



Artificial Intelligence Technologies for Smart Libraries: An Overview

Mr. Suresh C. Jakati

Library Assistant (Temp.)

College of Agriculture, Vijayapur (UAS, Dharwad), Karnataka.

Dr. G. Kiran Kumar

Assistant Librarian and Head

College of Agriculture, Vijayapur (UAS, Dharwad), Karnataka.

Abstract

The twenty-first century is a field of rapid transformation and technological advancements, organizations must adapt to evolving technologies to meet consumer demands. The use of Artificial Intelligence in libraries can be seen as a collection of technologies enabling machines to sense, comprehend, act and learn and can perform administrative functions and have provided cutting edge technologies for libraries. This article attempts to trace the application and potential impact of Artificial Intelligence in Smart Libraries. The application of Artificial Intelligence under four domains like educational, informative, assistive and social networking have been captured and explained along with their implications. It also describes conversational agents such as chatbots, AI-based participatory library services, research impact, and information discovery and virtual reality.

Keywords: Artificial Intelligence, Innovative Services, Smart Libraries.

1.1. Introduction

In the past ten years, under the influence of the new technology revolution, smart library has realized the physical space intelligence, information resource (knowledge) organization intelligence, service mode intelligence and management method intelligence of library with the help of the Internet of things, big data, cloud computing, RFID technology, artificial intelligence, virtual reality and other new technologies. Smart library strives to provide users with more efficient and high-quality services, build a more attractive information interconnection environment, and create a more diversified information sharing space. The mature application scenarios of smart library include 24/7 self-borrowing and returning system, mobile phone/network self-renewal system, intelligent inventory/positioning system, intelligent seat reservation system, 3D/AR/VR navigation system, etc. However, as a high-level development stage of digital libraries, smart libraries need to introduce modern scientific and technological means to increase readers' experience and enhance readers' services. Only relying on the Internet of things, RFID and other technologies has been unable to fully meet the technical requirements of smart library, artificial intelligence will be a new driving force for the development of smart library.

1.2. Artificial Intelligence

Artificial intelligence (AI) is the ability enabled by a digital computer or computer-controlled machine or software replicating intellectual characteristics like intelligent organisms (human) in their functionality. The Artificial Intelligence can be understood as the collection of technologies that enables machines to sense, comprehend, act and perform several functions matching up with human intelligence. The major components of the Artificial Intelligence bucket are machine learning, big data, natural language processing, decision logic, data visualization, data analytics. Accordingly, Liu viewed Artificial Intelligence as intelligent machines or intelligent systems that simulate human intelligence activities and extend the science of human intelligence. Artificial Intelligence technologies also could be used to provide innovative real-time virtual reference services through mobile and social networking environments, by combining the existing library resources and third-party contents. Additionally, some other promising areas of Artificial Intelligence in libraries include natural language processing, indexing systems, and application of robotics in library activities.

1.3. Areas of Artificial Intelligence

Artificial Intelligence centre on symbolic, non-algorithmic problem-solving method. Intelligence trust on capability to manipulate symbols. Artificial Intelligence though is a recent discipline, has change the society beyond one can think. The goal of its sub field i.e expert system, natural language processing, pattern recognition, and robotics is to replicate human intelligence with computers. Some of the recent computational techniques and areas that are used in enhancing fields of Artificial Intelligence as follows:

- a) **Expert System:** Expert System are the skill based computerized systems which play a title role of intelligence interface or gateway for give entry to database and to obtain appropriate information. They span in scale from simple rule-based systems with flat data to very big scale, integrated developments taking many people, years to develop. An expert system is a computer program that gives expert advice, determination, or recommended solutions for a given condition. The different module of expert systems are Knowledge base, Inference Engine, and User Interface.
- b) **Natural Language Processing:** The ultimate generation of computer language is the Natural language. Artificial Intelligence scientists do well in building Natural language interface to a great extent using limited vocabulary and syntax. Natural Language Processing allows a computer to understand the main linguistic idea within a question or solution. Its aim is to make and build computer that analyze, understand, and generate language that human use naturally. The different module of natural language processing is speech synthesis, speech identification, machine translation, linguistic approaches, information recovery and information extraction.
- c) **Pattern Recognition:** It is the actions of establishing a nearest match between some new data and previously stored data patterns. This process is being carry out continually through the lives of all living things. Pattern identification is studied in many fields, including psychology, ethnology, cognitive science, and computer science. Pattern recognition is based on either a prior knowledge or on statistical information extracted from the patterns. The patterns to be classifieds are usually groups of measurements or observations, defining points in an appropriate multi-dimensional space. The components of pattern recognition are data acquisition, pre-processing, feature extraction, model selection and training, and evaluation.
- d) **Robotics:** It is the sub area of Artificial Intelligence that is carrying out with perceptual and motor tasks. Robot is a mechanical device which does automation tasks, either according to direct human supervision or a pre-defined program or a set of standard guidelines, using artificial intelligence skills.

- e) **Machine learning:** Arthur Samuel, an American pioneer in computer gaming and artificial intelligence, named the term 'machine learning' in 1959 and state it as 'it gives computer the ability to learn without explicit programming'. Depending on the behavior of the signal or responses to the learning system, machine-learning applications which are classified into four main categories, like Supervised learning, Unsupervised learning, Reinforcement learning and Semi-supervised learning.

1.4. Advantages and Disadvantages of Artificial Intelligence (AI)

The major benefits of Artificial Intelligence is that its conclusion is based on data rather than emotions. The advantages of artificial intelligence are incredible, what this field can offer us, is to evolve definitively and move on to the history of artificial robots.

The Advantages of Artificial Intelligence (AI) are: It finished task quicker than a human, multiple functions can do at a time, success ratio is great, stressful and tough work completed easily, complex assignment done in limited period, less defects in task and error also, more efficiency in short time, low space and less size, manipulation of long term and complex situations and discover unexplored things. i.e. outer space.

The Disadvantages of Artificial Intelligence (AI) are: Some time it can be misused leading to mass scale demolition, programme discrepancy sometime done opposite to the command, human jobs affected, unemployment case increase, quality of the Artificial Intelligence is dependent upon programmer, need a lot of time and money, technological dominancy increases, absence of the human touch and new generation becomes lazy.

1.5. Application of Artificial Intelligence (AI) in Smart Libraries:

Artificial intelligence covers almost all of the business activities of the Smart Library. Through the case analysis and systematic review of a large number of domestic and foreign literature and practical applications, the three application areas are Intelligent resource system, intelligent management, and intelligent services.

- a) **Intelligent Resource System:** With the development of big data and artificial intelligence technology, the intelligent resource procurement system can automatically collect and integrate all users' personalized demand information and various types of document resource information through deep learning mechanism. Therefore, it is possible to construct an intelligent document resource procurement decision system. Intelligent procurement system construction needs to pay attention to two key points.
- i) It is necessary to scientifically and reasonably determine the influencing factors. The library can establish a scientific and objective decision-making model by combining the comprehensive factors such as user group characteristics (such as gender, age, educational background, occupation, etc.), user personalized information (such as in colleges and universities, the number of teachers and students of various majors, subject setting, subject status ranking, school key construction disciplines, teachers and students hobbies, school opening Course name), recommendation and purchase of books (related to professional degree, popularity or utilization of books, book prices, etc.), expert advice (discipline construction, book utilization rate, book reproduction rate, etc.) and annual budget, so as to complete the book ordering plan and optimize the allocation of book purchasing funds.
 - ii) To comprehensively collect and analyze open resources. Through intelligent collection and analysis of open resources, the intelligent procurement system can provide reference for procurement librarians to make decision.

b) Intelligent Management

It consists of Intelligent warehouse management and Intelligent Security Management:

i) **Intelligent warehouse management:** Intelligent warehousing management has several distinct characteristics like

(a) Realize the self-service management of the book library with the goal of automatic book circulation and paper document management.

(b) The books can be stored randomly on the bookshelf, no need for the book number, reducing the multifarious bookshelf arrangement.

(c) Introduce a robot system to realize the management of automatic and unmanned counting, checking and sorting of book storage. There are many successful cases in the library intelligent warehouse management system. The ultrahigh-frequency RFID technology intelligent book inventory robot of Nanjing University Library in China mainly uses the automatic identification technology and RF phase technology in RFID technology, as well as machine automation technology to realize the automatic library book counting function. And the library book inventory can be realized accurately and quickly, so that the library administrator can find and manage the book conveniently and quickly, which greatly reduces the reader's time to find books.

Similarly BookBot, the Hunter Library of North Carolina State University, is a robotic book delivery system that uses high-density automated shelf technology to store up to two million items and deliver any item within five minutes of clicking on the online catalog. BookBot only accounts for one-ninth of the space of traditional traditional bookshelves, transforming the library from a storage facility into a rich learning and collaborative space environment. Books and other items are bar coded, sorted by size, and stored in more than 18,000 boxes, and each book and item is scanned as it is borrowed or returned from the system, allowing the library's online catalog to track all data at any time.

(ii) **Intelligent Security Management:** The library's daily services include seat management, lending management and identity management and other security management, while face recognition, fingerprint recognition and other artificial intelligence technology can further solve the library's security management. For example, face recognition technology specially designed by artificial intelligence technology is used to collect students' face information and bind it with students' information. After binding, students no longer need to carry student identification information, but can directly enter and exit the library through face brushing.

c) Intelligent Services

Intelligence services has been categorized as Intelligent Application Service, Intelligent Consulting Service and Intelligent Knowledge Service.

(i) **Intelligent Application Service:** At present, the technology of library self-service application service is relatively mature, and the forms and contents of services are also rich and diverse. The main representatives are: Self-service seat management system, self-service library ATM, self-service print copy management, lecture training appointment management system, etc. Self-service applications have the following advantages over traditional application services are as it break through the space-time boundary with artificial intelligence to realize instant service in no-show, extend the service form of library services and expand the scope of service targets, thereby reducing the logistics and labor costs of library services, enhance the user's willingness to participate and protect the service application privacy of reader users, promote the rational allocation of service resources and reduce the probability of service errors caused by manual services. The above intelligent application services are visible in the general smart library.

(ii) **Intelligent Consulting Service:** Consulting services are an important part of library services. Traditional consulting services are inevitably insufficient, such as the limited number of consulting librarians, the low efficiency of manual consultation, and the time limit for consulting work, etc. The emergence of intelligent

consulting services can effectively meet the needs of users' consulting services, make up for the above shortcomings, and realize the library's independent, instant, convenient and all weather intelligent consulting services.

(iii) **Intelligent Knowledge Service:** Knowledge service is the core of library service, and intelligent knowledge service is the new positioning of library service innovation, with strong vitality and broad prospects. The rapid development of artificial intelligence technologies such as cross-media awareness, big data management, deep autonomous learning, virtual bionic functions and simulation language interaction provides convenient conditions for the intelligentization and specialization of knowledge services. The patterns and deep knowledge mining processes of intelligent knowledge service are mainly embodied in intelligent analysis of user behavior, intelligent management of information data and intelligent operation of service business, etc., which are realized through knowledge analysis tools, knowledge presentation methods, research conceptual models and analytical research methods. It effectively manages Intelligent analysis of user behavior, Intelligent management of information data and The intelligent operation of the service business.

1.6. Conclusion

Due to the impact of artificial intelligence, the education system will change. The status of the library as a social education, learning center, knowledge center and communication center will be more important, and the library can obtain a broader development space. The combination between artificial intelligence and libraries can be a major step towards the future of libraries. Artificial Intelligence brings in tools for enhancing services such as discovery, search and retrieval processes more efficient. These intelligent information systems have the potential to engage and foster human skills. Librarians can adopt artificial intelligence for several purposes such as reference services, teaching information literacy skills, monitoring and evaluation, information search and retrieval processes. Artificial Intelligence will have implications over several services from offering insights to collections, easily storing and transferring files. This form of collaborative technology will emerge in enhanced partnerships between librarians and stakeholders.

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