Mapping the Research Landscape of Chatbots, Conversational Agents, and Virtual Assistants in Business, Management, and Accounting: A Bibliometric Review

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ABSTRACT

This bibliometric review aims to map the research landscape of chatbots, conversational agents, and virtual assistants in the business, management, and accounting of the subject area. The review begins by examining the growth of research in this area over time, revealing an increasing interest in the application of chatbots, conversational agents, and virtual assistants in business, management, and accounting contexts. This study aims to contribute to the field of chatbot research by conducting a bibliometric analysis of chatbot, conversational agent and virtual assistant papers available in the Scopus databases. A comprehensive analysis of 378 articles was performed utilizing the Bibliometric software package. The keywords "Chatbot", "conversational agent" and “virtual assistant” emerged as the most frequently employed terms in the majority of publications. It explores the various domains within which these technologies have been studied, including customer service, marketing, human resources, and financial management.

Keywords: Chatbots; Conversational agent; Virtual Assistant; Bibliometric study; R package

INTRODUCTION

A chatbot or conversational agent (CA) or virtual assistant is a software system that can engage in natural language conversations with human users (Shalwar, B. A., 2007). The initial chatbot, ELIZA, was created by Joseph Weinbaum in 1966 (Weinbaum., 1966). Originally designed to simulate a psychotherapist, ELIZA paved the way for the development of subsequent chatbots like A.L.I.C.E. and Mitsuku. These chatbots often utilize Artificial Intelligence Markup Language (AIML), a programming language that enables them to recognize patterns in user input and respond using predefined templates. Since 1991, numerous chatbots have been developed for the Loaner Prize competition, the oldest Turing Test contest aimed at identifying the most human-like chatbot according to judges. In recent years, Mitsuku and Rose have emerged as winners of this (Atwell, 2002). They have gained popularity in various fields, including business, management, and accounting.

These technologies aim to facilitate collaboration, knowledge sharing, and decision-making among different stakeholders involved in business analysis (Cherednichenko et al., 2023). Collaborative Business Analysis (CBA) is a methodology that brings together business users, analysts, and technical specialists to analyse data and gain insights into business operations. Virtual collaboration tools, such as virtual assistants, are an important part of Business Intelligence (BI) platforms, enabling users to customize their experience and make data exploration more accessible (Andouille *et al.*, 2021). In the commercial market, chatbots are evaluated based on metrics like market share, user range, and advanced features (Agarwal and Wadhwa, 2020). Different approaches, such as rule-based and neural network-based, have been proposed for chatbot development, with rule-based approaches being suitable for task-oriented conversations and neural network-based approaches for open-domain conversational modelling (Sengupta Subhashish, 2021)**.** In business management, conversational agents can assist with tasks such as project management, scheduling, and resource allocation. They can provide real-time updates, generate reports, and offer insights based on data analysis, enabling managers to make informed decisions and streamline operations. Virtual assistants, with their comprehensive capabilities, have become indispensable tools for businesses in the accounting field. These assistants can handle a wide range of financial tasks, such as managing expenses, generating invoices, and tracking transactions. Systems and methods have also been developed to enhance chatbot conversational experiences, using knowledge graphs or domain models to provide more natural and efficient dialogue experiences (Gupta *et al.*, n.d.) Chatbots have diverse applications, including task completion, entertainment, home automation, and business strategy tips. In the realm of business, management, and accounting, the integration of chatbots, conversational agents, and virtual assistants has brought about significant transformations. These intelligent systems have revolutionized the way organizations interact with their customers, manage operations, and handle financial tasks. Chatbots, as computer programs designed to simulate human conversation, have found immense utility in the business world. They can be deployed on websites, messaging platforms, and social media channels to provide instant customer support, answer frequently asked questions, and assist with basic inquiries. By automating these interactions, chatbots enhance customer service, reduce response times, and free up human resources for more complex tasks. Conversational agents, a more advanced form of chatbots, have proven to be invaluable in the management domain. These agents leverage sophisticated algorithms and machine-learning techniques to engage in context-aware conversations with users. The paper discusses the benefits of adopting chatbots for customer service, an overview of chatbot technology, a few case studies about how companies are using chatbots, and challenges in adopting chatbot technology for providing customer service, (Tarakan and Badoglian, 2022). They can integrate with accounting software, access financial databases, and provide real-time financial information and analysis. Virtual assistants not only save time and effort but also minimize the risk of human error, ensuring accurate and efficient financial management. The integration of chatbots, conversational agents, and virtual assistants in the business, management, and accounting subject area has transformed the way organizations operate. These intelligent systems enhance customer service, streamline operations, and improve financial management. As technology continues to advance, we can expect further advancements in these areas, leading to even more sophisticated and capable AI-powered assistants in the business world.

This paper explores the existing literature on chatbots, conversational agents, and virtual assistants. The authors conduct a bibliometric analysis using journals from sources like Scopus to gain a comprehensive understanding of the field. The study aims to achieve three main objectives: a) Determine the number of published papers on chatbots, conversational agents, and virtual assistants, including analyzing the authors, sources, affiliations, and countries that contribute the most articles in this area. b) Investigate the intellectual structure of studies on chatbots, conversational agents, and virtual assistants. c) Explore the social structure of studies related to chatbots, conversational agents, and virtual assistants.

METHODOLOGY

The study utilized Scopus, a widely used bibliometric database that adheres to global academic standards. The search query included terms like "Chatbot," "conversational agent," and "virtual assistant" in the Scopus database. The initial results were filtered based on subject areas, resulting in 673 articles in the fields of Business, Management, and Accounting. The document was further limited to articles and review articles, resulting in 407 articles. Only papers from English language journals were selected for further analysis, resulting in 402 articles. The analysis focused on articles published in journals, resulting in 401 articles, and those in the final publication stage, resulting in 378 articles for analysis.

The study employed bibliometric analysis, along with content analysis, to understand future research possibilities and identify gaps in the existing literature. The findings were based on four types of analyses: descriptive, conceptual, intellectual, and social structural analyses. Bibliometric analysis, along with content analysis, has gained popularity among scholars for understanding future research possibilities and identifying gaps in the existing literature (Koskinen, 2008). The findings of this study are based on four types of analyses: descriptive, conceptual, intellectual, and social structural analyses. The descriptive analysis focuses on various aspects, including the characteristics of authors, articles, author keywords, countries, and institutions involved in Chatbot research. It employs bibliometric indicators such as publication and authors, institutions, author dominance factor and author keyword characteristics. Additionally, co-authorship analysis examines the collaborative relationships between countries/regions, institutions, and authors (Higaki, A., Uetani, T., Ikeda, S., & Yamaguchi, 2020). The conceptual analysis explores significant concepts and themes studied in the field of chatbots. Co-word analysis using author keywords is employed to determine the relationships between different keywords within the article (Al-Zaman, 2021). Citation analysis assesses the impact and quality of countries/regions, organizations, sources, and authors by analyzing the number of citations they receive (Lim, H. J., & Suh, 2021). In the social structural analysis, the study investigates the connections between nations and institutions in the context of Chatbot research. Partnership networks at the national and institutional levels are visualized to emphasize these connections. Thematic evolution study examines the evolution of the field, shifts in research orientations, and emerging trends by analyzing the evolutionary routes of themes based on centrality and density measures (Furstenau, L. B., Sott, M. K., Homrich, A. J. O., Kipper, L. M., Dohan, M. S., López-Robles, J. R., ... & Tortorella, 2021).

For scientific mapping analysis, the R program was employed, as it provides a comprehensive set of tools for quantitative research in bibliometrics and scientometrics. R, being a free and open-source platform and ecosystem, offers advantages such as access to high-quality numerical routines, large statistical algorithms, and integrated data visualization capabilities (Aria, M., & Cuccurullo, 2017). Two tools, namely the Bibliometrix library and Biblioshiny, were used for bibliometric analysis. Through an in-depth evaluation of research publications in each area, this study identified research gaps that can serve as valuable topics for future investigations, contributing to the advancement of knowledge in the field of Chatbot research.

RESEARCH QUESTION

RQ1: What are the patterns and trends observed in the number of publications and citations over time?

RQ2: Who are the highly productive authors and what are their collaborative networks based on their h-index and total publication count?

RQ3: Which countries have the highest productivity in terms of total citations?

RQ4: Based on the h-index, which publications are considered the most influential?

RQ5: Which articles have received the highest number of citations, and what are the networks associated with these highly cited articles?

RQ6: What are the main research themes and keywords that form the intellectual structure of the field?

DESCRIPTIVE STATISTIC

The descriptive statistics pertaining to chatbot research (Table 1) indicate that there have been 378 published papers on the topic of chatbots, distributed across 163 publications. Thus far, a total of 1268 keywords have been employed in this area, with authors utilizing 1184 unique keywords.

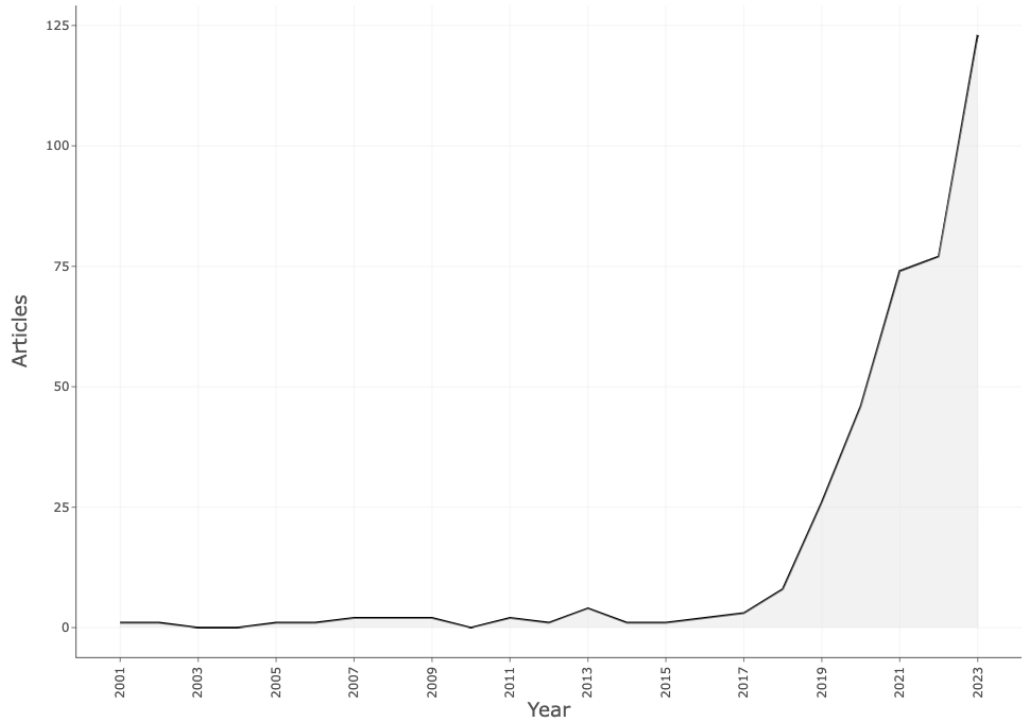
Table 1: Descriptive Statistic

Description	**Results**
Timespan	2001:2023
Sources (Journals and Review)	163
Documents	378
Average citations per documents	26.36
Document Contents	
Keywords Plus (ID)	911
Author's Keywords (DE)	1268
Authors	
Authors	1090
Authors of single-authored docs	38
Authors Collaboration	
Single-authored docs	40
Co-Authors per Doc	3.29
International co-authorships %	23.28
Document Types	
Article	363
Review article	15

ANNUAL PRODUCTION

Based on the information provided in Figure 1, there has been a substantial rise in the number of research publications related to chatbots. The data reveals a remarkable surge in publications from 2019 to 2023, with the highest number of documents, 123 in total, being published in 2023. This is followed by 77 publications in 2022 and 74 in 2021. The annual growth rate of publications between 2001 and 2023 is calculated to be 24.45%. These findings clearly indicate a growing research interest in chatbots.

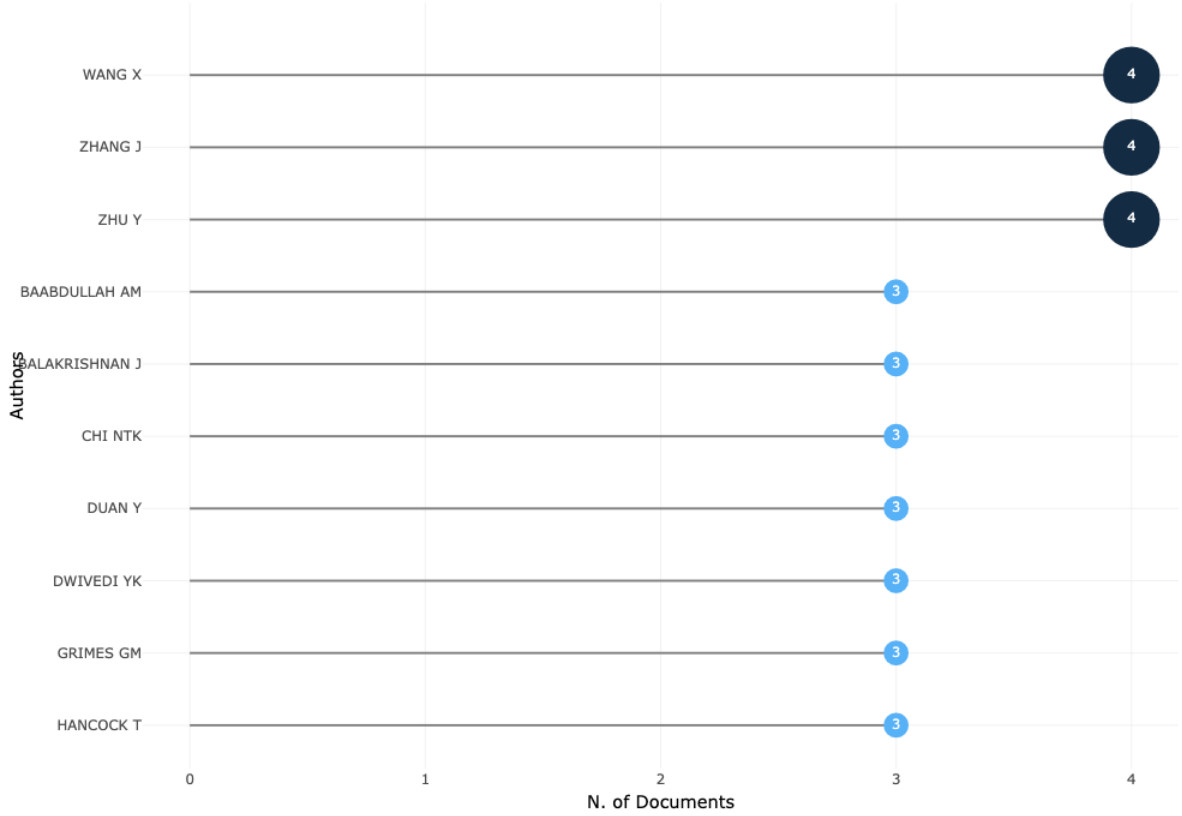
Figure 1: Annual Production



AUTHORS

The most influential authors in the field of chatbot research are those who have contributed the most publications to the study. Figure 2 represents that Wang X, Zhang J, and Zhu Y are considered the most relevant authors, having published 4 papers on chatbots. They are closely followed by Baabdullah AM, Balakrishnan J, Chi NTK, Duan Y, Dwivedi YK, Grimes GM, and Hancock T, who have each published three papers. A common characteristic among these authors is that the majority of their articles were published between 2019 and 2021. Their research primarily focuses on chatbots, conversational agents, and virtual assistants in the domains of business, management, and accounting. According to chatbot research, 51% of chatbots can be accessed through separate applications, and it is predicted that by 2022, there will be a global access to 3.5 billion chatbots.

Figure 2: AUTHORS



AUTHORS IMPACT

The h-index and g-index are measures that assess an author's productivity and impact by considering their publication count and the number of citations their work has received. Table 2 provides additional information about the top authors, including their publication count, h-index, and g-index. Among these authors, Duan Y stands out for having the highest publication count and impressive h-index and g-index scores. Duan Y's specialization lies in language learning using chatbots, indicating a specific research focus within the broader field of chatbots and artificial intelligence. The high citation scores associated with Duan Y's work highlight the significant impact and influence of their research. It is worth noting that there is a substantial difference in total citations between the authors ranked at positions 1 and 2, suggesting that Grimes GM and Schuetzler RM have received significantly more citations than Duan Y, further emphasizing the impact of their work. Overall, these top authors have made notable contributions to the field in terms of their publication records, citation scores, and influence.

Table 2: Authors Impact

Element	h_index	g_index	TC	NP	PY_start
DUAN Y	3	3	243	3	2022
GRIMES GM	3	3	176	3	2018
KUMAR S	3	3	85	3	2022
LI Y	3	3	33	3	2022
PIZZI G	3	3	174	3	2020
RAJAOBELINA L	3	3	70	3	2021
RICARD L	3	3	70	3	2021
SCHUETZLER RM	3	3	176	3	2018
SONG M	3	3	28	3	2022
STIEGLITZ S	3	3	74	3	2021

JOURNAL IMPACT

The journal impact of chatbot research the “JOURNAL OF BUSINESS RESEARCH" has an h-index of 11, a g-index of 19, total citations of 987, a number of publications of 19, and was published in 2020. "JOURNAL OF RETAILING AND CONSUMER SERVICES" has an h-index of 10, a g-index of 18, a total citation of 482, a number of publications of 18, and was published in 2015. "KNOWLEDGE-BASED SYSTEMS" has an h-index of 10, a g-index of 15, total citations of 494, a number of publications of 15, and was published in 2001.

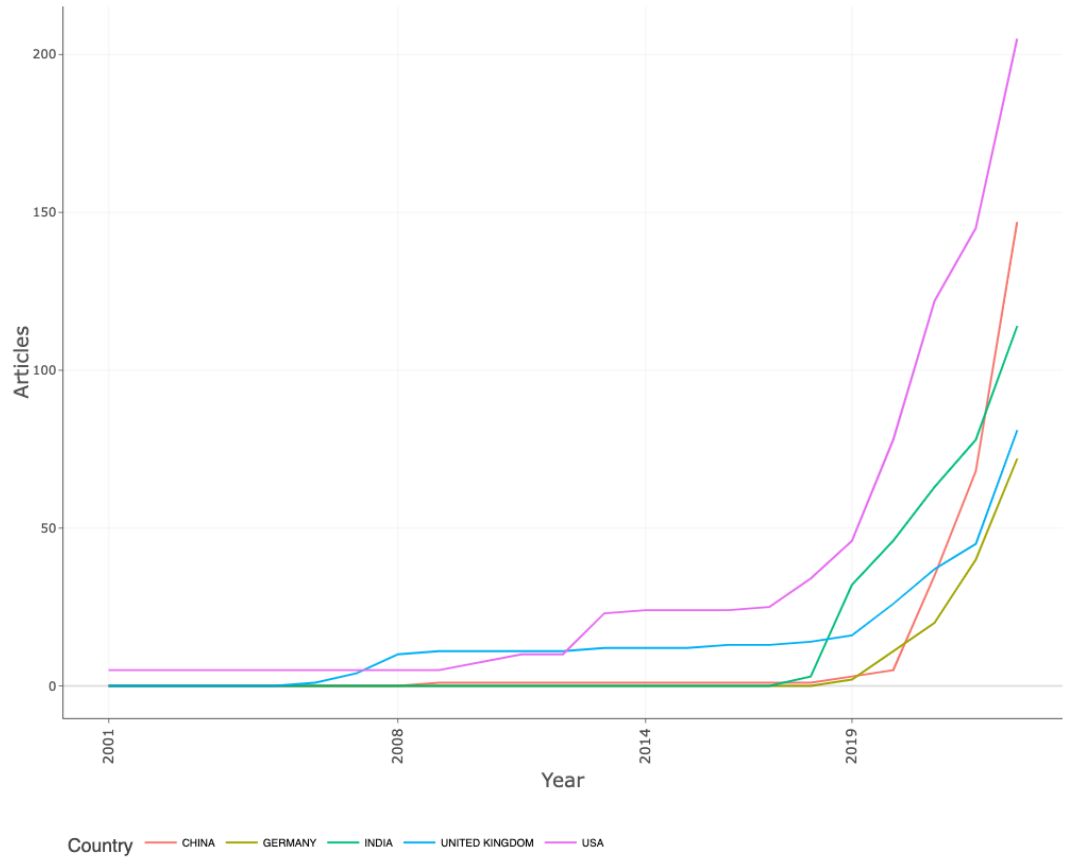
Table 3: Journal Impact

Element	h_index	g_index	TC	NP	PY_start
Journal of business research	11	19	987	19	2020
Journal of retailing and consumer services	10	18	482	18	2015
Knowledge-based systems	10	15	494	15	2001
Acm transactions on information systems	9	11	267	11	2020
Journal of service management	8	11	883	11	2018
Psychology and marketing	8	16	342	16	2021
Electronic markets	7	11	411	11	2020
International journal of information management	5	5	313	5	2021
Technology in society	5	6	261	6	2020
Electronic commerce research and applications	4	6	80	6	2021

MOST PRODUCTION COUNTRY

According to Figure 3, there are notable disparities in chatbot research contributions among different countries. The United States and China stand out with a frequency of 205 and 147 respectively, while developing countries like India have a frequency of 114. These numbers likely reflect the level of chatbot adoption or usage in each country. Interestingly, the United Kingdom leads in chatbot adoption, while the Asia-Pacific region is experiencing rapid growth in the chatbot market. Consequently, it can be inferred that countries with higher chatbot adoption rates tend to have a greater number of research publications on the subject.

Figure 3: **Most Production Country**



MOST CITED DOCUMENT

To summarize, Table 4 presents the top 10 most referenced documents and their respective citation counts in the field of chatbot research. Citation analysis utilizes the number of citations received by a publication to gauge its impact, making it a crucial method in mapping scientific knowledge. This approach assumes that citations reflect intellectual connections between articles (Appio *et al.*, 2014). The document with the highest number of citations is (Bolton *et al.*, 2018), which has been cited globally 391 times. In this study, the authors explore the challenges that digital customer experiences face. The second most cited article is (Luo *et al.*, 2019) with 372 citations, focusing on the influence of chatbots on consumer purchasing behavior. The total citation count serves as an indicator of the research work's usefulness, impact, and influence. These highly cited works demonstrate a significant level of originality or distinctiveness, leading to their extensive citation rates.

Table 4: Most Cited Document

Paper	Total Citations	TC per Year	Normalized TC
BOLTON RN, 2018, J SERV MANAGE	391	65.17	4.85
LUO X, 2019, MARK SCI	372	74.40	8.57
CHUNG M, 2020, J BUS RES	351	87.75	5.69
HOYER WD, 2020, J INTERACT MARK	277	69.25	4.49
ADAM M, 2021, ELECTRON MARK	246	82.00	7.41
PUNTONI S, 2021, J MARK	227	75.67	6.83
DWIVEDI YK, 2023, INT J INF MANAGE	224	224.00	41.18
PILLAI R, 2020, INT J CONTEMP HOSP MANAGE	202	50.50	3.27
KASILINGAM DL, 2020, TECHNOL SOC	201	50.25	3.26
SHEEHAN B, 2020, J BUS RES	200	50.00	3.24

Author keywords

By analysing the author keywords, valuable insights about the research on "chatbots" can be obtained. The word cloud visually represents the most commonly occurring keywords in the dataset. Among the top 10 keywords, their frequencies range from 127 to 15. The term "chatbot" appears most frequently with a frequency of 127, followed by "artificial intelligence" with a frequency of 97. Figure 4 presents a word cloud that illustrates the frequently used author keywords, where the size of each word corresponds to its frequency of occurrence.

Figure 4: Author keywords

CO-OCCURRENCE ANALYSIS

Figure 5 presents a visual representation of the co-occurrence network of author keywords, showcasing the structure of the research and the relationships between the most commonly used terms in the articles. The network is divided into six clusters, each distinguished by a different colour. The size of each node in the network corresponds to the frequency of the respective keyword, while the lines connecting the terms indicate their associations. The first cluster (blue) encompasses terms related to Artificial Intelligence, while the second cluster (red) focuses on keywords associated with Chatbots. The third cluster (green) includes keywords related to Service, such as loyalty, satisfaction, and service quality. The fourth cluster (orange) is centred around keywords related to virtual assistants and voice assistants. The fifth cluster (purple) pertains to keywords related to e-commerce and privacy concerns. Lastly, the sixth cluster (brown) consists of keywords related to competencies. The co-occurrence analysis reveals that terms appearing together frequently share thematic connections. This information can be valuable for future research, as it highlights the established link between chatbots and various theories of technology adoption

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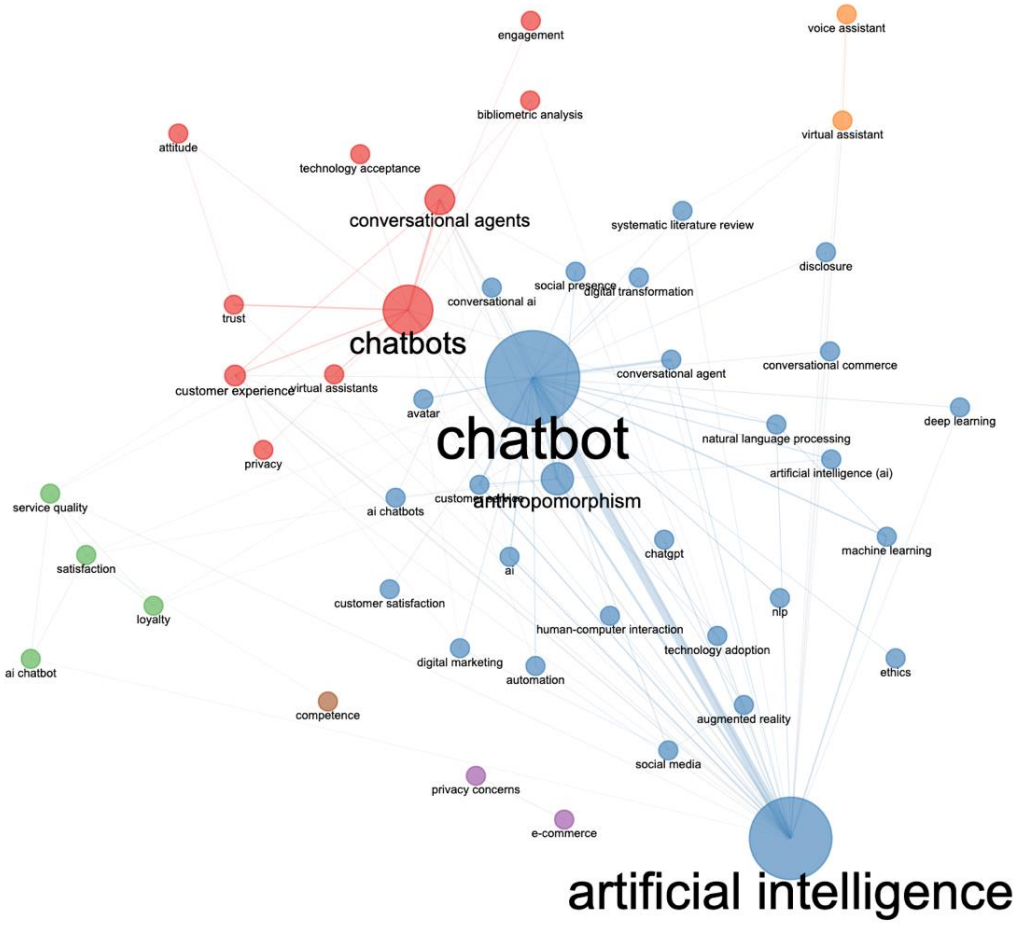
Figure 5: Co-occurrence analysis

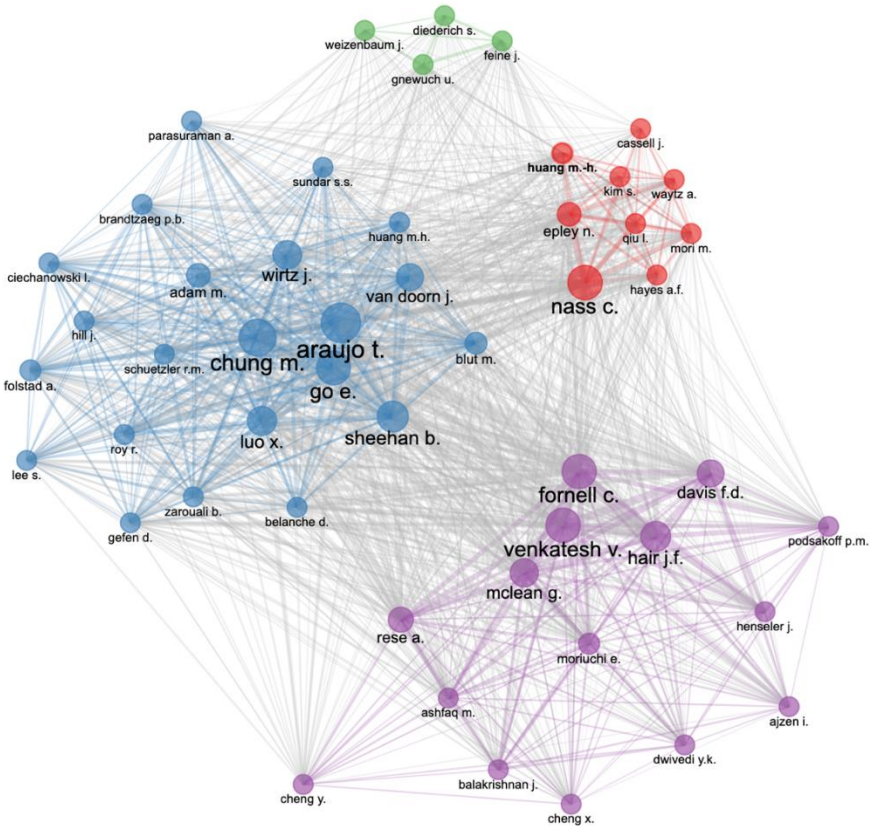


CO-CITATION ANALYSIS

Co-citation analysis is employed to establish the interconnections between existing research papers based on authors and cited materials (Small, 1999). The concept of co-citation analysis was developed by (Small, 1980), which examines the frequency and connections of citations between two papers. When two papers are cited together by another paper, it indicates a co-citation relationship. The strength of co-citation increases as papers are frequently cited together, suggesting a semantic connection between them.

In our study, we screened 378 articles related to chatbots, setting a minimum requirement of 20 citations, resulting in a selection of 47 articles as shown in Figure 6. As a general rule, closely linked journals should be positioned near each other in the co-citation figure generated by the VOS viewer. Based on the current status of four clusters determined through co-citation analysis, we observed that chatbot-related works published in different journals often cite related papers, indicating close relationships among these papers. Cluster 1 (Blue) the Araujo T, Chung M, Go E and Luo X articles emerge as highly cited articles in this field. Cluster 2 (Purple) Venkatesh Y and Fornel C articles are highly cited, Cluster 3 (Red) Nass C article is highly cited and Cluster 4 Weizanbaum J, Feine J, Gnewuch U and Diederich S articles are highly cited. Generally, articles that are in close proximity to the co-citation figure exhibit a higher degree of relatedness, and the lines connecting them signify stronger co-citation relationships. The papers within each cluster display a strong relationship through relevant co-citations, emphasizing the significance of papers published in various issues of the Chatbot domain.

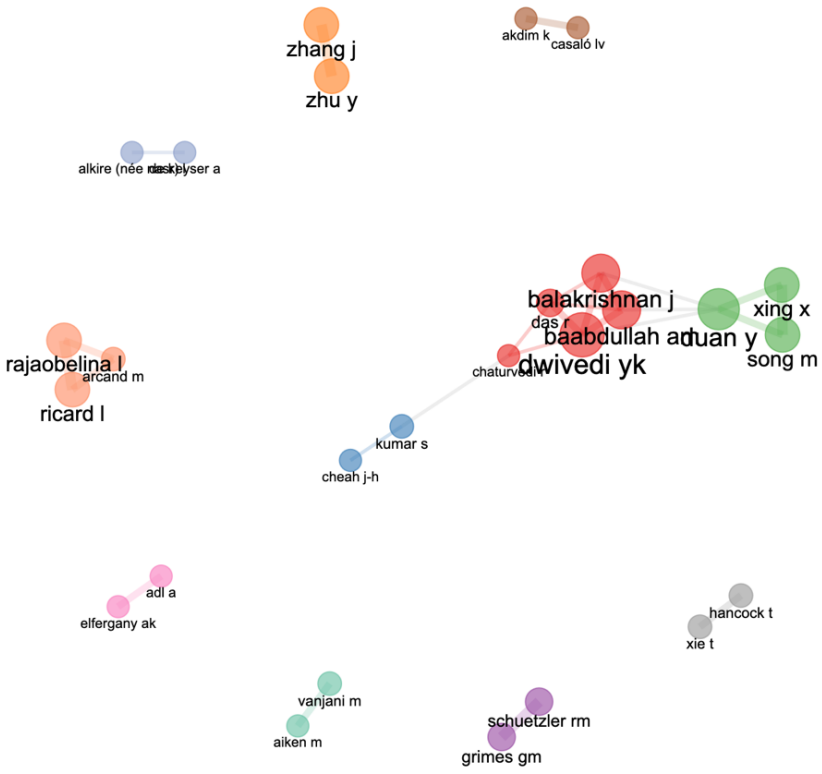
Figure 6: Co-citation analysis



AUTHOR COLLABORATION

Mutual cooperation plays a significant role in facilitating the rapid advancement of a research topic (Wang, C., Wu, R., Deng, L., Chen, Y., Li, Y. and Wan, 2020). Figure 11 illustrates the collaborative working relationships among the authors. The thickness of the lines in the graph represents the strength of collaboration between authors. Based on the visual representation, Dwivedi YK emerges as the most collaborative author in the field of Chatbot, having established the highest number of partnerships, notably with Balakrishnan J and Baabullah A. Duan Y, as indicated by the thickness of the line, ranks second in terms of collaboration, primarily collaborating with Song M and Xing X. Other contributors to the research include Balakrishnan J and Dwivedi YK.

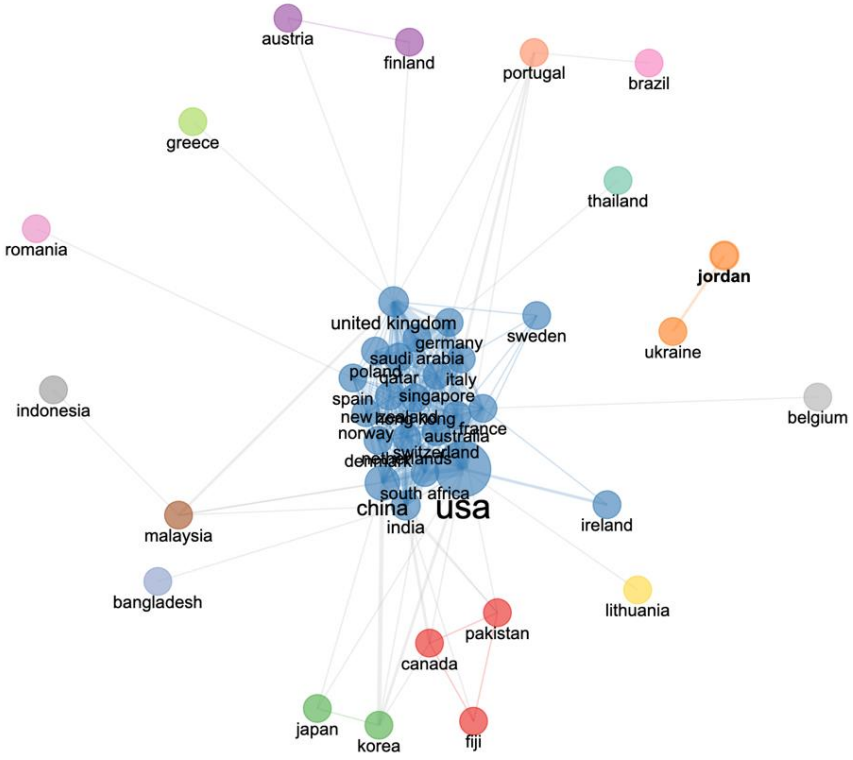
Figure 7: **AUTHOR COLLABORATION**



COUNTRY COLLABORATION

The country collaboration map presents an overview of the collaborative relationships among top countries engaged in Chatbot research. (Figure 12) Notably, the United States has emerged as the primary collaborator, engaging in partnerships with China, the United Kingdom, India, France, Germany, Spain, Malaysia, Portugal, Sweden, South Africa and Italy. It is worth mentioning that both the United States and the United Kingdom stand out as countries engaging in collaborations with at least five other countries.

Figure 8: Country Collaboration



CONCLUSION AND DIRECTION FOR FUTURE RESEARCH

In recent years, there has been a significant increase in the popularity of chatbot research. This study provides an overview of published articles on chatbots, analyzing a total of 378 papers. The analysis reveals that there is limited collaboration between authors and nations, highlighting the need for greater collaboration in future chatbot research. Additionally, the impact of authors seems to be limited, as there are relatively few articles specifically focused on chatbots. However, articles authored by Duan Y have gained prominence. Authors based in the United States have made substantial contributions to chatbot research and have received the highest number of citations (391 citations). On the other hand, the number of chatbot-related articles published in Europe is relatively low.

Since 2018, there has been a growing trend in the number of articles focused on chatbots. Service organizations have increasingly adopted chatbots to enhance customer experience in marketing. Existing research suggests that chatbots contribute to improved customer experience and trust, leading to greater chatbot adoption. Notably, when chatbots have human-like appearances and engage in human-like conversations, the interactions become more natural, resulting in enhanced customer experiences. However, there is still a lack of research on customer experience, customer service, anthropomorphism, trust, and customer satisfaction in the context of chatbots.

The study reveals a growing interest in chatbots, conversational agents, and virtual assistants in the fields of business, management, and accounting. The research landscape in these areas has expanded significantly in recent years, indicating the increasing importance of these technologies in various organizational contexts.

The paper identifies the dominant research themes and topics within this domain, including chatbot design and development, their impact on customer experience and satisfaction, their role in knowledge management and decision-making processes, and their potential for automation and cost reduction in business operations.

As chatbots become more prevalent in business and organizational settings, it is crucial to address ethical concerns related to privacy, data security, and transparency. Future research could delve into these ethical dimensions and propose guidelines and frameworks for responsible chatbot deployment. Understanding the dynamics of human-chatbot interaction is another important area for future research. This includes investigating how users perceive and interact with chatbots, exploring the factors that influence user acceptance and adoption, and identifying strategies to enhance user engagement and satisfaction.

While the paper primarily focuses on business, management, and accounting, there is potential for exploring chatbot applications in other industries such as healthcare, education, and finance. Future research could investigate the unique challenges and opportunities of deploying chatbots in these domains. It is also essential to assess the long-term impact of chatbot technology on organizations, employees, and society as a whole. Future research could explore the implications of widespread chatbot adoption, including changes in job roles, organizational structures, and customer relationships.

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