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Artificial Intelligence Technology in Library Scientific Research Support Service

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Abstracts: *This paper summarizes the path and method of applying artificial intelligence technology in library scientific research support service. Through the analysis of relevant research situation at home and abroad, this paper discusses its specific application path from six aspects, such as scientific research information retrieval, personalized recommendation and scientific research consultation, and analyses the existing difficulties, countermeasures and development trend. Applying artificial intelligence technology to library scientific research support service is a huge upgrade and innovation of university library service, which will greatly improve the efficiency and quality of library scientific research support service.*

Keywords: *Artificial Intelligence; Library Scientific Research Supports; Research Innovation*

1. Introduction

As an important repository for knowledge and a support platform for teaching and research, libraries naturally serve as vital research support institutions. With the continuous development of the Internet and artificial intelligence technology, the form and content of university research services are undergoing tremendous changes. Researchers are no longer satisfied with single, simple, traditional service forms, and conventional university libraries cannot fully meet their demands for efficient and accurate services. Recent technological breakthroughs in deep learning, natural language processing, computer vision, and large-scale pre-training models have made artificial intelligence increasingly powerful. In this context, the deep integration of machine learning-based AI technology with scientific research, driven by the fusion of models and data, has had a transformative impact on scientific research [1]. This study explores the application of AI technology in library research support services to better meet researchers' needs, improve research efficiency, promote innovation, and provide new ideas and methods for libraries to support research.

2. Research status of artificial intelligence technology applied to library research support services

Both domestic and international universities are actively exploring AI applications in library research support services, achieving significant results and experiences.

Chinese university libraries are applying various AI technologies to practical work. Wuhan University Library utilizes knowledge graph technology to form a heterogeneous knowledge base system for intelligent question-answering [2]. China University of Mining and Technology Library has designed an intelligent service robot with speech interaction capabilities [3]. Shanghai Jiao Tong University established a research data management service platform, while Zhejiang University created an immersive research training platform using virtual reality technology. Tsinghua University Library developed a cross-language literature analysis platform using an improved Transformer-XL model [4].

International university libraries are also implementing AI for research services. The University of Washington Library uses AI methods for literature analysis, helping researchers quickly access required content. Cambridge University developed the SciLens system using graph convolutional networks to predict emerging research directions in biomedicine [5]. Stanford University proposed the Dual-BERT annotation model for unstructured scientific data, achieving 91% accuracy in experimental log classification [6]. The ACM digital library launched the CollaboratorMatch algorithm to facilitate interdisciplinary research collaboration [7].

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3. Application path of artificial intelligence technology in library scientific research support service

Libraries provide support throughout the research lifecycle, which includes four stages: applying for research funding, research data management, writing papers, and disseminating results [8]. Libraries can offer diverse support services [9], and AI applications can be explored across six dimensions:

3.1 Intelligent retrieval

AI technologies applied to literature retrieval include natural language processing (NLP), computer vision, semantic retrieval, vector databases, machine learning, and deep learning. In the field of artificial intelligence, it mainly relies on the technology of natural language processing to realize the understanding of human natural language query, and to judge the corresponding retrieval requirements, and to output the correct retrieval information for users. The introduction of natural language processing technology breaks through the limitations of traditional keyword retrieval methods and makes the retrieval results more accurate. The use of speech or image recognition technology can automatically complete the content recognition of speech or the extraction of text semantic features and visual features in images, which helps to further improve the intelligence of information retrieval [11]. The metadata and ontology knowledge base are established to realize deep semantic indexing, and the corresponding semantic information, namely metadata, is added to form a knowledge retrieval system based on semantic association [10] .The best retrieval result model is obtained from the association between conceptual semantics and knowledge, and the search results are automatically sorted. Through the user 's preference, habits and other factors, more accurate search results are obtained [12]. Using machine learning, big data analysis and other methods to search, intelligent retrieval can continuously improve the search strategy and enhance the search recall rate and search accuracy. Intelligent retrieval improves the efficiency of scientific information retrieval, helping researchers save time and focus on key issues.

3.2 Personalized Recommendation

Libraries collect user interaction data in real-time through IoT, cloud computing, data mining, and machine learning algorithms [13]. After standardized processing, this data forms a user behavior database that enables AI to build user profiles, analyze relationships between resources and users, and provide personalized recommendations for research literature, conferences, and funding opportunities. Machine learning algorithms are crucial for personalized recommendation systems, with clustering algorithms, collaborative filtering, content-based recommendation, and hybrid models being most common [14]. Clustering algorithms analyze user characteristics to recommend information to different user groups [15]. Collaborative filtering pushes resources based on interest similarity between users. Content-based recommendation quantifies matching degrees between literature and user interests. Knowledge graph-based recommendation integrates meta-knowledge information to enhance knowledge support and push research-related information beyond literature resources.

In addition, personalized artificial intelligence information services are provided to users in combination with their interests and hobbies in the field of scientific research, such as providing some recent research results, subject frontier information, academic conference notices, journal papers, etc. So that researchers can understand the academic frontier, understand the research hotspots, understand the international development trends, and better improve the efficiency and quality of library scientific research support services.

3.3 Intelligent Consulting

Research consulting services provided by libraries include resources, policies, strategies, tools, and data guidance. Using generative AI trained on massive library data, intelligent question-answering systems can provide 24-hour online consulting services with semantic understanding and intention recognition capabilities. At the same time, through the semantic understanding and intention recognition of the problem, using natural language processing technology, the intelligent answer system can accurately answer the user 's personalized problem according to the characteristics and content of the problem [16]. From the perspective of model design, the intelligent question answering system is designed by combining the core technology of knowledge graph and the massive information with rich semantics in the graph, and the relevant knowledge is constructed into a graph to store and organize various digital resources, which can help understand user questions and provide intelligent answers and accurate retrieval [17]. Knowledge graph technology combined with machine learning enables more comprehensive

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problem-solving, improving response speed and intelligence of library research support services.

3.4 Intelligent Data Management

AI technology significantly improves the efficiency and quality of research data management across the project lifecycle . According to the project life cycle model, scientific research data management services can be divided into three stages : data management planning before scientific research projects, data organization and storage in scientific research projects, and data sharing and archiving after scientific research projects[18]. In the application stage, NLP and machine learning tools help automatically generate data management plans. During implementation, intelligent sensors improve data acquisition speed and accuracy, while deep learning enables automatic annotation, classification, and quality control of research data. Computer vision technology is used to mine the laws and development trends behind a large amount of data, and users need to automatically generate images or graphical reports.In the project completion stage, end-to-end encryption and multi-factor authentication ensure data security and privacy compliance with relevant laws.

3.5 Smart Writing

AI is widely used in academic writing. Libraries offer rich materials and frameworks for AI writing assistance, reducing researchers' time spent on literature collection and review by 30-50%. So that researchers can quickly complete the first draft of high-quality academic papers in a very short period of time ; second, librarians can guide researchers to correctly use artificial intelligence tools to assist paper writing, such as automatically generating abstracts, introductions, conclusions and other parts of the paper, reducing the workload of researchers and improving the accuracy of the text. Optimize language expression, strengthen the logic and rigor of reasoning, and reflect the scientific, objective and guiding significance of scientific research work ; in addition, there are intelligent writing auxiliary functions such as grammar proofreading, spelling correction, literature citation, etc., which can be used to improve and perfect the paper more effectively under the guidance of librarians.

However, AI-assisted writing raises concerns about potential errors, lack of original thinking, and academic ethics issues [19]. Libraries should explore policy norms, establish ethical standards, and implement technical testing to distinguish AI-written content [20][21], minimizing negative effects while maximizing positive contributions.

3.6 Intelligent Support for Research Decision-Making and Innovation

Libraries can leverage their extensive data resources with AI to mine cross-source information, enabling data analysis and modeling that transforms research decision-making. At the level of knowledge discovery, through the use of machine learning methods to mine the potential links and laws existing in the literature data, and combined with the real-time market situation, the latest research results and other content, the library can provide decision support with high reference value for scientific research personnel ; the technology based on knowledge graph forms a more intuitive knowledge context, which helps to stimulate the innovative consciousness of scientific researchers, and can determine new research directions from the perspective of scientific research decision-making. Through the prediction of the model, it is scientific and forward-looking to analyze the development trend of the discipline, the trend of the transfer of technical hotspots and the possible shortcomings of the research gap, so as to help researchers make correct scientific research decisions and adjust the direction of scientific research. For data processing, libraries can provide deep neural network tools for high-dimensional data deconstruction, helping researchers make scientific decisions. NASA's Kepler project applied convolutional neural networks to exoplanet identification with 92.3% accuracy [22]. MIT developed a multimodal learning framework combining chemical literature semantics with experimental video temporal information, published in Science [23].

In short, with the development of artificial intelligence technology, there are more and more applications in the library to carry out scientific research support services. It is mainly reflected in improving the accuracy of information retrieval, providing personalized scientific research support services, enriching and improving scientific research paper writing aids, optimizing scientific research data management, supporting scientific research decision-making and innovation, and promoting academic exchanges and cooperation. It provides high-quality, convenient and efficient scientific research support services for researchers, and truly improves the quality of scientific research services and service satisfaction.

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4. Difficulties and solutions

Existing artificial intelligence tools (such as literature recommendation tools and knowledge graph tools) cannot be used directly, and secondary development needs to be carried out according to the library scene. The existing artificial intelligence models generally do not have the service adaptability in the library scene. The impact on data quality. The various scientific research data collected by the library have different sources, and there are problems such as inconsistent format, lack of annotation information, and more noise data, which is not conducive to the training effect of the artificial intelligence model. The data used by scientific research institutes may contain personal privacy, so it is necessary to pay attention to the confidentiality of the user 's use when obtaining and studying the user 's use, avoid the user 's privacy leakage, and prevent others from using the data to commit illegal acts. Artificial intelligence itself must also abide by ethical norms and must not have biased or discriminatory results. Lack of talents and funds. The talent pool of the library is not enough, and it is necessary to train or introduce talents in the field of artificial intelligence ; the library is a public welfare institution, and it is impossible to have a lot of capital investment, so it can only do some simple application work that does not require a lot of capital investment.

In view of the above problems, this study proposes the following coping strategies:

Strengthen technology research and application. The library should take the initiative to seek and unite the strength of external experts, and vigorously carry out the technical research and development work of intelligent retrieval system, intelligent recommendation system, scientific research data mining and other aspects, so as to improve the level of scientific research support service. At the same time, it encourages and supports librarians to learn artificial intelligence technology to provide better and better services for researchers.

Promote the opening of data sharing. Libraries should actively carry out open sharing of scientific research data, strengthen exchanges and cooperation with scientific research institutions, universities, and enterprises, and jointly build a scientific research data sharing platform. And it is necessary to do a good job in scientific data management to ensure data security and privacy.

Improve the privacy and ethical protection system. On the one hand, it is necessary to strengthen the construction of user information security and privacy protection, and formulate ethical norms on the use and application of artificial intelligence, and increase the supervision and evaluation of the application process of artificial intelligence technology.

Pay attention to personnel training, broaden the channels of funds. Libraries should always pay attention to the development direction of artificial intelligence, encourage librarians to receive various trainings on artificial intelligence technology, and participate in different forms of technical exchange activities ; through various aspects of learning, the ability of librarians to develop, apply and promote artificial intelligence technology is improved. Libraries should actively carry out export-oriented work, actively link social resources, cooperate with governments, enterprises and other social organizations, obtain diversified financial support, and minimize the proportion of single-source funds.

Increase user acceptance and participation. We will increase the promotion of artificial intelligence technology and enhance the awareness and acceptance of new knowledge and new technologies by researchers ; encourage researchers to use and put forward suggestions for use, and continuously improve service levels and service methods.

5. Future Development Trends

Libraries will build dynamic collection optimization systems using AI to analyze reference gaps and global research trends, generating multilingual procurement priority lists and resource demand prediction systems. Learning spaces will deploy AI sensing systems to optimize functional configurations through behavior trajectory analysis and usage heat maps, with IoT sensors and adaptive algorithms providing personalized environmental control. Libraries will construct platforms integrating intelligent topic selection assistants, experimental design recommendation systems, and achievement transformation matching engines to provide comprehensive research process support. Libraries will develop cross-modal retrieval systems for patents, papers, and policies, using technology maturity prediction models and patent value evaluation algorithms to support analysis reports. Augmented reality navigation systems will visualize three-dimensional resource distributions and interdisciplinary knowledge correlation paths, with metaverse technology applications in virtual academic communities.

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6. Conclusion

Artificial intelligence technology can be applied to the scientific research support services of libraries from the aspects of improving the efficiency of scientific research information retrieval, personalized scientific research support, and scientific research data management. In addition, the research also mentions the problems and solutions in the application of artificial intelligence technology in library scientific research support services. Future related research should be devoted to the close integration of artificial intelligence technology and library core business, and solve the problems between service innovation and traditional functions on the basis of ensuring the mutual promotion of technology empowerment and humanistic value realization, so as to further ensure the quality of scientific research support services, and strengthen the protection of the main position and special mission of the library as a knowledge exchange community.

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