*Section A-Research paper*
*ISSN 2063-5346*

# Artificial Intelligence Tools and Perspectives in Academic Libraries: A Review

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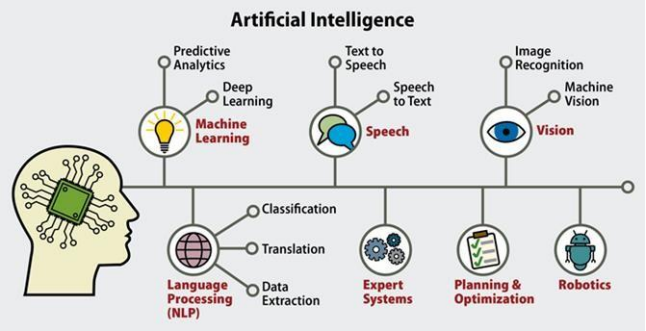
**DOI: 10.48047/ecb/2023.12.si4.1635**

***Abstract*— Artificial Intelligence (AI) has been one of the most transformative and emerging technologies. It is the effort of human understanding in training a robot-like machine to act like humans. Artificial intelligence aims to improve learning, thinking, and perception. Libraries are the core of academic activity; they attract teachers, students, and the community. The essential source of distributing knowledge and information to society deserves an upgrade. This review study will discuss the changes and upgrades an academic library need. In remote learning, digital libraries are precious. They are now one of the most important sources of information for learners in this education sector. With AI's aid, this transformation is achievable for the libraries. AI has many use cases in libraries, including reference systems, automation, book reading chatbots, robots, etc. We'll mainly cover how these methods are implemented in libraries using AI topics such as natural language processing, and pattern recognition. A Survey analysis id done for more descriptive analysis of AI in libraries. The Implementation of AI has specific benefits and drawbacks mentioned in this paper. It may appear like AI is distancing librarians from their patrons, but utilized to help librarians and improve library administration systems.**

***Keywords*— *Artificial Intelligence. Pattern Recognition. Natural Language Processing. Expert System. Academic Library. Digital Library***

## I. INTRODUCTION

Artificial intelligence (AI) is a part of cognitive science in which a machine or a robot-like structure has the ability to do human tasks. In simple words we can say that the aim of AI is to build a system capable of doing human-level tasks, better and faster than humans. The foundation for modern AI was laid by classical thinkers who sought to characterize the human mind as the mechanical manipulation of symbols. In the 1940s, this research resulted in the development of the programmable digital computer, a machine built on the conceptual underpinning of mathematical reasoning. This technology and the principles that underpin it spurred a group of scientists to investigate the possibility of developing an electronic brain seriously. By the 1950s, artificial intelligence had gained popularity and excitement in the minds of a generation of scientists, mathematicians, and philosophers. Alan Turing was a British Born polymath who researched the mathematical possibilities of artificial intelligence and introduced it to the world. A workshop on the campus of Dartmouth College in the United States in the summer of 1956 created the discipline of AI research. AI study has many subfields [Figure1] that focus on specific targets and approaches. Reasoning, knowledge representation, planning, learning, natural language processing, sensing, and the ability to move and manipulate objects are some of the highlights of AI research goals that we will study in this paper. For a few years, the fate of academic and research libraries in the digital realm has been a major focus in ongoing research. Libraries are, diligently, trying to promote themselves in a modern economy in which unlimited information can be found at the click of a mouse, and learning and teaching methods are steadily improving. Moreover, the present era of library users seems to be unaware of the library's tremendous perks and features. On these uncharted waters, libraries are looking for a competitive strategy and a way that could offer better service to their users [1]. This paper discusses the issues affecting the library's conventional operations and possible emergent responsibilities.




Source: https://www.aiiottalk.com/types-of-artificial-intelligence-details-that-everyone-should-know/

Figure 1: Fields of AI

## II. STUDY RESOURCES

### *A. Literature Review*

AI is a vast area and rapidly increases from self-driving cars to healthcare with time. The world has changed and will keep developing with this high technology. The educational management system is also becoming digitalized ever since the covid-19 hit the earth. On this note, academic libraries should experience the update as well. However, **Dr. Shivaranjini Mogali (2014)** mentioned in her paper how AI would benefit the library management system. AI fields like expert systems, NLP, Pattern Recognition, and Robotics [2]. **Amamda Wheatley and Sandy Hervieux (2019)** gave a statistical approach to AI, which will be growing in the upcoming years [11]. It was estimated through environmental scans that 25 universities and their libraries in America and Canada are collaborating with AI, although there were no strategic intentions involved. Even though many libraries are trying to engage themselves with AI, unfortunately, the partnership percentage is meager. They also gave insight into how AI will dominate in the future and what will be the reaction of the librarians to it. **Ex Libris (2019)** mentioned, "library as a platform" in their whitepaper. They discussed the libraries looking for their new place in the market and updating their management with AI and the challenges that libraries face worldwide. A survey from the "**2018 Ex Libris Future Survey**" talks about how librarians are familiar with necessity and the benefits advanced technology could deliver to the library [1]. However, **S. Vijayakumar and K.N. Sheshadri (2019)** explored various fields of AI being used in libraries to enrich management. These researchers concluded their paper with a blended sensation of fear and excitement that pursuers appear to concur when AI will shape the library [10]. **Isaiah Michael Omame and Juliet C. Alex Nmecha (2020)** justify the implementation of AI in libraries. Compressing the work in libraries makes them less prone to errors 24/7, unlike human beings [3]. Libraries must reinvent their services and re-examine their procedures to succeed in the new information economy, and artificial intelligence in libraries is a great way to do it.

## III. ARTIFICIAL INTELLIGENCE IN ACADEMIC LIBRARIES

Artificial intelligence (AI) refers to the development of computer systems that can perform tasks that typically require human intelligence. It involves the creation of algorithms and models that enable machines to learn from data, make decisions, solve problems, and perform various cognitive functions.

AI encompasses a range of techniques, including machine learning, natural language processing, computer vision, robotics, and expert systems. Machine learning algorithms allow computers to learn from data and improve their performance without being explicitly programmed. Natural language processing enables computers to understand and interact with human language. Computer vision enables machines to interpret and analyze visual information, while robotics combines AI and physical systems to create intelligent machines capable of interacting with the physical world.

### *A. Need to Develop AI in Libraries*

1. **Meeting up the standards of the New Generation**: As the younger generation becomes increasingly engrossed in technology, a library filled solely with books appears to be less appealing to them. Libraries should be modernized to attract a higher-tech audience. Revisiting the library's physical environment that has evolved from a peaceful surrounding. To stay relevant, the library must develop into an active location for collaboration, new activities and a quiet area for thoughtful contemplation [1]. Patrons should be viewed as creators. The library should be considered a creative hub, with maker spaces equipped with cutting-edge technologies like 3D printing, virtual reality, flexible displays, video production tools, etc.
2. **New dynamic experience in studies**: Students may effortlessly connect with their personal preferences while learning any software with the aid of AI. The restriction isn't limited to the books in front of them; instead, they can

quickly access all the literature accessible worldwide. That is why libraries require AI for their development and the wellness of their audience.

3. **Financial Uncertainty**: The battle for institutional or government funding is a situation of dilemma. Libraries are required to demonstrate cost-effectiveness and value for money. Still, they won't be able to do so until they employ current technology to improve their physical locations, add new services, and improve the user experience for present clients – all of which will need more funds. As a result, today's libraries are in financial debt, and are unable to demonstrate value in the absence of extra money [1].
4. **Upgrading to the current situation**: In 2020, when the whole world faced the covid-19 problem, everything went offline to online, from the education management system to working companies. Now the students are more engaged and interested in doing every work on online platforms. Keeping this current situation in mind, the libraries should also upgrade to digital libraries.

*B. Advantages*

1. **Better Communication**: There will be direct communication between the library and the users without involving a third party. Users can extract the specific amount of information they want without wasting time manually.
2. **Enhancement in User Experience**: The upgrade of the library will automatically attract more users, and they will see the dynamic change with maximum utilization of their time. There will be fewer human errors in service delivery with AI's involvement.
3. **Reduction in the workload of librarians**: Since the AI has taken over almost all the library tasks, it will reduce the workload of the librarians. They will get more time to focus on individuals in a better way rather than answering the questions of every user in a rushed manner.
4. **Availability of Space**: Unlike the extensive central libraries, there are small libraries as well for user services. But the problem lies in the space being lodged in with books and journals and much more educational stuff. It results in a way that the users don't get enough space to do their work in libraries; instead, they have to issue the book even if they don't want to. The development of digital libraries will clear up some space by reducing the extra informational material.
5. **Data Security**: Everyone has the right to privacy: According to the IFLA internet manifesto, "Libraries and information services have a responsibility to guarantee that their users' privacy is protected and the confidentiality of the materials and services they utilize"[14]. AI is the best option to adapt for the user's security to be maintained.

*C. Challenges Faced*

There are more than 7000 languages in the world. Apart from that, if we look at India as an individual country, it has more than 100 languages, but NLP provides translation to some specific languages, which is a limitation. International students from all over the world will not be able to use translation technology to convert the informational material into their native language for the betterment. AI undoubtedly is the most advanced and effective technology, but it requires a large amount of money for its development, and not every government of their country can afford that. It will be cost-effective if seen for long-term use, but a large amount of money is required for the implementation.

Librarians are not much involved in technology. They know the primary level usage of the computers. Still, because of the development of AI, it will be challenging and time-consuming for them to learn the conduction of the technology. Automated systems will solve the user's problem, but they will lack human empathy. Human to Human connection is what a user wants sometimes. If AI takes over the librarians, they will feel worthless, and there is a fear of facing unemployment in them.

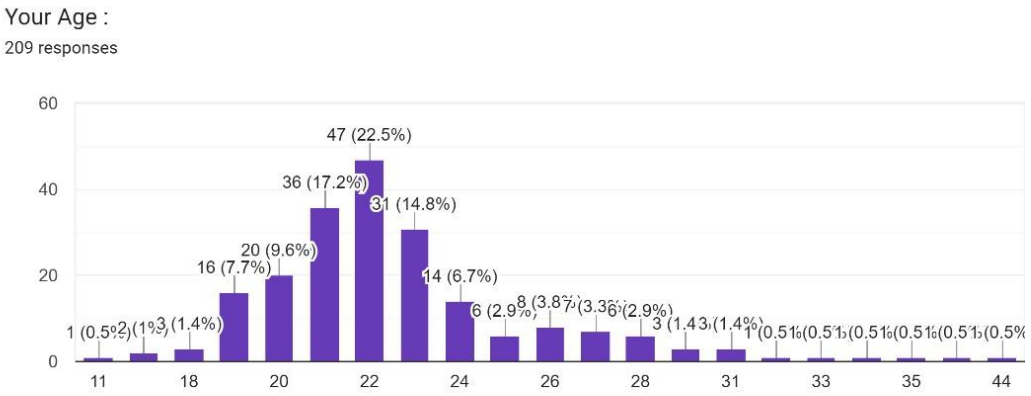
## IV. PERFORMANCE STUDY AND IMPLEMENTATION

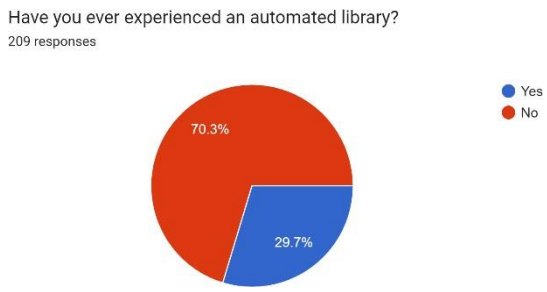
In recent years, the integration of artificial intelligence (AI) in various domains has sparked significant interest and speculation. Within the academic library context, the potential impact of AI on library services and user experiences has drawn considerable attention. To gain insights into the depth of interest and perceptions regarding AI-generated academic libraries, a survey was conducted among a diverse group of participants.

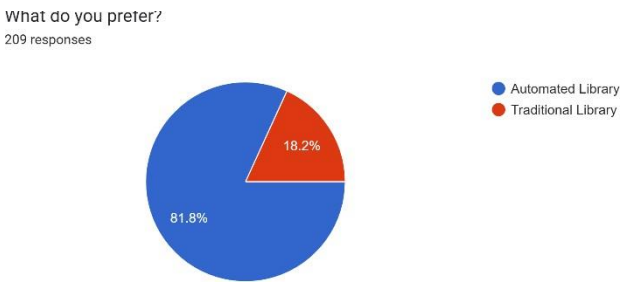
The survey aimed to capture the perspectives of individuals who utilize academic libraries, including students, faculty, researchers, and librarians. The following methodology was employed:

1. **Survey Design**: A structured questionnaire was developed, comprising multiple-choice and open-ended questions. The questionnaire was designed to explore participants' awareness, attitudes, expectations, and concerns related to AI-generated academic libraries.
2. **Sampling**: A purposive sampling method was employed to ensure representation across different educational levels, disciplines, and geographic locations. Participants were recruited through online platforms, educational institutions, and library networks.

3. **Data Collection**: The survey was conducted using an online survey platform, allowing for efficient data collection. Participants were provided with clear instructions and informed consent prior to participation. Data collection spanned a specified time frame to ensure adequate sample size.
4. **Data Analysis**: Quantitative data obtained from the multiple-choice questions were analyzed using descriptive statistics, such as frequencies and percentages. Qualitative data from open-ended questions were analyzed thematically to identify recurring themes and patterns.



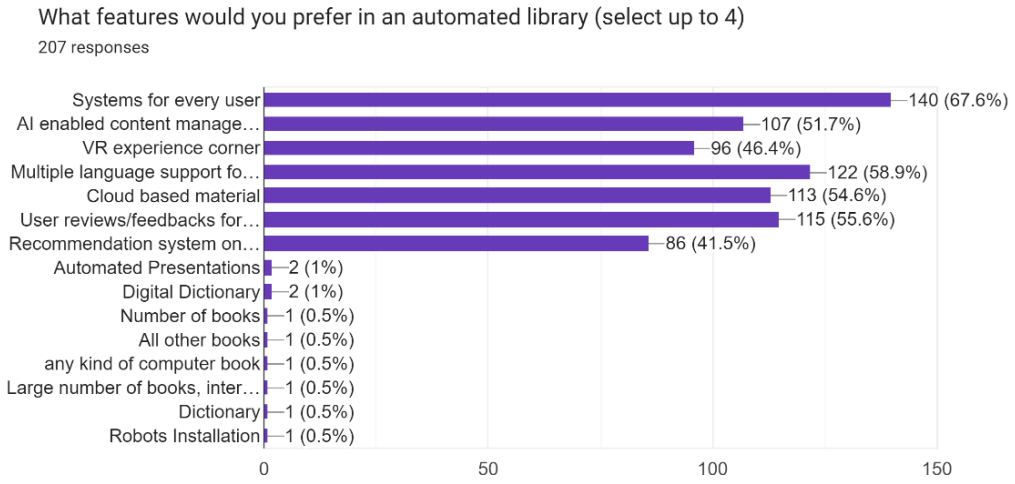




**Results:**

The survey generated a substantial response, with a diverse range of participants representing various academic backgrounds. Key findings from the survey included:

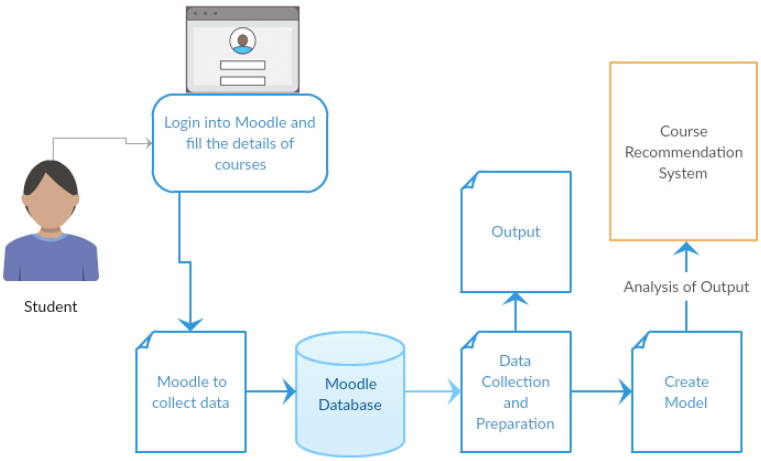
1. **Awareness and Familiarity**: A majority of participants demonstrated a moderate to high level of awareness regarding AI and its potential applications in libraries. Many were familiar with AI technologies such as machine learning, natural language processing, and data analytics.
2. **Interest and Expectations**: The survey revealed a widespread interest in AI-generated academic libraries. Participants expressed expectations such as personalized recommendations, enhanced search capabilities, automated administrative tasks, and improved user experiences through virtual assistants.
3. **Concerns and Challenges**: While participants showed enthusiasm, several concerns were raised. Privacy and security of personal data, potential bias in AI algorithms, and the impact on human interactions were identified as significant challenges that need to be addressed when implementing AI in libraries.
4. **User Involvement**: Participants emphasized the importance of user involvement in the development and implementation of AI systems in academic libraries. They highlighted the need for transparent decision-making processes, user feedback mechanisms, and ethical considerations to ensure user-centric and responsible AI integration.




The survey results provide valuable insights into the depth of interest and perspectives on AI-generated academic libraries among various stakeholders. The findings highlight the potential benefits and challenges associated with AI implementation in libraries, while emphasizing the importance of user involvement and ethical considerations. These insights can inform future initiatives and strategies aimed at harnessing the potential of AI to enhance academic library services and user experiences.

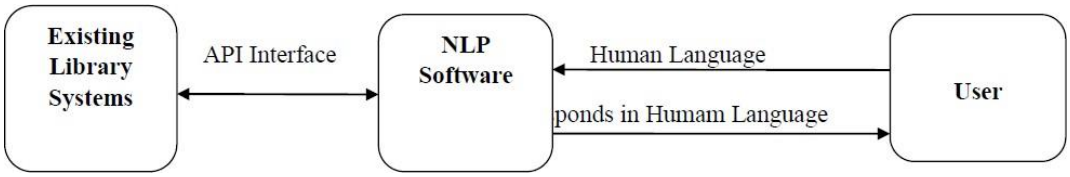
Based on the results of the survey we concluded that, there are some approaches that can be implemented for the improvement of the academic libraries:

1. **Intelligent Search and Recommendation Systems**: AI-powered algorithms can be used to develop advanced search systems that provide more accurate and relevant search results. Recommendation systems can suggest relevant books, research papers, or resources based on user preferences, previous searches, and behavior patterns.



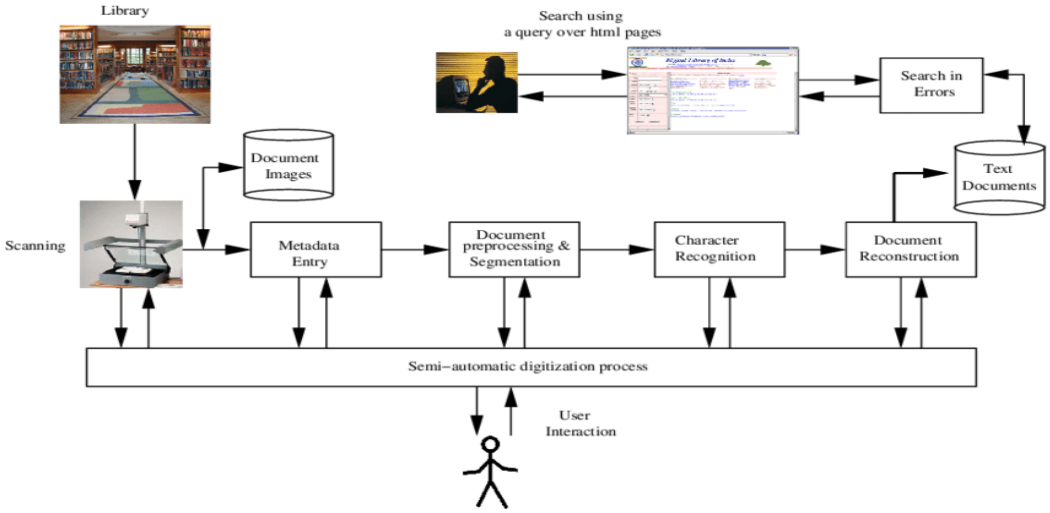

Source: https://www.researchgate.net/figure/Fig-C-Recommendation-System-in-Education-V-CONCLUSION-Recommender-Systems-are-an_fig2_362519255

2. **Natural Language Processing (NLP)**: NLP techniques can be employed to enable conversational interfaces or chatbots that can assist library users in finding information, answering queries, or providing guidance. Users can interact with the library system using natural language, making it more user-friendly and accessible.




Based on the diagram provided, NLP functions as an intermediary tool. It connects the existing library solutions to the preferred NLP tool through Application Programming Interfaces (APIs). The NLP tool then interacts with the user, receiving their natural language query, forwarding it to the library solution, retrieving the response, and delivering it back to the user in a natural language format.[16]

3. **Content Digitization and Text Recognition**: AI technologies such as Optical Character Recognition (OCR) can be used to digitize physical books, documents, and manuscripts, making them searchable and accessible in digital formats. This helps preserve rare or out-of-print materials and expands the availability of resources.




Above is the diagram of Block Diagram of the Flow of Operations in Content Generation and Delivery in Digital Libraries. It is a new method for creating a semi-automatic and adaptive Optical Character Recognition (OCR) system specifically designed for large collections of document images in digital libraries. This system incorporates an interactive approach that allows for ongoing refinement of OCR results. The paper demonstrates the applicability of a design for recognizing Indian Languages. By utilizing recognition errors, the OCR system is trained to adapt and improve its accuracy over time. While human intervention is limited, it is still permitted for evaluating the system's output and making necessary corrections during the recognition process.[15]

4. **Virtual Reality and Augmented Reality**: Incorporating VR and AR technologies in libraries can offer immersive experiences for users. For example, virtual tours of libraries, interactive exhibits, or virtual access to rare collections can be made available, enhancing engagement and learning.


Source: http://immersivegaze.com/blog/augmented-reality-and-next-generation-library/

This system assists readers in locating new materials on the bookshelf, facilitating the process of finding and exploring books at a more granular level. It enables easy identification of genres and book classifications, simplifying the search for the next book that patrons want to read.[17]

5. **Smart Space Management**: AI sensors and data analytics can optimize the use of library spaces by monitoring occupancy, noise levels, temperature, and lighting conditions. This data can help improve user experience, space utilization, and resource allocation.

It's important to note that implementing AI in academic libraries requires careful planning, collaboration with library staff, user privacy considerations, and ongoing maintenance. Additionally, user feedback and continuous improvement based on user needs are crucial for successful implementation.

## V. CONCLUSION

Computers doing human activities is what Artificial Intelligence is all about. The globe will change and have diverse perspectives in the approaching period. Starting from the introduction to artificial intelligence, then to its different areas like Pattern Recognition, Expert Systems, and NLP are being discussed in this paper. The advantages of employing these areas in libraries. The benefits and efficacy, as well as the obstacles, are reviewed in this paper. Even while librarians are well aware of the advantages of AI for their well-being, they are nevertheless fearful of being replaced. People created AI, and only humans can control AI before AI becomes super-intelligent. The libraries have been upgraded beautifully by AI. Digital Libraries are required around the world. People want a one-click, done-for-you solution, and AI is the essential means to get there. The transformation of libraries began a few years ago, but the process will take time to modify libraries worldwide.

"Any change, even a change for the better, is always accompanied by discomforts." - Arnold Bennett.

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