Digital Assistants for Therapy Use

Steven Au

Abstract—Chatbots have existed for some time in the commercial space and have seen a surge in usage to due extended periods of social isolation from a global pandemic. As a branch of digital assistants, chatbots are becoming more sophisticated with advancements in machine learning that provide faster response times, cheaper computation power, and easy scalability. Chatbots generally serve as an all-purpose usage to direct the user across a platform. This paper will explore the usage of chatbots in healthcare and therapy.

Index Terms—Digital Assistant, chatbot, accessibility, healthcare, mental health, therapy, machine learning, artificial intelligence, natural language processing

1 Introduction

Digital assistants are now incorporated into our everyday devices with Siri, Google Assistant, and Alexa. These general-purpose assistants allow us to navigate our respective devices better. Making calls to mom, navigating home, and adding items to a grocery list is one voice command away. The applications of digital assistants are branching out to more sophisticated tasks such as therapy chatbots and mental-health awareness agents.

1.1 What are digital assistants?

Digital assistants are computer programs that use natural language processing and other technologies to understand and respond to user requests. They are often used in devices like smartphones and smart speakers, and they can assist with a variety of tasks, such as setting reminders, playing music, and providing information. The term "digital assistant" is a broad umbrella that covers a variety of different technologies and applications, and it is often used interchangeably with other terms like virtual assistants, intelligent assistants, and voice assistants.

2 Scope of digital assistant applications

The impact of anxiety and depression on individuals and society is significant and far-reaching. Anxiety and depression are common mental health conditions that can affect people of all ages, genders, and backgrounds. These conditions can cause a wide range of physical, emotional, and behavioral symptoms, including feelings of worry, fear, and sadness, difficulty sleeping, changes in appetite, and difficulty concentrating.

The impact of anxiety and depression on individuals can be significant. These conditions can interfere with a person's ability to function in their daily life, affecting their work, relationships, and overall well-being. Anxiety and depression can also lead to an increased risk of other health problems, such as heart disease and substance abuse.

The impact of anxiety and depression on society is also significant. These conditions can lead to decreased productivity and increased absenteeism from work, which can have a negative impact on the economy. Anxiety and depression can also strain relationships and put a burden on the healthcare system, as individuals with these conditions often require treatment and support.

2.1 Medical and Healthcare applications

In "A study about current digital assistants for healthcare and medical treatment monitoring" published in 2021 aims to give a broad-scope review of digital assistants and evaluate their targeted medical specialties [1]. The paper introduces the concept of digital assistant with the history of the Turing machine and ELIZA in order to garner its usage in healthcare. Healthcare requires a lot of workers to take care of patients and automating tasks is beneficial in improving patient response time, cost, and scalability. As Martins et al notes the benefits of them,

> "Digital assistants in healthcare have had an important role in healthcare, proving that their use could potentially improve the efficiency of health systems, as well as guaranteed access to high-quality medical care to everyone" [1].

The paper evaluates existing digital assistants in psychological therapy, symptom diagnosis and patient triage, and treatment monitoring through prior academic papers on digital assistants and healthcare [1]. Their main search term was "digital assistant" as they were specifically analyzing its usage in healthcare. Psychological therapy treats anxiety, depression, and other psychological problems. They utilize a chatbot in order to interact with the patient. This section is sparse as there are few commercial digital assistants on the market to test. The authors evaluated four different applications that serve as chatbots for mental health with minor variations in differences [1].

2.2 Anxiety and Stress Mapping

In "Analysing IoT Data for Anxiety and Stress Monitoring: A Systematic Mapping Study and Taxonomy" published in 2022 covers various techniques used to measure stress and anxiety [2]. They are focused on collecting data from the Internet of Things(IoT) devices that apply machine learning to detect levels of stress and anxiety. They analyze

academic papers measuring stress or anxiety from the past 10 years from various databases [2]. The criteria for papers are studies published in a conference, workshop, or journal, presenting a computational approach to the problem, and a full paper [2].

After a thorough selection process, they reduced 260 papers to closely analyzing 56 papers that fulfilled their prerequisites of being pertinent to the research question. The paper answered five focus questions about sensors, identification of stress or anxiety, data analysis techniques, measurements of stress levels, and confirmation of said levels [2]. Generally, they focused on "presenting the data analysis techniques, the collection protocols, and the data collected" [2] into a visual to assess common trends. The paper used physiological data as concrete data on stress (or anxiety) and processed nonphysiological data into a more enriching dataset [2].

2.3 Depression Dectection

In "Ideal Construction of Chatbot Based on Intelligent Depression Detection Techniques" published in 2022 focuses on measuring levels of depression through sentiment analysis and facial recognition by evaluating respective papers [3]. It highlights the limitation of psychotherapy being contextual to society and certain aspects of psychology [3]. Chatbots are a way to alleviate issues of depression but do not solve them. This is hopeful as care is not universal for everyone. The pros and cons of technology show the gaps in our understanding of dealing with depression. Huang hopes that "From deep learning, it would be valuable to develop algorithms and instruments which are able to detect more featured variables and to process more data about the human's conditions in a short period in order to keep the fluent conservation" [3].

2.4 Examples

- Woebot is an automated conversation digital assistant designed around cognitive behavioral therapy with empathetic responses, goal setting, motivation, and reflection. It uses a survey to assess users' context and moods [1].
- Tess is a digital assistant aimed as a supplemental tool for therapy by providing support, psychoeducation, and reminders [1].
- Wysa is a mobile application chatbot designed to promote well-being and mental resilience [1].
- Mindful Moods is an application to assess depressive symptoms based on PHQ-9 (Patient Health Questionnaire-9 [1].

These commercial digital assistants all contribute to psychotherapy but have different functionality in terms of usage. They still aim to treat users in mental health, but only Wysa utilizes AI technology to better assess users. Perspective

2.5 Machine Learning Algorithms

The specific machine learning algorithm used by therapy chatbots will vary depending on the design and goals of the chatbot.

- Natural language processing algorithms, which are used to analyze and understand the meaning of the user's words and phrases. These algorithms can help the chatbot to identify the user's intent and respond appropriately.
- Sentiment analysis algorithms, which are used to automatically identify and extract emotional information from the user's words and actions. These algorithms can help the chatbot to understand the user's emotional state and provide appropriate support.
- Decision tree algorithms, which are used to model the decision-making process of the chatbot. These algorithms can help the chatbot to determine the most appropriate response to the user's request, based on a set of pre-defined rules and criteria.
- Reinforcement learning algorithms, which are used to improve the performance of the chatbot over time. These algorithms can help the chatbot to learn from its interactions with users and adapt its behavior accordingly.

2.6 Perspective

All papers are current and evaluate multiple academic papers to make a central conclusion that there is a growing interest in measuring stress, anxiety, and depression. These papers are new and not heavily cited, but the information is objective enough to provide a sufficient understanding of the development of quantifying emotion states with machine learning.

Each paper has its own perspective on the matter. Martins et al. take the stance of being prospective of emerging technology in the medical space. They are more optimistic in terms of the work done. This scope is beneficial for us to see how general digital assistants can be customized and tailored for specific uses. Paula et al. are a lot more thorough in their process to evaluate other academic papers with analysis [2]. This shows the extent of research that is being put into measuring anxiety and stress. Huang is explicitly targeting the elements of building a chatbot for the purpose of depression detection techniques [3]. Starting from a more general standpoint of digital assistants in healthcare [1] and working towards a particular treatment shows that predictive therapy chatbots with depression detection are a genuine concept [3].

These documents only show the computational approach of digital assistants and not the psychological perspective of psychoanalyzing users with technology. This proof of concept of measuring stress or anxiety [2], and depression [3] is not a machine learning solution, but merely a technological proof-of-concept [1]. Paula et al. show several tables of the various ways they used to record data such as wearable sensors from audio recording and heart-rate monitoring to mouse movements and gyroscopes [2]. The use case for anxiety and stress classification in varying academic papers shows the extent of research in modeling emotional behavior. Martins et al. and Narynov et al. show two different perspectives on the advent of well-being digital assistants. While Huang gives a more detailed approach to depression detection by providing past academic papers to display methods and techniques for a therapy chatbot.

2.7 Discussion

Depression is the 4th most common major disease [3] and affects 300 million people [2]. With the healthcare system overloaded [1] and the cost of psychologists prohibiting treatment [3], it makes sense to put automation and depression together to deal with this problem. Automation allows for care and access to be more widespread, but there are varying issues. Huang puts it together as

> "there is no such kind of chatbot that can independently make good counseling with the patients, and the best version of it is to act as an assistant to gather information for the human counselor [3]."

This summarizes the examples section of the digital assistant having limited usage within their respective scope. The current commercial products are simply band-aids for a cut. They do not replace the role of a therapist but serve as supporting [1] the injury. Even still a bandaid can greatly aid in healing an injury and promoting healthy bodily response. Digital assistants fulfill that role as a medium to provide more access to dealing with depression.

It would be great if we could combine all the current chatbots into one and have more coverage in use and treatment. Chatbots are successful since they are designed to do one thing well. Adding more features requires more data processing and training. More classification and categories will influence the accuracy of the machine learning model [2]. Paula et al. show that 45 papers out of 56 used machine learning as their main technique to analyze stress or anxiety [2]. Machine learning allows data to be sorted in high volumes by classifying information into categories. This in itself is a huge technological feat as thousands of academic papers on relevant algorithms [2] and thus need more development for an appropriate depression chatbot [3].

There are two main ways of effectively analyzing depression: sentiment analysis and facial recognition [3], each with its own drawbacks. Word-based detection is good for recognizing depressing speech and facial recognition can find hidden emotions to better evaluate a patient [3]. However, both lack the judgment to treat a patient and the overarching issue with a therapy-based chatbot. According to a study, dialog agents (digital assistants) were found to be ineffective in providing prompt help when needed because they did not recognize that the questions being asked were symptoms of emotional or physical distress. When asked about issues such as suicide risk, some of these agents simply recommended that people seek professional help [4]. This runs the risk of the digital assistants now knowing what to say [5] and exacerbates the situation where the user might feel neglected. There need to be more deep-learning algorithms to detect more expansive variables and more psychological procedures for dialoguing depression treatment [3].

2.8 Limitations

- Lack of personalization: Like other predictive therapy digital assistants, therapy chatbots use algorithms and machine learning to provide advice and suggestions. However, they are not able to fully personalize their advice to the individual user, which can make it less effective for some people.
- Limited understanding: Therapy chatbots are limited in their understanding of human emotions and motivations, which can make it difficult for them to provide accurate and helpful advice.
- Ethical concerns: There are also ethical concerns surrounding the use of therapy chatbots, such as the potential for misuse or abuse of the technology.
- Dependence: Some people may become overly dependent on therapy chatbots, which can prevent them from developing the skills and knowledge they need to manage their own mental health.

Therapy chatbots can be a useful tool for some people, they should not be relied upon as a substitute for professional therapy or medical treatment. They can be useful for providing support and information to people who may not have access to traditional therapy or who prefer to use a digital platform.

REFERENCES

[1] P. M. Martins, J. L. Vilaca, and N. S. Dias, "A study about current digital assistants for healthcare and medical treatment monitoring," in 2021 *IEEE 9th International Conference on Serious Games and Applications for Health* (SeGAH), 4-6 Aug. 2021, Piscataway, NJ, USA, 2021, p. 7 pp. doi: 10.1109/SEGAH52098.2021.9551864.

[2] L. dos S. Paula, L. Pfeiffer Salomao Dias, R. Francisco, and J. L. V. Barbosa, "Analysing IoT Data for Anxiety and Stress Monitoring: A Systematic Mapping Study and Taxonomy," 2022, doi: 10.1080/10447318.2022.2132361.

[3] X. Huang, "Ideal Construction of Chatbot Based on Intelligent Depression Detection Techniques," in 2022 IEEE International Conference on Electrical Engineering, Big Data and Algorithms (EEBDA), Feb. 2022, pp. 511–515. doi: 10.1109/EEBDA53927.2022.9744938.

[4] S. Narynov, Z. Zhumanov, A. Gumar, M. Khassanova, and B. Omarov, "Chatbots and Conversational Agents in Mental Health: A Literature Review," in 2021 21st International Conference on Control, Automation and Systems (ICCAS), Oct. 2021, pp. 353–358. doi: 10.23919/ICCAS52745.2021.9649855.

[5] J. Cho and E. Rader, "The Role of Conversational Grounding in Supporting Symbiosis Between People and Digital Assistants," Proc. ACM Hum.-Comput. Interact., vol. 4, no. CSCW1, p. 33:1-33:28, May 2020, doi: 10.1145/3392838.