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Application Of Artificial Intelligence In Academic Libraries

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Abstract:
The implementation of artificial intelligence encompasses various domains, including expert systems, artificial neural networks, fuzzy logic, image processing, natural language processing, speech recognition, and robotics. These fields are interconnected, and in many cases, multiple AI applications work together to enhance library services. This article examines the diverse applications of artificial intelligence in libraries, as outlined above. Additionally, the authors discuss potential areas where some of these technologies can be applied to improve service quality, ultimately highlighting AI's transformative impact on library operations.

Keywords:Artificial Intelligence, Academic Libraries, Expert Systems, Robotics, Machine Learning.

Introduction:

Academic libraries play an essential role in facilitating teaching, learning, and research within educational institutions. Artificial Intelligence (AI) technology has had a profound influence on the modern workplace in the 21st century. As technology advances rapidly, artificial intelligence (AI) has emerged as a transformative tool for enhancing library services and operations. AI applications provide opportunities to optimize workflows, tailor user experiences, and extract valuable insights from extensive data collections. However, incorporating AI into academic libraries also raises concerns regarding privacy, fairness, and resource distribution.

Libraries are increasingly integrating AI to enhance operational efficiency. Chatbots and virtual assistants are being utilized to manage routine inquiries, allowing librarians to concentrate on more complex responsibilities. These AI-driven tools offer round-the-clock assistance, ensuring users can access support whenever needed.

In the digital age, users of online libraries often seek the flexibility to navigate resources independently. Additionally, libraries have broadened their services to provide valuable solutions to societal challenges. Across various user groups, libraries are consistently acknowledged for their role in delivering information that empowers individuals to address everyday problems. Traditional libraries have often faced limitations in meeting these demands. AI has been suggested as a means to enrich library collections and enhance their usefulness to users (Cordell, 2020). Organizations such as the International Federation of Library Associations (IFLA) recognize the potential of AI, despite limited research and application in library settings.

As described by Nwakunor (2021), AI encompasses computer-operated robots designed to think intelligently, similar to

human beings. These robots operate electronically with computer assistance, mimicking human cognitive functions. AI keeps track of and evaluates every action taken by the user (Nwakunor, 2021). The origins of AI date back to John McCarthy's research in 1955, which proposed that all aspects of learning and intelligence could be replicated through machines (Wang, 2018). According to the Merriam-Webster English Dictionary (2018), AI is "a division of computer science dedicated to equipping machines with the ability to simulate natural human intelligence." AI refines its human-like capabilities by learning from past experiences and adapting over time. As a branch of computer science, AI encompasses expert systems, fuzzy logic, artificial neural networks, evolutionary algorithms, case-based reasoning, image processing, natural language processing, speech recognition, and robotics (Kusumanchi, 2019). This study seeks to explore the present state of AI adoption in academic libraries, highlight critical challenges, and suggest strategies for its effective implementation.

Statement of the Problem:

The incorporation of artificial intelligence (AI) in academic libraries presents multiple challenges and concerns. These include:

- **Privacy and data protection:** AI systems often depend on user data for learning and improvement, raising concerns about safeguarding privacy and ensuring secure data management.
- **Equity and inclusivity:** Unequal access to AI-driven services may widen existing disparities among library users.
- **Staff expertise and training:** Libraries may struggle to hire and train personnel with the specialized skills required developing, deploying, and managing AI technologies.
- **Ethical implications:** AI algorithms can reflect biases or reinforce stereotypes, creating ethical challenges in decision-making within library operations.

Objectives of the Study:

1. To analyse the present level of AI implementation in academic libraries.
2. To explore the challenges and potential benefits linked to integrating AI into library services and functions.
3. To evaluate how AI influences user interactions, staff responsibilities, and the distribution of resources in academic libraries.
4. To suggest strategies for the efficient and ethical deployment of AI in academic library environments.

Review of Literature:

(1) Kalbande et al., (2024) A quantitative research approach was employed using a structured questionnaire, designed in alignment with the study's objectives and validated by subject matter experts. Purposive sampling targeted individuals with adequate knowledge of Library and Information Science (LIS). Data were collected from 259 respondents via Google Forms and analysed using both descriptive and inferential statistical methods. The findings indicated that most participants held positive views regarding AI integration in libraries. Statements such as "AI can help bridge performance gaps among librarians" and "AI does not contribute to staff complacency" received high average ratings. Librarians expressed interest in the ethical dimensions of AI, a willingness to expand their knowledge on the subject, and confidence in AI's potential to improve library services.

(2) Pawar, V.M. (2024) Artificial intelligence (AI), a branch of computer science, focuses on developing machines capable of performing tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, understanding spoken language, and even exhibiting creativity.

Academic libraries can leverage AI to improve their services and operations. However, several challenges must be addressed before AI can be effectively implemented in these settings. These challenges include technological limitations, ethical concerns, and legal issues. This article explores the concept and evolution of AI, its significance, applications, methodologies, and areas of use. Additionally, it examines the challenges associated with integrating AI into academic libraries.

(3) Gajbhiye, C. K. (2024) This research investigates the impact of artificial intelligence (AI) on library services in India, aiming to assess the awareness, perspectives, and challenges faced by Indian library professionals. Through an extensive literature review and an analysis of existing AI applications in libraries, the study explores the potential benefits of AI, such as enhanced efficiency, improved accessibility, data-driven decision-making, and personalized user experiences. However, for AI to be adopted responsibly, concerns related to algorithmic bias, data privacy, and ethical considerations must be carefully addressed. The report underscores the necessity for librarians to prepare for the future of AI by staying informed about emerging technologies, engaging with AI tools, and keeping both themselves and stakeholders updated. While concerns exist regarding AI potentially surpassing human intelligence, a well-planned integration of AI could transform library services in India, fostering innovation and growth opportunities.

(4) Chandrashekara, G. S., & Mulimani, M. (2024) This article explores the impact of AI technologies on various Library and Information Science (LIS) functions, including user services, data analysis, information retrieval, and cataloguing. AI-powered tools such as chatbots, recommendation systems, and natural language processing have enhanced user experiences by enabling personalized suggestions and efficient information retrieval. Additionally, AI automates repetitive tasks, allowing librarians to focus on more complex duties such as community engagement and research support.

(5) Manjunatha, K. (2023) In the modern era, artificial intelligence (AI) is emerging as a transformative technology. AI is increasingly being utilized in library services, offering the potential to enhance and modernize information access. This study examines the impact of AI on library services. While numerous studies have explored this subject, most have focused on a limited range of applications. Although there is a clear connection between AI and libraries, uncertainties remain regarding its implementation and its influence on academic research. The research aims to investigate these unresolved questions. By addressing these concerns, it will provide valuable insights for policymakers, librarians, and researchers, helping them make informed decisions before integrating AI into library services.

(6) Ajakaye, J. E. (2021) The integration of AI has significantly enhanced the availability and utilization of library resources, contributing to the fulfilment of library goals and objectives. With AI playing a key role in various library functions, such as book management and classification, librarians must adopt innovative approaches to stay relevant in their profession. AI implementation has introduced new opportunities, including the seamless connection between digital and physical resources and the ability to integrate video assistance with specific materials. This chapter explores different aspects of artificial intelligence, the services libraries can offer through AI, the benefits of its adoption, and the challenges libraries may encounter while incorporating AI into their operations.

Advantages of AI for Library services in Academic Libraries:

Artificial intelligence (AI) has enabled libraries to address critical challenges, such as organizing books and materials, cataloguing, and acquiring resources. As a result, library services have become more efficient and effective, enhancing user satisfaction by providing quick and accurate access to information.

Fernandez (2016) highlighted that AI in academic libraries facilitates big data analysis, metadata creation, and improved search translation, ultimately increasing the accessibility of library materials and assisting staff in responding to AI-related queries. Tella (2020) emphasized the importance of academic libraries adapting to AI advancements to enhance service quality in the digital era. Similarly, Talley (2016) encouraged university librarians to adopt AI technologies to better serve researchers and library users.

Sagarjit et al. (2001) noted that AI adoption has improved user engagement in many advanced countries, allowing for more efficient and user-friendly information retrieval. AI-driven systems can simplify searches, assist in retrieving information across collections, and support users in their queries.

Asefeh and Asemi (2018) outlined several ways AI can enhance library services, including circulation management, book organization, cataloging, and metadata assignment. Fernandez (2016) also pointed out AI's potential in analyzing big data, integrating search results, and improving metadata creation.

Divayana et al. (2015) identified AI's advantages in library operations, such as increased efficiency in completing tasks that would take longer if performed manually. AI also aids in exploring new concepts, reducing human errors, and improving operational accuracy. Liu (2011) suggested that academic libraries could implement AI-powered expert systems in reference sections to recommend relevant materials to users based on their queries.

Mogali (2015) highlighted several key benefits of AI, including:

a) Handling complex and demanding tasks beyond human capability

b) Completing tasks faster than humans

c) Discovering unexplored concepts, such as space research

d) Reducing errors and defects in operations

e) Assisting researchers in accessing global studies with ease

f) Offering limitless operational potential

Application of Artificial Intelligence in Academic Libraries:

A: Expert Systems in Library Services: Library operations involve interactions between reading materials, users, and staff. The integration of expert systems enhances communication between staff and users, as well as between users and databases. These systems aid librarians in identifying ways to boost productivity and enhance service quality.

1. Reference Services: Reference service is a crucial library function. Expert systems can act as virtual reference librarians. Systems such as REFSEARCH, POINTER, Online Reference Assistance (ORA), ANSWERMAN, and PLEXUS serve as advisory tools for finding reference materials and factual information.

2. Cataloguing: As one of the oldest library practices, cataloguing has seen automation efforts, particularly in descriptive cataloguing, due to its rule-based nature (AACR2). Artificial intelligence in cataloguing can be implemented in two ways:

- Human-Machine Interfaces: Intellectual tasks are divided between librarians and automated support systems.
- Fully Automated Expert Systems: These systems, integrated with electronic publishing platforms, generate cataloguing

entries online. The knowledge-based system processes cataloguing data automatically, minimizing the need for human intervention.

3. Classification: Classification is fundamental to organizing knowledge in libraries and information centres. Various expert systems, including Coal SORT, EP-X, and BIOSIS, support library classification.

4. Indexing: Expert systems are also used for indexing periodicals. The process involves identifying key concepts, converting them into textual descriptions, and assigning controlled vocabulary terms. Automating intellectual aspects of indexing improves consistency and quality. Based on input from the indexer, the system determines the most appropriate terms and subdivisions, making logical inferences and executing necessary actions. The 'Med Index' is a prominent example of such a system. Since expert system-driven services are still evolving, many libraries and users have limited exposure to them. However, continuous improvements are being made to enhance their effectiveness.

5. Acquisition: Library users play a key role in developing library collections, particularly in acquiring online resources. Various expert systems facilitate this process. One such system, Monograph Selection Advisor, assists in selecting monographs. To be effective, the system's knowledge base must be comprehensive, and its interface should allow librarians to retrieve necessary information efficiently.

B: Natural Language Processing (NLP) in Library Services: Natural Language Processing (NLP) refers to the ability of machines to interpret and respond to human language, whether spoken or written. In library and information science, NLP is particularly useful for database searches, such as Online Public Access Catalogues (OPAC). Indexing plays a key role in document retrieval, improving precision by extracting relevant document sections while minimizing irrelevant results.

C: Machine Learning in Library Services: One of the key challenges in libraries is enhancing metadata generation. Libraries acquire thousands of metadata records from vendors when purchasing print and digital resources. In cases where e-books lack metadata, libraries must generate their own. Machine learning offers advanced tools to automate and refine metadata creation, significantly improving the depth, accuracy, and categorization of subject terms.

D: Robotics in Library Services: A robot is defined as a programmable, multi-purpose machine capable of performing automated tasks. While libraries continue to expand digital collections, they still manage large volumes of physical documents, leading to space constraints. To address this, the Comprehensive Approach to Printed Material (CAPM) system uses robotics for automated book retrieval and scanning. Through a web interface, users request materials, triggering robotic mechanisms that retrieve, open, and digitally scan documents, providing real-time access.

E: Intelligent Interfaces for Online Databases: Despite the availability of online databases, many users struggle with access due to complex communication protocols, search techniques, and database structures. Intelligent interfaces simplify this process by incorporating smart features into search systems. Unlike intelligent search engines, these interfaces enhance existing systems by making searches more intuitive.

An intelligent interface helps users by:

- Identifying the most suitable databases and hosts.
- Allowing users to input queries in natural language.
- Determining the scope and depth of requested information.
- Refining search results based on relevance.

- Translating queries into the required database format.
- Presenting results in an organized and meaningful manner.

Challenges of Adopting AI in Academic Libraries:

Although artificial intelligence (AI) has significant potential in library services, academic libraries in Nigeria have yet to adopt and implement it. This delay may be attributed to a lack of awareness and understanding of AI's relevance in the field, as research linking AI to librarianship remains limited. While AI is advancing rapidly in various sectors, its integration into library and information science has been slow. Libraries today face critical challenges that threaten their traditional roles, including inefficiencies in operations, technological disadvantages, difficulties in retaining and attracting users, and struggles to demonstrate their value to stakeholders.

Korinek and Stiglitz (2017) argued that advancements in AI technologies could lead to job losses or polarization in the workforce. Automation-driven AI adoption has the potential to exacerbate inequality. The World Bank (2016) reported that developing nations might be particularly vulnerable, predicting significant job losses due to AI: 69% in India, 72% in Thailand, 77% in China, and 85% in Ethiopia. These studies indicate that AI could contribute to widespread unemployment and economic disruption.

Beyond job concerns, several additional challenges hinder the adoption of AI in academic libraries:

1. Financial Constraints: In times of economic and political instability, cultural institutions often face budget cuts. Libraries must demonstrate cost-effectiveness to secure funding, yet without financial support, they struggle to modernize facilities, introduce new services, and enhance user experiences. This creates a cycle where libraries cannot prove their value without the necessary resources to innovate (Tella, 2020).

2. Skills Gap: The increasing digitalization of library operations requires librarians to acquire new competencies. To stay relevant, libraries must develop digital fluency, provide timely and relevant resources, and support interactive learning experiences for users in an evolving digital landscape.

3. Competition from Alternative Information Sources: A 2017 Horizon Report revealed that 68% of college students begin their research using Google and Wikipedia. With the rise of open-access publishing and free information sources, libraries must rethink their role in delivering high-quality, credible information while maintaining their relevance in the digital era.

4. Engaging Diverse Audiences: To attract and retain users, libraries must evolve to meet the expectations of tech-savvy and hyper-connected patrons. This requires reimagining library spaces, transforming them from quiet study areas with bookshelves into dynamic environments that foster collaboration, innovation, and creativity while still providing spaces for focused study.

Addressing these challenges is crucial for libraries to successfully integrate AI and remain valuable in an increasingly digital world.

Conclusion:

There are a number of possible applications of Artificial Intelligence implemented and they have been creating a positive impact on libraries. This has proved that applications of AI save time and money in almost all sectors in the society. The application of AI in the academic libraries have been increasing in very high speed. As authors of this paper discussed, implementation of AI in libraries has triggered the discovery of many new ideas. The development of expert system libraries

greatly benefited, sometimes it appears like "Librarianship is at stake" and now it is challenging to ensure the values of librarianship. Artificial intelligence (AI) systematically tops popular lists of the most imperative emerging technologies. With a mixed feeling of fear and eagerness, readers seem to agree that the AI shapes the future libraries.

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