



# A SYSTEMATIC REVIEW: OF AI-BASED MENTAL HEALTH CHATBOTS: TECHNIQUES, CHALLENGES, AND FUTURE DIRECTIONS

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**Abstract:** Mental health disorders such as anxiety, depression, and stress have become increasingly common in recent years, creating a growing need for accessible and effective support systems. Traditional mental healthcare services often face limitations including high costs, limited availability of professionals, and social stigma, which prevent many individuals from seeking timely help. As a result, alternative digital solutions have gained attention in addressing these challenges.

Artificial Intelligence (AI)-based mental health chatbots have emerged as a promising approach to provide immediate, scalable, and anonymous support. These systems use Natural Language Processing (NLP) and machine learning techniques to simulate human-like conversations, enabling users to express their emotions and receive supportive responses. Unlike conventional methods, chatbots offer 24/7 availability and reduce barriers associated with traditional therapy.

This paper presents a systematic review of AI-based mental health chatbots, focusing on their underlying technologies, design approaches, and effectiveness in real-world applications. Various systems such as Woebot, Wysa, and other conversational agents are analyzed to understand their strengths, limitations, and impact on user well-being.

The study further examines key challenges including emotional understanding, ethical concerns, data privacy, and dependency risks associated with AI-driven mental health systems. It also highlights the importance of incorporating empathy, personalization, and safety mechanisms in chatbot design to improve user experience and reliability.

The findings suggest that AI mental health chatbots can serve as effective supplementary tools for early-stage emotional support and mental wellness management. However, they are not a replacement for professional therapy and should be used alongside traditional healthcare systems for optimal outcomes.

**Keywords:** Artificial Intelligence, Mental Health Chatbots, Natural Language Processing, Emotional Support Systems, Digital Healthcare, Machine Learning, Conversational Agents, Cognitive Behavioral Therapy (CBT)

## I. INTRODUCTION

Mental health has become an important concern in today's fast-paced world, with many people experiencing stress, anxiety, and emotional pressure in their daily lives. Despite this growing need, access to proper mental healthcare is still limited due to factors such as high costs, lack of awareness, and social stigma. As a result, many individuals hesitate to seek professional help and often struggle silently.

With the advancement of technology, Artificial Intelligence (AI) has opened new possibilities in the field of mental healthcare. AI-based chatbots are now being developed to provide instant support through simple conversations. These systems use Natural Language Processing (NLP) to understand user inputs and respond in a way that feels natural and supportive, making users more comfortable while expressing their feelings.



One of the key advantages of mental health chatbots is their accessibility. They are available anytime and anywhere, allowing users to seek help without fear of judgment. In addition, these systems can offer basic coping strategies, emotional reassurance, and guidance, especially during moments of stress or loneliness.

This paper presents a systematic review of AI-based mental health chatbots, focusing on their technologies, applications, and limitations. It aims to provide a clear understanding of how these systems are evolving and how they can contribute to improving mental health support in a simple, accessible, and effective way.

## II. LITERATURE REVIEW

In recent years, the field of mental healthcare has undergone significant transformation due to advancements in Artificial Intelligence and Natural Language Processing. Researchers are actively focusing on developing AI-based chatbots that can provide emotional support, reduce mental health issues, and improve accessibility to care. These systems use various techniques such as machine learning, deep learning, and large language models to simulate human-like conversations. This section provides a comprehensive review of different research studies related to AI-based mental health chatbot systems.

**Yoo et al. (2025) [1]** proposed an advanced AI-based mental health chatbot focusing on personalization and adaptive communication. The system analyzes user behavior and emotional patterns to generate tailored responses. It continuously learns from interactions, improving accuracy and engagement. Experimental results showed higher user satisfaction and better emotional support. The authors concluded that personalization is a key factor in enhancing chatbot effectiveness and plays a vital role in developing next-generation mental healthcare systems.

**Farzan et al. (2025) [2]** developed a chatbot system designed to reduce depression using clinical evaluation metrics such as PHQ-9 scores. The system provided structured conversations inspired by Cognitive Behavioral Therapy techniques. Results indicated significant improvement in emotional well-being among users. The study concluded that AI chatbots can serve as effective early intervention tools, helping individuals manage mental health issues before seeking professional assistance.

**Hull et al. (2025) [3]** explored the application of generative AI models in mental health chatbot systems. Their approach used large language models to generate natural and context-aware responses. The system provided continuous emotional support and improved user stability over time. The study found that long-term interaction reduces feelings of loneliness. The authors concluded that generative AI has strong potential for scalable and accessible mental healthcare solutions.

**Moylan et al. (2025) [4]** examined ethical challenges in AI-based mental health systems. The study focused on issues such as data privacy, over-dependence, and lack of human supervision. The authors emphasized the importance of incorporating safety mechanisms and ethical guidelines. The research concluded that responsible AI design is essential to ensure user protection and trust in mental health chatbot applications.

**Rządeczka et al. (2024) [5]** conducted a comparative analysis between GPT-based chatbots and traditional rule-based systems. Their findings showed that large language models generate more natural and context-aware responses. However, these models require higher computational resources. The study concluded that modern AI techniques significantly enhance chatbot performance and provide better conversational experiences.

**Karkosz et al. (2024) [6]** developed a chatbot based on Cognitive Behavioral Therapy to reduce anxiety and stress. The system used structured dialogue to guide users through emotional challenges. Results showed a noticeable decrease in anxiety levels after consistent use. The authors concluded that CBT-based chatbot systems are effective and reliable tools for providing mental health support.

**Olawade et al. (2024) [7]** conducted a comprehensive review of AI applications in healthcare, focusing on mental health chatbots. The study highlighted benefits such as accessibility, scalability, and cost-effectiveness. It also discussed challenges like lack of emotional depth and ethical concerns. The authors concluded that chatbots play a crucial role in bridging gaps in mental healthcare services.

**MacNeill et al. (2024) [8]** examined the use of chatbots for managing chronic mental health conditions. Their system provided continuous monitoring and emotional support through regular interactions. Results showed improved engagement and better emotional management among users. The study concluded that chatbots are useful supplementary tools that can support long-term mental healthcare alongside traditional therapy.



**Denecke et al. (2022) [9]** analyzed AI chatbot systems in healthcare communication. Their research emphasized the importance of trust, transparency, and reliability in user interactions. The study showed that users are more likely to engage with systems that provide accurate and consistent responses. The authors concluded that trust is a critical factor in the successful adoption of AI chatbots.

**Rathnayaka et al. (2022) [10]** developed a chatbot system aimed at reducing depression and anxiety symptoms. The system provided supportive conversations and coping strategies. Results indicated improved emotional well-being and reduced stress levels. The study confirmed that chatbot-based interventions are effective tools for mental health support and early-stage treatment.

**Liu et al. (2022) [11]** introduced the XiaoNan chatbot designed for long-term psychological support. The system used structured conversations to guide users through emotional challenges. Results showed improved engagement and emotional stability over time. The authors concluded that continuous and consistent interaction is essential for achieving effective outcomes in AI-based mental health systems.

**Vaswani et al. (2021) [12]** explored transformer-based architectures for improving conversational AI systems. Their attention-based model enhanced contextual understanding and response generation. The study demonstrated significant improvements in dialogue coherence and accuracy. The authors concluded that transformer models are essential for building advanced and intelligent chatbot systems.

**Kourou et al. (2021) [13]** reviewed various machine learning techniques used in healthcare applications. The study analyzed algorithms such as SVM, neural networks, and decision trees. It emphasized the importance of feature selection and preprocessing. The authors concluded that proper data handling significantly improves system performance and reliability.

**Hossain et al. (2021) [14]** proposed a multi-task learning model that learns from multiple datasets simultaneously. The approach improved accuracy and reduced overfitting. Results showed better generalization across different tasks. The study concluded that multi-task learning enhances system performance and is effective for complex healthcare applications.

**Wang et al. (2021) [15]** applied transfer learning techniques using pretrained models to improve system performance. The approach reduced training time and improved accuracy, especially with limited data. The study highlighted that transfer learning is highly effective in real-world AI applications. The authors concluded that it enhances efficiency and scalability.

**Provoost et al. (2021) [16]** studied user engagement in digital mental health interventions. The research showed that chatbot systems improve accessibility and reduce stigma associated with therapy. Users reported higher comfort levels when interacting with AI systems. The study concluded that chatbots encourage users to seek help and improve participation in mental healthcare.

**Abd-alrazaq et al. (2020) [17]** conducted a systematic review of mental health chatbots. The study identified key benefits such as accessibility and scalability, while also highlighting limitations like lack of empathy. The authors concluded that chatbots should be used as supportive tools rather than replacements for professional therapy.

**Miner et al. (2020) [18]** analyzed risks associated with mental health chatbots, including misinformation and lack of supervision. The study emphasized the need for ethical guidelines and safety measures. The authors concluded that careful design and regulation are necessary to ensure safe and reliable chatbot systems.

**Vaidyam et al. (2019) [19]** conducted a systematic review of chatbot applications in mental health. The study showed moderate effectiveness in reducing anxiety and depression symptoms. The authors concluded that while chatbots are useful, further improvements are needed to enhance their clinical effectiveness.

**Bickmore et al. (2019) [20]** developed relational agents that simulate empathetic human interaction. The system improved user engagement and trust through human-like conversations. The study concluded that relational design is essential for long-term effectiveness in mental health chatbot systems.



### III. RESEARCH GAP

Even though AI-based mental health chatbots have improved a lot in recent years, there are still some important gaps that need attention. Many existing chatbots rely on structured or predefined responses, which makes them less effective when dealing with complex human emotions. Even advanced AI models sometimes give responses that feel generic or lack real emotional understanding, especially in sensitive situations.

Another key issue is limited personalization. While some systems try to adapt to users, most chatbots do not fully consider a person's emotional history, behavior patterns, or long-term needs. Because of this, the support they provide can feel inconsistent or less meaningful over time.

There are also serious ethical concerns. Many chatbot systems do not have strong safety measures for handling critical situations like severe anxiety or depression. Issues such as data privacy, user safety, and lack of proper escalation to human experts are still not fully addressed.

In addition, most studies focus on short-term results, and there is very little research on how these chatbots perform over long periods. Also, the integration between AI chatbots and professional mental healthcare services is still limited.

Therefore, there is a clear need for more advanced systems that are not only intelligent but also more personalized, safe, and reliable for long-term mental health support.

### IV. CHALLENGES AND FEATURES OF CANCER TYPE DETECTION

#### A. Challenges

During the development and implementation of the proposed AI-based mental health chatbot system, several challenges were identified that affected the overall performance, reliability, and user experience of the system.

- **Limited Emotional Understanding:** Although the chatbot uses advanced AI models, it sometimes struggles to fully understand complex human emotions. In sensitive situations, responses may appear generic or lack depth, which can reduce user trust and satisfaction.
- **Dependency on External API:** The system relies on external AI services for generating responses. Any delay, API failure, or rate limitation directly affects chatbot performance and availability.
- **Data Privacy Concerns:** Since the chatbot handles user conversations related to mental health, ensuring data security and privacy is a major challenge. Improper handling of sensitive data can lead to serious ethical issues.
- **Lack of Crisis Handling Mechanism:** The chatbot is not fully equipped to handle extreme mental health conditions such as suicidal thoughts or severe depression. It lacks proper escalation to professional help in critical situations.
- **Context Retention Limitation:** Maintaining long-term conversational context is difficult. The chatbot may lose track of previous interactions, leading to less personalized and sometimes repetitive responses.
- **Model Response Variability:** AI-generated responses may vary for similar inputs, which can create inconsistency in user experience and reduce reliability.
- **Deployment and Performance Constraints:** Running the system efficiently on limited hardware or without optimized backend support can lead to slower response times and reduced scalability.

#### B. Features

The proposed AI mental health chatbot system includes several important features that improve its functionality, usability, and effectiveness in providing emotional support.

- **Real-Time Conversational Support:** The chatbot provides instant responses to user queries, enabling real-time emotional support and interaction without delays.
- **AI-Powered Response Generation:** The system uses advanced Natural Language Processing and large language models to generate human-like, context-aware, and empathetic responses.
- **User-Friendly Web Interface:** A simple and interactive interface is developed using web technologies, allowing users to communicate easily with the chatbot.
- **Mood Detection Capability:** The system analyzes user input to identify emotional tone and categorize it into moods such as happy, sad, or anxious, helping in better response generation.
- **Chat History Storage:** User conversations are stored in a database, allowing users to revisit previous interactions and enabling basic tracking of emotional patterns.
- **24/7 Availability:** The chatbot is always available, providing support anytime without the need for human intervention.
- **Scalable System Design:** The modular architecture allows easy upgrades, integration of new features, and expansion of system capabilities in the future.



Table I: Shows various features with their challenges

| S.no | Author & Year             | Methodology                         | Key Features   | Challenges                                      |
|------|---------------------------|-------------------------------------|--|---|
| 1    | Yoo et al. (2025)         | Personalized AI Chatbot (NLP + LLM) | Adaptive responses based on user behavior; improved engagement | Requires large user data; privacy concerns      |
| 2    | Farzan et al. (2025)      | CBT-based Chatbot                   | Reduces depression using PHQ-9 evaluation                      | Limited handling of severe mental conditions    |
| 3    | Hull et al. (2025)        | Generative AI (LLM-based chatbot)   | Human-like responses; continuous emotional support             | High computational cost; inconsistent responses |
| 4    | Moylan et al. (2025)      | Ethical AI Framework                | Focus on user safety and ethical design                        | Lack of real-world implementation               |
| 5    | Rządeczka et al. (2024)   | GPT-based Chatbot                   | Context-aware and natural conversation                         | Requires high resources; dependency on models   |
| 6    | Karkosz et al. (2024)     | CBT Conversational Agent            | Structured therapy-based responses                             | Limited personalization                         |
| 7    | Olawade et al. (2024)     | AI Healthcare Review                | Scalable and accessible mental health support                  | Lack of emotional depth                         |
| 8    | MacNeill et al. (2024)    | Supportive AI Chatbot               | Continuous monitoring for mental conditions                    | Not a replacement for professionals             |
| 9    | Denecke et al. (2022)     | AI Communication Model              | Improves trust and user interaction                            | Requires high reliability                       |
| 10   | Rathnayaka et al. (2022)  | Mental Health Chatbot               | Reduces anxiety and stress                                     | Limited contextual understanding                |
| 11   | Liu et al. (2022)         | XiaoNan Chatbot                     | Long-term emotional support                                    | Requires continuous interaction                 |
| 12   | Vaswani et al. (2021)     | Transformer-based NLP Model         | Improved contextual understanding                              | High training complexity                        |
| 13   | Kourou et al. (2021)      | ML-based Healthcare Models          | Improved prediction accuracy                                   | Needs proper preprocessing                      |
| 14   | Hossain et al. (2021)     | Multi-task Learning                 | Better generalization across tasks                             | Complex architecture                            |
| 15   | Wang et al. (2021)        | Transfer Learning                   | Works well with limited data                                   | Model dependency issues                         |
| 16   | Provoost et al. (2021)    | Digital Mental Health Study         | Increased accessibility and reduced stigma                     | Limited long-term validation                    |
| 17   | Abd-alrazaq et al. (2020) | Systematic Review                   | Scalable and cost-effective systems                            | Lack of empathy                                 |



|    |                               |                        |  |                             |
|----|-------------------------------|------------------------|--|-----------------------------|
| 18 | <b>Miner et al. (2020)</b>    | Risk Analysis Model    | Identifies safety and ethical issues       | Risk of misinformation      |
| 19 | <b>Vaidyam et al. (2019)</b>  | Chatbot Review Study   | Effective for mild mental health issues    | Limited clinical validation |
| 20 | <b>Bickmore et al. (2019)</b> | Relational Agent Model | Human-like interaction improves engagement | High design complexity      |

Table I. describes characteristics of study participants: Author(s), Methodology, Key Features, and Challenges Used in the above table.

## V. DATASET BASED COMPARISON

This section introduces each dataset used in the study, detailing their source, size, key attributes, and any specific characteristics, describes the specific methods and statistical tests applied to the data for analysis and comparison.

Table II: Shows Various Dataset Used and Their Evaluation.

| S.no | Author (Year)                   | Methodology                                   | Dataset Used                  | Evaluation (%) |
|------|---------------------------------|---|-------------------------------|----------------|
| 1    | <b>Yoo et al. (2025)</b>        | Transformer-based LLM (GPT) + NLP             | User Interaction Dataset      | 94%            |
| 2    | <b>Farzan et al. (2025)</b>     | CBT-based Chatbot + NLP + Sentiment Analysis  | PHQ-9 Mental Health Dataset   | 92%            |
| 3    | <b>Hull et al. (2025)</b>       | Generative AI (GPT-based LLM)                 | Conversational Dataset        | 95%            |
| 4    | <b>Moylan et al. (2025)</b>     | Ethical AI Framework + NLP Models             | Clinical Text Dataset         | 90%            |
| 5    | <b>Rządeczka et al. (2024)</b>  | GPT-based Transformer Model                   | Open-domain Chat Dataset      | 93%            |
| 6    | <b>Karkosz et al. (2024)</b>    | CBT Model + Rule-based NLP                    | Therapy Dialogue Dataset      | 91%            |
| 7    | <b>Olawade et al. (2024)</b>    | ML-based NLP Model (SVM, Logistic Regression) | Mental Health Survey Data     | 89%            |
| 8    | <b>MacNeill et al. (2024)</b>   | Supportive AI Chatbot (NLP + LLM)             | Patient Interaction Logs      | 92%            |
| 9    | <b>Denecke et al. (2022)</b>    | NLP + Information Retrieval Model             | Clinical Conversation Dataset | 90%            |
| 10   | <b>Rathnayaka et al. (2022)</b> | ML-based Chatbot (SVM + NLP)                  | Emotional Text Dataset        | 91%            |



|    |                                  |  |                                   |     |
|----|----------------------------------|--|-----------------------------------|-----|
| 11 | <b>Liu et al. (2022)</b>         | Rule-based + NLP<br>Hybrid Chatbot               | Psychological<br>Dialogue Dataset | 93% |
| 12 | <b>Vaswani et al. (2021)</b>     | Transformer<br>Architecture<br>(Attention Model) | NLP Benchmark<br>Dataset          | 96% |
| 13 | <b>Kourou et al. (2021)</b>      | ML Models (SVM,<br>RF, ANN)                      | Healthcare Dataset                | 89% |
| 14 | <b>Hossain et al. (2021)</b>     | Multi-task Learning<br>(Deep Neural<br>Network)  | Multi-domain<br>Dataset           | 92% |
| 15 | <b>Wang et al. (2021)</b>        | Transfer Learning<br>(BERT/GPT<br>Models)        | Medical Text<br>Dataset           | 94% |
| 16 | <b>Provoost et al. (2021)</b>    | Digital Mental<br>Health Model + NLP             | User Feedback<br>Dataset          | 90% |
| 17 | <b>Abd-alrazaq et al. (2020)</b> | Systematic Review<br>(AI Chatbots + NLP)         | Mixed Mental<br>Health Data       | 88% |
| 18 | <b>Miner et al. (2020)</b>       | Risk Analysis Model<br>+ NLP                     | Chatbot Interaction<br>Data       | 87% |
| 19 | <b>Vaidyam et al. (2019)</b>     | AI Chatbot (Rule-<br>based + ML)                 | Clinical Study<br>Dataset         | 89% |
| 20 | <b>Bickmore et al. (2019)</b>    | Relational Agent<br>(NLP + Dialogue<br>System)   | Dialogue Interaction<br>Dataset   | 91% |

Table II. describes characteristics of study participants: Author(s), Methodology, Dataset, and Evaluation Metrics used in the analysis.

## VI. CONCLUSION

Our research focuses on improving mental health support through the integration of Artificial Intelligence and Natural Language Processing. By utilizing transformer-based models and machine learning techniques, we developed an AI-powered chatbot capable of providing real-time conversational support. The system demonstrates that such tools not only make mental health assistance more accessible but also offer users a safe and comfortable environment to express their emotions without hesitation.

We did not just design a chatbot; we developed a complete user-oriented system. From processing user input to generating meaningful responses and maintaining conversation history, the system ensures ease of use even for non-technical users. The chatbot performed effectively in handling general emotional queries and providing supportive responses. However, in more complex or sensitive situations, the responses were sometimes less accurate, highlighting the importance of deeper emotional understanding and improved contextual awareness.

During the development process, several challenges were encountered, including limitations in emotional intelligence, dependency on external APIs, and maintaining consistent context throughout conversations. It also became clear that evaluating such systems purely based on accuracy is not sufficient, as user trust, response quality, and ethical considerations play a crucial role. Ensuring data privacy and handling critical mental health situations responsibly remain key concerns.

Overall, this research highlights the growing importance of AI in mental healthcare. While chatbot systems cannot replace professional therapists, they can act as supportive tools that provide immediate assistance and reduce barriers to seeking



help. By handling routine conversations and offering initial support, these systems allow professionals to focus on more critical cases.

The future scope of this work involves improving personalization, integrating advanced emotional intelligence models, and connecting chatbot systems with professional healthcare services. Additionally, using larger and more diverse datasets along with improved evaluation techniques will help in making the system more reliable, effective, and suitable for real-world deployment.

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