International Journal of Robotics and Control Systems
Vol. 3, No. 4, 2023, pp. 955-1006
ISSN 2775-2658
http://pubs2.ascee.org/index.php/ijrcs

Evolving Conversations: A Review of Chatbots and Implications in Natural Language Processing for Cultural Heritage Ecosystems

Tri Lathif Mardi Suryanto [a,1,*], Aji Prasetya Wibawa [a,2], Hariyono [b,3], Andrew Nafalski [c,4]

[a] Electrical and Informatics Engineering Department, University of State Malang, Jl. Semarang 5, Malang, East Java 65145, Indonesia
[b] Faculty of Social Science, University of State Malang, Jl. Semarang 5, Malang, East Java 65145, Indonesia
[c] UniSA Education Futures, School of Engineering, University of South Australia SCT2-39 Mawson Lakes Campus, Adelaide, South Australia 5095, Australia
[1] trilathif.si@upnjatim.ac.id; [2] aji.prasetya.ft@um.ac.id; [3] hariyono.fis@um.ac.id; [4] andrew.nafalski@unisa.edu.au

ARTICLE INFO

Article history
Received October 02, 2023
Revised November 07, 2023
Accepted December 05, 2023

Keywords
Domain Chatbot;
Rule-based Chatbot;
Generative AI Chatbots;
NLP;
Culture Heritage

ABSTRACT

Chatbot technology, a rapidly growing field, uses Natural Language Processing (NLP) methodologies to create conversational AI bots. Contextual understanding is essential for chatbots to provide meaningful interactions. Still, to date chatbots often struggle to accurately interpret user input due to the complexity of natural language and diverse fields, hence the need for a Systematic Literature Review (SLR) to investigate the motivation behind the creation of chatbots, their development procedures and methods, notable achievements, challenges and emerging trends. Through the application of the PRISMA method, this paper contributes to revealing the rapid and dynamic progress in chatbot technology with NLP learning models, enabling sophisticated and human-like interactions on the trends observed in chatbots over the past decade. The results, from various fields such as healthcare, organization and business, virtual personalities, to education, do not rule out the possibility of being developed in other fields such as chatbots for cultural preservation while suggesting the need for supervision in the aspects of language comprehension bias and ethics of chatbot users. In the end, the insights gained from SLR have the potential to contribute significantly to the advancement of chatbots on NLP as a comprehensive field.

1. Introduction

Specialized conversational agents, also known as domain-specific chatbots, signify a significant advancement in the field of artificial intelligence. These exceptional robots are intricately designed to excel in their specific domains, guaranteeing an unparalleled level of knowledge and proficiency. In many domains such as healthcare and finance, these entities are prepared to provide information, help, or services with exceptional clarity, unparalleled relevance, and steadfast correctness.

The development of chatbots has undergone a significant transformation, driven by the goal of improving user pleasure and effectiveness, learning models like as T5, BERT, GPT, and XLNet have emerged as prominent examples of innovative advancements in the field. Through the utilization of

these sophisticated models, developers have initiated a pursuit to enhance the intelligence of chatbots, rendering them more perceptive and proficient in comprehending and addressing consumer inquiries and requirements.

The advancement of domain chatbots has led to the emergence of several obstacles and possibilities. The identification of these challenges and opportunities has become an essential component of the current context. By identifying the specific challenges and devising novel remedies, we may enhance the sophistication of these conversational agents, rendering them useful instruments in several industries, eventually transforming the manner in which humans engage with technological advancements.

Here are some of the major domains where domain-specific chatbots have found valuable applications. One of the main reasons for creating chatbots is to support organizations and businesses, in this case customer service [1] chatbots commonly used in industries such as e-commerce, telecommunications, and banking. They help customers by answering questions with chatbot helpdesk [2], service quality [3], service answer [4], solving problems [5], and providing support services [6]. They can handle tasks such as tracking orders, resetting passwords, and answering frequently asked questions.

Chatbots have become indispensable tools in providing customer service, enhancing customer interactions and optimizing operational processes. They handle various tasks, such as addressing inquiries, providing accurate responses, and managing complex tasks like order tracking. These chatbots are now the equivalents of concierges, leveraging digital technologies to enhance client satisfaction and free up human resources for more strategic endeavors. Besides being used in services, chatbots are also used in the health domain [8] and digital service healthcare [9].

Chatbots are used as healthcare support [10] improve patient outcomes in all stages of diagnosis, treatment, drug development and monitoring via conversational agents in healthcare [11], drug prescription [12], medical accessibility [13]. Conversational agents are revolutionizing medical practices by providing personalized care and information. They assist in diagnosis, treatment, drug development, and monitoring, empowering patients with a sense of control and care. These agents also facilitate prescription processes, ensuring patients receive the right medications at the right time. They also enhance medical accessibility, making healthcare information and support accessible to a wider audience. This transformative shift in healthcare management promises more patient-centric and efficient services.

Furthermore, the incorporation of chatbots in education has been another remarkable outcome of the digital transformation, especially during the COVID-19 pandemic era. These intelligent bots have played a pivotal role in revolutionizing the way students and educators interact with educational content and institutions. They can help answer student questions, deliver subject matter, and provide personalized learning recommendations [14]. Chatbots are revolutionizing education by bridging the digital divide, fostering inclusivity and adaptive learning environments, and their impact extends beyond the pandemic era.

In addition, chatbots are also involved in business domains such as e-commerce [15] that help integrate users to perform transactional activities, for example finding products, providing travel and lodging recommendations [16], determining the choice of viewing preferences [17] and helping to direct the payment process. Even in the scope of government, chatbots are used as government services [18], government chatbots can provide information to citizens regarding public services, answer questions about government programmes, and assist in submitting forms or applications.

The research gap in this paper lies in the need for a more comprehensive exploration of the specific challenges and opportunities that arise with the development and deployment of domain-specific chatbots, for example cultural heritage ecosystems. This paper provides an overview of chatbot applications in various domains, providing additional aspects of technology that are often used to improve chatbots.

Chatbots are revolutionizing various fields, including education, busssines, health, and goverment. This technology offers natural interaction and anthropomorphic capabilities. However, challenges such as language understanding, real-time processing, and ethical considerations remain. Responsible and ethical chatbot development is essential. Hence it is important to provide observations, analyses, and explanations of opportunities and challenges to chatbot technology.

The study focuses on significant areas within the rapidly evolving realm of chatbot technology, highlighting the crucial role of optimization in enhancing user experience and satisfaction. It emphasizes the need for cross-cultural research to develop culturally sensitive and adaptive chatbots. The study also highlights the importance of evaluating the impact of chatbots in various industries, such as healthcare, education, and customer service. It emphasizes the need for thorough rules and best practices for chatbot design and deployment, encompassing ethical issues, data privacy, and effective conversational design. The study result is used to highlights the potential of chatbots in cultural heritage ecosystems.

Therefore, we defined the scope for the collection, review and discussion of the surveyed papers as well as our research agenda during the idealization phase by answering the following research questions:

- RQ1: Why the chatbots are built on for all domain?
- RQ2: How the methods chatbots are built?
- RQ3: what's the outcome and challenge?

The rationale for conducting a systematic literature review (SLR) on chatbots is rooted in the need to comprehensively assess and synthesize the existing body of knowledge in this rapidly evolving field. Several compelling reasons support the undertaking of such a review:

1. Chatbots have experienced enormous growth and innovation over the years, so it is crucial to keep up with the most recent advancements. Modern applications, trends, and technology are easier to document using an SLR.
2. Chatbots have a multidisciplinary nature and are used in a variety of fields, including technology, healthcare, education, and customer service. A comprehensive knowledge of their impact across different areas is made possible by an SLR.
3. Identification of Research Gaps: By doing a thorough assessment of the current literature, it is feasible to pinpoint unresearched areas and questions as well as identify research gaps.

Overall, in this study program, we conducted an analysis of the objectives behind the development of chatbots by academics. On the basis of the overview research, we also looked into the typical difficulties they encountered. In addition, we conducted an examination of several approaches aimed at enabling the chatbot to acquire new knowledge. The chatbot or dialogue system's construction and training using machine learning models and methodologies is the final crucial issue that needs to be addressed and discussed.

The research contributions contributed by this paper are unique insights, findings, and advancements on domains that have the potential to be developed and researched in depth in the future utilization of chatbots such as cultural heritage that comes through the elaboration of various domains. Secondly, this paper reveals the rapid and dynamic advancements in chatbot technology utilizing NLP learning models through the utilization of Transformer machine learning models such as T5, BERT, GPT, and XLNet, which this research has illustrated the possibilities of Transformer machine learning being used to support potential domains.

2. Method

It has become a common approach in chatbot research. These SLRs extend the scope of traditional literature reviews by systematically searching, selecting, and analyzing relevant studies, ensuring a rigorous and transparent process. By adhering to PRISMA guidelines, researchers aim to reduce bias and provide a clear and comprehensive summary of existing research on chatbots and related topics. These reviews often involve a structured search strategy, data extraction, quality assessment, and synthesis of findings from multiple studies, contributing to a deeper understanding of the current state of knowledge in the field.

2.1. Process of Systematic Reviews

Conducting a Systematic Literature Review (SLR) requires a well-defined search strategy to identify relevant studies and literature. Here are the key steps to create shown in Fig. 1.

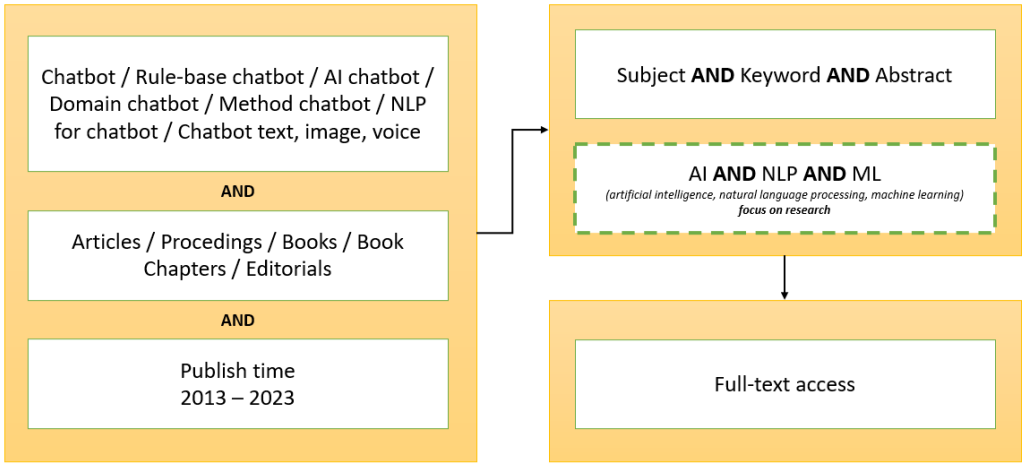


Fig. 1. The paper selection criteria process

The systematic literature review (SLR) employed a meticulous search strategy to ensure comprehensive coverage of relevant studies in the field of chatbots and their applications. Several academic databases and search engines were thoughtfully selected to source authoritative and scholarly materials. Among the commonly utilized databases were ScienceDirect, Springer, IEEE Xplore, Scopus, Web of Science, and Google Scholar. The search queries were strategically constructed by combining pertinent keywords and phrases, such as ("chatbot" OR "Rule-based Chatbot" OR "AI Chatbot") AND ("application chatbot" OR "use case chatbot" OR "domain chatbot") AND ("user experience chatbot" OR "customer service chatbot" OR "chatbot evolution"). This meticulous approach aimed to cast a wide net across the academic landscape, ensuring that the literature review encapsulated a diverse range of studies, insights, and perspectives related to chatbot technology and its multifaceted applications across various domains.

2.2. Literature Search and Selection

Describe the search process, paper searches were conducted through Google Scholar, ScienceDirect, Springer, ACM, and also by using web-based Elicit.org software as an effort to focus the search according to the research topic. Dates of the search start from August to October, 2023. The first stage obtained a total of 145 papers, the second stage received an additional 114 papers, until finally in the third stage an additional 97 papers so that the total papers collected amounted to 356 papers. The screening and selection process is based on the publication year of the last 10 years, with the following numbers shown in Table 1.

Highlighting specific studies that contribute significantly to the understanding of chatbot technology and its applications, e.g. The study explores the use of virtual dialogue chatbots for

enhancing customer service and satisfaction [81]. This study explores the use of chatbots for business purposes. It discusses the potential benefits of chatbots in enhancing customer service, improving customer satisfaction, and serving as alternative touchpoints for businesses [95]. and it also emphasizes the integration of emotion management in chatbots, highlighting how machine learning technologies can improve interaction and overall user experience [137], which could appropriately be examples of key studies.

Table 1. Chatbot in ten Year's

Year	Count	References
2015	6	[19]-[24]
2016	10	[25]-[34]
2017	11	[1], [35]-[44]
2018	27	[45]-[47], [49]-[71]
2019	30	[72]-[79], [6], [80]-[82], [7], [83]-[99]
2020	47	[13]-[15], [100]-[122], [113], [123]-[141], [309]-[310]
2021	40	[5], [142]-[166], [8], [167]-[169], [16], [170]-[177], [307]
2022	69	[2]-[4], [9], [12], [17], [178]-[238], [311]
2023	71	[11], [10], [18], [239]-[306]

In this case study, we have made a deliberate effort to introduce novelty to the existing literature review by incorporating references primarily from the years 2022 and 2023. This strategic decision was prompted by the shifting societal and research landscape following the unprecedented COVID-19 pandemic. The global outbreak of the pandemic significantly altered human behaviors, including research and information-seeking habits. As a result, there has been an accelerated pace of innovation, adaptation, and transformation in various domains. To capture these recent developments, we have drawn upon the most up-to-date sources available, enabling us to offer a comprehensive and timely perspective on the subject matter. This approach ensures that our case study reflects the rapidly evolving nature of chatbot technology and its diverse applications in a post-pandemic world, providing valuable insights and fresh perspectives for researchers and practitioners alike. Reference Presentation shown in Fig. 2.

Ranging from 2015 papers to 2023 papers, the last set includes studies with cleaning processes resulting in 311 papers processed as SLRs. A total of 45 publications were excluded from the study due to their lack of alignment with the research objectives. Specifically, these papers were found to be deficient in addressing the topic of chatbots, without sufficient and reliable references, focusing solely on theoretical aspects of artificial intelligence, and exhibiting a limited number of pages that were deemed to be of questionable quality.

In the process of preparing this SLR with PRISMA, 311 papers from reputable journals and international journals have been produced. These papers have been an invaluable resource in recognizing, analyzing, and presenting relevant knowledge related to the research topic. They reflect the diverse viewpoints and current research in the field, and have provided a solid framework for assessing the evidence. By integrating information from these quality sources, this SLR can provide a deeper understanding of the issues being researched and can provide a solid foundation for holistically compiling relevant findings.

2.3. Common Research Approaches

SLRs involve systematic searches, selection, and analysis of relevant studies, reducing bias and providing a comprehensive overview of existing research. Comprehensive Literature Reviews: Some studies focus on conducting comprehensive literature reviews. These reviews aim to summarize and synthesize existing research on chatbots and related topics. They provide a broad perspective on the current state of knowledge in the field. Both research approaches are essential for consolidating and

summarizing the vast information on chatbots. They help researchers and practitioners stay up-to-date with the latest developments and better understand the subject matter. Additionally, these approaches ensure the quality and reliability of research findings in the chatbot domain. A brief roadmap on evolving chatbot shown in Fig. 3.

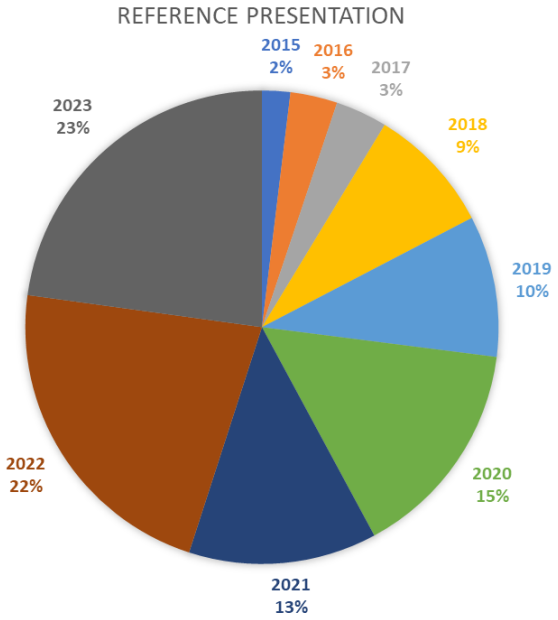


Fig. 2. Reference presentation

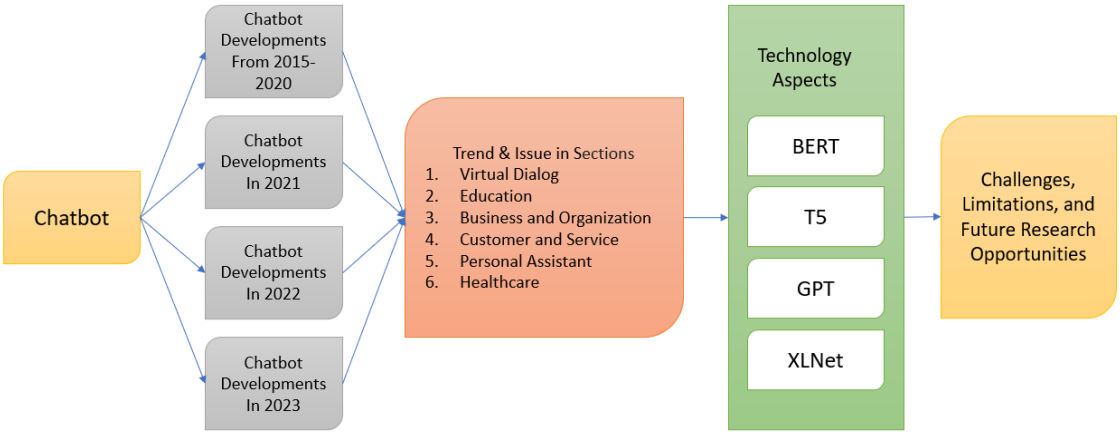


Fig. 3. A brief roadmap on evolving chatbot

The systematic literature review (SLR) is a valuable tool for identifying research gaps and providing a comprehensive overview of existing research. This method helps researchers identify areas where research is lacking or insufficient, thereby identifying research gaps. These gaps can arise from various factors, such as emerging technologies, evolving trends, or unanswered questions in the literature. By identifying these gaps, researchers can determine areas that require further exploration and contribute to the advancement of knowledge in the field. Additionally, an SLR provides a foundation for future research by synthesizing and summarizing existing literature, helping researchers understand the existing body of knowledge, identify limitations of previous studies, and propose new research directions. This can lead to the development of new theories, methodologies, or approaches that address the identified research gaps, contributing to the growth of knowledge.

2.4. Assessment of Research

Assessment of the quality and reliability of research is crucial in the field of chatbot studies. In this dynamic field, where technological advancements and applications are constantly evolving, ensuring the trustworthiness of research findings is crucial. Researchers typically employ a rigorous methodological approach. Methodological rigor includes a systematic search process, clear inclusion and exclusion criteria, and transparent data extraction and analysis methods. Peer review, which is an integral part of scientific publishing, serves as a critical checkpoint to evaluate the quality of research. Publications in high-impact journals and conferences often undergo a rigorous peer review process, which contributes to their credibility.

A synthesis method, was employed to amalgamate the findings across multiple studies, thus contributing significantly to the comprehension of the subject matter. This process serves as the cornerstone of a well-structured SLR, empowering researchers to meticulously condense, unify, and scrutinize the data gleaned from relevant studies. Our specific approach involved the meticulous categorization of keywords, domains, and publication years.

This systematic organization not only aids in streamlining the synthesis process but also facilitates the extraction of key insights and patterns from the diverse body of research. By sorting and classifying this information, we aimed to provide a comprehensive and structured overview of the existing literature, thus enhancing our collective understanding of the subject.

3. Results and Discussion

3.1. Themes and Findings

Overview of the main themes or categories identified, the organizing information into subsections based on different thematic areas related to chatbots in various domains is a highly effective approach can be seen in Fig. 4.

Upon analyzing the citation patterns within the domain of chatbots and their advancement, it becomes apparent that a significant proportion, specifically 55%, of the references originate from scientific publications. Conference proceedings, which are often comprised of papers and speeches from academic conferences, provide around 35% of the reference sources. In contrast, it is noteworthy that books, although constituting a lesser proportion, nonetheless hold considerable importance, accounting for around 6% of the cited sources. The inclusion of a wide array of reference materials in this study demonstrates the extensive and interdisciplinary character of research in the chatbot field. These sources encompass scholarly journals, conference proceedings, and reputable books, providing valuable insights and backing for the progress made in this area.

Developing chatbots across diverse domains is a multifaceted endeavor riddled with intricate challenges. From the technical complexities of natural language understanding and speech recognition to the user-centric aspects of personalization and creating positive experiences, chatbot development requires a comprehensive approach. Accommodating multiple languages, ensuring accurate speech recognition, protecting user data, and generating contextually relevant responses all contribute to the complexity. Additionally, issues like system scalability, real-time processing, ethical considerations, and feedback integration pose significant hurdles. The pursuit of chatbot excellence demands a fusion of technical prowess, user-centered design, and meticulous attention to regulatory and ethical guidelines, all aimed at delivering seamless and valuable conversational experiences.

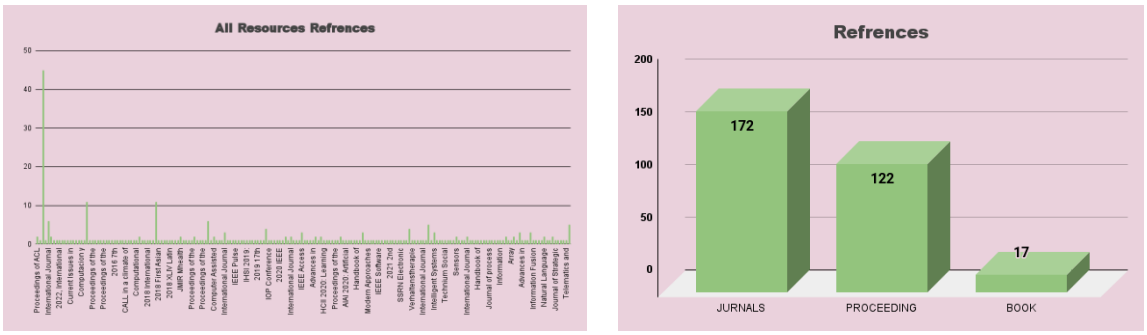
3.2. Chatbot Applications Trends in Ten Years

Bots have evolved from live responders to complex entities that can provide individualized and predefined responses. However, the emergence of software bots and robots with supervised, adaptive, and intelligent algorithms is a sign of the future. This work focuses mainly on intelligent

software, which efficiently receives inputs and performs vital operations, such as pre-processing and analyzing raw data. We will share the findings of chatbot development ten years ago.

3.2.1. Various Chatbot Application Developments in up to 2020th

The realm of chatbot applications is a dynamic and multifaceted landscape, encompassing a wide range of innovative uses and transformative capabilities. Chatbot technology has experienced considerable expansion and diversification across numerous industries. These adaptable software agents have improved a number of industries, including customer service, healthcare, and education. Researchers have looked into their potential as instruments for business operations streamlining, mental health support, and language learning aids. Chatbots have proven useful and adaptable by being used in a variety of settings, including consumer interaction initiatives, cultural heritage areas, and even job search procedures. As such, chatbots have evolved into an essential element in contemporary technology, finding use cases in areas such as science, education, healthcare, and e-commerce can be seen in Table 2.



(a) (b)

Fig. 4. Reference distribution diagram (a). overall reference distribution, (b). number of references per source

Table 2. Evolving chatbot in up to 2020th

Year	Topic and Domain	References
2015	A based chatbot to answer FAQ	[19]
	Chatterbot system for sensing and releasing adolescents' stress	[20]
	A design of a chatbot with avatar and voice interaction	[24]
2016	Leveraging chatbots to improve self-guided learning	[25]
	Chatbot for dialogue system	[26]
	Chatbot as virtual human and ads teens	[27]
	Virtual agent to prevent major depression	[28]
	Chatbot in ecommerce systems, businesses, and organizations	[30]
	Chatbot using a knowledge in database	[34]
	"Botplication" a bot interface paradigm	[35]
	Chatbots for troubleshooting: a survey	[37]
	Cloud-based chatbots technologies	[38]
	Chatbot for a dialogue-based computer-assisted second language learning	[39]
	Chatbot design: free will and Turing test with multiple agents	[41]
2017	Chatbot for university related FAQs	[42]
	Chat bot with iterative content exploration	[44]
	Chatbot for student supervision in a pre-registration process	[46]
	Messenger chatbot	[47]
	Chatbot: an automated conversation system for the educational domain	[50]
	Arabic chatbots	[51]
	Interactive virtual assistant for smart urbanism	[53]
	Chatbot for consumer satisfaction	[56]
	Chatbot in educational domain	[57]
	Chatbot for the regional museum	[58]
	Conversational agents in healthcare	[59]
	Chatbot for a customer engagement program	[60]
	Chatbot for digital mental well-being	[62]

Year	Topic and Domain	References
2018	Chatbot for virtual customer service	[6]
	Chabot for supporting primary health care systems	[14]
	Chatbots across diverse domains, each catering to unique and significant needs	[63]
	Human-chatbot interaction using python	[64]
	Ever evolving landscape of technological applications chatbots	[65]
	Built a chatbot dedicated to English learners	[66]
	Developed a system to provide support to university students on some courses	[67]
	Chatbot for communication	[69]
	Using chatbots for mental health	[72]
	Chatbot for messaging	[73]
	Customer service chatbot	[77]
	Chatbots are applied in fields like medical, e-commerce, business	[78]
	Chatbot in industrial revolution	[80]
2019	Chatbot for e-commerce to address selection products	[15]
	On a chatbot providing virtual dialogues	[81]
	Chatbot application on cryptocurrency	[82]
	Health Care Chatbots Are Here to Help	[83]
	Chatbot for virtual medical assistant	[84]
	Using chatbot in trading system	[85]
	Chatbot customer service	[86]
	Chatbot for university resource booking	[87]
	Sentiment analysis towards the development chatbot	[88]
	Chatbot as smart assistants for accompanying human specialists	[89]
	QnA chatbot design	[90]
	Conversational Agents (CAs) are an integral component of business	[91]
	Chatbots as conversational agents in mental health	[93]
	Chatbot for college website	[94]
	Chatbot for business purposes	[95]
	Chatbot for emotions model	[96]
	Chatbot for M-health	[97]
	Chatbots can be involved in the education process	[98]
	User service chatbot for college	[99]
	Chatbot for peer support realization based on mutual care	[100]
	Chatbot is used to automate customer interactions	[101]
	Chatbot for social aware	[102]
	Chatbot as an alternative means to access online information systems	[103]
	Chatbot performance evaluation	[141]
	Chatbot for contextual assistant	[104]
2020	Chatbot for news	[105]
	Chatbot for the educational institute to help and guide the students	[106]
	Chatbot currently being used in various important domains	[107]
	Chatbot-building platform	[108]
	Chat as personal assistants in foreign language learning	[109]
	Chatbot for teens with autism spectrum disorder	[110]
	Chatbot for chatting	[112]
	Chatbots for brand representation	[113]
	Chatbot for university	[114]
	Chatbot application in a 5th grade science course	[115]
	A multimodal low-code chatbot development framework	[117]
	Chatbot for the cultural heritage domain	[118]
	Chatbot in the context of job searching and application processes	[121]
	Chatbot developments in the business world	[122]
	Chatbot FAQ for health care	[124]
	Chatbot useful for teachers, students, and educative assistant personnel	[127]
	Chatbot: A Deep Neural Network Based Human to Machine Conversation	[128]
	Interactive Transport Enquiry with AI Chatbot	[129]
	Chatbots continued to prove their value across diverse domains	[130]
	Chatbots and its techniques using AI: A review	[131]
	Chatbot for customer services	[133]
	Chatbot for orchestrate conversational assistants	[135]
	Chatbots for improving customer service or for streamlining operations and increasing their productivity	[137]

Year	Topic and Domain	References
	Chatbots for conversational web browsing	[138]
	A chatbot for business promotion	[139]

Chatbots have become an indispensable tool in today's digital environment thanks to their capacity to offer automated and rapid responses, improve customer service, and assist with various activities. The role that chatbots play in improving user experience and efficiency in various fields continues to be the focus of research and development as the field of chatbot research and applications expands.

Chatbot technology in 2020s has grown rapidly across industries, improving efficiency and customer service. However, this technology faces limitations such as complex questions, lack of empathy, language barriers, privacy and security concerns, and technical issues. As chatbots continue to evolve, it is imperative to address these challenges to ensure effectiveness, user-friendliness, and ethics across different industries. Overcoming these limitations is critical to the continued growth and success of chatbots.

3.2.2. Various Chatbot Application Developments in up to 2021th

In recent studies conducted in 2021, the utilization and development of chatbots continued to expand across various domains, showcasing their ever-growing relevance and versatility can be seen in Table 3.

Chatbots continue to expand their roles across various sectors, including education, healthcare, and mental health support. They've been integrated into messaging platforms like Telegram and infused with empathy. The synergy between AI and chatbot technology has led to innovative applications like AI-powered health chatbots and COVID-19 tracking.

Chatbot technology's evolution in 2021 has highlighted its versatility across various fields, including education and industry-specific solutions. However, it's crucial to acknowledge its limitations, such as integrating empathy, ensuring data privacy, and addressing user engagement challenges. Additionally, advanced chatbots require substantial resources. Researchers, developers, and organizations must address these limitations and ethical considerations to effectively and ethically utilize chatbots in various applications, revolutionizing human-computer interactions.

3.2.3. Various Chatbot Application Developments in 2022th

In the dynamic landscape of chatbot research and applications in 2022, several notable studies and developments emerged. In 2022, the landscape of chatbot research and development continued to expand, showcasing their diverse and significant applications across various domains can be seen in Table 4.

These studies highlighted the growing role of chatbots in healthcare, customer service, agriculture, education, mental health, and many other sectors. They serve as versatile tools, offering support, information, and assistance to individuals, whether in medical diagnosis, educational guidance, or even enhancing customer experiences. As chatbot technology evolves, it becomes increasingly apparent that they can cater to short-term, medium-term, or long-term goals, making them adaptable for a wide range of user needs and preferences.

Moreover, chatbots are not limited to one particular region or industry; they are becoming integral to global and cross-sectoral initiatives, providing innovative solutions to complex challenges. In an era where artificial intelligence is transforming various aspects of our lives, chatbots continue to play a pivotal role in enhancing human experiences and accessibility to essential services, promising an exciting and dynamic future in the realm of digital interactions.

Chatbot research in 2022 has shown the growing role of chatbots in various sectors, including healthcare, customer service, agriculture, education, and mental health. However, challenges persist, such as data privacy, user adoption, validation, and cross-cultural considerations. Despite these

challenges, chatbots are shaping a promising future in digital interactions. They offer diverse applications, enhance user experiences, and provide accessibility to essential services. Addressing these limitations is crucial for their continued success and ethical utilization in the digital landscape.

Table 3. Evolving chatbot in 2021th

Topic and Domain	References
Machine learning approach for understanding hospitality customer Chatbots in healthcare	[5]
Chatbot for the improvement of conversational skills of Japanese language	[8]
Empathetic chatbots	[142]
Survey of the machine learning (ML) research done against covid-19	[143]
Chatbot for virtual assistant	[144]
Web-based telegram chatbot management system	[145]
Chatbot for any specific domain	[146]
Chatbot for career counselling	[147]
Improving user attention to chatbots	[148]
Utilization of self-diagnosis health chatbots in real-world	[149]
Chatbot for banking	[150]
Chatbot to help users of public services	[151]
Artificial intelligence in tactical human resource management	[153]
Chatbot for learning 5th grade science course	[154]
Choosing a chatbot development tool	[155]
Chatbot on university website	[156]
A platform based on artificial intelligence supporting medics	[157]
Chatbot as futuristic conversational agent for user interaction	[159]
Chatbot for development of information technology telecom	[160]
Chatbot for software engineering teams	[161]
Decisional DNA chatbot	[162]
Chatbot using telegram	[163]
Chatbot for virtual assistant, a minimum viable assistant with rasa	[164]
Teaching AI chatbots	[166]
AI-powered health chatbots	[167]
Chatbot for consumer perspective	[168]
Chatbot development for educational institute	[169]
Artificial intelligence applications for tracking covid-19	[170]
Chatbot for restaurant	[171]
Chatbot for virtual application	[172]
Chatbots for conversational	[173]
Chatbot for troubleshooting queries based on transfer learning	[174]
Mental health chatbot	[175]
Edu-chatbot	[176]
	[177]

3.2.4. Various Chatbot Application Developments in 2023th

In the rapidly advancing landscape of chatbot technology in 2023, a myriad of studies has emerged, highlighting their transformative potential across diverse domains can be seen in Table 5. In the ever-evolving landscape of artificial intelligence (AI) and chatbot technology, 2023 has witnessed a burgeoning array of studies and applications that underscore the transformative potential and ethical considerations surrounding these AI-driven conversational agents. Chatbots have found their footing in e-learning, mental health support, medical diagnostics, academic inquiries, enterprise systems, and various other domains, showcasing their versatility and adaptability in addressing a wide spectrum of user needs.

The year also brought a heightened focus on responsible AI, with studies delving into biases, governance, anthropomorphism, and ethical integrations into education and various applications, emphasizing the importance of ethical AI development. As chatbots evolve, their influence and multifaceted applications across domains are poised to shape the future of human-technology interaction and usher in new possibilities for improved user experiences and services.

In the ever-evolving landscape of artificial intelligence (AI) and chatbot technology, 2023 has witnessed a burgeoning array of studies and applications that underscore the transformative potential and ethical considerations surrounding these AI-driven conversational agents. Chatbots have found their footing in e-learning, mental health support, medical diagnostics, academic inquiries, enterprise systems, and various other domains, showcasing their versatility and adaptability in addressing a wide spectrum of user needs. The year also brought a heightened focus on responsible AI, with studies delving into biases, governance, anthropomorphism, and ethical integrations into education and various applications, emphasizing the importance of ethical AI development. As chatbots evolve, their influence and multifaceted applications across domains are poised to shape the future of human-technology interaction and usher in new possibilities for improved user experiences and services.

Table 4. Evolving chatbot in 2022th

Topic and Domain	References
Chatbot helpdesk design for digital customer service	[2]
Chatbots in customer service: their relevance and impact on service quality	[3]
Implementation of chatbot customer service features	[4]
Healthcare services using dual chatbots as conversational agents	[9]
Chatbot in healthcare	[12]
The role of chatbots in enhancing customer experience	[17]
Chatbot for interview	[178]
Artificial psychologist	[179]
Chatbot symptom-checkers	[182]
Chatbot for medical	[183]
Chatbot for ShopRite shopping mall	[185]
Customer service chatbot	[186]
An effective query response using chatbot	[187]
Overview of chatbot structure	[189]
A privacy-preserving dialogue system	[190]
Chatbot for FAQs	[191]
Virtual assistant in mental healthcare	[192]
Artificial intelligence in the field of employment	[193]
Object recognition and speech generation for visually impaired	[194]
Chatting with AI chatbots applications to improve English communication skill	[195]
Chatbot application for mental healthcare in Bahasa Malaysia	[198]
Chatbot for tourism	[199]
Analysis and applicability of artificial intelligence technologies	[200]
Chatbots as cognitive, educational, advisory & coaching systems	[201]
Chatbot for customer assistance	[202]
Use of emotes in toxic chat on twitch	[203]
Chatbot for mental health	[204]
Using chatbots to teach languages	[206]
Chatbot-delivered depression therapy	[208]
Application of chatbot at a higher education institution	[210]
Chatbots for assisting the teaching and learning process	[211]
Chatbot as an educational support system	[212]
Human–virtual service assistant	[213]
Design taxonomy to characterize user-chatbot relationships	[214]
Chatbot for virtual human that provides socioemotional benefits	[215]
Chatbot for medical applications	[217]
Chatbot for children assistance	[219]
A mental health chatbot	[220]
An intelligent automated infrastructure for hospitals	[221]
Chatbots in marketing	[222]
Developed a chatbot called Tami for smoking cessation then assists patients	[224]
Chatbot for the Brazilian virtual school of government	[225]
Chatbots in healthcare: challenges, technologies and applications	[226]
Chatbot implementation in a steel company in Russia	[227]
Chatbot-mediated learning, it's chatbot use cases in education	[228]
Chatbot for disease diagnosis	[229]
Chatbot application to support smart agriculture in Thailand	[230]

Topic and Domain	References
Management affects this relationship with a focus on psychological contracts	[231]
Chatbot for consulting system	[232]
Chatbot using Microsoft azure's question answering and bot framework	[233]
Conversation chatbot	[234]
Chatbot for education in the republic of Serbia	[235]
Chat match for chatbot evaluation tournament	[237]

Table 5. Evolving chatbot in 2023th

Topic and Domain	References
AI in Healthcare	[10]
Conversational agents in healthcare	[11]
Governing ghostbots	[18]
Cody, a smart conversational chatbot agent, an interactive campus map to direct students within the campus, digital wallet to show all the university IDs, and Academic advisor communication session	[239]
Social Search research studies methodologies exploiting social information to better satisfy user information needs in Online social media	[240]
Chatbot conversational systems & the future generation enterprise systems	[242]
A medical chatbot	[243]
integrate artificial intelligence (AI)-based tools into education	[247]
Chatbot as Support Platform for Smoking Cessation	[253]
chatbot-based mobile mental health apps	[255]
Chatbot prototype for the educational sector is e-learning	[256]
anthropomorphism for chatbot service interfaces	[257]
Chatbots as a conversational agent	[262]
Chatbot for predicting medical specialty	[264]
Chatbot as human-model interaction	[265]
Chatbot for university	[266]
Chatbot to reduce stress and improve quality of life in university students	[270]
Chatbot technologies have evolved into modern information and communication technology applications that perform many virtual tasks, including learning	[275]
Chatbot for college enquiry	[280]
Artificial intelligence for secondary prevention of myocardial infarction	[282]
Chatbot for banking customer	[283]
Describes the different types of biases and emphasizes the importance of responsible AI in firms in order to reduce the risk from AI	[285]
Conversational AI systems like ChatGPT	[287]
Chatbot for university students	[289]
GISSA intelligent chatbot experience	[292]
Research on Human-Technology Interactions revealed that, under certain conditions, people instinctively interact with social robots in ways comparable to Human–Human Interactions	[293]
Chatbot for developing job applications	[295]
A novel approach for mHealth interventions	[298]
ChatGPT for augmentation mammoplasty	[301]

The expeditious progression of chatbot technology in the year 2023 poses a multitude of obstacles, encompassing ethical considerations in its creation, interactions between humans and technology, and adherence to legal frameworks. The emphasis on responsible artificial intelligence necessitates the implementation of ethical governance mechanisms in order to address and reduce biases and discriminatory practices. Specialized chatbots, such as those designed for medical diagnoses, need thorough validation procedures. The sensitivity of healthcare data gives rise to several difficulties in terms of regulation, privacy, and security. The varied applications of chatbots necessitate the use of sophisticated strategies to ensure user acceptability and efficacy. The responsible and ethical advancement necessitates the prioritization of data protection and security, adherence to ethical norms, and the establishment of successful human-machine collaboration.

This section research distinguishes itself by providing a holistic viewpoint on the evolutionary trajectory of chatbots, showcasing their growing and diverse impact across several fields. The present

study examines the development and evolution of chatbots in certain domains, including e-learning, healthcare, business systems, and ethical considerations. More profoundly, these technologies do not replace the role of doctors or healthcare personnel, but rather enrich their role by providing additional support.

3.3. User Experience and Interaction

The use of chatbots in various domains has been the subject of significant research and development. These automated conversational agents have the potential to transform the interaction between humans and machines, offering a wide range of benefits. In this comprehensive compilation of research findings, we explore the diverse applications and implications of chatbots in various fields. Chatbots offer numerous benefits, including enhanced user experience, improved accessibility, and increased efficiency. They can provide quick and efficient responses, 24/7 availability, and tailored recommendations, leading to increased user satisfaction and engagement. However, they also pose potential risks, such as data privacy and security concerns, and the risk of biases embedded in chatbot algorithms.

Ethical alignment is crucial in the development and deployment of chatbots, as it ensures privacy protection, avoids biases, and promotes transparency and user consent. By aligning with these principles, chatbots can build trust, respect user autonomy, and mitigate potential harms. Despite these benefits, potential risks include concerns about data privacy and security, as well as the risk of biases embedded in chatbot algorithms. Addressing these risks through robust privacy measures, bias detection, and mitigation strategies is essential. While chatbots can enhance user experiences, improve accessibility, and increase efficiency, they also pose potential risks, necessitating ethical considerations to ensure user privacy, mitigate biases, and promote transparency and consent. Emotionally-abled chatbots raise significant ethical considerations, such as their potential impact on users and their ethical alignment that we can discuss in each domain.

The following sections describe chatbot for virtual dialog, education, business and organization, customer and service, personal assistance, and healthcare, will be described scientifically. Each section disccusses several issues such as main-present findings, and comparisons with other studies. The final discussion should be mention the impacts of implementation including its sstrengths and limitations.

3.3.1. Chatbot for Virtual Dialog

Virtual conversational chatbots have the capacity to offer information, assistance, and amusement, rendering them suitable for applications in customer support, education, and entertainment. The technology in question possesses the capability to identify and analyze user behavior [27], hence enabling it to deliver content references that are relevant and suitable [28]. Virtual chats have the potential to impact an individual's emotional well-being [62], as they are influenced by the emotional responses generated by the bot [96].

Virtual conversational chatbots possess the capability to respond to inquiries and offer conversational replies to users [118], utilizing only verbal language and choosing actionable communication sequences [112]. Individuals have the ability to engage in both formal and casual conversations with chatbots, as demonstrated by research findings [110]. These chatbots have the capacity to communicate in a reactive manner, responding to user input, as well as in a proactive manner, initiating conversations [162].

Chatbots possess the ability to establish parameters and make choices, enabling seamless interaction with users [173]. Additionally, these chatbots can effortlessly transmit messages in a direct manner [146] and verify inquiries posed by users [265]. Furthermore, chatbots that can replicate user preferences and interpersonal connections will readily garner social approval [240].

Users favor chatbots that mimic real human talks in virtual communication. Chatbots can now process text and read and respond to nonverbal signs in real time. Such qualities deepen discussion

and enhance it. Additionally, chatbots' emotional involvement and believability, especially those that evoke emotions, have become crucial to user happiness. More engaging and empathic conversations result from chatbots that can effectively convey and imitate emotions. Emotionally intelligent chatbots may enlighten and comfort users, improving interactions and leaving a lasting impression.

3.3.2. Chatbot for Education

Many studies have investigated new ways to increase chatbots' knowledge base in education, including the University of Leeds, which developed FAQs [19], designed them efficiently and accurately in text form [46], and helped answer any questions [42], including exam questions [25] via Telegram. By using natural language for education [307], chatbots help lecturers answer frequent queries [308] and save administrative effort [99]. Good chatbot communication management may give academic replies [57], helping students understand topics [66], and provide practice questions with natural language growth [67].

Teaching chatbots enable multitasking and make instructors' work easier and more successful [109], answering university information requests fast and accurately [114] by providing shareable news [105]. Student learning and experimentation with chatbots rose after Covid-19 [155]. This chatbot system gives parents student growth information [170] to improve school-parent relations [157].

Educational chatbots based on learning success criteria [228] can aid with course selection, entrance, study programs, and scientific services [211] using systems [206] and virtual teachers [201]. Educational chatbots let students practice English [195], obtain information online or through information systems [235], and engage with teachers [212]. Chatbots can be included in many languages [266], including English and Greek [289], to help students [256] improve their personality [275] through AI optimization [247] supervised by teachers or lecturers to strengthen institutional communication between stockholders [239].

Successful implementation of educational chatbots has been demonstrated. Chatbots provide interactive language practice and depersonalized feedback in Duolingo [5]. Millions of people have used it to learn languages. Georgia State University chatbots help students with class registration, campus navigation, and academic support [239]. Chatbots enhance education by expanding knowledge transfer across courses. Modern education relies on intelligent conversational agents as learning tools and companions. One of its main goals is the expansion of knowledge. Chatbots provide students with curated learning tools.

This tool helps students learn by providing quick access to additional materials, reference sites, and instructional information. Educational chatbots can help students. They promote curiosity, knowledge, and independent learning with the instructor. Chatbots make education more engaging, accessible, and empowering. Depersonalized learning Chatbots are changing education. however, privacy protocols must be adhered to to ensure confidentiality. Ethics include accessibility, cultural awareness, and learning needs also need to be considered. Educational chatbots are learning companions and explore students' skills, not teaching and replacing classroom teachers.

3.3.3. Chatbot for Business and Organization

Chatbots with high levels of proficiency have the capability to effectively identify and comprehend the intentions of users [104], hence facilitating enterprises [129] in automating and expediting their processes [124]. This phenomenon is used in the retail industry to facilitate the expeditious and efficient execution of operations [83]. By promptly addressing client inquiries [60], it ensures that organizations may develop chatbots [88] endowed with strategic verbal competencies [91] to enhance service provisions.

The utilization of chatbots in developing countries has been observed in the realm of business operations and the enhancement of organizational capabilities [151]. The potential of chatbot applications extends to various contexts, including corporate settings [174], where they facilitate the

acquisition of skills related to the utilization of novel systems by employees [242]. This, in turn, contributes to advancements in domains such as accounting, human resources, sales, procurement, and logistics [200].

In the realm of organizational studies, chatbots play a crucial role in assisting hiring teams during technical interviews [178]. They also offer job applicants the opportunity to expedite their application process [121]. Moreover, chatbots empower candidates by allowing them to seek clarifications, acquire the skills to respond to repetitive inquiries through training data, and promptly address queries to minimize delays [233]. Consequently, chatbots effectively streamline the recruitment process while concurrently mitigating the occurrence of fraudulent activities [231].

Chatbots are vital in many industries, from retail to complex systems. AI-enabled virtual assistants speed up and support essential processes. Chatbots improve retail efficiency by providing personalized product recommendations, answering questions, and optimizing operations. Their expertise in answering questions and enabling transactions has transformed the client experience and created a smooth interface. Adaptable chatbots improve enterprise internal communication. They simplify recruitment by automating applicant first-contact interactions and early screening. Chatbots also provide reliable and interactive modules for employee training.

3.3.4. Chatbot for Customer and Services

Chatbot customer service functions as an automated form of customer support, offering guidance on various aspects such as product features, usability, suitability, and problem-solving [44]. Additionally, it can serve as a travel guide [53] and help users save time and money [65]. Indeed, ten million consumers [85] can be served autonomously by chatbots; this increases the productivity of organizations [6], investors, and other interested parties [82]. Bot can help with customer support and provide business updates [122], as a business contact person [113], helping to increase revenue and customer satisfaction [15].

Modern company with chatbots has altered customer service and communication [198]. Customers can directly query the chatbot [4] and obtain an accurate response [2], improving service [3]. For example, the implementation of a chatbot on Sephora Virtual Artist that allows consumers to try on virtual makeup and get individual product recommendations [3], the bot significantly increases online purchases and customer interactions. Chatbots with personality, emoticons, helpfulness, and politeness can improve the user experience, as seen at Bank of America [283] and Apple [3].

Chatbots are vital for managing customer queries, complaints, and comments in customer support. As the first point of contact for businesses and organizations, their role is important. Users now value chatbots as effective problem-solvers in customer service. Users are most impressed by chatbots' quick, accurate, and customized solutions, which increase problem-solving. This efficiency creates positive customer experiences, the foundation of good customer service. Customers and responsive chatbots speed up customer service.

3.3.5. Chatbot for Personal Assistant

Personal assistant chatbots have the ability to assist individuals in their daily tasks, provide access to information, and enhance overall productivity. These chatbots are commonly found on popular messaging platforms such as Facebook Messenger, Skype, and Viber [69]. Their integration is typically based on expert systems [56]. Chatbots have the capability to assimilate information in order to minimize mistakes in interactions [58], so enhancing their interactivity [90] and making them a viable choice for seeking advice [50].

Chatbots enable human-like human [234] and conversations [128] by enhancing the connection between people and bots [107] via various platforms such as websites [138] and different software or hardware [166]. These advances have led to the emergence of intelligent advisors that are perceived to build trust [213] as well as being able to offer advice and recommendations to users

[102] so that it can change other people's feelings [215]. Another observation regarding personal assistants is that chatbots that are humanistic designed can convey a sense of trust, empathy and satisfaction [257], and can substantially influence social feelings [293].

User attitudes and expectations are shifting toward chatbots as adaptive personal assistants that can simplify tasks and deliver helpful information. These AI-powered companions seamlessly integrate functionality and interactivity for users. Users like conversational, anthropomorphic chatbots. Their ability to mimic human behaviors makes them desirable because it generates a sense of connection and fulfillment beyond transactional interactions. Bringing technology and humanity closer together, these anthropomorphic chatbots improve user interactions and engagement. Therefore, they have become more than tools but virtual pals that can adapt to shifting demands.

3.3.6. Chatbot for Healthcare

In the ever-evolving landscape of healthcare and mental well-being, chatbots have emerged as a significant force of change. Their effectiveness in sensing and alleviating stress, especially among adolescents, has drawn attention from researchers and practitioners alike. These conversational agents play a pivotal role in enhancing psychological well-being, promoting health literacy, and streamlining access to appropriate mental health support.

Chatbots is a meaningful mark in the fields of medicine and mental health, as evidenced by a series of recent studies.They are effective on sensing and helping adolescents' stress [20], psychological distress and health knowledge [63], self-care [59], mental health needs [72]. Chatbots are making a mark in the field of Medicine and provides an effective way to handle patients of medical organizations [84] for example chatbots for psychiatric use [93]. Chatbots have not only demonstrated their effectiveness but are poised to continue playing an instrumental role in reshaping healthcare and mental health support.

The use of chatbots goes beyond information retrieval. This paradigm shift in healthcare is particularly illustrated in several studies conducted in recent years. These systems can be used for effective information search in the same way as Siri, Alexa, etc. but their scope is limited to disease diagnosis [14]. The user experience was positive, with all subscales of the user experience questionnaire (UEQ) indicating a useful and acceptable SISU format as a mental health chatbot [176], mobile communication and IoT used as communication [159]. A.I. chatbot became a useful remote service [171] to get answers to user requests during the Covid-19 pandemic [168].

Chatbots were shown to be superior to minimal-level bibliotherapy in terms of depression reduction, anxiety, and therapeutic alliance [208]. Illnesses predicted by chatbots were shown to be illnesses anaesthetised by doctors [229]. Chatbots can automatically notify staff in emergency departments [221], psychological therapists, virtual friends [192], and can even consult chatbots about various medical conditions [150]. Chatbots are becoming the driving force of modern communication for healthcare [198].

Chatbots have the ability to perform health diagnoses and provide basic information before patients contact doctors [9]. For example, if someone wants to quit smoking, they can interact with a bot [253], enabling virtual consultations with patients and providing therapies that conform to medical guidelines [255] although it still requires confirmation from a doctor. The frequent utilization of chatbots in healthcare has led to the rise of bots in healthcare [270] to the extent that in Brazil chatbots are being used as a primary healthcare service [292].

Bots are revolutionizing healthcare to the extent that they can provide benefits to management, patient conditions [282], hospitals [264], drug prescribing [10], although the justification of eligibility rests entirely with doctors and medics by enforcing data security and confidentiality protocols. It is imperative to have robust data protection measures in place to protect patient information and comply with relevant regulations [204], [285].

Woebot [287] and Ada-Health [229] are examples of successful implementation of chatbots in the health domain, providing cognitive behavioral therapy and emotional support to patients. These chatbots improve mental health outcomes and facilitate access to health services. However, ethical issues including privacy, confidentiality, accuracy, and consent are still an obstacle, hence the implementation of health chatbots must comply with data protection requirements and reduce health prejudice.

The application of chatbots in healthcare needs to be supported but also given caveats, for example regarding strong security [204], auditing, and evaluation [285]. Also, hospitals need to provide information regarding patient engagement with chatbots [190]. Health chatbots are required to adhere to the health regulations established by medical professionals and healthcare authorities in accordance with international or relevant healthcare legislation.

Healthcare chatbots are revolutionizing the healthcare industry by providing personalized support and transferring medical history data. However, ethical challenges such as privacy, confidentiality, accuracy, and reliability remain. Chatbots must be trained on high-quality medical knowledge to avoid biases and discrimination. Human oversight and accountability are crucial, and they should be integrated into existing systems for continuity of care. Chatbots should be communicated as complementary to professional medical advice and continuously monitored for accuracy. Users should have control over their interactions and adhere to established ethical guidelines.

The overall finding of this section is to ascertain the comprehensiveness and use of chatbots in several aspects, while highlighting the challenges and opportunities they bring. In addition, this research also explains ethical principles to protect user privacy, thus differentiating it from previous studies.

3.4. Technological Aspects

Rule-based chatbots are the first technology chatbot form of conversational agent that follow a predetermined set of rules and patterns. Joseph Weizenbaum at the MIT Artificial Intelligence Laboratory, is one of the earliest examples of a chatbot. ELIZA was designed to simulate a Rogerian psychotherapist engaging in text-based conversations with users to mimic the behavior of a human. Is a more advanced chatbot than ELIZA, Richard Wallace in the mid-1990s designed to provide interactive and engaging conversations with users on various topics, ALICE used pattern-matching and rule-based techniques to understand and respond to user queries.

These rules specify how the chatbot reacts to user inputs or inquiries, making them appropriate for particular activities or domains where the discussion can be expected and pre-scripted. Rule-based chatbots are frequently used in scenarios with a clear and structured set of interactions since they are reasonably simple to design. Notably, many popular chats dialogue systems rely heavily on meticulously crafted rules, often expressed in the Artificial Intelligence Markup Language (AIML), to guide their conversations. A Chatbot Based on AIML Rules Extracted from Twitter Dialogues [49]. Rule-based Chabot for student enquiries Rule-based Chabot for student enquiries [79]. e-JAVA Chatbot for Learning Programming Language: A Post-Pandemic Alternative Virtual Tutor [126]. An Overview of Chatbot Technology [136]. Google Dialogflow and IBM Watson, which are two most popular rule-based Chatbot implementation frameworks [132].

Rule-based chatbots display several important traits and factors. They respond to user input according to predefined rules and patterns often created by human designers or developers. They work well for predictable and repetitive encounters due to their limited flexibility, which can be a problem when faced with challenging or unexpected questions. Thus, a need to conduct another in-depth study related to chatbots with other guidelines, for example, based on Generative AI chatbots. Therefore, this technology still applicable with its limitation.

Generative AI chatbots, powered by large language models are a new type of chatbot that uses advanced algorithms to generate responses based on the context and content of a conversation. These chatbots offer several advantages over rule-based chatbots, such as handling a wider range of user inputs, adapting to various conversation styles, and providing more natural and human-like interactions. However, they also face challenges such as requiring substantial computing resources and data for training, producing factually incorrect or inappropriate responses, and ensuring ethical guidelines in their responses.

The development and deployment of generative AI chatbots have been on the rise, with applications in customer service and virtual assistants. The choice between rule-based and generative AI chatbots depends on the specific use case and requirements. Rule-based chatbots are suitable for structured interactions, while generative AI chatbots are better equipped for open-ended and dynamic conversations. Organizations should consider their goals and the nature of interactions when selecting the appropriate chatbot technology. AI Components for NLP shown in Fig. 5.

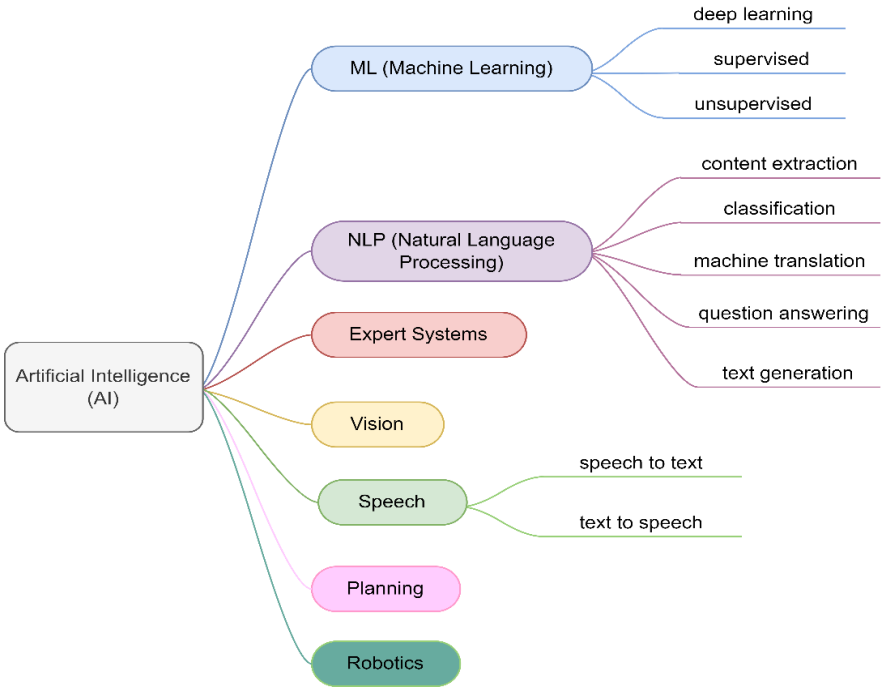


Fig. 5. AI components for NLP

The discussion on Generative AI chatbots is inseparable from natural language processing (NLP) and machine learning (ML) techniques. Generative AI chatbots explores the technology behind chatbots capable of generating human-like responses and engaging in open-ended conversations. These often-generative AI chatbots are designed to understand and produce human language effectively.

Between BERT Variants and Predicting medical specialty from text based on a domain-specific pre-trained BERT: Moreover, Arabic Named Entity Recognition in Arabic Tweets Using BERT-based Models [180]. Bert for Question Answering applied on Covid-19 [236]. Fake News Classification using transformer based enhanced LSTM and BERT [218]. Contextual semantic embeddings based on fine-tuned AraBERT model for Arabic text multi-class categorization [188]. Amazon Fine Food Reviews with BERT Model [238]. The extensive array of research studies, such as Predicting medical specialty from text based on a domain-specific pre-trained BERT, Development, and validation of deep learning and BERT models for classification of lung cancer radiology reports, and many others, collectively demonstrate the growing influence and versatility of BERT-based models in diverse natural language processing tasks.

Between Predicting medical specialty from text based on a domain-specific pre-trained BERT and ChatGPT and the rise of generative AI. Additionally, predicting medical specialty from text based on a domain-specific pre-trained BERT [264]. Development and validation of deep learning and BERT models for classification of lung cancer radiology reports [274]. Research category classification of scientific articles on human health risks of electromagnetic fields using pre-trained BERT [267]. BERT base model for toxic comment analysis on Indonesian social media [277]. Comparison of BERT implementations for natural language processing of narrative medical documents [296]. Topic Modelling and Opinion Analysis on Climate Change Twitter Data Using LDA And BERT Model [297].

Using Bidirectional Encoder Representations from Transformers (BERT) to classify traffic crash severity types [278]. Contextual Embeddings based on Fine-tuned Urdu-BERT for Urdu threatening content and target identification [271]. Summarization of scholarly articles using BERT and BiGRU: Deep learning-based extractive approach [245]. Boosting BERT-Based Knowledge Graph Completion with Contrastive Learning and Hard Sample Training [299]. Extractive social media text summarization based on MFMMR-BertSum [251]. Multilingual hope speech detection: A Robust framework using transfer learning of fine-tuning RoBERTa model [272]. LyEmoBERT: Classification of lyrics' emotion and recommendation using a pre-trained model [288]. Hierarchical graph-based text classification framework with contextual node embedding and BERT-based dynamic fusion [279].

SPU-BERT: Faster human multi-trajectory prediction from socio-physical understanding of BERT [276]. BERT-CNN: Improving BERT for Requirements Classification using CNN [261]. These studies showcase BERT's effectiveness in tasks ranging from medical specialty prediction to sentiment analysis in social media, summarization of scholarly articles, and even traffic crash severity classification. As we explore the rise of generative AI, including ChatGPT and its various applications, we must recognize the significant strides in harnessing BERT variants to improve the efficiency and effectiveness of language-related tasks across different domains. These advancements continue to shape the landscape of natural language processing and hold promise for even more innovative applications in the future.

The proliferation of generative AI, as exemplified by ChatGPT, has sparked both excitement and concerns, particularly in academic integrity and various practical applications. The studies discussed, including Optimization of paraphrase generation and identification using language models in natural language processing (NLP), delve into the capabilities and potential limitations of generative AI systems like ChatGPT. Between ChatGPT and the rise of generative AI: Threat to academic integrity and Optimization of paraphrase generation and identification using language models in natural language processing (NLP): Furthermore, ChatGPT and the rise of generative AI: Threat to academic integrity [249]. Use prompt to differentiate text generated by ChatGPT and humans [241].

GPT understands, too [268]. Collaborative Work Alternatives with ChatGPT Based on Evaluation Criteria for its Use in Higher Education: Application of the PROMETHEE-SAPEVO-M1 Method [284]. A comprehensive evaluation of ChatGPT consultation quality for augmentation mammoplasty: A comparative analysis between plastic surgeons and laypersons [301]. ChatGPT: Jack of all trades, master of none [265]. GPT-3.5, GPT-4, or BARD? Evaluating LLMs reasoning ability in zero-shot setting and performance boosting through prompts [269]. Analyzing the potential benefits and use cases of ChatGPT as a tool for improving the efficiency and effectiveness of business operations [286]. ChatAgri: Exploring potentials of ChatGPT on cross-linguistic agricultural text classification [303]. Here are concrete examples of successful chatbot implementations in domains Agriculture, the Thai Smart Agriculture chatbot assists farmers in Thailand by providing real-time weather updates, crop management advice, and pest control recommendations [230]. This chatbot helps farmers make informed decisions and optimize agricultural practices.

Harnessing GPT-4 for generation of cybersecurity GRC policies: A focus on ransomware attack mitigation [273]. Application of ChatGPT in multilingual medical education: How does ChatGPT fare in 2023's Iranian residency entrance examination [263]. Research on the impact of trends related to ChatGPT [300]. Unlocking the opportunities through ChatGPT Tool towards ameliorating the education system [258]. Benchmarking, ethical alignment, and evaluation framework for conversational AI: Advancing responsible development of ChatGPT [287]. While ChatGPT demonstrates remarkable versatility, from consultation quality analysis to business operations improvement, there's a growing awareness of the need for ethical alignment and responsible development. Researchers continue to evaluate its performance, understand its reasoning abilities, and explore diverse use cases, ranging from agriculture to cybersecurity. These efforts aim to harness the benefits of generative AI while addressing potential challenges, ultimately shaping the future landscape of AI-driven

The landscape of natural language processing has been substantially transformed by the proliferation of transformer-based models, as evidenced by the studies examined here. From improving paraphrase generation to developing novel question-answering systems and thoroughly evaluating transformer architectures for tasks like adverse drug event extraction, these models have revolutionized our ability to process and generate textual content. Between Optimization of paraphrase generation and identification using language models in natural language processing and utilizing a multi-class classification approach to detect therapeutic and recreational misuse of opioids on social media: Moreover, Optimization of paraphrase generation and identification using language models in natural language processing [165]. End-to-End generation of Multiple-Choice questions using Text-to-Text transfer Transformer models [223]. Feasibility of Using Zero-Shot Learning in Transformer-Based Natural Language Processing Algorithm for Key Information Extraction from Head and Neck Tumor Board Notes [305]. Building a deep learning-based QA system from a CQA dataset [260]. Transformer based Answer-Aware Bengali Question Generation [290].

An extract-then-abstract based method to generate disaster-news headlines using a DNN extractor followed by a transformer abstractor [244]. Extensive evaluation of transformer-based architectures for adverse drug events extraction [291]. Dialog summarization for software collaborative platform via tuning pre-trained models [250]. English grammar multiple-choice question generation using Text-to-Text Transfer Transformer [248]. Collectively Text-to-Text Transfer Transformers (T5) these studies underscore the immense potential of transformer models, including Text-to-Text Transfer Transformers, in advancing the fields of information extraction, comprehension, and generation across diverse domains. This signifies a significant stride in the evolution of natural language processing and its practical applications, promising a future of enhanced text-based interactions and insights.

In this section offer valuable insights into the innovative applications of natural language processing and machine learning techniques in various domains. Utilizing a multi-class classification approach to detect therapeutic and recreational misuse of opioids on Twitter [152]. Hierarchical label-wise attention transformer model for explainable ICD coding [209]. What do Twitter comments tell about news article bias? Assessing the impact of news article bias on its perception on Twitter [294]. Machine learning to automatically generate billing codes for a variety of orthopedic surgery procedure operative notes: a study of 922 patients [302]. Text-based personality prediction using XLNet [259]. XLNet exemplify how these technologies can streamline processes and provide valuable support in healthcare. As we progress, these studies pave the way for further advancements in leveraging text data to improve healthcare, communication analysis, and information management. Methods of transformer chatbot research shown in Table 6.

The evolution of conversational agents, from early rule-based chatbots like ELIZA to more advanced systems like ChatGPT, has demonstrated the remarkable progress in natural language processing and machine learning. Rule-based chatbots, although limited in flexibility, have found their niche in structured interactions and specific domains. However, the rise of generative AI,

exemplified by BERT-based models and ChatGPT, has opened up new possibilities for open-ended conversations and diverse applications.

In utilizing BERT variants has showcased their effectiveness across a wide range of tasks, from medical specialty prediction to sentiment analysis and text summarization. As we explore the potential of generative AI, including ChatGPT, it is crucial to address ethical concerns and ensure responsible development. Furthermore, transformer-based models, including Text-to-Text Transfer Transformers (T5), have revolutionized natural language processing, enabling advancements in paraphrase generation, question-answering, and information extraction. These models hold great promise for enhancing text-based interactions and insights.

Table 6. Methods of transformer chatbot research

Method	Impact	References
BERT Variants	BERT a clever computer model, can be used in many different ways. It helps predict reports. BERT can shorten long posts on social media and help spot fake news. BERT can even understand the feelings in song lyrics and make food reviews easier to understand. It's like a superhero for computers, matter what language we speak. So, BERT is like a big helping hand in computers and words	[245], [180], [188], [251], [261], [264], [271], [272], [274], [276], [277], [278], [279], [218], [288], [296], [297], [236], [299], [238]
GPT Variants	The rise of ChatGPT and generative AI is a big deal. People are considering how it could affect education, medicine, and even cybersecurity. They're testing it to see if it can understand and respond like a human and also making sure it's used responsibly and ethically	[241], [249], [258], [263], [265], [268], [269], [273], [284], [286], [287], [300], [301], [303]
T5 (Text-to-Text Transfer Transformer)	Paraphrasing techniques are a linchpin in recognizing or generating expressions and sentences with akin meanings. With a keen focus on generating coherent and semantically akin paraphrases, this model, powered by a finely-tuned Text-To-Text Transfer Transformer (T5)	[244], [248], [250], [260], [165], [223], [290], [291], [305]
XLNet	Personality is a complex mix of traits that define how we think, act, and feel, and it's studied in various fields like healthcare and social media. smart computer models like XLNet to predict personality traits from text, making it more accurate and helpful.	[152], [259], [208], [294], [302]

The development of chatbots for cultural heritage in the future can benefit from various insights and research findings mentioned in the provided text. Here are some potential developments and applications of chatbots for culture and heritage shown in Fig. 6.

The innovative applications of natural language processing and machine learning in various domains, such as healthcare, communication analysis, and information management, underscore the transformative potential of these technologies. As we continue to harness the power of text data, we can look forward to further advancements that will shape the future of AI-driven interactions and information processing. In this section, we discuss the importance of incorporating Transformer models, such as T5, BERT, GPT, and XLNet, into chatbot construction as an additional component in various fields, especially in the field of cultural heritage, which has not been discussed in previous studies.

3.5. Ethical and Social Implications

The exploration of ethical considerations related to chatbots in the context of cultural heritage is of paramount importance. Chatbots, when employed in this domain, have the potential to both

preserve and promote cultural heritage, but they also raise several ethical concerns that need to be carefully addressed. Objectives of chatbot research shown in Table 7.

In summary, the use of chatbots in the domain of cultural heritage can be a powerful tool for education, preservation, and engagement. However, it must be done thoughtfully, with careful attention to ethical considerations to avoid potential harm or disrespect to the cultures and communities being represented.

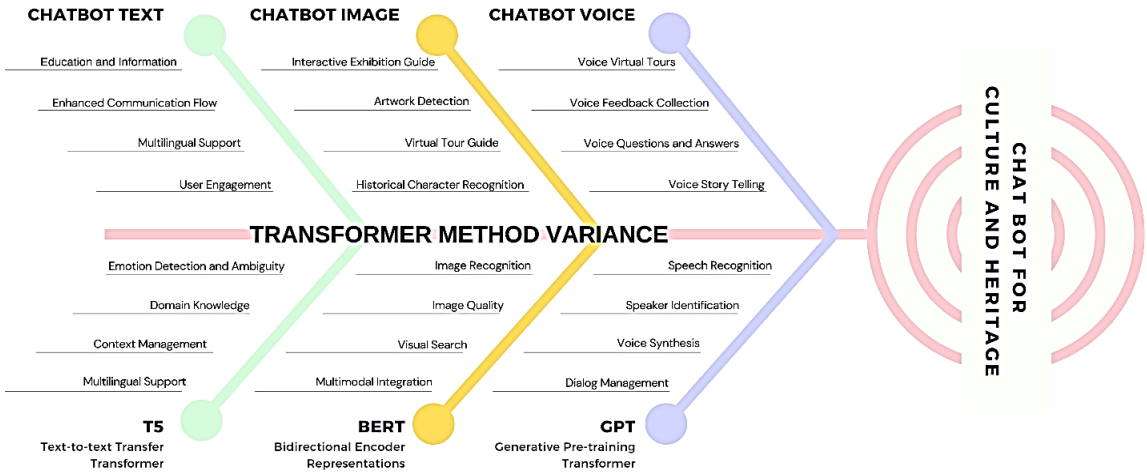


Fig. 6. Fish-bound chatbot diagram for future research in culture and heritage

Chatbots are a crucial tool in the digital age, but they also present ethical challenges. To ensure they adhere to ethical standards, they must be designed with a focus on transparency, inclusivity, and data privacy. This involves identifying potential biases, ensuring transparency, and promoting inclusivity. Data privacy and security measures must be implemented to safeguard user data and comply with privacy regulations. Regular monitoring and maintenance are necessary to identify and address any ethical issues. User empowerment is also crucial, offering clear information about chatbot capabilities and limitations, and allowing users to control their interactions. Proactive measures to identify and mitigate biases in chatbot responses are also necessary. Human oversight is also crucial, with human moderators or experts reviewing and intervening in chatbot interactions. User feedback and accountability mechanisms should be established to address any ethical concerns. Finally, ethical guidelines and standards should be developed and adhered to for chatbot development and deployment.

By implementing these suggestions, developers and organizations can promote ethical practices in chatbot design and usage, fostering trust, transparency, and responsible AI deployment. Ethical considerations in chatbot design and usage are crucial to ensure that chatbots conform to ethical standards. Suggestions include incorporating ethical design principles, implementing robust data privacy and security measures, regularly monitoring and maintaining chatbots, empowering users, mitigating biases, incorporating human oversight, encouraging user feedback and accountability, and following ethical guidelines and standards.

The current systematic literature review (SLR) provides insightful information about the social and cultural effects of developments in chatbot, artificial intelligence, and natural language processing (NLP) technologies. These effects have a variety of effects, from altering how people and machines interact to possibly increasing accessibility and inclusivity. The review also emphasizes the significance of cultural sensitivity and multilingualism in the creation of AI systems, emphasizing the demand for responsible and impartial AI answers across a range of languages and cultural situations.

Additionally, the discussion of the financial, intellectual, and educational ramifications of generative AI models like ChatGPT sheds light on how academia and the customer service sector are changing. The ethical issues surrounding the development of AI and its possible effects on the news media, public perception, and healthcare are also discussed. Finally, AI's versatility and ability to tackle a wide range of global difficulties are demonstrated by its cross-linguistic and cross-domain applications. In essence, this SLR highlights the complexity of AI's impact on society and culture, emphasizing the need for moral and responsible AI development to properly navigate these impacts.

Table 7. Objectives of chatbot research

Category	Item Description	Follow-up of study
Cultural Sensitivity	Chatbots interacting with users in cultural heritage must be culturally sensitive and respectful. They should avoid any content or responses considered offensive, derogatory, or culturally insensitive. This includes refraining from making jokes or inappropriate comments related to cultural heritage.	[18], [58]
Accuracy and Authenticity	Ensuring the accuracy and authenticity of information provided by chatbots is crucial. They should not disseminate false or misleading information about cultural artifacts, traditions, or history. Any information shared should be well-researched and verified.	[311], [300], [193], [194], [259], [221], [268], [229], [310]
Privacy and Data Protection	Chatbots may collect user data during interactions. It's essential to have stringent data protection measures in place to safeguard users' personal information. Users should also be informed about data collection practices and allowed to consent.	[190], [18], [204], [285]
Inclusivity and Accessibility	Chatbots should be designed to cater to a diverse audience and be accessible to people with disabilities. They should support multiple languages and accommodate various cultural backgrounds to be truly inclusive.	[242], [185], [275]
Ownership and Copyright	When chatbots are used to share cultural content, questions of ownership and copyright may arise. It's vital to respect intellectual property rights and obtain the necessary permissions for using copyrighted material.	[191], [18]
Transparency	Users should be aware that they are interacting with a chatbot and not a human. Transparency about the bot's capabilities and limitations is essential to establish trust.	[190], [204], [10]
User Consent	Users should be able to opt in or out of interacting with a cultural heritage chatbot. Consent should be freely given, and users should be able to control the extent of their engagement.	[176], [246], [159], [208], [283], [309]
Long-Term Preservation	If chatbots are used in cultural heritage preservation, there must be considerations for the long-term preservation of data and content.	[214], [298], [45]
Community Involvement	In cases where chatbots represent specific cultural groups, involving those communities in the development process is vital. Their input can help ensure the chatbot accurately reflects their culture and values.	[240], [220], [287], [298], [88]
Ethical AI Development	Developers should follow ethical AI development practices, including avoiding algorithm biases and ensuring that chatbots do not perpetuate stereotypes or discriminatory behavior.	[10], [287], [247], [190]

The present research offers a comprehensive analysis of the Ethical and Social Implications of chatbot technology, addressing concerns related to data privacy, security, and bias in algorithms. This research distinguishes itself from previous investigations, providing valuable insights into the implications of chatbot technology across various industries.

3.6. The Potential of Chatbot in Cultural Heritage Ecosytems

The preceding chapters explore a range of topics including trends in chatbots, interactions and experiences, technological considerations, and ethical considerations. The discourse covers a

conceptual framework of cultural heritage ecosystems. Fig. 7 depicts the various ecosystems and their constituent components.

The current literature on user experiences with chatbots reveals several essential findings and identifies specific gaps. Firstly, research suggests that chatbots can generally satisfy users, but there is room for improvement in communication flow to guide users effectively in their interactions [58]. Secondly, factors influencing user satisfaction are multifaceted, and chatbots' applications span various domains. In the realm of virtual dialog, studies highlight the importance of natural conversation, real-time feedback on nonverbal behavior, and the impact of emotional variables on chatbot believability [27], [28], [96]. Chatbots effectively respond to user queries, offer customization, and integrate with different channels [112], [118], [162]. However, recognizing different accents and pronouncing words accurately remains a challenge.

Fig. 7. Potential of chatbot in cultural heritage ecosytems

In education, chatbots have been employed to assist students in various ways, from answering queries and managing communication to aiding in language learning [19], [46], [66], [195]. They have streamlined processes, enhanced user experiences, and contributed to students' learning journeys. Nevertheless, there is a need for more comprehensive research to evaluate the long-term impact of chatbots on education. Chatbots have been utilized in business and organizational contexts for customer support, recruitment, and automation of various processes [60], [178], [200], [178]. They have demonstrated efficiency and effectiveness, especially in job searching, banking, and logistics tasks. However, studies are required to explore the potential of chatbots in other industries and assess their scalability and adaptability.

In customer service, chatbots have improved customer interactions, recommendation quality, and service efficiency [3], [283]. They have also become essential for providing information and support in various languages and domains. However, the impact of anthropomorphic design on chatbot satisfaction requires further investigation. Chatbots have shown promise in addressing mental health issues, providing information, and assisting patients [93], [179], [208]. They have been treasured during crises like the COVID-19 pandemic. Nevertheless, there is a need for more rigorous evaluation of their efficacy in specific medical contexts and a focus on privacy and data security.

Despite these valuable insights, some gaps in the literature persist. Firstly, there is a need for more comprehensive and longitudinal studies to assess the long-term impact of chatbots in education and other domains. Secondly, research should explore the ethical and privacy implications of chatbot interactions, especially in cultural heritage. Thirdly, more work is required to investigate the influence of chatbot design, personality, and emotions on user experiences and outcomes. Lastly, research on integrating chatbots with emerging technologies like AI and IoT in various sectors remains limited. Literature offers valuable insights into user experiences with chatbots across different domains. However, further research is needed to address the identified gaps and provide a deeper understanding of the potential and limitations of chatbot technology in diverse applications.

Suggestions for future research areas and trends, provided text offers an extensive overview of the development and application of chatbots, highlighting the evolution from rule-based chatbots to more advanced AI-based chatbots. However, within this expansive body of research, there exists a notable research gap that warrants exploration and investigation. While the text provides a comprehensive survey of chatbot technologies and their potential applications, it does not explicitly address the critical issue of evaluating the real-world effectiveness and user acceptance of these chatbots. One of the fundamental aspects that require attention in future research is user experience and acceptance. Investigating how end-users perceive and interact with chatbots across different domains and applications is paramount. Understanding user preferences, satisfaction levels, and any usability challenges faced when engaging with chatbots is crucial.

This research can shed light on the factors that drive user adoption and retention, ultimately leading to more user-centric chatbot designs. Customization and adaptability are essential for enhancing chatbot utility. Investigating the degree to which chatbots can be customized to individual user needs and adapt to changing user requirements is crucial. This includes exploring the potential for chatbots to provide personalized assistance, tailoring their responses and interactions to meet unique user preferences. To facilitate research and development in the field, standardized evaluation metrics and benchmarks should be established. These metrics should account for factors like response time, accuracy, and user satisfaction, allowing for consistent and meaningful assessments of chatbot performance. Moreover, the integration of chatbots into existing systems requires thorough investigation. Future studies should focus on studying the challenges and benefits of integrating chatbots into software ecosystems, addressing compatibility issues, and assessing their impact on workflow efficiency.

Addressing these research gaps will not only contribute to a deeper understanding of the practical implications of chatbot technology but will also guide the development of more effective and user-friendly chatbot solutions across various domains. By addressing these critical research areas, we can further unlock the potential of chatbots to improve user experiences and streamline interactions in numerous fields, including the domain of culture heritages and cultural institutions. The integration of chatbots into the culture heritage experience is an emerging area of research that holds great promise for the future of visitor engagement and education. Culture heritages are increasingly exploring the use of chatbots as interactive guides and educational companions for visitors. These chatbots can provide real-time information about exhibits, historical context, and artist insights, enhancing the overall culture heritage experience. For example, a visitor could engage with a chatbot on their smartphone to learn more about a specific painting, sculpture, or artifact, deepening their understanding and appreciation of the artworks.

Moreover, chatbots can adapt to the preferences and interests of individual visitors, providing personalized recommendations for exhibits or events based on their past interactions and feedback. This level of customization enhances user engagement and encourages return visits to the culture heritage. Research in this area is focused on optimizing the user experience within the culture heritage context. Studies are being conducted to evaluate the effectiveness of chatbots in facilitating learning and engagement among visitors. Metrics such as visitor satisfaction, knowledge retention, and the impact on the overall culture heritage experience are being measured to assess the value of chatbot-

guided interactions. Additionally, chatbots in culture heritages are also addressing accessibility concerns. They can provide text descriptions, translations, and accessibility features for visitors with disabilities, ensuring that culture heritages are inclusive spaces for all.

In the domains of customer services and virtual dialogue, chatbots present an exciting array of opportunities to enhance visitor engagement and enrich cultural heritage experiences. Their interactive capabilities enable them to offer historical context, provide valuable insights from artists, and incorporate accessibility features, ultimately elevating the overall visitor experience. The potential benefits are substantial, but they must be weighed against the imperative ethical considerations that underpin cultural heritage representations. Ensuring the accuracy and authenticity of these representations is paramount. Chatbots, when used in cultural contexts, demand a high level of cultural sensitivity, necessitating the avoidance of any content that could be construed as offensive or biased. Additionally, language nuances and cultural barriers present formidable challenges for chatbots. Overcoming these hurdles mandates robust natural language processing capabilities and an in-depth understanding of cultural intricacies.

One of the prevalent challenges is the ability to comprehend the context and complexity of culturally inherited topics, which can lead to the delivery of inaccurate responses. While chatbots undoubtedly serve as valuable sources of information, they cannot entirely supplant human interaction in the cultural heritage domain. This underscores the enduring importance of human expertise and deep cultural knowledge, as they play an irreplaceable role in ensuring the authenticity and richness of the cultural heritage experience. Chatbots represent a compelling avenue for engaging visitors and promoting cultural heritage, provided they are meticulously developed with due regard for ethical, cultural, and linguistic considerations, while remaining complemented by human guidance and expertise in this intricate domain.

In parallel to these transformative developments in chatbot technology, information technology (IT) concepts are widely regarded as a new addition to academic discourse. Further examining the interaction between humans as individuals and society as a collective entity is essential to prevent society from feeling alienated by the rapid breakthroughs in IT within the scope of computers and society. This proactive dialogue is crucial as it contributes to a point of view where advances in AI technology are not seen as a looming danger that detracts from the overall purpose of existence. Instead, these technologies have the potential to be a catalyst for expanding horizons and exploring the deeper meaning of life when examined critically and reflectively. This strategy promotes a future where technology enhances, rather than diminishes, the diversity and depth of human experience.

This research shows that chatbots has potential to preserve and promote cultural heritage, overcoming communication biases and ethical use. This research highlights the potential of technology, culture and ethics in this area, emphasising the importance of a balanced approach to cultural and communication, thus provide a different perspective to other research.

4. Future Challenges

4.1. Integration Existing Systems and Model Learning

The integration of chatbots into current software ecosystems is a crucial consideration as they continue to play a significant role in numerous sectors. In this particular setting, it is imperative for scholarly investigation to focus on the obstacles and advantages associated with this integration, while also considering the assimilation of state-of-the-art technologies like as T5 and BERT, which have surfaced as noteworthy contributors to the advancement of chatbot systems.

The T5 (Text-To-Text Transfer Transformer) technology, renowned for its adaptability in addressing diverse natural language processing problems, offers a significant advantage in the advancement of chatbot creation. The primary advantage of T5 is its capacity to convert textual inputs into textual outputs, so facilitating chatbots in managing a diverse range of user inquiries and

producing replies that are contextually appropriate. Nevertheless, it is essential to recognize that the deep neural network design of T5 may need significant computational resources, which might have an impact on reaction times and scalability.

In contrast, the BERT (Bidirectional Encoder Representations from Transformers) technology significantly improves the comprehension of contextual information in natural language. The bidirectional technique employed in text analysis enables chatbots to deliver replies that are more contextually aware. BERT demonstrates a high level of proficiency in comprehending the complexities inherent in language, rendering it a great augmentation to the capabilities of chatbots. However, it is crucial to acknowledge that the training and deployment of BERT might require significant computing resources, thereby affecting the performance of chatbots, particularly in real-time scenarios.

The selection of either T5 or BERT technology for chatbot creation necessitates a comprehensive and well-founded rationale. The decision should be in accordance with the particular objectives and criteria of the chatbot system. If the main goal is to effectively address a diverse set of natural language processing (NLP) problems and produce complete outputs, T5 might be considered as the favored option. On the other hand, if the prioritization is in context-awareness and nuanced language comprehension, BERT may be seen as the more favorable choice. In brief, the incorporation of chatbots into pre-existing software ecosystems requires a careful evaluation of the merits and limitations of technologies such as T5 and BERT. The choice of the most suitable approach should be in accordance with the particular use case and requirements, guaranteeing the seamless integration and efficient operation of the chatbot within the provided environment

Within the framework of the cultural heritage ecosystem, T5 exhibits a versatile capacity to undertake various tasks, including text generation, summarization, translation, and question answering. This renders T5 an optimal selection for extracting and communicating information pertaining to cultural heritage, which predominantly consists of extensive and boundless textual data sources. The inclusion of T5 multilingual support enhances the value of chatbots catering to a worldwide user base with a keen interest in a wide range of cultural heritage places and artifacts. The pre-existing model, which underwent extensive training using a substantial corpus of textual data, offers a robust basis for the advancement of chatbot technology. The T5 models possess the capability to undergo customization in order to cater to specific activities and domains, hence guaranteeing their alignment with the distinctive requirements and preferences of cultural heritage applications.

4.2. Cultural Heritage Applications, Customization, Adaptability

The utilization of chatbots in cultural heritage applications shows great potential in improving tourist engagement and educational experiences. By incorporating chatbots into cultural heritage environments, institutions and organizations have the ability to develop inventive strategies that effectively address the needs of a wide range of individuals. Chatbots have the potential to enhance the user experience by providing a streamlined and engaging exploration of historical sites, museums, and cultural displays. By means of intuitive and instructive exchanges, chatbots have the capability to offer useful insights, narratives, and contextual information, so ensuring that visitors not only acquire knowledge about the legacy but also establish a more profound emotional attachment to it.

The measurement of visitor satisfaction is a critical element in the utilization of chatbots within cultural heritage applications. By utilizing real-time feedback and analytics, educational institutions are able to assess the extent to which chatbots are fulfilling the expectations of their target audience. The feedback loop plays a crucial role in optimizing the chatbot's responses, customizing them to cater to the distinct requirements and preferences of various visitors, hence enhancing the overall visitor experience. By fulfilling this function, chatbots have the potential to assume a crucial role in enhancing the accessibility, interactivity, and overall satisfaction of those engaging with cultural material.

Moreover, the utilization of chatbots within cultural heritage contexts has the potential to enhance the preservation of knowledge. Chatbots have the potential to enhance visitors' retention and comprehension of historical facts and narratives by presenting information in a conversational and captivating manner. The augmentation of retention not only serves to intensify the process of learning, but also cultivates a heightened sense of admiration for cultural heritage. Chatbots possess the capacity to transform a singular visit into a sustained educational encounter that persists in the memories of visitors much beyond their departure from the cultural place.

In conclusion, the use of chatbots into cultural heritage applications has the potential to greatly enhance the entire cultural heritage encounter. These virtual companions has the capability to navigate visitors through exhibitions, respond to inquiries, and offer comprehensive narratives, all the while adjusting to the distinct interests and requirements of individual visitors. Chatbots play a significant role in the protection and promotion of cultural heritage in today's digital and interactive society by improving interaction, assessing satisfaction, aiding knowledge retention, and enhancing the tourist experience.

4.3. User Experience, Evaluation Metrics, Computer and Society

User Experience, Evaluation Metrics, and Computer and Society at the intersection of human-technology interaction, a multifaceted exploration unfolds. It begins with the intricate realm of user experience, where the dynamic interplay between humans and chatbots takes center stage. In a world brimming with diverse domains and applications, it's essential to discern how users perceive and engage with chatbots. This exploration delves deep into the realms of user preferences, satisfaction levels, and the very essence of usability.

The need for standardized evaluation metrics becomes apparent. In the ever-evolving landscape of chatbot technology, it's crucial to establish benchmarks that serve as a compass for assessing chatbot performance. These standardized metrics extend their reach, encompassing facets such as response time, accuracy, and the pivotal factor of user satisfaction. These metrics, akin to guiding stars, enable consistent and meaningful assessments, enhancing the quality and effectiveness of chatbot solutions.

In this intricate dance between technology and society, a compelling narrative emerges—one that recognizes the augmentative power of chatbots in enhancing cultural heritage experiences. These virtual companions serve as illuminating guides, adding a layer of depth to the visitor's journey into the past. However, the balance must be struck; chatbots, despite their knowledge and capabilities, should be perceived as supplements rather than replacements for human expertise and the wealth of cultural knowledge held by experts. It's a partnership where chatbots complement the guidance of human curators and historians, collectively weaving a rich tapestry of heritage understanding.

As we navigate this intricate relationship between chatbots, technology, and society, it is evident that these advances should uplift rather than diminish human experiences. The proactive dialogue between technology and society is not merely a dialogue but a commitment—a commitment to ensure that technological progress serves as a catalyst for enhancing human existence. This exploration seeks to reinforce the idea that technology, including chatbots, should be harnessed to augment, enrich, and elevate the human experience, ensuring that it remains at the heart of every technological advancement.

Through an examination of diverse evaluation frameworks pertaining to the intersection of computer technology and society, namely Embodied Theory, Computers As Social Actors Framework (CASA), Uses And Gratification (UGT), Cognitive Theory, Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Heart Metric for User Experience (UI/UX), it is possible to generate insights regarding the existing gap in the implementation of chatbots. These

insights provide a foundation for understanding how chatbots can be designed and integrated to enhance the human experience while considering the intricacies of technology and society's interplay.

4.4. Ethical, Privacy, and Linguistic Dimensions

Incorporating chatbots in cultural heritage contexts presents a range of intricate issues encompassing ethical, privacy, and linguistic dimensions, necessitating a thorough analysis. The problems at hand cover not just the ethical and privacy considerations associated with chatbot interactions but also delve into the complex realm of language nuances and cultural boundaries.

Within the domain of ethics and privacy, chatbots are required to negotiate a precarious equilibrium carefully. These individuals function within cultural heritage environments, wherein the material they interact with have significant historical and emotional importance. Hence, it is imperative for research to thoroughly examine not only the veracity and legitimacy of the information disseminated by chatbots but also the wider ethical implications associated with their utilization.

For example, are virtual guides successfully uphold the holiness and integrity of cultural artifacts and tales, or do they unintentionally create the potential for misinformation or distortion? In addition, it is imperative to ensure the diligent protection of the privacy of individuals who engage with chatbots, especially when personal information and preferences are involved. Ensuring strict adherence to robust privacy rules is of utmost importance in maintaining the confidence of tourists and upholding the sanctity of cultural heritage sites.

Simultaneously, the linguistic difficulties associated with the implementation of cultural heritage chatbot applications are similarly arduous. Chatbots are required to adeptly handle the various linguistic complexities that are inherent in historical and cultural narratives. To successfully accomplish this task, one must possess a deep comprehension of the intricacies inherent in languages and the cultural subtleties that significantly influence the understanding and communication of legacy material. The acquisition of a high degree of linguistic and cultural competence is crucial in order to guarantee that chatbots effectively communicate information while also demonstrating the utmost respect and sensitivity towards the many backgrounds and perspectives of users.

Fundamentally, the matter at hand is not exclusively focused on language itself, but rather on comprehending the cultural framework within which language is intricately intertwined. The successful implementation of cultural heritage chatbot applications necessitates addressing these complex problems. In this context, chatbots play a dual role as both expert advisors and cultural ambassadors, facilitating a deep connection between tourists and the diverse fabric of our shared history.

5. Conclusion

5.1. Summary of Key Findings

Using the concise plan for chatbot development as depicted in Fig. 7, the potential of chatbots in the cultural heritage ecosystem can be realised in light of the findings. This research successfully the rule-based and generative AI chatbots approaches have distinct advantages and disadvantages. For example, some domains that have successfully implemented chatbots, starting from Sephora, Apple, Bank of America, Woebot, and Duolingo are some of the successful chatbot implementations in various industries. Woebot offers cognitive behavioral therapy techniques and emotional support to users, while Duolingo provides interactive language exercises and personalized feedback.

In the customer service domain, companies such as Bank of America and Apple have implemented chatbots to provide fast and efficient assistance, reducing the need for human intervention and increasing customer satisfaction. In the e-commerce domain, Sephora's Sephora Virtual Artist enhances the online shopping experience and increases customer engagement. In the agriculture domain, Thai Smart Agriculture's chatbot provides real-time weather updates, crop

management advice and pest control recommendations, helping farmers make informed decisions and optimize farming practices.

Rule-based and generative AI chatbots, the two basic approaches to chatbot development, have seen substantial evolution. The earliest examples of rule-based chatbots, like ELIZA, relied on established sets of rules and patterns to react to user inputs. They work best in situations when dialogues can be written and in structured encounters. In contrast, generative AI chatbots have expanded the capabilities of conversational agents thanks to technologies like transformer-based models.

Based on the outcomes of this research, the advantages and disadvantages of rule-based and generative AI may be outlined as follows. Rule-based chatbots are simple and straightforward to design and implement, excelling in structured and predictable interactions. They provide a high degree of control over conversation flow and responses, ensuring they adhere to predefined rules. However, rule-based chatbots have limitations, such as limited flexibility and difficulty in handling complex or unexpected user queries. They also struggle to grasp the nuances of natural language and context, resulting in less human-like interactions.

Generative AI chatbots, such as ChatGPT, offer unique advantages, excelling in open-ended conversations and fostering dynamic user experiences. They can be trained on large datasets and adjusted to various domains and topics, making them versatile and applicable across a wide range of use cases. However, generative AI chatbots also bring ethical concerns, as their responses can sometimes include misinformation, biased content, or potentially malicious use. They require substantial amounts of high-quality training data to achieve optimal performance, which can be challenging to acquire in certain specialized domains.

Choosing the right chatbot approach is crucial in chatbot development, as it aligns with the specific requirements and ethical considerations of the intended application. Rule-based chatbots offer structured interactions and control, but have limitations such as limited flexibility and scalability. Generative AI chatbots, on the other hand, offer open-ended conversations, adaptability, and language understanding. However, they also face ethical concerns, data requirements, and lack of control. The evolution of chatbots, from rule-based to generative AI, varies depending on the specific implementation and context.

Due to their excellent adaptability and utility, chatbots are created for a wide range of domains. They provide a host of advantages in each of these fields, including increased productivity, openness, and scalability. Chatbots are excellent at holding natural conversations in virtual dialogue and giving users real-time feedback, which improves user experiences. In education, they help in query resolution, provide individualized learning experiences, and lighten the load on teachers. Chatbots eliminate monotonous operations for businesses and organizations, promote user engagement, and improve customer service. Chatbots provide prompt responses in customer support, improving the department's effectiveness. They contribute significantly to healthcare by sharing knowledge, providing mental health assistance, and even helping with pandemic response operations. Additionally, chatbots gather essential data, resulting in data-driven insights.

For example, of the influence of Transformer models have significantly impacted the classification of radiology reports related to lung cancer. In a study titled “Development and validation of deep learning and Transformer for classification of lung cancer radiology reports” researchers used Transformer models to classify radiology reports into various categories, such as tumor size, lymph node involvement, and metastasis. This application of Transformer based models in real-world scenarios improves the classification and analysis of medical text, providing valuable insights for healthcare professionals and researchers. Another example is the classification of toxic comments on social media, where researchers fine-tuned a Transformer base model to achieve high accuracy in identifying and classifying toxic content. The diverse technological applications of NLP can be utilized in the context of cultural heritage encompassing a wide variety of uses aimed at

preserving, promoting, and enhancing our understanding and appreciation of the world's cultural heritage.

These important findings show the value of chatbots in several sectors. This paper aims to emphasize the trade-offs associated with rule-based and generative AI, especially in the domain of NLP methodologies. In addition, the utilization of chatbots has the capacity to enhance user experience and facilitate knowledge acquisition, thus offering advantages in various domains, including education, virtual assistants and business services. Moreover, by delving deeper into this technology, these sectors can be expanded to include cultural heritage services, thereby significantly strengthening cultural preservation efforts. The insights gained from this SLR have the potential to contribute significantly to the advancement of chatbots and NLP as a comprehensive field. In addition, these insights may have far-reaching implications for the future development and application of AI technologies in other areas.

The research limitations and future research prospects of this study are as follows, the problem in this study is that the sample size is too small to cover the entire chatbot area well, and the existing papers are not sufficiently dispersed in terms of demographics, which may affect the results so that in the future there is a need for more comprehensive chatbot domain mapping. Furthermore, the planning or research methods section has limitations that can make it difficult to follow the steps, so future research needs to create a roadmap that is simple but can explain a lot of meaning. In terms of technology, the limitation of the research is that it only provides observations of chatbots related to trending domains, this means that the results may not apply to all chatbots so there needs to be an effort to expand the target of chatbot implementation in future research.

5.2. Implications

SLR presented here has significant implications for chatbots and NLP. The abundance of research on generative AI chatbots highlights the potential and need for continued investigation to address critical questions and challenges. The significance of enhancing chatbot skills in practical situations is shown by these findings, which encompass several aspects such as enhancing conversation flow, optimizing user pleasure, and enabling customization. As chatbots continue to be utilized in many domains such as education, business, customer service, and healthcare, it is imperative for research to explore their long-term effects, scalability, and adaptability.

Ethical considerations, especially in the context of culture heritage, demand thorough exploration, alongside in-depth studies of the influence of design, personality, and emotion on user experience. In addition, the integration of chatbots with emerging technologies is still an interesting area for further research. By addressing the implications of this research, we can improve user experience and simplify interactions across multiple domains while upholding the highest standards of effectiveness and ethical responsibility. Ways of addressing these ethical concerns through collaboration between researchers, industry experts, and cultural institutions are essential in unlocking the full potential of generative AI chatbots and their diverse applications.

Supplementary Materials: supporting information can be downloaded at: https://s.id/SupplementSLR_RCB

Author Contribution: All authors contributed equally to the main contributor to this paper. All authors read and approved the final paper.

Funding: This research received no external funding.

Acknowledgment: We would like to thank the University of Pembangunan Nasional “Veteran” Jawa Timur for supporting us to be able to carry out further studies. Thanks also to the University of State Malang for guiding us to conduct research in this field. And of course, thanks to the members MSI Laboratory UPNVJT.

Conflicts of Interest: The authors declare no conflict of interest.

References

[1] L. Cui, S. Huang, F. Wei, C. Tan, C. Duan, and M. Zhou, "SuperAgent: A Customer Service Chatbot for E-commerce Websites," *Proceedings of ACL 2017, System Demonstrations*, pp. 97–102, 2017, https://doi.org/10.18653/v1/P17-4017.

[2] P. D. Larasati, A. Irawan, S. Anwar, M. F. Mulya, M. A. Dewi, and I. Nurfatima, "Chatbot helpdesk design for digital customer service," *Applied Engineering and Technology*, vol. 1, no. 3, pp. 138–145, 2022, https://doi.org/10.31763/aet.v1i3.684.

[3] C. V. Misischia, F. Poecze, and C. Strauss, "Chatbots in customer service: Their relevance and impact on service quality," *Procedia Computer Science*, vol. 201, pp. 421–428, 2022, https://doi.org/10.1016/j.procs.2022.03.055.

[4] H. S. Putra, H. Santoso, and C. Cifran, "Implementation of Chatbot Customer Service Features on PT Dian Prima Jayaraya Using Dialogflow," *Infotech: Journal of Technology Information*, vol. 8, no. 2, pp. 143–148, 2022, https://doi.org/10.37365/jti.v8i2.151.

[5] R. Sharma, A. Kumar, and C. Chuah, "Turning the blackbox into a glassbox: An explainable machine learning approach for understanding hospitality customer," *International Journal of Information Management Data Insights*, vol. 1, no. 2, p. 100050, 2021, https://doi.org/10.1016/j.jjimei.2021.100050.

[6] D. N. Sousa, M. A. Brito, and C. Argainha, "Virtual customer service: building your chatbot," *Proceedings of the 3rd International Conference on Business and Information Management*, pp. 174–179, 2019, https://doi.org/10.1145/3361785.3361805.

[7] W. Huang, K. F. Hew, and L. K. Fryer, "Chatbots for language learning—Are they really useful? A systematic review of chatbot-supported language learning," *Journal of Computer Assisted Learning*, vol. 38, no. 1, pp. 237-257, 2022, https://doi.org/10.1111/jcal.12610.

[8] H. G. Cavalcante *et al.*, "Developing chatbots in the field of healthcare: A systematic review," *Anais do XIV Encontro Unificado de Computação do Piauí (Enucompi)*, pp. 192–199, 2021, https://doi.org/10.5753/enucompi.2021.17771.

[9] K. Denecke and R. May, "Investigating conversational agents in healthcare: Application of a technical-oriented taxonomy," *Procedia Computer Science*, vol. 219, pp. 1289–1296, 2023, https://doi.org/10.1016/j.procs.2023.01.413.

[10] E. Mbunge and J. Batani, "Application of deep learning and machine learning models to improve healthcare in sub-Saharan Africa: Emerging opportunities, trends and implications," *Telematics and Informatics Reports*, vol. 11, p. 100097, 2023, https://doi.org/10.1016/j.teler.2023.100097.

[11] G. Niranjana and D. S. Trinadh, "A Review on Healthcare Services Using Dual Chatbots as Conversational Agents," *International Journal for Research in Applied Science & Engineering Technology*, vol. 10, no. 1, pp. 1295–1300, 2022, https://doi.org/10.22214/ijraset.2022.40014.

[12] A. Prasad, B. S. S. S. Jennifer, D. Ghsoh, H. Busshetty, and T. J. Thirukrishna, "Chatbot in Healthcare," *International Journal of Engineering Research in Computer Science and Engineering*, vol. 9, no. 11, pp. 26–28, 2022, https://doi.org/10.36647/IJERCSE/09.11.Art008.

[13] A. F. Ur Rahman Khilji, S. R. Laskar, P. Pakray, R. A. Kadir, M. S. Lydia, and S. Bandyopadhyay, "HealFavor: Dataset and A Prototype System for Healthcare ChatBot," *2020 International Conference on Data Science, Artificial Intelligence, and Business Analytics (DATABIA)*, pp. 1-4, 2020, https://doi.org/10.1109/DATABIA50434.2020.9190281.

[14] B. Kidwai and N. Rk, "Design and Development of Diagnostic Chabot for supporting Primary Health Care Systems," *Procedia Computer Science*, vol. 167, pp. 75–84, 2020, https://doi.org/10.1016/j.procs.2020.03.184.

[15] P. M. Shafi, G. S. Jawalkar, M. A. Kadam, R. R. Ambawale, and S. V. Bankar, "AI—Assisted Chatbot for E-Commerce to Address Selection of Products from Multiple Products," *Internet of Things, Smart Computing and Technology: A Roadmap Ahead*, pp. 57–80, 2020, https://doi.org/10.1007/978-3-030-39047-1_3.

[16] S. M. González, D. G. Taño, and J. B. Gidumal, "Predicting the intentions to use chatbots for travel and tourism," *Current Issues in Tourism*, vol. 24, no. 2, pp. 192–210, 2021, https://doi.org/10.1080/13683500.2019.1706457.

[17] B. El Bakkouri, S. Raki, and T. Belgnaoui, "The Role of Chatbots in Enhancing Customer Experience: Literature Review," *Procedia Computer Science*, vol. 203, pp. 432–437, 2022, https://doi.org/10.1016/j.procs.2022.07.057.

[18] E. Harbinja, L. Edwards, and M. McVey, "Governing ghostbots," *Computer Law and Security Review*, vol. 48, p. 105791, 2023, https://doi.org/10.1016/j.clsr.2023.105791.

[19] S. B. Abu and E. Atwell, "A chatbot as a Question Answering Tool," *2015 International Conference on Advances in Software, Control and Mechanical Engineering (ICSCME'2015)*, pp. 1-6, 2015, http://uruae.urst.org/siteadmin/upload/7422U0915120.pdf.

[20] J. Huang *et al.*, "TeenChat: A Chatterbot System for Sensing and Releasing Adolescents' Stress," *Health Information Science: 4th International Conference*, pp. 133–145, 2015, https://doi.org/10.1007/978-3-319-19156-0_14.

[21] B. AbuShawar and E. Atwell, "ALICE Chatbot: Trials and Outputs," *Computación y Sistemas*, vol. 19, no. 4, 2015, https://doi.org/10.13053/cys-19-4-2326.

[22] A. Sordoni *et al.*, "A Neural Network Approach to Context-Sensitive Generation of Conversational Responses," *A Neural Network Approach to Context-Sensitive Generation of Conversational Responses*, pp. 196–205, 2015, https://doi.org/10.3115/v1/N15-1020.

[23] J. Hill, W. Randolph Ford, and I. G. Farreras, "Real conversations with artificial intelligence: A comparison between human–human online conversations and human–chatbot conversations," *Computer in Human Behavior*, vol. 49, pp. 245–250, 2015, https://doi.org/10.1016/j.chb.2015.02.026.

[24] A. A. Kurniawan, W. E. Fachri, A. Elevanita, Suryadi, and R. D. Agushinta, "Design of chatbot with 3D avatar, voice interface, and facial expression," *2015 International Conference on Science in Information Technology (ICSITech)*, pp. 326-330, 2015, https://doi.org/10.1109/ICSITech.2015.7407826.

[25] J. Pereira, "Leveraging chatbots to improve self-guided learning through conversational quizzes," *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality*, pp. 911–918, 2016, https://doi.org/10.1145/3012430.3012625.

[26] S. Mallios and N. Bourbakis, "A survey on human machine dialogue systems," *2016 7th International Conference on Information, Intelligence, Systems & Applications (IISA)*, pp. 1-7, 2016, https://doi.org/10.1109/IISA.2016.7785371.

[27] S. Z. Razavi, M. R. Ali, T. H. Smith, L. K. Schubert, and M. Hoque, "The LISSA Virtual Human and ASD Teens: An Overview of Initial Experiments," *Intelligent Virtual Agents: 16th International Conference*, pp. 460–463, 2016, https://doi.org/10.1007/978-3-319-47665-0_55.

[28] A. Bresó, J. M. Miranda, C. Botella, R. M. Baños, and J. M. García-Gómez, "Usability and acceptability assessment of an empathic virtual agent to prevent major depression," *Expert Systms*, vol. 33, no. 4, pp. 297–312, 2016, https://doi.org/10.1111/exsy.12151.

[29] H. Shah, K. Warwick, J. Vallverdú, and D. Wu, "Can machines talk? Comparison of Eliza with modern dialogue systems," *Computer Human Behavior*, vol. 58, pp. 278–295, 2016, https://doi.org/10.1016/j.chb.2016.01.004.

[30] L. Lin, L. F. D'Haro, and R. Banchs, "A Web-based Platform for Collection of Human-Chatbot Interactions," *Proceedings of the Fourth International Conference on Human Agent Interaction*, pp. 363–366, 2016, https://doi.org/10.1145/2974804.2980500.

[31] J. Li, M. Galley, C. Brockett, G. P. Spithourakis, J. Gao, and B. Dolan, "A Persona-Based Neural Conversation Model," *Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pp. 994-1003, 2016, https://doi.org/10.18653/v1/P16-1094.

[32] S. So, "Mobile instant messaging support for teaching and learning in higher education," The *Internet and Higher Education*, vol. 31, pp. 32–42, 2016, https://doi.org/10.1016/j.iheduc.2016.06.001.

[33] J. Li, M. Galley, C. Brockett, J. Gao, and B. Dolan, "A Diversity-Promoting Objective Function for Neural Conversation Models," *Proceedings of the 2016 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, pp. 110–119, 2016, https://doi.org/10.18653/v1/N16-1014.

[34] B. Setiaji and F. W. Wibowo, "Chatbot Using a Knowledge in Database: Human-to-Machine Conversation Modeling," *2016 7th International Conference on Intelligent Systems, Modelling and Simulation (ISMS)*, pp. 72-77, 2016, https://doi.org/10.1109/ISMS.2016.53.

[35] L. C. Klopfenstein, S. Delpriori, S. Malatini, and A. Bogliolo, "The Rise of Bots," *Proceedings of the 2017 Conference on Designing Interactive Systems*, pp. 555–565, 2017, https://doi.org/10.1145/3064663.3064672.

[36] S. Sato, N. Yoshinaga, M. Toyoda, and M. Kitsuregawa, "Modeling Situations in Neural Chat Bots," *Proceedings of ACL 2017, Student Research Workshop*, pp. 120–127, 2017, https://doi.org/10.18653/v1/P17-3020.

[37] C. Thorne, "Chatbots for troubleshooting: A survey," *Language and Linguistics Compass*, vol. 11, no. 10, p. e12253, 2017, https://doi.org/10.1111/lnc3.12253.

[38] A. M. Rahman, A. A. Mamun, and A. Islam, "Programming challenges of chatbot: Current and future prospective," *2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC)*, pp. 75-78, 2017, https://doi.org/10.1109/R10-HTC.2017.8288910.

[39] J.-X. Huang, K.-S. Lee, O.-W. Kwon, and Y.-K. Kim, "A chatbot for a dialogue-based second language learning system," *CALL in a climate of change: adapting to turbulent global conditions – short papers from EUROCALL 2017*, pp. 151–1562017, 2017, https://doi.org/10.14705/rpnet.2017.eurocall2017.705.

[40] L. K. Fryer, M. Ainley, A. Thompson, A. Gibson, and Z. Sherlock, "Stimulating and sustaining interest in a language course: An experimental comparison of Chatbot and Human task partners," *Computers Human in Behavior*, vol. 75, pp. 461–468, 2017, https://doi.org/10.1016/j.chb.2017.05.045.

[41] Y. Ishida and R. Chiba, "Free Will and Turing Test with Multiple Agents: An Example of Chatbot Design," *Procedia Computer Science*, vol. 112, pp. 2506–2518, 2017, https://doi.org/10.1016/j.procs.2017.08.190.

[42] B. R. Ranoliya, N. Raghuwanshi, and S. Singh, "Chatbot for university related FAQs," *2017 International Conference on Advances in Computing, Communications and Informatics (ICACCI)*, pp. 1525-1530, 2017, https://doi.org/10.1109/ICACCI.2017.8126057.

[43] A. Følstad and P. B. Brandtzæg, "Chatbots and the new world of HCI," *Interactions*, vol. 24, no. 4, pp. 38–42, 2017, https://doi.org/10.1145/3085558.

[44] B. Galitsky and D. Ilvovsky, "Chatbot with a Discourse Structure-Driven Dialogue Management," *Proceedings of the Software Demonstrations of the 15th Conference of the European Chapter of the Association for Computational Linguistics*, pp. 87–90, 2017, https://doi.org/10.18653/v1/E17-3022.

[45] L. Zhou, J. Gao, D. Li, and H.-Y. Shum, "The Design and Implementation of XiaoIce, an Empathetic Social Chatbot," *Computational Linguistics*, vol. 46, no. 1, pp. 53–93, 2018, https://doi.org/10.1162/coli_a_00368.

[46] L. D. Krisnawati, B. E. Butar-Butar, and G. Virginia, "Prototyping a Chatbot for Student Supervision in a Pre-Registration Process," *CommIT (Communication and Information Technology) Journal*, vol. 12, no. 2, p. 87, 2018, https://doi.org/10.21512/commit.v12i2.4813.

[47] J. Lehvä, N. Mäkitalo, and T. Mikkonen, "Case Study: Building a Serverless Messenger Chatbot," *Current Trends in Web Engineering*, pp. 75–86, 2018, https://doi.org/10.1007/978-3-319-74433-9_6.

[48] A. Rapp, L. Curti, and A. Boldi, "The human side of human-chatbot interaction: A systematic literature review of ten years of research on text-based chatbots," *International Journal of Human-Computer Studies*, vol. 151, p. 102630, 2021, https://doi.org/10.1016/j.ijhcs.2021.102630.

[49] H. Yamaguchi, M. Mozgovoy, and A. Danielewicz-betz, "A Chatbot Based On AIML Rules Extracted From Twitter Dialogues," *Communication Papers of the Federated Conference on Computer Science and Information Systems*, vol. 17, pp. 37–42, 2018, https://annals-csis.org/Volume_17/drp/pdf/297.pdf.

[50] A. Mondal, M. Dey, D. Das, S. Nagpal, and K. Garda, "Chatbot: An automated conversation system for the educational domain," *2018 International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP)*, pp. 1-5, 2018, https://doi.org/10.1109/iSAI-NLP.2018.8692927.

[51] S. AlHumoud, A. A. Wazrah, and W. Aldamegh, "Arabic Chatbots: A Survey," *International Journal of Advanced Computer Science and Applications*, vol. 9, no. 8, 2018, https://doi.org/10.14569/IJACSA.2018.090867.

[52] J. Gao, M. Galley, and L. Li. *Neural Approaches to Conversational AI: Question Answering, Task-oriented Dialogues and Social Chatbot*. Now Foundations and Trends, 2019, https://doi.org/10.1561/1500000074.

[53] A. Rahate, S. Chitnis, L. Talekar, and P. Chandratre, "UrbanAssist: An Interactive Virtual Assistant for Smart Urbanism," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 6, no. 4, pp. 3835–3841, 2018, https://doi.org/10.22214/ijraset.2018.4634.

[54] X. Sun, X. Chen, Z. Pei, and F. Ren, "Emotional Human Machine Conversation Generation Based on SeqGAN," *2018 First Asian Conference on Affective Computing and Intelligent Interaction (ACII Asia)*, pp. 1-6, 2018, https://doi.org/10.1109/ACIIAsia.2018.8470388.

[55] E. Tallyn, H. Fried, R. Gianni, A. Isard, and C. Speed, "The Ethnobot: Gathering Ethnographies in the Age of IoT," *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, pp. 1–13, 2018, https://doi.org/10.1145/3173574.3174178.

[56] Y. Jeong, J. Suk, J. Hong, D. Kim, K. O. Kim, and H. Hwang, "Text Mining of Online News and Social Data About Chatbot Service," *International Conference on Human-Computer Interaction*, pp. 429-434, 2018, https://doi.org/10.1007/978-3-319-92270-6_61.

[57] F. Clarizia, F. Colace, M. Lombardi, F. Pascale, and D. Santaniello, "Chatbot: An Education Support System for Student," *International Symposium on Cyberspace Safety and Security*, pp. 291–302, 2018, https://doi.org/10.1007/978-3-030-01689-0_23.

[58] A. P. Santos Alves, D. Oliveira Gherard de Alencar, A. M. Gonçalo Filho, S. Costa Paiva, and D. Barbosa Feres Carvalho, "Development and Evaluation of a Chatbot for the Regional Museum of São João del-Rei," *2018 XLIV Latin American Computer Conference (CLEI)*, pp. 388-397, 2018, https://doi.org/10.1109/CLEI.2018.00054.

[59] L. Laranjo *et al.*, "Conversational agents in healthcare: a systematic review," *Journal of the American Medical Informatics Association*, vol. 25, no. 9, pp. 1248–1258, 2018, https://doi.org/10.1093/jamia/ocy072.

[60] F. Castro *et al.*, "Developing a Corporate Chatbot for a Customer Engagement Program: A Roadmap," *International Conference on Intelligent* Computing, pp. 400-412, 2018, https://doi.org/10.1007/978-3-319-95930-6_37.

[61] H. Shum, X. He, and D. Li, "From Eliza to XiaoIce: challenges and opportunities with social chatbots," *Frontiers of Information Technology & Electronic Engineering*, vol. 19, no. 1, pp. 10–26, 2018, https://doi.org/10.1631/FITEE.1700826.

[62] B. Inkster, S. Sarda, and V. Subramanian, "An Empathy-Driven, Conversational Artificial Intelligence Agent (Wysa) for Digital Mental Well-Being: Real-World Data Evaluation Mixed-Methods Study," *JMIR Mhealth Uhealth*, vol. 6, no. 11, p. e12106, 2018, https://doi.org/10.2196/12106.

[63] M. H. Luerssen and T. Hawke, "Virtual agents as a service: Applications in healthcare," *Proceedings of the 18th International Conference on Intelligent Virtual Agents*, pp. 107-112, 2018, https://doi.org/10.1145/3267851.3267858.

[64] B. Kohli, T. Choudhury, S. Sharma and P. Kumar, "A Platform for Human-Chatbot Interaction Using Python," *2018 Second International Conference on Green Computing and Internet of Things (ICGCIoT)*, pp. 439-444, 2018, https://doi.org/10.1109/ICGCIoT.2018.8753031.

[65] R. Singh, M. Paste, N. Shinde, H. Patel and N. Mishra, "Chatbot using TensorFlow for small Businesses," *2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)*, pp. 1614-1619, 2018, https://doi.org/10.1109/ICICCT.2018.8472998.

[66] X. L. Pham, T. Pham, Q. M. Nguyen, T. H. Nguyen, and T. T. H. Cao, "Chatbot as an Intelligent Personal Assistant for Mobile Language Learning," *Proceedings of the 2018 2nd International Conference on Education and E-Learning*, pp. 16-21, 2018, https://doi.org/10.1145/3291078.3291115.

[67] F. Colace, M. De Santo, M. Lombardi, F. Pascale, A. Pietrosanto, and S. Lemma, "Chatbot for E-Learning: A Case of Study," *International Journal of Mechanical Engineering and Robotics Research*, pp. 528–533, 2018, https://doi.org/10.18178/ijmerr.7.5.528-533.

[68] B. Eicher, L. Polepeddi, and A. Goel, "Jill Watson doesn't care if you're pregnant: Grounding AI ethics in empirical studies," *Proceedings of the 2018 AAAI/ACM Conference on AI, Ethics, and Society*, pp. 88–94, 2018, https://doi.org/10.1145/3278721.3278760.

[69] V. Koumaras, A. Foteas, A. Papaioannou, M. Kapari, C. Sakkas, and H. Koumaras, "5G Performance Testing of Mobile Chatbot Applications," *2018 IEEE 23rd International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD)*, pp. 1-6, 2018, https://doi.org/10.1109/CAMAD.2018.8515004.

[70] J. Pereira and O. Díaz, "A quality analysis of facebook messenger's most popular chatbots," *Proceedings of the 33rd Annual ACM Symposium on Applied Computing*, pp. 2144-2150, 2018, https://doi.org/10.1145/3167132.3167362.

[71] M. Ghazvininejad *et al.*, "A Knowledge-Grounded Neural Conversation Model," *Proceedings of the AAAI Conference on Artificial Intelligence*, vol. 32, no. 1, 2018, https://doi.org/10.1609/aaai.v32i1.11977.

[72] A. P. Chaves and M. A. Gerosa, "How should my chatbot interact? A survey on social characteristics in human–chatbot interaction design," *International Journal of Human–Computer Interaction*, vol. 37, no. 8, pp. 729-758, 2021, https://doi.org/10.1080/10447318.2020.1841438.

[73] L. C. Klopfenstein, S. Delpriori, and A. Ricci, "Adapting a Conversational Text Generator for Online Chatbot Messaging," *International Conference on Internet Science*, pp. 87-99, 2019, https://doi.org/10.1007/978-3-030-17705-8_8.

[74] S. Bibauw, T. François, and P. Desmet, "Discussing with a computer to practice a foreign language: research synthesis and conceptual framework of dialogue-based CALL," *Computer Assisted Language Learning*, vol. 32, no. 8, pp. 827–877, 2019, https://doi.org/10.1080/09588221.2018.1535508.

[75] J. Feine, U. Gnewuch, S. Morana, and A. Maedche, "A Taxonomy of Social Cues for Conversational Agents," *International Journal of Human-Computer Studies*, vol. 132, pp. 138–161, 2019, https://doi.org/10.1016/j.ijhcs.2019.07.009.

[76] B. Galitsky and D. Ilvovsky, "On a chatbot conducting virtual dialogues," *Proceedings of the 28th ACM International Conference on Information and Knowledge Management*, pp. 2925–2928, 2019, https://doi.org/10.1145/3357384.3357842.

[77] M. Stojanov, "Prospects for Chatbots," *Izvestia Journal of the Union of Scientists - Varna. Economic Sciences Series*, vol. 8, no. 3, pp. 10–16, 2019, https://doi.org/10.36997/IJUSV-ESS/2019.8.3.10.

[78] V. K. Sree, G. Sahitya, C. Kaushik, G. Sahitya, and R. Rohan, "Various Real Time Chat Bots and Their Applications in Human Life," *International Journal of Recent Technology and Engineering (IJRTE)*, vol. 8, no. 4, pp. 3461–3467, 2019, http://www.doi.org/10.35940/ijrte.D6902.118419.

[79] Y. Windiatmoko, R. Rahmadi, A. F. Hidayatullah, D. Kovacek, and J. C. L. Chow, "Rule-based chabot for student enquiries Rule-based chabot for student enquiries," *Journal of Physics: Conference Series,* vol. 1228, no. 1, p. 012060, 2019, https://doi.org/10.1088/1742-6596/1228/1/012060.

[80] G. N. Kumar, D. Sreenivasarao, and S. K. Saheb, "Chatbot and its Practical Applications in the Materialistic World," *International Journal of Recent Technology and Engineering (IJRTE)*, vol. 8, no. 4, pp. 4459–4463, 2019, http://www.doi.org/10.35940/ijrte.D8396.118419.

[81] B. Galitsky, D. Ilvovsky, and E. Goncharova, "On a chatbot providing virtual dialogues," *Proceedings - Natural Language Processing in a Deep Learning World*, pp. 382–387, 2019, https://doi.org/10.26615/978-954-452-056-4_045.

[82] Q. Xie *et al.*, "Chatbot Application on Cryptocurrency," *2019 IEEE Conference on Computational Intelligence for Financial Engineering & Economics (CIFEr)*, pp. 1-8, 2019, https://doi.org/10.1109/CIFEr.2019.8759121.

[83] M. Bates, "Health Care Chatbots Are Here to Help," *IEEE Pulse*, vol. 10, no. 3, pp. 12-14, 2019, https://doi.org/10.1109/MPULS.2019.2911816.

[84] N. Belgaumwala and Rajashekarappa, "Chatbot: A Virtual Medical Assistant," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 7, no. 6, pp. 1042–1050, 2019, https://doi.org/10.22214/ijraset.2019.6179.

[85] S. Prasomphan, "Using Chatbot in Trading System for Small and Medium Enterprise (SMEs) by Convolution Neural Network Technique," *Proceedings of the 2019 3rd High Performance Computing and Cluster Technologies Conference*, pp. 93-98, 2019, https://doi.org/10.1145/3341069.3341092.

[86] S. Jeong and Y. Seo, "Improving response capability of chatbot using twitter," *Journal of Ambient Intelligence and Humanized Computing*, pp. 1-14, 2019, https://doi.org/10.1007/s12652-019-01347-6.

[87] C. B. R. Mohan, A. B. Divi, A. Venkatesh, and B. S. Teja, "Chatbot for University Resource Booking," *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, pp. 113-116, 2019, https://doi.org/10.32628/CSEIT1951144.

[88] P. Widyaningrum, Y. Ruldeviyani, and R. Dharayani, "Sentiment analysis to assess the community's enthusiasm towards the development chatbot using an appraisal theory," *Procedia Computer Science*, vol. 161, pp. 723-730, 2019, https://doi.org/10.1016/j.procs.2019.11.176.

[89] I. Safiulin, N. Butakov, D. Alexandrov, and D. Nasonov, "Ensemble-based method of answers retrieval for domain specific questions from text-based documentation," *Procedia Computer Science*, vol. 156, pp. 158–165, 2019, https://doi.org/10.1016/j.procs.2019.08.191.

[90] R. Liu and Z. Dong, "A Study of User Experience in Knowledge-Based QA Chatbot Design," *International Conference on Intelligent Human Systems Integration*, pp. 589–593, 2019, https://doi.org/10.1007/978-3-030-11051-2_89.

[91] R. M. Schuetzler, G. M. Grimes, and J. S. Giboney, "The effect of conversational agent skill on user behavior during deception," *Computers in Human Behavior*, vol. 97, pp. 250–259, 2019, https://doi.org/10.1016/j.chb.2019.03.033.

[92] A. A. Abd-alrazaq, M. Alajlani, A. A. Alalwan, B. M. Bewick, P. Gardner, and M. Househ, "An overview of the features of chatbots in mental health: A scoping review," *International Journal of Medical Informatics*, vol. 132, p. 103978, 2019, https://doi.org/10.1016/j.ijmedinf.2019.103978.

[93] A. N. Vaidyam, H. Wisniewski, J. D. Halamka, M. S. Kashavan, and J. B. Torous, "Chatbots and Conversational Agents in Mental Health: A Review of the Psychiatric Landscape," *The Canadian Journal of Psychiatry*, vol. 64, no. 7, pp. 456–464, 2019, https://doi.org/10.1177/0706743719828977.

[94] S. V. Sonawane and S. R, "ChatBot for College Website," *International Journal of Innovative Technology and Exploring Engineering*, vol. 8, no. 10, pp. 566–569, 2019, http://doi.org/10.35940/ijitee.J8867.0881019.

[95] V. Selvi, S. Saranya, K. Chidida, and R. Abarna, "Chatbot and bullyfree Chat," *2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN)*, pp. 1-5, 2019, https://doi.org/10.1109/ICSCAN.2019.8878779.

[96] R. Sutoyo, A. Chowanda, A. Kurniati, and R. Wongso, "Designing an emotionally realistic chatbot framework to enhance its believability with AIML and information states," *Procedia Computer Science*, vol. 157, pp. 621–628, 2019, https://doi.org/10.1016/j.procs.2019.08.226.

[97] P. MacEclo, C. Pereira, P. Mota, D. Silva, A. Frade, and R. N. Madeira, "Conversational agent in mhealth to empower people managing Parkinson's disease," *Procedia Computer Science*, vol. 160, pp. 402-408, 2019, https://doi.org/10.1016/j.procs.2019.08.226.

[98] S. Ondáš, M. Pleva, and D. Hládek, "How chatbots can be involved in the education process," *2019 17th International Conference on Emerging eLearning Technologies and Applications (ICETA)*, pp. 575-580, 2019, https://doi.org/10.1109/ICETA48886.2019.9040095.

[99] J. Ghorpade-Aher, S. Kukreja, T. Karpe, S. Kakkad, and R. Kontamwar "Chatbot: A User Service for College," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 7, no. 5, pp. 3905–3909, 2019, https://doi.org/10.22214/ijraset.2019.5642.

[100] A. Yorita, S. Egerton, C. Chan, and N. Kubota, "Chatbot for Peer Support Realization based on Mutual Care," *2020 IEEE Symposium Series on Computational Intelligence (SSCI)*, pp. 1601-1606, 2020, https://doi.org/10.1109/SSCI47803.2020.9308277.

[101] M. P. Nath and S. Sagnika, "Capabilities of Chatbots and Its Performance Enhancements in Machine Learning," *Machine Learning and Information Processing*, vol. 1101, pp. 183-192, 2020, https://doi.org/10.1007/978-981-15-1884-3_17.

[102] J. Fernandes *et al.*, "ISABELA – A Socially-Aware Human-in-the-Loop Advisor System," *Online Social Networks and Media*, vol. 16, p. 100060, 2020, https://doi.org/10.1016/j.osnem.2020.100060.

[103] A. F. Sugondo and R. Bahana, "Chatbot as an Alternative Means to Access Online Information Systems," *IOP Conference Series: Earth and Environmental Science*, vol. 426, no. 1, p. 012168, 2020, https://doi.org/10.1088/1755-1315/426/1/012168.

[104] K. Deepika, V. Tilekya, J. Mamatha, and T. Subetha, "Jollity Chatbot- A contextual AI Assistant," *2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT)*, pp. 1196-1200, 2020, https://doi.org/10.1109/ICSSIT48917.2020.9214076.

[105] T. A. Maniou and A. Veglis, "Employing a Chatbot for News Dissemination during Crisis: Design, Implementation and Evaluation," *Future Internet*, vol. 12, no. 7, p. 109, 2020, http://dx.doi.org/10.3390/fi12070109.

[106] R. Dharaniya, K. Vijayalakshmi, R. Tejasree, and P. Naveena, "Survey on Interactive Chatbot," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 8, no. 6, pp. 1698–1704, 2020, https://doi.org/10.22214/ijraset.2020.6277.

[107] S. Singh and H. K. Thakur, "Survey of Various AI Chatbots Based on Technology Used," *2020 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, pp. 1074-1079, 2020, https://doi.org/10.1109/ICRITO48877.2020.9197943.

[108] S. Srivastava and T. V. Prabhakar, "Desirable Features of a Chatbot-building Platform," *2020 IEEE International Conference on Humanized Computing and Communication with Artificial Intelligence (HCCAI)*, pp. 61-64, 2020, https://doi.org/10.1109/HCCAI49649.2020.00016.

[109] I. Dokukina and J. Gumanova, "The rise of chatbots-new personal assistants in foreign language learning," *Procedia Computer Science*, vol. 169, pp. 542–546, 2020, https://doi.org/10.1016/j.procs.2020.02.212.

[110] M. R. Ali *et al.*, "A Virtual Conversational Agent for Teens with Autism Spectrum Disorder," *Proceedings of the 20th ACM International Conference on Intelligent Virtual Agents*, pp. 18, 2020, https://doi.org/10.1145/3383652.3423900.

[111] P. Smutny and P. Schreiberova, "Chatbots for learning: A review of educational chatbots for the Facebook Messenger," *Computers & Education*, vol. 151, p. 103862, 2020, https://doi.org/10.1016/j.compedu.2020.103862.

[112] D. Duncker, "Chatting with chatbots: Sign making in text-based human–computer interaction," *Sign Systems Studies*, vol. 48, no. 1, pp. 79–100, 2020, https://doi.org/10.12697/SSS.2020.48.1.05.

[113] J. Kühnel, M. Ebner, and M. Ebner, "Chatbots for Brand Representation in Comparison with Traditional Websites," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 14, no. 18, p. 18, 2020, https://doi.org/10.3991/ijim.v14i18.13433.

[114] N. N. Khin and K. M. Soe, "University Chatbot using Artificial Intelligence Markup Language," *2020 IEEE Conference on Computer Applications (ICCA)*, pp. 1-5, 2020, https://doi.org/10.1109/ICCA49400.2020.9022814.

[115] N. Sabbag Filho and R. rio Rossi, "Chatbot Based Solution for Supporting Software Incident Management Process," *Journal of Software*, vol. 15, no. 3, pp. 68-73, 2020, https://doi.org/10.17706/jsw.15.3.68-73.

[116] A. Muniasamy and A. Alasiry, "Deep Learning: The Impact on Future eLearning," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 15, no. 01, p. 188-199, 2020, https://doi.org/10.3991/ijet.v15i01.11435.

[117] G. Daniel, J. Cabot, L. Deruelle, and M. Derras, "Xatkit: A Multimodal Low-Code Chatbot Development Framework," *IEEE Access*, vol. 8, pp. 15332-15346, 2020, https://doi.org/10.1109/ACCESS.2020.2966919.

[118] R. Canonico *et al.*, "A Smart ChatBot for Specialist Domains," *Workshops of the International Conference on Advanced Information Networking and Applications,* vol. 1150, pp. 1003-1010, 2020, https://doi.org/10.1007/978-3-030-44038-1_92.

[119] S. Nithuna and C. A. Laseena, "Review on Implementation Techniques of Chatbot," *2020 International Conference on Communication and Signal Processing (ICCSP)*, pp. 0157-0161, 2020, https://doi.org/10.1109/ICCSP48568.2020.9182168.

[120] E. H. -K. Wu, C. -H. Lin, Y. -Y. Ou, C. -Z. Liu, W. -K. Wang, and C. -Y. Chao, "Advantages and Constraints of a Hybrid Model K-12 E-Learning Assistant Chatbot," *IEEE Access*, vol. 8, pp. 77788-77801, 2020, https://doi.org/10.1109/ACCESS.2020.2988252.

[121] V. Dutt, S. M. Sasubilli, and A. E. Yerrapati, "Dynamic Information Retrieval With Chatbots: A Review of Artificial Intelligence Methodology," *2020 4th International Conference on Electronics, Communication and Aerospace Technology (ICECA)*, pp. 1299-1303, 2020, https://doi.org/10.1109/ICECA49313.2020.9297533.

[122] A. C. Sari, N. Virnilia, J. T. Susanto, K. A. Phiedono, and T. K. Hartono, "Chatbot Developments in The Business World," *Advances in Science, Technology and Engineering Systems Journal*, vol. 5, no. 6, pp. 627–635, 2020, https://www.semanticscholar.org/paper/Chatbot-Developments-in-The-Business-World-Sari-Virnilia/b7b172ce183ae40b34e0942e894a1db66e9be3db?p2df.

[123] S. H. M. Daud, N. H. I. Teo, and N. H. M. Zain, "e-JAVA Chatbot for Learning Programming Language: A Post-Pandemic Alternative Virtual Tutor," *International Journal of Emerging Trends in Engineering Research*, vol. 8, no. 7, pp. 3290–3298, 2020, https://doi.org/10.30534/ijeter/2020/67872020.

[124] S. Sinha, S. Mandal, and A. Mondal, "Question Answering System-Based Chatbot for Health care," *Proceedings of the Global AI Congress 2019*, pp. 71–80, 2020, https://doi.org/10.1007/978-981-15-2188-1_6.

[125] A. Abd-Alrazaq, Z. Safi, M. Alajlani, J. Warren, M. Househ, and K. Denecke, "Technical Metrics Used to Evaluate Health Care Chatbots: Scoping Review," *Journal of Medical Internet Research*, vol. 22, no. 6, p. e18301, 2020, https://doi.org/10.2196/18301.

[126] A. Przegalinska, L. Ciechanowski, A. Stroz, P. Gloor, and G. Mazurek, "In bot we trust: A new methodology of chatbot performance measures," *Business Horizons*, vol. 62, no. 6, pp. 785-797, 2019, https://doi.org/10.1016/j.bushor.2019.08.005.

[127] S. Mendoza, M. Hernández-León, L. M. Sánchez-Adame, J. Rodríguez, D. Decouchant, and A. Meneses-Viveros, "Supporting Student-Teacher Interaction Through a Chatbot," *International Conference on Human-Computer Interaction*, vol. 12206, pp. 93–107, 2020, https://doi.org/10.1007/978-3-030-50506-6_8.

[128] G. K. Vamsi, A. Rasool, and G. Hajela, "Chatbot: A Deep Neural Network Based Human to Machine Conversation Model," *2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, pp. 1-7, 2020, https://doi.org/10.1109/ICCCNT49239.2020.9225395.

[129] M. Dharani, J. V. S. L. Jyostna, E. Sucharitha, R. Likitha, and S. Manne, "Interactive Transport Enquiry with AI Chatbot," *2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS)*, pp. 1271-1276, 2020, https://doi.org/10.1109/ICICCS48265.2020.9120905.

[130] S. Pérez-Soler, G. Daniel, J. Cabot, E. Guerra, and J. de Lara, "Towards Automating the Synthesis of Chatbots for Conversational Model Query," *International Conference on Business Process Modeling, Development and Support International Conference on Evaluation and Modeling Methods for Systems Analysis and Development*, vol. 387, pp. 257–265, 2020, https://doi.org/10.1007/978-3-030-49418-6_17.

[131] S. Maher, S. Kayte, and S. Nimbhore, "Chatbots & Its Techniques using AI: A Review," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 8, no. 12, pp. 503–508, 2020, https://doi.org/10.22214/ijraset.2020.32537.

[132] S. A. Thorat and V. D. Jadhav, "A Review on Implementation Issues of Rule-based Chatbot Systems," *Proceedings of the International Conference on Innovative Computing & Communications (ICICC) 2020*, pp. 1–6, 2020, https://doi.org/10.2139/ssrn.3567047.

[133] A. H. Al-Sinani and B. S. Al-Saidi, "A Survey of Chatbot creation tools for non-coder," *Journal of Student Research*, pp. 1-4, 2020, https://doi.org/10.47611/jsr.vi.896.

[134] G.-J. Hwang, H. Xie, B. W. Wah, and D. Gašević, "Vision, challenges, roles and research issues of Artificial Intelligence in Education," *Computers and Education: Artificial Intelligence*, vol. 1, p. 100001, 2020, https://doi.org/10.1016/j.caeai.2020.100001.

[135] J. F. Zolitschka, "A Novel Multi-agent-based Chatbot Approach to Orchestrate Conversational Assistants," *International Conference on Business Information Systems*, vol. 389, pp. 103–117, 2020, https://doi.org/10.1007/978-3-030-53337-3_8.

[136] E. Adamopoulou and L. Moussiades, "An Overview of Chatbot Technology," *Springer International Publishing*, vol. 584, pp. 373-383, 2020, https://doi.org/10.1007/978-3-030-49186-4_31.

[137] P. Suta, X. Lan, B. Wu, P. Mongkolnam, and J. H. Chan, "An Overview of Machine Learning in Chatbots," *International Journal of Mechanical Engineering and Robotics Research*, vol. 9, no. 4, pp. 502–510, 2020, https://doi.org/10.18178/ijmerr.9.4.502-510.

[138] P. Chittò, M. Baez, F. Daniel, and B. Benatallah, "Automatic Generation of Chatbots for Conversational Web Browsing," *International Conference on Conceptual Modeling*, vol. 12400, pp. 239–249, 2020, https://doi.org/10.1007/978-3-030-62522-1_17.

[139] J. Zhang, H. Huang, and G. Gui, "A Chatbot Design Method Using Combined Model for Business Promotion," *International Conference in Communications, Signal Processing, and Systems*, vol. 517, pp. 1133–1140, 2020, https://doi.org/10.1007/978-981-13-6508-9_137.

[140] H. D. Wijaya, W. Gunawan, R. Avrizal, and S. M. Arif, "Designing Chatbot for College Information Management," *IJISCS (International Journal of Information System and Computer Science)*, vol. 4, no. 1, p. 8-13, 2020, https://pdfs.semanticscholar.org/9051/b39edd0406151f8d804e201a02b8977d59fb.pdf.

[141] V. Vijayaraghavan, J. B. Cooper, and R. L. Rian Leevinson, "Algorithm Inspection for Chatbot Performance Evaluation," *Procedia Computer Science*, vol. 171, pp. 2267–2274, 2020, https://doi.org/10.1016/j.procs.2020.04.245.

[142] O. Villanueva-Mendoza, M. V. González, M. Varela, and L. Zamora, "Chatbot for the Improvement of Conversational Skills of Japanese Language Learners," *Handbook of Research on Natural Language Processing and Smart Service Systems*, pp. 101–134, 2021, https://doi.org/10.4018/978-1-7998-4730-4.ch005.

[143] A. K. Wardhana, R. Ferdiana, and I. Hidayah, "Empathetic Chatbot Enhancement and Development: A Literature Review," *2021 International Conference on Artificial Intelligence and Mechatronics Systems (AIMS)*, pp. 1-6, 2021, https://doi.org/10.1109/AIMS52415.2021.9466027.

[144] O. Shahid *et al.*, "Machine learning research towards combating COVID-19: Virus detection, spread prevention, and medical assistance," *Journal of Biomedical Informatics*, vol. 117, p. 103751, 2021, https://doi.org/10.1016/j.jbi.2021.103751.

[145] F. Haefner, R. C. Härting, and J. Bueechl, "Potentials and challenges of emotionally sensitive applications in apprenticeship," *Procedia Computer Science*, vol. 192, pp. 2606–2615, 2021, https://doi.org/10.1016/j.procs.2021.09.030.

[146] M. W. Hasyim, S. Pramono, and Sutrisno, "Web-Based Telegram Chatbot Management System: Create Chatbot Without Programming Language Requirements," *IOP Conference Series: Materials Science and Engineering*, vol. 1096, no. 1, p. 012075, 2021, https://doi.org/10.1088/1757-899X/1096/1/012075.

[147] B. Ali, V. Ravi, C. Bhushan, M. G. Santhosh, and O. Shiva Shankar, "Chatbot via Machine Learning and Deep Learning Hybrid," *Modern Approaches in Machine Learning and Cognitive Science: A Walkthrough*, vol. 956, pp. 255–265, 2021, https://doi.org/10.1007/978-3-030-68291-0_19.

[148] M. Katre, S. Manchanda, and R. Agarwal, "Chatbot for Career Counselling," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 9, no. 7, pp. 2543–2554, 2021, https://doi.org/10.22214/ijraset.2021.36718.

[149] K. Fornalczyk, K. Bortko, and J. Jankowski, "Improving user attention to chatbots through a controlled intensity of changes within the interface," *Procedia Computer Science*, vol. 192, pp. 5112–5121, 2021, https://doi.org/10.1016/j.procs.2021.09.289.

[150] X. Fan, D. Chao, Z. Zhang, D. Wang, X. Li, and F. Tian, "Utilization of Self-Diagnosis Health Chatbots in Real-World Settings: Case Study," *Journal of Medical Internet Research*, vol. 23, no. 1, p. e19928, 2021, https://doi.org/10.2196/19928.

[151] R. Arjun, A. Kuanr, and K. R. Suprabha, "Developing banking intelligence in emerging markets: Systematic review and agenda," *International Journal of Information Management Data Insights*, vol. 1, no. 2, p. 100026, 2021, https://doi.org/10.1016/j.jjimei.2021.100026.

[152] S. J. Fodeh, M. Al-Garadi, O. Elsankary, J. Perrone, W. Becker, and A. Sarker, "Utilizing a multi-class classification approach to detect therapeutic and recreational misuse of opioids on Twitter," *Computers in Biology and Medicine*, vol. 129, p. 104132, 2021, https://doi.org/10.1016/j.compbiomed.2020.104132.

[153] M. R. D. Silva, A. M. D. R. Fernandes, and G. F. D. S. Campos, "Implementação de Chatbot para Aprimorar a Comunicação com Usuários de Serviços Públicos," *Anais do Computer on the Beach*, pp. 480–482, 2021, https://doi.org/10.14210/cotb.v12.p480-482.

[154] A. M. Votto, R. Valecha, P. Najafirad, and H. R. Rao, "Artificial Intelligence in Tactical Human Resource Management: A Systematic Literature Review," *International Journal of Information Management Data Insights*, vol. 1, no. 2, p. 100047, 2021, https://doi.org/10.1016/j.jjimei.2021.100047.

[155] A. Deveci Topal, C. Dilek Eren, and A. Kolburan Geçer, "Chatbot application in a 5th grade science course," *Education and Information Technologies*, vol. 26, no. 5, pp. 6241–6265, 2021, https://doi.org/10.1007/s10639-021-10627-8.

[156] S. Pérez-Soler, S. Juárez-Puerta, E. Guerra and J. de Lara, "Choosing a Chatbot Development Tool," *IEEE Software*, vol. 38, no. 4, pp. 94-103, 2021, https://doi.org/10.1109/MS.2020.3030198.

[157] L. Fauzia, R. B. Hadiprakoso, and Girinoto, "Implementation of Chatbot on University Website Using RASA Framework," *2021 4th International Seminar on Research of Information Technology and Intelligent Systems (ISRITI)*, pp. 373-378, 2021, https://doi.org/10.1109/ISRITI54043.2021.9702821.

[158] R. A. Sekarwati, A. Sururi, R. Rakhmat, M. Arifin, and A. Wibowo, "Survei Metode Pengukuran Aplikasi Chatbot Berbasis Media Sosial," *Gema Teknologi*, vol. 21, no. 2, pp. 67–73, 2021, https://doi.org/10.14710/gt.v21i2.36170.

[159] M. Hajder, P. Hajder, T. Gil, M. Krzywda, J. Kolbusz, and M. Liput, "Architecture and organization of a Platform for diagnostics, therapy and post-covid complications using AI and mobile monitoring," *Procedia Computer Science*, vol. 192, pp. 3711–3721, 2021, https://doi.org/10.1016/j.procs.2021.09.145.

[160] P. Goel and A. Ganatra, "A Survey on Chatbot: Futuristic Conversational Agent for User Interaction," *2021 3rd International Conference on Signal Processing and Communication (ICPSC)*, pp. 736-740, 2021, https://doi.org/10.1109/ICSPC51351.2021.9451763.

[161] M. G. CP, A. Srivastava, S. Chakraborty, A. Ghosh, and H. Raj, "Development of Information Technology Telecom Chatbot: An Artificial Intelligence and Machine Learning Approach," *2021 2nd International Conference on Intelligent Engineering and Management (ICIEM)*, pp. 216-221, 2021, https://doi.org/10.1109/ICIEM51511.2021.9445354.

[162] A. H. Hefny, G. A. Dafoulas, and M. A. Ismail, "A Proactive Management Assistant Chatbot for Software Engineering Teams: Prototype and Preliminary Evaluation," *2021 3rd Novel Intelligent and Leading Emerging Sciences Conference (NILES)*, pp. 295-300, 2021, https://doi.org/10.1109/NILES53778.2021.9600547.

[163] S. I. Shafiq, C. Sanin, and E. Szczebicki, "Integrating experience-based knowledge representation and machine learning for efficient virtual engineering object performance," *Procedia Computer Science*, vol. 192, pp. 3955–3965, 2021, https://doi.org/10.1016/j.procs.2021.09.170.

[164] J. Muthuswamy, S. Bhattacharya, H. P. Sai, M. Deepthi, N. Nagaraj, and P. Das P, "IoT Based Covid Chatbot using Telegram," *Journal of Trends in Computer Science and Smart Technology*, vol. 4, no. 2, pp. 83–95, 2021, https://doi.org/10.36548/jtcsst.2022.2.004.

[165] H. Palivela, "Optimization of paraphrase generation and identification using language models in natural language processing," *International Journal of Information Management Data Insights*, vol. 1, no. 2, p. 100025, 2021, https://doi.org/10.1016/j.jjimei.2021.100025.

[166] N. Malamas and A. Symeonidis, "Embedding Rasa in edge devices: Capabilities and limitations," *Procedia Computer Science*, vol. 192, pp. 109–118, 2021, https://doi.org/10.1016/j.procs.2021.08.012.

[167] E. Tebenkov and I. Prokhorov, "Machine learning algorithms for teaching AI chat bots," *Procedia Computer Science*, vol. 190, pp. 735–744, 2021, https://doi.org/10.1016/j.procs.2021.06.086.

[168] A. Khadija, F. F. Zahra, and A. Naceur, "AI-Powered Health Chatbots: Toward a general architecture," *Procedia Computer Science*, vol. 191, pp. 355–360, 2021, https://doi.org/10.1016/j.procs.2021.07.048.

[169] A. Savanur, M. Niranjanamurthy, M. P. Amulya, and P. Dayananda, "Application of Chatbot for consumer perspective using Artificial Intelligence," *2021 6th International Conference on Communication and Electronics Systems (ICCES)*, pp. 1479-1483, 2021, https://doi.org/10.1109/ICCES51350.2021.9488990.

[170] K. Shingte, A. Chaudhari, A. Patil, A. Chaudhari, and S. Desai, "Chatbot Development for Educational Institute," *SSRN Electronic Journal*, 2021, https://doi.org/10.2139/ssrn.3861241.

[171] H. Haneya, D. Alkaf, F. Bajammal, and T. Brahimi, "A Meta-Analysis of Artificial Intelligence Applications for Tracking COVID-19: The Case of the U.A.E.," *Procedia Computer Science*, vol. 194, pp. 180–189, 2021, https://doi.org/10.1016/j.procs.2021.10.072.

[172] K. Aghi, Nayyum, and Anoopa, "Chatbot using Zomato API," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 9, no. 6, pp. 488–493, 2021, https://doi.org/10.22214/ijraset.2021.34944.

[173] S. D. Nithyanandam, S. Kasinathan, D. Radhakrishnan, and J. Jebapandian, "NLP for Chatbot Application," *Deep Natural Language Processing and AI Applications for Industry 5.0*, pp. 142–168, 2021, https://doi.org/10.4018/978-1-7998-7728-8.ch008.

[174] S. Meshram, N. Naik, M. VR, T. More, and S. Kharche, "Conversational AI: Chatbots," *2021 International Conference on Intelligent Technologies (CONIT)*, pp. 1-6, 2021, https://doi.org/10.1109/CONIT51480.2021.9498508.

[175] Z. H. Syed, A. Trabelsi, E. Helbert, V. Bailleau, and C. Muths, "Question answering chatbot for troubleshooting queries based on transfer learning," *Procedia Computer Science*, vol. 192, no. 2019, pp. 941–950, 2021, https://doi.org/10.1016/j.procs.2021.08.097.

[176] E. Bendig, B. Erb, D. Meißner, N. Bauereiß, and H. Baumeister, "Feasibility of a Software agent providing a brief Intervention for Self-help to Uplift psychological wellbeing ('SISU'). A single-group pretest-posttest trial investigating the potential of SISU to act as therapeutic agent," *Internet Interventionsentions*, vol. 24, p. 100377, 2021, https://doi.org/10.1016/j.invent.2021.100377.

[177] T. A. Baha, M. E. Hajji, Y. Es-Saady, and H. Fadili, "Towards highly adaptive Edu-Chatbot," *Procedia Computer Science*, vol. 198, pp. 397–403, 2021, https://doi.org/10.1016/j.procs.2021.12.260.

[178] V. Agarwal and A. Shukla, "Chatbot for Interview," *International Journal of Recent Technology and Engineering (IJRTE)*, vol. 11, no. 2, pp. 46–49, 2022, http://www.doi.org/10.35940/ijrte.B7092.0711222.

[179] A. S. Anisimova *et al.*, "Artificial Psychologist: An intelligent virtual/robotic assistant based on a cognitive modeling framework," *Procedia Computer Science*, vol. 213, pp. 793–800, 2022, https://doi.org/10.1016/j.procs.2022.11.136.

[180] B. A. Benali, S. Mihi, N. Laachfoubi, and A. A. Mlouk, "Arabic Named Entity Recognition in Arabic Tweets Using BERT-based Models," *Procedia Computer Science*, vol. 203, pp. 733–738, 2022, https://doi.org/10.1016/j.procs.2022.07.109.

[181] E. Bendig, B. Erb, L. Schulze-Thuesing, and H. Baumeister, "The Next Generation: Chatbots in Clinical Psychology and Psychotherapy to Foster Mental Health – A Scoping Review," *Verhaltenstherapie*, vol. 32, no. 1, pp. 64–76, 2022, https://doi.org/10.1159/000501812.

[182] N. Ben-Shabat *et al.*, "Assessing data gathering of chatbot based symptom checkers-a clinical vignettes study," *International Journal of Medical Informatics*, vol. 168, p. 104897, 2022, https://doi.org/10.1016/j.ijmedinf.2022.104897.

[183] C. Blanc *et al.*, "FlauBERT vs. CamemBERT: Understanding patient's answers by a French medical chatbot," *Artificial Intelligence in Medicine*, vol. 127, pp. 0–4, 2022, https://doi.org/10.1016/j.artmed.2022.102264.

[184] G. Caldarini, S. Jaf, and K. McGarry, "A Literature Survey of Recent Advances in Chatbots," *Information*, vol. 13, no. 1, p. 41, 2022, https://doi.org/10.3390/info13010041.

[185] D. J. Chinenye, A. E. Duroha, and N. Mcdonald, "Development of the Natural Language Processing-Based Chatbot For Shoprite Shopping Mall," *International Journal of Engineering Applied Sciences and Technology*, vol. 7, no. 6, pp. 372–381, 2022, https://doi.org/10.33564/IJEAST.2022.v07i06.044.

[186] B. Deshpande and M. B. Chandak, "Survey of designing tools for chatbot application," *International Journal of Health Sciences*, vol. 6, no. S5, pp. 1403–1413, 2022, https://doi.org/10.53730/ijhs.v6nS5.8889.

[187] J. Rajendra Prasad and S. S. Kumar, "An Effective Query Response using Chatbot," *International Journal of Advanced Research in Science, Communication and Technology*, vol. 2, no. 2, pp. 499–502, 2022, https://doi.org/10.48175/IJARSCT-3339.

[188] F. El-Alami, S. O. E. Alaoui, and N. E. Nahnahi, "Contextual semantic embeddings based on fine-tuned AraBERT model for Arabic text multi-class categorization," *Journal of King Saud University - Computer and Information Sciences*, vol. 34, no. 10, pp. 8422–8428, 2022, https://doi.org/10.1016/j.jksuci.2021.02.005.

[189] A. M. Eltahir, H. Abdulla, J. Platos, and V. Snasel, "An Overview of Chatbot Structure and Source Algorithms," *2022 26th International Conference on Circuits, Systems, Communications and Computers (CSCC)*, pp. 91-98, 2022, https://doi.org/10.1109/CSCC55931.2022.00026.

[190] B. Fazzinga, A. Galassi, and P. Torroni, "A privacy-preserving dialogue system based on argumentation," *Intelligent Systems with Applications*, vol. 16, p. 200113, 2022, https://doi.org/10.1016/j.iswa.2022.200113.

[191] G. Pradeepa, R. V. Sudh, S. Janani, V. Vidhya, and R. T. Veera, "AI Based Chatbot for FAQs," *Irish Interdisciplinary Journal of Science & Research*, vol. 6, no. 2, pp. 93–100, 2022, https://doi.org/10.46759/IIJSR.2022.6213.

[192] D. Gifu and E. Pop, "Smart Solutions to Keep Your Mental Balance," *Procedia Computer Science*, vol. 214, no. C, pp. 503–510, 2022, https://doi.org/10.1016/j.procs.2022.11.205.

[193] G. M. Sridevi and S. K. Suganthi, "AI based suitability measurement and prediction between job description and job seeker profiles," *International Journal of Information Management Data Insights*, vol. 2, no. 2, p. 100109, 2022, https://doi.org/10.1016/j.jjimei.2022.100109.

[194] K. Guravaiah, Y. S. Bhavadeesh, P. Shwejan, A. H. Vardhan, and S. Lavanya, "Third Eye: Object Recognition and Speech Generation for Visually Impaired," *Procedia Computer Science*, vol. 218, pp. 1144–1155, 2022, https://doi.org/10.1016/j.procs.2023.01.093.

[195] R. Hakim and R. Rima, "Chatting with AI Chatbots Applications to Improve English Communication Skill," *Journal of English Language Studies*, vol. 7, no. 1, p. 121, 2022, http://dx.doi.org/10.30870/jels.v7i1.14327.

[196] L. Hsu, "To CALL or not to CALL: empirical evidence from neuroscience," *Computer Assisted Language Learning*, vol. 35, no. 4, pp. 792–815, 2022, http://dx.doi.org/10.30870/jels.v7i1.14327.

[197] M. Ingaldi and D. Klimecka-Tatar, "Digitization of the service provision process - Requirements and readiness of the small and medium-sized enterprise sector," *Procedia Computer Science*, vol. 200, pp. 237–246, 2022, https://doi.org/10.1016/j.procs.2022.01.222.

[198] M. I. Ismael, N. N. W. Nik Hashim, N. S. Mohd Shah, and N. S. Mohd Munir, "Chatbot System for Mental Health in Bahasa Malaysia," *Journal of Integrated and Advanced Engineering (JIAE)*, vol. 2, no. 2, pp. 135–146, 2022, https://doi.org/10.51662/jiae.v2i2.83.

[199] K. R. Trisha, S. Ebina, J. Sahana Akshadha, and T. Subashini, "Chatbot Application for Tourism Using Deep Learning," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 10, no. 6, pp. 2661–2663, 2022, https://doi.org/10.22214/ijraset.2022.44516.

[200] F. Kanakov and I. Prokhorov, "Analysis and applicability of artificial intelligence technologies in the field of RPA software robots for automating business processes," *Procedia Computer Science*, vol. 213, pp. 296–300, 2022, https://doi.org/10.1016/j.procs.2022.11.070.

[201] M. Karyotaki, A. Drigas, and C. Skianis, "Chatbots as Cognitive, Educational, Advisory & Coaching Systems," *Technium Social Sciences Journal*, vol. 30, no. 1, pp. 109–126, 2022, https://doi.org/10.47577/tssj.v30i1.6277.

[202] M. Kathirvelu, A. Janaranjani, A. T. Navin Pranav, and R. Pradeep, "Voice Recognition Chat bot for Consumer Product Applications," *2022 IEEE International Conference on Data Science and Information System (ICDSIS)*, pp. 1-5, 2022, https://doi.org/10.1109/ICDSIS55133.2022.9915884.

[203] J. Kim, D. Y. Wohn, and M. Cha, "Understanding and identifying the use of emotes in toxic chat on Twitch," *Online Social Networks and Media*, vol. 27, p. 100180, 2022, https://doi.org/10.1016/j.osnem.2021.100180.

[204] K. P. Kruzan, E. E. Fitzsimmons-Craft, M. Dobias, J. L. Schleider, and A. Pratap, "Developing, Deploying, and Evaluating Digital Mental Health Interventions in Spaces of Online Help- and Information-Seeking," *Procedia Computer Science*, vol. 206, pp. 6–22, 2022, https://doi.org/10.1016/j.procs.2022.09.081.

[205] K. P. Kruzan *et al.*, "Social media-based interventions for adolescent and young adult mental health: A scoping review," *Internet Interventionsentions*, vol. 30, p. 100578, 2022, https://doi.org/10.1016/j.invent.2022.100578.

[206] Y. Li *et al.*, "Using Chatbots to Teach Languages," *Proceedings of the Ninth ACM Conference on Learning @ Scale*, pp. 451–455, 2022, https://doi.org/10.1145/3491140.3528329.

[207] C.-C. Liu, M.-G. Liao, C.-H. Chang, and H.-M. Lin, "An analysis of children' interaction with an AI chatbot and its impact on their interest in reading," *Computers & Education*, vol. 189, p. 104576, 2022, https://doi.org/10.1016/j.compedu.2022.104576.

[208] H. Liu, H. Peng, X. Song, C. Xu, and M. Zhang, "Using AI chatbots to provide self-help depression interventions for university students: A randomized trial of effectiveness," *Internet Interventions*, vol. 27, p. 100495, 2022, https://doi.org/10.1016/j.invent.2022.100495.

[209] L. Liu, O. Perez-Concha, A. Nguyen, V. Bennett, and L. Jorm, "Hierarchical label-wise attention transformer model for explainable ICD coding," *Journal of Biomedical Informatics*, vol. 133, p. 104161, 2022, https://doi.org/10.1016/j.jbi.2022.104161.

[210] R. Matić, M. Kabiljo, N. Deretić, and A. Vukomanović, "Application of Chatbot at a Higher Education Institution in Republic of Serbia," *41 st International Conference on Organizational Science Development*, pp. 605–615, 2022, https://doi.org/10.18690/um.fov.3.2022.

[211] S. Mendoza, L. M. Sánchez-Adame, J. F. Urquiza-Yllescas, B. A. González-Beltrán, and D. Decouchant, "A Model to Develop Chatbots for Assisting the Teaching and Learning Process," *Sensors*, vol. 22, no. 15, p. 5532, 2022, https://doi.org/10.3390/s22155532.

[212] M. L. B. M. Khidir and S. N. B. Sa'ari, "Chatbot as an Educational Support System," *EPRA International Journal of Multidisciplinary Research (IJMR)*, vol. 8, no. 5, pp. 182–185, 2022, https://doi.org/10.36713/epra10328.

[213] J. Munnukka, K. Talvitie-Lamberg, and D. Maity, "Anthropomorphism and social presence in Human–Virtual service assistant interactions: The role of dialog length and attitudes," *Computers in Human Behavior*, vol. 135, p. 107343, 2022, https://doi.org/10.1016/j.chb.2022.107343.

[214] M. Nißen *et al.*, "See you soon again, chatbot? A design taxonomy to characterize user-chatbot relationships with different time horizons," *Computers in Human Behavior*, vol. 127, 2022, https://doi.org/10.1016/j.chb.2021.107043.

[215] L. S. Pauw, D. A. Sauter, G. A. van Kleef, G. M. Lucas, J. Gratch, and A. H. Fischer, "The avatar will see you now: Support from a virtual human provides socio-emotional benefits," *Computers in Human Behavior*, vol. 136, p. 107368, 2022, https://doi.org/10.1016/j.chb.2022.107368.

[216] Ł. Pawlik, M. Płaza, S. Deniziak, and E. Boksa, "A method for improving bot effectiveness by recognising implicit customer intent in contact centre conversations," *Speech Communication*, vol. 143, pp. 33–45, 2022, https://doi.org/10.1016/j.specom.2022.07.003.

[217] M. Prakash, M. Sumithra, and B. Buvaneswari, "General ChatBot for Medical Applications," *Journal of Cognitive Human-Computer Interaction*, vol. 4, no. 1, pp. 08–14, 2022, https://doi.org/10.54216/JCHCI.040101.

[218] N. Rai, D. Kumar, N. Kaushik, C. Raj, and A. Ali, "Fake News Classification using transformer based enhanced LSTM and BERT," *International Journal of Cognitive Computing in Engineering*, vol. 3, pp. 98–105, 2022, https://doi.org/10.1016/j.ijcce.2022.03.003.

[219] P. L. Patil, A. D. Raskar, A. S. Inamdar, R. B. Kamble, and A. S. Dongare, "Chatbot for Children Assistance," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 10, no. 7, pp. 1485–1493, 2022, https://doi.org/10.22214/ijraset.2022.40830.

[220] P. Rathnayaka, N. Mills, D. Burnett, D. De Silva, D. Alahakoon, and R. Gray, "A Mental Health Chatbot with Cognitive Skills for Personalised Behavioural Activation and Remote Health Monitoring," *Sensors*, vol. 22, no. 10, p. 3653, 2022, https://doi.org/10.3390/s22103653.

[221] M. A. Rehmat, M. A. Hassan, M. H. Khalid, and M. Dilawar, "Next level of hospitalisation through smart ICU," *Intelligent Systems with Applications*, vol. 14, p. 200080, 2022, https://doi.org/10.1016/j.iswa.2022.200080.

[222] L. Reis, C. Maier, and T. Weitzel, "Chatbots in Marketing: An In-Deep Case Study Capturing Future Perspectives of AI in Advertising," *Proceedings of the Conference on Computers and People Research*, pp. 1–8, 2022, https://doi.org/10.1145/3510606.3550204.

[223] R. Rodriguez-Torrealba, E. Garcia-Lopez, and A. Garcia-Cabot, "End-to-End generation of Multiple-Choice questions using Text-to-Text transfer Transformer models," *Expert Systems with Applications*, vol. 208, p. 118258, 2022, https://doi.org/10.1016/j.eswa.2022.118258.

[224] A. Saiyed *et al.*, "Technology-Assisted Motivational Interviewing: Developing a Scalable Framework for Promoting Engagement with Tobacco Cessation Using NLP and Machine Learning," *Procedia Computer Science*, vol. 206, pp. 121–131, 2022, https://doi.org/10.1016/j.procs.2022.09.091.

[225] G. A. Santos, G. G. de Andrade, G. R. S. Silva, F. C. M. Duarte, J. P. J. D. Costa, and R. T. de Sousa, "A Conversation-Driven Approach for Chatbot Management," *IEEE Access*, vol. 10, pp. 8474-8486, 2022, https://doi.org/10.1109/ACCESS.2022.3143323.

[226] D. Sharma, S. Kaushal, H. Kumar, and S. Gainder, "Chatbots in Healthcare: Challenges, Technologies and Applications," *2022 4th International Conference on Artificial Intelligence and Speech Technology (AIST)*, pp. 1-6, 2022, https://doi.org/10.1109/AIST55798.2022.10065328.

[227] A. Skuridin, "Chatbot Implementation in a Steel Company in Russia," *Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies*, pp. 268–290, 2022, https://doi.org/10.4018/978-1-7998-7712-7.ch015.

[228] S. Sonderegger and S. Seufert, "Chatbot-mediated Learning: Conceptual Framework for the Design of Chatbot Use Cases in Education," *Proceedings of the 14th International Conference on Computer Supported Education*, pp. 207–215, 2022, https://doi.org/10.5220/0010999200003182.

[229] A. Sridhar, A. Mawia, and A. L. Amutha, "Mobile Application Development for Disease Diagnosis based on Symptoms using Machine Learning Techniques," *Procedia Computer Science*, vol. 218, pp. 2594–2603, 2022, https://doi.org/10.1016/j.procs.2023.01.233.

[230] P. Suebsombut, P. Sureephong, A. Sekhari, S. Chernbumroong, and A. Bouras, "Chatbot Application to Support Smart Agriculture in Thailand," *2022 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering (ECTI DAMT & NCON)*, pp. 364-367, 2022, https://doi.org/10.1109/ECTIDAMTNCON53731.2022.9720318.

[231] M. Tomprou and M. K. Lee, "Employment relationships in algorithmic management: A psychological contract perspective," *Computers in Human Behavior*, vol. 126, p. 106997, 2022, https://doi.org/10.1016/j.chb.2021.106997.

[232] S. Tripathy, R. Singh, and M. Ray, "Natural Language Processing for Covid-19 Consulting System," *Procedia Computer Science*, vol. 218, pp. 1335–1341, 2022, https://doi.org/10.1016/j.procs.2023.01.112.

[233] A. G. Usigan, Ma. I. Salomeo, G. J. L. J. Zafe, C. J. Centeno, A. A. R. C. Sison, and A. G. Bitancor, "Implementation of an Undergraduate Admission Chatbot Using Microsoft Azure's Question Answering and Bot Framework," *Proceedings of the 2022 5th Artificial Intelligence and Cloud Computing Conference*, pp. 240–245, 2022, https://doi.org/10.1145/3582099.3582135.

[234] V. C. Mahavishnu, R. Roopakumar, S. G. Vikhas, and A. Abivishvas, "Standalone Chatbot Application in Python," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 10, no. 7, pp. 1244–1250, 2022, https://doi.org/10.22214/ijraset.2022.45445.

[235] A. Vukomanović, N. Deretić, M. Kabiljo, and R. Matić, "An Example of Chatbot In The Field of Education In The Republic of Serbia," *Journal of process management and new technologies*, vol. 10, no. 1–2, pp. 125–139, 2022, https://doi.org/10.5937/jpmnt10-38635.

[236] A. Widad, B. L. El Habib, and E. F. Ayoub, "Bert for Question Answering applied on Covid-19," *Procedia Computer Science*, vol. 198, pp. 379–384, 2022, https://doi.org/10.1016/j.procs.2021.12.257.

[237] R. Yang, Z. Li, H. Tang, and K. Zhu, "ChatMatch: Evaluating Chatbots by Autonomous Chat Tournaments," *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics Association for Computational Linguistics*, pp. 7579–7590, 2022, https://doi.org/10.18653/v1/2022.acl-long.522.

[238] X. Zhao and Y. Sun, "Amazon Fine Food Reviews with BERT Model," *Procedia Computer Science*, vol. 208, pp. 401–406, 2022, https://doi.org/10.1016/j.procs.2022.10.056.

[239] W. Y. Alghamdi *et al.*, "Software Smart Agent for Taif University Services," *Procedia Computer Science*, vol. 220, pp. 64–70, 2023, https://doi.org/10.1016/j.procs.2023.03.011.

[240] M. Amendola, A. Passarella, and R. Perego, "Social search: Retrieving information in Online Social platforms – A survey," *Online Social Networks and Media*, vol. 36, p. 100254, 2023, https://doi.org/10.1016/j.osnem.2023.100254.

[241] R. An, Y. Yang, F. Yang, and S. Wang, "Use prompt to differentiate text generated by ChatGPT and humans," *Machine Learning with Applications*, vol. 14, p. 100497, 2023, https://doi.org/10.1016/j.mlwa.2023.100497.

[242] E. Asfoura, G. Kassem, B. Alhuthaifi, and F. Belhaj, "Developing Chatbot Conversational Systems & the Future Generation Enterprise Systems," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 17, no. 10, pp. 155-175, 2023, https://doi.org/10.3991/ijim.v17i10.37851.

[243] S. K. Gupta, S. Jaiswal, P. Kanchale, B. Kumar, and K. V. Wankhede, "Chatbot for Healthcare System Using Artificial Intelligence," *International Research Journal of Modernization in Engineering Technology and Science*, vol. 5, no. 3, pp. 895-898, 2023, https://www.doi.org/10.56726/IRJMETS34164.

[244] S. Banerjee, S. Mukherjee, S. Bandyopadhyay, and P. Pakray, "An extract-then-abstract based method to generate disaster-news headlines using a DNN extractor followed by a transformer abstractor," *Information Processing & Management*, vol. 60, no. 3, p. 103291, 2023, https://doi.org/10.1016/j.ipm.2023.103291.

[245] S. Bano, S. Khalid, N. M. Tairan, H. Shah, and H. A. Khattak, "Summarization of scholarly articles using BERT and BiGRU: Deep learning-based extractive approach," *Journal of King Saud University - Computer and Information Sciences*, vol. 35, no. 9, p. 101739, 2023, https://doi.org/10.1016/j.jksuci.2023.101739.

[246] B. Bernárdez, J. I. Panach, J. A. Parejo, A. Durán, N. Juristo, and A. Ruiz-Cortés, "An empirical study to evaluate the impact of mindfulness on helpdesk employees," *Science of Computer Programming*, vol. 230, p. 102977, 2023, https://doi.org/10.1016/j.scico.2023.102977.

[247] I. Celik, "Towards Intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education," *Computers in Human Behavior*, vol. 138, 2023, https://doi.org/10.1016/j.chb.2022.107468.

[248] P. Chomphooyod, A. Suchato, N. Tuaycharoen, and P. Punyabukkana, "English grammar multiple-choice question generation using Text-to-Text Transfer Transformer," *Computers and Education: Artificial Intelligence*, vol. 5, p. 100158, 2023, https://doi.org/10.1016/j.caeai.2023.100158.

[249] D. O. Eke, "ChatGPT and the rise of generative AI: Threat to academic integrity?," *Journal of Responsible Technology*, vol. 13, p. 100060, 2023, https://doi.org/10.1016/j.jrt.2023.100060.

[250] G. Fan *et al.*, "Dialog summarization for software collaborative platform via tuning pre-trained models," *Journal of Systems and Software*, vol. 204, p. 111763, 2023, https://doi.org/10.1016/j.jss.2023.111763.

[251] J. Fan, X. Tian, C. Lv, S. Zhang, Y. Wang, and J. Zhang, "Extractive social media text summarization based on MFMMR-BertSum," *Array*, p. 100322, 2023, https://doi.org/10.1016/j.array.2023.100322.

[252] J. Fang, "Analysis on Chatbot Performance based on Attention Mechanism," *Highlights in Science, Engineering and Technology*, vol. 39, pp. 151–156, 2023, https://doi.org/10.54097/hset.v39i.6517.

[253] F. Fonte, C. Grilo, R. Frontini, S. Jacinto, and S. S. Dias, "Chat2Quit – Support Platform for Smoking Cessation," *Procedia Computer Science*, vol. 219, pp. 1309–1315, 2023, https://doi.org/10.1016/j.procs.2023.01.415.

[254] Z. Han, "The applications of chatbot," *Highlights in Science, Engineering and Technology*, vol. 57, pp. 258–266, 2023, https://doi.org/10.54097/hset.v57i.10011.

[255] M. D. R. Haque and S. Rubya, "An Overview of Chatbot-Based Mobile Mental Health Apps: Insights From App Description and User Reviews," *JMIR Mhealth Uhealth*, vol. 11, p. e44838, 2023, https://doi.org/10.2196/44838.

[256] S. Hussain, S. H. Al-Hashmi, M. H. Malik, and S. I. Ali Kazmi, "Chatbot in E-learning," *SHS Web of Conferences*, vol. 156, p. 01002, 2023, https://uwe-repository.worktribe.com/index.php/preview/10553894/Chatbot%20in%20E-learning.pdf.

[257] A. Janson, "How to leverage anthropomorphism for chatbot service interfaces: The interplay of communication style and personification," *Computers in Human Behavior*, p. 107954, 2023, https://doi.org/10.1016/j.chb.2023.107954.

[258] M. Javaid, A. Haleem, R. P. Singh, S. Khan, and I. H. Khan, "Unlocking the opportunities through ChatGPT Tool towards ameliorating the education system," *BenchCouncil Transactions on*

Benchmarks, Standards and Evaluations, vol. 3, no. 2, p. 100115, 2023, https://doi.org/10.1016/j.tbench.2023.100115.

[259] A. K. Jayaraman, G. Ananthakrishnan, T. E. Trueman, and E. Cambria, "Text-based personality prediction using XLNet," *Advances in Computers*, 2023, https://doi.org/10.1016/bs.adcom.2023.08.002.

[260] S. Jin, X. Lian, H. Jung, J. Park, and J. Suh, "Building a deep learning-based QA system from a CQA dataset," *Decision Support Systems*, vol. 175, p. 114038, 2023, https://doi.org/10.1016/j.dss.2023.114038.

[261] K. Kaur and P. Kaur, "BERT-CNN: Improving BERT for Requirements Classification using CNN," *Procedia Computer Science*, vol. 218, pp. 2604–2611, 2023, https://doi.org/10.1016/j.procs.2023.01.234.

[262] I. ullah Khan, J. Javed, A. Sajid, Shahnoor, and I. Tabassum, "Comparative Analysis of Classical and Neural Networks based ChatBot's Techniques," *Sir Syed University Research Journal of Engineering & Technology*, vol. 13, no. 1, pp. 61–73, 2023, https://doi.org/10.33317/ssurj.508.

[263] H. Khorshidi *et al.*, "Application of ChatGPT in multilingual medical education: How does ChatGPT fare in 2023's Iranian residency entrance examination," *Informatics in Medicine Unlocked*, vol. 41, p. 101314, 2023, https://doi.org/10.1016/j.imu.2023.101314.

[264] Y. Kim, J. H. Kim, Y. M. Kim, S. Song, and H. J. Joo, "Predicting medical specialty from text based on a domain-specific pre-trained BERT," *International Journal of Medical Informatics*, vol. 170, p. 104956, 2023, https://doi.org/10.1016/j.ijmedinf.2022.104956.

[265] J. Kocoń *et al.*, "ChatGPT: Jack of all trades, master of none," *Information Fusion*, vol. 99, p. 101861, 2023, https://doi.org/10.1016/j.inffus.2023.101861.

[266] V. Kumari, A. A. Sharma, Y. Sharma, and L. Goel, "Scalability and Sustainability in Chatbot and Mobile Application Development," *2023 13th International Conference on Cloud Computing, Data Science & Engineering (Confluence)*, pp. 397-403, 2023, https://doi.org/10.1109/Confluence56041.2023.10048882.

[267] S.-W. Lee, J.-H. Kwon, D. Kim, and E.-J. Kim, "Research category classification of scientific articles on human health risks of electromagnetic fields using pre-trained BERT," *ICT Express*, 2023, https://doi.org/10.1016/j.icte.2023.08.006.

[268] X. Liu *et al.*, "GPT understands, too," *AI Open*, 2023, https://doi.org/10.1016/j.aiopen.2023.08.012.

[269] J. López Espejel, E. H. Ettifouri, M. S. Yahaya Alassan, E. M. Chouham, and W. Dahhane, "GPT-3.5, GPT-4, or BARD? Evaluating LLMs reasoning ability in zero-shot setting and performance boosting through prompts," *Natural Language Processing Journal*, vol. 5, p. 100032, 2023, https://doi.org/10.1016/j.nlp.2023.100032.

[270] J. Maciejewski and E. Smoktunowicz, "Low-effort Internet Interventionsention to reduce students' stress delivered with Meta's Messenger chatbot (Stressbot): A randomized controlled trial," *Internet Interventions*, vol. 33, p. 100653, 2023, https://doi.org/10.1016/j.invent.2023.100653.

[271] M. S. I. Malik, U. Cheema, and D. I. Ignatov, "Contextual Embeddings based on Fine-tuned Urdu-BERT for Urdu threatening content and target identification," *Journal of King Saud University - Computer and Information Sciences*, vol. 35, no. 7, p. 101606, 2023, https://doi.org/10.1016/j.jksuci.2023.101606.

[272] M. S. I. Malik, A. Nazarova, M. M. Jamjoom, and D. I. Ignatov, "Multilingual hope speech detection: A Robust framework using transfer learning of fine-tuning RoBERTa model," *Journal of King Saud University - Computer and Information Sciences*, vol. 35, no. 8, p. 101736, 2023, https://doi.org/10.1016/j.jksuci.2023.101736.

[273] T. McIntosh *et al.*, "Harnessing GPT-4 for generation of cybersecurity GRC policies: A focus on ransomware attack mitigation," *Computer & Security*, vol. 134, p. 103424, 2023, https://doi.org/10.1016/j.cose.2023.103424.

[274] S. Mithun *et al.*, "Development and validation of deep learning and BERT models for classification of lung cancer radiology reports," *Informatics in Medicine Unlocked*, vol. 40, p. 101294, 2023, https://doi.org/10.1016/j.imu.2023.101294.

[275] K. Mzwri and M. Turcsanyi-szabo, "Chatbot Development using APIs and Integration into the MOOC," *Central-European Journal of New Technologies in Research, Education and Practice*, vol. 5, no. 1, pp. 18–30, 2023, https://doi.org/10.36427/CEJNTREP.5.1.5041.

[276] K.-I. Na, U.-H. Kim, and J.-H. Kim, "SPU-BERT: Faster human multi-trajectory prediction from socio-physical understanding of BERT," *Knowledge-Based Systems*, vol. 274, p. 110637, 2023, https://doi.org/10.1016/j.knosys.2023.110637.

[277] G. Z. Nabiilah, S. Y. Prasetyo, Z. N. Izdihar, and A. S. Girsang, "BERT base model for toxic comment analysis on Indonesian social media," *Procedia Computer Science*, vol. 216, pp. 714–721, 2023, https://doi.org/10.1016/j.procs.2022.12.188.

[278] A. H. Oliaee, S. Das, J. Liu, and M. A. Rahman, "Using Bidirectional Encoder Representations from Transformers (BERT) to classify traffic crash severity types," *Natural Language Processing Journal*, vol. 3, p. 100007, 2023, https://doi.org/10.1016/j.nlp.2023.100007.

[279] A. Onan, "Hierarchical graph-based text classification framework with contextual node embedding and BERT-based dynamic fusion," *Journal of King Saud University - Computer and Information Sciences*, vol. 35, no. 7, p. 101610, 2023, https://doi.org/10.1016/j.jksuci.2023.101610.

[280] D. Patel, Ni. Shetty, P. Kapasi, and I. Kangriwala, "College Enquiry Chatbot using Conversational AI," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 11, no. 5, pp. 903–915, 2023, https://doi.org/10.22214/ijraset.2023.51324.

[281] J. Pavão, R. Bastardo, M. Santos, and N. P. Rocha, "The Fast Health Interoperability Resources (FHIR) Standard and Homecare, a Scoping Review," *Procedia Computer Science*, vol. 219, pp. 1249–1256, 2023, https://doi.org/10.1016/j.procs.2023.01.408.

[282] M. Pelly, F. Fatehi, D. Liew, and A. Verdejo-Garcia, "Artificial intelligence for secondary prevention of myocardial infarction: A qualitative study of patient and health professional perspectives," *International Journal of Medical Informatics*, vol. 173, p. 105041, 2023, https://doi.org/10.1016/j.ijmedinf.2023.105041.

[283] A. H. Petersson, S. Pawar, and A. Fagerstrøm, "Investigating the factors of customer experiences using real-life text-based banking chatbot: A qualitative study in Norway," *Procedia Computer Science*, vol. 219, pp. 697–704, 2023, https://doi.org/10.1016/j.procs.2023.01.341.

[284] L. H. C. Pinochet, M. Â. L. Moreira, L. P. Fávero, M. dos Santos, and V. I. Pardim, "Collaborative Work Alternatives with ChatGPT Based on Evaluation Criteria for its Use in Higher Education: Application of the PROMETHEE-SAPEVO-M1 Method," *Procedia Computer Science*, vol. 221, pp. 177–184, 2023, https://doi.org/10.1016/j.procs.2023.07.025.

[285] P. S. Varsha, "How can we manage biases in artificial intelligence systems – A systematic literature review," *International Journal of Information Management Data Insights*, vol. 3, no. 1, 2023, doi: https://doi.org/10.1016/j.jjimei.2023.100165.

[286] R. Raj, A. Singh, V. Kumar, and P. Verma, "Analyzing the potential benefits and use cases of ChatGPT as a tool for improving the efficiency and effectiveness of business operations," *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, vol. 3, no. 3, p. 100140, 2023, https://doi.org/10.1016/j.tbench.2023.100140.

[287] P. P. Ray, "Benchmarking, ethical alignment, and evaluation framework for conversational AI: Advancing responsible development of ChatGPT," *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, vol. 3, no. 3, p. 100136, 2023, https://doi.org/10.1016/j.tbench.2023.100136.

[288] V. R. Revathy, A. S. Pillai, and F. Daneshfar, "LyEmoBERT: Classification of lyrics' emotion and recommendation using a pre-trained model," *Procedia Computer Science*, vol. 218, pp. 1196–1208, 2023, https://doi.org/10.1016/j.procs.2023.01.098.

[289] S. Rizou *et al.*, "Efficient intent classification and entity recognition for university administrative services employing deep learning models," *Intelligent Systems with Applications*, vol. 19, p. 200247, 2023, https://doi.org/10.1016/j.iswa.2023.200247.

[290] J. F. Ruma, T. T. Mayeesha, and R. M. Rahman, "Transformer based Answer-Aware Bengali Question Generation," *International Journal of Cognitive Computing in Engineering*, vol. 4, pp. 314–326, 2023, https://doi.org/10.1016/j.ijcce.2023.09.003.

[291] S. Scaboro, B. Portelli, E. Chersoni, E. Santus, and G. Serra, "Extensive evaluation of transformer-based architectures for adverse drug events extraction," *Knowledge Based System*, vol. 275, p. 110675, 2023, https://doi.org/10.1016/j.knosys.2023.110675.

[292] R. Silveira *et al.*, "GISSA intelligent chatbot experience - How effective was the interaction between pregnant women and a chatbot during the COVID-19 pandemic?," *Procedia Computer Science*, vol. 219, pp. 1271–1278, 2023, https://doi.org/10.1016/j.procs.2023.01.411.

[293] F. Spaccatini, G. Corlito, and S. Sacchi, "New dyads? The effect of social robots' anthropomorphization on empathy towards human beings," *Computers in Human Behavior*, vol. 146, p. 107821, 2023, https://doi.org/10.1016/j.chb.2023.107821.

[294] T. Spinde, E. Richter, M. Wessel, J. Kulshrestha, and K. Donnay, "What do Twitter comments tell about news article bias? Assessing the impact of news article bias on its perception on Twitter," *Online Social Networks and Media*, vol. 37–38, p. 100264, 2023, https://doi.org/10.1016/j.osnem.2023.100264.

[295] M. Tarafdar, I. Rets, and Y. Hu, "Can ICT enhance workplace inclusion? ICT-enabled workplace inclusion practices and a new agenda for inclusion research in Information Systems," *Journal of Strategic Information Systems*, vol. 32, no. 2, p. 101773, 2023, https://doi.org/10.1016/j.jsis.2023.101773.

[296] A. Turchin, S. Masharsky, and M. Zitnik, "Comparison of BERT implementations for natural language processing of narrative medical documents," *Online Social Networks and Media*, vol. 36, p. 101139, 2023, https://doi.org/10.1016/j.osnem.2023.100264.

[297] S. E. Uthirapathy and D. Sandanam, "Topic Modelling and Opinion Analysis on Climate Change Twitter Data Using LDA And BERT Model.," *Procedia Computer Science*, vol. 218, pp. 908–917, 2023, https://doi.org/10.1016/j.imu.2022.101139.

[298] C. Vandelanotte *et al.*, "Increasing physical activity using an just-in-time adaptive digital assistant supported by machine learning: A novel approach for hyper-personalised mHealth interventions," *Journal of Biomedical Informatics*, vol. 144, p. 104435, 2023, https://doi.org/10.1016/j.procs.2023.01.071.

[299] Y. Xu and Q. Su, "Boosting BERT-Based Knowledge Graph Completion with Contrastive Learning and Hard Sample Training," *Procedia Computer Science*, vol. 222, pp. 71–80, 2023, https://doi.org/10.1016/j.procs.2023.08.145.

[300] Y. Yan *et al.*, "Research on the impact of trends related to ChatGPT," *Procedia Computer Science*, vol. 221, pp. 1284–1291, 2023, https://doi.org/10.1016/j.procs.2023.08.117.

[301] J. Y. Yun, D. J. Kim, N. Lee, and E. K. Kim, "A comprehensive evaluation of ChatGPT consultation quality for augmentation mammoplasty: A comparative analysis between plastic surgeons and laypersons," *International Journal of Medical Informatics*, vol. 179, p. 105219, 2023, https://doi.org/10.1016/j.ijmedinf.2023.105219.

[302] B. Zaidat, J. Tang, E. Geng, V. Arvind, S. Cho, and J. Kim, "Machine learning to automatically generate billing codes for a variety of orthopedic surgery procedure operative notes: a study of 922 patients," *The Spine Journal*, vol. 23, no. 9, pp. S98–S99, 2023, https://doi.org/10.1016/j.spinee.2023.06.215.

[303] B. Zhao, W. Jin, J. Del Ser, and G. Yang, "ChatAgri: Exploring potentials of ChatGPT on cross-linguistic agricultural text classification," *Neurocomputing*, vol. 557, p. 126708, 2023, https://doi.org/10.1016/j.neucom.2023.126708.

[304] J. Zhao *et al.*, "Navigating the labyrinth of RI through a practical application — A case study in a cross-disciplinary research project," *Journal of Responsible Technology*, vol. 15, p. 100064, 2023, https://doi.org/10.1016/j.jrt.2023.100064.

[305] S. Zhu, M. Gilbert, A. I. Ghanem, F. Siddiqui, and K. Thind, "Feasibility of Using Zero-Shot Learning in Transformer-Based Natural Language Processing Algorithm for Key Information Extraction from Head and Neck Tumor Board Notes," *International Journal of Radiation Oncology, Biology, Physics*, vol. 117, no. 2, p. e500, 2023, https://doi.org/10.1016/j.ijrobp.2023.06.1743.

[306] I. Celik, "Exploring the Determinants of Artificial Intelligence (AI) Literacy: Digital Divide, Computational Thinking, Cognitive Absorption," *Telematics and Informatics*, vol. 83, p. 102026, 2023, https://doi.org/10.1016/j.tele.2023.102026.

[307] A. N. Handayani, H. W. Herwanto, K. L. Chandrika, and K. Arai, "Recognition of Handwritten Javanese Script using Backpropagation with Zoning Feature Extraction," *Knowledge Engineering and Data Science*, vol. 4, no. 2, p. 117, 2021, https://doi.org/10.17977/um018v4i22021p117-127.

[308] D. D. Prasetya and T. Hirashima, "Associated Patterns in Open-Ended Concept Maps within E-Learning," *Knowledge Engineering and Data Science*, vol. 5, no. 2, p. 179, 2022, https://doi.org/10.17977/um018v5i22022p179-187.

[309] S. Sendari, I. A. E. Zaeni, D. C. Lestari, and H. P. Hariyadi, "Opinion Analysis for Emotional Classification on Emoji Tweets using the Naïve Bayes Algorithm," *Knowledge Engineering and Data Science*, vol. 3, no. 1, pp. 50–59, 2020, https://doi.org/10.17977/um018v3i12020p50-59.

[310] A. P. Wibawa, H. K. Fithri, I. A. E. Zaeni, and A. Nafalski, "Generating Javanese Stopwords List using K-means Clustering Algorithm," *Knowledge Engineering and Data Science*, vol. 3, no. 2, p. 106, 2020, https://doi.org/10.17977/um018v3i22020p106-111.

[311] H. Ar Rosyid, A. Y. H. Putra, M. I. Akbar, and F. A. Dwiyanto, "Can Multinomial Logistic Regression Predicts Research Group using Text Input?," *Knowledge Engineering and Data Science*, vol. 5, no. 2, p. 150, 2022, https://doi.org/10.17977/um018v5i22022p150-159.