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IMPLICATIONS OF ARTIFICIAL INTELLIGENCE AND ROBOTICS IN LIBRARY AND INFORMATION SERVICES

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Abstract

This study examined how artificial intelligence (AI) and robotics in library and information services are transforming the way libraries operate and interact with users. AI-powered systems analyze vast amounts of data, catalogue, classify documents, and provide personalized recommendations, while robots automate routine tasks, enhance user experience, and expand accessibility. This article explores the future directions of AI and robotics in library and information services, investigating benefits, challenges, and implications for libraries, librarians, and users. The benefits of AI and robotics in libraries include improved user experience, automation of routine activities, increased efficiency, reduced human error, and integration of data sets. However, challenges such as job loss, inadequate funds, staff training, data quality and management, cybersecurity and privacy, and ethical considerations must be addressed. The future directions of AI and robotics in library and information services include advanced conversational AI, autonomous robots for complex tasks, AI-powered predictive analytics, assistance and highly customized learning, enhanced accessibility features, smart environment management, integrated augmented reality (AR) and virtual reality (VR), and robust data analytics for improved services

INTRODUCTION

The adoption of Artificial Intelligence (AI) and Robotics into library and information services sector transforms operations, user interactions, and service delivery. AI-powered systems

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analyze vast amounts of data, classify documents, and provide personalized recommendations, while robots automate routine tasks, enhance user experience, and expand accessibility. As libraries evolve, AI and robotics shape the future of information services.

The last few years have seen a wave of excitement and hype around AI and robots and their potential to create, according to some, a Fourth Industrial revolution. This seems to have touched every sector of work from agriculture and retail, through to scientific research (Luca et'al, 2022).

Artificial intelligence (AI) refers to the ability of machines to perform human-like intellectual tasks such as learning, problem solving, understanding and generating language, and making decisions (The Spatial Studio).

Crawford (2021) explained that it is also important to recognise that the application of AI in consumer technology creates an industrial complex based on intensive (perhaps unsustainable) use of energy, raw materials, and often low-paid labour. Like every other sector, Library and information services are being transformed by artificial intelligence (AI) and robots. In many ways, they are already being reshaped by AI in search and recommendation, with their implications for data and AI literacy (Luca et.al., 2022).

However, the use of Artificial Intelligence (AI) and Robotics in libraries has been increasing steadily over the past decade. This growth is driven by advancements in technology, decreasing costs, and the need for libraries to adapt to changing user expectations and behaviors. For example, new uses in scientific research will impact scholarly communication and how it is supported (Jones et al., 2019). Hence, in order to increase efficiency and effectiveness, many libraries are moving towards automation of their services.

AI and robotics have impacted libraries in so many ways which include improved operational efficiency in cataloguing, classification and serials management, book retrieval, shelving and shelf-reading(Mmejim & Otu 2023). Libraries also use AI and robotics as virtual assistants to provide reference help or answer user queries around the clock. (Kaur, 2023).

Integration of AI and robotics in libraries improves efficiency, enhances user experience, and expands access to information. However, this integration raises important questions about the

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role of human librarians, the ethical implications of AI-driven decision-making, and the potential impact on traditional library services. This article explores the current state and future directions of AI and robotics in library and information services, examining benefits, challenges, and implications for libraries and users.

Objectives

This article will focus on the following:

I. Applications of Artificial Intelligence and Robotics in Library Services
II. Benefits of AI and Robotics in Library Services
III. Challenges/ Solutions of AI and Robotics in Library Services
IV. Implications of AI and Robotics for Library Professionals, Services, and Users.
V. The Future Directions of AI and Robotics in Library and Information Services.

Review of Literature

Artificial Intelligence

Artificial intelligence (AI), as broad as it is, is intelligence exhibited by machines, particularly computer systems. It is a field of research in computer science that develops and studies methods and software that enable machines to perceive their environment and use learning and intelligence to take actions that maximize their chances of achieving defined goals (Russell, 2019). It is the development of computer systems that can perform tasks that typically require human intelligence, such as: learning, problem-solving, reasoning, perception, language understanding.

The term "artificial intelligence" was first coined by John McCarthy in 1956, marking the beginning of a revolutionary journey that has transformed the world. Over the past 60 years, significant advancements in machine learning, search algorithms, and other areas have reshaped the landscape. For modern robotics, Norbert Wiener was the one who laid the foundation in 1948, with his development of cybernetics principles. In the late 20th century, the first autonomous robots surfaced. Installation of Unimate, the first digitally controlled and

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programmable robot, for stacking and removing hot metal parts from a die-casting machine in 1961, and George C. Devol's invention of the first modern robots, including the reprogrammable manipulator "Unimate" in 1950s are notable milestones in robotics (Ezekwibe and Okafor, 2025). However, for many people, especially in rural or semi-urban libraries in developing countries, the effective implementation of AI in education and libraries remains an elusive dream. Even those with limited technological expertise are often unaware of AI's groundbreaking capabilities and potential applications.

In contrast, for those familiar with the internet, AI has become an integral part of daily life, influencing aspects such as business proposals, e-commerce, content creation, and financial management. The widespread adoption of AI has enabled most computer-based processes, and AI-powered devices, including smartphones and gadgets, have become widespread. As a result, AI is being leveraged in various domains, knowingly or unknowingly, with profound implications for fields like medicine, education, commerce, defense, banking, marketing, and finance. The knowledge-driven society is harnessing AI's potential to drive innovation and transformation.

Robotics

Robotics on the other hand is a part of artificial intelligence concerned with the practical use of robots. It was first used as a word by Isaac Asimov, a Russian-born American and a fiction writer in his 1942 short story, "Runabout". The word "robot" originated from the Czech word "robota", which means "forced labor". Czech writer Karel Čapek first introduced the word "robot" to the public in his 1920 play, R.U.R. (Rossum's Universal Robots). A robot is an autonomous machine that follows a computer program to complete difficult tasks (Indraji et.al., 2024). Robotics in libraries has gained ground, with institutions introducing robots to automate routine tasks, such as book sorting and shelving. Some libraries have even deployed robots to interact with users, providing directions and answering questions.

The presence of robots in libraries allows librarians to have more time to concentrate on other important information service delivery to today’s dynamic needs (Teller & Ajani, 2022). Robotics has five major primary areas which are operator interface, mobility or locomotion,

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manipulator & effectors, programming, sensing & perception. These areas are used to build the robots to perform specific tasks in the library. Ezekwibe and Okafor, (2025) revealed that the adoption of robotics in libraries is transforming the way information is accessed, interacted with, and utilized.

Artificial Intelligence and Robotics in Library and Information Centres

The use of Artificial Intelligence (AI) and Robotics in library and information centres has been increasing steadily over the past decade. This growth is driven by advancements in technology, decreasing costs, and the need for libraries to adapt to changing user expectations and behaviors. Library and Information Services has gained significant attention in recent years. AI applications in libraries have transformed the way users interact with library services, including chatbots, recommendation systems, and data analytics. Libraries offer innovative efforts that empower users and improve research competence. (Papy & Jakubowicz, 2017).

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).

Bradley (2022) explains how library activities such as research literature searching, language tools for textual analysis, and access to collection of data are represented in national AI plans, and ways that libraries have engaged with other aspects of AI regulation including the development of ethical frameworks. The paper also suggests a way forward for ethical, trustworthy, and transparent AI.

Overall, the literature suggests that AI and robotics have the potential to transform Library and Information Services, enhancing user experience and improving efficiency. However, careful consideration must be given to the ethical implications and the need for librarians to develop new skills.

Applications of Artificial Intelligence and Robotics in Library and Information Services:

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AI and Robotics can bring about positive changes in libraries, leading to improved services and user satisfaction in some of these ways:

1. Virtual Library Assistants: AI-powered chatbots can assist users in finding books and answering research questions.

2. **Personalized Book Recommendations:** AI-driven book recommendation systems can suggest books based on users' reading habits and preferences.

3. **Automated Cataloging and Classification:** Nwobu, et. al. , (2024) Stated that digital transformation enables automated Cataloging systems.

4. Intelligent Search Systems: AI-driven search engines can improve search results, relevance, and user experience (Nwobu, et. al., 2024)

5. Digital Asset Management: AI can automate the process of ingesting, processing, and delivering digital assets, freeing up staff to focus on higher-value tasks.

6. Research Data Management: AI can assist with data cleaning, organization, and analysis.

7. Collection Development and Maintenance: AI-driven systems can predict demand and recommend materials to be bought and the ones to be weeded out.

9. Language Translation and Transliteration: AI-powered language translation and transliteration tools that increase accessibility and global reach.

Benefits of AI and Robotics in Library and Information Services

The introduction of AI and Robotics in libraries offers numerous benefits which include:

1. Improved user experience: AI and robots can provide personalized suggestions, help users find information, and make libraries more accessible for people with disabilities (Rathod, et. al, 2024)

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2. Automation of routine activities (Indraji et al, 2024): Repetitive tasks like shelving, inventory management, and cataloging are automated by AI and Robotics. This helps librarians to concentrate on more complex projects.

3. Increased efficiency: AI algorithms can also make information seeker to retrieve information faster and more accurate.

4. Reduced human error (Isiaka, 2023): AI helps reduce human error and inefficiencies.

5. Integration of data sets (Mogali, 2015): AI can help libraries integrate data sets with other institutions, which can facilitate the exchange of data and research.

6. Intelligent security services: AI and robots can be used for intelligent security services, such as monitoring the cleanliness of desks and the proximity of fire doors.

This statement supports the idea that AI and Robotics can bring about positive changes in libraries, leading to improved services and user satisfaction.

Challenges/Solutions of AI and Robotics in Library and Information Services

1. Network: Network issues sometimes make it impossible for librarians/library users to make Use of AI in their search. Libraries and information centres should ensure that they replace outdated routers, switches, and other network equipment to ensure reliable and fast connectivity.

2. Job loss: Korinek and Stiglitz (2017) stated that advances in AI technologies might bring about job loss or job polarization. Librarians should always receive trainings on the ICT trends which includes AI and Robotics.

3. Inadequate Funds: The economy of the nation is threatening therefore the funds from the government are shrinking. Finance is very important in the implementation of AI, so the library have to budget their funds, as little as it may be, for the adoption of AI. One possible problem that will not make this work is corruption because though most libraries have been budgeted for a long time, there is still no visible change (Isiaka, 2023). To effectively tackle this challenge, each library should be made to stand independently from any organizational body receiving funds for it from the government, lay down organizational charts in line with the library budget

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and then map out offices that would be held responsible if the project which money has been set aside for is left undone within the stipulated period of time.

4. Staff Training: Adapting to the adoption of AI requires library staff to continuously update their skills. Training and professional development programs are essential, but they can be time consuming and may require additional funding. Technological skills gap and poor technical expertise of the library staff is may pose a challenge in effective applications and use of AI technologies in academic libraries. Absence of training and retraining of library staff to adapt to the changing technological landscape (Isiaka, 2023)

5. Data Quality and Management: There is a great need for high-quality data for training AI models and powering robotic systems in libraries.

6. Cybersecurity and Privacy: Ensuring the security and privacy of user data and library systems when implementing AI and robotics is extremely important.

7. Ethical Considerations: it is important to address ethical concerns around AI and robotics, such as bias, transparency, and accountability.

IMPLICATIONS OF AI AND ROBOTICS IN THE LIBRARY ON

1. Library Professionals

- **Developing new skills:** Librarians need to develop skills in emerging technologies such as AI, machine learning, and data science to remain relevant.
- **Adapting to new roles and responsibilities:** The role of librarians is shifting from being mere information providers to becoming facilitators of knowledge creation and innovation.
- **Supporting digital scholarship:** Librarians must support researchers in managing and analyzing large datasets, and provide expertise in data visualization and communication.
- **Addressing ethical concerns:** Librarians must address ethical concerns related to AI, such as bias, privacy, and transparency, to ensure equitable access to information.

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- **Collaboration and continuous learning:** Librarians must engage in continuous learning and collaboration with other professionals to stay current with emerging technologies and trends.
- **Leadership and managing change:** Library leaders must be prepared to manage change, foster innovation, and develop strategies for implementing AI and other emerging technologies.

2. Library Services

- **Enhanced Services:** AI-powered chatbots provide 24/7 support, and suggest resources based on user preferences while robotics streamline check-in and check-out processes.
- **Opportunities for Innovation:** AI and Robotics enable collaborations with other industries and institutions, may generate new revenue opportunities and can enhance the overall user experience.
- **Changes in Services:** AI and Robotics may reduce the need for physical library spaces), enable new service models, such as AI-powered research assistance, may alter user behavior and expectations.
- **Potential Service Gaps:** Users may need training to effectively use AI-powered services). Technical issues may impact service availability.

3. Library Users

- **Improved accessibility:** AI-powered chatbots and virtual assistants can provide 24/7 support, making library resources more accessible.
- **Personalized user experiences**: AI-driven recommendation systems can suggest resources tailored to individual users' preferences.
- **Enhanced discovery**: AI-powered search engines can improve resource discovery and retrieval.
- **Increased efficiency:** Robotics can automate routine tasks, freeing up staff to focus on high-touch services.
- **New skills requirements**: Users may need training to effectively use AI-powered tools and services.

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- **Technological dependence:** Users may become too reliant on AI-powered services, potentially reducing critical thinking skills.
- **Equity and access concerns:** Unequal access to AI-powered services may exacerbate existing inequalities.
- **Changing user behavior:** AI and robotics may alter user behavior and expectations, requiring libraries to adapt.

The Future Directions of AI and Robotics in Library and Information Services

The following are the future advancements in robotics and artificial intelligence for enhancing library services

1. Advanced Conversational AI: Priya and Shivarama, Rao, (2023) proposed an AI-based conversational agent named InfoRef to provide reference services by creating an interactive interface between library services and users. The application works on the AAA (Anytime, Anywhere, Anyone) model and routes the users to the available information. It also provides access to 24/7 information to patrons. The free version of Dialog flow (a natural language understanding engine by Google) was used for building the InfoRef application. After its development, the InfoRef was integrated with different online platforms like the website, Koha ILS, and Telegram. The integration worked well and generated a similar response on all platforms.

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 (Indraji, Satishkumar and Dominic, 2024)

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

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(Indraji, Satishkumar and Dominic, 2024)

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 (Indraji, Satishkumar and Dominic, 2024).

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 (Indraji, et al, 2024)

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. (Indraji, Satishkumar and Dominic, 2024)

6. Smart Environment Management: Robotics and artificial intelligence may help create smarter library spaces. AI systems may, for instance, control lighting, temperature, and noise levels to provide the best environment for learning and reading. Robots could take care of physical alterations or upkeep, guaranteeing that users are in a clean and comfortable environment (Indraji, Satishkumar and Dominic, 2024).

7. Integrated Augmented Reality (AR) and Virtual Reality (VR): Prouzeau et al. 2020) stated that libraries are leveraging AR and VR to create eye-catching educational content and bridge the gap between physical and digital library spaces, fostering deeper user engagement.

Experiences at libraries could be changed by fusing AI and robotics with VR and AR technology. To boost participation and create distinctive educational possibilities,

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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 (Indraji, Satishkumar and Dominic, 2024)

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 (Indraji, Satishkumar and Dominic, 2024)

CONCLUSION

Introducing AI and Robotics into libraries and Information centres can change the way they work and help their patrons. Though there are some challenges, benefits like saving time, making it easier for people to use, and helping more people make it worth it. Libraries and information centres should make sure the are offering the best to their users and not just relying on technology. If they do this, libraries can be exciting places where people can learn, create, and come together."

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