Comprehensive Review of Recent Chatbot Technology Advancements

Anuradha B[1], Gowtham V[2], Priyadharshan R[3], Nishanth S[4], Naveenrosanth J

[1]Associate Professor, [2,3,4,5]UG Students - Department of Computer Science and Design, SNS College of Engineering(Autonomous), Coimbatore, India. [1]pskanu80@gmail.com, bharathi.a.v.43@gmail.com, hemavathykamal08@gmail.com, Kuttykeerthi255@gmail.com, joelinrani44@gmail.com

Abstract Chatbots are sophisticated conversational computer programmes created to simulate human-to-human communication in order to provide online assistance and advice automatically. Many businesses have used chatbots widely to provide virtual support to clients due to their growing advantages. Chatbots use techniques and algorithms from the fields of machine learning and natural language processing within the field of artificial intelligence. Nevertheless, there are several difficulties and restrictions with their use. We examine current developments in artificially intelligent machines and processing of natural language for chatbots in this study. We draw attention to the primary difficulties and constraints of the existing research and provide suggestions for further study.

Keyword- Chatbots, Chat GPT, Generative AI, Generative AI Models, Healthcare Chatbots, Educational Chatbots.

I. INTRODUCTION

Chatbots are sophisticated software programmes designed to replicate real conversations between people [1, 2, 3]. An output may be generated by a chatbots by processing user input [4,5]. Conversational writing is often entered by chatbots, and the result that they provide ought to reflect a particularly pertinent statement based on the user input. "Online human-computer conversation system(s) utilizing organic speech" is another definition of chatbots [6]. Thus, chatbots are an automatic means of communication that may serve many prospective customers simultaneously. At the moment, chatbots are used in a wide range of industries and contexts, including medical care, recreation, online shopping, and academia. Consequently, consumers may get both enjoyment and assistance from chatbots [7, 8].

Examples of such include chatbots that focus on "small talk, "like Mitsuku and Jessie Humani, and which may help consumers feel more socially connected. As a matter of fact, users seem to find chatbots more entertaining than an organization's basic FAQ section. Chatbots can help numerous users at once, which makes them cheaper and more effective than human client service representatives. Chatbots may be utilized to amuse and accompany users as well as to provide assistance and guidance to customers [9]. However, users' participation and confidence in chatbots seem to be impacted by varying degrees of embodiment the degree to which chatbots resemble humans [10] and

disclosure the manner and timing of the chatbot's nature revelation to the user [11].

Chatbot systems have been more prevalent lately due to the commercialization of software, the rise in computing power, and the collaboration of free frameworks and techniques. Chatbots are becoming steadily more like real-world conversations be-cause to advancements in machine learning and the processing of natural languages. They are also becoming simpler to use and manage. Prejudices based on gender and situational and psychological understanding need to be improved in human-chatbots communication, nevertheless. In actuality, chatbots' capacity to communicate in an increasingly engaging and amiable way is hampered by their inferior comprehension of informal environment [12] and psychological signals [13]. However, chatbots frequently adopt conventional behaviors and typically feminine attributes to fulfil traditionally feminine functions, exposing gender stereotypes in the development and use of chatbots [9]. Because chatbots have become so prevalent and deployed across a broad range of industries, advancements in their execution and assessment make them valuable study subjects. This article's primary contributions are (i) a thorough review of the available literature on chatbots and the current state of the art in chatbots adoption techniques, with an emphasis on Deep Learning computations; (ii) a description of the difficulties and constraints associated with the creation and utilization of chat-bots; and (iii) recommendations for subsequent research on chatbots.

II.   INFORMATION GATHERING

We find pertinent search phrases for the topic's literary work initially, after which we find appropriate websites with study papers. Next, we gather academic papers about chatbots using the designated sources. The purpose of all of this is to obtain knowledge on the subject.

A. *Search Terms and Databases Identification*

We found studies on chatbots using the databases of three significant publications. IEEE, Science Direct, and Springer are these. In the areas of machine learning, interactions between humans and computers, and the processing of natural languages, these publications offer a decent selection of publications that have undergone peer-reviews. Since they offered a significant amount of articles and content, we also looked for articles on arXiv, Google Scholar, and JSTOR alongside the aforementioned sources. Articles across a range of disciplines, such as computing, computer science, computer engineering, interaction, and cultural arts, were chosen. We chose to obtain papers from every one of the sources, indexes, and libraries as we could access the journals for free and since we were able to utilize search terms to conduct searches for the content.

B. *Reviewing Articles*

For the purpose of finding a few significant chatbots features based on the indicated research material, we went through an extensive number of publications. We examined 287 publications using the method of content analysis. We solely reviewed the abstracts of the publications in this stage and determined their primary goals. After that, a second assessment of the 287 chosen publications was carried out to determine the crucial elements of chatbots that were the subject of earlier research.

III.   LITERATURE ANALYSIS

We examined chatbots as well as their learning procedure in great depth in the parts that came before this one. This section provides a thorough summary of the most recent chatbot study results. In order to enable a methodical examination, the 47 publications that underwent evaluation were methodically separated into eleven discrete research areas (segments) according to the field of study. To determine how significant and influential each publication was, a defined indication (citation indication) was also used; the sequence in which the indicators were presented indicated the importance of every piece, having those with the greatest important articles being shown foremost. Powerful assertions had been carefully developed as well as organized in an organised manner specific to the publications, collectively alongside the publications' domains and associated reference figures.

A research comparing ChatGPT's effectiveness to the USMLE was carried out by Kung T et al. [14]. Questions with open ends created by the writers were transformed to several- choice, single-answer inquiries. According to the research, ChatGPT can answer over sixty percent of questions correctly with no need for direct assistance by actual instructors. Satisfaction in ChatGPT's dependability as well as understanding grew as a result of its clear rationale and pertinent clinical results. The researchers suggested integrating ChatGPT into healthcare decision-making procedures as well as employing it to support people trainees in medical schooling. The overall results of the research demonstrate ChatGPT's promise for an instrument to advance healthcare decisions and instruction in medicine.

Using ChatGPT, Aydın Ö et al. created an analysis of the literature on "Digital Twin in Healthcare" by rewording summaries of the most frequently referenced works on the subject matter found on Google Scholar [15]. ChatGPT was questioned on relevant subjects to gauge its understanding of the subject. The contributors care-fully evaluated the ChatGPT-generated papers' originality percentages against the ones of the related texts found online and in university library collections, employing an authorized originality software. Although ChatGPT's responses to queries that were pertinent to the discussion indicated a lack of plagiarism, the paraphrasing revealed substantial rates. The contributors came to the conclusion that ChatGPT's paraphrasing failed to result in creative works and proposed that less human labor would be needed down the road for educational publication procedures, freeing up academics to concentrate on their work. In order to assess conceptuality and the reliability of the data generated by ChatGPT, the writers intend to monitor references to the work in subsequent investigations.

ChatGPT was used in the Macdonald et al. study to generate a piece of writing on the efficacy of vaccines [16]. The contributors created a replicated database with the various attributes of one hundred thousand medical professionals. ChatGPT used this collection of data to assess the effectiveness of vaccines and produce a study report. The findings of the investigation show ChatGPT's ability as a helpful instrument for research for carrying out analysis and producing publications across a range of sub-jects. The research does, nevertheless point out that ChatGPT's search function for paper citations has to be updated.

Sallam looked at the legitimate and possible worries about utilizing ChatGPT in the medical field studies and instruction in an examination of the previous research [17]. ChatGPT possesses the capacity to conquer linguistic obstacles and advance fairness as well as variety in scientific inquiry. To prevent such issues, norms and

guidelines are desperately required to guarantee the appropriate and secure application of ChatGPT. Prior to when ChatGPT became widely used, Sallam suggested evaluating its effects from a healthcare standpoint using a dependent on risk methodology. The writer came to the conclusion that breakthroughs in medicine may be accelerated by proactively embracing LLM technology while carefully weighing legal and moral issues.

A thorough analysis of the benefits and drawbacks of using ChatGPT can be found in the paper by Dahmen J et al. [18]. Its capacity to effectively evaluate enormous volumes of knowledge, retrieve pertinent details, and arrange it methodically was noted by the investigators as a key benefit. They nevertheless also bring out a number of issues, such as the absence of setting, incorrectness, prejudice, and insufficient linguistic and clinical scientific understanding. When using ChatGPT for study or additional reasons, it is important to carefully evaluate these restrictions because they can restrict its efficacy in particular circumstances.

A thorough chronological and scientific examination of ChatGPT was given by Shahriar S et al. [19], who also highlighted the capabilities of the technology uses in a number of fields, including studies, instruction, and medicine. The writers spoke as well about ChatGPT's shortcomings, such as its propensity to convey accurate material incorrectly as well as to mistake in fundamental rationality, arithmetic, and thinking. The investigation also showed that ChatGPT can only handle an aggregate of 5000 language characters feed. The writers also brought up major worries about ChatGPT's reliability for current understanding and its possible immoral usage in the classroom, that raises moral questions about copying and ownership theft. In general, the paper emphasizes how crucial it is to carefully weigh ChatGPT's benefits and drawbacks in a variety of contexts.

The influence of AI chatbots, such as ChatGPT, upon educational institutions as well as future advancements and consequences were investigated in the research by Rudolph J et al. [20]. An analysis was conducted on the advantages of implementing applications based on artificial intelligence for pupils, which included enhancing smart aid for student's platforms. It was further examined if teacher-facing AI apps might be used to streamline processes like evaluation, copyright detection, as well as systems that provide feedback. The contributors offered advice on how pupils as well as educational organizations might lessen the possible negative effects to employing AI technologies like ChatGPT.

Exam integrity was emphasized by Susnjak T. in a research that examined ChatGPT's possible danger to online exams [21]. Concerns regarding cheating were raised by the study's findings that ChatGPT could generate

very genuine text with sophisticated reasoning abilities. The author used a three-step process to investigate ChatGPT's capacity for higher-order thinking, and the answers that were produced were pertinent and on-topic. In order to decrease cheating, the author proposed reintroducing oral tests, using GPT output detection algorithms, and creating test question that are difficult to get from cheating means. All things considered, the study highlights the need of discussing the possible hazards of ChatGPT in academic integrity and urges further investigation to create practical countermeasures.

The issues surrounding the use of ChatGPT in education were investigated by Tlili A et al. [22]. Three phases of data analysis were employed in the study: user experience inquiry, content analysis of interviews, and social network analysis of tweets. The results showed that while users thought ChatGPT was a great tool for changing education, they also expressed a number of concerns about equitable access for all users, material quality, and cheating prevention. In order to address the problems raised, the authors recommended future research directions and included ChatGPT into teaching practices. Overall, the research emphasizes how critical it is to weigh the advantages and disadvantages of AI-based tools in the classroom.

The difficulties and policy ramifications of integrating AI into education and pre-paring students for a world powered by AI were also covered by Pedro et al. [23]. The challenges include creating inclusive and equitable public policies for sustainable development, training educators to use AI in the classroom, creating meaningful and inclusive data systems, addressing ethical issues with data collection, use, and dissemination, and preparing teachers for AI-powered education. Partnerships on a global and national level as well as open dialogue on security, ethics, accountability, and transparency are needed to address these issues. The writers also discussed some of the technological and moral issues surrounding the use of AI in education. The sixth difficulty with using AI in education was brought up by the writers. According to Pedro et al. [24], there are a number of worries about artificial intelligence (AI) and how it will affect education. These worries include the possibility of discrimination, inadequate recommendations for specific student groups, concentration of personal data, liability, and the effect of AI automation on teaching positions. Protecting personally identifiable information and privacy preferences is a difficulty, especially for younger students who are unable to provide their explicit consent. As a result, Pedro et al. [24] brought out the need of addressing the ethical issues surrounding the gathering, using, and sharing of data.

Tlili et al.'s exploratory research [25] looked at the potential of using conversation-al agents—like ChatGPT—as a

means of improving online learning environments. Because conversational agents offered a more dynamic and interesting learning environment, they discovered that students favored utilizing them for educational tasks. Additionally, Kuhail et al.[26] discovered that chatbots can provide students personalized learning experiences along with immediate feedback and assistance. Addition-ally, the scientists discovered that chatbots could boost students' enthusiasm and involvement in the classroom. In a similar vein, a different research [27] investigated chatbots' possible use in higher education. According to the research, using chatbots during a student's first year of university helps them adjust more easily and becomes more engaged in their academics. The results demonstrated a favorable relationship between peer involvement, study engagement, and chatbot usage. Students said the chatbot made it easier for them to get in touch with their programme leader and get assistance.

A research assistant is essential to a researcher's ability to accomplish his goals since they provide necessary assistance and ensure that the project runs smoothly. A research assistant's responsibilities include supporting the planning, carrying out, and analyzing research initiatives as well as preparing research papers and presentations, according to Stevano and Deane [27]. Turner [28] acknowledged that research assistant are essential to the field. She acknowledges that their contribution to the process of knowledge production is essential. As such, it is critical to recognize the contributions they have made to our comprehension of field experiences and the results we achieve. According to Johnson and Harris [29], research assistants play a crucial role in many phases of the research process, such as gathering and analyzing data and preparing manuscripts. In summary, we contend that research assistants, via their work on projects related to planning, carrying out, and analyzing research, as well as creating research reports and presentations, are vital to the success of academic re- search.

We highlight Araujo's study [30] among the few that address the potential use of chatbots as research assistants. The Conversational Agent Research Toolkit (CART), a tool created to help researchers create conversational bots for experimental investigations, is introduced in that article. The article offers a description of the technology as well as a detailed guide on how to create a chatbot experiment. On March 11, 2023, a different study report [30] was released that focused on the future cooperation between researchers and chatbots. This study acknowledged that chatbots would help promote the concept of hybrid work and act as research assistants for desk re-search in the near future. Thus, once again, given the paucity of research in the field under discussion, the second research question asks if chatbots will change the nature of academic research.

IV. CONCLUSIONS

Artificial intelligence chatbots are still unable to mimic human speech, despite technical breakthroughs. This is caused by a flawed conversation modelling methodology and a deficiency of publicly available domain-specific data. An AI model that has been learned is also lacking for chatbots that retrieve information. Such a methodology might find application across other industries. In terms of applications, there is still a gap between industrial models and the most recent developments in the field. Large models need large amounts of training data and processing resources. A common approach for assessing chatbots does not yet exist. A number of models rely on human review, yet human evaluation is biased, incoherent, costly, and time- consuming. It is necessary to create a fresh, trustworthy automated assessment method to get over these limitations. Moreover, recent research has shown a dearth of information on the most current advancements in language models that may be used to chatbots such as Trans-formers. Because of this, it's essential to go over and evaluate the data that was used to train the different models. This kind of research enables a more precise comparison between various models and their outcomes. Indeed, it is difficult to distinguish between applications for chatbots and social or companion chatbots. A fascinating problem that combines natural language processing and deep learning is chatbot modelling. Even though the first chatbots were developed sixty years ago, the field has expanded and is now home to a variety of intriguing new challenges. Smaller, more adaptable, and less domain-dependent models might be helpful in bridging these discrepancies. Better assessment structures, more comparable to human model structures, enhanced, and adaptable models of language specific to an industry type of solutions could all undoubtedly be significant advancements within the discipline. Currently, the most widely used chatbot model that can generate text replies to user questions that seem human-like is called ChatGPT, which is an advanced kind of AI generative model. This technology can produce code and methods to correct code faults; it has also undergone intensive training using massive quantities of data. However, Since ChatGPT's formal release in February 2023, a wealth of new concepts and possible uses for the technology have been added to the literature. This article explores the background and training methodology of ChatGPT and concludes with a thorough literature review that examines 47 scholarly publications on the subject. Eleven separate study areas were used to categories the reviewed publications, and their contributions were then shown. Additionally, the article's domain, citation count, and strong assertions were automatically retrieved and calculated. In summary, this paper provides an analysis of the benefits and drawbacks of ChatGPT and identifies future research directions to further

current technological understanding. All things considered, this article provides scholars and practitioners looking to learn more about chatbots with a useful starting point.

REFERENCES

[1] Jia, J. The Study of the Application of a Keywords-based Chatbot System on the Teaching of Foreign Languages. arXiv 2003, arXiv:cs/0310018.

[2] Sojasingarayar, A. Seq2Seq AI Chatbot with Attention Mechanism. Master's Thesis, Department of Artificial Intelligence, IA School/University-GEMA Group, Boulogne-Billancourt, France, 2020.

[3] Bala, K.; Kumar, M.; Hulawale, S.; Pandita, S. Chat-Bot For College Management System Using A.I. Int. Res. J. Eng. Technol. (IRJET) 2017, 4, 4.

[4] Ayanouz, S.; Abdelhakim, B.A.; Benhmed, M. A Smart Chatbot Architecture based NLP and Machine Learning for Health Care Assistance. In Proceedings of the 3rd International Conference on Networking, Information Systems & Security, Marrakech, Morocco, 31 March–2 April 2020; pp. 1–6.

[5] Kumar, R.; Ali, M.M. A Review on Chatbot Design and Implementation Techniques. Int. J. Eng. Technol. 2020, 7, 11. [Google Scholar] [CrossRef][Green Version]

[6] Cahn, J. CHATBOT: Architecture, Design, & Development. Ph.D. Thesis, University of Pennsylvania, School of Engineering and Applied Science, Philadelphia, PA, USA, 2017.

[7] Okuda, T.; Shoda, S. AI-based Chatbot Service for Financial Industry. FUJITSU Sci. Tech. J. 2018, 54, 5.

[8] Brandtzaeg, P.B.; Følstad, A. Why People Use Chatbots. In Internet Science; Kompatsiaris, I., Cave, J., Satsiou, A., Carle, G., Passani, A., Kontopoulos, E., Diplaris, S., McMillan, D., Eds.; Lecture Notes in Computer Science; Springer International Publishing: Berlin/Heidelberg, Germany, 2017; Volume 10673, pp. 377–392.

[9] Costa, P. Conversing with personal digital assistants: On gender and artificial intelligence. J. Sci. Technol. Arts 2018, 10, 59–72.

[10] Go, E.; Sundar, S.S. Humanizing chatbots: The effects of visual, identity and conversational cues on humanness perceptions. Comput. Hum. Behav. 2019, 97, 304–316.

[11] Luo, X.; Tong, S.; Fang, Z.; Qu, Z. Frontiers: Machines vs. Humans: The Impact of Artificial Intelligence Chatbot Disclosure on Customer Purchases. Mark. Sci. 2019, 38, 913–1084.

[12] Christensen, S.; Johnsrud, S.; Ruocco, M.; Ramampiaro, H. Context- Aware Sequence-to-Sequence Models for Conversational Systems. arXiv 2018, arXiv:1805.08455.

[13] Fernandes, A. NLP, NLU, NLG and How Chatbots Work. 2018. Available online: https://chatbotslife.com/nlp-nlu-nlg-and-how- chatbots-work-dd7861dfc9df (accessed on 11 November 2023).

[14] Kung, T.H.; Cheatham, M.; Medenilla, A.; Sillos, C.; De Leon, L.; Elepaño, C.; Madriaga, M.; Aggabao, R.; Diaz-Candido, G.; Maningo, J.; et al. Performance of chatgpt on USMLE: Potential for AI-assisted medical education using large language models. PLOS Digit. Health 2023, 2, e0000198.

[15] Aydın, Ö.; Karaarslan, E. OpenAI ChatGPT Generated Literature Review: Digital Twin in Healthcare. Emerg. Comput. Technol. 2022, 2, 22–31.

[16] Macdonald, C.; Adeloye, D.; Sheikh, A.; Rudan, I. Can ChatGPT draft a research article? An example of population-level vaccine effectiveness analysis. J. Glob. Health 2023, 13, 01003.

[17] Sallam, M. ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns. Healthcare 2023, 11, 887.

[18] Dahmen, J.; Kayaalp, M.E.; Ollivier, M.; Pareek, A.; Hirschmann, M.T.; Karlsson, J.; Winkler, P.W. Artificial Intelligence Bot CHATGPT in medical research: The potential game changer as a double-edged sword. Knee Surg. Sport. Traumatol. Arthrosc. 2023, 31, 1187–1189.

[19] Shahriar, S.; Hayawi, K. Let's have a chat! A conversation with chatgpt: Technology, applications, and limitations. arXiv 2023, arXiv:2302.13817.

[20] Rudolph, J.; Tan, S. Chatgpt: Bullshit spewer or the end of traditional assessments in higher education? J. Appl. Learn. Teach. 2023, 6.

[21] Susnjak, T. CHATGPT: The end of online exam integrity? arXiv 2022, arXiv:2212.09292.

[22] Tlili, A.; Shehata, B.; Adarkwah, M.A.; Bozkurt, A.; Hickey, D.T.; Huang, R.; Agyemang, B. What if the devil is my guardian angel: Chatgpt as a case study of using Chatbots in education. Smart Learn. Environ. 2023, 10, 15.

[23] Pedro, F.; Subosa, M.; Rivas, A.; Valverde, P. Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development; UNESCO: Paris, France, 2019.

[24] Tlili, A.; Shehata, B.; Adarkwah, M.A.; Bozkurt, A.; Hickey, D.T.; Huang, R.; Agyemang, B. What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. Smart Learn. Environ. 2023, 10, 51.mith, J. R., et al. (2020). "Temporal Credentials in Network Security: A Comprehensive Review." Journal of Cyber Defense, 15(3), 45-58.