



**AI-POWERED CHATBOTS FOR IMPROVING INTERACTIVE USER EXPERIENCE:
STATE-OF-THE-ART**

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ABSTRACT

Recent advancements in chatbot technology, driven by Natural Language Processing (NLP) and machine learning techniques, have led to the widespread adoption of Artificial Intelligence (AI) chatbots across various sectors. These AI chatbots are designed to enhance user and customer experience by providing customized services. While existing literature on chatbots normally covers technical aspects, impact, and applications across disciplines, there is limited research from the perspective of users and customers that focuses on user experience (UX) improvement during the interaction process. To offer a more thorough analysis of the interactive user experience between users and AI chatbots, this paper reviews relevant studies from databases Scopus, Web of Science, and IEEE over the past decade. The review highlights the significance of user-centred design for AI chatbots, identifying key factors influencing UX from pragmatic and hedonic quality. It points out how AI technology empowers chatbots to deliver tailored and personalized services to enhance UX. Moreover, the review reveals that current methods for evaluating UX with AI chatbots lack objectivity and comprehensiveness, emphasizing the necessity of establishing evaluation frameworks and standardized metrics for effective cross-system comparison. Finally, the review outlines future research directions for academic exploration of AI-powered chatbots and UX.

Keywords: AI chatbot, User experience, Customer experience, Chatbot design, Interactive design, UX evaluation

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1 INTRODUCTION

Since Joseph Weizenbaum developed the first chatbot, ELIZA, in 1966 [1], the technology has gained increasing popularity, especially with recent advancements in NLP and machine learning technology. According to Spherical Insights & Consulting, the global chatbot market size is estimated to grow from USD 5.39 Billion in 2023 to USD 42.83 Billion by 2033 [2], demonstrating promising prospects for chatbots. Chatbots have been applied across various industries, such as healthcare, retail and e-commerce, education, and finance, where they provide services to improve user and customer experiences.

The types of chatbots are classified into three categories: rule-based model, retrieval-based model, and generative-based model [3]. Different from rule-based conversational agents, AI chatbots leverage the capabilities of generative models with a human-like quality. These bots are flexible and can adapt to diverse sectors by learning from extensive interaction data while retaining interaction history [3]. The primary technology behind these chatbots involves NLP and machine learning. NLP enables a more accurate understanding of user language inputs compared to traditional methods. With NLP and machine learning techniques, chatbots can learn from large datasets or predefined conversational flows, enabling them to understand user intents and generate appropriate responses [4]. Therefore, AI chatbots can offer a more natural and interactive user experience to meet the varied and evolving needs of modern users and customers.

Research on AI chatbots has consistently captured the attention of scholars, highlighting their potential to reshape user interactions. Existing literature reviews have explored various aspects of chatbot research, including technical aspects [5], impact on business interface transformations [6], practical applications such as healthcare applications [7] and finance industry [8], and interdisciplinary perspectives [9]. Recognizing the lack of comprehensive synthesis and analysis regarding the dynamic interaction process between AI chatbots and users, further exploration and development are necessary. This review aims to provide a thorough analysis of the interaction process, focusing on five primary themes: user-centred design of AI chatbots, factors influencing UX, enhancing UX through AI-powered chatbots, UX evaluation, and application. It will analyse each theme and propose future research directions.

2 METHODOLOGY

To identify key themes and the latest trends in AI chatbots and user experience research, this study employed a systematic review method based on guidelines by Kitchenham and Charters [10]. It involves three stages: defining criteria and search queries, article selection, and analysing selected papers.

2.1 Search Strategy and Selection Criteria.

The papers in this review were collected in April 2024 from Web of Science, IEEE and Scopus to identify relevant articles on AI-chatbots interaction. The search query used Boolean operators: ("AI chatbots" OR "conversational agent") AND ("customer experience" OR "consumer experience" OR "user experience") in titles, abstracts and keywords. The inclusion criteria and exclusion criteria are detailed in Table 1.

Table 1: Inclusion criteria and exclusion criteria

Inclusion criteria	Exclusion criteria
All the articles related to research topics	Book chapter/Note
All the articles were written in English	Articles whose full text is not available.
All the articles were published from 2014 to 2024	Articles without text chatbots but other forms like voice

2.2 Article Selection

The comprehensive filtering process was applied to improve the result, which encompassed initial selection, final selection, snowball search, and quality assessment stages, as shown in Figure 1. During these stages, predefined inclusion and exclusion criteria were rigorously applied to ensure the relevance and quality of the selected papers. The final corpus comprises 46 papers that met the established criteria.

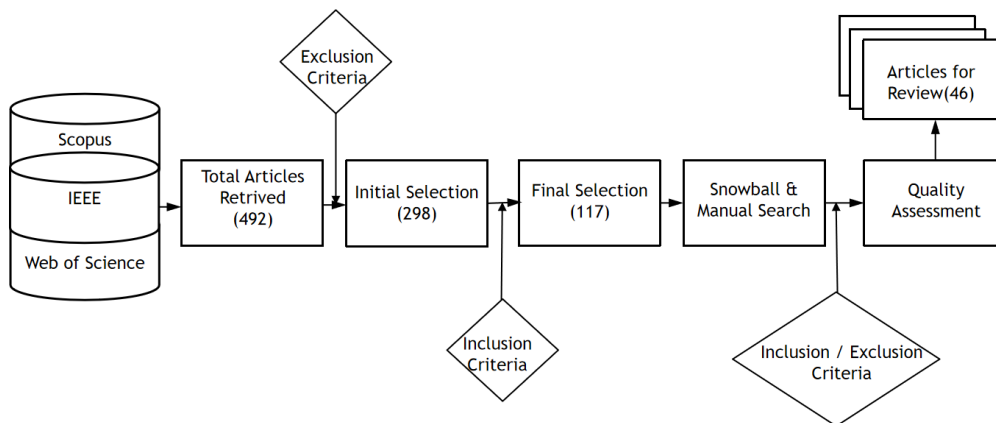


Figure 1: Framework of the Proposed Article Selection Process

2.3 Data Analysis

After the final selection process, 46 articles comprising 15 conference papers and 31 journal articles were chosen for analysis. Keywords and abstracts were extracted for text clustering by VOS viewer software which facilitated the organization of the literature into thematic categories in Figure 2. The literature was then categorized into five themes: user-centred design of AI chatbots, factors influencing UX, enhancing UX through AI-powered chatbots, UX evaluation, and application. These categories were derived through a systematic review process for organizing and analysing the selected literature on AI chatbot interaction.

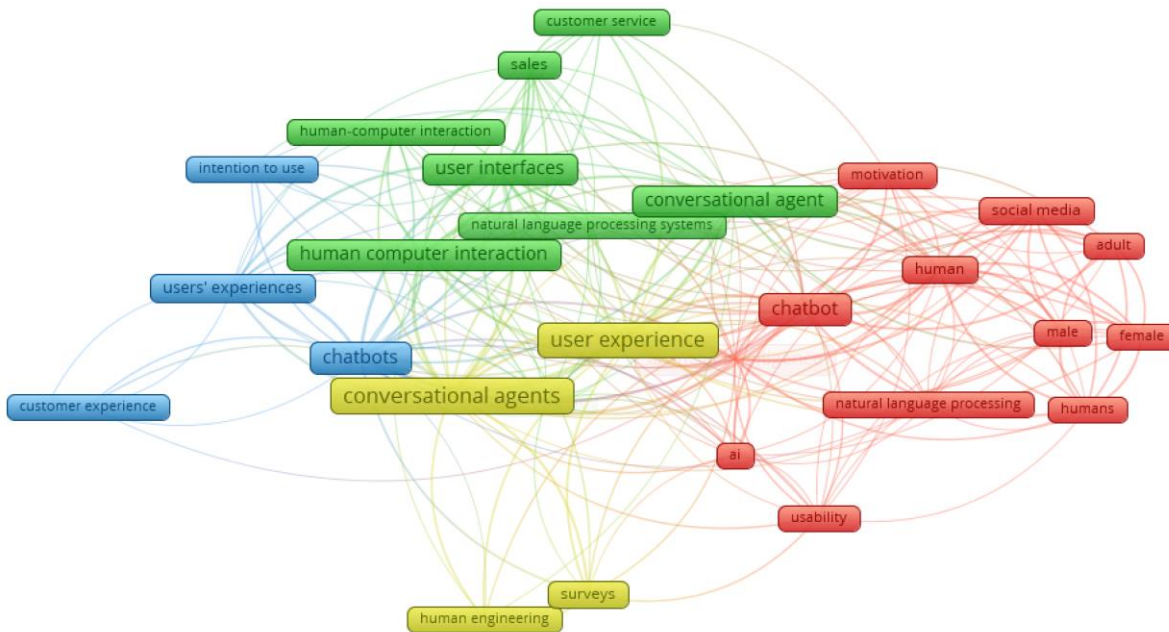


Figure 2: Visualization of Clusters

3 RESULTS AND DISCUSSION

The present narrative synthesis includes the description of the publications and the thematic analysis.

3.1 Descriptive Analysis

The distribution of reviewed papers as shown in Table 2 across publication sources and years reveals insights into the academic landscape of AI chatbot interaction research. Among the 46 papers, notable contributions came from ACM (10.9%, N=5), the International Journal of Human-Computer Interaction and CHI (each 8.7%, N=4), and the International Journal of Human Computer Studies and Proceedings of the ACM on Human-Computer Interaction (each 6.5%, N=3). These findings highlight the diverse scholarly venues contributing to AI chatbots and user interaction discourse. Since 2017, there has been continuous growth in publications, peaking in 2022, followed by a decline in the past two years.

In addition, AI chatbots have found extensive applications across various sectors, particularly in health and wellness, where they serve as pivotal tools for enhancing user engagement. Following closely is retail and e-commerce, which has extensively integrated chatbots to enhance user support and satisfaction. Furthermore, AI chatbots are also making significant inroads into the education, tourism, finance, agriculture and film industries. The widespread adoption underscores the adaptability of AI chatbots in meeting the demands of different sectors and the potential to revolutionize human interaction and service delivery.



Table 2: Number of Papers Reviewed by Publication

Conferences can be recognized from the presence of an acronym in brackets.

Venue	2017	2018	2019	2020	2021	2022	2023	2024	Total
ACM International Conference Proceeding Series(ACM)			2	2	1				5
Conference on Human Factors in Computing Systems (CHI)		1	1	1	1				4
International Journal of Human-Computer Interaction							1		4
International Journal of Human Computer Studies	1				1				3
Proceedings of the ACM on Human-Computer Interaction				1		2			3
Personal and Ubiquitous Computing						1	1		2
Journal of Medical Internet Research					1	1			2
Journal of Business Research							1		2
Computers in Human Behavior					1	1			2
International Conference on Technologies and Applications of Artificial Intelligence(TAAI)					1				1
IEEE Transactions on Emerging Topics in Computing							1		1
International Conference on Human-Agent Interaction(HAI)			1						1
Digital Health			1						1
Neurocomputing								1	1
Studies in Higher Education								1	1
ACM Transactions on Computer-Human Interaction									1
International Journal of Eating Disorders							1		1
Journal of Consumer Behaviour								1	1
Americas Conference on Information Systems (AMCIS)				1					1
Human Technology			1						1
Journal of Biomedical Informatics				1					1
International BCS Human Computer Interaction Conference(HCI)		1							1
Journal of the Association for Information Systems						1			1
Journal of Service Theory and Practice								1	1
Journal of Management Information Systems								1	1
International Journal of Consumer Studies							1		1
Journal of Service Management								1	1
International Journal of Retail and Distribution Management					1				1
Total	1	2	6	6	8	13	4	6	46



3.2 Thematic Analysis

3.2.1 User-Centred Design for AI Chatbots

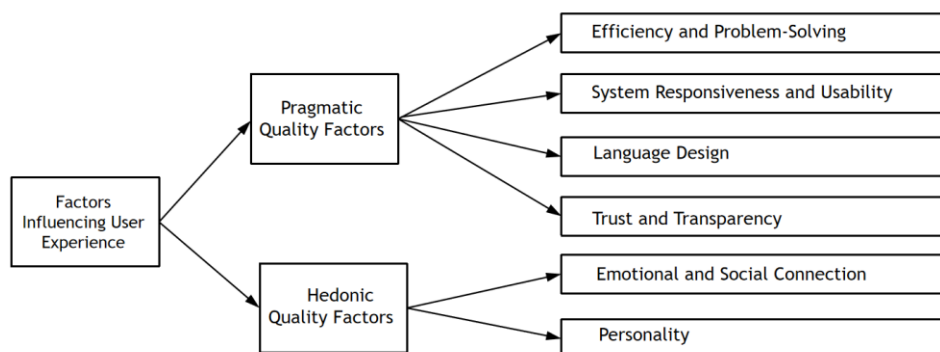
User-centred design (UCD) is an interdisciplinary design approach that prioritizes user involvement to enhance understanding of user and task requirements through iterative design and evaluation [11]. In Human-Computer Interaction (HCI), UCD has emerged as a dominant method with widespread agreement on its principles, focusing on user needs and preferences to improve usability and practicality [12]. Considering the significant role of AI chatbots in facilitating human-computer interaction, UCD plays a crucial role in designing AI chatbots, particularly in the education, healthcare, and business sectors [13]. Employing a user-centred approach facilitates AI chatbots in addressing user requirements effectively, thereby augmenting engagement, satisfaction, and trust. For instance, UCD-based AI chatbots have shown the potential to improve information retrieval efficiency and enhance learning experiences [14].

Furthermore, UCD contributes to the development of more effective, safer, and satisfying AI chatbots. By actively incorporating user feedback into the design process, UCD ensures that AI chatbots can provide personalized interactions based on user preferences, thereby enhancing user enjoyment and acceptance. Blazevic and Sidaoui [15] introduced the framework TRISEC, which aligns with service, technology, and customer needs, enabling chatbots to adapt flexibly to different environments and user demands. Additionally, addressing constructs such as perception, attitude, performance and acceptance is crucial for designing effective chatbots, as emphasized by Diederich et al [16].

3.2.2 Factors Influencing UX

Factors influencing the UX of AI chatbots encompass a variety of elements that can be classified into pragmatic and hedonic quality, as depicted in Figure 3. Yang et al. [17] explored affective experiences with conversational agents, investigating the influence of pragmatic factors such as helpfulness and responsiveness, and hedonic quality like conversational comfort and enjoyment. Also, Kim et al. [18] demonstrated that perceived usability and enjoyment significantly influenced satisfaction with the chatbot by analysis of data from 446 ChatGPT users.

Figure 3: Factors Influencing UX of AI Chatbots



Pragmatic quality describes the task completion capability and efficiency of chatbots: (a) Efficiency and problem-solving: engaging users in task-oriented dialogues and providing



proactive assistance contribute to improved user experience [17] [19]. (b) System responsiveness and usability: ensuring smooth interaction without interruptions or delays [20] and prioritizing an intuitive and usable interface are imperative for efficient interaction [21]. (c) Language design: designing chatbots with resonating linguistic styles enhances user satisfaction [22]. (d) Trust and transparency: aligning user expectations with capabilities and building trust through transparent communication are essential for fostering user trust and confidence in chatbot interactions [23].

Hedonic quality involves the interaction experience with chatbots, including user affection, enjoyment, and emotional experiences: (a) Emotional and social connection: users derive enjoyment and comfort from human-machine conversations, emphasizing the importance of emotional connection [24] and parasocial relationships [25]. (b) Personality: aspects such as humour [26], anthropomorphism [27], and personality traits, like extraversion [28], influence user satisfaction and communication quality with chatbots.

3.2.3 Enhancing UX through AI-powered Chatbots

With the advent of the AI era, it has been significant transformations in AI chatbots, evolving from simple rule-based systems and predefined templates to advanced interfaces capable of understanding human language and offering interactive and customized conversations with users [29]. AI empowers chatbots through various techniques such as NLP, LLMs, deep learning, and fine-tuning, enabling them to interact intelligently and provide tailored services. NLP enhances user interactions by comprehending and interpreting human language effectively, consisting of components of Natural Language Understanding, Dialogue Manager, and Natural Language Generation [30]. Leveraging extensive data and advanced algorithms, LLMs like ChatGPT generate accurate, context-aware responses, enriching human-computer interaction quality [4]. Additionally, techniques like deep learning and reinforcement learning facilitate learning and improvement, with models like GPT-4 refining responses through human feedback [5]. Progress in long-text processing and multimodal understanding enable chatbots to excel in handling complex interactions and diverse inputs [31]. Active listening skills empower chatbots to comprehend user input accurately and respond appropriately, contributing to higher-quality responses [32]. These advancements combined with fine-tuning and personalized services seamlessly integrate into various applications, enhancing user satisfaction and engagement across different scenarios [33].

3.2.4 UX Evaluation of AI Chatbots

Assessing and comparing UX with chatbots is essential for improving system effectiveness, understanding user preferences, and enhancing UX. The evaluation of UX for AI Chatbots involves various tools. Weber and Ludwig's evaluation framework [34] considers the entire interaction process from initial setup to post-interaction stages. Skjuve et al. [35] emphasize the importance of assessing conversation content, demeanour, and flow, providing insights into the holistic user experience. The User Experience Questionnaire offers both qualitative and quantitative evaluation across hedonic, aesthetic, and pragmatic dimensions [36]. To evaluate UX comprehensively, multiple questionnaires are recommended. The Chatbot Usability Scale includes five dimensions: perceived accessibility to chatbot functions, perceived quality of chatbot functions, perceived quality of conversation and information provided, and perceived privacy and security. It has evolved from BUS-15 to BUS-11 for improved reliability and efficiency [37]. Additionally, Borsci et al. [38] introduce diagnostic tools BOT-Check to assess chatbot experiences, supporting the evaluation of short-term and



long-term conversational agents inclusively. Current methodologies for UX evaluation in chatbots may lack completeness, concentrating on particular aspects rather than a holistic view. Future improvements should prioritize the development of exhaustive evaluation frameworks to capture user perceptions and emotions more effectively. Standardized evaluation metrics and benchmarks are necessary for comparing different chatbot systems.

3.2.5 Application of AI-powered Chatbots

AI chatbots have become increasingly pervasive across various sectors, providing users and customers with enhanced service and interaction experiences, as shown in Table 3. Within the healthcare industry, AI chatbots are revolutionizing patient engagement and service delivery by offering support for mental health [39], health education [40] [41], blood donation [42] and self-diagnosis [43]. These chatbots not only improve access to healthcare information but also provide personalized support, ultimately promoting overall well-being [44]. Moreover, AI chatbots are being utilized in diverse customer service contexts, such as the use of AI chatbots in small family businesses [45] or providing financial services of Mobile Banking [46] to enhance customer experience and satisfaction. In agriculture, Wang et al. [47] suggest that AI chatbots are employed to disseminate information and improve efficiency. AI chatbots play a crucial role in educational assistance and transforming learning experiences. They help improve learning outcomes, facilitate personalized education, and enhance student engagement [48]. Furthermore, AI chatbots contribute to social interaction and social presence by offering services such as virtual tourist counselling [49]. Potdevin et al. [50] state perceiving virtual intimacy significantly enhances user experience in human-agent interaction, independently influencing emotional reactions and social presence. Lastly, the study by Sachdeva et al [51]. shows that AI chatbots are utilized for user review collection, usability testing, and evaluation of conversational agents. The widespread application of AI chatbots highlights the user-centred focus across various industries, as well as the promising prospects of chatbots in providing a range of services.

Table 3: Applications of AI-Powered Chatbots Across Industries

Industry	Application
Healthcare	Support for mental health, health education, blood donation and self-diagnosis
Retail and E-commerce	Offer various customer supports to create a personalized shopping experience
Finance	Personalized, efficient, and secure assistance for a wide range of financial services
Agriculture	Provide consultation and services for agricultural e-commerce platforms
Education	Improve student engagement, personalized education and learning outcomes
Tourism	Virtual tourist counselling to enhance social presence

4 FUTURE RESEARCH DIRECTIONS

As AI chatbots become increasingly prevalent in kinds of sectors, there is a growing need for future research focusing on the following key areas:



4.1 User Experience Enhancement

This review examines the factors influencing UX with chatbots from both pragmatic and hedonic perspectives. Given the distinctive characteristics of AI chatbots, further exploration into factors like anthropomorphism could enhance our understanding of this interactive process. Also, future research should focus on improving user interfaces and experiences by developing more natural and intuitive chatbot interfaces through multimodal inputs such as voice and gestures. Additionally, personalized adaptation and fine-tuning of LLMs are crucial to effectively cater to individual user preferences. Employing user feedback mechanisms and adaptive algorithms can deliver tailored and contextually relevant responses.

4.2 User-Centred Design for AI Chatbots

User-centred design principles and iterative processes are crucial in AI chatbot design. Considering factors influencing UX is essential to create a more engaging and satisfying user experience. While existing literature highlights the positive impact of these design principles on user satisfaction and trust, empirical studies remain limited. Future research should prioritize the practical implementation of these principles to optimize the design process.

4.3 UX Evaluation

The evaluation of UX with chatbots currently relies on established methods such as the User Experience Questionnaire and the Chatbot Usability Scale, which lack comprehensiveness and objectivity. Emerging research is exploring alternative methodologies to enhance the evaluation process. For example, studies are investigating the use of electroencephalogram (EEG), which offers greater resolution and data accuracy compared to traditional methods [52]. Despite these advancements, there remains a need to develop an exhaustive framework specifically tailored to evaluating UX with chatbots, ensuring cross-study comparability.

4.4 Human-Chatbot Collaboration

With the profound integration of humans and technology, particularly emphasizing humanization and humanistic values in Industry 5.0, future research should systematically examine the roles assumed by each partner and their implications across diverse contexts. Conducting empirical research becomes imperative to explore incentive structures, develop precise measurement instruments, discern task-specific nuances, and evaluate levels of engagement in human-chatbot collaborations. Moreover, establishing trust in AI-powered interactions is pivotal, thus addressing emerging challenges such as ethical concerns, privacy issues, and bias mitigation in chatbot applications is necessary.

5 CONCLUSIONS

Recent applications of AI chatbots highlight their transformative potential for affordable and efficient services. This study identifies five research themes from 46 papers over the past decade. By exploring these themes, the review offers both researchers and practitioners a profound understanding of the intricate interaction processes between AI chatbots and users. The analysis reveals the importance of user-centred design for AI chatbots, integration of advanced AI technologies in enhancing UX and analyses factors influencing UX from hedonic and pragmatic dimensions. This review also suggests future research directions, including exploring technological advancements like multimodal integration into chatbots, optimizing AI chatbot design, developing a comprehensive and comparable evaluation framework for assessing the UX of AI chatbots, and human-chatbot collaboration.



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