

---

## Use of Robotics and Artificial Intelligence for Enhancing Library Services

Indraji C<sup>1</sup>, Satishkumar Naikar<sup>2</sup>, Dr. Dominic J<sup>3</sup>

---

<sup>1</sup>Research Scholar

Hindustan Institute of Technology and Science, Padur, Chennai – 603103.

Tamil Nadu, India

[indragee18@gmail.com](mailto:indragee18@gmail.com)

[0009-0001-9808-3785](tel:0009-0001-9808-3785)

<sup>2</sup>Librarian

Badruka School of Management (BSM), Dabilpur, Hyderabad -504401. Telangana, India

[satish.naikar1432@gmail.com](mailto:satish.naikar1432@gmail.com)

[0000-0002-7621-5388](tel:0000-0002-7621-5388)

<sup>3</sup>Chief Librarian

Hindustan Institute of Technology and Science,

Padur, Chennai - 603103,

Tamil Nadu, India.

[jdom16@gmail.com](mailto:jdom16@gmail.com)

[0000-0002-6039-641X](tel:0000-0002-6039-641X)

---

**How to cite this article:** Indraji C, Satishkumar Naikar, Dominic J (2024) Use of Robotics and Artificial Intelligence for Enhancing Library Services. *Library Progress International*, 44(3), 3002-3010.

---

### Abstract

The way libraries function and provide services to their customers is being revolutionized by the incorporation of Robotic Technologies and Artificial Intelligence (AI). The employment of these cutting-edge technologies in cataloguing, information retrieval, user support, and maintenance are some of the areas of library services that this study investigates. While robotic systems offer interactive and customized user support, enhancing the overall user experience, AI-driven systems increase the efficiency of cataloguing procedures by automating metadata production and classification. Furthermore, advanced information retrieval is made easier by AI algorithms, giving users faster and more accurate access to pertinent information. In addition, the study looks at how robotics can help with standard maintenance duties like book retrieval and shelf organizing, freeing up human labour for more intricate and valuable work. The results imply that the application of AI and robotic technology in libraries increases service quality and operational efficiency while also improving accessibility and user-friendliness. Possible obstacles to the broad use of these technologies are also explored, along with future research goals.

**Keywords:** Robotic Technology, Artificial intelligence, User Perceptions, Library Services

---

### Introduction

Artificial intelligence (AI) and robotics have been developing at a rapid rate in recent years, and this has started to have a big impact on a lot of different industries, including library services. Libraries

are changing from being considered quiet study areas and places to store actual books to becoming vibrant hubs for learning and creativity (De Sarkar, 2023). The use of cutting-edge technology aimed at boosting operational efficiency, optimizing user experiences, and expanding information accessibility is driving this shift. Applications for robotic technology in libraries are numerous and include automated systems that handle book sorting and shelving and robotic assistants who assist users in finding materials (Oladokun et al., 2023; Wójcik, 2023). In addition to streamlining library operations, these innovations free up staff time for more difficult and user-centered activities. To decrease human error and boost overall efficiency, robotic devices, for example, can perform repetitive jobs like inventory management and book retrieval (Blut et al., 2021; Nguyen, 2020; Tella & Ajani, 2022). However, libraries now have access to advanced methods for organizing and retrieving information thanks to artificial intelligence. Users may more easily and rapidly locate pertinent information with the use of AI-powered search algorithms, which offer more accurate and user-friendly search results (Tella, 2020). AI may be utilized to create tailored suggestions for library patrons, by customizing library materials to meet each user's requirements and preferences, personalization improves user experience (Owolabi et al., 2022).

The research on robots and artificial intelligence applications in libraries identifies several significant impact areas. Automation of the processes involved in cataloging and classification is one important topic. AI algorithms enable faster and more accurate cataloging because they are significantly more efficient than traditional approaches at analyzing and classifying enormous volumes of data (Kelner et al., 2022; Muratore et al., 2020; Tait & Pierson, 2022; Yueh et al., 2020). Libraries that have large collections or those that are constantly growing their digital archives would especially benefit from this. User help and contact is another important area of influence. In addition to providing children with educational activities, robotic assistants can answer often-asked inquiries, lead users through the library, and more (Edwards et al., 2022). These sophisticated AI-enabled robots can converse with people in a variety of languages and adjust to their specific needs, improving accessibility and diversity (Adorno & Marinho, 2021). Robotics and artificial intelligence are also very important in efforts to preserve digital media. To protect priceless materials and make them available to a larger audience, libraries are digitizing their holdings more frequently. Machine learning techniques can be used to improve the quality of digital reproductions, and artificial intelligence (AI) technology can help automate the scanning and processing of documents (Adetayo et al., 2023).

### **The Objectives of the Study:**

- ❖ Examine how robotic systems might increase operational efficiency by streamlining repetitive processes like book retrieval, shelving, and sorting.
- ❖ Examine how AI-powered solutions may improve user engagement with features like searching with more depth and automated customer assistance.
- ❖ Examine how these technologies may affect the roles played by employees, the need for training, and the general administration of libraries.
- ❖ Examine how robotics and artificial intelligence affect the effectiveness and efficiency of library operations and services.
- ❖ Determine the obstacles and constraints related to the application of robotic and artificial intelligence technologies, taking into account technical, ethical, and financial factors.

### **Literature Review:**

Artificial intelligence and robotics are expanding quickly in libraries. Traditionally, automated book circulation systems and automated storage and retrieval systems with automatic control technology have been employed by libraries. Robots have been employed in Japanese libraries in several additional capacities in recent years. A common example is a humanoid robot that guides itself. There are now hundreds of libraries using Softbank's humanoid robot Pepper, and at least 500

more are planned (Harada, 2019; Sambo & Oyovwe-Tinuoye, 2023). Animal-type robots, such as rabbit, are also utilized as guiding robots. Robotics and AI technology are only now starting to be used in Japanese libraries, although the progress is quite rapid. Robots are currently mostly used for library guidance, although other uses are anticipated in the future (Sambo & Oyovwe-Tinuoye, 2023).

The discussion offered a history of industrial robotics during the 20th century. Industrial robot evolution was traditionally divided into four generations, the first three of which encompassed the years 1950 to the end of the twentieth century. This historical sketch took into account not only the advancements in science and technology but also the economic and geopolitical factors that influenced the spread of industrial robots. The history of industrial robotics is not complete; it is still evolving today. New concepts, cutting-edge hardware, and programming methods involving artificial intelligence are redefining industrial automation and revitalizing the industrial setting (Gasparetto & Scalera, 2019). Define looked into the effects of AI-enabled robots and how to use them in a library environment. This study examined the successful usage of artificially intelligent robots by several libraries, including the University of Chicago Library, Temasek Polytechnic Library, UMKC Library, and New York Public Library. They also talked about the different activities that robots can do in libraries, like organizing books, sorting, retrieving, taking inventory, handling materials, etc. They also emphasized that it is still in its infancy in India and will grow with time. Thus, this study looks at the implications of robots in a library context for a variety of operations (Vysakh & Rajendra Babu, 2019).

Humanoid robots with AI are presently available in libraries worldwide, as stated (Tella, 2020). AI encompasses robotics design, development, and application (Abram, 2019). A robot is an autonomous machine that follows a computer program to complete difficult tasks. According to (Kim, 2019) humanoid robots can welcome visitors and provide instructions at libraries. Libby, a robot at the University of Pretoria Libraries in South Africa, already performs similar functions (Sambo & Oyovwe-Tinuoye, 2023). (Papy & Jakubowicz, 2017) found that libraries offer innovative efforts that empower users and improve research competence. Several professional bodies, including the South African Library Association, American Library Association, and International Federation of Library Associations and Institutions (IFLA), have recognized the importance of robotic technologies in library operations and librarianship (Sambo & Oyovwe-Tinuoye, 2023). Robot adoption in libraries can improve library services and provide users with trustworthy information, fostering growth and progress in the information age (Oladokun et al., 2023). Robotic technology in academic libraries was studied by (Ali et al., 2020). The major goals of the study were to find out how libraries are utilizing technology and what role librarians would play when robots become more commonplace. The authors examined scholarly literature, university library strategic plans, and library programming.

The study found that librarians reacted negatively to the usage of technology. The survey found that librarians and library administrators struggle to adopt technology into their systems due to a lack of understanding of its benefits and cost savings. According to (Adebayo et al., 2018) library managers are more likely to embrace and implement RT if they are well-informed on the need to provide routine services using technology. The use of robotic technologies in university libraries is dependent on several factors, including data availability, policy documentation, software and algorithm deployment, and subject-matter expertise (Martínez-Plumed et al., 2021). (Qomariyah et al., 2020) conducted a study on Indonesian university libraries to identify the necessary facilities for the usage of robotic technology. Policy and procedure documents, technical know-how, and organizational resources, including human and technological resources, are among these.

University libraries need to enhance the quality of their offerings if they want to establish themselves in a better position to benefit from artificial intelligence (Tella, 2020). Robots can also be

utilized to scan the library's inventory utilizing barcode and RFID technologies (Bomble Pranit et al., 2015; More & Naikar, 2021). Robots are advantageous in a library environment. Robotics are currently being used in libraries for various tasks and may have future applications. It represents the increasing need for technology adoption, with a focus on AI and robotics in libraries (Shubha, 2023).

### **Robotics and Artificial Intelligence (AI) Applications in Libraries:**

The study analyzes how artificial intelligence (AI) and robotic technologies are changing library services. The primary points are as follows:

1. **Improved User Experience:** By providing specialized suggestions, aiding in information discovery, and increasing accessibility for individuals with disabilities, robots and AI contribute to better user interactions.
2. **Automation of Routine Activities:** Robotics and artificial intelligence (AI) automate administrative and repetitive operations like inventory management, shelving, and cataloguing, freeing up librarians to work on more difficult and interesting projects.
3. **Innovative Services:** Through the use of robotic technology, innovative services such as virtual library tours, interactive learning environments, and mobile book delivery are made possible.
4. **Data Analytics:** AI examines user data to better understand preferences, which helps with resource allocation and library collection development.
5. **Challenges and Considerations:** The paper also discusses ethical issues about data protection, the necessity of ongoing maintenance and upgrades, and the initial installation costs. Libraries may become dynamic, user-focused centres of knowledge and community participation by adopting these technologies.

### **Future Advancements in Robotics and Artificial Intelligence for Enhancing Library Service**

1. **Advanced Conversational AI:** More complex user-library system interactions will be possible with the advancement of conversational AI and natural language processing (NLP). Virtual librarians powered by AI might have sophisticated, context-aware discussions with users, answering more complicated questions and offering individualized, in-depth recommendations. Improved natural language processing (NLP) may also facilitate multilingual functions, enabling libraries to better serve a variety of user groups.

2. **Autonomous Robots for Complex Tasks:** A greater variety of complex tasks may be able to be completed independently by next-generation robots. Robots may do maintenance duties, handle event setup and management, and dynamically sort and organize books based on real-time data. These robots would be able to engage with people securely and travel more effectively if they had improved sensors and AI systems.

3. **AI-Powered Predictive Analytics:** Predictive analytics can be used by AI to predict future trends and user needs. Libraries could be better able to develop programs, provide resources, and maintain collections by keeping an eye on usage trends and user behaviour. Additionally, by allocating resources and personnel optimally, predictive tools may enhance overall service performance.

4. **Assistance and Highly Customized Learning:** Artificial Intelligence may enable extremely customized learning. AI systems could, for example, modify library resources and course materials to fit the tastes and learning styles of each user. Libraries become invaluable tools for lifelong learning when they offer this degree of customization, which may facilitate both focused educational programs and self-directed learning.

**5. Enhanced Accessibility Features:** Future developments in AI and robots may make it even easier for people with disabilities to utilize the internet. Novelties such as sophisticated assistive robots, artificial intelligence-powered sign language interpreters, and enhanced text-to-speech systems have the potential to offer enhanced assistance and inclusion, guaranteeing that every user may effectively utilize library resources and services.

**6. Smart Environment Management:** Robotics and artificial intelligence may help create smarter library spaces. AI systems may, for instance, control the lighting, temperature, and noise levels to provide the best possible environment for learning and reading. Robots could take care of physical alterations or upkeep, guaranteeing that users are in a clean and comfortable environment.

**7. Integrated Augmented Reality (AR) and Virtual Reality (VR):** Experiences at libraries could be changed by fusing AI and robotics with VR and AR technology. To boost participation and create distinctive educational possibilities, libraries could provide immersive learning spaces, virtual tours, and interactive exhibitions. These experiences might be customized by AI to suit the requirements and tastes of each user.

**8. Robust Data Analytics for Improved Services:** AI-powered advanced data analytics may offer a more in-depth understanding of consumer behaviour and preferences. These findings could be used by libraries to better curate resources, improve services, and create programs that better serve the needs of the local population. In addition, real-time analytics may facilitate the quick modification of services in response to customer input and usage trends.

### **User Perceptions of Library Services Using Robotics and AI**

**1. Enhanced Convenience and Efficiency:** Automation and artificial intelligence (AI) users frequently view libraries as being more convenient and efficient. To cut down on wait times and streamline operations, robots can help with duties like book shelving, item check-in and check-out, and directing customers to particular sections. AI-powered solutions can offer customized recommendations, which speed up and improve the personalization of information retrieval. Most people view this enhanced efficiency favorably because it meets the growing desire for smooth, rapid service in many spheres of life.

**2. Enhanced Accessibility:** AI and robotics can make a website more accessible to people with disabilities. For example, people with visual impairments or mobility challenges can browse the library more easily with the assistance of robots outfitted with navigational aids and AI-powered voice assistants. By being inclusive, library services can become more equal and improve the overall user experience.

**3. Perceived Human Element and Personal Interaction:** Although many users value the creativity and efficiency that robotics and AI bring, there is the worry that human interaction may decline as a result. In the past, user assistance and community building have greatly benefited from in-person contact with librarians at libraries. The adoption of robotic and artificial intelligence (AI) technologies may be seen as a loss of this human touch, which could affect the user experience for individuals who value interpersonal interaction.

**4. Trust and Security Issues:** Data security and privacy are issues that are brought up by the usage of AI in libraries. Users might be concerned about how AI systems gather, retain, and use their data. Libraries must make sure that strong safeguards are in place to protect user data and handle any privacy issues since trust in these technologies is essential.



#### 4. Artificial Intelligence Systems:

- AI-driven Cataloguing: AI-driven Cataloguing processes new books and updates the database.
- AI Chatboxes: AI Chatboxes handle user queries and provide assistance.
- Recommendation Engine: The recommendation Engine processes user data and offers suggestions.
- Data Analytics: Data Analytics monitors system performance and user behaviour.

#### 5. Integration Layer:

- API Gateway: API Gateway controls requests to both internal and external APIs.
- Middleware: Middleware enables smooth communication between robotic systems, artificial intelligence (AI), and LMS.

#### Conclusion

The research indicates that the integration of robotic technology and artificial intelligence into library services presents significant opportunities for advancement and novelty. These technologies have the potential to completely change the function of libraries in the digital age by streamlining regular processes, improving information retrieval, and offering individualized user experiences. To exploit the advantages of new technologies while resolving the related obstacles, however, extensive thought and strategic planning are necessary. This article's subsequent sections will go into greater detail about the state of research and real-world robotics and artificial intelligence applications in libraries, giving readers a thorough understanding of this fascinating and quickly developing topic. Different user views arise when robotics and AI are included in library services. Although modernization, accessibility, and convenience can all be greatly increased by new technologies, there are worries that data privacy and human interaction may be diminished. The successful integration of robotics and artificial intelligence (AI) into libraries will depend on striking a balance between these variables and properly resolving user concerns. Robotics and artificial intelligence (AI) in library services have the potential to significantly improve user experiences, increase operational effectiveness, and promote wider accessibility. Libraries will be in a position to further establish themselves as vital and dynamic community resources by utilizing the developments in technology to provide more individualized, effective, and engaging services.

#### Reference

- Adebayo, O. A., Ahmed, Y. O., & Adeniran, R. T. (2018). The role of ICT in the provision of library services: A panacea for sustainable development in Nigeria. *Library Philosophy and Practice (e-Journal)*. <https://digitalcommons.unl.edu/libphilprac/1951/>
- Adetayo, A., Abwage, K., & Oduola, T. (2023). Robots and Human Librarians for Delivering Library Services to Patrons. *The Reference Librarian*, 64(2-4), 69-84. <https://doi.org/10.1080/02763877.2023.2183303>
- Adorno, B. V., & Marinho, M. M. (2021). DQ Robotics: A Library for Robot Modeling and Control. *IEEE Robotics & Automation Magazine*, 28(3), 102-116. <https://doi.org/10.1109/MRA.2020.2997920>
- Ali, M. Y., Naeem, S. B., & Bhatti, R. (2020). Artificial intelligence tools and perspectives of university librarians: An overview. *Business Information Review*, 37(3), 116-124. <https://doi.org/10.1177/0266382120952016>

- Blut, M., Wang, C., Wunderlich, N. V., & Brock, C. (2021). Understanding anthropomorphism in service provision: A meta-analysis of physical robots, chatbots, and other AI. *Journal of the Academy of Marketing Science*, 49(4), 632–658. <https://doi.org/10.1007/s11747-020-00762-y>
- Bomble Pranit, R. G., Dipika, S., & Meervali, D. S. (2015). Library management robot. *International Journal of Recent Technology and Engineering*, 1(3), 21–30. <https://doi.org/16.0415/IJARIE-1192>
- De Sarkar, T. (2023). Implementing robotics in library services. *Library Hi Tech News*, 40(1), 8–12. <https://doi.org/10.1108/LHTN-11-2022-0123>
- Edwards, A., Edwards, C., Abendschein, B., Espinosa, J., Scherger, J., & Vander Meer, P. (2022). Using robot animal companions in the academic library to mitigate student stress. *Library Hi Tech*, 40(4), 878–893. <https://doi.org/10.1108/LHT-07-2020-0148>
- Gasparetto, A., & Scalera, L. (2019). A Brief History of Industrial Robotics in the 20th Century. *Advances in Historical Studies*, 08(01), 24–35. <https://doi.org/10.4236/ahs.2019.81002>
- Harada, T. (2019). *Robotics and artificial intelligence technology in Japanese libraries*. 1–12. <https://library.ifla.org/id/eprint/2695>
- Kelner, J., Lin, P.-C., Tsoi, K. K. F., Maamar, Z., Hung, P. C. K., Chiu, D. K. W., & Ho, K. K. W. (2022). Guest editorial: Social robots, services and applications. *Library Hi Tech*, 40(4), 873–877. <https://doi.org/10.1108/LHT-08-2022-511>
- Kim, B. (2019). *AI-Powered Robots for Libraries: Exploratory Questions*. 1–10. <https://library.ifla.org/id/eprint/2700>
- Martínez-Plumed, F., Gómez, E., & Hernández-Orallo, J. (2021). Futures of artificial intelligence through technology readiness levels. *Telematics and Informatics*, 58, 101525. <https://doi.org/10.1016/j.tele.2020.101525>
- More, V., & Naikar, S. (2021). RFID Technology Implementation at Prof. Y. K. Bhushan information and Knowledge Resource Centre: A Case Study. *Indian Journal of Library and Information Technology (IJLIT)*, 11(4), 7–9. <https://doi.org/10.5281/zenodo.8130056>
- Muratore, L., Laurenzi, A., Mingo Hoffman, E., & Tsagarakis, N. G. (2020). The XBot Real-Time Software Framework for Robotics: From the Developer to the User Perspective. *IEEE Robotics & Automation Magazine*, 27(3), 133–143. <https://doi.org/10.1109/MRA.2020.2979954>
- Nguyen, L. C. (2020). The Impact of Humanoid Robots on Australian Public Libraries. *Journal of the Australian Library and Information Association*, 69(2), 130–148. <https://doi.org/10.1080/24750158.2020.1729515>
- Oladokun, B. D., Owolabi, A. K., Aboyade, M. A., Wiche, H. I., & Aboyade, W. A. (2023). Emergence of robotic technologies: Implications for Nigerian academic libraries. *Library Hi Tech News*, 40(6), 15–18. <https://doi.org/10.1108/LHTN-02-2023-0031>
- Owolabi, K. A., Okorie, N. C., Yemi-Peters, O. E., Oyetola, S. O., Bello, T. O., & Oladokun, B. D. (2022). Readiness of academic librarians towards the use of robotic technologies in Nigerian university libraries. *Library Management*, 43(3/4), 296–305. <https://doi.org/10.1108/LM-11-2021-0104>
- Papy, F., & Jakubowicz, C. (2017). *Digital Libraries and Innovation*. Elsevier. <https://doi.org/10.1016/C2016-0-04850-7>



Qomariyah, A. N., Mursidah, E., Gonti, Y. A., & Wahyuni, D. (2020). Analysis of Organizational Readiness towards Library 4.0: A Case Study at X Library. *Record and Library Journal*, 6(2), 110. <https://doi.org/10.20473/rlj.V6-I2.2020.110-119>

Sambo, A. S., & Oyovwe-Tinuoye, G. (2023). Awareness and Perception of certified librarians of Nigeria towards the use of robotic technologies in the libraries. *Ghana Library Journal*, 28(1), 26–34. <https://doi.org/10.4314/glj.v28i1.3>

Shubha, T. A. (2023). Future Prospects of Robotics and AI in Libraries. In *Digital Transformation in Libraries and Information Centres* (pp. 287–294). Tomorrow's Printers and Publishers. [https://www.researchgate.net/publication/372628615\\_Future\\_Prospects\\_of\\_Robotics\\_and\\_AI\\_in\\_Libraries](https://www.researchgate.net/publication/372628615_Future_Prospects_of_Robotics_and_AI_in_Libraries)

Tait, E., & Pierson, C. M. (2022). Artificial Intelligence and Robots in Libraries: Opportunities in LIS Curriculum for Preparing the Librarians of Tomorrow. *Journal of the Australian Library and Information Association*, 71(3), 256–274. <https://doi.org/10.1080/24750158.2022.2081111>

Tella, A. (2020). Robots are coming to the libraries: Are librarians ready to accommodate them? *Library Hi Tech News*, 37(8), 13–17. <https://doi.org/10.1108/LHTN-05-2020-0047>

Tella, A., & Ajani, Y. A. (2022). Robots and public libraries. *Library Hi Tech News*, 39(7), 15–18. <https://doi.org/10.1108/LHTN-05-2022-0072>

Vysakh, C., & Rajendra Babu, H. (2019). Application of Artificially Intelligent Robot in Libraries. *Reshaping of Librarianship, Innovations and Transformation*, 59–63. [https://www.researchgate.net/publication/338712408\\_Application\\_of\\_Artificially\\_Intelligent\\_Robot\\_in\\_Libraries](https://www.researchgate.net/publication/338712408_Application_of_Artificially_Intelligent_Robot_in_Libraries)

Wójcik, M. (2023). Areas and contexts of the use of robotics in libraries: An overview of the applied solutions and a discussion of prospects. *Library Hi Tech*. <https://doi.org/10.1108/LHT-10-2022-0487>

Yueh, H., Lin, W., Wang, S., & Fu, L. (2020). Reading with robot and human companions in library literacy activities: A comparison study. *British Journal of Educational Technology*, 51(5), 1884–1900. <https://doi.org/10.1111/bjet.13016>