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A Descriptive Study on Digital Innovations and Technologies in Libraries

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Abstract

Libraries are social institutions that adopt new innovations for enhancing service and quality. This paper is about the descriptive study of three major technologies such as Artificial Intelligence, Big Data, BlockChain and their application in libraries and information centers. This paper also investigates, Libtech, an innovative open platform in Iran by merging these technologies. The adoption of new technologies will help the libraries to be up to date in quality and it also improves the user experience.

Keywords: Artificial Intelligence, BlockChain, Big data, LibTech, Libraries, Innovation.

Introduction

The expeditious advancement of technologies is affecting almost all industries. The development of these technologies not only change the day-to-day experience but also influenced the entire sector globally. Conventional roles and responsibilities are changing with new skill developments, opportunities, and challenges. This up-gradation is also required for the libraries, librarians, and library service. Innovation is always needed for the success of any organization. Research of humans contributed innovations in all spheres of life. They made the dissemination of information quite easy which is a vital thing for the world with the discovery

of the internet. Internet helps the world to communicate, transfer literature which leads to the information explosion. Information explosion denotes the abundance of data and its effects. The conventional method of library services will not be able to satisfy the requirement of users in this era of information explosion. The days are long gone when a library can, passively, assume that it will be recognized as an asset without having to defend that proposition and prove its worth (Lubbe, 2016). So the libraries which are the knowledge powerhouses should also be able to adopt innovations in their functions and services to meet their objectives, as stated by S.R.Ranganthan in his fifth law “Library is a growing organism”. As time evolved, we witnessed the revolutionary and dynamic changes that had happened to the libraries. As the new technologies were discovered libraries had the flexibility to adapt those for the fulfillment of their objectives. One of the major innovations adopted by the library is acceptance of electronic documents along with the printed ones and started serving patrons digitally. This had made a revolutionary change in the entire field of librarianship. This change made ICT an inevitable component of the library. The implementation of ICT had made drastic changes and made new concepts such as library networks, Resource sharing, etc which helped to uplift the enrichment of resources and service quality of the library. By various innovations adopted in libraries help the patrons to meet their information requirements even in the midst of the pandemic where the physical access of libraries was prohibited. So, innovations and technological advancements are very much vital in the field of librarianship and the librarians should eager to understand the operations of such modern innovations for the better quality of service in their institutions.

Latest Digital Innovations and Technology for the Current and Future Generations

Digital innovations are a necessity to manage the information in this era. Globally the libraries have reshaped, reconstructed to provide a wide variety of digital information services by adapting the modern technologies. The digital information service simply “saves the time

of the user” which is the fourth law stated by S.R.Ranganthan and allows the users remote access to the contents. Nowadays libraries are influenced by cloud services, social media, and other digital innovations which made a difference not only in the packing of information but also the customized way of dissemination of information according to the patrons’ interests. The latest digital innovations are:

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is a topic in computer science that is concerned with human behavior and how machines can imitate intelligent human behavior. The developments of AI depend on deep learning, machine learning, and natural language processing that will aid the computer to accomplish various tasks or jobs by analyzing a large amount of data. AI helps the system to recognize patterns, input data to drive predictions and improve accuracy with feedback data. AI can be defined as “The subfield of Computer Science concerned with understanding the nature of intelligence and constructing computer systems capable of intelligent action.”(Winston, 1999). That means the AI program will enable computers to perform activities that require the intelligence of humans such as visual perception, speech recognition, decision making, and translation of languages. Logic and rules-based decisions, pattern-based learning, deep learning, and neural networks are the components of artificial intelligence. AI includes expert systems, talking specifically about libraries Artificial Intelligence can do much in information packaging, organizing, and dissemination.

By the adaptation of AI quality of service and efficiency of the libraries will be improved. AI will lead the information retrieval skills of the librarians to their best. We retrieve information using keywords as input but AI will search using semantic text matching. Semantic text matching is the task of estimating semantic similarity between the source and the target text pieces. It can also be applied in query-to-document matching, web search, question

answering etc. Through this technology the information retrieval will be more accurate and stricter to the area of interest. AI can also produce a data visualization tool from the trends of previous searches of the user which may find the users to new dimensions of the existing data. It also helps the librarians to observe and explore the flow of information within their organization which may help them to recognize the weak points in the process and make necessary changes.

AI can introduce Chatbots which can be used in library websites to interact with patrons 24*7. These chatbots will give clarifications to the doubts of the users accessing the website at any time, irrespective of their location. It can satisfy the user with all statistical information related to the functioning, services, and policies of the library. Chatbots can guide the user throughout the website and help the user to explore the electronic resources. Webopac and other digital library services. It can also alert the users about the due date of the book.

Another important feature of AI is the user-centric customization of information. AI will identify the information behavior of each user and suggest documents on the basis of their previous searches. CAS and SDI services will be more specific and updated as per the requirement of the user. Alerts will be sent to the user as soon as a matching document is found on the database. Content indexing using AI will allow the user to navigate documents interdisciplinary and most updated information about the requirement. By the application of AI, we can retrieve information from images, voice recognition, audio, and video streams. There are many data visualization tools that can be used to get connections among concepts, research scholars, and scientists working on the same topic, with their affiliated institutions.

Advancement in AI will enable a web browser in which keyword search strategy will be replaced by semantic web technology. Tools for multilingual voice translation and cloud-based translation of webpages. Librarians can use AI tools to provide not just information but

“deep intelligence”. They can offer “Insight As A Service” (IAAS). This service can be provided by identifying relevant tools for user groups accordingly. Thus, AI is one of the best innovations for the library to provide better quality of service to its patrons as their requirements.

BIG DATA

Big data is the huge enormous data collected by different organizations around us. There are many applications that we use so often based on big data. All the social media websites are examples of big data applications which help us to get connected with each other and entertained with the contents provided. Big data contains an enormous amount of data that are both structured and unstructured and these huge data cannot be processed by conventional methods. By analyzing big data, we can make better and faster decisions based on previous statistics. Gartner Group Inc. (2001) defined Big Data as “high volume, high velocity, and or high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery, and process optimization. “Its analysis will lead to cost reduction, time reduction, development of a new product which can be optimized, and smart decision making. Characteristics of Big Data are:

Big data is characterized by 4 V:

Volume: Big data will always be a huge amount in size when compared with ordinary data. This is machine-generated data and it is loosely defined and cannot be stored in conventional hardware and software. Conventional data have size belongs to Kilobyte (kb), megabyte(mb) while big data are of a terabyte, petabyte size.

Velocity: Velocity denotes the speed at which data is generated. We all experience lightning speed in the production and dissemination of information while using social networking sites.

Variety: This denotes different number of ways the information can be generated. Earlier there was only textual information. But with the advancement of technology now information can be generated using photographs, audio, video, and many other forms.

Veracity: This V refers to the quality, authenticity, and availability of data. Veracity means the accuracy of data. In the case of big data, veracity is so important as an inference from big data is used in the decision-making process so if the data is inaccurate corresponding decisions will not be accurate.

In the case of libraries, the V characteristics of big data are not that important as the library does not store such a huge amount of data. For libraries, the data open for analysis and inference from the data are more important than storing and processing the data.

Types of big data from the outlook of a library are:

Archetypal big data sources: Archetypal big data sources are produced through government, projects, and organizations. These data will have high volume, veracity, velocity but less variety. These data are given by automated systems and devices. The type of archetypal data in libraries are:

Exhaust data: These data are produced when the patrons use self-service. That is self-checkout using advancements in technologies.

Patron activity data: These data are from the circulation section such as transactional loans, fine payments, reservations, etc.

User Behaviour Data: The data produced by the user while accessing the library website and other subscribed resources.

Usage pattern data: These data are produced as per the usage of resources by the user. The libraries get this data from the activity log.

Crowd-sourced big data sources: This type of data is of huge amount, variety in form, velocity may not be uniform, low veracity and short-lived. In libraries, such data are produced by the comments from social networking pages of the library.

Sensor stream big data sources: These are data taken from personal wearable devices, environmental systems, and automated surveillance systems. These data have mixed veracity but are high in other vs. such data in libraries are produced from the CCTV footages, gate counters, temperature control meters, from connected networks, etc.

Long-tail big data sources These types of data sources denote the scholarly data generated through scholarly publications. These data have high volume veracity but low in variety and velocity. These types of data are mainly seen in academic libraries and R and D special libraries. With the help of big data, these libraries can also provide access to their data sources under their stewardship.

Use of Bigdata in libraries and Information Centres:

The application of big data will lead to shedding light on many issues in the library. By this big data analysis, the librarians can take better decisions in all the spheres of library activities and services based on the inference from the previous data.

Analytics in Library: Library analytics is a term inspired by analytics conducted in other firms. The library analytics help the libraries with library planning, improving efficiency in operations, and optimizing collections in the library. By analytics, the libraries would get an insight into the demand and trends of collection, problems faced by the users in accessing the library, efficient dissemination of research data.

Library dashboards can be used to visualize library analytics. Dashboards are systems that can store data taken from heterogeneous sources. The dashboard of a particular library may contain data from all diverse systems, both open and proprietary. The advantage of a library dashboard is that the user can navigate the resources of the library from a single point. In order to start a library, a dashboard requires a serious effort that brings data from different sources to one common format. From the library dashboard, the libraries get the information-seeking behavior of the user in seeking library resources both digital and print. So that the library can optimize their collection and services according to the pattern. This will increase the service quality. For the user, the library dashboard will help them in saving time and can access all the resources a single entry.

Crowdsensing of the interest of users: Crowdsensing is a technique where a large group of individuals having mobile devices capable of sensing and computing (computers, mobiles, tablets...) data is collectively shared and extract information to measure, map, analyze or infer any process of common interest. (Wikipedia). Libraries generate the data regarding them by their online resources, websites, digital services, and social media pages maintained by libraries for promotions and other extension services. By this, the librarians will know the patterns of users and areas of improvement in the library. such as collection development, library timings, loan period, etc. As the interest of the user known the libraries can optimize according to that, which will enhance the quality and usage of resources of libraries.

Library services: Libraries are traditional service-oriented institutions that provide reliable information to users in an unbiased manner. The library data services can be broadly divided into

Research data service and Collection data service:

Research Data Services: The data services which aid in the progression of research can be termed as research data services. Research data can be defined as data collected, observed, created, or collated to analyze and eventually verify research findings (Boston University Libraries, [2016] & EPSRC, 2016). Research data management (RDM) in turn refers to an explicit process of effectively organizing, structuring, storing, and caring for research data – during and after research (Ingram, 2016, DCC, 2016c & University of Edinburgh, 2016a:3). Academic libraries and special R&D libraries give more importance to the research data service. They have a special organizational structure in order to disseminate the research data services. RDM plays an important role in organizing and managing data during the research and after the research, it also helps in the collection, organizing, processing, analysing, sharing, and reuse of data. Using research data management tools, the libraries satisfy the data requirements of the researchers. The main RDM services provided by the libraries are creating awareness about the purpose relevance and ethics of research, training, and consultation of RDM activities like creating, analysing, synthesizing, storage, sharing, and citing of data, developing of data repository for future use.

Collection's data service: This service is associated with the resources subscribed to in the libraries. The resources in the library can be considered as big data and analyzing, arranging, and mining this data will lead to huge potential for the users. Libraries are playing an intermediary role between the clients of data providers and users. Libraries have subscribed or purchased a large amount of data from different vendors for the institution they belong to. The libraries should organize such data for the students or the users as per their requirements. From the perspective of big data, libraries can provide different types of consultancy services for the researchers in assisting their research.

BLOCK CHAIN

Block chains allow us to have a distributed peer-to-peer network where non-trusting members can verifiably interact with each other without the need for a trusted authority (Christidis and Devetsikiotis, 2016). Bitcoin integrates various inventions like b-money, time-stamping, Hash cash, and Merkle Tree to develop a decentralized system that does not rely on the third party for the authorization of currency issuance or validation of the transaction (Miau and Yang, 2018). “A blockchain is an electronic ledger of digital records, events, or transactions that are cryptographically hashed, authenticated, and maintained by a shared network of participants using a group consensus protocol” (Condos et al., 2016).

Blockchain has three versions. Blockchain 1.0 completely deals with bitcoin, the cryptocurrency. Blockchain 2.0 deals with the whole economical market. Blockchain 3.0 deals with all other applications which are not covered in the first and second generations. (swan2015) According to Chen et al. (2018), the current applications of blockchain technology are still in the 1.0 and 2.0 stages.

Blockchain is a type of “distributed ledger” or “distributed ledger technology.” Which consist of a series of data blocks created by cryptography. Bitcoin, a cryptocurrency based on blockchain technology, was first introduced in 2009. The Bitcoin blockchain is a set of blocks strung together that record Bitcoin transactions. Each data block contains a batch of transaction information on the Bitcoin network. (Zhang, 2019). Blockchain have a distributed database of records that can perform transactions and each transaction is maintained and validated by the network of computers called nodes, In this technology, the records are handled by a large community and not a single individual so the transaction history cannot be edited or deleted. This technology allows everyone in the network to access the complete data in the network.

The transaction cycle contains three steps. First one is request for transaction. The transaction request is broadcasted to all nodes in the network. The transaction made should be recorded and authenticated. The authentication is done by cryptographic hash function by the others. The validated block is then added to the existing block chain. The next block will get connected to this block using hash function and the process will continue. Each block in a block chain constitutes of transaction and meta data, cryptographic hash (used for validation), a hash of the previous block.

Major characteristics of block chain technology are decentralization, Immutability and Security. Decentralization means there is no single authorities to manage all the participants are equal. Immutability is denoted that once a block is added to the block chain it cannot be altered. The data in the block chain is highly secured as each block is connected to each other, so if there occur a single alteration to any of block will affect all previous block.

Application of Block Chain technology in libraries:

Libraries are always open to adapt innovations and technologies to enhance its user services. It provides an opportunity for library and information science professionals for identifying, collecting, organizing, customizing or processing and disseminating information products and services to the users on-demand or in anticipation (Ragavan et al., (n.d.). The main objectives of the libraries are to collect, organize, preserve, and disseminate information which is similar to block chain.

In the case of journal articles blockchain has a potential use of creating verifiable and time-stamped versions of it (Hoy, 2017). In the field of scholarly publishing where it can be used for managing manuscript submissions, reviewing manuscripts in a timely manner and for its further verification (Casino et al., 2019). Block chain can also be used for transferring funds from libraries to vendors and maintaining contracts and records (Coghill, 2018). According to

Hoy (2017), Rving and Holden successfully examined the use of the block chain “as a low cost, independently verifiable method that could be widely used to audit and confirm the scope of scientific studies”. Block chain can assure transaction authenticity by confirming parties’ submitting a record and its content, date and time of the submission (Condos et al., 2016). Blockchain technology may be a solution wherever the need arises to exchange sensitive information which requires encryption (Coghill, 2018). The reproducibility of digital resources is a major problem faced by libraries nowadays using Digital Rights Management (Block chain tool) this problem can be solved by using Digit Rights Management block chain technology is linked with digital resources, because this will make these resources to be identified, controlled, processed and transferred uniquely (Griffey, 2016). If the libraries use this block chain technology than this might change the scenario of buying and paying of the e-resources (Coghill, 2018). Using block chain method we can lend a book to the user or to another library without physical access to the library. This can be made possible using LibChain. It is a Distributed Library Management System based on blockchain technology and ideate advanced processes to borrow books from the libraries. (Hasan, 2020). With the help of LibChain, a user can transfer the document to another valid patron of any other library. This system also supports inter library lend services which will boost the cooperativeness and resource sharing among the libraries.

Libtech: OPEN INNOVATION PLATFORM IN THE NATIONAL LIBRARY AND ARCHIVES OF IRAN

Libtech is the integration of emerging technologies such as Artificial Intelligence (AI), Blockchain, Deep Learning, Big Data Analysis, and other related technologies into library and archive systems and services in order to improve use and delivery to the user. Indeed, Libtech seeks to develop a value-added service that is most useful in libraries and archives. Its mail

purpose is to improve a user's experience with developing technologies as well as promote productivity (Zendehdel Nobari, 2020).

In the modern world the conventional role of libraries and national archives which usually collect, acquire, organize, preserve and access to the heritage of nation alone will not satisfy the requirement of the user. NLAI has a great collection of millions and it has about 2.5 lakh registered users. As information explosion is occurring globally, Iran also has good contribution to it. The information published in the Persian language has tremendously increased and the technologies used to process was efficient enough manage. So the NLAI need new technologies to handle this data fruitfully. So, they found a systematic and consistent solution to this problem. As a result, the NLAI planned to launch open innovation platform for data-driven solutions (in the field of libraries, information centres and archives) in Iran called Libtech.(Tayarani, n.d.)in 2018. The major goals of LibTech are response to a change in need to adopt to new technologies and innovations by users in an open collaborative platform; developing a network chain of Libtech ecosystem; and involving users, researchers and entrepreneurs to improve service standards.

A Persian/Arabic Word Spotting system for historical handwritten manuscripts (SANADJOO):

Writing is an important means of communication. We discovered the culture, traditions, and all the details of previous generations through the literature they wrote. Before the invention of papers people used various medium for written communications. These heritages are preserved in various archives of the world with at most care. Due to the preservation researchers, historians do not get much access to the content of these preserved manuscripts.

Then with the advancement of technology the documents started to digitize, so as the historical handwritten manuscripts. As the digitisation moves further and the amount of documents starts flourishing the need of transcribe, extract retrieval of information is also

necessary. Since manual transcription by human experts is prohibited developing an automated extraction of information became a challenge.

The LibTech created SANADJOO (A Persian/Arabic Word Spotting system) to solve this challenge. With full text search technology, SANADJOO has developed a new indexing and searching method for historical manuscripts, particularly in Persian/Arabic.

This project is divided into two phases, that are Indexing document and search keyword. In the first phase we index content of the scanned document hierarchically and this phase is completely an offline phase. The phase Search keyword deals with the retrieval of documents. The indexed documents which match with the query should be shown and this is an online phase.

Word spotting or keyword spotting is a process in which a query is formulated by the user the system searches the matching document in the database and a list of documents which similar to the query is displayed as output. The retrieval process is based on matching of different features such as colour, texture, etc of the query with the documents of the database. But here we want to search textual information from the digitized document images, which can be done by using document image word spotting techniques. Two different methods for this technique. First one is the conventional method which optical character recognition (OCR) techniques but they cannot be used for recognizing handwritten documents. Second one is the word spotting technique in the image domain. Word spotting is introduced as an alternative to the OCR technique. Word spotting finds a specific keyword in document images by comparing features that are extracted from word images. Majority of the word spotting based techniques find keywords as follows: firstly, that build indexes based on low level features that are retrieved from word images. these features are also can extracted from query images. Secondly, they search the full database for similarity between the query image and each of the database's

word images. Finally, the results are arranged based on the similarity matching level. Document image word spotting presents problems worth solving.(Tayarani, n.d.)

The system developed by the NLAI of Iran is of great importance as they provide access to each countries heritage data. Which were inaccessible to the public. This automated system recognises the what is written on the manuscripts and are able to retrieve the acquired data as per the requirement of the user which lead to more studies, research, discoveries of the past.

Conclusion

The innovations mentioned throughout this paper are for the upliftment of the user experience of the libraries. Libraries stand as a social institution to disseminate information and enrich the society for a better standard of living. By the adoption of new innovations and technologies the quality of service to the user will be improve and service can be customised for each user. Such steps will help the library to become more user friendly. Innovations in technology will provide the librarian with an opportunity to work as hand in glove with the users in this digital era. Adaptations of new innovations will give the library more reputation and attract new users. Innovations make the library more interesting, relevant, with better service experience for the user,

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