ARTIFICIAL INTELLIGENCE BASED ACADEMIC LIBRARIES: A REVIEW

Abstract

The idea of implementing artificial intelligence in academic libraries is gaining momentum worldwide. Intelligent and automated systems integrated with machine learning algorithms have the capability to analyse data, find and retrieve information accurately and quickly, and provide relevant recommendations based on user behaviour. The implementation of such systems can significantly improve user satisfaction and experience by enabling more efficient access to resources, enhancing personalized searching, reducing processing time for content management tasks, and enabling faster query resolution. Additionally, AI-powered smart libraries can help institutions become more cost-effective while there are challenges around embracing this technology due to concerns about privacy breaches; however, it is believed that the benefits outweigh such risks. This study focuses to make an overall view on the potential for employing AI in academic libraries throughout the LIS domain to enhance library services by creating smart libraries that can better cater to the needs of their users. In this chapter, we will explore origin, types, importance, benefits and challenges of using AI in academic libraries, as well as the different applications of AI in cataloguing and metadata management, information retrieval and recommendation systems, user services and support, and future directions and possibilities. This chapter also will converse the ethical, legal, and social implications of AI in academic libraries, future of AI based academic libraries in India, role of librarians, etc.,

Keywords: Academic Libraries, Artificial Intelligence, Expert Systems, Machine Learning, Automated Systems, Chatbot, Big data.

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I. INTRODUCTION

Artificial intelligence (AI) is viewed as an extension of human intelligence and has dominated many industries. The use of artificial intelligence in libraries has been a game changer in the information industry. Many human abilities can be stimulated by technological advancements, including calculating, reading, speaking, grasping, remembering, making judgments, and interactive learning. The use of artificial intelligence in virtual reference services is thought to provide libraries with a new online service model. Librarians are always on the cutting edge of technology in order to engage and improve services for their users. Some valid additions include virtual reality, which engages users with libraries and improves information literacy skills. Among these applications are systems for improving user services, such as quick references and information storage and retrieval.

1. **Definition of Artificial Intelligence:** "The science and engineering of creating intelligent machineries, where intelligence is the computational part of the ability to achieve goals in the world" **John McCarthy[1] (1955)**. "The science of making machines do things that would require intelligence if done by men" **Marvin Minsky[2] (1968).** "AI is the field of computer science that enables machines to perform tasks requiring human-like intelligence. It involves creating intelligent agents that can sense, comprehend, learn, and act in a way that extends human capabilities" **Jair Ribeiro[3].** "Intelligence demonstrated by a machine or by software…[where] intelligence measures an agent's general ability to achieve goals in a wide range of environments" **Calum Chase[4]**. "A constellation of technologies that extend human capabilities by sensing, comprehending, acting and learning allowing people to do much more" **Accenture[5].** "Anything that makes machines act more intelligently" **IBM[6].** "Defining artificial intelligence isn't just difficult; it's impossible, not the least because we don't understand human intelligence. Paradoxically, advances in A.I. will help more to define what human intelligence isn't than what artificial intelligence is" **OReilly[7]**. "A field of computer science that focuses on creating machines that can learn, recognize, predict, plan, and recommend --plus understand and respond to images and language" **Sales Force[8].** "The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings" **B.J. Copeland defined in Encyclopaedia of Britannica[9].** "It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but A.I. does not have to confine itself to methods that are biologically observable" **University of Stanford [10].**

II. EARLIER STUDY

1. **Adejo, Alhaji Augustine and Misau, Ali Yakubu[1] (2021)** opined that, Artificial intelligence is becoming an essential technical aspect in the present lifestyle of human being in everywhere on the globe. They explained in detail the use of AI in academic libraries of Nigeria get faster to access the information. Within the same way libraries also have to inculcate the artificial intelligence assisted systems and services to its user community. In order to the contemporary scenario, the librarians and library professionals are to be adapting the technological aspects to meet the requirement of users by using AI. Artificial Intelligence should introduce in the national curriculum to reach every corner of the nation.

2. **Isaiah Michael Juliet C. Alex-Nmecha**[2] **(2020)**, opined that AI is one of the superlative developments and applications of computing in libraries. The supreme presentation of AI in libraries is to inculcate the computing machines which can think, behave and reacts like human being mind-sets. In libraries, application of artificial intelligence becomes an international issue. The libraries are making place of expert systems, robots, virtual reality techniques on part of artificial intelligence exploitation. AI helps to the library professionals to do more prospective than their efforts in library services. The libraries can enhance the technology oriented statures and provide tremendous services to the users in the continually changing environment in the digital era via artificial intelligence only.

3. **Amanda Wheatley and Sandy Hervieux**[3]**(2020)**, opined in their study, Artificial Intelligence in Academic libraries an Environmental Scan, due to the steadily expanding presence of man-made brainpower (computer based intelligence), an ecological sweep on scholarly libraries commitment with simulated intelligence was led. The both authors given a conclusion that, the essential objective was to find which job the administrator will play in a man-made intelligence predominant future, as well as libraries are answering this change.

4. **Gujral Garima, Shivarama, J and Choukimath Puttaraj A**[4]**(2019)**, opined that, Artificial intelligence (AI), which has dominated a number of industries, is thought of as an expansion of human intelligence. A breakthrough in the information industry has been made possible by the use of AI in libraries. Numerous human talents, including reasoning, reading, speaking, grasping, remembering, making decisions, and interactive learning, can be stimulated by technological improvements. Virtual reference services that incorporate artificial intelligence are thought to offer libraries a new online business paradigm. A few of the useful features are virtual worlds that engage users with libraries and improve information literacy abilities. Librarians are constantly on the cutting edge of technologies to engage and enhance services for its users.

5. **Edward Iglesias**[5]**(2013)** opined in his article, due to the robotic activities in the libraries used by artificial intelligence, the computerization of the tasks of librarians has, limited the interest for human interaction. Robots in Scholarly Libraries: Progressions in Library Robotization gives an outline on the present status of library mechanization, addresses the requirement for changing staff to oblige these changes, and surveys the future for scholastic libraries in general. His article is fundamental for library pioneers, innovation specialists, and library merchants keen on the fate of library robotization and its effect on the decay of human association in libraries.

III. ARTIFICIAL INTELLIGENCE: AN OVERVIEW

1. **Origin of AI:** AI has been familiarized before the 12th century by **Alexander Heron**[1] in his invention of "antiquity made automatons with mechanical mechanisms working with water and steam power." Later **Ebru İz Bin Rezzaz Al Jezeri**[2]**(1202)** who was a discoverer of cybernetic science has made water functioned automatic controlled machines. After that **Wilhelm Schickard**[3] **(1623)** invented a machine and calculator proficient of four tasks. Far along **Gottfried Leibniz**[4] **(1672)** has advanced a binary counting system that forms the abstract basis of present computers. Far ahead **Charles Babbage**[5] **(1822-1859)** invented a mechanical calculator. Later **Karel Capek**[6] **(1923)**

introduced the robot concept. **Kurt Godel[7](1931)** brings together Godel theory of deficiency. Later **Alan Turing[8](1950)** founder of computer science introduced Turing test. In **1965** An artificial intelligence program **ELIZA** was transcribed. Lastly in 2000 **Kismet** named robot which can use sign and mimic movements in communication is introduced. In **2005 Asimo,** the closest robot to artificial intelligence and human ability and skill was came into exist. 2010 **Asimo** was made to perform using mind power.

2. **AI- Overview:** Artificial intelligence focuses on non-algorithmic methods for problem solving and symbol recognition. AI is dependent on the ability to map symbols. Multimedia systems, digital libraries, GISs, and e-commerce have all created new opportunities for information researchers. As the application becomes more powerful, diverse, and pressing, several well-known issues with finding information have become even more important in this technological era.
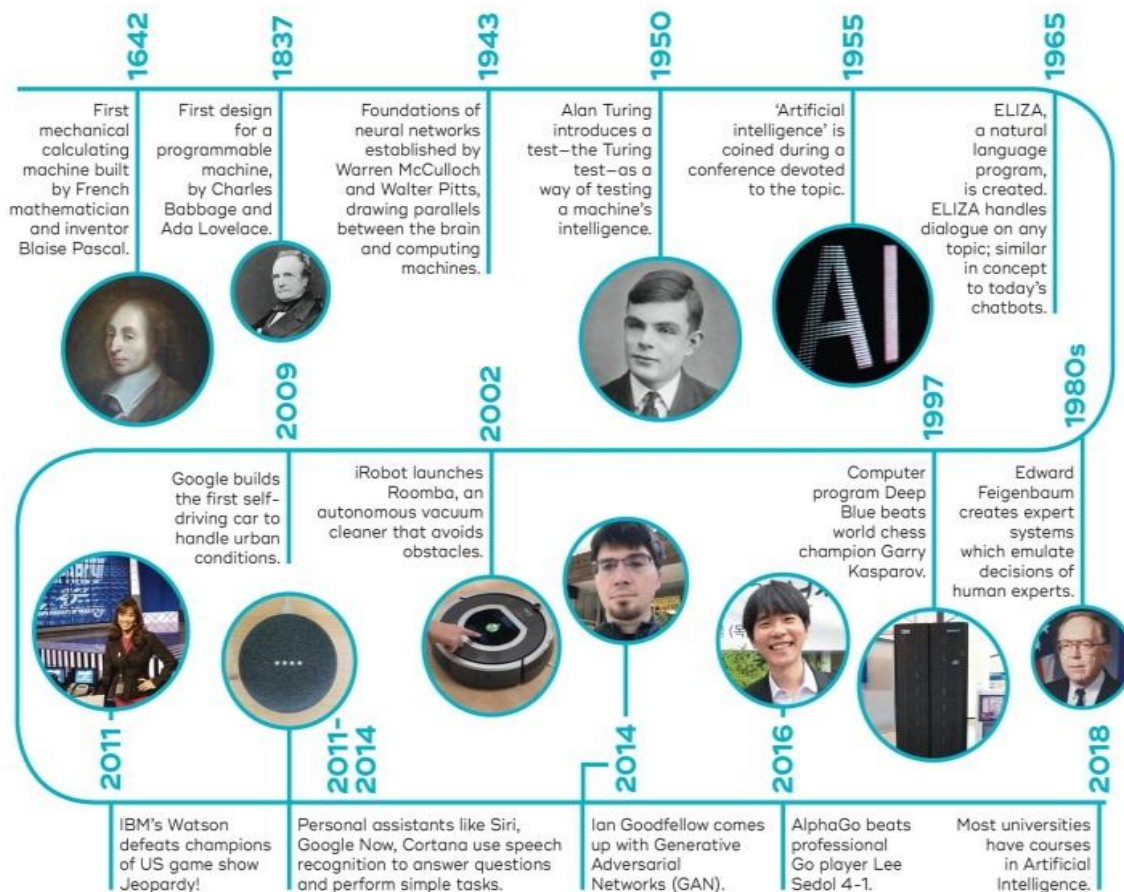

Figure 1: AI Timeline

3. **Types of AI:** Artificial Intelligence (AI) is a branch of computer science that aims to create intelligent machines that can perform tasks that typically require human cognition, such as learning, reasoning, and problem-solving. AI can be broadly classified into three types: weak, strong, and superintelligence. Weak AI involves machines that can perform specific tasks with human-like intelligence. Strong AI aims to create machines that can

perform any intellectual task that a human can. Superintelligence is an advanced form of AI that surpasses human intelligence.

AI also can be categorized into two major type based on the nature as in type-1 Narrow AI, General AI, Strong AI and in type-2 Reactive machines AI, Limited Memory AI, Theory mind AI and Self-awareness AI.
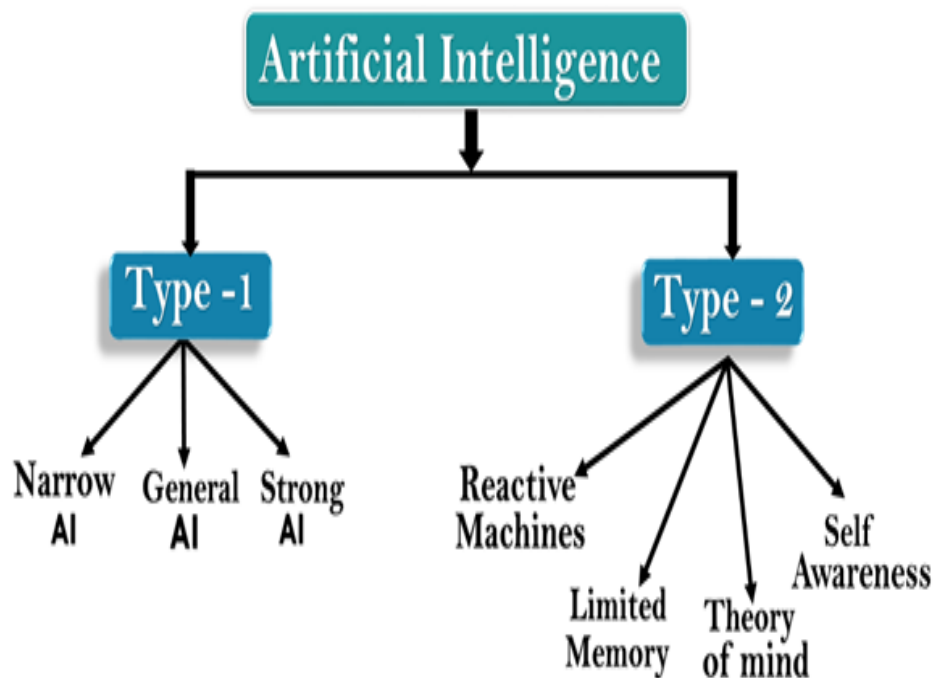
Figure 2: Types of AI

The fundamental technique in IR includes identifying key features in the object. Natural language processing and automatic indexing, for example, are used to distinguish meaningful words. In general, picture identification employs indexing and segmentation techniques based on texture, colour, or shape. They used to find meaningful descriptions in their streams for use in applications like audio, video, speech recognition, and scene segmentation. Several techniques are used to perform semantic analysis on multimedia objects or text.

Popular techniques include machine learning, graph-based clustering and classification, statistical-based multivariate analysis, artificial neural networks, and evolution-based programming. These technologies are a good alternative for summarising, analysing, and processing a large number of diverse and rapidly changing multimedia messages. The results of semantic analysis expressed as semantic networks, decisions, rules, or predicate logic. Activation-based, Propagation-based reasoning methods are commonly used to negotiate various large-scale knowledge structures.

All text search engines, Images and videos raise user expectations for how information is presented and manipulated. Recent advances in language and platform development, such as VRML, Java, OpenGL, and the availability of low-cost high-quality graphic workstations, have also shifted the focus of information visualisation research.

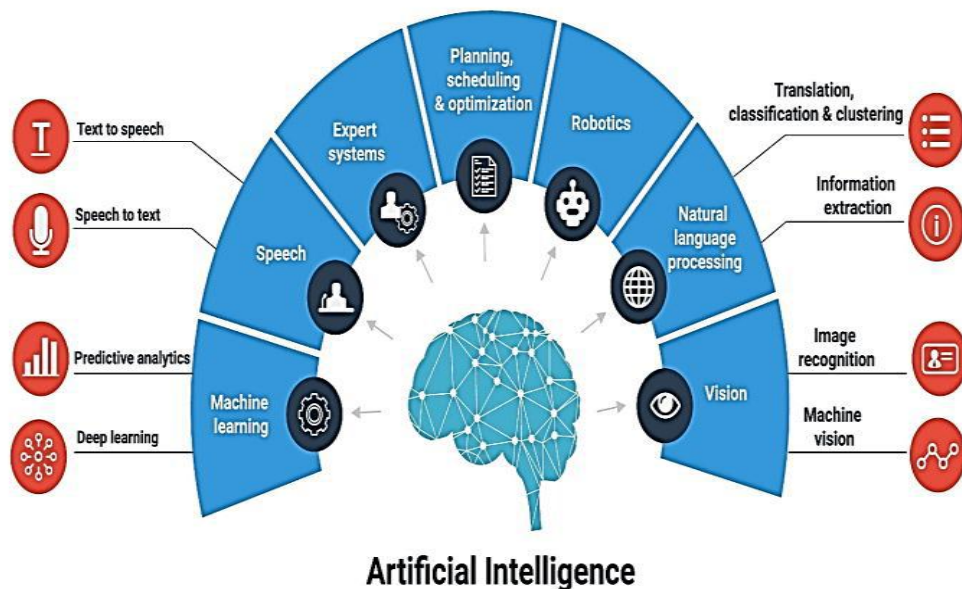Although artificial intelligence is a young discipline, it has far-reaching implications for society.

Figure 3: Component Diagram of Artificial Intelligence (Vijay Kumar & Sheshadri 2019)

IV. IMPORTANCE OF AI IN ACADEMIC LIBRARIES

The importance of AI in academic libraries lies in its ability to enhance library services, improve user experiences, and streamline library operations. With AI, academic libraries can automate routine tasks such as cataloguing and classification, freeing up staff members to focus on more complex tasks such as providing research assistance to students and faculty. AI can also help improve accessibility by automatically translating texts into different languages or generating summaries of lengthy articles.

And also AI-powered search algorithms can provide more accurate and relevant search results for users. By utilizing AI, academic libraries can stay ahead of the curve when it comes to meeting the needs of their users and keeping up with technological advancements in the information industry. It is important for academic libraries to explore ways in which they can incorporate AI into their operations to ensure that they continue **to provide high-quality services** and resources for their patrons.

V. ROLE OF AI IN ACADEMIC LIBRARIES

1. **Content Indexing:** Content Indexing plays a crucial role in AI-based libraries by enabling efficient and accurate search of information. It involves analysing the content

of digital resources, such as text or images, and identifying relevant keywords, topics, and other metadata that can be used to categorize and organize them. Users can quickly find materials that are most relevant to their needs using natural language queries through this process. Content Indexing also enables personalized recommendations based on user behaviour, queries, needs and preferences. In addition, it can help libraries to provide value-added services such as sentiment analysis or topic modelling. As AI continues to evolve and become more sophisticated, content indexing will become an increasingly important aspect of library technology, improving access to information for users and enhancing the efficiency of library operations.

2. **Big Data:** In AI-based libraries, big data supports to enhance the ability of seeking the information from the vast amount of data generated from library users, materials, and systems. It can be leveraged to improve library services and enhance user experiences. With refined algorithms and machine learning techniques, AI-based libraries can analyse and predict the preferences of users, recommend books based on their reading history, optimize collection development by analysing usage trends, personalize outreach campaigns on social media platforms and provide interactive virtual assistance services. The integration of big data technologies into libraries presents an opportunity to improve access to information resources, increase engagement with readers and respond more rapidly to changing trends and needs. However, it also requires careful consideration of privacy concerns associated with collecting user data. A balance between utilizing big data for enhanced services while respecting user privacy must be maintained to ensure the trust and confidence of library patrons.

3. **Chatbots:** Chatbots are transforming the mode that libraries interact with their patrons. With the advent of artificial intelligence, chatbots have become an integral part of modern library systems that can provide personalized assistance and guidance to users in a fast and efficient manner. These chatbots interact with library users through text or voice commands, providing instant access to information about books, journals, and other resources available at the library. Chatbots can also help users get directions around the physical space of the library which is particularly useful for unfamiliar visitors. They can additionally provide reminders for upcoming events which may be relevant to patron's interests, such as author talks or book clubs, and even recommend resources based on user's search history data. As AI-based technologies continue to evolve, it is likely that chatbots will play an even greater part in facilitating interaction between users and libraries in years to come.

VI. APPLICATIONS OF AI IN ACADEMIC LIBRARIES

1. **Web and mobile search:** Web and mobile search are integral components of AI-based libraries, revolutionizing the way we access and retrieve information. AI algorithms can now understand users' search queries better than ever before, providing personalized results that match their specific needs. By examining massive data sets and incorporating user history and preferences, AI-based libraries deliver highly targeted results in real-time. Likewise, they continually learn from new data to improve their accuracy over time. This type of intelligent search technology has led to a more efficient and effective research experience for both professional researchers and amateur users alike. From

academia to business to personal use, the potential applications of AI-enhanced search are limitless and will continue to shape how we interact with knowledge for long run.

2. **Search Interfaces:** As AI technology continues to transform the way we gather and analyse information, search interfaces have become an increasingly important feature of libraries powered by machine learning. These interfaces provide users with fast access to massive amounts of data, enabling them to quickly find relevant information and improve their research outcomes. Advanced search algorithms make use of natural language processing techniques and semantic analysis to understand user queries and generate more nuanced results.

3. **Licensing an AI product:** Licensing of an AI product in libraries is a critical process that plays a key role in ensuring the efficient functioning and deployment of machine learning solutions. As AI technologies are becoming increasingly sophisticated, numerous challenges have arisen concerning how intellectual property rights can be maintained over complex algorithms, machine learning models, and data sets that ai-product developers have created. The licensing agreement developed between the copyright owners and users ensure that access to copyrighted information is granted only after complying with specific permission grants or by paying specified fees. This approach helps to ensure that creators' rights are protected while providing end-users with access to useful and innovative applications. Proper licensing ensures compliance with legal requirements as well as maximum utilization of available resources thus promoting innovation and progress in the field of artificial intelligence.

4. **Idiomatic Agents and Voice Assistants:** Idiomatic agents and voice assistants are increasingly being incorporated into AI-based libraries as a means of enhancing user experience and accessibility. These tools utilize natural language processing to interpret and respond to spoken or written requests, enabling users to access library resources in a more intuitive way. By integrating idiomatic agents and voice assistants into library systems, institutions can provide patrons with personalized assistance that is available 24/7. Additionally, the use of these AI technologies allows librarians to focus on more complex queries and requests while freeing up time for other tasks. Here it is essential that libraries take appropriate measures to ensure privacy and security in the collection, storage, and interpretation of user data when using these tools.

5. **Learning Analytics:** Learning analytics in AI-based libraries has emerged as a powerful method for analysing user data to provide valuable insights into patterns of behaviour, preferences, and learning outcomes. AI technologies are applied to analyse various types of data such as online search histories, bibliographic records, user interaction data, and social media feeds. These analytics are then used to improve library services through personalized recommendations for users, suggesting relevant reading materials or resources based on their interests. Learning analytics can also be useful for tracking library usage trends and assessing the effectiveness of library programs and outreach activities.

6. **Library Analytics:** Library analytics in AI based libraries has become a crucial aspect of modern library operations. These libraries use advanced technologies such as artificial intelligence to generate insights from data gathered from various resources, including

digital and physical ones. The analytical tools integrated into these libraries help administrators monitor different metrics, including the number of visitors, frequency of visits, popular materials borrowed or downloaded, peak periods for library usage, and many others. Tools powered by machine learning can also help to predict future library usage trends and enable libraries to make data-driven decisions related to staffing schedules, collection management, program offerings and outreach strategies. Using this approach to library analytics, libraries have the opportunity for proactive decision making for their patrons with more efficient services that match their needs resulting in satisfied and loyal users visiting much more frequently contributing significantly to the organizational goodwill.

7. **Sentiment Analysis:** Sentiment analysis plays an essential part in AI-based libraries, enabling them to comprehend and categorize huge amounts of unstructured data by evaluating the underlying emotions expressed by a user. With the help of machine learning algorithms, sentiment analysis identifies positive, negative, or neutral sentiments from text sources such as book reviews or social media posts. This not only enhances the search experience but also facilitates personalized recommendations for users based on their past preferences and feedback. However, accurate sentiment analysis is not always easy, different dialects and idioms require special processing techniques that need to be taken into account to avoid any biases. Nevertheless, effective sentiment analysis remains a vital part of modern library systems that provide high-level services to the public while assisting scholars and researchers with their studies.

8. **Robotic Process Automation:** Robotic process automation (RPA) has been top of mind for libraries seeking to streamline their processes in order to improve operational efficiency. In recent years, AI based libraries have also sought to leverage the power of RPA technology to automate mundane, repetitive tasks such as cataloguing and data entry. By automating these tasks using robotics software platforms, library staff can free up more time to focus on other important aspects of their role such as patron engagement and research support. Additionally, RPA can enable libraries to scale their operations without significantly increasing staffing levels, which is particularly appealing to institutions with limited budgets or where manpower resources are scarce. While there remains some residual scepticism surrounding the use of robotics within libraries, early adopters of the technology report significant improvements in productivity and cost savings which support its continued implementation across the industry.
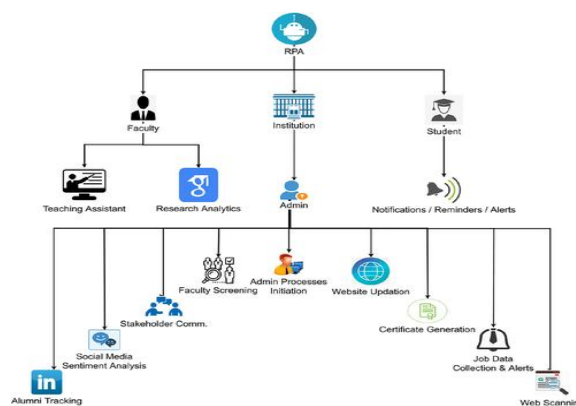

Figure 4: Prospective RPA use cases in Academia

9. **Smart Library Making:** Smart library making in AI-based libraries refers to the integration of advanced technologies such as Artificial Intelligence (AI), machine learning, and natural language processing into traditional library systems to enhance their functionality and efficiency. With the rapid evolution of technology, modern libraries are transitioning from manual cataloging processes towards digitalization. AI-based libraries offer personalised experiences to users by suggesting relevant reading materials based on their preferences, search history and user behaviour analysis. Moreover, these intelligent systems help library personnel manage resources effectively by automating tasks such as shelf-planning, inventory management and book suggestion algorithms through machine learning models. This digital transformation of libraries has led to the creation of a smart library ecosystem that is more integrated, efficient and facilitates knowledge discovery while enhancing user experience. Therefore, adopting smart library technologies not only saves time but also enables librarians to focus on patron support services, expanding collections through innovative acquisition practices such as e-books.

VII. MAJOR FEATURES OF ARTIFICIAL INTELLIGENCE IN ACADEMIC LIBRARIES

1. **AI-Powered Cataloguing and Metadata Management in Academic Libraries:** AI-powered cataloguing and metadata management in academic libraries involves the use of advanced technologies such as natural language processing, machine learning, and image recognition to automate the process of organizing and managing library resources. With the exponential growth of digital resources available in academic libraries, manual cataloguing and metadata management can be time-consuming and ineffective. AI technologies make it possible to accurately identify, classify, tag and describe library resources while also enriching them with additional relevant information such as author's affiliations or links between related items. The benefits of employing AI-powered techniques include improved resource discovery, enhanced user experience, increased efficiency for librarians as well as greater collaboration among institutions through shared data models. However, challenges such as accuracy issues in automated tools need to be addressed to ensure that the quality of catalogue records is not compromised and user privacy concerns are taken into consideration.

2. **AI-Enabled Information Retrieval and Recommendation Systems:** AI-enabled information retrieval and recommendation systems are powerful tools for organizations to mine and leverage large volumes of data in order to improve operational efficiency and customer experiences. With the ability to analyse vast amounts of data from various sources, these systems enable organizations to quickly identify patterns, insights, and correlations that would otherwise go unnoticed. By integrating machine learning algorithms into these systems, they can continually learn and adapt based on user behaviour and feedback, providing increasingly personalized recommendations and improving accuracy over time. Additionally, AI-enabled recommendation systems can unlock new revenue streams by cross-selling related products or services. As technology continues to advance at a breakneck pace, AI-enabled information retrieval and recommendation systems will become increasingly essential for companies looking for a competitive edge in their respective markets.

3. **AI-Assisted User Services and Support in Academic Libraries:** Application of artificial intelligence (AI) in academic libraries for user services and support are becoming more prevalent as libraries adapt to the rising demand for personalized services. AI-assisted technologies such as chatbots, virtual assistants, and recommendation engines enable students and faculty to access library resources more efficiently, saving them time and effort. Through the integration of these tools, librarians can focus on providing specialized research assistance while AI-powered systems handle routine inquiries such as checking out books or resetting passwords. Another benefit is that AI collects data from usage patterns which help to inform collection development decisions based on student needs. However, despite the advantages of AI-driven services in academic libraries, concerns over privacy issues and data ethics remain integral points in the implementation strategy for effective service delivery. Empowering scholars with these cutting-edge tools is waiting for a continuous evolution towards better practices that balance machine-generated outputs with the human touch necessary in providing support-oriented services.

4. **Future Directions and Possibilities of AI in Academic Libraries:** The future directions and possibilities of AI in academic libraries are vast. Through the advances in technology and increased accessibility to data, academic librarians can influence artificial intelligence tools to enhance their services, optimize their operations, and improve user experience. Some potential applications of AI in academic libraries include implementing virtual assistants to provide personalized assistance and reference services to users; leveraging machine learning algorithms to perform intelligent searches and analyze large datasets for research purposes; using natural language processing techniques to improve information retrieval capabilities; or even developing smart chatbots that can communicate with students at scale. There is also a growing trend towards using AI-powered analytics tools to gain insights into library usage patterns, resource allocation, or student behaviour. The challenge for academic librarians will be balancing the benefits of AI technologies with privacy concerns and ethical considerations related to data management. Still, if implemented thoughtfully, AI has the potential to revolutionize how we approach research support and knowledge dissemination in academia.

5. **Ethical, Legal, and Social Implications of AI in Academic Libraries:** AI is becoming more prevalent in academic libraries, it's important to consider the ethical, legal, and social implications of this technology. On the one hand, AI can be exceedingly useful for managing large amounts of data effectively and accurately identifying patterns that human intelligence might miss. The use of personal data raises concerns about privacy, additionally there are questions surrounding biases inherent in algorithms and whether they need to be regulated or audited to ensure they don't perpetuate discrimination or reinforce existing inequalities. Finally, there is a risk of decreased human interaction-AI cannot replace librarians' expertise and empathy. Consequently, while AI has great potential in academic libraries, it must be used with respect for privacy and fairness as well as recognition that it can never substitute human expertise and nuance.

VIII. BENEFITS OF USING ARTIFICIAL INTELLIGENCE

The integration of artificial intelligence (AI) in academic libraries provides several benefits, such as increased efficiency in **cataloguing, organizing, and digitizing collections**. AI can also enhance the user experience by providing personalized recommendations for research materials based on individual needs and interests. There are so many benefits as following:

1. In Academic Libraries

- **To Enhance Library Services**: With AI, it is now possible to automate routine tasks such as cataloguing, indexing, and data retrieval while ensuring accuracy and consistency. Library professionals must ensure to maintain ethical standards such as privacy protection as they integrate these innovative technologies into their work processes.

- **To Support Teaching Information Literacy:** Artificial intelligence (AI) has the potential to revolutionize the way teachers support information literacy skills in their students. The integration of AI technologies such as virtual assistants, chatbots, and machine learning algorithms can provide students with personalized feedback and immediate access to credible resources. By analysing student interactions and learning patterns, these tools can offer tailored guidance on areas where individuals may struggle or need additional support. Incorporating AI in this context can free up valuable time for educators by automating certain administrative tasks such as grading assignments or creating lesson plans also.

- **To encourage active learning:** AI can encourage active learning by tailoring lessons to each individual student's unique needs and abilities. By leveraging machine learning algorithms and advanced analytics, AI can identify areas where a student may be struggling and suggest personalized interventions or alternative teaching methods that are better suited to their learning style. Additionally, AI can use predictive modelling to anticipate future challenges and proactively provide targeted guidance before a student falls behind**.**

- **To lead personalized learning:** The application of AI in education has sparked increasing interest and potential for transforming teaching and learning processes. One of the key benefits of AI is its ability to personalize learning. Through data tracking and analysis, AI can adapt educational content and strategies to meet the individual needs and preferences of each learner. This customized approach can enhance motivation, engagement, and academic performance by tailoring instruction to student strengths, weaknesses, and learning styles. Moreover, access to vast amounts of digital information allows AI-enabled platforms to generate real-time feedback and support as students' progress through various tasks

- **To Create smart content:** Artificial Intelligence (AI) has the potential to revolutionize education by facilitating personalized and smart content for educators. With the use of AI, educational institutions/libraries/learning resource centres can develop learning materials tailored to the individual needs of students. AI also will

offer extraordinary opportunities for creating unique teaching experiences that stimulate creativity and curiosity among learners while maintaining pace with advances in technology.

- **To bring about automation:** AI can answer simple reference questions, freeing librarians to address more complex research needs. Additionally, machine learning algorithms can help streamline collection management by analysing usage patterns to guide acquisitions decisions and identify items for withdrawal. AI can also enhance accessibility efforts, such as captioning videos or describing visual content for visually impaired patrons. However, it is important to be mindful of potential biases in AI decision-making and ensure equitable implementation across all user groups

- **To help users make smarter and faster decisions:** A I can help the users to make the decisions in the critical positions faster and smarter. It can be support the users in research and analyses the situation within less time and provide clarity to make a good decision for the futuristic attainments.

2. In Education Industry

- To determine classroom vulnerabilities
- To close the skill gaps
- An effective platform for this digital age users
- Task Automation
- Adaptable access
- Customized database feedback
- 24/7 Assistance with chatbots
- Secure and decentralized learning systems
- Helps to solve complex problems
- Improves education World wide
- Manage human errors
- Helps in research and data analysis

3. In other fields

- Advances the medical field, health and hunger
- Improves criminal justice system
- Helps to preserve the environment
- Automobiles, industrial and infrastructure
- Business, economic empowerment
- Finance and banking sector
- Manufacturing
- Gaming Industry
- Government Operations
- Military Operations

IX. CHALLENGES AND LIMITATIONS OF IMPLEMENTING ARTIFICIAL INTELLIGENCE

There are some challenges and limitations for using Artificial Intelligence.

1. **Challenges**

- **Security and Privacy:** AI has its own advantages in the present era to the individuals and various fields, but it has also led to significant security and privacy challenges. One major concern is the potential misuse of personal data collected by AI-powered systems. The lack of transparency and control over how data is collected, analysed, and shared can lead to breaches in security and loss of privacy for individuals.

- **Network Issues:** Artificial intelligence is being leveraged to anticipate and mitigate these issues before they occur, ensuring that business-critical systems remain operational. AI can predict potential failures in real-time, enabling technicians to take pre-emptive action to prevent more serious problems from occurring. At last, the integration of AI into network management strategies will require ongoing refinement and improvement as new threats inevitably emerge in an ever-changing digital landscape.

- **Substantial Time Commitments:** AI often requires a substantial time commitment from professionals in various industries. Creating effective AI systems demands the collaboration of individuals with diverse skill sets, ranging from data scientists to software engineers. Moreover, the process of developing and testing an AI system typically involves multiple iterations to refine and improve its performance. This cyclical nature of development can significantly prolong the duration of projects, as teams work tirelessly to optimize the machine learning algorithms that underpin these systems.

- **Design Interface defect:** Design Interface defect-AI is a critical issue that has emerged in the field of Artificial Intelligence (AI) and Human-Computer Interaction (HCI). It refers to the inability of AI systems to effectively communicate with humans due to poor design interface. These defects can take many forms, including unclear communication, confusing icons or symbols, and unpredictable responses to user commands.

- **User acceptance:** AI is a critical mechanism in professional usage and maintenance. User should accept the work process and to provide good services. For that, the user should aware of the mechanisms and other related aspects. That can be only happens when the user can understand the AI and its features.

- **High Cost:** Establishment of AI technologies can come at a high cost, particularly in terms of financial investment and infrastructure requirements. Implementing these systems often involves substantial R&D efforts, as well as specialized expertise to design, develop, and optimize the algorithms powering the platforms.

There may be significant expenditures associated with procuring necessary hardware and software solutions to support robust AI deployments also.

2. Limitations

- **Governments are Restricted to Adapt:** The Governments are not accepting the AI oriented projects due to the security and privacy reasons. The major countries around the world are restricted in their ability to adapt AI due to a number of complex issues. One significant concern is the potential for bias in algorithms, particularly those used by government agencies for processes like hiring and decision-making. There is also the issue of security and transparency; as AI becomes increasingly sophisticated, it becomes more difficult for governments to fully understand how algorithms are reaching certain conclusions or make certain decisions.

- **People Get Unemployment:** People may become unemployed due to advancements in Artificial Intelligence (AI) is the replacement of repetitive and predictable tasks that were previously performed by humans. With the development of AI, companies have been able to automate many processes such as data entry, inventory management, and customer service, which were once carried out by human workers Therefore, it is crucial for individuals to upskill themselves to remain relevant in an increasingly technologically-driven workplace. Additionally, governments and organizations need to support those who have been displaced by providing retraining programs and other resources to help them transition into other professions or industries.

- **Controlling problem:** AI involves managing the ability of artificial intelligence algorithms to change their behaviours in response to new or unexpected situations. This capability is essential for enabling AI systems to be responsive and adaptive, but it can also create risks if not effectively managed. One key challenge is balancing the need for control and predictability with the potential benefits of exploration and learning. Ethical issues related to bias, decision-making transparency, and accountability must also be considered when developing strategies for controlling problem adaptation in AI, ensuring that these systems are safe, responsible, and trustworthy.

X. THE FUTURE OF AI BASED ACADEMIC LIBRARIES IN INDIAN CONTEXT

The future of AI-based academic libraries in the Indian context looks bright, as technology continues to evolve and transform the way we access and utilize information. With the growing emphasis on digitization, automation, and data-driven decision-making, academic libraries are increasingly expected to leverage AI tools and techniques to enhance their services and better meet the needs of their users. AI-powered applications can help librarians manage massive collections more efficiently, streamline complex tasks such as cataloguing and searching for resources, generate personalized recommendations based on user preferences and behaviour, predict future trends in usage patterns or research interests, and provide insights that can inform strategic planning. Implementing AI solutions requires careful consideration of ethical concerns such as data privacy, bias prevention, and transparency in decision-making processes. Thus it is crucial that academic libraries form

partnerships with tech companies or organizations engaged in developing AI-based tools adhering to ethical standards while meeting needs of end-users.

1. **On the way to AI-Research:** Comparing with major developed countries like USA, Russia, China, Australia, Denmark, UK and Germany, India is not contributing that much of budgetary standards towards the research of Artificial Intelligence. The research ecosystem towards Artificial Intelligence stall has quite a lot of noticeable gaps. According to the Inter-ministerial National Mission on interdisciplinary cyber physical systems (**IM-ICPS- National strategy for Artificial Intelligence-2018**) there are distinguishable gaps in the research and development towards AI and that has emphasized some of these points as following:

   ➢ Deficiency of collaborative / interdisciplinary approach
   ➢ Deficiency of scale for experimental validation
   ➢ Deficiency of facilities to support large scale experimental test beds
   ➢ Absence of connect with stakeholders and practitioners to convert outputs to outcomes
   ➢ Deficiency of large scale mission mode project management capabilities

2. **Research Framework:**

   • **As per IM-ICPS suggested a four tire frame work to develop the AI as:**

     ➢ **ICON (International Centres of New Knowledge):** concentrating on creation of new knowledge through basic research,
     ➢ **CROSS (Centre for Research On Sub-Systems):** concentrating on developing and integrating coretechnologies developed at ICON layer and any other sources

     ➢ **CASTLE (Center for Advanced Studies, Translational research and Leadership):** concentrating on Development and deployment of application based research and

     ➢ **CETIT (Centre of Excellence in Technology Innovation and Transfer):** concentrating on commercialisationof technologies developed.

          While the above structure enjoys critical benefits, an undeniably more improved and coordinated approach is required to guarantee consistent, designated and responsible system for advancing examination. Consequently the accompanying two-level coordinated way to deal with support both centre and applied research in COREs (Centres of Research Excellence in Artificial Intelligence): COREs mutated intelligence is proposed:

     ➢ **COREs (Centres of Research Excellence in Artificial Intelligence):** COREs will zero in on centre examination of simulated intelligence, and will accept the responsibility of executing the obligations of both Symbol and CROSS according to the IM-ICPS structure. In this manner, Centres will represent considerable authority in making new information through essential exploration and will hotspot for basic information/necessary advancements to keep India ready for the

up and coming age of innovations. Besides, Centres will likewise accentuated on advancement foundation instruments for direct use of essential examination, including improvement of new areas of computer based intelligence engineering/stages.

> **ICTAI (International Centre for Transformational Artificial Intelligence):** ICTAIs will give the environment to application based innovation advancement and arrangement, and will accept the responsibility of executing the obligations of both Palace and CETIT according to the IM-ICPS system. This will be an industry-drove determination and expected to take on the high level difficulties recognized or between ecclesiastical activities calling for artificial intelligence based arrangements. Moreover, ICTAIs will likewise be answerable for conveying business innovation, and taking thoughts/ideas or models and transforming them into attractive items via proactive coordination, correspondence and communicating for innovation move to the business.

3. AI Research Institutions in India

- **The PRAIRIE Institute:** The PRAIRIE Institute (PaRis Artificial Intelligence Research Institute) is a joint effort of industry and the scholarly community upheld by the French government to make an establishment which turns into a global benchmark in artificial intelligence.

- **AIRAWAT (AI Research, Analytics and knowledge Assimilation plaTform):** AIRAWAT will be a cloud stage for Enormous Information Investigation and Digestion, with a huge, power-improved simulated intelligence Figuring foundation utilizing progressed artificial intelligence handling. The proposed Foundation will be outfitted with offices for world's driving AI including profound learning, superior execution high throughput supercomputing, framework to store, process, mimic and dissect huge informational collections like pictures, video, text, sound, discourse. AIRAWAT will uphold progression of man-made intelligence based improvements in picture acknowledgment, discourse acknowledgment, normal language handling for examination, advancement and making of assortments of new applications for the help of headways in the fields of Horticulture and Medical services.

- **AI based academic institutions in India:** In recent years, several academic institutions in India have embraced the potential of artificial intelligence (AI) to enhance education and research. The Indian Institute of Technology Madras (IITM) has been a pioneer in researching AI, with numerous projects focused on natural language processing, computer vision, machine learning and robotics. **Centre for Responsible AI (CeRAI)**, an interdisciplinary exploration community, to guarantee moral and capable advancement of computer based intelligence based arrangements in reality.

    More institutions such as the Indian Institute of Science Bangalore (IISc-Bangalore), Indian Statistical Institute (ISI), and Tata Institute of Fundamental Research (TIFR) have also established dedicated AI labs to explore new frontiers in this field. In addition to research, AI is being used by universities for student

admissions processes and personalized teaching methods that adapt to individual learning styles.

The National Programme on Technology Enhanced Learning (NPTEL), a joint initiative by IITs and IISc Bangalore that offers online courses in engineering disciplines, has also included several courses on AI to cater to the growing demand. Overall, academic institutions in India are embracing the transformative potential of AI across various domains including education and research.

In the MVGR College of Engineering (A) where we are working for long years, we present providing the library services to the users by using QR Code Applications and RFID technology enabled devices like self-service, drop box, ICS workstations and entry and exit gates for user walk-ins. Shortly we are planning to make a library application as a short term project. We are also passionate and hope to develop the cloud based database management system, explore AI/Machine learning, AI based robotic circulation practice, Lib4.0, Block chain technology and Augmented reality projects in the nearest future.

XI. ROLE OF LIBRARIANS-AI BASED LIBRARIES

In recent ages, librarians have been increasingly adopting artificial intelligence (AI) based libraries to meet the changing needs of their patrons. These technologies not only automate routine tasks, but also enhance the ability of librarians to provide personalized service to their users. This essay will discuss the role of librarians in AI based libraries, and how they can leverage this technology to better serve their users.

Additionally, AI based libraries offer a number of opportunities for librarians to better serve their patrons. For example, natural language processing technologies can be used to provide virtual reference services that are available around the clock. These services not only improve the accessibility of libraries, but also allow librarians to focus on more complex reference queries. Additionally, AI can be employed to provide personalized reading recommendations, based on an individual user's reading history and preferences. By tailoring these recommendations to each user, librarians can help to foster a greater love of reading among their patrons. It is important to note that while AI can automate many routine tasks, it will never replace the crucial human touch that is so important to the library experience. Librarians will continue to play a critical role in connecting users with the resources they need, and helping to navigate complex topics. Indeed, as AI based libraries become more prevalent, librarians will be relied upon even more heavily to provide the human expertise necessary to guide users through the information landscape.

The Librarian should be a data expert in this contemporary stage. He should adopt the technology for all intents and purposes. The librarian should be act like a customizer, commissioner, interpreter/translator, follower, and avoider. In the end, AI based libraries offer an exciting opportunity for librarians to modernize their services and better serve their users. By working with data scientists and developers, librarians can ensure that these technologies are designed with users in mind, and provide personalized services that were previously impossible.

XII. CONCLUSION

Integration of artificial intelligence technology in academic libraries is an inevitable and necessary change. With the gigantic amount of information and data available to students, researchers, and faculty members, AI can assist in the organization and management of these resources, making it more efficient for users to access and retrieve relevant information. It is important to note that AI technology can never replace human intelligence and critical thinking skills, particularly in the field of academia where important decisions are made based on research, analysis, and interpretation of data. Therefore, the appropriate use and application of AI technology in academic libraries should be carefully considered and regulated.

As library and information science professionals, we believe that AI technology can be a useful tool in enhancing the academic experience and increasing efficiency in information retrieval. Though, it is essential that academic institutions maintain the human element in the decision-making process, especially in fields that involve critical thinking, analysis, and interpretation.

Moreover, the integration of AI technology in academic libraries should be accompanied by proper training and education for librarians and library users to ensure that they are proficient in using the technology and aware of its limitations and potential biases. Generally, the appropriate use of AI technology in academic libraries can lead to significant improvements in the academic experience, but it should be done in a responsible and regulated manner.

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