APPLICATION AND USE OF ARTIFICIAL INTELLIGENCE (AI) FOR EFFECTIVE LIBRARY SERVICE DELIVERY IN FEDERAL UNIVERSITY LIBRARIES IN NIGERIA

Musa Baba Adamu PhD, (CLN)[1]
(08036758480) adamu.musa@futminna.edu.ng;
University Library Services,
Federal University of Technology Minna, Niger State, Nigeria
Mohammed Abubakar Abdullahi PhD, (CLN)[2]
Centre for Energy Research and Training,
Ahmadu Bello University, Zaria
(080837788655) abubakara@yahoo.com
Garba Shambo Mohammed PhD, (CLN)[3]
(07032605330) garba.mohd@futminna.edu.ng;
&
Abdulkadir Mustapha Gana (CLN)[4]
mus.abdulkadir@futminna.edu.ng;
University Library Services,
Federal University of Technology Minna, Niger State, Nigeria

Abstract
Artificial Intelligence (AI) is now applied with evidence in almost all aspects of disciplines, in the institutions of learning, health care services, the innovation in economic development as well as in the University library for efficiency and effectiveness. This study focused on the application and use of artificial intelligence (AI) for effective library services delivery in University libraries in Nigeria. (It was centered on how, and which areas in the University library that artificial intelligence (AI) is applied). It was found that artificial intelligence has different component such as the expert system, pattern recognition, natural language processing, as well robotics, and these different components of AI can be applied in Nigeria Academic libraries. For example, they could be applied in the area of acquisition of library materials, cataloguing, classification and indexing. Literature surveyed equally revealed that there are many is an example of artificial intelligence such as robotics, expert system, natural language and so on with advantages that could revolutionize service delivery in University libraries. Nigerian University libraries could use artificial intelligence in its operations conveniently. There are also the challenges that pose some barriers which should be looked into in order to ensure that Artificial Intelligence efficiency, effectiveness and quality University library service delivery is achieved.

Keywords: Artificial intelligence, expert system, natural language processing, robotics, University libraries

Introduction
University libraries are information centres established in support of the mission and vision of their parent institutions to generate knowledge and people equipped with knowledge in order to serve the society and advance the well-being of mankind. University Libraries are considered as the storage house of academic information and all the relevant information for the role of knowledge management in the welfare of the institutions. University considers knowledge as the key resource in the development of any society. University libraries are adopting digital technologies and services to provide improved access to modern information resources for effective research. University libraries are evolving which make it possible to offer a wide

range of services and resources beyond just books. Key aspects of University libraries to be able serve staff and students include automated systems, digital collections, and innovative services. This resulted in the introduction in Information and Communication Technology in University libraries.

The introduction of Information and Communication Technology (ICT) which is a generic terms that refers to the technologies that are used to collect, store, edit, and communicate information in various formats. University Libraries have become one of the institutions mostly used to manage, disseminate, and preserve knowledge (Jones & Umoh, 2022). The University library's ICT collection comprises both the physical materials and all digital or electronic information resources and services that the library provides to staff and students (Jones & Umoh, 2022). Information and Communication Technology is one of the wonderful gifts of modern science and technology, which has brought tremendous changes in Library and Information Science discipline. It has opened up a new window in library communication and facilitated global access to information across geographical limitations (Tomar, 2021). University libraries worldwide have embraced ICT solutions to modernize their services and improve users' experiences. These include the adoption and application of automated systems for cataloging, circulation, and resource management using library management software, the establishment of digital repositories and online databases for open access and through subscription, the implementation of virtual reference services, and the provision of remote access to library resources (Verma, 2015). However, despite the global advancements in ICT adoption in University libraries, challenges and disparities exist across different regions and institutions. Factors such as inadequate infrastructure, limited funding, lack of digital skills, and resistance to change pose obstacles to the full realization of the potential benefits of ICT revolution in University libraries (Chutia, 2015). University libraries are the nerve center of an educational institution and a place where information is provided to serve all patrons irrespective of their ages, political or ethical background, religion, sex, etc. It could be seen that the role of higher institutions cannot be achieved without the presence of libraries that are adequately equipped with printed materials, Information and Communication Technology (ICT) and its related facilities, well trained staffs and a high level of services to users that will satisfy their information needs (Ajibero, 2004).

Artificial simply means something that is not natural. Accordingly, Collins online dictionary (2021) defined artificial as "made in imitation of or as a substitute for something natural" it could be noted from the Collins dictionary that artificial can be known as man-made, a work or something made out of human knowledge and skills, for example an artificial leg, or artificial teeth, another example is artificial intelligence. Intelligence can therefore be defined in several ways, from the layman perspective, intelligence could simply mean ability to comprehend and apply knowledge, however, the definition of intelligence can be understood from different point of view. The concept of intelligence is not a recent term, thus, Hindes, Schoenberg & Saklofske , (2011) defined intelligence in terms of judgment, practical sense, initiative, and adaptability, this definition stills suit this current generation and it could be noted that intelligence has different types such as moral intelligence, emotional intelligence, human intelligence, spatial intelligence, musical intelligence, linguistic intelligence, naturalistic intelligence as well as artificial intelligence. Artificial Intelligence (AI) therefore is the capability of a device to perform functions that are normally associated with human intelligence such as reasoning and optimization through experience. AI can be said to be the intelligence of machines.

The application of Artificial Intelligence in University libraries will influence connectivity of information technology and actively support information usage as well as easing staff and students' search and immediately address their needs. The impact of artificial intelligence and advanced computer technology on the nature of future University libraries will be enormous and the quality difference varies from different researchers (Vijayakumar & Sheshadri, 2019). Asefeh and Asemi (2018) list various ways in which Artificial Intelligence technologies can be used to improve library services delivery to include the followings: circulation services, shelving of books, cataloguing of library materials, among others. Many University libraries, most especially those in the developed countries make use of Artificial Intelligence for the provision of library services to the academic and students.

Conceptualizing Artificial Intelligence (AI)

Artificial Intelligence (AI) is the ability of a digital computer or computer-controlled robot to execute tasks often associated with intelligent beings (Abdullahi ,2023). This phenomenon is widely given to the endeavor of producing systems with human-like cognitive processes, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the development of the digital computer in the 1940s, it has been proved that computers can be taught to perform extremely complex jobs with great proficiency, such as discovering proofs for mathematical theorems or playing chess. Despite ongoing increases in computer processing speed and memory capacity, no programs can yet match human adaptability across broader fields or in activities requiring extensive everyday knowledge. On the other hand, some programs have surpassed the performance levels of human experts and professionals in performing specific tasks, so artificial intelligence in this limited sense can be found in applications ranging from medical diagnosis to computer search engines and voice or handwriting recognition (Abdullahi ,2023). AI research has mostly focused on the following aspects of intelligence: Learning, reasoning, problem solving, to discuss a few.

The Learning Stage: The learning stage is the first stage in the growth process of artificial intelligence, just as it is with humans. There are several types of artificial intelligence learning. The most basic method is trial and error. In the context of artificial intelligence development, the learning process entails memorizing of particular things such as different issue solutions, vocabulary, and foreign languages, among others. Through this learning process, artificial intelligence algorithms can keep track of any activities or moves that resulted in favorable outcomes, allowing the program to harness this knowledge within its data if similar situations emerge in the future (Abdullah, 2023).

Reasoning Stage: The second fundamental component of artificial intelligence is reasoning. While the concept of mental thinking has mainly been limited to the human mind for much of recorded history, much of the development of artificial intelligence is based on software programs that can draw conclusions and inferences from a situation without the need for human intervention. Furthermore, these inferences are classified into two types: inductive and deductive reasoning. The most significant difference between these forms of reasoning is that in the deductive case the truth of the premises guarantees the truth of the conclusion, whereas in the inductive case the truth of the premise lends support to the conclusion without giving absolute assurance. It has been quite successful to train computers to make conclusions, particularly deductive inferences. True reasoning includes more than just making assumptions; it entails making assumptions that are pertinent to finding a solution for the specific problem or circumstance.

Problem Solving: The third major component that makes up the development of artificial intelligence programs and systems is problem-solving. Problem solving, particularly in artificial intelligence, can be defined as a methodical search through a set of feasible actions to achieve a stated goal or solution. Problem-solving techniques are classified as either special purpose or general purpose. A special-purpose method is tailored to a specific problem and frequently takes advantage of highly unique elements of the setting in which the problem is embedded. A general purpose approach, on the other hand, is applicable to a wide range of problems. 3 AI Application for Academic Library Services Delivery Academic libraries are to re-position themselves to take relative advantage of artificial intelligence's potentials by refining the quality of library services in this era of the information age (Tella, 2020). Nigerian Universities may adopt a combination of traditional and online teaching methodologies like their counterparts in developed countries (Atayero, 2020).

Application of Artificial Intelligence in University Libraries

Librarianship is a branch of information provision and dissemination concerned with the timely and effective delivery of information to users on demand and in advance Idemodia and Makinde, (2022). In other words, they put information and its sources at the users'/clientele's "fingertips" and "doorsteps." Librarians should aid their patrons in completing research on specialized topics as well as in selecting recreational reading resources. In other words, they provide reference services to inexperienced clients who are not sure on how to conduct a successful library search, this encourage people to value reading, improve their reading habits, and consider University libraries, as essential resources for the development of knowledge. The higher institutions libraries particularly the University libraries are seen as the heart of the institutions because of the essentialities of the services they provide. Laboratories, equipment, teachers/classrooms, and libraries are the four key pillars in higher learning, and they all contain vast and comprehensive information and resources that can support teaching, learning, and research. University Libraries are the central hub of an educational institution, serving all clients regardless of their generations, philosophical and moral beliefs, religion, sex, and other characteristics Idemudia and Makinde, (2022). It can be seen that the role of institutions of higher learning cannot be realized without libraries that are integrated strategy with print, information and communications technologies and supporting facilities, well-trained staff, and a high level of support to clients that will meet their information requirements. In the view of Dawa, (2021), it could be noted that the University library is no longer just a physical structure that house information resources, it could be any platform either physical or in cloud space whose primary aim is to make accessible and available information materials to different users to satisfy and meet their information need through a sequence of a systematic classified and organized pattern, the University library as a cloud space which functions simultaneously as the digital library of today have harness and deploy emerging technologies in its workspace, emerging technologies such as mobile technologies, cloud computing, software packages, robotics and other areas of artificial intelligence applications such as expert system, natural language processing, machine learning, pattern recognition, neural network. According to Dawa, (2021), the different areas that can be deployed in carrying out library services in the University such as the reference services, acquisition services, cataloguing services, classification, indexing etc (Dawa, 2021).

1. **Applications of Expert Systems in Reference Services:** Reference services are personal assistance given by libraries to users who are in pursuit of information. Ayanlola & Uchendu (2017) The implication of this is that the reference unit of a University library serve as the compass of the library for instance for every user to adequately utilize the information resources in the library, the clients should be provided with some reference services such as current awareness services, translational

services, information services, user education, selective dissemination of information, to mention but a few. Thus, Reference service is one of vital services rendered in any library and the Expert System has to be used so as to substitute the reference librarian, the different ways in which expert systems can be used as cited by Mogali (2015) are stated below:

- Research: It is a designed system that supplies clients with recommended sources to lookup for certain question. This is a system that teaches reference skills or computerized aid for practicing reference librarians and information specialists.
- Answerman: It is a Knowledge based system that aid users for reference questions on topics of agriculture. It has series of menus that narrow down the subject of the questions and the type of tool needed. It can function as either a consultation system or as a front end to external databases and CD-ROM reference tools
- Online Reference Assistance (ORA): This system intended to stimulate the services of an academic reference Librarian for questions of low and medium level by using several technologies: Examples are videotext like database, computer assisted instruction modules and knowledge-based system. ORA consist of directional transactions like library locations, services and policies (Dawa, 2021).
- Pointer: It is also known as knowledge-based system but acting as computer assisted reference program. It directs patrons to reference sources.
- PLEXUS: This is a referral tool used in Public Libraries. It includes knowledge about the reference process, information retrieval about certain subject areas, reference sources, and library users. All the above systems are advisory systems for locating reference source books and factual data

2. **Application of Expert System in Cataloguing:** Cataloguing is the systematic arrangement of information materials pointing out their bibliographic details such as the author, title, imprint etc. Cataloguing as a means to enable easy retrieval of information, it is carried out by a professional librarian. Cataloguing is known as the oldest library crafts. Recent attempts to automate cataloguing through Expert Systems have focused on descriptive cataloguing because it is considered as rule-based. There are two approaches for applying artificial intelligence techniques to cataloguing as stated by Adejo and Misau, (2021) below:
   - An Expert System with full cataloguing capability linked into electronic publishing system so that as a text is generated on-line, it can be passed through knowledge-based systems and cataloguing process done without any intellectual input from an intermediary.
   - A human-machine interface, where the intellect effort is divided between the intermediary and the support system.

3. **Application of Expert System in Classification:** Classification is the fundamental activity in the organization of knowledge. For this reason, it is prominent in all systems for organizing knowledge in libraries and information centres. Application of Expert System in the area of classifications in libraries as stated by Adejo and Misau, (2021) includes the following:
   - Coal SORT: It is a conceptual browser designed to serve either as a search or an indexing tool. Coal SORT consists primarily of a frame-based semantic network and the software needed to allow users to display portions of it and to move around in the conceptual structure. The expert knowledge in the system is embodied almost entirely in the semantic network.

- BIOSIS: BIOSIS uses knowledge-based devices including a significant amount of procedural knowledge that automatically assigns documents to various categories. It is designed as an indexer aid. BIOSIS uses the information in the titles of biological documents to assign many categories as possible of those that would be assigned by human indexers. The indexing languages are structured and practical representation of information that can be used to very good advantage of AI applications.
- EP-X: The Environmental Pollution Expert (EP-X) has certain things in common with coal SORT in that both are concentrating on enhancing interface using a knowledge-based approach. The knowledge base of EP-X consists of hierarchical frame-based semantic network of concepts and a set of templates that expresses the patterns called the pragmatic relationship among concepts. These patterns are referred to as conceptual information.

4. **Application of Expert System in Indexing:** The systematic technique of arranging entries to enable information consumers to locate objects in a document is known as indexing. It's a method for giving a roadmap to the data and knowledge contained in papers. In indexing, subject terms, headings, and descriptors that describe the intellectual substance of texts or cover the major theme are carefully picked. In essence, indexing is the process of constructing substitutes for information items by analyzing the content of documents, revealing the main elements of the document item in a simplified form, and showing the location of the information. Indexing of periodicals is another area where expert systems are being developed. Indexing a periodical article involves identification of concepts to translate these concepts into verbal descriptions by selecting and assigning controlled vocabulary terms that are conceptually equivalent to verbal descriptions. The reason for automating the intellectual aspects of indexing is to improve the indexing consistency and quality. Based on the information provided by the indexer, the systems can arrive at appropriate preferred terms to automatically assign relevant subdivisions. The system can make inferences and based on those inferences; it can take appropriate action. "'Med Index' is the best example of indexing system used in the library Indexing activity".Mogali (2015). Very few library users have interacted with knowledge-based systems. Generally, users have had very little contact with these systems due to the fact that most of them are not perfect enough to be used by the everyday library patron.

5. **Application of Expert System in Acquisition:** The collection development area is another integral unit of the University library. The librarian or the information officer is the key person in this activity. University Library users have a significant role to play in building electronic collections and that their help and advice should be solicited in the process. Umoh, Effiom and Igaja (2021), opines that the quality and quantity of collection development in the library is a necessary measure or criteria for accrediting new faculties/ programmes in universities and other related higher institutions of learning in Nigeria. Moreover, resource development is a very important service in the University library because without adequate and appropriate resources; no University library can claim to be effective in serving her users. The process of adding to the University library's collections is known as acquisition or collection development. As a result, it comprises the order, gift, exchanges, and other procedures in an institution library that present the true character of acquisition through the coordination of these events. The acquisition of information materials and tools for University library operations is an aspect of collection development. According Mogali, (2015) diverse means have been implemented in the application of expert system in acquisition.

Monograph Selection Advisor is a pioneering effort in applying this emerging technology in another area of library science i.e. building library collection. Specifically, the task modelled is the item by-item decision that a subject bibliographer makes in selecting monographic details. The knowledge base has to be broad enough and the interfacing aspect must be easy enough for the University library to get the desired information from the machine.

6. **Applications of Natural Language Processing in Library Activities:** Natural Language Processing basically means the ability of a system or device to understand man's everyday language, NLP can be applied in different field, and this could be applied to the field of library and information science and more specifically in the area of searching database such as Online Public Access Catalogues (OPAC). Indexing is the basis for document retrieval. "The aim of indexing is to increase precision, the portion of the retrieved documents that are relevant; and recall, the proportion of relevant documents that are retrieved" Pattern Recognition as Applied to University Library operations New and rising types of information system applications have rushed into the life of office workers in this era of the Internet and information distribution, multimedia computing. Digital libraries, multimedia systems, geographic information systems, collaborative computing, and electronic commerce are just a few of the new applications that have opened up huge prospects for information researchers and practitioners. Robotics

7. **Applications in Library Operations (circulation):** A robot is an automatically controlled, re - programmable, multi-purpose manipulator programmable in three or more axes that can be fixed in place or mobile for use in automation application. Robotics is generally referred to as a subset of Artificial Intelligence that deals with perceptual and motor tasks as well as machine learning. A robot is a machine that can perform a complex series of tasks automatically, particularly one that can be programmed by a computer (Abraham, 2019). According to Tella (2020), University libraries feature huge print collections in addition to a growing array of digital library services and resources. It's time-consuming to keep track of huge volumes in libraries, but automation can help. Robots are already in certain University libraries in both rich and poor countries, which is no longer news. Graham (2019) in his research identified four types of robots currently used in University libraries. These are shelf-reading robots, telepresence robots, humanoid robots and Chatbots. These are described as follows along with the tasks they perform in University libraries. Tella (2020) defined Telepresence as a sophisticated form of robotic remote control in which a human operator has a sense of being present themselves. Similarly, Decker (2015) opined that telepresence are technologies that allow the user to see, hear, and speak to another individual from a remote location, virtually replicating presence. Shelf reading robot that can critically analyze the books on the shelves and would indicate if any books is wrongly shelved or missing in the library. According to Liau (2019), he was of the opinion that robots can autonomously scan the print collection after the library closes by detecting RFID tags embedded in the textbooks. The implication of this is that the shelf reading robot will reduce the work of librarian and save their work time as well as the tedious work of shelf reading which is required almost every day before users start coming. According to Nguyen (2020), humanoid robots' or "social robots" are an emerging generation of robots that have the ability to perceive their environment, recognize faces, read emotions and communicate with people. Similarly, Schaffhauser (2019) explained "humanoid", as a human-like robot, which can strike up a

conversation, tell a story and also teach kids and adults coding. Humanoid robots are those machines that are super intelligent and code tell the gender of the client/user, it masters its environment. Chatbots assist with scanning on a library website, create an alert when a particular textbook is due, directs users to relevant University library resources, answer simple queries and redirects more complex reference queries to a reference librarian (Tella, 2020). Chatbots are simply messaging platform, the libraries in developed world are already using chatbots. Many libraries, particularly academic research libraries especially the Universities, are experiencing severe space restrictions as a result of the demand to provide both electronic and print-based resources and services. The goal of the Comprehensive Access to Printed Material (CAPM) is to build a robotic on demand and batch scanning system that will allow for real-time browsing of printed material through a web interface. The user will engage the CAPM system that, in turn, will initiate a robot that will retrieve the requested item. The robot will deliver this item to another robotic system that will open the item and will automatically turn the pages. By using existing scanners, optical character recognition (OCR) software and indexing software developed by the Digital Knowledge Centre, the CAPM system will not only allow for browsing of images of text, but also for searching and analyzing of full-text generated from the images.

Advantages of Artificial intelligence in Nigerian University Libraries

The advantages of artificial intelligence in libraries was summarized by Dawa, (2021) are as follows:

1. Artificial intelligence in libraries can make research more discoverable which can boost research productivity among faculty members.
2. Constant and timely accessibility to the information.
3. The space occupied by piles of books, journals, bound newspaper and other information materials has been reduced by the introduction of digitization, electronic copies and use of robotic cranes that stores and retrieve books from a compact off-site storage location
4. It will maximize the efficiency of library operations: selection and acquisition of materials, technical services, circulation services, reference services, serial management etc.
5. Effective delivery of library services and elimination of human errors in library operation
6. The efforts of librarian in technical services, circulation services, reference services and serial management etc. can be minimized
7. User services can be enhanced

Challenges for the application of Artificial Intelligence in Nigerian University libraries.

According to Idemudia and Makinde, (2022), the challenges of applying artificial intelligence in Nigerian Academic Libraries are quite numerous. Artificial Intelligence is still tied up with several technological, social and economic challenges. Language readiness, system requirements, privacy concerns, and a threat to intellectual freedom are all key problems in the application of artificial intelligence technologies in University libraries. They have been briefly described as follows:

- Privacy: Artificial Intelligence when fed with massive amounts of data, eventually learns toidentify certain data sets with the help of machine learning. Personal data becomes a commodity that might get misused for illicit purposes. Librarians need to secure privacy by providing anonymous ways of interacting with artificial intelligence systems.
- Linguistic styles: Chatbots have limited memory and processing power does not support extensive vocabulary or the ability to deal with diverse conversational styles. Developers need

to predict the types of interactions and develop suitable responses to them, which is a challenging task for a country like India as the dialect varies in every state, prescribed conversation styles might not be suitable for all kinds of interactions.

- Bias: The transparency and accountability of artificial intelligence systems are being questioned; the algorithms may function based on developer bias or commercial organizations which may lead to disparity in the academic sector.
- Quality of Intelligence: The quality level of a particular artificial intelligence system is determined by two main factors i.e. logical algorithms which are technical related and corpus capacity which is related to data. With technological advancements taking place at a skyrocketing pace more and more complicated algorithms are being formulated and more and more crawlers would be required to obtain the internet and improve its quality of intelligence.
- Intellectual freedom: Seeking and receiving information from Artificial Intelligence systems lead to intellectual freedom at threat, as personal data is sought through machine learning. Queries and search history get saved which can be used against people.
- Cost: Cost is one of the major barriers to the implication of Artificial Intelligence (AI) in the information sector; Most of the AI systems are in the form of proprietary software. Investment in AI-based technologies has not become a trend in libraries and require more dialogue and clarity among professionals. Conclusion Artificial intelligences is an emerging technology that is programmed to have human behavioral characteristics, Artificial Intelligence (AI) is gradually and at the same time rapidly taking root in the different sectors of the world, the library is not an exception, the use of Robotics have a great prospects for quality library services delivery, the use of cha

Conclusions

The application and use of Artificial Intelligence technology in Federal University libraries is setting a new level of accurate and effective library services delivery that has been shown to be very valuable in this study. This study concluded that the use of Artificial Intelligence enhances security of University library resources and enabling access to information from any geographical location. It is of no news that University libraries have greatly benefitted from Artificial Intelligence as it has proven to be time effective and job efficient in almost all sections of the University library. However, despite the various benefits associated with the application and use of Artificial Intelligence in University library services delivery, there are some challenges facing the University library as regard application such as financial constraints, lack of technical skills, loss of job, epileptic power supply still hinder application and use of Artificial Intelligence in Federal Universities libraries. This study can ascertain that the application and use of Artificial Intelligence shape the future of Federal University libraries in Nigeria.

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