of software as fought for by the famous Free Software Foundation discussed in this article.

HP Labs is a short form of *Hewlett-Packard Laboratories*. HP Labs is an exploratory and advanced research group with headquarters in Palo Alto which is found in California in the United States of America. It started in 1963 as an initiative of Bill Hewlett and David Packard who happen to be cofounders.

HTML is an acronym for *HyperText Markup Language*. HTML is a standard markup language used with Cascading Style Sheets (CSS) and JavaScript, to create web pages and user interfaces for mobile and web applications.

IBM refers to *International Business Machine*. In reality this is a huge multimillion dollars company which is at the helm of computer manufacture, sale and distribution. Haven existed for over a century; it is a global technology that is responsible for salient issues in computing or computer technology some of which include artificial intelligence (AI), automation and hybrid cloud solution.

JPEG is an abbreviation for *Joint Photographic Experts Group* and it is pronounced jay-peg. JPEG is a commonly used method of losing compression for digital images, particularly for those images produced by digital photography.

LDAP is the contraction form of *Lightweight Directory Access Protocol*. It is an open, vendor-neutral, industry standard application protocol for accessing and maintaining distributed directory information services over an Internet Protocol (IP) network.

Linux is an operating system based off of the Linux kernel, created by Linus Torvalds (the computer wizard) in 1991. Linux is an open source operating system, meaning that the underlying code can be modified, built upon, and changed by anyone under the GNU General Public License. Most desktops computers run on Windows or Mac, and Linux remains an open source alternative, capable of being installed on a variety of hardware devices.

MIT is an acronym for *Massachusetts Institute of Technology* which is a private research university in Cambridge, Massachusetts that went operational in the year 1861.

Mozilla Project was a project designed to demonstrate to the entire world that there is a need to open the horizon of Internet and online elements of technology.

Netscape is a Web service company which is fully presented as Netscape Communications Corporation. Headquartered in California, Netscape in short is by every means an American based computer corporation which enjoys a lot of independence.

OPAC is the contracted form of what is known as *Online Public Access Catalogue*. In reality, OPAC is the electronic version or equivalence of traditional, physical or manual catalogue which helps in directing library users unto rightful resources which they are in need of. Unlike physical catalogue which can be touched with human hands, OPAC is virtual or electronic in nature and can only be observed with the eyes.

Open source means that the software is most likely free and the source code is completely open. Someone can modify, fix, add to, take away, and change the code any way he/she wishes.

Proprietary means that the software costs money and the source code is restricted. Someone cannot modify, fix, add to, take away, or change the code in any form.

Thumbnails are reduced-size versions of videos and pictures. They are very important in that they help experts to be able to recognise and organise video images and other digital pictures. Thumbnails carry out the same function for digital videos and pictures as normal texts index do for words.

UNIX which is equally addressed as UNICS is a multitasking computer operating system. Its full meaning is Uniplexed Information Computing System.

REFERENCES

- [1] Adamson, & Veronica. (2008). *JISC and SCONUL library management systems study*. Sheffield, UK: Sero Consulting. Available at www.jisc.ac.uk and retrieved on 20/02/2024.
- [2] Corrado, E. M., Sandy, M. H., & Mitchell, E. T. (2018). Nullis in Verba: The Free Software Movement as a model for openness and transparency. *Technical Services Quarterly*, 35 (3), 269-279. Retrieved from www.tandfonline.com on 10/02/2024.
- [3] Das, W., & Krishnamurthy, E. H. (2014). *Encyclopédie de l'informatique et des systèmes d'information*. Vuibert, Paris: Hermès Lavoisier.

- [4] Ferilli, S., Esposito, F., Biba, M., Basile, T. M. A., & Mauro, N. D. (2010). *Handbook of research on machine learning applications and trends: Algorithms, methods and techniques*. Available at www.igi-global.com and retrieved on 22/01/2024.
- [5] Kochtanek, T., & Mathews, J. R. (2002). *The evolution of library and information science, and enabling technologies. Library information systems: From library automation to distributed information access solutions*. Westport, CT: Library Unlimited. Available at www.archive.org and accessed on 22/01/2024.
- [6] Kogut, B. & Metiu, A. (2001). Open-source software development and distributed innovation. *Oxford Review of Economic Policy*, 17 (2), 248-264.
- [7] Mellon. (2004). *Final report on the initial development of the DSpace Federation*. Available at www.msc.mellon.org and retrieved on 12/01/2024.
- [8] Morris, C. M. (2019). *LYRASIS and DuraSpace complete merger: Members and community benefits*. Available at www.duraspace.org and retrieved on 03/02/2024.
- [9] Neary, D. (2018). *Six pivotal moments in open source history*. Available at www.opensource.com and retrieved on 19/01/2024.
- [10] Relean-Jeans, M. (2024). *School library: School and educational library media centre*. In press.
- [11] Tansley, R., Bass, M., Stuve, D., Branschofsky, M., Chudnov, D., McClellan, G., & Smith, M. (2003). *The DSpace institutional digital repository system: current functionality*. In Proceedings of the 3rd ACM/IEEE-CS joint conference on Digital libraries (pp. 87-97). IEEE Computer Society, available online at <http://www.lib4dev.org/journal>, retrieved on 13/02/2024.
- [12] Tennant, R. (2008). *Picking when to jump, part 2*. Available at www.web.archive.org on 12/02/2024.
- [13] Trambo, S., Humma, Shafi, S. M., Gul, S. (2012). A Study on the open source digital library software's: Special reference to DSpace, EPrints and Greenstone. *International Journal of Information* 16 (59), 75 – 87.
- [14] Waters, D. J. (1998). What are digital libraries? *CLIR Issues*. Available at www.clir.org and retrieved on 19/02/2024.