

Research Article

Investing of Chatbots to Enhance the Library Services

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Abstract

Artificial Intelligence (AI) has become an indispensable tool in our daily lives and is a concept that refers to complex tasks that usually require significant human effort. Chatbots stand out as one of the primary applications of artificial intelligence, aiming to foster an interactive dialogue environment between humans and machines to address inquiries through textual or voice interfaces that simulate human cognition. Libraries can serve as an ideal environment for implementing this technology, where it can deliver advanced information services and streamline repetitive routine tasks typically performed by library staff. The paper discusses the applications of chatbots in automating library services, including reference services, user recommendations, information retrieval, data analysis, and other related processes, and their mechanism of action in processing natural language queries and responding to them accurately. Through a web survey, the study identified eighteen chatbot models that could be implemented in libraries. This survey provided details about these bots, including their type (free or commercial), ownership, release date, operating platforms, and key features. This allows libraries to choose from them. Integrating chatbots into libraries will open new horizons for enhancing their services and improving the user experience. Despite the benefits offered by these chatbots, they face several challenges and concerns regarding their usage, notably data privacy and security, and bias in retrieval. It is expected that in the future, these chatbots will become a fundamental component of providing library services.

Keywords

Chatbots, Library Services, Artificial Intelligence, User Experience

1. Introduction

Libraries are undergoing substantial changes in the digital era, progressing from conventional information storage to dynamic knowledge and engagement centers. The core of this progression is emerging technologies that enrich user experiences and streamline processes. Among these technologies, chatbots have emerged as potent instruments with extensive potential for implementation in library services [1].

Chatbots, or conversational agents, are computer programs designed to simulate human conversations through natural language processing [2]. Sanji, Behzadi [3] offer libraries a

versatile solution for engaging with patrons, providing assistance, and delivering information in real-time. With the ability to interact with users via text or speech interfaces, chatbots offer an accessible and user-friendly means to access library resources and services.

The application of chatbots in libraries extends across various facets of library operations, from reference and research assistance to circulation management. By automating routine tasks and providing immediate responses to inquiries, chatbots can alleviate the burden on library staff, allowing them

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Received: 15 March 2024; Accepted: 8 April 2024; Published: 24 May 2024



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to focus on complex queries and personalized services. Additionally, chatbots can facilitate round-the-clock access to library resources, catering to the diverse needs of users, regardless of time or location [1].

Furthermore, chatbots have the potential to enhance user engagement and satisfaction by offering personalized recommendations, guiding users through library collections, and delivering targeted information based on user preferences and behaviors. Through continuous learning and improvements, chatbots can adapt to user interactions, ensuring a seamless and tailored experience for patrons [4].

In this paper, we explore the various applications of chatbots in library services, and the most popular open-source and commercial models are available for application. By understanding the capabilities and limitations of chatbots, librarians can harness their potential to optimize library services, foster greater accessibility, and enrich their overall user experience. Through critical analysis and case studies, we aim to provide insights into the integration of chatbots as strategic assets in modern libraries, paving the way for innovative approaches to information access and service delivery.

2. Literature Review

Chatbots provide immediate assistance to users, offering guidance on locating materials, accessing digital resources, and integrated with library systems. Moreover, chatbots enhance the accessibility of library services by providing round-the-clock support, catering to the diverse needs of patrons regardless of their location or time zone [5]. By leveraging natural language processing algorithms, chatbots can understand and respond to user inquiries effectively, simulating human-like interactions. Their integration into library websites and digital platforms has streamlined information retrieval processes, empowering patrons to find answers to their queries swiftly and efficiently [6]. Additionally, chatbots play a crucial role in disseminating library-related information, including activities, events, and awareness of new collections. Therefore, the integration of chatbots in libraries signifies noteworthy progress in improving user experiences and facilitating accessibility to library resources [3].

After conducting a thorough analysis of studies that dealt with application of chatbot technology in libraries, with the aim of enhancing user experience and optimizing repetitive tasks, Abdelghani [7] identified the primary purpose of chatbots in libraries as supplementing human interaction and reducing the workload of librarians by handling repetitive inquiries. However, the study highlighted that libraries have not fully recognized the significance of chatbots in automating their services and providing remote access, with limited experiences in their use. Mansour [8] delved into the application of chatbot technology in Assiut University libraries, emphasizing the potential for increased interaction between users and the library, along with enhanced user experience. The study identified the lack of awareness of chatbot benefits

in completing routine tasks and budget constraints as major challenges to their adoption. Similarly, Barakat and El-Hafi [9] developed a chatbot for the Central Library at the University of Oran 1 in Algeria using the Facebook Messenger application, which effectively promoted library services and attracted a significant number of users. They also emphasized the potential of chatbot technology to analyze user conversations and guide the library in enhancing its collections. Furthermore, Fatouh [10] investigated the usage of smart chatbots in scientific research by faculty members in Egyptian universities, establishing a positive correlation between the use of smart chatbots and increased productivity in scientific research. The study recommended promoting interdisciplinary collaboration between library and information specialists and computer science majors to design artificial intelligence applications supporting educational and research activities through library services. Additionally, Hassan [11] has developed a chatbot specifically designed to deliver reference services and address inquiries from users in libraries and information centers. The chatbot has demonstrated a high level of accuracy and efficiency in retrieving information, thus greatly aiding in the remote provision of reference services. The study of Sanji, Behzadi [3] and Panda and Chakravarty [5], highlighted the limited use of chatbots in libraries, emphasizing the need for libraries to utilize the capabilities of this powerful tool to provide satisfaction to their users and initiate virtual assistance, overcoming time and location barriers. Moreover, Ehrenpreis and DeLooper [12] presented a case study of the implementation of Ivy chatbot on Lehman College's Leonard Leaf Library website. This chatbot serves as a new tool that helps users search for information and provides insight to librarians into the types of topics students are searching for via the library's website. The paper titled "Conceptualizing a Library Chatbot using Open-Source Conversational Artificial Intelligence" by [13] explores the potential of implementing a libraries chatbot using the Rasa Stack, an open-source conversational AI platform, to enhance library services and user interactions. The research findings highlight that incorporating chatbots into library semantic knowledge management systems can provide patrons with a more comprehensive information service. Therefore, the study recommends allocating sufficient resources for technical training and budgetary considerations to promote the widespread adoption of AI-powered conversational software in libraries.

In conclusion, the studies collectively underscore the potential of chatbot technology in libraries to enhance user experience, automate routine tasks, and provide remote access to information services. However, they also highlight challenges such as limited awareness of chatbot benefits, budget constraints, and the need for technical training to facilitate widespread adoption. Overall, these findings emphasize the need for further exploration and promotion of chatbot technology in library settings to optimize user services and operational efficiency.

3. History of Chatbots

The inception of chatbots can be traced back to 1950, when researcher Alan Turing laid the groundwork for machine thinking and the creation of dialogue systems that imitate human intellectual behavior. Chatbots have evolved into two generations: the first is the traditional (restricted) type with limited capabilities, which emerged between 1966 and

2009. With advancements in artificial intelligence technologies and the enhancement of natural language processing models, second-generation chatbots, known as the intelligent (unrestricted) generation, have emerged between 2010 and now. These chatbots simulate human conversations, provide answers across various fields, and have the ability to self-improve through machine learning algorithms [10].

Table 1. Timeline of the evolution of chatbot generations.

Chatbot Name	Company/ Designer	Product Data
Traditional Generation		
ELIZA	MIT	1966
PARRY	—	1972
Jabber wacky	Rollo Carpenter	1988
Dr. Sbaits	Creative Labs	1992
WeChat	WeChat	2009
Smart Generation		
SIRI	Apple	2010
Google Assistant	Google	2012
Cortana	Microsoft	2014
Alexa	Amazon	2015
ChatGPT	OpenAI	2023
Gemini	Google	2024

4. Understanding the Operations of Chatbot AI

A study by Senthilkumar and Chowdhary [14] and Gupta, Akiri [15] revealed that chatbots use natural language processing (NLP) technology to understand user input and interact with it in a way that mimics human cognition. The following figure shows the mechanism of the chatbot supported by artificial intelligence.

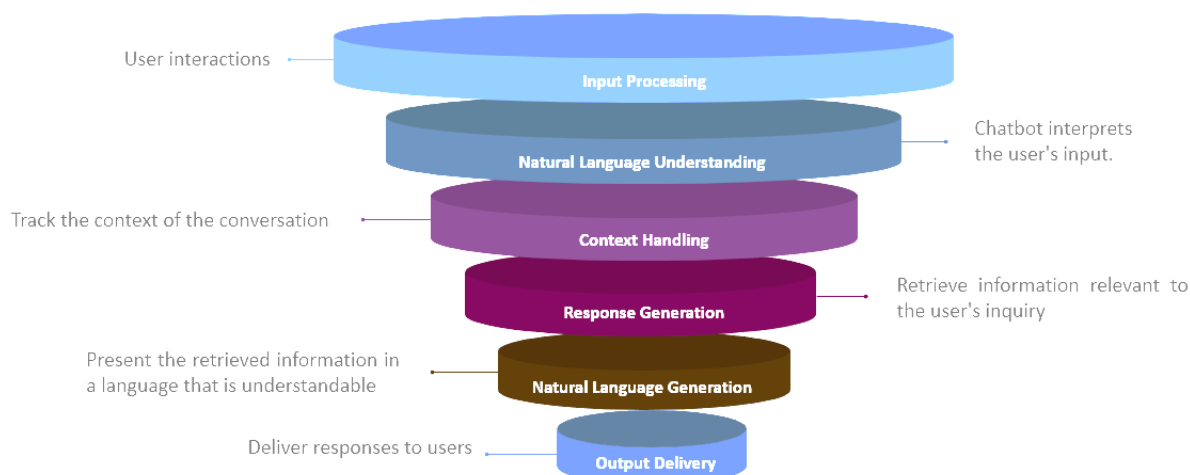


Figure 1. Components of Chatbot.

1. **Input Processing:** involves the reception and handling of user interactions with a chatbot, where the system receives and processes the input, whether in the form of text or voice.
2. **Natural Language Understanding (NLU):** This is a vital element in which the chatbot deciphers the user's input. NLU includes tasks such as structuring (dividing input into words or phrases), entity identification (recognizing crucial details such as names, dates, and locations), and intent recognition (determining the user's goal or desire).
3. **Context Handling:** Chatbot frequently maintains contextual awareness throughout discussions to provide pertinent replies. This involves remembering previous interactions and the current context of conversation.
4. **Response Generation:** The chatbot generates a response based on the interpreted input and context. This could involve retrieving information from a knowledge base, generating a response from predefined templates, or even generating new text using machine-learning models (GPT models).
5. **Natural Language Generation (NLG):** This is the process of converting the chatbot's internal representation of a response into natural language that the user can understand. NLG involves tasks like selecting appropriate words, forming grammatically correct sentences, and ensuring coherence and relevance in the response.
6. **Output Delivery:** Finally, the generated response is delivered to the user through the appropriate channel, whether it's text on a chatbot interface, spoken output in a voice interaction, or any other type.

5. Application of Chatbots in Library Services

The recent evolution of chatbots and their applications in various fields have been explored. However, few studies have explored the potential of chatbots for applications in the library and information science fields. Perhaps this area is quite new and still an unexplored territory for library professionals, particularly in developing countries. The core library functions involve acquiring information, developing the collection, processing information, organization, storage, and dissemination through various means. Within the overall operation of the library functions, these chatbots can strengthen user relations and information retrieval within the library system. The chatbots can offer assistance in the following areas of library services:

5.1. Reference Service

Libraries aim to aid users in finding needed information and addressing inquiries. Chatbots embedded within library websites or integrated into online public access catalogs

(OPAC) can instantly assist users. Once integrated, these chatbots may recommend relevant resources, help answer basic research questions, and supply details about library services, policies or other topics [6].

5.2. Virtual Assistants

Libraries can use chatbots as virtual assistants to improve user experience. Chatbots can be created to provide pre-programmed services such as book renewals, reading room reservations, book recommendations, and information about library activities. Libraries using chatbots can provide basic processes outside official working hours and throughout the week, allowing librarians to focus on more complex user needs [16].

5.3. Information Retrieval

The use of chatbots for information retrieval within libraries enhances search experience in an innovative and efficient manner. These chatbots can guide visitors to be reactive and easily retrieve information through intelligent conversations. Furthermore, natural language voice search enhances interaction with the library, allowing users to make search requests in their own personal style without the need for traditional typing [17].

5.4. User Recommendations

Chatbots can interact with visitors. Based on user preferences, reading history, or internet surfing habits, they can be programmed to provide tailored book recommendations by matching the user profile stored in the library system database [17].

5.5. Big Data Analytics

By conducting in-depth analysis of user interactions with chatbots, libraries can gain meaningful insights into patron behavior, preferences, and information needs. Such data analysis can aid in informing collection development efforts to align better with patron interests. Additionally, regularly analyzing interaction trends allows libraries to stay abreast of evolving patron demands to understand additional needed resources. Chatbot questions and topic logs further help pinpoint frequently asked queries as well as topics lacking coverage, thereby enhancing user experience. Overall, leveraging data from chatbot usage opens new doors for libraries to refine their services to better serve their communities [18, 19].

5.6. Technical Operations

Libraries can adopt chatbots in the procedures of cataloging and classification books and indexing periodicals accurately, which saves time and effort in completing these ardu-

ous tasks [3].

6. Objectives

Based on the literature review provided, the objective of this study is to examine different online chatbots, both free and commercial. This section aims to offer libraries a concise overview of the available chatbots, including the date they were released, ownership, operating platforms, and key features. The intention is to provide librarians and decision makers with a readily available resource, enabling them to effectively integrate these chatbots into library activities and services according to their budgetary constraints.

7. Methodology

The research drew its data primarily from the websites of various chatbots, serving as the primary source of information. Data collection was conducted over a period spanning from April 2012 up to the present, allowing for a comprehensive examination of available chatbot offerings over an extended timeframe. In total, (18) distinct chatbots were scrutinized as part of the study, providing a diverse sample for analysis. To ensure systematic data collection, a checklist was utilized as the primary data collection instrument. This checklist facilitated the organized gathering of pertinent information from each chatbot's website, ensuring consistency

and thoroughness in the data collection process. Through this approach, the study aimed to compile a comprehensive overview of the features and characteristics of the examined chatbots, shedding light on the landscape of chatbot technology over the specified period.

8. Findings

The findings of the survey revealed the presence of (18) distinct chatbot models accessible on the internet. These chatbots were meticulously assessed and compared across several dimensions, including their respective owners, release dates, notable features, nature (whether free or commercial), and operating environments (Web or App). Through a comprehensive descriptive analysis, key characteristics and features of each chatbot were elucidated, providing valuable insights into the evolving landscape of chatbot technology. Table 2 serves as a succinct repository of these findings, offering readers a consolidated overview of the surveyed chatbots and facilitating comparisons across various attributes. This scholarly presentation of findings not only contributes to our understanding of the current state of chatbot development but also serves as a valuable resource for librarians and decision-makers alike to integrate chatbots into library services and activities in a way that suits their budget and enhances the user experience.

Table 2. Survey of the most popular chatbots available online.

No.	Chatbot Name	Date	Company	Main Features	Platform		Type
					APP	Web	
1	Bing Chat	2023	Microsoft	It runs on the same technology as ChatGPT-4. What distinguishes this bot is that it provides detailed responses with footnotes containing the original sources of information, which gives a positive impression to users regarding the credibility of the information provided.	✓	✓	Free
2	Pop AI	2023	INAIPTTE	PopAI is armed with an extensive library of templates, transforming the art of creation into a more accessible endeavor. From drafting academic papers, designing PowerPoint presentations, crafting resumes, to writing code, converting text, translating languages, and optimizing SEO copy.	✓	✓	Commercial
3	ChatSpot	2023	HubSpot	Free AI-powered assistant that combines the power of ChatGPT with unique data sources, including the HubSpot CRM, to help users.	×	✓	Free
4	NOVA	2023	NOVA AI	Powered by ChatGPT & GPT-4 and supports audio search.	✓	✓	Commercial
5	Cloude AI	2023	Anthropic	Powered by an LLM called Claude 2, it can write different kinds of creative content, translate languages, and even generate simple visuals. It supports the feature of attaching files and analyzing their content to extract information.	×	✓	Commercial
6	ChatGPT	2022	Open AI	It is fed large amounts of data and uses the advanced GPT-4	✓	✓	Commercial

No.	Chatbot Name	Date	Company	Main Features	Platform		Type
					APP	Web	
				linguistic processing model, allowing it to generate text that is indistinguishable from human-type text.			
7	Gemini (Bard)	2022	Google AI	It is an interactive chatbot based on Google's PaLM2 modern language model, which is designed to understand conversations in multiple languages.	×	✓	Free
8	Perplexity	2022	Perplexity AI, Inc.	A search engine and chatbot that uses the ChatGPT-3 language processing model. What distinguishes this bot is that it is designed to search the web in real time and provide links to online search results, in addition to allowing voice search.	✓	✓	Free
9	Jasper	2022	Jasper Studios	Uses different LLMs, including GPT-4, and check for grammar and plagiarism and write in over 50 different templates, including blog posts, Twitter threads, video scripts, and more. It also offers SEO insights.	✓	✓	Commercial
10	ChatSonic	2022	Writesonic	Powered by GPT-3.5 or GPT-4, it includes the ability to web search and generate images. It offers some tools including Article Writer and Article Rewriter.	✓	✓	Commercial
11	Poi AI	2021	Quora	Poe supports GPT-4 and DALL-E 3 from OpenAI.	✓	✓	Free
12	Watson	2021	IBM	This bot uses NLP and machine learning to gather context and it also supports voice search.	×	✓	Free
13	Sider	2021	Meta	Supports GPT-3.5/GPT-4 models. Provides YouTube summaries, Chat PDF, AI painting, translation, proofreading, OCR, and content writing in a professional manner.	✓	✓	Free
14	YouChat	2021	YouCom	Powered by OpenAI's GPT-4 language model, the latest and greatest artificial language model, this gives me the ability to understand and manipulate texts in advanced and accurate ways.	✓	✓	Free
15	Socratic	2020	Google, Inc.	It supports voice search and scan papers to recognize the content and provide direct answers.	✓	×	Free
16	Alexa	2015	Amazon	Alexa can understand the user's natural language, analyze it, and extract information. It is used in libraries to provide information retrieval services.	✓	×	Commercial
17	Google Assistant	2012	Google, Inc.	It uses artificial intelligence and machine learning techniques to understand voice commands and is characterized by its ability to understand complex questions and extract information from the internet.	✓	×	Free
18	SIRI	2010	Apple, Inc.	It works with the iOS operating system. It is an intelligent personal assistant that uses natural conversational language and supports conversational voice search.	✓	×	Free

The survey findings have revealed a significant increase in the proliferation of chatbots in recent years, accompanied by a steady influx of innovative chatbot models entering the market. Libraries can utilize this survey to determine which type of chatbot (commercial or free) is most suitable, based on their budgetary constraints, to apply it in their services.

9. Conclusion

The paper explores various applications of chatbots in library services, such as technical operations, user recommendations, big data analytics, and remote reference services. It emphasizes the importance of conducting web scanning to explore and evaluate new chatbot models and select the most suitable ones for

implementation in libraries. Moreover, the paper provides a comprehensive overview of chatbots available from 2010 to the present, including details on their release dates, ownership, operating platforms, and key features. This serves as a valuable resource for librarians and decision-makers who are considering integrating chatbots into library activities. Furthermore, the paper highlights the broader landscape of chatbot technology and its potential for widespread adoption among the public. This could potentially lead to a paradigm shift, where chatbots replace conventional search engines as the primary means of online information retrieval. As a result, the term "search engine" may gradually become outdated.

Finally, it is anticipated that chatbot technology will be extensively embraced by the public in the future. This has the potential to bring about a significant transformation in the information retrieval process, with chatbots replacing traditional search engines as the primary method of accessing information online. As a result, the term "search engine" may gradually become outdated.

Abbreviations

AI	Artificial Intelligence
LIS	Library and Information Science
NPL	Natural Language Processing
NLU	Natural Language Understanding
GPT	Generative Pre-trained Transformer
NLG	Natural Language Generation
OPAC	Online Public Access Catalog
PaLM2	Pathways Language Model (Version 2)
LLMs	Large Language Models
DALL	Digital Assisted Language Learning
OCR	Optical Character

Author Contributions

Amr Hassan Fatouh is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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