



Artificial Intelligence in Libraries: Prospect and Challenges for Nigerian Academic Libraries.

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Abstract

Artificial Intelligence is now being applied with evidence in all facets of life, in the academic, health, economic sectors as well as in the library for efficiency and effectiveness. This study focused on the application of Artificial intelligence in libraries: prospects and challenges for Nigerian Academic Libraries. It was centered on how, and which areas in the library that artificial intelligence could be applied. It was found that artificial intelligence have 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, indexing etc. Literature surveyed equally revealed that robotics is an example of artificial super intelligence with advantages that could revolutionize service delivery in academic libraries. Nigeria Academic libraries could use artificial intelligence in its operations irrespective of the challenges that may pose as barriers, because AI ensures efficiency, effectiveness and quality library service delivery.

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

Introduction

The world has over the years migrated from different levels of technological innovation, in the earliest times, the computer systems served as just input aiding devices and output devices but as man's activities progress, the need for ease of work became prevalent, hence interactive technologies came to the picture, where man can communicate with another person irrespective of the distance and the location, researches have shown that experts continuously work endlessly on the different ways that can bring about a more efficient system to yield high productivity and as well reduce the challenges imposed by human factor, in some developed countries of the world where the working population are aging and decreasing, the need to have a system that can ensure continuity birthed the vast innovation of emerging technologies. Thus, systems that can imitate human behaviours and intelligence came to the picture which is known as Artificial Intelligence.

Workers in different sectors have come to the realization that it is only a matter of time before the present generation sees the impact and usability of new artificial intelligence-based apps in businesses, factories, libraries, and homes. Artificial intelligence is a concept that encompasses two main terms which are "Artificial" and "intelligence", to understand what artificial intelligence really is, it is pertinent to understand what "artificial" and "intelligence" means independently.

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, Hinds Y., Schoenberg M.R. & Saklofske D.H., (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.

This is to say that the application of artificial intelligence is gradually setting its place in the library, the 5th law of Ranganathan state that “the library is a growing organism” and as a growing organism, emerging technologies are also being incorporated in the library space and one of these technologies is Artificial Intelligence.

Overview of Artificial Intelligence

A group of scientists from many professions (mathematics, psychology, engineering, economics, and political science) began to examine the potential of developing an artificial brain in the 1940s and 1950s, and artificial intelligence research was established as an academic discipline in 1956.

Artificial intelligence has emerged as one of the major engines propelling modern society forward. Artificial intelligence is reported to have been implanted in machines or computers to reduce human mortality as a result of human error in conflicts, dangerous work settings, car accidents, airline crashes, fire explosions, and disasters. In a professional environment like a library, artificial intelligence helps people work faster, more efficiently, and more effectively.

Artificial intelligence (AI) is the programming and development of computers to perform tasks that need human intelligence, such as speech recognition, decision-making, visual perception, language translation, conversing, and emotional reactions (Irizarry-Nones, Palepu & Wallace, 2017). Accordingly, Liu (2016) was of the opinion that AI are intelligent machines or intelligent systems that simulate human intelligence activities and extend the science of human intelligence. Similarly, Oname & Alex-Nmecha, (2020) were of the opinion that artificial intelligence is an area of computer science that deals on how computers systems learn (Machine Learning), interpret information, vision: character recognition, picture analysis, 3D perception, modelling of the function of the eye. They further stated that artificial intelligence also encapsulates speech recognition; speech production, understanding and use of natural language (Natural Language Processing) and Expert System which continues to gain more attention. It could be noted that AI uses intelligent symbols to solve problems in real time. Non-algorithmic ways for solving problems and symbols are the subject of Artificial Intelligence. Heath (2018) opined that artificial intelligence is the technology that enables machines to have the abilities to plan, learn, reason, solve problems, move, and to some extent be creative. Thus, Artificial intelligence can be divided into three types: symbolism, connectionism, and behaviourism. Symbolism is an intelligent

simulation method based on logical reasoning to simulate human intelligent behaviour. The connection mechanism and learning algorithm between neural networks and neuronal networks are the central principles of connectionism. The behaviourism theory is based on a cybernetic and perceptual-action control system. Problem solving, natural language processing, artificial neural networks, genetic algorithms, expert systems, knowledge engineering, artificial life, and deep learning are now the most popular technological disciplines in artificial intelligence research (Liu, 2016). It could be noted according to Kumar & Sheshadri, (2019) that AI depends on the skill of mapping the symbols. Multimedia systems, digital libraries and e commerce are just a few of the new applications that have opened up new doors for information researchers. Several well-known challenges in locating information have grown much more essential in modern technology era as the application grows more powerful, diverse, and pressing.

Components of Artificial intelligence

Artificial intelligence has various aspect and component which depends on the ability to manipulate symbols and imitate human intelligence. Mogali (2015) noted in his work that Intelligence depends on ability to manipulate symbols. Artificial Intelligence, despite being a relatively new discipline, has transformed society in ways that were previously unimaginable." He went on to explain the various areas of artificial intelligence contained within the sub classes below:

Expert System

Expert System are the knowledge based computerized systems which play a role of intelligence interface or gateway for providing access to database and to obtain relevant information Mogali (2015). Basically, the expert system is a computer system design in a way it can make good and informed decision to solve problems in a human-like way. Conventionally, computer system was coded and in order for it to be understood an IT specialist interpret the coded information. However, the expert system is programmed to solve problem in real time with little to no human interference. The expert system has five main component which are Knowledge base, Inference Engine, Knowledge acquisition and learning module, User Interface and the Explanation module as noted by Bhat (2020). The expert system is advantageous in several ways, it ensures reduction in risk i.e. the expert system can work in an environment that is dangerous to man, thereby reducing

risk, another advantage is the consistency and permanent nature of the expert system, unlike human whom are prone to inconsistency.

- **Natural Language Processing**

One of the long-standing goals of computer science is to teach computers to understand the language we speak. Mogali (2015). This simply means that artificial intelligence is programmed to understand natural language i.e. the everyday language of man, the ability for a system to not only understand but also interact in natural language makes the system intelligent. Natural language processing improves the accuracy and efficiency of documents, it has the ability to make automated readable summary text. It's excellent for personal assistants like Alexa, it allows businesses to choose chatbots for customer support, and it simplifies sentiment analysis (Tyagi, 2020).

- **Robotics**

It was noted by Mogali (2015) that the field robotics is often described as the subfield of AI that is concerned with perceptual and motor tasks. Robotics is the branch of engineering and computer sciences where machines are built to perform programmed tasks without further human intervention, they are Robots are deployed often for conducting tasks that might be laborious for humans to perform steadily.

- **Neural Network**

Incorporating cognitive technology and machines to carry out responsibilities, the neural community is a department of artificial intelligence that uses neurology (part of biology that worries the nerve and nervous system of the human mind), neural community replicates the human mind wherein the human mind accommodates an countless wide variety of neurons and to code mind-neurons right into a device or a device is what the neural network functions. (Tyagi, 2020).

- **Pattern Recognition**

“The new stimulus and the pre-stored stimulus coincide closely by this process. This process takes place continuously through the lives of all living beings. Pattern recognition is being studied in many areas, including psychology, ethology, cognitive science, and informatics. Recognition of

pattern is based on previous knowledge or on data from the patterns. Classified patterns typically consist of groups of dimensions or observations that define points in a multi-dimensional space. Components for pattern recognition are data collection, pre-processing, selection of characters, selection of models and training, and evaluation” kumar & Sheshadri, (2019).

Types of Artificial Intelligence

Artificial Intelligence (AI) is the ability of a computer-controlled robot to think intelligently in the same way that a human would. It also refers to a computer's or device's ability to mimic the abilities of the human mind. Singh, K.P. (n.d) mentioned that there are essentially 3 forms of artificial intelligence, they're:

1. ANI – Artificial Narrow Intelligence
2. AGI – Artificial General Intelligence
3. ASI – Artificial Super Intelligence

ANI – Artificial Narrow Intelligence: this includes basic/function responsibilities such as those completed by chatbots, personal assistants such as Apple's SIRI and Amazon's Alexa.

AGI (Artificial General Intelligence) entails long-term mastery through the use of machines. Self-Driving Cars by Uber, Autopilot with the aid of using Tesla

ASI – Artificial Super Intelligence: Consists of intelligent machines smarter than people, such as Robotics, Missiles and Satellites.

Application of Artificial Intelligence in 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. In other words, they put information and its sources at the users'/cliente'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

unsure how to conduct a successful library search, this encourage people to value reading, improve their reading habits, and consider libraries, particularly public libraries, as essential resources.

The higher institutions 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. 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. 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. It could be noted that the 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 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 such as expert system, natural language processing, machine learning, pattern recognition, neural network. The different component can be deployed in carrying out library services such as the reference services, acquisition services, cataloguing services, classification, indexing etc.

Applications of Expert Systems in Reference Services

Reference services are personal assistance given by libraries to users who are in pursuit of information. Ayanlola, A.L. & Uchendu, C. (2017) The implication of this is that the reference unit of a library serve as the compass of the library i.e 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.
- **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

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

(AACR2). There are two approaches for applying artificial intelligence techniques to cataloguing as stated by Adejo, A. A. & Misau, A. Y. (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.

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, A. A. & Misau, A. Y. (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.

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 analysing 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.

Application of Expert System in Acquisition

The collection development area is another integral unit of the library. The librarian or the information officer is the key person in this activity. 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, M. S.; Effiom, A. P. & Igaja, M. N. (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 library because without adequate and appropriate resources; no library can claim to be effective in serving her users.

The process of adding to the library's collections is known as acquisition. As a result, it comprises the order, gift, exchanges, and other procedures in a library that present the true character of acquisition through the coordination of these event. The acquisition of information materials and tools for 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 library to get the desired information from the machine.

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 especifically 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 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 Applications in Library Operations

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 AI 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, A. (2020), 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 libraries in both rich and poor countries, which is no longer news.

Graham, M. (2019) in his research, identified four types of robots currently used in libraries. These are shelf-reading robots, telepresence robots, humanoid robots and Chatbots. These are described as follows along with the tasks they perform in libraries.

Tella, A. (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 can do critically analyze the books on the shelves and would indicate if any books is wrongly shelved or missing. According to Liao (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 books. 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.

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, who can strike up a conversation, dance, 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 book is due, directs users to relevant library resources, answer simple queries and redirects more complex reference queries to a librarian (Tella, A. 2020). Chatbots are simply messaging platform, the banking sector have deployed the use of chatbot, so also libraries in developed world are already using chatbots.

Many libraries, particularly academic research libraries, 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 Libraries

The advantages of artificial intelligence in libraries was summarized by Dawa, S. (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 academic libraries.

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 libraries. They have been briefly described as follows:

- Privacy: Artificial Intelligence when fed with massive amounts of data, eventually learns to identify 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

optimized. To catch up with the same, 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 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, 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 chatbots for example will reduce the workload of the librarian , most especially the reference librarian, also the application of expert systems which is a knowledge-based machine that can make quick and informed decision in a human like way would have save the library their time and resources, the expert systems is perceived to beuseful in the different section of the library, such as classification, acquisition, cataloguing etc. In Nigeria Academic Libraries, AI could be implemented in the effective and efficient running of the library and rendering quality services to its user community.

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