

TOWARDS LEVERAGING FREE ARTIFICIAL INTELLIGENCE (AI) SOFTWARE TO ENHANCE LIBRARY ACCESSIBILITY AND INCLUSIVENESS FOR PERSONS WITH DISABILITIES IN NIGERIA: A REVIEW

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Abstract

Libraries of all kinds are democratic institutions established to provide information services to all persons irrespective of their status. Extant literature suggests that persons with disabilities are denied most rights accorded to able-bodied library users. As people with information needs, persons with disabilities deserve the same rights to accessibility and inclusiveness in library services. This literature review paper focused on how free AI software can be leveraged to enhance library services for persons with disabilities in Nigeria libraries given the dwindling finances experienced by libraries in Nigeria. Among other things, the paper looked at the status of library services for persons with disabilities, AI, and library services for persons with disabilities while outlining some free AI software that can enhance accessibility and inclusiveness. The place of training and retraining for capacity building, commitment, and diligence among librarians and management are also emphasized.

Keywords: Library accessibility, library inclusiveness, disability, Artificial Intelligence, AI software

Introduction

Libraries are democratic and social institutions that exist to provide information and service to all irrespective of their status. To that extent, they are expected to encourage social inclusion and accessibility in service provision by removing all barriers for all persons including those with disabilities. This is important given that Nigeria has a huge population of persons with disabilities as the National Commission for Persons with Disabilities puts the population of this segment of society at 35.1 million (Abdullahi, 2023). However, as in most developing nations, persons with disabilities in Nigeria face a lot of challenges ranging from inequality, lack of political participation, violations of their rights, and denial based on their disabilities (World Health Organization cited in Onalu & Nwafor, 2021). This is worsened by inadequate social support. As a result, persons with disabilities often experience depression, isolation and social exclusion (Onalu & Nwafor, 2021).

The social exclusion is mostly noticeable in the lack of provision of facilities and resources including libraries that are tailored to them. This is one of the reasons why institutions like libraries must strive to include people with disabilities fully in library services provision. Invariably, libraries must make “deliberate and intentional efforts to create service delivery models that will facilitate access to their resources by every member of society” (American Library Association, 2015).

Unfortunately, library service provision to persons with disabilities in Nigeria is hampered by many factors, including the continuing dependence on the traditional model of service provision, inaccessible library environments, and inadequate funds to acquire resources that are tailored to them among other things (Ola, 2020; Horsfall and Opara, 2023). The inability of mainstream libraries to factor in the needs of people with disabilities in library services makes library resources inaccessible to them and service provision exclusive. This in turn results in a decline in the use of library services by most of them and the consequent widening of the social exclusion gap (Williams-Ilemobola & Unegbu, 2021).

However, Applin cited in Carter (2004) posits that “equal access to public services requires that libraries not only become physically accessible to all disabled users; they must ensure that all services are adequately adapted to meet the special needs of these individuals.” Vandembark (2010) adds that making all resources accessible to everyone is the mandate of the library and to that extent, the challenges that persons with disabilities face must be attended to and libraries must offer appropriate services to the special needs of this group in mind. In essence, accessibility connotes ensuring that “library information, library activities, and/or library environments must be made sensible, meaningful, and usable for as many people as possible regardless of their abilities or circumstances” (SeeWriteHear, 2023).

With the rapid advancements in artificial intelligence (AI) technologies, there is a promising potential to overcome the barriers to accessibility and inclusiveness in library services for persons with disabilities through personalized assistance, increasing the availability of assistive technology, and facilitating easier navigation of library resources. However, Wheatley and Hervieux (2019) assert that the library (especially in developing countries) is mostly “slow in its uptake on automation and digital technologies...reluctant to change, often waiting for a particular technology to reach market saturation before reacting to a new trend.” Some authors have examined how academic library service delivery can be enhanced with Artificial Intelligence (Akinyemi, 2023; Informology, 2023) however; the application of AI for library services for persons with disabilities in Nigerian libraries is still underexplored. With this in mind, this paper will explore how free AI software can be effectively leveraged to support persons with disabilities by reviewing existing AI technologies and their potential to transform library services to enhance accessibility and inclusiveness for persons with disabilities.

Concept of Disability

The Center for Disease Control and Prevention (2020) defines disability as “any condition of the body or mind (impairment) that makes it more difficult for the person with the condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions).” From the definition, one can infer that disability manifests in various forms: impaired vision, impaired hearing, speech handicaps, or orthopedic/neurological impairments. However, Prince (2009) perceives disability as something that is “socially constructed, administratively negotiated, and politically contested.” In other words, disability is contextual and if unfavourable contexts or conditions i.e. limiting factors are addressed within society using the instruments of society the problem of “disability” will be addressed. Terzi (2008) seems to support this view because disability is “a phenomenon of the interface between personal characteristics of the individual and the specific design of the social and physical environment that the individual inhabits.” To that extent, how people experience and respond to their surroundings should be looked at holistically. Therefore, personal characteristics such as personality behaviour, beliefs, skills and experiences, and the social and physical environment should not be viewed in isolation. One of the implications of this argument is that the design of the social and physical environments environment should be done with consideration for the diverse characteristics of the individuals who will use it. Concerning libraries Rumsey cited in Ola (2020) notes that many persons with disabilities are challenged in accessing library services because the typical library is designed for and works best for able-bodied patrons. Be that as it may, the picture of library services for people with disabilities in developed countries cannot be described as bleak compared to developing countries. The findings of some studies on library services for people with disabilities support this assertion.

Status of Library Services for Persons with Disabilities in Nigeria: An Overview

The status of library services for persons with disabilities in Nigeria leaves much to be desired. Iroeze, Umunakwe and Eze (2017) studied library services for the physically challenged in Southeast Nigeria and found that there were only 2 libraries for them. In terms of resources, while Braille, large print books, talking books, twin vision and sign language books were available they were inadequate and outdated. Also, traditional library services were provided in poorly architecturally designed buildings. Similarly, Horsfall and Opara (2023) reported that most of the twenty university libraries in Nigeria that they investigated lacked information resources for visually impaired students.

In another study, Williams-Ilemobola and Unegbu (2018) examined the use of library services and user satisfaction of physically challenged students in federal universities in Southwest Nigeria. The results revealed that physically challenged students were aware of various services rendered in the university library including advisory and consultancy services. The major challenges they faced were a lack of current awareness service, inadequate relevant materials, navigation of the building, and a lack of current books and journals. Without a doubt, this suggests that students with disabilities in these institutions were somewhat excluded from library

services. However, a later study by Ola (2020) that investigated library funding and physically challenged students in seventeen public universities in South-west, Nigeria found that the library facilities for physically challenged students in universities were walk-way free of obstacles, clear and well-lit signs in the building, and automatic doors. These are hardly library services; moreover, the findings can be challenged given that the study population was librarians rather than disabled students. The practice of excluding the views of persons with disabilities is not a new phenomenon as Cassner, Maxey-Harris, and Anaya cited in Brunskill (2020) notes that “despite most academic libraries [in the United States] having an accessibility webpage as part of their larger website, only a few studies were found that examined these pages, and none of them involved consultation with users with disabilities.”

More recently, Williams-Ilemobola et al. (2022) investigated the information-seeking behaviour and use of library services by disabled students in federal universities in South-West, Nigeria, and found that advisory, carrel, and consultancy services were available. The researchers counseled the library management to tailor their current awareness services to the needs of disabled students. Additionally, library staff should be trained to serve every library user irrespective of their challenges.

On physical design, Nkiko et al. (2020) focused on library facilities in selected libraries in Lagos State, Nigeria to determine their relative accessibility by wheelchair library users. The study revealed that none of the libraries had ramps or functional elevators, and other facilities such as catalogues, circulation desks, shelves, and toilets were designed to exclude wheelchair users from accessing them. The picture above is not encouraging as it suggests that thought is not given to library accessibility and inclusiveness for persons with disabilities in Nigeria. Kulikauskienė & Liukinevičienė (2020) advocate that public libraries should contribute to “the reduction of social exclusion by meeting the informational, cultural and social needs of people with disabilities.” The authors further suggest that the process should involve “appropriate management, while the implemented changes should include activities associated with the key elements of an inclusive library – organizational management, accessibility of library services, and environment, improved staff competencies...” This requires an all-round approach to library services for people with disabilities and suggests that people with disabilities in Nigeria will benefit from an innovative process such as applying artificial intelligence in information services, especially in resource accessibility.

Concept of Artificial Intelligence

Technological advances are increasing rapidly today as people seek innovative ways to solve problems or meet the needs of society. This can be seen in all spheres of society: education, economics, politics, and so on. Some years back, the rave was automation as efforts were made to incorporate computers into jobs that were done mostly by human beings. In recent times, in addition to automation, new frontiers are being charted in technology, and innovations that can carry out functions that were hitherto thought impossible are being seen and felt. One of the trending technologies accorded heightened importance in society is artificial intelligence (AI).

Park (2018) in trying to describe the reshaping of society occasioned by AI calls it the fourth industrial revolution. In terms of the definition of the term, Wheatley & Hervieux (2019) note that there are differing definitions of what it is and what can be considered as AI. In the author's view, while "AI is a computer program designed to replicate human intelligence, the truth is that it is so much more."

Similarly, Holmes et al (2019) see it as computer programs that carry out tasks that require intelligence when done by humans. Additionally, the OECD cited in Olayode (2022) defines an AI system as "a machine-based system that is capable of influencing the environment by making recommendations, predictions or decisions for a given set of objectives." They note that the system uses machine and or/human-based inputs/data to achieve the following: i) perceive real and/or virtual environments; ii) abstract such perceptions into models manually or automatically; and iii) use Model Interpretations to formulate options for outcomes." In essence, the possibilities and the potential inherent in AI are numerous. They can be used to achieve whatever objective(s) an individual(s) dreams and is willing to achieve with them. That is why despite the differing definitions, Boden cited in Wheatley and Hervieux (2019) notes that AI is seen all around us and everyday applications of AI in society are evident in "technology such as driverless cars, satellites, the Internet of Things, and perhaps most obviously, the Google search engine." Libraries services are also delivered with AI applications.

Libraries and Artificial Intelligence (AI)

It is instructive that only a few years ago, studies on AI in library research were insignificant. For instance, Wheatley & Hervieux's (2019) environmental scan on the engagement of artificial intelligence in academic libraries in the United States of America and Canada whose primary goal was to discover the role librarians will play in an AI-dominated future as well as how libraries are responding to the change revealed at the time, a lack of response or awareness of the AI trend. However, the potential of the application of AI in library services has revealed the tremendous possibilities that exist. Asemi, Ko, and Nowkarizi (2020) reviewed the literature on the application of intelligent systems, mainly, Expert Systems/Artificial Intelligence (ES/AI) and robots in libraries. Among other things, the findings showed that the current information systems in libraries have a high potential to be improved by integrating with AI technology.

In their study which corroborated the earlier findings of Wheatley & Hervieux (2019), Gasparini & Kautonen (2022) examined the roles conceived for libraries and librarians, their users, and AI. The study, an extensive literature review, gave an overview of how research libraries understand, react to, and work with AI. The authors conceded that the landscape of AI and libraries is complex and unclear, and library personnel and leaders are uncertain about where they should lay the path ahead. The authors concluded by presenting design thinking as an approach to solving emerging issues with AI and opening up opportunities for AI technology at a more strategic level.

AI and Library Services for Persons with Disabilities

IFLA (2023) posits that AI is not new to libraries as many of its applications are being used “in auto-suggestion, spam filtering, plagiarism detection, audio transcription, text summarization, and translation [while] many familiar features of search and recommendation use AI.” Furthermore, specifically in the library context, they note that “text and data mining (TDM), and the application of machine learning to library and archive collections in the digital humanities can be seen as AI.” Thus, while AI adoption in library services in developed countries cannot be described as far in between, the same cannot be said of developing countries. Informology (2023) investigated the level of Artificial Intelligence adoption to support library services delivery in 102 African English-speaking countries and found that its adoption is at the basic level. The study found that only few university libraries in Africa have “adopted AI technologies such as Chatbot, ChatGPT, LibKey from ThirdIron, robots, RFID technology and Grammarly.” Some of the library services in which AI technologies are used include “answering of directional and ready reference questions posed by library users, serving as a knowledge base for cataloguing information of library materials, self-check-out machine for books, used as a marketing tool for the library, a tool for statistics evaluation and recommendations, assisting in the charging and discharging of library materials, and so on.” There is no mention of services for users with disabilities.

However, artificial intelligence (AI) can be applied in library services for persons with disabilities through artificial intelligence (AI) powered assistive technology. Assistive technology is any piece of equipment or software, whether acquired commercially, modified, or customized used to increase, maintain or improve functional capabilities of individuals with disabilities.” (Disabilities Advisory Services, n.d). Domingo (2021) notes that ‘assistive technology can be crucial to improve the quality of life of people with disabilities, facilitate their equal participation in society, and make them more independent... as it offers people with disabilities opportunities for work, education, leisure, social engagement, access to public services, and information” (Domingo, 2021). Additionally, Green cited in Chigwada & Phiri (2021), posit that among many other benefits, assistive technology “save time; motivate and engage users; make tasks easier and more enjoyable; have real-life value; support unique learning styles, abilities and backgrounds....”

Sadly, while these assistive technologies can aid accessibility for persons with disabilities, it is not possible, practically, for most libraries in Nigeria to provide all of them because of funding constraints. Nevertheless, some of the needs of this category of users must be included during acquisitions given the perception that “the basic structures have always been made for the ‘normal’ population and thus students with disabilities don’t get recognized” (Farooq and Shazia, 2021). In addition, new options can be explored to enhance service for persons with disabilities. This includes exploring and leveraging free AI.

Leveraging Free AI to Enhance Accessibility and Inclusiveness for Persons with Disabilities

Even with known economic challenges, AI can still be leveraged in library services for persons with disabilities in Nigerian libraries especially, in resource provision. There are several free AI software out there that libraries can harvest and develop given that the paid versions while more beneficial are costly. The free software can greatly enhance accessibility and inclusiveness for persons with disabilities. Some of the free software to achieve this objective are outlined and discussed below:

1. **AI-Powered Reading Tools:** With Text-to-Speech (TTS) software driven by AI, written text can be converted into spoken words. This is particularly important for aiding visually impaired library users. In addition to other free resources, **Google Text-to-Speech** offers free TTS services that convert text into spoken words. Additionally, **Natural Reader** provides a free version that supports TTS functionalities.

Speech-to-Text software converts spoken words into text. It can assist users by making audio materials accessible. Some fee versions include **Google Speech-to-Text**; however, it is free for a limited number of minutes in each month. Another software **Otter.ai** offers a free plan with limited transcription minutes.

2. **AI-Enhanced Braille Translators:** The visually impaired depend on Braille for reading but the process of translating texts into Braille is tasking, AI can improve the accuracy and speed of translating digital texts into Braille, providing faster access to resources for Braille readers. **Liblouis** is an open-source Braille translator that can be integrated with AI tools for enhanced accuracy. Another open-source solution tool for Braille translation is **BRL-CAD**.
3. **Natural Language Processing (NLP) for Catalog Searches:** With AI-powered search engines users with cognitive disabilities can find resources without using complex search terms or Boolean logic. This is possible because AI-powered search engines can understand and respond to natural language queries, making it easier for users with cognitive disabilities to find resources. Some free natural language processing software includes **Google Cloud Natural Language API** which offers free tier usage for basic NLP tasks and **SpaCy** which is another open-source NLP library that can be used to build custom search engines.
4. **Automated Sign Language Interpreters:** For the hearing impaired, AI systems can interpret and translate sign language in real-time thereby assisting them in accessing spoken content and participating in events or discussions. **HandTalk** and **SignAll** are two available free-access software. **HandTalk** offers a free version of their sign-language interpreter app while **SignAll** provides limited free access to their sign-language translation tools.
5. **Automated Translation Services:**

Today, libraries engage in digitization of their collection. This service can be extended by translating the digitized collection. AI can facilitate the translation of library resources into multiple languages, including sign languages, ensuring accessibility for users with different linguistic needs. Among many others, **ADER Sentiment Analysis** and **TextBlow** are free and open-source sentiment analysis tools.

6. **Enhanced Metadata and Content Tagging:** A library may have many resources but without discoverability and accessibility, they are as good as unavailable. Given that several libraries in Nigeria are traditional, some disabled users cannot use the catalogues. AI can automatically generate descriptive metadata and tags for resources, improving discoverability and accessibility of materials tailored to the needs of users with disabilities. **Tagtog** provides free tools for automated tagging and annotation of texts while **Google Cloud Vision** offers a free tier for image and document analysis, including metadata generation.
7. **AI Chatbots and Virtual Assistants:** For all categories of users with disabilities, AI chatbots can assist with navigating library services, answering queries, and providing information in an accessible manner. **Dialog Flow** is Google's free AI chatbot platform that can be integrated into library websites and services. Microsoft's version, **Microsoft Bot Framework** offers free tools to build and deploy chatbots.
8. **AI-Driven Accessibility Audits:** Libraries can adopt AI tools to conduct accessibility audits of digital library resources and websites. This will assist them in identifying areas for improvement and ensuring compliance with accessibility standards. To achieve this, **AVE** (a Web Accessibility Evaluation Tool) a free online tool for evaluating web accessibility, and **Axe Accessibility Checker** which offers free browser extensions for accessibility auditing among other free resources are available.
9. **Personalized Recommendations:** Knowing the needs of our users is part of design thinking. Libraries engage in special services such as current awareness and alerts to provide personalized recommendations to their users. This can be done with AI algorithms to analyze user preferences and reading habits to recommend books, articles, and other resources tailored to individual needs and interests, including accessible formats.
10. **Sentiment Analysis and Feedback Systems:** In the words of Dam and Siang (2024), "Design thinking revolves around a deep interest in developing an understanding of the people for whom we're designing the products or services. It helps us observe and develop empathy with the target user." AI-driven sentiment analysis tools can help libraries gather and analyze feedback from users with disabilities, enabling continuous improvement of services and resources. **VADER Sentiment Analysis** and **TextBlob** are two free open-source sentiment analysis tools that come in handy.

Staffing Imperative

Training librarians in artificial intelligence (AI) to serve persons with disabilities is crucial for maximizing the benefits of AI tools and ensuring effective, inclusive library services. Some of the earlier reviewed literatures have identified inadequate knowledge among librarians as one of the barriers to accessibility and inclusiveness in the provision of library services to persons with disabilities (Williams-Ilemobola, Adetayo, Buhari. and Omorinkoba, 2022; Ayoung, Baada and Baayel, 2021). The fact remains that this is a crucial factor that must be addressed. Even with the availability of free resources, librarians will need training for a better understanding of AI and the ethical implications of using AI, including privacy concerns and data security. They must also be trained in ensuring that AI tools are used responsibly and inclusively and how knowledge of these resources can be used to improve accessibility.

Librarians will need to stay updated about AI, and this calls to mind retraining. In addition to paid continuous learning through workshops, seminars, and courses, librarians serving persons with disabilities must explore available opportunities to collaborate with other librarians, technology experts, and organisations focused on accessibility. In this way, they will both learn and contribute to fostering a community of practice and support.

Conclusion

Using a literature review approach, the paper focused on leveraging free AI software to enhance library services for persons with disabilities in Nigerian libraries. Areas covered include the concept of AI, the concept of disability, the status of library services for persons with disabilities, libraries and AI, Artificial Intelligence and library services for persons with disabilities, and leveraging free AI in library accessibility for persons with disabilities. The study outlined some free AI resources and their uses, outlining also, how they may be used to serve persons with disabilities. The place of training and retraining for capacity building, commitment and diligence among librarians and management was also emphasized.

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