Mental Health Therapist Chatbot Using NLP

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Abstract— Artificial intelligence (AI) is being used in mental health care to create chatbots that act as therapists. The chatbots, using natural language processing (NLP), communicate with users to provide therapeutic support. This abstract discusses the development of chatbots serving as agents for individuals seeking mental health assistance. They offer convenient and confidential ways for people to talk about and ease issues such as anxiety, depression, and stress. The chatbot does not only inform users about mental health choices but also help decrease stigma and encourage a proactive approach to mental wellness. The innovative AI-driven therapist chatbot aims to tackle the intricate issues of depression, anxiety, and stress. By employing advanced Natural Language Processing (NLP) techniques, the proposed system aims to offer personalized and empathetic virtual support for individuals managing mental health challenges. It also utilizes sentiment analysis to interpret the emotional tone or sentiment conveyed in user inputs, usually in text form. Sentiment analysis, also referred to as opinion mining, determines whether a text expresses positive, negative, or neutral sentiment. The chatbots powered by AI and NLP play a crucial role in providing mental health support and breaking down barriers to seeking help. Their ability to analyze sentiments contributes to a better understanding of users' emotional needs and enables more effective communication in therapy sessions.

Keywords— Chatbot, Mental Health, NLP, Sentiment Analysis.

I. Introduction

Globally, mental health poses a significant issue, with approximately 264 million individuals experiencing depression. In severe instances, this can tragically culminate in suicides. Stress and anxiety impact numerous people, particularlythose between the ages of 15 and 29, who may be facing challenges[1]. to the World Health Organization, mental health challenges couldresult in a colossal \$1.03 trillion loss to India's economy from 2012 to 2030. The need for virtual assistance is on the rise to offer comfort and aid during difficult times, especially as face-to-face consultations are becoming scarce. In wealthiernations,there exists a ratio of 1 mental health professional to every 10,000 patients, including therapists, psychiatrists, psychiatric social workers, and mental health nurses.

Chatbots are like digital therapists, available 24/7, providing immediate help for mental health. They're not here to replace human practitioners but to enhance support. These user-friendly tools offer a timely response, especially crucial when traditional healthcare services face delays[2]. Beyond depression, chatbots assist those experiencing temporary lows or needing motivation. They are especially helpful for students dealing with financial constraints or availability issues. In this study, we explore how these chatbot therapists, equipped with natural language processing, can revolutionize self-mental healthcare for stress reduction and motivation.

This study explores the significance of chatbot therapists as an advanced method for therapy. These AI-driven tools use natural language processing (NLP) to assess users' emotional states and customize responses and material to meet their individual needs. Various modules are employed to enhance the chatbot's functionality[3].

Emotions are feelings we have in response to things that happen to us or around us[4]. They include how we feel inside, how our bodies react, and how we express those feelings. Unfortunately, many people struggle with mental health issues like depression, which can be caused by various factors such as difficult life events, health problems, or substance abuse. Depression doesn't discriminate; it can affect anyone, but certain factors like poverty, unemployment, or personal loss can increase the chances of experiencing it.

A. Sentiment Analysis

Sentiment analysis falls under the umbrella of natural language processing (NLP) and is dedicated to isolating and extracting subjective elements from written information. This involves discerning the tone, perspective, emotion, or expression conveyed through written content like news articles, product reviews, social media posts, and customer feedback. By leveraging natural language processing (NLP), sentiment analysis empowers mental health chatbots to identify and collect subjective insights from user interactions.

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In the context of mental health chatbots, sentiment analysis employs various methodologies including lexicon-based, rule-based, machine learning, and deep learning approaches. Lexicon-based methods rely on sentiment dictionaries to assign values to words based on their emotional context, while rule-based systems utilize predefined rules to detect sentiments. Machine learning and deep learning algorithms leverage annotated data to predict sentiments in new textual inputs.

II. RELATED WORK

Generative chatbots are chatbots that don't rely on a predefined set of answers to generate a response to the user's input. Instead, they use a large volume of corpus data to create a response. These chatbots can use models like Seq2Seq Model or Bert. BERT stands for Bidirectional Encoder Representations from Transformations, and it is a language model technique developed by Google that helps chatbots better understand the context of the words given as input[5].

Rasa serves as a platform for developing advanced chatbots driven by artificial intelligence[6]. Developers leverage Rasa to craft chatbots and virtual assistants, including task-oriented and FAQ-style chatbots, as well as those capable of responding to inquiries, implementing business rules, and executing tasks based on predefined logic[7]. Within the realm of mental health chatbots, various commercial versions like Wysa and Woebot exist, accessible through Android and iOS mobile applications. Wysa and Woebot are two commercial implementations of virtual therapists formental wellbeing. Wysa is available on Android and IOS systems as an application, and it engages the user in a friendly dialogue using a blend of Cognitive Behavioural Therapy and mental health practices[8]. Wysa protects the user's conversational data by using encrypted chats and allows them to use a concealed identity. On the other hand, Woebot is also available on iPhone and Android as an application[9]. Woebot differs from Wysa by requiring user login and then conducting a brief user survey to gain insights into the user. Additionally, Woebot utilizes Cognitive Behavioral Therapy techniques to enhance mental well-being. The application offers regular check-ins, concisepre-filled choices, and an engaging gamified interface[10].

III. PROPOSED SYSTEM

The proposed AI-powered mental health therapist chatbot is an innovative solution to complex mental health challenges such as depression, anxiety, and stress. By utilizing advanced Natural Language Processing (NLP) technologies, thissystem intends to offer personalized and empathetic virtual support to individuals dealing with mental health issues.

A. NLP Approaches **:** Advanced natural language processing models can be utilized for comprehending and producing text responses that are similar to human-like language.

B. Domain-Specific Language Models[11]: Fine-tune pretrained models on mental health-related data to makethem more contextually aware and suitable for therapeutic conversations.

C. Emotional Understanding[12]: The chatbot will utilize advanced sentiment analysis through NLP to comprehend the emotional state of users, enabling it to respond with empathy and tailored support.

D. Sentiment Analysis[13] A chatbot uses sentiment analysis to understand and interpret the emotional tone or sentiment expressed in user inputs, typically in the form of Mental Health Therapist Chatbot Using NLP text. Sentiment analysis, also referred to as opinion mining, aims to discern the sentiment expressed in a piece of text, whether it portrays favourable, unfavourable, or neutral feelings.

E. Personalized Responses:

- **GPT model**: GPT-3 or GPT-4 can be used to generate contextually relevant and personalized responses. These models excel in natural language understanding and generation[14].
- **Open AI's Chatgpt[15]:** A fine-tuned version of GPT specifically designed for chat-based applications. The integration of these features aim will to create a comprehensive and accessible mental health support system, empowering individuals to proactively manage their mental well-being with the assistance of advanced AI technologies. Ongoing development and testing will be conducted to improve the system and ensure its efficacy in providing meaningful support to users experiencing depression, anxiety, and stress.

IV. METHODOLOGY

A. Text Preprocessing: The datasets was obtained from the Kaggle Mental Health FAQ and the other is customized according to streams such as stress, anxiety and depression. Intent: Represents the purpose or goal of a user's input. Tag: A label or identifier for a specific intent.

Patterns: Input phrases or sentences that users might use to convey a particular intent.

Responses: Corresponding output phrases or sentences that the chatbot should generate in response to a specific intent.

B. Text Preprocessing: Text Preprocessing, an essential component of natural language processing (NLP) endeavors like chatbot construction, is pivotal for converting raw textual data into a structured format suitable for subsequent analysis and modeling.

- *Tokenization:* It is a fundamental process within text preprocessing, entails dividing text into smaller entities referred to as tokens, which may encompass words, phrases, or other semantically significant units. The prevalent method involves segmenting text into words based on whitespace or punctuation. For instance, the sentence "Hello, how are you?" would yield the tokenized form ["Hello", ",", "how", "are", "you", "?"]. Tokenization facilitates the decomposition of text into manageable components conducive to further analytical endeavors.

- *Lemmatization:* Lemmatization, another integral facet of text preprocessing, involves reducing words to their base or root form, termed as the lemma. This process aids in standardizing words to their canonical representations, thereby enhancing the precision of text analysis. By considering the contextual usage of words, lemmatizationtransforms them into their corresponding dictionaryforms. For example, "running" would be lemmatized to "run", "better" to "good", and "going"to "go". Leveraging lemmatization proves beneficial in minimizing vocabulary size and optimizing the performance of NLP models by treating various word forms as identical.
- *Stopwords removal:* Stopwords removal targets the elimination of common words that frequently occur in a language but often lack substantive meaning in the realm of text analysis. Examples of such stopwords in English encompass "the", "is", "and", "in", among others. By filtering out these extraneous words from the text corpus prior to analysis, stopwords removal diminishes noise within the data and accentuates the focus on semantically significant terms. This more efficient method can improve the effectiveness of various NLP tasks,such as analyzing sentiment, exploring topics, and classifying text.

C. Feature Extraction: Feature Extraction, a crucial phase in natural language processing (NLP), entails converting raw textual data into numerical representations comprehensible to machine learning algorithms. One common approach to feature extraction in NLP involves utilizing techniques such as Bag of Words and Term Frequency-Inverse Document Frequency.

- *Bag of Words:* Bag of Words is a simple yet powerful technique that converts textual data into a numeric feature array. It functions by establishing a vocabulary containing all distinct words in the set of data. Following this, each document (or portion of text) is depicted as an array, where each element corresponds to a word from the vocabulary. The value of each element indicates how often the associated word appears in the document.
- *Team Frequency-Inverse Document Frequency(TF-IDF):* The Term Frequency-Inverse Document Frequency (TF-IDF) technique is a statistical measure used to evaluate the importance of a word in a document compared to the entire collection of documents (corpus). This method combines the frequency of a term in a document (TF) and the scarcity of that term across all documents (IDF). TF indicates how often a term appears in a document relative to the total number of terms in that document, whereas IDF measures the rarity of a term by calculating the logarithm of the ratio between the total number of documents and the number of documents containing the term.

D. Model Training:

- *Neural Network Model:* The neural network operates as a feed-forward architecture with three linear layers and ReLU activation functions between them.It takes input data with input_size features and passes it through the first linear layer, followed by a ReLU activation function. Then, it passes the output through the second linear layer and another ReLU activation function. Finally, it passes the output through the third linear layer to produce the final output, which represents the logits for each class. There is no softmax activation applied at the end of the network, which suggests that the model is used for tasks where the raw logits are needed (e.g., during training with CrossEntropyLoss, where softmax is often integrated) rather than probability scores. This neural network can be used for various classification tasks by adjusting the input_size, hidden_size, and num_classes parameters according to the specific problem.The neural network model can play a role in a chatbot system, it's just one component of a larger architecture that includes data preprocessing, dialog management, and potentially other machine learning models or modules.

- *Long Short-Term Memory(LSTM):*
It is a recurrent neural network that consists of an embedding layer, LSTM layer, and a dense layer.
Embedding layer: In a mental health chatbot, words and phrases related to mental health issues, emotions, and sentiments would be encoded into these dense vectors. This helps the understanding the context of the model conversation.
LSTM Layer: In the mental health chatbot, the LSTM layer analyzes the sequence of encoded words/phrases to understand the context of the conversation and predict the next course of action or response.
Dense Layer: The dense layer functions as a layer that is fully interconnected that receives input from the LSTM layer and produces the final output.
The training process employs categorical cross-entropy loss, a widely adopted selection for addressing multi-class classification challenges. It uses the Adam optimizer, which is an efficient optimization algorithm for training neural networks. During training, the model learns to map input sequences to the appropriate output classes (e.g., responses related to mental health support, coping strategies, etc.).

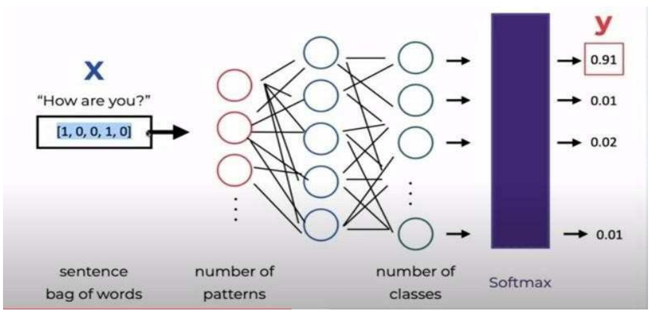

Fig.1 Feed forward neural network

E. Evaluation Metrics:

As chatbots proliferate across diverse sectors, spanning customer service to mental health assistance, researchers and developers are dedicated to implementing robust evaluation techniques to precisely gauge their effectiveness.

There are several metrics to assess its effectiveness in understanding user queries and delivering appropriate responses. Cosine similarity is a crucial metric among various measures to gauge how alike user inputs are to present patterns stored within a chatbot's dataset.

Cosine Similarity:

The cosine similarity acts as a tool for measuring the likeness between two non-zero vectors in an inner product space by calculating the cosine of the angle formed between them. This method is widely utilized in the fields of text mining and information retrieval, providing a measurable comparison between two text documents. Within mental health chatbots, cosine similarity is employed to gauge the resemblance between the user's input and the stored patterns in the dataset..

- *Text Normalization*: Before calculating cosine similarity, the user input and the patterns from the dataset are normalized using text normalization techniques like converting to lowercase, removing special characters, tokenizing, and lemmatizing.
- *Vectorization*: Once the text is normalized, it is converted into numerical vectors. Two vectorization techniques – BoW, TF-IDF, which stands for Term Frequency-Inverse Document Frequency, finds application.
- *Cosine Similarity Calculation:* Once the user input and patterns are represented as vectors, cosine similarity is calculated between the user input vector and each pattern vector in the dataset. This measures how similar the user input is to each pattern.
- *Response Selection:* The pattern with the highest cosine similarity score is selected as the most relevant response to the user input.

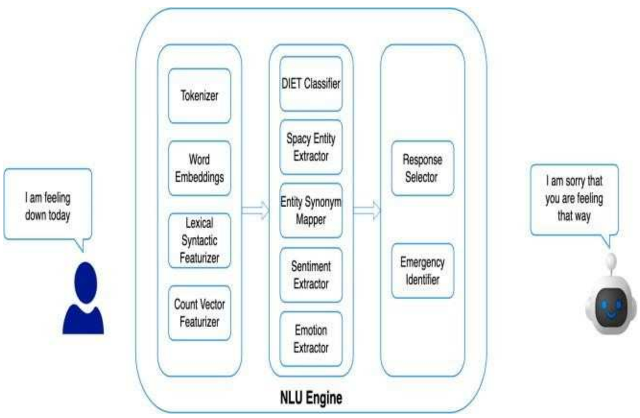

Fig.2 Working of the Chatbot

V. RESULTS

Fig.3 Chatbot Interface

This is the main area where users interact with the chatbot. Users can type their messages here and receive responses from the chatbot. It also includes feature such as refresh button.

Fig.4 Chatbot Greetings

When a user initiates a conversation with a chatbot by greeting with "hi" or "hello," the chatbot recognizes that the user wants to start a conversation. Upon recognizing the user's greeting, the chatbot generates a response to acknowledge the user's initiation of the conversation. This response often includes a friendly greeting back to the user.

Fig.5 Testing the Chatbot

When the user responds back with their problem, the chatbot identifies the emotions such as “stress”, “depression” or “anxiety” and then provides the treatment accordingly.

Fig.6 Feedback

The Chatbot tries to collect the feedback from the user based on the emojis which represents how satisfied they are with the chatbot conversations and suggestions.

Fig.7 Positive Feedback

If the user is satisfied and happy with the chatbot suggestions then the user clicks the happy emoji representing the positive feedback.

Fig.8 Neutral Feedback

If the user is not much satisfied with the chatbot suggestions then they will respond back with neutral emoji. The chatbot tries to motivate them to feel little better.

Fig.9 Negative Feedback

If the user is not at all satisfied with the chatbot suggestions then they will respond back with sad emoji. The chatbot suggests the user to meet the professional.

VI. Conclusion

The development and implementation of mental health therapist chatbots utilizing Natural Language Processing (NLP) present a promising avenue for augmenting mental health support services. Through the integration of advanced NLP techniques, these chatbots offer personalized and accessible interventions, potentially bridging gaps in MentalHealth care delivery. While challenges like accuracy, privacy, and ethical considerations remain, ongoing research and advancements in NLP technologies continue to enhance the effectiveness and acceptance of these chatbots. As we strive for greater inclusivity and effectiveness in mental health support, the utilization of NLP-powered chatbots represents a significant step forward in providing scalable, accessible, and responsive mental health interventions.
The two neural network models, each serving a unique purpose within the context of mental health chatbots. While the feedforward neural network provides versatility and simplicity in classification tasks, the recurrent neural network offers a more nuanced understanding and response capability tailored specifically for mental health-related conversations.

Collectively, these models play a vital role in crafting empathetic and efficient chatbot systems designed to offer support and aid to individuals navigating mental health difficulties.

VII. FUTURE SCOPE

This study on understanding emotions and feelings opens up exciting new paths for more investigation. Here are some important areas to explore further:

The vocabulary could potentially be enhanced and upgraded; however, the project relied on a fixed set of emotion terms. This will help it understand emotions better. Also, it can make the project more flexible for different areas by adding words specific to those areas.

Integrating text data with information from other sources like images, videos, or audio can enhance the depth of sentiment analysis and emotion recognition. Diverse forms emotional expression offer richer insights, augmenting the accuracy of emotion classification and sentiment analysis.

Expanding the study to multiple languages would increase its relevance across different contexts. Overcoming challenges like language-specific expressions of emotion, cultural differences, and translation issues is essential for analyzing emotions across languages. By tackling these hurdles, we can enable to Analyze sentiments and recognize emotions across a variety of linguistic contexts. To make the chatbot better at understanding emotions, we need a feedback system where users can tell us how accurate it is and help it detect different emotions.

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