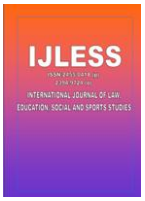
International Journal of Law, Education, Social and Sports Studies (IJLESS)
Volume: 12, Issue S1, 2025 (Special issue-1)
ISSN: 2455-0418 (Print), 2394-9724 (online)[Impact Factor: 6.0176 (ICI)]

Enhancing Library Accessibility for Visually Impaired Persons Through Artificial Intelligence

Srikanth. H.G.
Librarian, Soundarya Institute of Management and Science - [SIMS]
Soundaryanagar, Sidedahalli, Nagasandra Post, Bangalore-560073
E-mail: srikanth.hg@soundaryainstitutions.in
Phone: +91 73536 16666
DOI: 10.33329/ijless.12.S1.305



ABSTRACT
Visually Impaired Persons (VIPs) encompass a wide range of disabilities, including limited vision, complete blindness, and glaucoma. These conditions can significantly disrupt everyday activities and stem from a variety of ocular disorders or health issues. This research investigates the function of artificial intelligence (AI) in enhancing library accessibility for individuals with disabilities through literature review, case studies, and data analysis. AI-powered assistive technology, including text-to-speech systems, navigation aids, and virtual assistants, has transformed library operations, encouraging a more inclusive feeling that allows all community members to use library resources. In addition, enhancing knowledge and offering training on assistive technologies for visually impaired individuals are essential measures for libraries to promote inclusion and accessibility. This study addresses efficient techniques and possible strategies for the integration of AI in library services. The study explores the extent to which AI-driven solutions enhance the independence and engagement of physically challenged library patrons, highlighting their efficacy and adaptability to various requirements.
Keywords: Artificial Intelligence, Assistive Technology, Library Services, Visually Impaired Persons.

1. Introduction

Libraries have to prove a strong commitment to providing access to the entirety of their services and facilities for all users, irrespective of their abilities. The libraries have recognized their responsibility in offering information resources to everyone. Assistive services and technology now accessible in the marketplace enable the meeting of the needs of persons with impairments. A librarian can often identify users with impairments requiring help with confidence (Stephen & Ikbal, 2023).

However, traditional methods of obtaining printed information provide considerable difficulties for Visually Impaired Persons (VIPs). At present, the majority of academic libraries in poor countries operate in traditional ways, with inadequate ICT and infrastructure resources that restrict the integration of VIPs into standard library services. These limitations make it challenging for VIPs to

access essential educational materials, further exacerbating the disparities in information access. Many individuals lack the necessary tools to fully engage in their academic pursuits without proper support and resources.

The Right of Persons with Disabilities (RPWD) Act of 2016 and the American Library Association (ALA) both highlight the significance of equitable access to information resources and services for all individuals, including those with disabilities. Academic libraries must reconfigure resources, equipment, and ICT technologies to provide fair access to these standards (Singh, 2024). By doing so, they can foster an inclusive environment that empowers all students to thrive. Furthermore, collaboration with disability advocacy groups can enhance these efforts, ensuring that libraries effectively address the diverse needs of their users.

The problems with library accessibility can be fixed with artificial intelligence, since new technologies like text-to-speech systems, navigation aids, and virtual assistants are changing how libraries work. These innovations not only enhance the user experience for individuals with disabilities but also promote inclusivity by ensuring that all community members can enjoy and benefit from library resources (Chauhan, 2024). By implementing AI-driven solutions, libraries can better serve diverse populations and adapt to the evolving needs of their users. This study examines the function of AI in improving library accessibility using literature review, case studies, and data analysis. It looks at how much AI-powered solutions improve the independence and participation of physically challenged library users, focusing on how well they work and how adaptable they are to different needs. This study highlights effective methods and potential strategies for implementing AI in library services. Libraries must effectively use AI technology for solving accessibility concerns, ensuring equitable access to materials and opportunities for learning and participation.

2. Visual Impairment

The human eye functions similarly to a camera, regulating light intake and modifying the pupil in response to varying brightness levels. The iris, cornea, and lens collaborate to concentrate light effectively. The retina converts light into nerve signals, which the optic nerve then relays to the brain. Visual impairments, including low vision and total blindness, can significantly impact daily activities and may arise from a range of eye conditions or health concerns. Elements such as cognitive capabilities, interpersonal skills, and educational background can affect the way individuals manage their condition. Medical professionals utilize various diagnostic methods to assess vision health and find out the extent of visual deficiencies. There are many things that can affect a person with a visual impairment's experience, such as the accessibility of buildings, transportation options, preventative measures, visual rehabilitation services, assistive devices, and information accessibility challenges. Approximately 253 million individuals experience visual impairment worldwide, with 36 million facing complete blindness.

At present, India is home to approximately 4.95 million individuals who are blind and around 70 million who experience vision impairment, including 0.24 million blind children. Timely identification and intervention for the primary contributors to blindness, such as cataracts, play a crucial role in decreasing the rates of blindness and vision impairment. Significant advancements have been made in the area of preventing, managing, and controlling blindness since the launch of the "Vision 2020: The right to sight" initiative. This initiative has not only raised awareness about the importance of eye health but has also fostered collaboration among governments, non-governmental organizations, and healthcare providers. By implementing comprehensive eye care programs, communities can significantly improve access to essential services, ultimately enhancing the quality of life for millions affected by visual impairments.

1887: The first special school for the visually impaired was established in Amritsar.

1923: The state decided to establish a Braille press to produce books in Braille.

1958: Mrs. Rehmut Sultan Fazelbhoy admitted three visually impaired boys in New Activity School in Mumbai.

1951: The National Association for the Blind (NAB) set up its Education Committee to handle general problems related to the education of the visually impaired.

1980: NAB appointed its first Education Officer, Mr. M. K. Choudhary, and established a full-fledged Department of Education.

2001: The government launched the zero-rejection Sarva Shiksha Abhiyan (SSA). No disabled kid may be refused entrance or ignored under this policy.

2005: The government launched the National Action Plan to include children and youth with disabilities in mainstream education and ensure that all children have access to school.

2009: Right to Education Act (RTE): Ensured free and compulsory education for children with disabilities, including those with visual impairments.

2013: Universal Eye Health: Global Action Plan 2014-19: Adopted by the World Health Assembly to reduce the prevalence of avoidable visual impairment.

2016: The RPWD Act guarantees free and compulsory education for children with 29 baseline impairments until 18.

2020: Ongoing Initiatives: Continued efforts under the National Program for Control of Blindness (NPCB) to combat blindness and visual impairment

3. Assistive technology

Assistive technology is essential for improving quality of life and fostering independence in those with impairments. These technologies assist persons with diverse impairments, including physical, sensory, cognitive, or developmental problems in their everyday activities. They may enhance the accessibility of physical surroundings and information for all individuals, irrespective of disabilities.

Assistive technology has traditionally led the way in the advancement of new technological innovations. There are several examples where the disability community utilized technologies long before they gained widespread acceptance. For example, individuals with disabilities originally created audiobooks and text-to-speech software (Ovide, 2021). These innovations not only provided essential tools for accessibility but also laid the groundwork for broader applications in various sectors. As society increasingly recognizes the importance of inclusivity, the influence of these early adaptations continues to inspire new developments in assistive technology.

3.1 Assistive Technology Overview

-Assistive technology (AT) includes tools, equipment, software, or systems designed to enhance or preserve the capabilities of individuals with disabilities.

-AT can be advanced and sophisticated, such as special purpose computers, or simple and low-tech, like Braille Slate.

-AT includes special switches, keyboards, pointing devices, prosthetics, mounting systems, and positioning devices.

-Specialized or Inclusive learning materials & aids for transacting the curriculum are classified as AT.

-AT includes computer software like screen readers and communication programs to assist people with disabilities in using technology.

-AT aims to empower people with disabilities to live more independently and engage more actively in their daily activities.

-AT can be specialized curricular software.

3.2 Key Assistive Technology Tools

• Screen magnification software: Adjusts the size of on-screen text and graphics on a computer screen.

• Screen readers: Helps individuals with blindness or visual impairments read out text on their computer screens.

• Speech input software: Enables individuals who struggle with typing to input text and operate their computer using voice commands.

• Text readers: Uses a synthesized voice to read text aloud, possibly incorporating a highlighter feature.

• Alternative input devices: Utilized by people who cannot operate a computer using a mouse or keyboard.

• Single switch entry devices: Used with on-screen keyboards.

• Head pointers: Enables people with limited to no hand usage to interact with a computer keyboard.

• Motion tracking or eye tracking devices: Allows users to control the movement of the mouse pointer.

4. Role of AI in assistive technology

Artificial intelligence (AI) is revolutionizing assistive technology by enhancing the effectiveness of assistive tools. AI uses algorithms and data-driven insights to perform tasks typically requiring human intelligence, thereby increasing independence and enabling individuals with disabilities to access education, employment, and fully participate in society.

i. **Enhancing Accessibility and Inclusivity:** AI has significantly changed libraries, enhancing their accessibility and inclusivity. AI-driven assistive technology provides essential support to those with disabilities, enabling independent access to information and resources.

ii. **Personalized Assistance:** AI-driven systems are excellent in customizing services to address individual requirements. AI-driven recommendation systems can suggest books and resources based on a user's preferences and reading trends. This customized strategy improves patron participation and happiness, rendering library trips more productive and pleasurable.

iii. **Improved Navigation:** Going through a library might be challenging for those with physical disabilities. AI-driven navigation tools, such as intelligent wheelchairs and indoor navigation applications, direct users to particular areas, books, or resources. These instruments utilize sensors and machine learning to generate comprehensive maps of the library, offering real-time navigation and avoiding obstacles, so facilitating a seamless navigation experience.

iv. **Enhanced Reading Experience:** Artificial intelligence provides several techniques to improve the reading experience for those with visual impairments. Optical Character Recognition (OCR) technology converts printed text into a digital version, which text-to-speech software can then vocalize. AI algorithms enhance the precision and authenticity of created speech, making it more accessible and understandable for users.

v. **Speech Recognition and Communication Aids:** AI-driven voice recognition technology aids those with disabilities by converting spoken language into text. This facilitates efficient contact with library personnel and fellow patrons. Moreover, AI-powered communication tools may convert text into sign language, offering enhanced assistance for individuals with hearing disabilities.

vi. **Virtual Assistants:** Virtual assistants, including AI chatbots, are important in modern libraries. They perform multiple functions, such as addressing frequently asked issues, assisting users with the library's online resources, and offering customized suggestions. Accessible around the clock, these assistants guarantee uninterrupted help, thereby improving the customer experience.

vii. **Real-time Language Translation:** In multilingual environments, AI-driven translation systems facilitate communication across language hurdles. These solutions facilitate real-time translation of text and spoken language, allowing users from diverse linguistic backgrounds to access identical information. This cultivates a more inclusive atmosphere, allowing all individuals to benefit from the library's resources.

5. Implementation of Assistive Technologies in Libraries

i. **Needs Assessment:** The libraries first need to determine the exact needs of their users with disabilities. It is therefore important to administer questionnaires, interviews and focus groups to establish the difficulties that the users encounter and the technology solutions that can be applied to solve these problems.

ii. **Selecting Appropriate Technologies:** Depending on the findings from the needs assessment, libraries can now choose the right assistive technologies. This could encompass AI screen readers for the benefit of the visually impaired users, text to speech applications for the benefit of the deaf or cognitive aids for the benefit of the intellectually disabled.

iii. **Training Staff:** To this end, it is important that the library staff are well prepared on the use and implementation of the assistive technologies that are to be introduced. This comprises knowing the features of the devices as well as how to fix the most frequent problems.

iv. **Infrastructure Upgrades:** Modifying the library to accommodate the implementation of assistive technologies may need some improvement on the infrastructure. For instance, in order to accommodate the users with disabilities, it is important to ensure that there is fast internet connection, well defined paths for walking aids and/ or wheel chairs and places that are equipped with assistive devices.

v. **User Education and Outreach:** Libraries should also hold workshops and information sessions so that the people know about the existent assistive technologies. Such programs can assist in creating awareness and make people with disabilities to start using such resources.

vi. **Continuous Support and Maintenance:** Support system is crucial for the effective usage of the assistive technologies hence the libraries should ensure that there is a constant supply of the same. Some of the things that libraries should have include a way of maintaining devices and updating software regularly and a way of ensuring that

6. Challenges in Implementing Assistive Technologies in Libraries

i. **Cost and Funding:** One of the greatest challenges is the considerable cost of acquiring and maintaining assistive technologies. This places Library Budget Constraints, especially those of limited budgets, from allocating adequate funding for incoming and installed technologies.

ii. **Technical Expertise:** Advanced technologies are very dependent on sufficient technical expertise that might not be easily available in libraries. Training librarians and staff to install, use and maintain these technologies will take time and additional expenditure.

iii. **User Adoption:** Some users may hesitate to take on new technologies out of either lack of familiarity or discomfort with using functional and functional computer tools. Libraries must invest in user education and support to promote the use of assistive technologies.

iv. **Accessibility and Compatibility:** Accessibility makes establishing the compatibility of assistive technologies with existing library facilities quite a challenge. Libraries must be mindful that these technologies must be accessible and available to all users devoid or restricted of some disabilities.

v. **Privacy and Security:** Oftentimes, assistive technologies collect and store personal information that raises privacy and security issues. Consequently, libraries have a duty to implement data protection measures on various strengths of library positions.

vi. **Keeping up with Technological Advances:** Repeated change with rapidly evolving technology will constitute a real challenge for some libraries. Therefore, libraries that seek more new technologies must view constant investments in new ways of updating various internet applications, along with maintenance and updates in-house.

7. Impact of Assistive Technologies on Enhancing Access to Library Resources for Visually Impaired Individuals

i. Assistance technologies in libraries have made a remarkable shift in the capabilities of the visually impaired through accessibility. These technologies narrow the gulf between disabilities and the enormous database within the libraries so that the library's services can be extended to all without consideration of one's visual capability.

ii. Optical Character Recognition (OCR) Technology: One of the most advanced developments is Optical Character Recognition, or OCR. OCR converts printed texts into digital ones to enable visually impaired users to access printed materials through screen readers. Users can now read books, articles, and other printed resources that were previously unreadable due to the advent of this technology. Some of the well-known OCRs are the Kurzweil 3000 and ABBYY FineReader, which greatly enhance the reading experience by offering clear and accurate text conversion.

iii. Screen Readers and Text-to-Speech (TTS) Software: The screen readers and TTS software also complement one another. Screen readers like JAWS and NVDA read aloud the content shown on the computer screen, allowing visually impaired people to navigate digital resources and websites. The TTS software converts any digital text into spoken words. These are precious tools to access online catalogs, digital books, academic journals, and other electronic resources.Braille

iv. Displays and Notetakers: The Braille displays and notetakers have also revolutionized the interface of digitality with the visually impaired. Their operation is through the soft, refreshable Braille displays that convert the text on screen to the Braille parts, allowing their reading by finger touch. The BrailleNote and Orbit Reader devices offer reading and notetaking functions, acting as portable mechanisms for information access and organization. These devices are especially useful in an academic environment when studying in detail and taking notes is required.

v. Voice Activation Assistants: Platforms such as Amazon's Alexa, Google Assistant, and Apple's Siri further enhance accessibility. These AI-driven assistants will be able to help people in

navigating library services through voice commands. They can assist in searching for books, accessing electronic resources, maintaining library accounts, and even reading them aloud. This hands-free interaction becomes vastly useful for disabled persons in terms of mobility or manual dexterity.

vi. Mobile Applications: Mobile applications specially designed for the visually impaired provide further support. Apps like Seeing AI or Be My Eyes can describe the environment, read text aloud, and offer real-time assistance by connecting with volunteers through video calls. Such applications are practical during the experience in the library because they help with wayfinding, book identification, and information access without requiring constant assistance from others.

vii. Real-world Implementation: Practice Among the many libraries in the world that have canceled out of these technologies, the following stand out: For example, the National Library Service for the Blind and Print Disabled (NLS) of the Library of Congress, which offers a variety of options for accessible reading materials that include books in braille and audiobooks. The New York Public Library has a whole range of digital tools and resources, like accessible e-readers and some databases. Their projects illustrate the tangible benefits of assistive technologies in enhancing library access.

8. Assistive technology awareness and training in libraries for visually impaired users

8.1 Providing Training

- **Staff Training:** Enhance staff development training by focusing on troubleshooting assistive and adaptive technologies in the library. Staff should create a reference and resource manual, or guidebook, for quick reference when assisting patrons with these technologies.
- **Public training:** To establish comfort with the use of assistive technologies, provide one-on-one training sessions for visually impaired clients. Bring users together in a group setting where they could learn from each other's experiences or the tips they offer.
- **Online tutorials and resources:** Create online tutorials and video demonstrations on how to use these assistive technologies. Draw up a section on the library website for resources, FAQs, instructions, and video demonstrations.
- **Technical assistance:** Technical assistance for adaptive technologies through a helpline or a dedicated email could provide some respite. We should ensure the presence of trained staff to assist with technologies that enhance the user experience.
- **Follow-up and evaluation:** Regularly seek feedback from each visually impaired user to identify and understand their needs and difficulties. This will then allow for the transformation of training programs, improvements to technologies, and ensuring the library remains an inviting environment for users.
    - **Peer support groups:** It's important to organize peer support groups so that blind people can share their experiences and feel included. Organizing discussions and meetups is crucial for sharing issues related to adaptive technology.

8.2 Raising Awareness

- **Community Outreach Programs:** Collaborate with clinics that benefit visually impaired people to create awareness events. The library organizes open house days where the public can view the assistive technologies it provides.

- **Workshops and demonstrations:** Organize regular workshops to demonstrate the use of assistive technologies (e.g., screen readers, OCR tools, and Braille displays). Bring on experts and users of these technologies to share their experiences and insights.
- **Online and Print Campaigns:** Feature available assistive technologies on social media, library websites, and newsletters. The library should distribute brochures and posters inside the library as well as at community centers to raise awareness among patrons about the resources.
- **Collaboration with Schools and Colleges:** Collaborate with educational institutes to create awareness among students and teachers. Prepare dedicated sessions for teachers and students to exhibit the role assistive technology holds in supporting the education of blind students.
- **Library Tours and Orientations:** Integrate demonstrations of assistive technologies into regular library tours and orientations for novice users. You should introduce specialized tours designed to cater to the visually impaired and help them understand what services you can provide them.

9. Conclusion

It is imperative for libraries to demonstrate a strong commitment to providing equitable access to their services and facilities for all users, regardless of their abilities. The role of artificial intelligence (AI) in improving library accessibility for individuals with disabilities is significant, as it enhances inclusivity and ensures independent access to information and resources. AI-driven assistive technology, such as text-to-speech systems, navigation aids, and virtual assistants, has revolutionized the way libraries work, promoting a more inclusive environment where all community members can benefit from library resources. The implementation of AI in library services requires a thorough needs assessment, appropriate technology selection, staff training, infrastructure upgrades, user education, and continuous support and maintenance. While there are challenges in implementing assistive technologies in libraries, including cost, technical expertise, user adoption, compatibility, privacy, and keeping up with technological advances, the impact of these technologies on enhancing access to library resources for visually impaired individuals is undeniable. Furthermore, raising awareness and providing training on assistive technologies for visually impaired users are crucial steps for libraries to ensure inclusivity and accessibility. By embracing AI and assistive technologies, libraries can fulfill their responsibility in offering equitable access to information resources and services for all individuals, including those with disabilities.

References

[1]. Bhoi, N. K. (2017). Use of Information Communication Technology (ICT) and Library Operation: An Overview proceedings. International Conference on Future Libraries: From Promises to Practices, 445-45.

[2]. Chauhan, S. P. S. (2024). Enhancing Accessibility in Special Libraries: A Study on AI-Powered Assistive Technologies for Patrons with Disabilities. arXiv preprint arXiv:2411.06970.

[3]. Craven, Jenny (2003). Access to electronic resources by visually impaired people. Information Research, 8(4). Retrieved 01, May 2023, from https://informationr.net/ir/8-4/paper156.html/

[4]. Dodamani, Anand M., & Dodamani, Sukanya M. (2019). Provision of Assistive Technology for Students with Visual Impairment in University Libraries in India. DESIDOC Journal of Library & Information Technology, 39(3), 104-108. DOI : 10.14429/djlit.39.3.14329

[5]. Habibu Salisu B. (Ed.). (2023). What is Assistive Technology? Retrieved 11, June 2023, from https://www.physio-pedia.com/What_is_Assistive_Technology

[6]. Marta Montenegro-Rueda et al., (2022). Impact of ICT on university students with visual impairment. British Journal of Special Education, 50 (1). DOI:10.1111/1467- 8 578.12433

[7]. NcubeIt, M., et al. (2022). The conceptualisation of the Provisioning of Assistive Resources for Patrons with Visual Impairment within Academic Libraries in Zimbabwe. Library Philosophy and Practice (e-journal). 6825. DOI: https://digitalcommons.unl.edu/libphilprac/6825/

[8]. Ovide, S. (2021, October 14). Disability drives innovation. The New York Times. Retrieved September 5, 2023, from https://www.nytimes.com/2021/10/14/technology/audiobooks-innovation.html

[9]. P, Prabhu, Sujathamalini, J., & Ravichandran, G. (2023). Assistive and Digital Technology for the Education. International Journal of Research and Review, 10(2). DOI: https://doi.org/10.52403/ijrr.20230287/

[10]. Singh, D. (2024). Breaking Barriers: AI Tools for Academic Libraries to Improve Equitable Access to Information Resources for Visually Impaired.

[11]. Smith, A., & Johnson, B. (2018). Enhancing accessibility for visually impaired individuals in library settings. Journal of Library Accessibility, 15(2), 123-137.

[12]. Stephen. G, & Ikbal, A. (2023). Artificial Intelligence Powered Tools for People who are Blind Users in Libraries – An Overview to Guide Special Users by the Librarians. International Journal of Science Engineering and Technology, 11(6), 1–7. https://doi.org/10.61463/ijset.vol.11.issue6.106

[13]. Suryawanshi, Sachin. (2024). USING AI tools in Libraries. Indian Journal of Psychology. 2. 205-213.

[14]. Tripathi, M. & Shukla, A. (2014). Use of Assistive Technologies in Academic Libraries: A Survey Assistive Technology. Journal of RESNA, 26(2), 105-118. DOI: 10.1080/10400435.2013.853329