CareBot: A Mental Health Chatbot

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***Abstract*—The cognitive, behavioral, and emotional health of a person is referred to as their mental health. In the present, mental health has emerged as one of the most important yet neglected facets of a person's entire well-being. Though mental health chatbots are up and coming, there is still a need for a cost-effective, reliable, and interactive system. Stress and anxiety are two of the few factors that damage mental health. A person with mental health issues may suffer negative outcomes if sufficient care is not provided. Nowadays, with advancements in technology, one can use a computer to foretell the start of such mental health issues. Despite the fact that numerous academics have examined a range of methods for predicting depression, they frequently depend solely on the use of facial expressions, which, because they are subtle and small, can alter the performance of the model. Therefore, using more elements like textual analysis and emotion detection can help increase accuracy. In this study, a method for predicting mental health status using facial expression and sentiment analysis results is introduced. Through emotion detection and text data characterising the user's mood, the suggested system replicates a one-on-one conversation between the user and the chatbot. Emotional detection and textual analysis are two features that can help predict mental health states more accurately. The suggested chatbot uses cutting-edge technology to analyse the user's mood using a variety of inputs and offer suggestions for managing the feeling.**

***Index Terms*—Artificial neural network, Convolution neural network, Web scraping, Natural language Processing, Machine learning**

I. Introduction

The state of mental health has recently emerged as one of the most undervalued yet genuine perspectives on an individual's overall well-being. One in every four people in the world will experience mental or neurological problems. The bad effects of such disorders are currently experienced by almost 450 million individuals, making mental illnesses one of the leading causes of rehabilitation difficulties and handicaps worldwide. Untreated mental illness can have a number of detrimental effects, such as reduced life expectancy, an increase in the prevalence of physical illness, and an increased chance of suicide [1]. Around 66% of people with these conditions never seek assistance from a trained mental health professional. According to the World Health Organisation, 7.5% of India's 1.3 billion people, or over 90 million people, suffer from a mental illness. Despite recent advances in raising awareness of the need for mental health care, many people are reluctant to confess they need assistance out of fear of stigma.

With improved human-computer interaction, digitised, cost-effective, and adaptable health solutions can be provided. Applying the integration of digitised platforms with AI [2], there is significant potential for improving prediction, identification, coordination, and treatment in mental healthcare and suicide prevention services. Using interactive AI enables real-time screening and treatment. A combination of machine learning algorithms and automation can provide an effective solution to managing mental health issues.

A chatbot is an application that simulates human-like conversations by using AI and Natural Language processing (NLP). Technology can improve the efficacy, efficiency, and quality of healthcare services. However, it's crucial to make sure that these technologies are applied in a way that complements human abilities and attends to patients' requirements, especially those of the most fragile and those needing extra care [3]. The chatbots' ability to accept input inquiries, evaluate the text they receive, and answer by producing output text is greatly influenced by NLP. NLP enables computers to interpret user input. Like humans, chatbots analyse input from the user and then produce responses based on contextual analysis.

The proposed AI chatbot is probably seen as impartial, non-obstructive, and generally nonjudgmental. Another feature is that these chatbots are available at any time.

II. Literature Survey

This section provides the review on the literature on the mental health support system developed over the years. A detailed review of the increasing prevalence of mental health problems and the growing need for effective medical care in this area is discussed in this section. The focus is on the application of machine learning techniques to predict and address mental health issues. The research articles are categorised as related to mental health problems such as schizophrenia, bipolar disorder, anxiety, depression, post-traumatic stress disorder, and mental health issues in children. The work in [4] highlights the challenges and limitations faced by researchers in the field and provides recommendations for future research and development in applying machine learning to mental health. The study [5] looked at addressing the gap between eating disorders and mental health services. As a solution, a chat bot was developed with the goal of enhancing motivation for treatment and self-efficacy in individuals with eating disorders, thus encouraging them to seek mental health services. To design the chat bot, a decision tree was used along with theoretically informed elements, including psychoeducation, motivational interviewing, personalised recommendations, and repeated administration.

The study in [6] addresses the challenges associated with providing mental health support, which include stigma, limited awareness, and insufficient resources. It explores the potential of conversational agents, specifically chatbots, to improve mental healthcare, particularly for young adults who are familiar with such systems in other contexts. It is observed that there is limited research on the acceptability of conversational agents in mental health.

The conversational AI industry has been on the rise for a few years now. Eliza was one of the first natural language processing computer programmes created in 1964 by Joseph Weizenbaum [7]. Eliza is a pretty basic bot that was built in 1964, which is something to be respectful of. Personal dialogues are efficient when a person needs urgent interventions [8]. A few chatbots that help with anxiety and depression are Woebot, Wysa, and Joyable. Woebot is a therapy chatbot that helps its users monitor their mood and improve themselves. This is one of the top mental health chatbots to be found in the AI world right now. Woebot uses humour to familiarise the user with the environment and make them comfortable. Using puns, gifs, and funny jokes to help users cheer up their mood, Woebot uses cognitive behavioural therapy (CBT) to help users cope with symptoms of depression and anxiety. CBT is one of the most effective approaches to depression and anxiety developed to date. Wysa also uses humour and CBT to help users, but unlike Woebot, the conversations are repetitive at times. One thing that stands out from Wysa is the diary of positive thoughts that are stored to cheer up users when they are going through stressful times. Wysa also provides the option to book a therapy session with an actual therapist.

The creation and use of conversational bots in the field of mental healthcare create significant ethical issues. It is essential to guarantee informed consent, privacy protection, and openness about the potential and potential limitations of these agents [9]. Chatbot features include everything from delivering psychoeducation and self-help therapies to providing individualised support and engaging in therapeutic dialogues. User satisfaction, symptom reduction, increased self-awareness, and improved access to mental health resources are among the results that have been documented in the research [10]. In order to gauge conversational agents' efficacy, user pleasure, and ethical implications, the authors of the research [11] stress the significance of ongoing monitoring and evaluation.

By utilising sentiment analysis, emotion recognition, and machine learning algorithms in personalised interactions, the Virtual Mental Health Assistant is intended to support people with mental health difficulties [12]. The study in [13]] demonstrates that face feature analysis can be used to identify depression. Preprocessing is done on the 2-D face landmarks in the work. A Decision Tree (DT) has been created by examining the responses that participants have provided in response to a series of questions about sleep status, depression, diagnosis, feelings, and personality. The proposed method is that the actor or user interacts with the web application by providing the user image and text. The text is then processed by a sentiment analysis model and a facial expression recognition model. The results of these two models are compared, and a depression status is returned to the user.

Various machine learning methods and parameters that interpret the user's written description of emotion have been taught and tested on the Emotions dataset. A chatbot is created to give people a platform for interaction and to address their mental health issues. Rule-based chatbots and conversational chatbots are two different categories of chatbots. In rule-based chatbots, each query is mapped to an output response that will be provided. Conversational chatbots employ NLP to glean information from the user's text and provide the most pertinent answers [14].

In [15], important future directions for chatbots in mental healthcare are identified. It addresses how chatbots could promote preventive measures, provide psychoeducation, support self-help programmes, and serve as virtual behaviour change coaches. In order to improve the user experience and emotional involvement, the authors also consider the possibility of integrating virtual reality and affective computing technologies into chatbot systems. In order to shape the future of chatbots in mental healthcare, the authors also stress the significance of interdisciplinary cooperation between mental health specialists, computer scientists, designers, and users. To assure the moral and efficient use of chatbots, they urge joint research initiatives, the creation of evidence-based strategies, and the adoption of rules and norms.

The research focuses on the recognition of emotions expressed in natural language conversations. The authors in

[16] highlight the importance of understanding emotions in conversations for various applications, including mental health analysis, customer service, and social robotics. They discuss the complexities involved in detecting and interpreting emotions in conversational data due to factors such as linguistic variations, context dependence, and cultural influences.

The paper presents an overview of the existing datasets available for emotion recognition in conversations. It discusses the characteristics of these datasets, including their size, diversity, and annotation methods. The authors highlight the importance of high-quality annotated datasets for training and evaluating emotion recognition models and provide insights into the challenges associated with dataset collection and annotation.

The bot mimics a discussion with a psychotherapist by using natural language processing to grasp what the user is saying. The chatbot is equipped with some humour to make the user comfortable and ready to share a few details. It asks a few questions to understand the user's current mental state. The answer to those questions gets stored in a journal called the Happiness Journal, and the bot chats with the user to help him overcome his difficulties. The main aspects the bot deals with are anxiety, depression, and stress. To achieve this, the bot gets trained on a lot of stories that are explained in the RASA architecture [17].

The research in [18] focuses on examining the role of sentiment analysis and emotion detection in enhancing the capabilities of mental health chatbots. The authors highlight the significance of chatbots as an automated and accessible platform for providing mental health support. They emphasise that incorporating sentiment analysis and emotion detection enables chatbots to better understand and respond to users' emotional states, enhancing the quality of interaction and support provided.

The paper presents a systematic review of existing literature in the field of mental health chatbots, specifically focusing on sentiment analysis and emotion detection. It discusses various methodologies and techniques used in sentiment analysis, such as lexicon-based approaches, machine learning algorithms, and deep learning models. Similarly, it explores different approaches to emotion detection, including rule-based systems, machine learning, and ensemble methods.

Rasa X is a tool for conversation-driven development (CDD) that helps improve the chatbot by providing an interactive learning interface [19]. If the chatbot fails to correctly interpret the user's response, the interface serves as an interactive GUI and aids in developing the responses. Natural language processing often goes like this: first, the language is identified, then the text is divided in the pre-processing stage, and finally, the meaning is assessed using a neural networks [20].

These chatbots won't ever replace therapists because nothing can match the human connection. They are here because there are millions of people in this world who wouldn't go to a psychiatrist, although doing so would help them tremendously. There are many reasons why people find it hard to reach out. It is said that one should talk to someone if feeling low; however, some may find it difficult to find a trustworthy person. In such situations, well-trained chatbots play a major role. This study is an attempt to develop a chatbot that can understand the user's emotions based on the text entered. The bot will respond accordingly.

III. Proposed Methodology

CareBot is a conversational AI chatbot that uses natural language understanding at its core to understand user input. The motivation to develop this bot is to tackle day-to-day mental health challenges. A machine learning mode is used to convert user inputs into structured data and use that data to choose the optimal response for each user message.

A. Proposed Architecture

The architectural design of the model depicted in Fig. 1. The general overview of the system is that the user interacts with the web application by providing an image and text through a chatbot. The text is then processed by a sentiment analysis model, and the image is processed by an emotion detection model. The results of these two models are compared, a mental health status is returned to the user, and thereby suitable recommendations are provided to improve the mental health status of the user. The emotion detection model is trained with a database and optimized for better results.

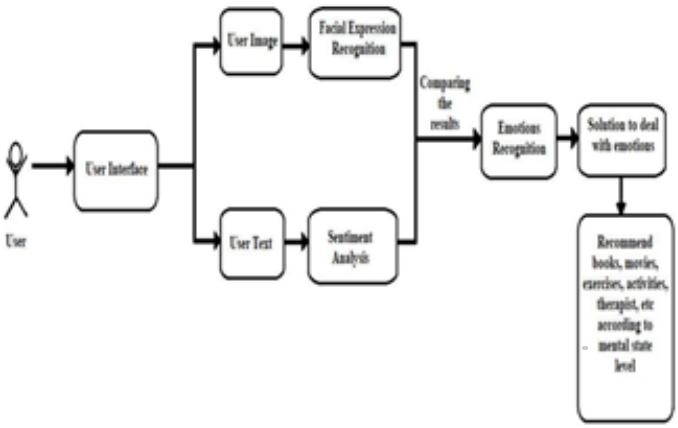

Fig. 1. Architecture Diagram

Fig. 2 depicts the detailed flow of the data and the process of the proposed method. The user will login to the system, and the bot will start communicating with the user. Based on the user's choice of words, NLP is applied to recognise the user's state of emotion. The system can trace the database and provide advice and suggestions to the user. Different stories are created to determine the flow of the conversation and the amount of time the conversation is driven by the chatbot. This whole process can be broken down into several components. Once the user sends a message, we use a tokenizer to split the sentence into tokens. A featurizer is used to transform the tokens into features that can be used by machine-learning algorithms. The intent classifier is used to classify intents

based on input features. and once the model gets trained, Rasa X is used.

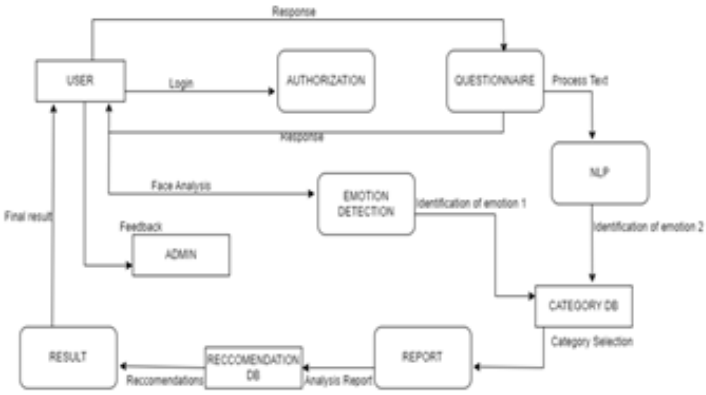

Fig. 2. Data Flow Diagram

IV. Implementation

In this section, the implementation details of a movie recommendation model that incorporates facial emotion recognition are presented. The system offers three input modalities: facial expression analysis, voice pitch analysis, and text-based input. The implementation is divided into two main subsections: Dataset and Tools and Frameworks.

A. Tools and Frameworks used

The Rasa X is used for an interactive learning interface. Two primary components of Rasa are Rasa NLU and Rasa Core. Rasa NLU is the part that handles NLP, classifying intents, entity extraction, and response retrieval. The dialogue management tool Rasa Core chooses the subsequent course of action in a conversation based on the circumstances. Natural language comprehension, dialogue state tracking, policy learning, and response generation are supported by the architecture. Through the provision of modular and extendable components, it seeks to facilitate the creation of scalable and individualised conversational bots. Rasa has been utilised in a variety of applications, including task-oriented dialogue systems, information retrieval, and customer service [21].

Rasa Core and Rasa X act as the drivers of the bot and engage in conversation with the user. Rasa X is an interactive learning interface that learns while conversing with the user. Rasa is an open-source machine learning framework to automate text- and voice-based conversations. Rasa X is part of the Rasa repo. It is an attempt to develop a probability model that determines the set of actions to take based on the prior set of user inputs.

B. Methodology

In the development of this chatbot system, a multifaceted strategy has been adopted by integrating Rasa, Pandas, and Keras. Rasa, an open-source framework, is employed for its proficiency in managing conversational flow and dialogue. Through the training of the system on labelled textual dialogues, Rasa facilitates sentiment analysis, a crucial element in comprehending user emotions. The efficient processing of textual data is achieved using Pandas, a powerful data manipulation library. This enhances the chatbot's ability to interpret and respond to user sentiments. Furthermore, Keras, a high-level neural network API, is used for emotion identification from visual data, thereby expanding the system's empathetic capabilities beyond textual interactions.

Algorithm 1 Capturing the emotion

1: Take input from the user.
2: Wait for the user performance of the users over time
3: Convert text to words
4: Do preprocessing of the obtained data
5: Convert words to features.
6: Recognize the features.
7: Classify Intent.

Algorithm 1 provides a detailed execution process. The first step is to capture the user's input. This will be considered the raw data for intent classification. Next, the user input is observed over a period of time to get a stable input. Next, utilise the tokenization mechanism to break down the input text into individual words. Then preprocess the obtained data. Then convert words to features using Word Embeddings methods. This process assigns each unique word a vector in a multi-dimensional space, forming the word space. These embeddings capture semantic relationships between words. Then apply the labelling feature to assign labels to the features. The labels correspond to different user intentions, such as happy, sad, anxious, etc. The intent is classified by feeding the vector space of word embeddings, along with labelled features, into a classification model. This model, trained on the labelled data, predicts the intent of the user input based on patterns learned during training. The possible intents are determined by the categories used during the labelling.

The methodological procedure entails creating an HTML and CSS frontend interface and combining it with the Rasa chatbot server and emotion recognition component on the backend. The emotion detection component constantly assesses user feelings while the frontend interacts with the Rasa server via API calls to evaluate user inputs and produce suitable responses. Through this seamless integration, users may interact with the chatbot system through an intuitive interface and get tailored responses that take into consideration their emotional state.

V. Results and Discussion

An user interface application is developed, in which user has to select the option, one to ON the camera or only chat with the application.This option window is provided in Fig 3. Hence the system takes two types of input. The user face image and user text.

The facial image is used to analyze the emotion of the user based on the facial expression.Fig 4 represents on of the test

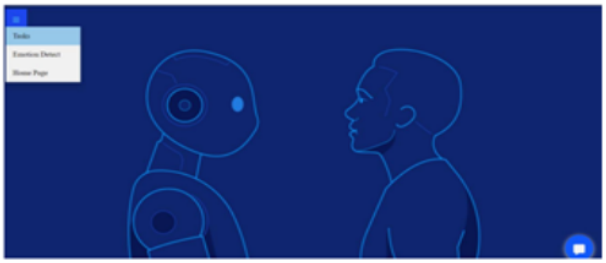

Fig. 3. Front Page

cases where we try to analyze the facial image and recognize the emotion. 'Neutral' is the expression detected in this image.

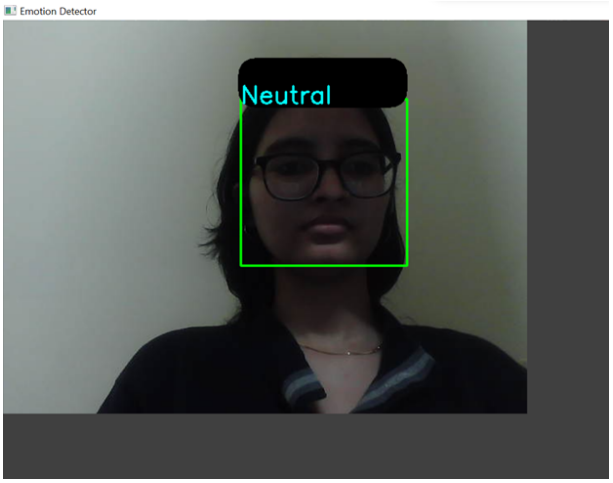

Fig. 4. Face Image Sample

Fig 5 is providing the textual chat between bot and the user. Here emotions of the user is analysed using the type of words used by the user to frame the sentences. As the communication continues , based on the analysis the user is suggested to do the activities like watching movies or plying some sport or seek medical help.

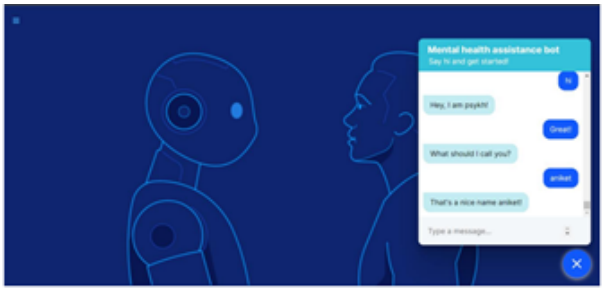

Fig. 5. Bot and User Communication

VI. Conclusion and Future Scope

In conclusion, the creation of a chatbot system that incorporates sentiment analysis and emotion detection utilising Rasa has enormous promise for delivering individualised and sympathetic encounters. The chatbot can recognize and respond to user emotions and sentiment by integrating Rasa as the chatbot framework with emotion detection powered by deep learning models and sentiment analysis using trained stories. Users can engage with the chatbot through a user-friendly interface while the backend processes their inputs and creates relevant responses thanks to the seamless integration of frontend and backend components. By analysing user emotions based on visual or verbal input, the emotion detection component adds a new level of comprehension and improves the chatbot's capacity to offer sympathetic support.

By enabling the chatbot to recognise and categorise user sentiment, modify its responses, and provide support as necessary, the incorporation of sentiment analysis further improves the chatbot's capabilities. By taking a personalised approach, the chatbot may adjust its interactions to meet the unique emotional demands and requirements of each user. Overall, this chatbot system's integration of Rasa, emotion recognition, and sentiment analysis provides a strong and comprehensive solution for mental health support. This chatbot can offer customers a unique and individualised experience by utilising cutting-edge technology and approaches, supporting them on their journey to mental wellness. The potential of this approach to provide mental health support is enhanced by the ongoing developments in chatbot technology and the rising understanding of emotional intelligence.

References

[1] J. L. Y. M.D., "Untreated mental illness," 2015, online; accessed 23-Februry-2023.

[2] L. Balcombe and D. De Leo, "Human-computer interaction in digital mental health," in *Informatics*, vol. 9, no. 1. MDPI, 2022, p. 14.

[3] W. H. Organization, *The world health report 2000: health systems: improving performance*. World Health Organization, 2000.

[4] J. Chung and J. Teo, "Mental health prediction using machine learning: taxonomy, applications, and challenges," *Applied Computational Intelligence and Soft Computing*, vol. 2022, pp. 1–19, 2022.

[5] ——, "Mental health prediction using machine learning: taxonomy, applications, and challenges," *Applied Computational Intelligence and Soft Computing*, vol. 2022, pp. 1–19, 2022.

[6] T. Koulouri, R. D. Macredie, and D. Olakitan, "Chatbots to support young adults' mental health: an exploratory study of acceptability," *ACM Transactions on Interactive Intelligent Systems (TiiS)*, vol. 12, no. 2, pp. 1–39, 2022.

[7] C. Bassett, "The computational therapeutic: exploring weizenbaum's eliza as a history of the present," *AI & SOCIETY*, vol. 34, pp. 803–812, 2019.

[8] D. Elmasri and A. Maeder, "A conversational agent for an online mental health intervention," in *Brain Informatics and Health: International Conference, BIH 2016, Omaha, NE, USA, October 13-16, 2016 Proceedings*. Springer, 2016, pp. 243–251.

[9] K. M. Palmer and V. Burrows, "Ethical and safety concerns regarding the use of mental health–related apps in counseling: Considerations for counselors," *Journal of technology in behavioral science*, vol. 6, pp. 137–150, 2021.

[10] A. N. Vaidyam, H. Wisniewski, J. D. Halamka, M. S. Kashavan, and J. B. Torous, "Chatbots and conversational agents in mental health: a review of the psychiatric landscape," *The Canadian Journal of Psychiatry*, vol. 64, no. 7, pp. 456–464, 2019.

[11] B. Y. Kasula, "Ethical considerations in the adoption of artificial intelligence for mental health diagnosis," *International Journal of Creative Research In Computer Technology and Design*, vol. 5, no. 5, pp. 1–7, 2023.

[12] S. Iyer, D. Shetty, P. Badgujar, A. Nambiar, and K. Jewani, "A proposal for virtual mental health assistant," in *2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)*, vol. 1. IEEE, 2021, pp. 953–957.

[13] M. Mohan, A. Abhinav, A. Ashok, A. Akhil, and P. Achinth, "Depression detection using facial expression and sentiment analysis," in *2021 Asian Conference on Innovation in Technology (ASIANCON)*. IEEE, 2021, pp. 1–6.

[14] A. Deepa, P. Karlapati, M. R. Mulagondla, P. Amaranayani, and A. P. Toram, "An innovative emotion recognition and solution recommendation chatbot," in *2022 8th International Conference on Advanced Computing and Communication Systems (ICACCS)*, vol. 1. IEEE, 2022, pp. 1100–1105.

[15] C. Sweeney, C. Potts, E. Ennis, R. Bond, M. D. Mulvenna, S. O'neill, M. Malcolm, L. Kuosmanen, C. Kostenius, A. Vakaloudis *et al.*, "Can chatbots help support a person's mental health? perceptions and views from mental healthcare professionals and experts," *ACM Transactions on Computing for Healthcare*, vol. 2, no. 3, pp. 1–15, 2021.

[16] S. Poria, N. Majumder, R. Mihalcea, and E. Hovy, "Emotion recognition in conversation: Research challenges, datasets, and recent advances," *IEEE Access*, vol. 7, pp. 100 943–100 953, 2019.

[17] "Documentation," online; accessed 23-April-2023.

[18] "Rasa architecture overview," online; accessed 23-April-2023.

[19] I. Pavel, "Comparing chatbot frameworks: a study of rasa and botkit," Master's thesis, 2021.

[20] A. Jiao, "An intelligent chatbot system based on entity extraction using rasa nlu and neural network," in *Journal of physics: conference series*, vol. 1487, no. 1. IOP Publishing, 2020, p. 012014.

[21] T. Bocklisch, J. Faulkner, N. Pawlowski, and A. Nichol, "Rasa: Open source language understanding and dialogue management," *arXiv preprint arXiv:1712.05181*, 2017.