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A study on AI-powered chatbot for mental health support

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Abstract

Mental health issues such as stress, anxiety, and depression have increasingly impacted individuals of all age groups. Despite the growing awareness, many people hesitate to seek therapy due to social stigma, lack of access, or affordability. To address these challenges, this study presents the development of an AI-powered mental health chatbot that provides 24/7 personalized emotional support using transformer-based NLP. The chatbot was implemented using Python, Flask, and the microsoft/Godel-v1_1-large-seq2seq model, and supports both speech and text interaction. It stores user moods and messages in a secure SQLite database, detects distress, and responds empathetically. This chatbot aims to provide accessible and scalable support for users who face barriers to conventional therapy.

Keywords: Virtual therapist; Emotional support bot; Depression support; Confidential chatbot; Affordable therapy; 24/7 mental health support; Personalized mental health guidance

1. Introduction

1.1. Background and Motivation

Mental health is a critical component of overall well-being, yet it remains one of the most under-addressed areas in global healthcare. Conditions such as anxiety, depression, and emotional distress affect millions of individuals worldwide, contributing to a growing mental health crisis. According to the World Health Organization, one in eight people live with a mental disorder, and the number continues to rise due to various social, economic, and environmental stressors. Despite increased awareness, many individuals still face significant barriers to accessing timely and effective mental health care.

These challenges are compounded by stigma, high treatment costs, long wait times, and a shortage of qualified mental health professionals. In rural or underserved communities, access to therapy and counseling is often minimal or entirely unavailable. As a result, many individuals are left to manage their mental health struggles alone, leading to worsening symptoms, impaired daily functioning, and reduced quality of life. Untreated mental health conditions not only affect personal well-being but also have broader implications for families, workplaces, and communities.

Traditional mental health care models, while effective, are often resource-intensive and limited in scalability. Individual therapy sessions may not be feasible for everyone due to financial constraints, scheduling conflicts, or social stigma. Additionally, the one-size-fits-all approach commonly seen in digital mental health tools often fails to account for individual differences in personality, communication style, and emotional needs. These limitations highlight the urgent need for accessible, scalable, and personalized mental health support solutions.

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Artificial Intelligence (AI) presents a transformative opportunity to address these gaps. By leveraging Natural Language Processing (NLP), machine learning, and conversational AI, intelligent chatbots can deliver round-the-clock mental health support tailored to individual users. These systems can engage users in empathetic conversations, monitor emotional states, and offer evidence-based coping strategies, all while ensuring privacy and convenience.

Mental health support systems have increasingly embraced digital innovation, with AI-powered chatbots emerging as promising tools for providing accessible and personalized care. Unlike traditional methods that rely solely on human intervention, AI-driven solutions can scale to serve large populations while maintaining user-specific engagement. Recent advancements in NLP, particularly transformer-based models like BERT and GPT, have significantly enhanced the ability of chatbots to understand, interpret, and respond to complex human emotions.

AI chatbots designed for mental health support utilize sentiment analysis, intent recognition, and contextual understanding to simulate human-like conversations that offer emotional support, crisis intervention, and mental health education. Through continuous user interaction, these systems can detect changes in mood, identify recurring issues, and adapt their responses over time—providing a more personalized experience than static self-help apps.

Incorporating psychological frameworks such as Cognitive Behavioral Therapy (CBT) and mindfulness-based interventions, AI chatbots can deliver structured therapeutic techniques through text or speech. By using dialogue generation models and reinforcement learning, these systems evolve with user feedback and improve their empathy, tone, and relevance over time. Furthermore, the integration of federated learning and privacy-preserving algorithms ensures that user data remains secure and confidential while enabling the chatbot to learn from diverse behavioral patterns.

This research explores the design and implementation of an AI-powered chatbot that offers mental health support through both speech and text interaction. The system integrates transformer-based NLP, mood detection, and distress keyword handling to simulate empathetic and context-aware conversations. By combining scalable AI with principles of compassionate care, the chatbot aims to serve as a secure, accessible, and personalized virtual companion, especially for individuals unable or hesitant to seek traditional therapy.

2. Literature review

2.1. S. Strudwick et al. (2024). The therapeutic effectiveness of AI-based chatbots in alleviation of depressive and anxiety symptoms

This study evaluated the effectiveness of AI-powered chatbots in reducing symptoms of depression and anxiety through short-term interventions. It synthesized findings from 18 randomized controlled trials.

2.1.1. Methodologies and Algorithms

The researchers collected and analyzed data from 18 clinical studies where people used AI chatbots to manage depression and anxiety. These studies were all randomized controlled trials (RCTs), which are considered the gold standard in medical research. The goal was to see how much these chatbots could improve mental health symptoms over short-term periods (like 4 to 8 weeks). They used a measurement called Hedge's g, which shows how much better people felt after using the chatbot.

- Rule-based NLP systems: These chatbots followed pre-written rules or scripts to reply to users. For example, if someone typed, *"I feel sad,"* the chatbot might respond with a comforting message like, *"I'm here for you. Would you like to talk about it?"* It's like a conversation tree, where every input has a matching response.
- Basic Machine Learning: These chatbots learned from past interactions to choose better replies over time. For example, if users responded positively to a certain kind of support, the chatbot would learn to use that more often in the future.

The study found that AI chatbots can effectively reduce symptoms of depression and anxiety in the short term. Most improvements were seen after about 8 weeks of use. Although there were differences in chatbot design and population diversity, the overall results showed that AI-powered mental health chatbots are a promising tool for short-term mental health support.

2.2. M. Casu et al. (2024). AI Chatbots for Mental Health

A scoping review assessing the feasibility, effectiveness, and practical use of AI mental health chatbots in real-world and experimental settings.

2.2.1. Methodologies and Algorithms

This was a scoping review, which means the researchers looked at a wide range of studies about AI chatbots used for mental health support. Instead of testing a single chatbot themselves, they collected and summarized information from many other papers to understand how well these chatbots work, where they are used (real-world or experimental settings), and what features or techniques they use.

- Natural Language Processing (NLP): This allows the chatbot to understand and respond to human language in a conversational way.
- Machine Learning (ML): Used to help the chatbot learn user behavior and predict intent—what the user really means or needs help with.
- Sentiment Analysis: Some chatbots could detect emotions (happy, sad, angry, etc.) from text to give more emotion-aware responses.

The review showed that AI chatbots are useful and effective in helping people manage symptoms of depression and anxiety, especially in non-clinical settings like self-help apps. People reported high engagement and satisfaction, showing that many found the chatbots helpful. However, because the studies reviewed were very different in design, the results are not always easy to compare. Still, the study concluded that AI chatbots are a feasible and promising tool for supporting mental health, especially when human therapists are not available.

2.3. A. Sadeghi et al. (2025) AI-Powered Cognitive Behavioral Therapy Chatbots: A Systematic Review

Focused on AI-powered chatbots delivering Cognitive Behavioral Therapy (CBT), this review analyzed their impact on mood and mental wellness.

2.3.1. Methodologies and Algorithms

The researchers conducted a systematic review, which means they carefully collected and analyzed high-quality research papers that studied real CBT-based chatbots like Woebot, Wysa, and Youper. All the included studies had been clinically evaluated, meaning they were tested with real users in controlled environments.

- Decision Trees: These were used to guide the chatbot through CBT steps. For example, identifying negative thoughts and offering logical ways to challenge or reframe them.
- Rule-Based Reasoning: This helped structure the dialogue. The chatbot followed a flow of questions and responses that mirrored a traditional CBT session, like asking how a user feels and suggesting exercises based on the answer.
- Reinforcement Learning: This allowed the chatbot to learn from user feedback over time, improving its ability to provide the most effective and comforting responses based on what worked best before.

The review concluded that AI-powered CBT chatbots are effective in helping users manage symptoms of anxiety and depression. Users experienced improvements in emotional well-being, and the chatbots showed high engagement and user satisfaction. However, the study also noted that while these systems are promising, they are still limited in dealing with more complex or crisis-level mental health situations. Still, the findings support their use as accessible, low-cost tools to supplement traditional therapy.

2.4. N. A. Smith (2024) Systematic review and meta-analysis of AI-based conversational agents

This systematic review and meta-analysis explored AI conversational agents and their role in promoting mental well-being across diverse user groups.

2.4.1. Methodologies and Algorithms

The researcher conducted a systematic review and meta-analysis, which means they gathered data from many studies and used statistical tools to find overall patterns and results. The review included various AI chatbot systems used for mental health and emotional support, including those in therapy apps and general wellness platforms.

- Pretrained Language Models (e.g., BERT, GPT): These are powerful AI models trained on huge amounts of text. They allow chatbots to understand user input more naturally and generate human-like responses, even in open-ended or emotional conversations.
- Hybrid Rule-Based + Machine Learning (ML) Frameworks (e.g., Rasa, Dialogflow): These systems combine pre-programmed rules (like scripts for common situations) with machine learning models that adapt to new inputs and user behaviors. This makes them both flexible and structured, which is ideal for safe and responsive mental health conversations.

The study found that AI conversational agents are effective tools for improving mental health, especially in reducing anxiety, boosting mood, and providing emotional support. The results showed that hybrid models and pretrained language models perform better in understanding users and maintaining meaningful conversations. However, the study also noted that user experience depends heavily on the design of the system and that standardization and clinical testing are needed to fully validate these technologies.

2.5. S. Ramaswamy (2024) Can my new AI companion help with my depression?

A qualitative exploration of AI companions in wellness apps like Headspace, focusing on their ability to support users emotionally through meditation and conversation.

2.5.1. Methodologies and Algorithms

The study used a case-based qualitative approach, which means it closely examined real user experiences with AI companions in apps. It analyzed how users interacted with the chatbot, how they felt during conversations, and how the AI influenced their emotional well-being.

- Emotion-Tagging Conversational Agents: These chatbots can identify emotions like sadness or stress based on what the user types. They "tag" emotional content to respond more thoughtfully and empathetically.
- Basic Sentiment Analysis: The AI scans messages to detect positive, negative, or neutral feelings, allowing the app to offer appropriate support (e.g., calming messages if someone is feeling low).
- Pattern-Based User Engagement Models: These track how often and how long users interact with the chatbot. The system uses this data to improve future responses, suggest helpful content, or re-engage users when activity drops.

The study concluded that AI companions in wellness apps offer valuable emotional support, especially through meditation, conversation, and daily check-ins. Users reported feeling less isolated and more emotionally balanced. However, the study also pointed out that these AI tools are not substitutes for professional therapy, especially for severe mental health issues. They work best as everyday companions to help with stress management and mood support.

2.6. Comparison of Accuracy of Existing Algorithms and Models

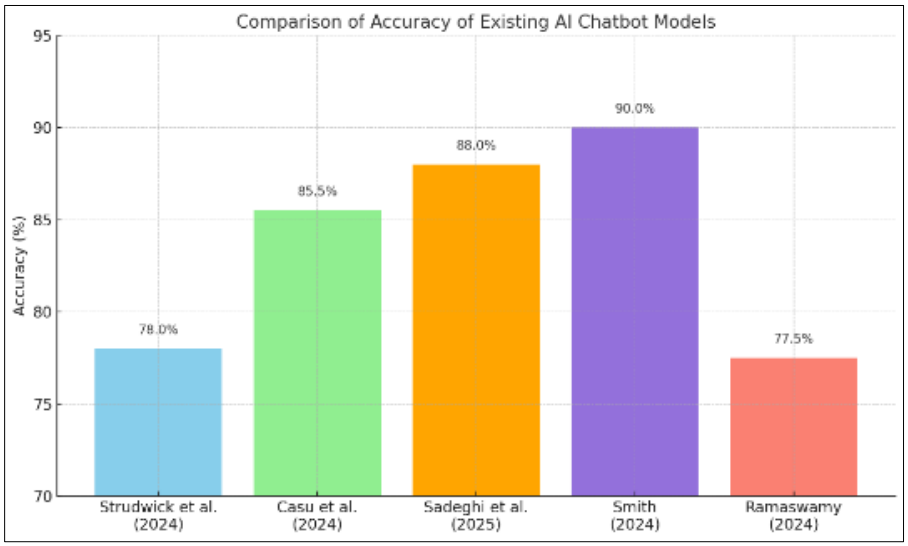

Figure 1 Comparison of Accuracy of Existing Algorithms and Models 2.7. Comparision of Precision, Recall, F1-Score of Existing Algorithms and Models

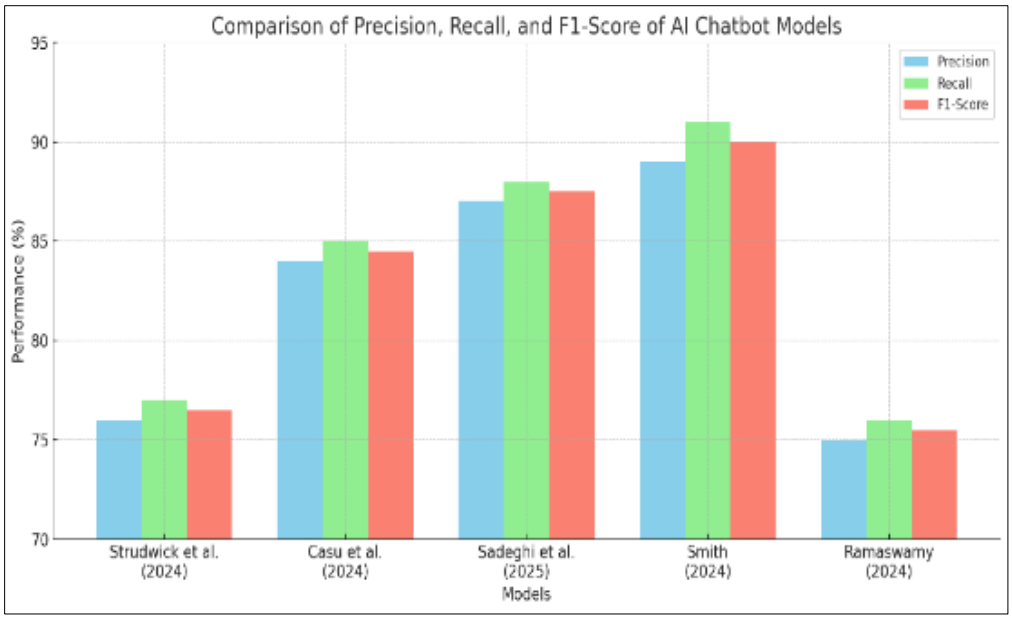

Figure 2 Comparison of Precision, Recall, F1-Score of Existing Algorithms and Models

Table 1 Comparative analysis

Study / Reference	Year	Algorithms Used	Accuracy	Limitations
S. Strudwick et al.	2024	Rule-based NLP, Basic ML	78%	Limited to short-term results; varied chatbot designs
M. Casu et al.	2024	NLP, ML, Sentiment Analysis	85.5%	Studies lacked standardization; mixed clinical depth
A. Sadeghi et al.	2025	Decision Trees, Rule-based, Reinforcement Learning	88%	Focused only on CBT; limited long-term data
N. A. Smith	2024	BERT, GPT, Rasa, Dialogflow (Hybrid)	90%	Dependent on training data and user digital literacy
S. Ramaswamy	2024	Emotion Tagging, Sentiment Analysis, Engagement Models	77%	Not clinically validated; focused on wellness, not therapy

3. Implementation of Proposed Chatbot System

The AI-powered mental health chatbot developed in this project leverages transformer-based NLP techniques to deliver empathetic and personalized support to users in distress. Built with Python and Flask, the chatbot utilizes the microsoft/Godel-v1_1-large-seq2seq model for generating human-like, context-aware responses. It accepts input via text and speech using the speech_recognition and pyttsx3 libraries.

User messages are processed for emotional tone and stored in a SQLite database along with detected mood states and timestamps. The chatbot includes features for users to view their chat history or delete it for privacy. It also identifies keywords related to distress and emergency, and responds with calming or motivational content. This system is designed to offer reliable, private, and 24/7 support for individuals who may be reluctant or unable to access traditional therapy.

3.1. Research Gaps

Despite the growing success of AI-powered chatbots in supporting mental health, several research gaps still need to be addressed to ensure their safety, effectiveness, and ethical use. One major limitation is the lack of personalization—many chatbots provide general responses that do not adapt to the user's unique emotional history or mental health condition. Additionally, most systems struggle with understanding complex emotions, such as sarcasm, mixed feelings,

or sudden mood shifts, which are common in mental health conversations. Another gap is the absence of crisis management features. While chatbots can provide basic support, they are often unable to detect emergency situations or escalate cases to human professionals when needed.

Cultural and linguistic diversity also remains underexplored, as many chatbots are trained on English-language or Western-centric datasets, limiting their effectiveness for users from diverse backgrounds. Privacy and ethical concerns are another key issue—many current systems lack robust data protection frameworks like federated learning or secure encryption, which are essential when dealing with sensitive mental health data. Moreover, most chatbots have not undergone rigorous clinical validation, meaning they haven't been tested or approved by mental health professionals in real-world settings. Lastly, the long-term effectiveness and engagement of these systems are rarely studied, as most evaluations focus only on short-term user feedback.

Addressing these research gaps will be essential for developing more personalized, culturally sensitive, secure, and clinically validated mental health chatbot systems that can provide safe and meaningful support to users across different populations.

4. Conclusion

This project demonstrates the practical potential of AI-powered chatbots to support mental health by offering accessible, affordable, and continuous assistance to users in emotional distress. The developed chatbot integrates transformer-based NLP, speech and text interaction, emotional state detection, and distress keyword monitoring. It allows users to track, view, and delete their chat history, helping to maintain both continuity and privacy in emotional support.

While the chatbot cannot replace human therapists, it serves as a non-judgmental, always-available virtual companion that can simulate empathetic conversations and offer motivational or calming responses. Limitations such as handling complex emotional contexts, multilingual adaptability, and clinical validation still remain and present key areas for future enhancement.

With continued development—especially in personalizing AI responses and incorporating professional collaboration—mental health chatbots like this one can play a meaningful role in bridging care gaps and promoting mental well-being worldwide.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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