International Journal of Digital Content Management (IJDCM)
Vol. 7, No. 12, Autumn & Winter 2026; P 80-114
dcm.atu.ac.ir
DOI: 10.22054/dcm.2025.77753.1231

ATU PRESS

ISSN: 2717-3305 eISSN: 2717-3313 Submit Date: 15-01-2024 Revise Date:10-08-2025 Accept Date:10-09-2025 Original Research

Identification of Artificial Intelligence Functions in Digital Libraries Based on the Wright Model

Jalal Rezaeenour *
Professor, department of industrial engineering, University of Qom, Qom, Iran

Rahil Karimian
Ph.D. Candidate , Knowledge and Information Science, Faculty of Literature and Humanities, Qom University, Qom. Iran

Abstract

Purpose: In the 21st century, digital libraries have emerged in new ways in the professional career of librarians and other library users worldwide. The aim of the present study is to identify the functions of artificial intelligence in digital libraries.

Method: This research is a qualitative systematic review. The population of the study includes all quantitative and qualitative research articles on the identification of artificial intelligence functions in digital libraries.

Findings: A total of 500 research titles were retrieved through a multi-stage search in internal and external databases. Following a three-stage monitoring process (based on title, abstract, and full-text study), 34 research sources (9 foreign research titles and 25 domestic research titles) in the form of published journals articles and conference papers were identified and analyzed using thematic content analysis. For qualitative evaluation of the studies, 8 questions were posed to the experts, resulting in 1 selective code, 8 central codes and 42 open codes.

Conclusion: The results of this research show that artificial intelligence can play an important role in the functioning of digital libraries and providing services to users. The findings demonstrate that AI-based systems are useful

* Corresponding Author: j.rezaee@qom.ac.ir
How to Cite: Rezaeenour J., Karimian, R. (2026). Identification of Artificial Intelligence Functions in Digital Libraries Based on the Wright Model, International Journal of Digital Content Management (IJDCM), 7(12), 80-114. DOI: 10.22054/dcm.2025.77753.1231

in various areas such as reference services, database search, organization, indexing, collection management, information retrieval, convenience and development, planning, and circulation. Moreover, librarians can enhance the quality of their works by employing this technology, which contributes to user satisfaction and the improvement of library services.

Keywords: Artificial Intelligence, Digital Libraries, Wright Model, Information Retrieval, Information Organization

Introduction

The library is an important institution in any society. The role of library has evolved over time, from preserving documents to meeting the information needs of society in the digital age. In recent decades, information search patterns have changed significantly along with advances in technology and shifts in user attitudes and approaches. In 21st century, digital libraries have emerged as a new way of life for librarians and other library users worldwide (Tavakoli, 2010). The term digital library (DL) refers to a collection of electronic resources and services, shared databases, and library systems on the World Wide Web (Covi, 1999). The functions of digital libraries include collecting digital information resources and making them accessible to the general public. In fact, digital libraries electronically store and organize a variety of information resources, including books, articles, images, films, music, and other forms of information. They enable users to access these resources via the internet and offer many advantages over traditional libraries. DL allows users' access to information resources from anywhere and at any time. It also helps users develop information skills and enhance learning. Creating a digital library in a smart space involves multiple factors, including artificial intelligence, which is indeed a new technology in today's world.

In 1956, the term artificial intelligence was introduced for the first time by Marvin Minsky, John McCarthy, and their colleagues at Dartmouth Conference. Since then, multiple definitions of artificial intelligence have been proposed. In AI encyclopedia, the field of artificial intelligence has been considered a subfield of computer science that examines the nature of intelligence and the construction of computer systems capable of intelligent behavior. As a result, artificial intelligence encompasses different dimensions such as speech processing, machine learning, robotics, expert systems, image processing, and natural language processing (Azimi, Hosseinizadeh, 2022).

Artificial Intelligence is a comprehensive subject that has expanded through computer science, cognitive science, information science, control science, neuroscience, psychology, linguistics, neural physiology, brain science, and other fields. The essence of AI lies in the study of intelligent systems or the production of intelligent machines, as well as simulating human intelligence activities and expanding the science of human intelligence (Liu, 2016). The development of artificial intelligence should be defined in terms of enhancing human capabilities and its beneficial application in the surrounding world (Qasemi, 2021). The importance and necessity of artificial intelligence in digital

libraries are evident in several ways: improving the efficiency and productivity of digital libraries, automating tasks such as order processing, retrieving resources, responding to user queries, freeing up librarians' time to focus on more strategic tasks, and providing better services to users. In fact, artificial intelligence in digital libraries is used to personalize resource recommendations, create interactive content, and respond to user queries in a more natural manner. This capability helps libraries better understand users' requirements and deliver services that are both useful and relevant. Overall, artificial intelligence can be a powerful tool for improving the services of digital libraries. Therefore, in the second part, we will describe the research method and extract the primary codes; in the third part, we will describe the findings and their analysis, and finally, in the fourth part, we will discuss and conclude. Therefore, the problem of the current research is as follows: what functions can artificial intelligence serve in digital libraries?

Literature Review

Norouzi et al. (2025) identified the challenges and opportunities of using artificial intelligence in specialized libraries through a qualitative Delphi method involving 16 experts. After multiple rounds of analysis, 32 key indicators were finalized. Findings highlight that effective AI adoption requires careful planning, adequate funding, user and staff training, and ongoing research to optimize technology use in specialized libraries.

Pourajbari (2024) examined the future of information retrieval and digital library services using artificial intelligence. Given recent advances in AI, new concepts and methods have emerged to improve digital library services. Topics discussed include more accurate and faster information retrieval, recommending relevant content, error detection and correction, and enhancing user experience. Additionally, challenges such as user trust, balancing technology and human involvement, and ethical issues are addressed. Consequently, the use of artificial intelligence in digital libraries can significantly improve service delivery and user experience; however, special attention must be given to ethical considerations and maintaining user trust.

Azimi et al. (2022) identified and categorized artificial intelligence (AI) applications in library services using a meta-synthesis approach. The study found AI most impactful in circulation, reference, information retrieval, and resource organization, with minimal effect on management services. Key AI-influenced indicators include understanding user needs and search strategy analysis. Conversely, knowledge management and digital library design were least affected.

The findings highlight AI's potential to transform libraries and improve service quality.

Kang (2021) in his study, examined the role and significance of artificial intelligence technology in the development of digital libraries. Focusing on text classification, he introduced and analyzed related algorithms and technologies. In this regard, a model based on the Rough-RBFNN neural network was designed and optimized for automatic text classification. The research findings indicate the efficiency of this model in improving the organization of digital textual resources. The study also emphasizes the need for the intelligent use of AI to promote digital reading in alignment with users' reading habits.

Yu et al. (2019) in their study examine the fundamental concepts of smart libraries and artificial intelligence, analyze the ways of applying artificial intelligence technologies within the framework of smart libraries, and demonstrate the value of these applications in improving library services. The findings of the research indicate that artificial intelligence will be widely used in the near future in the development process of smart libraries.

Given that the aim of the present study is to identify the applications of artificial intelligence in digital libraries, a systematic review method has been employed as a precise and structured approach to examine the research background. Accordingly, relevant studies have been identified and analyzed, the details of which are presented in Table 4.

Method

This study utilizes a qualitative approach through a systematic review framework. A systematic review is a comprehensive method for identifying and evaluating valid research conducted by researchers in a scientific field. In fact, it focuses on a specific question and methodically seeks to answer that question based on credible scientific evidence. It involves searching for resources using predetermined inclusion and exclusion criteria, screening approved research and extracting, generating and evaluating data (Oyelude, 2017). The statistical population of this research includes all quantitative and qualitative research articles regarding the identification of AI functions in digital libraries. Various researchers have noted that systematic review processes differ primarily in the number or names of the proposed stages. Wright et al. (2007) introduced a seven-step process, which includes: determining the research question, defining the research protocol, searching for theoretical foundations, data extraction, evaluation and analysis of data, presenting the results, and finally interpreting the results (Jafarinia et al., 2021). Given that most articles focused on library topic, the researchers of this study designed 8

questions in the field of AI functions in digital libraries. They consulted experts in this filed and continued this work until no new code was extracted. Their answers in this area are shown in Table 6. The research process involved determining the research question, defining the search strategy, searching for texts, extracting studies, evaluating the quality of studies, and interpreting the findings.

– First Step: Research Question Design

With respect to scientific sources, it was found that few studies have been conducted on identifying the functions of artificial intelligence in digital libraries. This study can contribute to these functions and create a documented summary of the results obtained from the review of scientific texts. Defining the research question is an important step in systematic reviews. Answering these questions is the main goal of every systematic article. Accordingly, the question of the current research to conduct a systematic review is as follows as presented in Table 1:
What functions can artificial intelligence have in digital libraries?

Table 1. Steps to Determine the Research Questions

Question	Response
What?	What is the identification of artificial uses in digital libraries? Identifying the functions of artificial intelligence in digital library from the standpoint of experts.
Who?	Magiran, Noormags, Elmnet, Civilica, SID, Web-Of science, Emerald, Google Scholar
What time?	Persian articles: 1996 to 2022 English articles: 2000 to 2023
How?	Appropriate sources with the subject of research and their analysis

– The Second Step: Determining Search Strategies

The purpose of setting search strategies is in fact determining the methods of conducting a daily review of texts related to the field in question. The implementation of this step reduces the bias and intrusion of the researcher while doing the work. In this study, first the level of articles and sources that could be included in the systematic review was determined.

Table 2. Search Strategies

Target Keywords	Academic Disciplines Examined	Checked Databases	
Artificial Intelligence	Information Science and Knowledge	Foreign	Domestic
Digital Libraries	Computer	Web of Science	Element
Wright Model	Architecture	Emerald	Magiran
Collecting, Development and Indexing and Reference	Artificial intelligence	Google Scholar	Noor Mags
Information Organization	------	------	SID
Information Retrieval	-------	------	Civilica

– **The Third Step: Searching for Texts**

In this study, the extraction of artificial intelligence functions in digital libraries was searched in domestic and foreign scientific databases based on the academic fields that have addressed these areas. As shown in Table 1, the researcher conducted a search to extract relevant sources from the databases using initial keywords such as artificial intelligence, digital libraries, functions, advantages, collection development, reference, organization, management, and information retrieval relevant to the research question, After that, the search in domestic and foreign databases was done by combining the desired keywords using different search strategies and operators in order to maintain comprehensiveness and prevent duplicate search, , and articles related to the topic were retrieved to perform the next steps

– **The Fourth Step: Extraction of Studies.** After extracting the articles and establishing the relevance of the extracted items to the research, inclusion and exclusion criteria for the study were determined, as shown in Table 3.

Table 3: Inclusion and Exclusion Criteria of Research

Exclusion Criteria	Inclusion Criteria
- Articles that have been published in different databases and are redundant. - Articles that have not addressed the main subject of the present research. - Inaccessibility to research abstracts.	- Researches that have paid attention to digital libraries using artificial intelligence. - Research that transparently addresses artificial intelligence and digital libraries. - Scientific research articles that are fully available in domestic and foreign databases.

Based on the mentioned inclusion and exclusion criteria, searching and examining databases using the specified keywords yielded a total of 500 articles. After reviewing the titles, this number was reduced to 300. After further review and removal of duplicates, 266 articles were examined, out of which 34 articles contained the functions of AI in digital libraries.

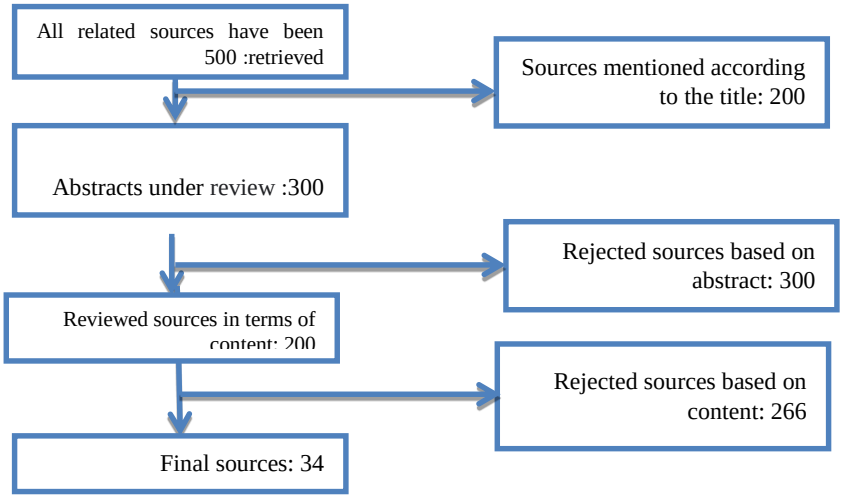

Figure 1. Summary of Search Results and Selection of Articles

By studying 34 selected articles and extracting the mentioned function of artificial intelligence in digital libraries according to these articles, the information includes name, year of publication, and categories extracted in each research, which can be seen in Table 4:

Table 4. Study Codes and Sources

tier	Code	Source
1	Costs and changes in hardware and software equipment for automation	Qasemi (2021), Shahmoradi (2022), Lee and Lee (2019), Azimi, et al. (2022), Yaqoob, et al. (2023), Huynh-The, et al. (2023)
2	Access to funding for implementing artificial intelligence projects	Qasemi (2021), Shahmoradi (2022), Lee, et al. (2019)., Azimi, et al. (2022)
3	AI-based systems	Qasemi (2021), Huynh-The, et al. (2023), Jeevan (2004)
4	Providing high-speed internet access	Huynh-The, et al. (2023), Jeevan (2004), Mahmoudi and Sadeghi (2022)
5	Desirable access and sharing of information	Rahmani (2022), Azimi et al. (2022), Aebi and Largo (2008)
6	Attention to indexing	Yaqoob, et al. (2023), Rahmani (2022)
7	Attention to human resources	Jeevan (2004), Rahmani, (2022), Azimi et al. (2022)
8	Attention to processing and software infrastructure	Qasemi (2021), Azimi et al. (2022), Yaqoob, et al. (2023)
9	Attention to technical infrastructure in the digital library	Rahmani (2022), Azimi et al. (2022), Lee, et al.(2019)
10	Attention to technical infrastructure of artificial intelligence	Rahmani (2022), Azimi et al. (2022)
11	Library Automation	Hassanzadeh (2022), Azimi et al. (2022), Fu, et al. (2022)
12	Attention to modernization	Rahmani (2022), Azimi et al. (2022)
13	Attention to privacy	Fu, et al. (2022), Al-Ghaili et al. (2022)
14	Attention to intellectual property rights	Mahmoudi and Sadeghi (2022), Torabi et al. (2021), Qasemi (2021), Haddad Araghi (2022), Darabpour (2023), Moradi (2023), Mirashrafi (2022), Shahmoradi (2022), Pashaie (2020), Azimi et al.(2022), Fu, et al (2022) ، Al-Ghaili et al .(2022)
15	Ordering materials based on budget	Mohammadbagheri and Seyedbagheri (2022), Rahmani

		(2022), Hassanzadeh (2022), Moradi (2022), Mirashrafi (2022), Yeganeh and Saeedian et al. (2022), Azimi et al. (2022), Yaqoob, et al. (2023)
16	Automatic preparation of references	Poormanaaf and Mali (2004), Azimi et al. (2022)
17	Ordering resources based on library size and type	Poormanaaf and Mali (2004), Azimi et al. (2022)
18	Order rejection	Poormanaaf and Mali (2004), Azimi et al. (2022), Lee, et al.(2019)
19	Resource brokerage	Poormanaaf and Mali (2004), Azimi et al. (2022), Lee, et al.(2019)
20	Updating databases	Poormanaaf and Mali (2004), Azimi et al. (2022), Lee, et al. (2019)
21	Identifying missing sequence numbers, requesting follow-up and preparing statistics and reports	Poormanaaf and Mali (2004), Azimi et al. (2022), Lee, et al. (2019)
22	Automating the review process	Poormanaaf and Mali (2004), Azimi et al. (2022), Lee, et al. (2019)
23	Scheduling dates and procurement timing	Poormanaaf and Mali (2004), Azimi et al. (2022), Lee, et al. (2019)
24	Speech processing technology	Abu Ardakan, et al (2016), Faraj Zadeh (2022), Azimi et al. (2022)
25	Assisting librarians in finding titles, publishers, editions, dates, using Anglo-American standards	Shah Shojaei (1999), Azimi et al. (2022), Lee, et al. (2019)
26	Identifying concepts in journal articles, translating and appropriate rules in oral and written forms of subject descriptors and subheadings	Keshavarzian and Asnafi (2016), Azimi et al. (2022), Lee, et al.(2019)
27	Text classification	Kousha (2004), Azimi et al. (2022), Lee, et al. (2019)
28	Text extraction	Kousha (2004), Azimi et al. (2022), Lee, et al. (2019)
29	Creating links between texts	Kousha (2004), Azimi et al. (2022), Lee, et al (2019)

30	Text generation	Kousha (2004), Azimi et al. (2022), Lee, et al. (2019)
31	Text translation	Kousha (2004), Azimi et al. (2022), Lee, et al. (2019)
32	text Summarization	Kousha (2004), Azimi et al. (2022), Lee, et al. (2019)
33	Meeting users' information needs anywhere in the world	Hassankhani and Mohammadhani (2008), Azimi et al. (2022), Lee, et al. (2019)
34	Creating sufficient time for librarians	Hassankhani and Mohammadhani (2008), Azimi et al. (2022(, Lee, et al.(2019)
35	Ability to refer complex and difficult questions to librarians	Hassanzadeh and Mohammadkhani (2008), Azimi et al. (2022), Lee, et al. (2019)
36	Providing user responses at any time of the day	Hassanzadeh and Mohammadkhani (2008), Azimi et al. (2022), Lee, et al. (2019)
37	Ability to establish a logical connection between real needs and expressed needs	Hassanzadeh and Mohammadkhani (2008), Azimi et al. (2022), Lee, et al. (2019)
38	Choosing the best search strategy	Hassanzadeh and Mohammadkhani (2008), Azimi et al. (2022), Lee, et al. (2019)
39	Managing documents	Yu, et al. (2019), Azimi et al. (2022), Lee, et al. (2019)
40	Introducing a system to organize resources	Yu, et al. (2019), Azimi et al. (2022), Lee, et al.(2019).
41	Resource control	Yu, et al. (2019), Azimi et al. (2022), Lee, et al. (2019)
42	Resource encoding by the system	Yu, et al. (2019), Azimi et al. (2022), Lee, et al. (2019)
43	Tracking resources at any time	Yu, et al. (2019), Azimi et al. (2022), Lee, et al. (2019)
44	Identifying and locating books on shelves	Yu, et al. (2019), Azimi et al. (2022), Lee, et al. (2019)
45	Retrieving the required books for users	Yu, et al. (2019), Azimi et al. (2022), Lee, et al. (2019)
46	Facial recognition and fingerprint detection for user entry and book borrowing	Yu, et al. (2019), Azimi et al. (2022), Lee, et al. (2019)

47	Finding potential databases	Azad and Delili (2004), Azimi et al. (2022), Lee, et al. (2019)
48	Access to the required resources	Azad and Delili (2004), Azimi et al. (2022), Lee, et al. (2019)
49	Finding keywords and logical Boolean operators	Azad and Delili (2004), Azimi et al. (2022), Lee, et al. (2019)
50	Expanding the scope of exploration	Azad and Delili (2004), Azimi et al. (2022), Lee, et al. (2019)
51	Finding related web pages	Robin, et al. (2010) , Azimi et al. (2022) Lee, et al. (2019)
52	Finding documents and sources	Rubin, et al. (2010) , Azimi et al. (2022), Lee, et al. (2019)
53	Searching in databases or repositories	Rubin, et al. (2010) , Azimi et al. (2022), Lee, et al. (2019)
54	Simulating reasoning power	Falah and Shirzad (2012), Khoshian and Mirzayian (2019), Poormanaaf and Mali (2014), Kousha (2004), Li, et al. (2019), Azimi et al. (2022)
55	Selecting relevant and appropriate keywords for the search topic in information databases	Falah and Shirzad (2012), Khoshian and Mirzayian (2019), Poormanaaf and Mali (2014), Kousha (2004), Li, et al. (2019) Azimi et al. (2022)
56	Ranking retrieved records based on their relevance probability	Falah and Shirzad (2012), Khoshian and Mirzayian (2019), Poormanaaf and Mali (2014), Kousha (2004), Li, et al. (2019), Azimi et al. (2022)
57	Interpreting meanings	Falah and Shirzad (2012), Khoshian and Mirzayian (2019), Poormanaaf and Mali (2014), Kousha (2004), Li, Li, et al. (2019), Azimi et al., (2022)
58	Intelligently retrieving from multiple sources	Falah and Shirzad (2012), Khoshian and Mirzayian (2019), Poormanaaf and Mali (2014), Kousha (2004), Li, et al. (2019), Azimi et al. (2022)
59	Utilizing user feedback	Falah and Shirzad (2012) Khoshian and Mirzayian (2019) Poormanaaf and Mali (2014), Kousha (2004), Li, Hao, and Ding, (2019), Li, et al. (2019), Azimi et al. (2022)

60	Automatic content analysis	Falah and Shirzad (2012), Khoshian and Mirzayian (2019), Poormanaaf and Mali (2014), Kousha (2004), Li, Li, et al. (2019), Azimi et al. (2022)
61	Automatic information extraction	Falah and Shirzad (2012), Khoshian and Mirzayian (2019), Poormanaaf and Mali (2014), Kousha (2004), Li, Li, et al. (2019), Azimi et al. (2022)
62	Employing personnel based on library needs	Khoshian and Mirzayian (2019), Azimi et al. (2022), Lee, et al. (2019)
63	Strategic planning and collection development	Khoshian and Mirzayian (2019), Azimi et al. (2022), Lee, et al. (2019)
64	Designing digital libraries	Khoshian and Mirzayian (2019), Azimi et al. (2022), Lee, et al. (2019)
65	Image recognition system	Faraj Zadeh (2022), Azimi et al. (2022), Lee, et al. (2019)

The Fifth Step: Qualitative Assessment of Studies

The key to successful systematic review is the qualitative assessment of studies. This stage significantly contributes to identifying systematic review errors. It ensures the accurate interpretation of research results using various patterns and standards. In fact, the important components of this research in qualitative assessment are as follows: title, abstract, content, authors' names, and relevant databases. Therefore, researchers' evaluation of the extracted codes of 8 open ended questions in the field of artificial intelligence applications in the digital library produced components of one selected code, 8 social codes and 42 open codes, which are shown in Table 6 along with the experts' opinion.

– The Sixth Step: Data Analysis and Results Presentation

As revealed in the systematic review, 34 studies were discovered on the identification of artificial intelligence functions in digital libraries and subsequently extracted. These functions were encoded into one main category, 8 subcategories, and 68 topics. From the interviews with experts, 1 selected category, 8 core categories and 42 open codes were

extracted. Therefore, a time frame has also been addressed in this research. As it is evident, the trend of articles in this field in recent years is most prominent in Persian sources from 1996 to 2023 and in English sources from 2000 to 2023, and the progress in this field continues.

- The Seventh Step: Interpretation of Findings

In this section, the results of systematic review of 34 selected articles are presented. The findings of this research are shown with the aim of addressing the research question.

Table 5. Categorization Findings

Principal Component	Subcomponent	Extracted Codes	Source
Identification of artificial intelligence functions in digital libraries based on the Wright model	Acquisition	Ordering materials based on budget, ordering resources based on library size and type, automatic preparation of references, order rejection, resource brokerage, updating databases, determining the number of missing sequences and requesting follow-up, and preparing statistics and reports, automating the process of reviewing and scheduling dates and procurement scheduling, speech processing	Purmanaf and Mali (2004), Ayoubi Ardakan, et al.(2016), Faraj Zadeh (2022), Li, et al. (2019), Azimi et al. (2022)
	Organization	Assisting librarians in finding titles, publishers, series, dates, editions, using Anglo-American standards, with attention to cataloguing	Yaqoob, et al. (2023), Shah Shojai (2000), Rahmani (2022), Li, et al. (2019), Azimi et al. (2022)
	Indexing	Identification of concepts in journal articles, translation and appropriate rules in oral and written forms, subject descriptors and subsections, text classification, text extraction, creating links between texts, summarizing text, text generation, and ultimately text translation	Keshavarzian, Asnafi (2016), Kousha, (2004), Lee, et al. (2019), Azimi et al. (2022)

	Reference	Meeting the information needs of users worldwide, allowing sufficient time for librarians, ability to refer complex questions and issues to librarians, providing user responses at all hours, establishing a logical connection between real needs and expressed needs, and selecting the best search strategy	Hassanzadeh and Mohammad khani (2008), Li, et al. (2019) Azimi et al. (2022)
	Management	Employing individuals based on library needs, strategic planning and collection development, designing digital libraries, providing access to funds for implementing artificial intelligence projects, costs and changes in hardware and software for smart automation, providing high-speed internet, attention to human resources, attention to technical infrastructure in digital libraries, attention to technical infrastructure for artificial intelligence, attention to intellectual property rights, attention to privacy preservation	Yaqoob, et al. (2023), Fu, et al. (2022), Al-Ghaili et al. (2022), Jeevan, (2004), Huynh-The, et al. (2023),Kousha, (2004), Qasemi (2022), Shahmoradi (2022), Mahdavi and Sadeghi (2022), Rahmani (2022), Torabi et al. (2022), Haddad Araghi (2022), Darabpour (2023), Moradi (2022), Mirashrafi (2022), Pashaee (2020), Mohammadbagheri and Seyedbakhti (2022), Hassanzadeh (2022), Mirashrafi (2022), Yeganeh, et al. (2022), Li, et al. (2019), Azimi et al. (2022)
	Information retrieval	Simulation of reasoning power, selection of relevant and appropriate keywords for the search topic in databases, ranking retrieved records based on their relevance probability, interpretation of meanings, intelligent retrieval from multiple sources, user feedback utilization,	Fu, et al. (2022) Huynh-The, et al. (2023) ، Jeevan, (2004). Falah and Shirzad (2012), Khoshian and Mirzaeian (2019), Poormonaf and Mali (2014), Kousha (2004), Qasemi (2021), Hassanzadeh (2022), Li,

		automatic content analysis, automatic information extraction, artificial intelligence-based systems, technology	et al. (2019), Azimi et al. (2022)
	Circulation	Document management, introducing a system to organize resources, Quality Control, resource coding by the system, tracking resources at any time, identifying and locating books on shelves, retrieving the required books for users, face and fingerprint recognition for user entry, and book borrowing.	Yu, et al. (2019), Faraj Zadeh (2022), Li, et al. (2019), Azimi et al. (2022)
	Search in databases	Finding potential databases, entering exploration areas, finding keywords and Boolean logical operators, expanding the scope of search, finding related pages on the web, finding documents and resources, searching in APIs or databases, desired access and sharing of information, updating.	Aebi and Largo (2008.), Rubin, et al. (2010), Azad and Dalili (2004), Rahmani (2022), Lee, et al. (2019), Azimi et al. (2022)

Findigs

The Answer to the question 1. What are the functions of AI in digital libraries?

The use of artificial intelligence in digital libraries is still in its early stages (Shah Shujaei, 2018). Also, artificial intelligence (AI) has the potential to change the performance of digital libraries and service to users. AI-based systems can exist in a variety of applications, including reference services, database searching, organizing, indexing, collection, management, information retrieval, and loan assistance, allowing librarians to assume higher-level responsibilities. AI is similar to instructions, knowledge and information research.

Research results extracted 10 functions of information collection in digital libraries. Therefore, artificial intelligence in the collection section uses machine algorithms to analyze library collections and the

patterns of these data. It helps librarians to create a comprehensive collection of resources and order materials based on budget, order resources based on size and type of library, automated preparation, purchase names for collections, orders, broker resources, update databases, the number of missing sequences, tracking and checking statistics and reports, automatic checking and scheduling of dates and procurement scheduling. With the help of speech processing technology and the possibility of using continuous resources, the requests can be saved directly in the computer

Another category that was investigated in this research was organization in digital libraries. In this research, organization is one of the categories that should be given a special look. As a result of the selected researches, 7 codes were extracted in the organization section in digital libraries. Artificial applications are developing in the field of organization in digital libraries. With the advancement of artificial intelligence technology, it is expected to increase the role of this technology in the library organization sector. Since the organization is considered as one of the most canonical aspects of a library, it can help librarians find useful titles, publishers, lists, dates, and editions using Anglo-American standards. Amy Sin software is among the software widely used in this field.

From the selected research results, 8 codes were extracted in the indexing section of digital libraries. Indexing in artificial intelligence can apply concepts in magazines, translation and appropriate oral rules and books of thematic descriptors and its subsets. Another function of artificial intelligence is organizing resources, classifying texts, creating links between texts, summarizing, generating and finally translating text.

From the selected research results, 6 codes were extracted in the reference section of digital libraries. Reference is one of the parts that is always discussed in libraries. Artificial intelligence has great potential to improve the reference services of digital libraries. This technology can be used to automate some references such as answering simple and common questions. It can also be used to provide new and innovative services such as analyzing reference data to identify patterns and processes. In fact, the following functions of artificial intelligence in this sector are significant: meeting the information needs of users anywhere in the world, creating enough time for librarians, referring complex and difficult questions to librarians, providing answers to users round the clock, logically connecting between real and required needs and choosing the best search strategy.

According to the results of selected research, 7 codes were extracted in circulation in digital libraries. Artificial functions are being developed in the lending department of digital libraries. Artificial intelligence provides customized services for different users using machine algorithms. It can help users to borrow books according to their needs. Therefore, the lending section is one of the important sections of the library, which is basically organized according to the user's needs. Therefore, artificial intelligence has the following functions under the title of intelligent management in the lending sector: document management without the need for resources, introducing robots to provide resources, controlling resources, coding resources by linking, tracking resources in any time, identifying and locating books on the shelves, retrieving books needed by the user, recognizing faces and fingerprints for checking in and borrowing books, and so forth.

Based on the results of the selected research, 9 codes have been extracted in the special search section in databases of digital libraries. Using search algorithms, artificial intelligence retrieves information in databases quickly and accurately. This can help users gain access as soon as possible. Artificial intelligence improves the search in databases, and its important functions in this field include finding potential databases, entering exploration areas, finding keywords and logical Boolean operators, expanding the scope of exploration. In their research, researchers have mentioned things such as finding relevant pages on the web, retrieving documents and resources, searching OPECs or databases.

As a result of the selected research, more than 10 codes related to information retrieval in digital libraries have been extracted. One of the most important functions of artificial intelligence in digital libraries is information retrieval. Therefore, the functions of artificial intelligence in information retrieval include things such as simulation of reasoning power, selection of relevant and appropriate keywords in searching databases, ranking of records to retrieve probability of relevance, interpretation of meanings, intelligent retrieval of several items, user feedback check, automatic content analysis and information retrieval.

The results of the selected research extracted more than 11 codes related to the management section in digital libraries. Artificial intelligence provides customized library services for different users using administrative data. This allows users to receive library services based on their needs. Every organization has a management unit to coordinate between human resources and financial costs, and digital libraries are no exception to this rule. The functions of artificial intelligence in this unit include employment of people in the library,

strategic planning and collection development, design of digital libraries and so forth.

The Answer to Question 2: Identifying the Functions of Artificial Intelligence in the Digital Library from the Standpoint of Experts. After interviews with experts in the field of digital library, 8 core codes and 42 open codes were identified, which can be seen in Table 6 along with the experts' opinion. From the standpoint of experts, a number of components were common in some core codes; for example, natural language search can be used both in the information retrieval section and in the database search section, and such a case can be clearly seen in the Table 6.

Table 6. The Function of Artificial Intelligence in Digital Libraries from the Standpoint of Experts

Selected Code	Code Oriented	Sub Codes	Expert Opinion
The function of artificial intelligence in digital libraries	Acquisition	Selection of sources	The use of machine learning algorithms to identify and select potentially valuable resources for the digital library based on criteria such as subject matter, popularity, quality, and relevance to the existing collection. Improving the quality and relevance of resources in the collection, identifying new and unknown resources, and saving librarians' time in manually selecting resources
		Organize and categorize	Using natural language processing (NLP) to automatically categorize digital resources by subject, author, title, and other criteria improves search and resource discovery, creates relevant subject collections, and saves librarians time

		Utilization of resources	Using artificial intelligence tools to extract key information from digital resources, such as author names, subject headings, abstracts, and keywords, and create rich metadata for resources, improve search ability, and enable analysis and discovery of patterns in the collection
		Identify and remove inappropriate content	Using machine learning algorithms to identify and remove inappropriate or illegal content from the digital library and create a safe and suitable environment for users, protect the library's reputation and comply with laws and regulations.
		Evaluation and enrichment of resources	Using artificial intelligence to evaluate the quality and credibility of resources, enriching them with additional information such as reviews and ratings, and suggesting relevant resources to users, and finally, helps users choose reliable and high-quality resources
		Evaluation and analysis of the collection	Use data analysis tools to assess the strengths and weaknesses of the library collection, identify gaps in the collection, and measure resource utilization and improve decision-making about material selection and exclusion, allocate funds more effectively, and better respond to users' needs
		Development of specialized	Use artificial intelligence to create specialized

		collections	collections of materials based on specific topics, languages, or formats and improve access to resources for users with special needs, support research and education, and promote diversity in the collection
		Identification and management of copyright	Use image and text recognition tools to identify copyrighted content in digital resources and track their license status and copyright compliance, prevent copyright infringement, and protect the library from lawsuits
	Organize information	Automatic Classification	Using machine learning algorithms to automatically categorize digital resources based on standard subjects such as Library of Congress or local library subjects and improve the organization and browsing of resources, create relevant subject collections and save librarians time
		Extracting key terms	Use natural language processing (NLP) to automatically extract key terms and topic phrases from the text of digital resources and improve search and resource discovery, create more accurate topic indexes, and increase the relevance of search results
		Modification and enrichment of metadata	Using natural language processing (NLP) to automatically extract information from digital resources, such as author

			names, publication dates, and subjects, and add them to metadata records to improve resource search and discovery, create links between related resources, and improve information accessibility for users
	Indexing	Automatic extraction of key terms	Using natural language processing (NLP) to extract key terms and concepts from the text of digital resources such as books, articles, and websites and create accurate and relevant indexes, improve search and resource discovery, and save mon ey for librarians.
		Subjective productivity	Using machine learning algorithms to automatically categorize digital resources based on standard subjects such as Library of Congress subjects or specialized thesauruses and to be more compatible with other indexing systems, improving subject searching and browsing, and saving librarians time
		Links to related resources	Using similarity algorithms to identify and link related digital resources to each other based on their textual content, topics, and key terms and improve content discovery, create a network of related resources, and provide more context for users
		Quality Control	The use of natural language processing to identify and correct errors

			and anomalies in indexing records, such as incorrect key terms, unrelated topics, and incomplete information, and improve the accuracy and coherence of indexes, increase the reliability of search results, and reduce the need for manual review of records
		Multilingual indexing	Using machine translation language models to automatically translate digital resources into different languages and create their indexes in the corresponding languages and provide access to resources for users worldwide, promote diversity and inclusion, and improve access to information for linguistic minority communities
	Reference	Answer questions automatically	Using natural language processing (NLP) to understand users' questions and provide accurate and relevant answers to various digital library resources, databases, scientific articles and e-books, actually increases user satisfaction.
		Suggest related resources	Analyzes and search history of users to suggest relevant resources, such as books, articles and databases, that may be useful to them. And discovers new and relevant information, saves users time, and personalizes the search experience

Conclusion

		Classification and organization resources	Of the machine to automatically categorize digital resources by subject, author, title, and other qualities. It improves the ability to search, browse and discover, and save librarians' time.
		Extracting information	Key information from digital sources, such as author names, publication dates, key topics, and keywords. As the data is searched, the database is analyzed and the data is analyzed, and new trends are discovered.
		Translation	Automatic translation of digital resources into different languages for access by international users. Increasing access to information promotes learning and breaks down language barriers.
		Recapitulation	Providing reliable information to users and combating the spread of false information will help users quickly understand key information and save time.
		Identification and classification of fake news	Increase the number of users, and collect valuable data. Providing reliable information to users and combating the spread of false information.
		Providing chatbots services	Providing chatbots to answer frequently asked questions, help users search, and receive feedback services enhances service with users, and collects valuable data.

	Management	Experience and data analysis	The use of artificial intelligence tools to collect, analyze data related to library use, such as search patterns, borrowing, and user interaction, and improve understanding of users' needs and preferences, identify opportunities for service improvement, and optimize resource allocation
		Demand forecasting	Using machine learning algorithms to predict demand for library resources and services, such as specific books, databases, and reading spaces, and better prepare for users' needs, effectively manage resources, and reduce costs
		Staff management	The use of artificial intelligence for tasks such as shift planning, performance management and employee training improves operational efficiency and productivity, reduces costs, and increases employee engagement
		Personalization	The use of artificial intelligence to improve user satisfaction, increase interaction with the library, and promote lifelong learning
	Information retrieval	Natural language search	Using natural language processing (NLP) to understand user queries in natural language and find relevant resources from the digital library collection and improve the relevance of search results, create a

			more user-friendly search experience, and reduce the need to use precise keywords
		Question and answer	Using question and answer systems (Q&A) to answer users' questions on specific topics or specific resources of the digital library and providing accurate and quick answers to users' questions, improving access to information, and reducing workload in the library
		Thematic classification	Use machine learning algorithms to automatically categorize digital resources based on standard subjects such as Library of Congress or library-specific subjects and improve resource organization and browsing, create relevant subject collections, and save librarians time
		Extracting information	Using data mining techniques to extract key information such as people's names, places, and dates from the text of digital resources and create searchable databases of the extracted information, improving searchability and resource discovery, and facilitating data analysis
		Automatic summarization	Using automatic summarization tools to create a concise and accurate summary of the text of digital resources and help users quickly understand the content of

			resources, save users time, and improve access to information
	Circulation	Suggest related resources	Using machine learning algorithms to suggest relevant resources to users based on their borrowing history, ratings, and reviews and help users discover new and relevant resources, increase interaction with the library, and improve the user experience
		Automatic managemetof loanrenewal	Helping users discover new and relevant resources, increasing interaction with the library, and improving user experience and reducing staff workload, improving user experience, and preventing late fines
		Identifying and recovering sources of delay	Using artificial intelligence to identify sources of lateness and send notifications to relevant users and increase resource return rates, reduce library financial losses, and ensure users have fair access to resources
		Reservation management	Using artificial intelligence to manage resource reservations by users and send them notifications when resources become available and Improve user experience, prevent user frustration, and ensure fair access to popular resources
	Search in databases	Natural language Search	Using natural language processing (NLP) to understand user queries in natural language and find

			relevant resources from the digital library collection and improve the relevance of search results, create a more user-friendly search experience, and reduce the need to use precise keywords
		Semantic search	Using semantic search techniques to understand the meaning of users' queries and find relevant resources, even if they do not contain exact keywords, and to improve the relevance of search results, especially for complex or multifaceted queries, and to help users find information they may be aware of
		Personalized search	Using machine learning algorithms to provide more relevant search results to each user based on their search history, interests and preferences and improve the search experience for each user, increase the likelihood that users will find the information they need, and promote the discovery of new resources
		Search suggestions	Using suggestion algorithms to provide users with relevant search suggestions as they type their query helps users phrase their queries more effectively, find relevant resources faster, and make the search experience more efficient

The emergence and widespread use of artificial intelligence in the field of knowledge and information science, have led to significant changes.

		Visual search	Using image recognition technologies to find relevant resources based on images or scans that users provide, allowing users to find resources based on images or scans without having to use keywords. Improving access to information for users with reading disabilities, and expanding search possibilities for different types of resources

One important change is the generation of new ideas and the enhancement of information services and essential library functions. As a result, the next generation of libraries is evolving into intelligent libraries that utilize artificial intelligence to perform information tasks and services, resulting in improved performance and better compatibility with previous professional systems. The advancement of new artificial intelligence technologies is crucial for the new generation of digital libraries.

Artificial intelligence programs provide us with convenience, cost reduction, and more. The main goal of this research is to identify the functions of artificial intelligence in digital libraries. Based on the findings, it can be stated that AI systems are useful in various areas such as reference services, searching in databases, organization, indexing, information retrieval, and other functional areas. The use of artificial intelligence allows digital library staff to focus more on their core tasks. As mentioned in the findings, chatbots can be considered as one of the functions of artificial intelligence. The deployment of chatbots is important, as they can be used in many library functions to answer user queries. Since they are intelligent, users can access them even outside library hours.

As mentioned in the findings section, chatbots are among the functions of artificial intelligence. This important tool can be used in many functions of the library for answering users' questions because it is intelligent, and users can use it even outside the working hours of the library. Additionally, it can be said that with the help of artificial intelligence, libraries can categorize or sort books based on the subject, author, year of publication and other features. This enable libraries to offer users favorite books related to their interests using artificial intelligence algorithms. Another function of artificial intelligence is predicting users' behavior. By analyzing the reading behavior of users,

artificial intelligence can forecast their reading patterns and interests, thereby facilitating the presentation of relevant content.

Based on the review of the selected articles and expert opinions, in the reference section, artificial intelligence in the collection section can also be used to select sources, identify and remove inappropriate content, evaluate and analyze the collection. Hence, the extracted components in this section is in line with studies conducted by Pourmanaf, Mali, (2013); Abouei et al. (2007); Farajzadeh (2022); Li, et al. (2019)؛ Azimi et al. (2022). According to review of the selected articles in this research and expert opinion, in the reference section, things such as suggesting relevant sources, extracting information, choosing the best search strategy, providing answers to users at all hours of the day and night can be mentioned, which are in line with the researches of Hassanzadeh and Mohammadkhani, (2008); Li, et al (2019). Azimi et al. (2022). In the section of indexing components such as translation, creating links between texts, text classification, automatic extraction of key terms, quality control, multilingual indexing, that the results were consistent with the researches of Keshavarzian and Asnafi (2015); Kosha, (2013); Li, et al (2019); Azimi et al (2022). In the management department, we can mention things like data analysis, demanding forecasting, attention to maintaining intellectual property rights, attention to technical infrastructures, which were in line with the researches of Hassanzadeh (2022), Mirashrafi (2022), Yeganeh et al. (2022); Li, et al. (2019); Azimi et al. (2022).

In the book loan section, things such as suggesting related resources, automatic management of loan renewal, identification and recovery of late resources, coding of resources by robot, tracking resources at any time can be mentioned, which were in line with the researches conducted by Yu, Gang, Sun and Jiang (2019); Farajzadeh (2022); Li, et al. (2019), Azimi et al. (2022).

In the information retrieval section, we can mention components such as natural language search, question and answer, automatic summarization, simulation of reasoning power, selection of relevant and suitable keywords for searching in databases, automatic content analysis, which were in line with the researches of Falah and Shirzad (2012); Khushian and Mirzaian, (2019); Pourmanaf and Mali, (2014); Kosha, (2004); Ghasemi (2021); Hassanzadeh (2022); Li et al. (2019); Azimi et al. (2022). In the information organization section, it is possible to include things such as modifying and enriching metadata, extracting key terms, automatic classification, helping librarians to find

titles, publishers, lists, dates, editions, using Anglo-American standards, paying attention to cataloging that were consistent with researchers such as Shah Shujaei, (1999); Rahmani (2022); Li, et al. (2019); Azimi et al. (2022)..And finally, in the database search section, they pointed out components such as semantic search, search suggestions, visual search, which were in line with the researches of Rubin, Chen, and Thorimbert (2010); Azad, Dalili (2013); Rahmani (2022); Li, et al. (2019); Azimi et al. (2022).

As mentioned, artificial intelligence can be used purposefully in all parts of the library. In addition to its role in retaining and attracting library users, it can improve the efficiency and productivity of digital libraries and automate the processes. In other words, it can be said that artificial intelligence is useful in digital libraries for the creation of interactive content, resource retrieval and indexing, etc. The application of artificial intelligence helps libraries to better understand the needs of users and provide services that are valuable for them. In general, artificial intelligence can be a powerful tool for improving the services of digital libraries, and according to the findings, it is suggested that relevant authorities apply artificial intelligence in libraries to take full advantage of it.

CONFLICT OF INTEREST: The authors declare that they have no conflicts of interest regarding the publication of this manuscript.

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