

# Application of Artificial Intelligence on Therapy Chatbots

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**Abstract:** Beginning from the last decade, artificial intelligence (AI) has emerged into numerous industries and countless processes were automated. Furthermore, there is always an active deliberation in the healthcare industry on the application of artificial intelligence to automate certain tasks and to replace AI robot doctors with human doctors in the future. In the mental health area, artificial intelligence is becoming clinically appropriate for therapeutic applications such as psychiatry, psychology, and psychotherapy. Moreover, there are few studies conducted in recent years on the application of artificial intelligence especially in the mental health area. Therefore, this paper provides a summary on some of the most effective applications of artificial intelligence in the therapy chatbots, and the advancements of the chatbots throughout the years along with its limitations.

**Keywords:** Artificial Intelligence, Chatbot, Machine Learning, Deep Learning, Mental Health, Therapy, Robot.

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## 1. INTRODUCTION

Virtual agents outperformed their human counterparts in a 2009 study of patients in the hospital and were found to be preferable by a wide margin when it came time for patients to be discharged, particularly those with poor literacy levels [2]. Although there has been some discussion about the potential of chatbots to resolve some of the barriers to healthcare over the years [1] such as waiting lists and geographic issues that prevent people from attending face-to-face counseling appointments, very little research has been done on the impact of chatbots specifically on mental health area. As part of a scaled delivery of services [6], these applications might be a tremendous help for mild instances of depression, bipolar and other non-acute diseases, enabling health care providers to devote more time to the more severe and urgent situations [4]. There are important advantages to take into account in light of the overall increase in mental disease and of the limited resources throughout the globe. Besides that, AI applications in mental health care, on the other hand, have the potential to both increase service quality and reduce expenses for many. People in need of mental health therapy might benefit from its reach and the ability to better their lives.

## 2. THERAPY CHATBOTS

### 2.1 Woebot

A commercialized self-help therapy chatbot began with Woebot emerging into the market. Woebot is a mobile application chatbot developed by Alison Darcy, a psychologist in 2017.

The chatbot utilizes Artificial Intelligence and Natural Language Processing (NLP) techniques to learn a vast number of conversations on a yearly basis and to provide therapeutic responses that are psychologically related based on the user's mental state [3]. Woebot remembers previous conversations with users and continues conversations from where it stopped. It provides empathetic response, setting goal, motivational, daily check in and follow up sessions, a daily customized message to users, as well as mood charts on weekly basis to help users on self-reflection [5]. In a study conducted by (Demirci, 2018), it is found that Woebot has a friendly and engaging nature, it initiates a conversation with the participants.

However, Woebot has its limitations where it is unable to exchange common interest, thoughts or experience which then led to participants to abandon the application. The study also found that Woebot gives generic responses for conversations that are personal or negative in nature. At some point of conversations, the chatbot did not understand participant's responses and kept on repeating a certain preset response [5]. Furthermore, Woebot is unable to convey the full range of human emotions throughout the conversation. A participant has given his/her feedback that due to the canned/preset responses; he/she feels restricted to express his/her views and thoughts [3]. During the conversation, participants were not permitted to write their own replies. Besides that, the preset responses from Woebot are limited. Some of the participants of the study felt using a chat script to guide the discussion made him/her to believe he/she was conversing with a programmed robot rather than a conversational agent with Artificial Intelligence.

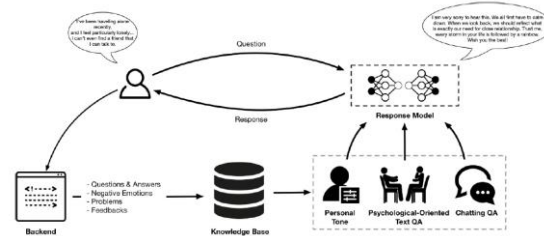
## **2.2 WYSA**

Moving on, WYSA is a mobile based emotionally intelligent chatbot developed in Touchkin [8], another commercial use chatbot, that uses a text-based conversational interface aimed to assist people who are dealing with bad mood, stress, or anxiety, or who want to improve their emotional resilience. WYSA utilizes artificial intelligence to provide a responsive and external environment for self-reflection that encourages individuals to express themselves positively. WYSA uses evidence-based techniques in her healthcare, such as Cognitive Behavioral Therapy (CBT). WYSA has its limitations whereby the responses tend to repeat and fall into a non-stop loop. The daily tasks, daily check-ins and checklist was not received well by users [8].

## **2.3 Evebot**

Evebot is a completely generative conversational system based on sequence to sequence (Seq2seq) for diagnosing negative emotions and to prevent depression by providing positive responses in the hope that would help campus students [13]. The architecture of Evebot consists of a collection of separate sub-models combined to provide accurate response. The response model of Evebot consists of casual chat and psychological counseling chatbot. The response models are determined by the classifier model as shown in Fig 1. Evebot also consists of sentiment analysis model which determines user's emotion through the chats. Bi-LSTM RNN-based model was used to categorize the answers into two groups: positive and negative. For responses to be more meaningful, a Seq2Seq model was developed based on Maximum Mutual Information (MMI), an objective function. Evebot can respond to users and differentiate the

user's mood well. It works well and encourages users to have positive thoughts. However, Evebot's limitation was evident when about 10% of the responses are still unrelated and incorrect for a quality conversation. If the user's input is outside of the training data, the grammar and meaning of the responses from Evebot have shortcomings.



**Fig 1 : Architecture of Evebot**

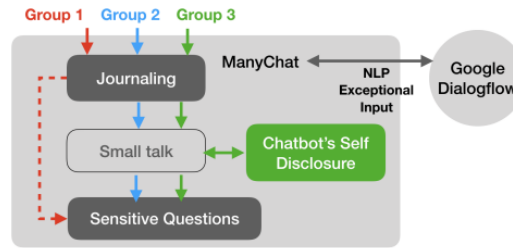
Furthermore, Evebot lacks the ability to remember prior conversations. This happens when the user is talking about the same topic for two different questions during the chatbot, Evebot is unable to recall the conversations before. Thus, responses provided by Evebot may be different and potentially confusing to the user.

## 2.4 Mobile Application for Mental Health

A mobile application chatbot for mental health issues that uses machine learning algorithms to identify whether a person has a mental disease and propose preventative techniques was developed recently [11]. The chatbot was developed using Dialogflow as it was thought to decrease the need of predefined answers. The chatbot analyzes the user's free responses to predict his/her mood. The chatbot application enables users to record their responses to the chatbot. The recorded data is then gathered and analyzed by the speech patterns to detect emotions. The chatbot also does facial recognition via the video recording of the user, to identify the user's emotions. A user profile will be constructed using all of the text, audio, and video data collected. This will be compared to the PHQ-9 survey and used to forecast the mental health condition of the user. However, this chatbot is still at the beginning stage, hence further improvement is needed on the prediction accuracy of a person's mental health state by gathering huge data as it is still not in the satisfactory level.

## 2.5 Self Disclosure Chatbot

A chatbot that incorporates self-disclosure characteristics while making small conversations with individuals in the research was created and tested [9]. Manychat is used to keep track of whether chatbot users had completed their specified talking duties and to deliver reminders to those who hadn't. The daily conversations were created with predefined responses and questions. Then, Dialogflow was connected to Manychat to give participants the impression that they were conversing organically with the chatbot as shown in Fig 2.



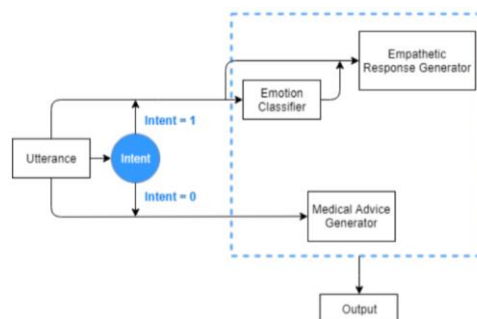
**Fig 2:** Self-disclosure chatbot with Manychat integration

When a chatbot makes inquiries about a user's emotions, that could lead to a variety of responses (e.g., "How are you today?"); these responses are sent to Dialogflow, which uses natural language processing (NLP) to select a suitable response.

The chatbot is found to be delightful and was able to communicate with users at ease. Its limitations were evident when it did not respect users and/or did not truly attempt to grasp what they were saying since it mostly continued asking users to answer questions and was not very engaged. There were also instances when the chatbot continued and moved on to the next question while ignoring the user's request. The chatbot's style of communication was very robotic where it felt like a survey-questionnaire series rather than actual conversations. Moreover, the replies were generic and shallow.

## 2.6 CARO

CARO, a chatbot to hold empathetic chats and offer medical advice to persons suffering from serious depression was developed and it emerged as one of a kind hybrid chatbot model [7]. CARO encompasses two models: medical advice generator and general empathetic conversation generator as shown in Fig 3. When a user interacts with CARO, the input is first categorized as 1 or 0; classifying which model it belongs to. The medical advice generator is built on an LSTM architecture which was trained on a dataset with various medical related responses. The general empathetic generator is trained on a dialogue dataset that contains empathetic responses. The emotions that have been pre-programmed aid in engagement. To produce empathetic responses, the emotion classifier's extracted emotions that were attached to the beginning of the context phrase.



**Fig 3:** Architecture of CARO

This model consists of the Encoder-Decoder model, with one or more LSTM/GRU units in each Encoder and Decoder block. To convert the input phrase into an embedding vector, an

Embedding Layer was used that was initialized with Glove embedding. The Intent Classifier creates a decoded sequence of the input embedding. This decoded sequence is sent to a Dense Layer. The output is transmitted to a dense layer with two output cells on which Softmax Activation is performed since there are only two intents, medical generator, and empathic generator. The purpose is determined by the cell with the highest probability. Facebook AI Empathetic Dialogue dataset and the Medical Question Answering dataset (Nielsen, 2017) was used in CARO. The chatbot resulted in a BLUE score of 0.179. CARO was able to provide medical responses as well as empathetic responses for people who are suffering from depression.

## **2.7 Facial & Voice Recognition Chatbot**

Chatbot for mental health became even more sophisticated with not only text-based input but also facial and voice recognition. By utilizing Tensorflow, an AI chatbot was designed for counseling therapy by utilizing Tensorflow [10]. To enable scalability, plug-ability, and faster operation and response time, the suggested system is installed on the AWS cloud. To capture text conversion, voice, and face data, the chatbot initiates an appropriate conversation with the user. The data from the conversation is sent to the API gateway. The decision lambda is triggered by the API gateway, which then receives the response data. The answer is segregated by the decision lambda, which then activates all the lambdas with the necessary data. To examine the response data received, the corresponding lambda invokes TensorFlow algorithms. For each emotion, the TensorFlow algorithm generates a confidence value, which is sent to the fusion function. The fusion lambda takes these three separate confidence levels and creates a composite value that is sent to the chatbot. The result of the TensorFlow algorithm is used to provide counseling for users.

After a series of evaluations, it was concluded that the artificial intelligence chatbot can resolve a variety of challenges that a psychologically stressed person may face in daily lives. The chatbot can determine a person's mood based on the textual input given by the user. For example, whether a person is in a good mood or not, if he is worried or not. However, it was also concluded that the chatbot requires more training data to improve the accuracy of detection [10].

## **2.8 Chabot That Diagnose Depression**

The latest discovery is to create a chatbot that detects depression in an individual and recommends a treatment session tailored to the individual's severity of depression [12]. The chatbot architecture consists of 2 chatbot models, one consisting of questionnaires and the other to converse with the user.

After the questionnaire session, users were presented with questions from the SAT's grin and image exams, as well as questions from the Patient Health Questionnaire (PHQ9) and Depression, Anxiety, Stress Scale 21 (DASS-21) questionnaires. A unique patient score will be produced based on the answers and words provided in the questionnaire. Users will be categorized into the severity level of depression by Normal, Moderate, and Severe based on their score. Then, based on the severity level category, the user is redirected to the second

chatbot model consisting of the recovery session. This part of the chatbot consists of daily conversations and educational as well as motivational images and videos for users. A psychotherapist may be able to cut down on their burden and reach out to more individuals, according to the chatbot's inventor [12].

### **3. DISCUSSION**

Based on the reviews, it is found that most of the chatbots are built to assist therapists in treating mental illness. Some are built as a self-help tool where users will need to update their activity daily. Despite recent developments in social chatbots, human-level intelligence as represented in human-to-human communication is still a mystery. It will be exceedingly challenging to build an intelligent social chatbot that can completely grasp people and the actual environment around them.

In terms of technicality, most of the applications are question-answer chatbots whereby there are already predefined sets of responses available for users to choose from. The accuracy of responses is at a satisfactory level and still requires further study and training with the right dataset. It's been discovered that certain chatbots can't have meaningful, in-depth discussions. Additionally, some user input is misread and repeatedly answered. Users would find it frustrating if the chatbot is stuck in a loop when they are attempting to respond to questions. Numerous improvements in cognitive and informed AI are required, including personalization, empathy, social intelligence, and secure use. Despite recent developments in social chatbots, human-level intelligence as reflected in human-to-human dialogue is still a mystery. Regardless, there are numerous benefits and improvements that artificial intelligence can bring into the world in terms of mental illness. It is also to explore, learn and fine tune how chatbots can imitate human nature; personality, emotions, gentle, kind, motivational by applying artificial intelligence.

### **4. FUTURE WORK**

One would assume that chatbots have succeeded and now have agents that communicate like human beings based on the present growth of chatbots. Because of the excitement around what chatbots can achieve, the expectations are too high that a chatbot is expected to answer any and every question. The expectation and requirements for different industries varies.

In the mental health care area, a chatbot is expected to understand and be able to grasp a user's behavior, mood, emotions, personality and provide some sort of counseling (or to imitate a therapist) where users can chat about anything and everything. Thus, by considering all the challenges the chatbot has in natural language processing and comprehension, future work would include a hybrid therapy chatbot that can diagnose the mental health issue of users and is able to carry out casual conversations with users. The chatbot would be able to detect a user's emotion via text and provide responses based on the emotions. This will seem more human-like. To achieve the human-like nature, the chatbot has a better understanding of the user's intentions to have a smooth conversation flow. Other features may include personality traits for the chatbot and the ability to recall previous conversations to enhance user experience

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