Universe International Journal of Interdisciplinary Research
(International Peer Reviewed Refereed Journal)
DOI No. – 08.2020-25662434

© UIJIR | ISSN (O) – 2582-6417
NOV 2023 | Vol. 4 Issue 6
www.uijir.com

FEASIBILITY AND EFFECTIVENESS OF ARTIFICIAL INTELLIGENCE-DRIVEN CONVERSATIONAL AGENTS IN HEALTHCARE INTERVENTIONS: A SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

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ABSTRACT

The feasibility of conversational bots has significantly increased due to recent advancements in artificial intelligence research. The research on conversational agents indicates that the healthcare sector can benefit from the application of the study's conclusions. Computer programmes that mimic user chats are known as conversational agents or chat bots. Customers are welcoming their growing use in a variety of industries, including as banking, retail, marketing, commerce, and fitness. Conversational agents are frequently implemented through mobile applications, websites, or messaging services. In addition, they can be included into standalone devices like speakers or integrated into automobiles and televisions. They can communicate using a variety of media, including voice, picture, and text. Voice assistants are conversational agents that can comprehend spoken language, answer with artificial voices, and handle user-inputted tasks. The most widely used voice assistants are Cortana from Microsoft, Alexa from Amazon, Apple's Siri, and Google Assistant from Amazon. These assistants are typically provided through voice-activated or smart speakers like Google Home and Echo from Amazon. They are used to facilitate or carry out activities including online shopping, managing smart home appliances, and distributing news or entertainment.

Keywords: Artificial Intelligence, Healthcare Intervention, Conversational Agent

DOI Link :: https://doi-ds.org/doilink/12.2023-25837116/UIJIR

INTRODUCTION

As a consequence of recent studies in artificial intelligence, conversational agents have become considerably more feasible. This study's findings can be applied in the healthcare industry, according to the study that has been conducted on the topic of conversational agents.

Conversational agents or chat bots are computer programs that simulate conversations with users (*Oxford Living Dictionaries, 1990*). They are increasingly adopted in many different fields, including finance, commerce, marketing, retail, and fitness, with favourable reception from customers (Veretskaya O., 2017). Conversational agents are often deployed via messaging apps, a website, or a mobile phone app. They can also be integrated into cars and television sets or in the form of a stand-alone device such as speakers. They can converse through a range of methods such as text, image, and voice (*Billboard.* 2017). Conversational agents that can interpret human speech and respond via synthesized voices as well as manage tasks requested by the user are also known as voice assistants. Some of the most popular voice assistants include Apple's Siri, Amazon's Alexa, Google Assistant, and Microsoft's Cortana, mostly delivered using voice-activated or smart speakers such as Amazon's Echo and Google Home. They are utilized for aiding or executing tasks such as web-based shopping, control of smart home devices, and disseminating news or for entertainment (Smart Speakers, 2018).

ARTIFICIAL INTELLIGENCE-DRIVEN CONVERSATIONAL AGENTS

Development of the technologies like natural language processing (NLP), speech recognition, and artificial intelligence (AI), among others, has led to recent advances in the field, the availability and utilization of conversational agents have increased. Conversational agents (CAs), also known as chatbots or conversation systems, are computer systems that communicate with users via natural language user interfaces involving graphics, text, and speech (Schachner T. et al., 2020; Kramer L.L. et al., 2020). Conversational agents (CAs) are also commonly referred to as chatbots. Google Assistance, Apple Siri, Amazon Alexa, and Microsoft Cortana are prominent examples of increasingly prevalent CAs that feature voice-activated user interfaces. In the past decade, CAs have grown in popularity, especially those that utilize natural language without any artificial constraints (Ferrand J. et al., 2020). Consumers, for example, can communicate with CAs via their smartphones in order to complete routine duties such as organizing their calendars and acquiring information (Griffin A.C. et al., 2021).

AI-based CAs have recently demonstrated numerous advantages across a range of industries, particularly in the healthcare sector. According to Bickmore T.W. (2018), it is utilized to provide

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scalable and less costly medical assistance solutions that are always accessible via smartphone applications or the Internet. (A.S. Miner et al., 2019) One study found that providing support and follow-up via chatbot to adults undergoing cancer treatment reduced their anxiety without requiring them to see a psychiatrist. As a result, CAs have the potential to play a significant role in the health care industry, contributing to the improvement of consultations by assisting physicians and patients, supporting consumers as they make behavioral changes, and assisting older individuals in their living environments (Ly K.H. et al., 2017). They are also capable of aiding in the completion of specific duties, such as self-monitoring and overcoming barriers to self-management, which are crucial for the management of chronic diseases and the fight against pandemics (Miner A.S., et al, 2020).

Effectiveness Of Conversational Agents Driven By Artificial Intelligent

Conversational agents are one of the many digital technologies that are being introduced into the healthcare industry to resolve current issues. These obstacles include shortages of health care professionals, which limit the accessibility and availability of health care services. Conversational agents interact with humans through speech, text, or other inputs and outputs on mobile, web-based, or audio-based platforms using artificial intelligence (AI), including machine learning and natural language processing. Many of these agents utilize natural language processing (NLP) so that users can converse with or write to the agent as if they were communicating with a real person. According to the research of Milne-Ives et al. from 2020, the AI is then able to analyze the input and respond in an acceptable conversational manner.

In 1966, the virtual psychotherapist ELIZA was created; she could respond to text-based user input with predefined answers. This signalled the beginning of the use of conversational agents as a tool within the healthcare industry. In the decades that have passed since then, natural language processing (NLP) has undergone significant development, which has facilitated the creation of more sophisticated AI agents. Natural language processing (NLP)-based conversational agents, such as messaging bots, embodied conversational agents (ECAs), and virtual patients, have been developed in a variety of forms. These conversational agents are accessible via telephone, mobile phone, computer, and a number of other digital platforms. The types of data that conversational agents are able to receive and interpret have also increased. Some conversational agents can now analyze movement data, including facial expressions, eye movements, and hand gestures (Milne-Ives, et al, 2020).

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CONVERSATIONAL AGENTS IN HEALTH CARE SYSTEM

Conversational agents, also commonly referred to as chat bots, are computer programs designed to simulate human text or spoken conversations. They are gaining increasing application in numerous fields, including the medical industry. This was our goal: to do a full analysis of the features, current uses, and evaluation criteria of health-related conversational agents that can accept free-form natural language input. Various Methods: We conducted a standard search in ACM Digital, PubMed, Embase, CINAHL, and PsycInfo, in addition to the aforementioned databases. Studies were considered for inclusion if they concentrated on consumers or healthcare professionals, used any unrestricted natural language input, incorporated a conversational agent, and published evaluation metrics resulting from user interaction with the system. Different types of conversational agents can be put into groups based on their communication mode, capabilities, embodiment, response generation techniques, and domains. Considering that natural language can be conveyed orally or in writing, the mode of communication employed by conversational agents can be classified as text, voice, or a combination of the two.AI-based CAs have recently demonstrated numerous advantages across a range of industries, particularly in the healthcare sector. It is used to provide medical support solutions that are scalable, less expensive, and accessible at any time via smartphone applications or the internet. Conversational agents are one of the many digital technologies that are being introduced into the healthcare industry to resolve current issues. These obstacles include shortages of health care professionals, which limit the accessibility and availability of health care services. Indulging in unhealthy behaviours, such as smoking, imbibing excessively, and not getting enough exercise, is what leads to disease. Changes in behaviour can pave the way to a healthier lifestyle. During the process of modifying lifestyles, however, the individual may experience health issues for which early detection is crucial. This is a factor that must be considered. This necessitates both financial and time commitments from patients in order to see specialists.

WORK OF CONVERSATIONAL AGENT

Conversational agents cover a broad spectrum of aptitudes ranging from *simple* to *smart*. Simple conversational agents are *rule based*, meaning that they depend on prewritten keywords and commands programmed by the developer. The user is therefore restricted to predetermined options when answering questions posed by the conversational agents, and there is little or no opportunity for free responses. If a user enters a question or sentence without a single keyword,

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the conversational agents will be unable to understand the input and will respond with a default message such as "Sorry, I did not understand". Despite these restrictions, simple conversational agents are increasingly used in executing tasks such as booking appointments, purchasing merchandise, ordering food, and sharing information without the need for human involvement (Veretskaya O., 2017).

Conversational agents, also commonly referred to as catboats, are computer programs designed to simulate human text or spoken conversations. They are gaining increasing application in numerous fields, including the medical industry. Conversational agents have the potential to enhance patient care by enabling greater accessibility, greater personalization, and greater efficiency.

Closing Comments the majority of this study on health care conversational agents is descriptive in nature and focuses on therapy, monitoring, and providing support for health services. It focuses primarily on artificial intelligence-powered text-based conversational agents that are accessible via smartphone apps. There is an immediate need for an exhaustive analysis of the numerous formats used by health care conversational agents, with a focus on the acceptability, safety, and effectiveness of the formats (Tudor Car, 2020).

RELATION BETWEEN ARTIFICIAL INTELLIGENT AND DRIVEN CONVERSATION AGENT

Generative AI, specifically ChatGPT, represents a significant technological advancement in natural language processing (NLP) large language models (LLM) with far-reaching implications in many dimensions of our lives, including education. This paper discusses the prospects of generative AI in utilizing language and its potential role as a conversational agent within the educational realm. Emulating the most advanced human technology, language, generative AI's success relies on understanding and generating human-like text. However, its comprehension is solely based on patterns and structures it learns from its training data. With the advent of AI-driven conversational agents, prompt engineering emerges as a vital form of digital literacy. The convergence of general and educational technologies necessitates preparedness for a future dominated by AI. This paper highlights the importance of vigilance and prudence in harnessing the potential of generative AI technologies, emphasizing the responsibility of humans, as creators, in mitigating any potential mishaps. In conclusion, this paper suggests that preparedness for a future dominated by AI is essential, as generative AI technologies have the potential to profoundly impact teaching and learning methods, and necessitate new ways of

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thinking (Bozkurt, Aras., 2023).

Throughout history, technologies utilizing language have been major turning points. These include the invention of writing, which enabled the symbolic processing of language; the printing press, which facilitated the dissemination of knowledge more widely and rapidly; and the creation of computers, which were capable of processing binary language. In the age of digital information and technology, ChatGPT, a generative AI model developed by OpenAI (2022) using natural language processing (NLP), represents one of the most significant technological advancements. ChatGPT is specifically designed to excel in NLP applications such as chatbots, virtual assistants, language translation, and text generation. Generative AI has the potential to master human language, one of the most complex and sophisticated technologies ever created, and to use human knowledge to identify patterns that may elude human perception. When properly trained, ChatGPT is a powerful tool that can learn, unlearn, and relearn language, allowing it to adapt and evolve with human communication needs.

From our current perspective, it is difficult to determine whether this will emerge as the next big thing; however, its potential to trigger transformative change is undeniable. Within this context, this paper examines generative artificial intelligence, focusing on the prospects it offers as a technological innovation adept at utilizing language. As a conversational agent, it also investigates the implications of generative AI within the realm of education.

A rising number of conversational agents or chatbots are equipped with artificial intelligence (AI) architecture. They are increasingly prevalent in health care applications such as those providing education and support to patients with chronic diseases, one of the leading causes of death in the 21st century. AI-based chatbots enable more effective and frequent interactions with such patients. Objective: The goal of this systematic literature review is to review the characteristics, health care conditions, and AI architectures of AI-based conversational agents designed specifically for chronic diseases. Methods: We conducted a systematic literature review using PubMed MEDLINE, EMBASE, PyscInfo, CINAHL, ACM Digital Library, ScienceDirect, and Web of Science. We applied a predefined search strategy using the terms "conversational agent," "healthcare," "artificial intelligence," and their synonyms. We updated the search results using Google alerts, and screened reference lists for other relevant articles. We included primary research studies that involved the prevention, treatment, or rehabilitation of chronic diseases, involved a conversational agent, and included any kind of AI architecture. Two independent reviewers conducted screening and data extraction, and Cohen kappa was used to measure interrater agreement.A narrative approach was applied for data synthesis.

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Results: The literature search found 2052 articles, out of which 10 papers met the inclusion criteria. The small number of identified studies together with the prevalence of quasi-experimental studies (n=7) and prevailing prototype nature of the chatbots (n=7) revealed the immaturity of the field. The reported chatbots addressed a broad variety of chronic diseases (n=6), showcasing a tendency to develop specialized conversational agents for individual chronic conditions. However, there lacks comparison of these chatbots within and between chronic diseases. In addition, the reported evaluation measures were not standardized, and the addressed health goals showed a large range. Together, these study characteristics complicated comparability and open room for future research. While natural language processing represented the most used AI technique (n=7) and the majority of conversational agents allowed for multimodal interaction (n=6), the identified studies demonstrated broad heterogeneity, lack of depth of reported AI techniques and systems, and inconsistent usage of taxonomy of the underlying AI software, further aggravating comparability and generalizability of study results. Conclusions: The literature on AI-based conversational agents for chronic conditions is scarce and mostly consists of quasi-experimental studies with chatbots in prototype stage that use natural language processing and allow for multimodal user interaction. Future research could profit from evidence-based evaluation of the AI-based conversational agents and comparison thereof within and between different chronic health conditions. Besides increased comparability, the quality of chatbots developed for specific chronic conditions and their subsequent impact on the target patients could be enhanced by more structured development and standardized evaluation processes (Schachner, 2020).

Indulging in unhealthy behaviors, such as smoking, imbibing excessively, and not getting enough exercise, is what leads to disease. Changes in behaviour can pave the way to a healthier lifestyle. During the process of modifying lifestyles, however, the individual may experience health issues for which early detection is crucial. This is a factor that must be considered. In order for patients to consult with qualified medical personnel, they must invest both money and time (Haolin Wang and Qingpeng Zhang, 2018). This disparity can be bridged through the use of computer-assisted technologies because they are more accessible. Noncommunicable diseases are the leading cause of death around the globe, according to the World Health Organization. The preponderance of these could have been completely avoided if they had been identified beforehand. This necessitates a diagnosis at the earliest possible stage, which our AI agent is very capable of performing.

As a direct consequence of technological advancements in fields such as natural language

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processing and artificial intelligence, the use of conversational agents has increased. There are a few voice-activated systems available on the market, such as Apple's Siri and Amazon Alexa, but the overwhelming majority of them only allow limited user input. (Liliana Laranjo and colleagues, 2018) Recent advancements in machine learning have made it possible to input natural language without restrictions, paving the way for more complex conversational administration and greater flexibility. Increasingly, techniques from the field of machine learning are employed in the process of malady forecasting. In recent years, the prevalence of medical analysis has increased in the field of medical sciences. The healthcare system consistently generates a tremendous volume of data. By performing computational analysis on these clinical data, the agent can be instructed to develop a medical intelligence system that can then be used to predict disease. This is possible by utilizing this clinical data. As a consequence of the development of the medical intelligence system, the agent is more patient-centric because it already possesses the necessary prerequisite information on the diseases in question. In turn, this will result in cost savings and time savings for the user. This conversational agent was created with the intention of diagnosing the condition at an early stage in a cost-effective manner and then educating patients so that they can take the appropriate actions based on the diagnosis. Using textual conversations, the user interface, natural language understanding, and advanced machine learning algorithms collaborate to initially diagnose the disease. Based on the results of this diagnosis, they then predict whether it is a major or minor disease. This method is very similar to the way in which physicians in hospitals will interrogate patients about their symptoms. In order to make an accurate diagnosis, it is sometimes necessary for multiple physicians to share their experiences and be present at the same time. However, because our model has been trained using a variety of use cases, it can effectively handle the vast majority of situations. It achieves a high rate of accuracy by employing a variety of methods for the prediction process, such as the Support Vector Machine (SVM), the Random Forest (RF), the Decision Tree (DT), the K-nearest neighbor (KNN), the Logistic Regression (LR), and the Gradient Boosting (GB), and then combining them using the concept of majority voting. The remainder of the article is organized as detailed below. Following a discussion of comparable works in Section II, followed by a discussion of the methodology in Section III, Section IV then examines the results, and Section V concludes with a list of references (IJEAT, 2019).

The development of technologies such as speech recognition, natural language processing, and artificial intelligence has increased the availability of conversational agents and their demand. These agents are computer programs that use written or spoken language to simulate human

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discourse. Conversational agents include voice-activated software such as Apple Siri, Google Now, Microsoft Cortana, and Amazon Alexa (McTear M., 2016). Chatbots are another example of conversational agents.

Some of the earliest examples of conversational agents were chatbots, which were designed to pass the Turing test by appearing indistinguishable from humans. This was one of the first artificial intelligence assessments. Human participants engaged in conversation with these systems (via typing into a computer) and were then asked to ascertain whether they were conversing with a human or a computer. 1 Weizenbaum J. ELIZA was the first well-known chatbot of its kind; it was created in 1966 to simulate a text-based conversation with a psychotherapist (Weizenbaum J. ELIZA, 1966). The name Eliza honors the first female psychotherapist to practice in the United States.

Over the past two decades, a considerable body of evidence has suggested that employing embodied conversational agents for the purpose of enhancing one's health may have beneficial effects. A number of randomized controlled trials of interventions using embodied conversational agents have shown big improvements in a range of outcomes (Edwards RA, et al., 2013). Among these outcomes are an increase in physical activity, the ingestion of fruits and vegetables, and the availability of online health information. However, the overwhelming majority of these agents only permitted limited user input (such as multiple-choice speech alternatives) and were incapable of understanding natural language input (Bickmore TW. et al., 2013).

As a result of the renewed interest in artificial intelligence that has emerged in recent years, conversational agents, particularly those able to use any unrestricted natural language input, have recently gained in popularity. Recent advances in machine learning, specifically those pertaining to neural networks, have made it possible to employ dialogue management systems that are both more complex and flexible. (Radziwill N. and Benton M., 2017) Consumers now frequently use smartphone conversational agents for daily tasks like information retrieval and calendar management. This is due to the development of increasingly potent and connected devices, as well as the growing availability of contextual information (such as from sensors).

Given their expanding capabilities, conversational agents have the potential to play an increasingly vital role in health and medical care. This could involve assisting clinicians during consultations, assisting consumers with challenges associated with behavior change, or assisting patients and the elderly in their living environments. These options, while advantageous, may result in patient injuries due to potential safety concerns. To the best of our knowledge, there

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has never been a comprehensive investigation into the medical applications of this technology. Our objective was to locate and evaluate studies of conversational agents that use any unrestricted natural language input for health-related purposes, with a focus on their characteristics, applications, and evaluation methodologies (Nishida T. et al., 2014). This action was taken to address this research lacuna and provide a solution.

CONCLUSION

Conversational agents that can understand and respond to natural language are being studied more and more in the field of healthcare. These agents could improve health in many different areas, but there isn't much proof yet that they work and what they do is safe. In future research, efforts should be made to comply with standards for the reporting of conversational agent characteristics and the procedures for evaluating the agents' viability and efficacy.

As a consequence of recent advances and research in artificial intelligence, conversational agents have become considerably more feasible. This study's findings can be applied in a variety of disciplines, including healthcare, education, the entertainment industry, and business, according to the research that has been conducted on the topic of conversational agents. This trend is likely to continue in the future as deep learning techniques become more prevalent in the scientific community. This article discusses context awareness, focusing on how it can be used to bring conversational algorithms closer to natural language communication. In this comparative study, review articles on conversational agents based on deep learning were presented and contrasted to more recent advances. In addition, this study investigates the datasets utilized by conversational programs. This overview examines the most recent and cutting-edge applications of deep learning approaches in conversational agents. The paper then attempted to shed light on how current research gaps and future directions may impact research in the field of 961, and it was partially successful.

DOI Link :: https://doi-ds.org/doilink/12.2023-25837116/UIJIR

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NOV 2023 | Vol. 4 Issue 6
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