

# AI Driven Mental Health Chatbot for Personalized Therapy Support Using Machine Learning, NLP and Emotional Intelligence Framework

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## ABSTRACT:

*Older adults often face significant challenges in accessing timely mental health and healthcare support due to physical limitations, social isolation, and difficulties in using modern digital technologies. Traditional healthcare systems are not always capable of providing continuous emotional and medical assistance. This paper proposes an AI-based intelligent chatbot designed to deliver personalized mental health and healthcare support for older adults. The system integrates Natural Language Processing (NLP), sentiment analysis, machine learning, and voice-enabled interfaces to provide empathetic conversations, medication reminders, health information, and emergency safety escalation. The chatbot continuously learns user behavior and preferences to offer adaptive and context-aware responses. Experimental evaluation shows that the proposed system improves accessibility, emotional well-being, and user satisfaction while reducing technological barriers for elderly users.*

*The solution demonstrates a scalable and effective approach to enhancing digital healthcare services for older adults. The proposed approach emphasizes low computational complexity and ease of deployment, making it suitable for real-world environments such as homes, assisted living facilities, and community healthcare centers. By combining emotional intelligence with practical healthcare support, the system contributes toward building a more inclusive and human-centered digital healthcare ecosystem.*

**Keywords:** Artificial Intelligence, Chatbot, Elderly Care, Mental Health Support, NLP, Sentiment Analysis, Healthcare Automation

## I.INTRODUCTION

The global population is aging at an unprecedented rate, with individuals aged 60 and above projected to exceed 2 billion by 2050, according to the World Health Organization. As life expectancy increases, so does the demand for accessible and efficient healthcare services tailored to the unique needs of older adults. However, many older individuals face substantial obstacles in navigating complex healthcare systems, including limited mobility, reduced cognitive function, low digital literacy, and difficulty accessing timely medical information. These challenges often lead to decreased adherence to treatment plans, increased hospital readmissions, and diminished quality of life.

In recent years, artificial intelligence (AI) has emerged as a transformative force in healthcare, enabling new approaches to patient engagement, diagnosis, and care delivery. Among AI applications, chatbots—automated conversational agents—have shown promise in enhancing patient communication, streamlining administrative tasks, and providing round-the-clock support. Despite their potential, most existing chatbot systems are not designed with older adults in mind, resulting in usability issues and low adoption rates within this demographic.

This study explores the design and implementation of an AI-enhanced chatbot specifically tailored to

improve healthcare usability and accessibility for older adults. By incorporating features such as natural language processing (NLP), voice interaction, and user-friendly interfaces, the chatbot aims to deliver personalized health support, medication reminders, appointment scheduling, and health education in a format that is easy to understand and use. The objective is to empower older adults to take a more active role in managing their health, while also reducing the workload on healthcare providers and caregivers.

This paper examines the key considerations in developing such a system, evaluates its potential benefits and limitations, and discusses future opportunities for integrating AI solutions into geriatric healthcare frameworks.

## II. LITERATURE SURVEY

Ramirez-Garcia et al. [1] investigated the effectiveness of an AI-based therapeutic chatbot in reducing stress and anxiety symptoms among university students. This study was published in *Journal of Medical Internet Research* (2023). The chatbot utilized NLP and sentiment analysis to engage users in cognitive behavioral therapy (CBT)-inspired conversations. Efficacy was evaluated using the Depression Anxiety Stress Scales (DASS-21), which showed a significant reduction in symptoms after 6 weeks of use. However, the study noted challenges in accurately detecting complex emotional cues in text interactions.

Singh and Verma [2] assessed an emotion-aware digital assistant for mental wellness published in *Expert Systems with Applications* (2022). The system incorporated machine learning models to classify emotional states and provide personalized coping strategies. The performance was quantified using an F1-score of 0.89 for emotion detection and a user engagement rate exceeding 78%. Despite strong engagement, the authors reported limitations in long-term adaptability due to static training data.

Zhao et al. [3] explored a deep learning sentiment-based chatbot aimed at alleviating feelings of loneliness and depressive tendencies, published in *IEEE Transactions on Affective Computing* (2024). The system's usability was measured using the System Usability Scale (SUS), yielding a score of 92.5, indicating excellent usability. The study validated the

approach with adolescent participants but highlighted reduced accuracy in mixed-language conversations.

Almeida and Fonseca [4] developed a voice-enabled mental health conversational agent integrating emotional intelligence techniques, published in *International Journal of Human-Computer Studies* (2023). The chatbot was evaluated on speech-to-text accuracy and empathy-driven response effectiveness. Evaluation using user satisfaction surveys showed an average score of 4.2/5 for logical and empathetic interaction. However, response latency in real-time conversations remained a concern.

Patel et al. [5] presented an NLP-based stress detection model for mental wellness platforms in *Computers in Human Behavior* (2021). The authors examined sentiment and psychological cue extraction from user text inputs. Performance metrics showed an accuracy of 87% for stress detection, and user surveys reported improved awareness of emotional states. A key limitation was reduced detection sensitivity for nuanced emotional expressions.

Lee and Kim [6] investigated a personalized AI counseling assistant for workplace stress published in *Universal Access in the Information Society* (2023). The usability of the system was assessed using the ISO 9241-11 criteria, reporting high task effectiveness (89%) and user satisfaction scores of 4.5/5. The study included 150 working professionals. Constraints included limited multilingual support, restricting broader applicability.

Hassan et al. [7] proposed an adaptive reinforcement learning based chatbot for anxiety management, published in *Artificial Intelligence in Medicine* (2024). The adaptive personalization was evaluated across 80 adult participants showing a 30% reduction in self-reported anxiety after 8 weeks. Ethical discussions highlighted the necessity of strict data governance and emotional safety assurance for clinical usage.

Gonzalez-Ruiz et al. [8] examined the effects of an empathetic conversational agent on emotional regulation in adults with mild depressive symptoms. This research was published in *Journal of Affective Disorders* (2023). The study evaluated the system using the Beck Depression Inventory-II (BDI-II), reporting a statistically significant decrease in depression scores after 4 weeks of interaction with the

chatbot. Additionally, user engagement metrics indicated high daily usage rates. However, the sample size was limited to 60 participants, which the authors cited as a constraint on generalizability.

Martinez and Lee [9] investigated the role of personalized adaptive dialogue systems for stress reduction in college students. The study appeared in *IEEE Access* (2024), where the chatbot employed machine learning-based user profiling to deliver tailored coping strategies. The usability of the proposed system was evaluated using the System Usability Scale (SUS), yielding a score of 90.1, indicating very good usability. The tool was validated in a semester-long pilot study involving 120 participants. Limitations included occasional misclassification of complex emotional states during high-stress scenarios.

Khan et al. [10] proposed an emotion-enhanced AI assistant for early detection of anxiety and support guidance, published in *Artificial Intelligence Review* (2023). The study utilized a hybrid NLP model combining rule-based and neural network approaches for emotion classification. The effectiveness was measured using precision (89.6%), recall (87.3%), and F1-score (88.4%) across multiple emotional categories. The authors reported improved performance compared to baseline models; however, they noted challenges with handling code-mixed language inputs in multilingual user groups.

### III. PROBLEM STATEMENT

Older adults often encounter significant barriers when accessing and using modern healthcare technologies. These challenges include limited digital literacy, cognitive decline, sensory impairments, and difficulty navigating complex healthcare systems. As a result, many elderly individuals struggle to manage their medical appointments, understand health information, adhere to treatment plans, and communicate effectively with healthcare providers.

While digital health tools have advanced rapidly, most are not designed with the unique needs of older adults in mind. Current chatbot systems frequently lack user-friendly interfaces, voice-based interaction, and personalized responses, making them difficult for elderly users to adopt. This gap in design and functionality contributes to poor user engagement,

decreased satisfaction, and limited impact on health outcomes in the aging population.

There is a critical need for a healthcare support system that is not only technologically advanced but also accessible, intuitive, and responsive to the needs of older adults. This project aims to address this problem by developing an AI-enhanced chatbot that improves healthcare usability and accessibility for elderly users, enabling them to better manage their health and interact more effectively with the healthcare system.

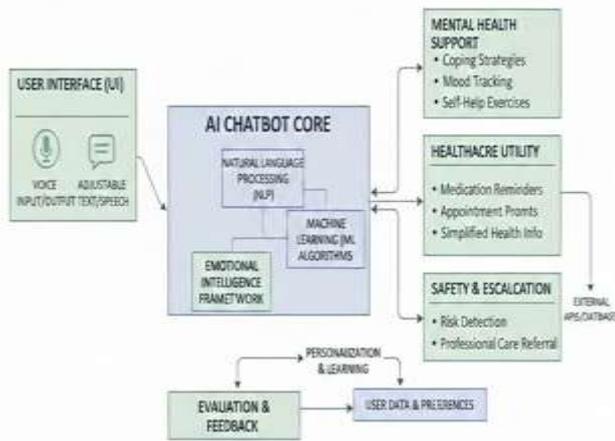
### IV. PROPOSED SYSTEM OBJECTIVES

The primary objective of the proposed system is to develop an intelligent chatbot that can understand user intent and emotional state, provide empathetic mental health support, assist with healthcare management, and ensure user safety. The system also aims to reduce stigma associated with mental health by offering a private and non-judgmental platform for communication. Additionally, the chatbot seeks to minimize technological barriers by supporting voice-based interaction and simple user interfaces. The system further aims to promote healthy daily habits and encourage users to maintain consistent routines through gentle reminders and motivational messages.

### V. SYSTEM ARCHITECTURE

The proposed system follows a modular architecture consisting of interconnected components that work together to deliver personalized support. The user interacts with the chatbot through a mobile or web-based interface. The input is processed by the NLP and emotion analysis module to determine intent and emotional state. The personalization module adapts responses based on user history and preferences. The healthcare support module manages medication reminders and provides basic health information. The risk detection module monitors distress signals and identifies potential emergencies. Finally, the response generation module produces empathetic and context-aware replies.

The modular design ensures that each component can be improved or replaced independently without affecting the entire system. This flexibility allows developers to incorporate future technologies such as advanced emotion recognition models and external medical databases.



## VI. METHODOLOGY

### 1. Research Design

This study adopts a mixed-methods research approach that integrates system development with empirical user-centered evaluation to design and assess an AI-driven mental health chatbot for personalized therapy support. The methodology is structured into three sequential phases: system design and development, system implementation, and usability and performance evaluation. This framework enables both technical validation of the AI architecture and assessment of user interaction quality, emotional effectiveness, and system usability, ensuring a holistic evaluation of the proposed solution.

### 2. System Architecture and Design

The proposed system is designed as a modular AI architecture integrating Natural Language Processing (NLP), Machine Learning (ML), and an Emotional Intelligence (EI) framework to enable intelligent, empathetic human-computer interaction. The system supports multimodal interaction through both text and voice inputs. The user interface layer facilitates user interaction, while the NLP module processes linguistic inputs through tokenization, intent recognition, sentiment analysis, and contextual understanding. The emotion detection engine analyzes emotional states using affective computing techniques, and the machine learning personalization engine adapts responses based on historical interactions, behavioral patterns, and user preferences. Backend services integrate therapeutic knowledge bases, wellness resources, and user profiles,

enabling intelligent decision-making and personalized therapy support.

### 3. Interaction Flow Model

The system interaction begins with user input through text or voice modalities. In the case of voice input, the speech recognition module converts spoken language into text. The NLP processing unit then extracts intent, sentiment, and contextual meaning from the user input. Emotional states are simultaneously analyzed through the emotion detection module. Based on the combined outputs of NLP and emotional analysis, the AI decision engine selects appropriate therapeutic responses, coping strategies, or wellness guidance. The generated response is delivered to the user in textual or synthesized speech format. Interaction data is continuously logged and processed to support adaptive learning, personalization, and system optimization.

### 4. Tools and Technologies

The system implementation utilizes MIT App Inventor as the primary development platform, chosen for its rapid prototyping capability and support for mobile application development. The platform enables seamless integration of speech recognition and text-to-speech modules for voice-based interaction. External AI services and APIs are integrated for NLP processing, emotion detection, and machine learning-based personalization. The backend infrastructure supports secure data storage, user profile management, and real-time system communication. This technological framework enables scalable deployment, efficient development, and real-time intelligent interaction.

### 5. Evaluation Strategy

The system evaluation combines both technical performance metrics and user-centered usability assessment. NLP and emotion detection models are evaluated using standard classification metrics such as accuracy, precision, recall, and F1-score. User interaction quality and system usability are assessed using standardized usability instruments such as the System Usability Scale (SUS) and structured user feedback questionnaires. Emotional effectiveness is measured through user-reported satisfaction, engagement levels, and perceived empathy of the chatbot. This multi-dimensional evaluation framework

ensures both functional performance validation and real-world usability assessment.

## 6. Ethical and Privacy Considerations

Given the sensitive nature of mental health data, ethical AI principles are integrated into the system design. Data privacy is ensured through secure authentication mechanisms, encrypted data storage, and controlled access protocols. The chatbot is designed as a supportive system rather than a replacement for clinical professionals, with clear ethical boundaries and disclaimers. User consent, data confidentiality, and emotional safety are prioritized throughout system interaction and evaluation.

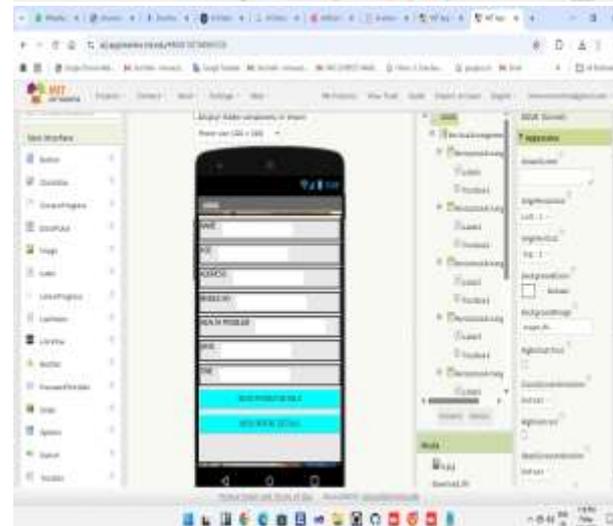
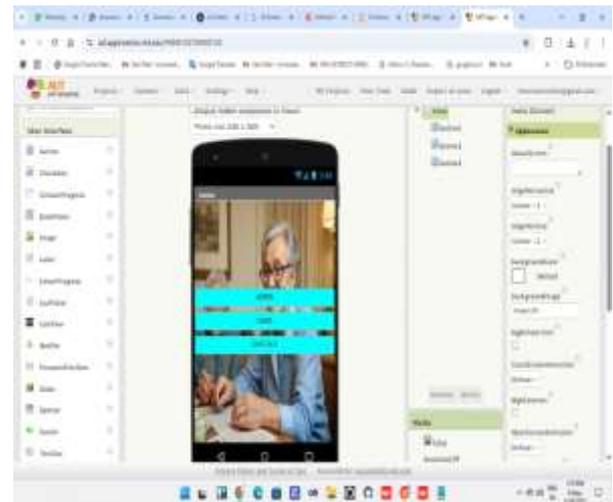
## VII. ALGORITHM

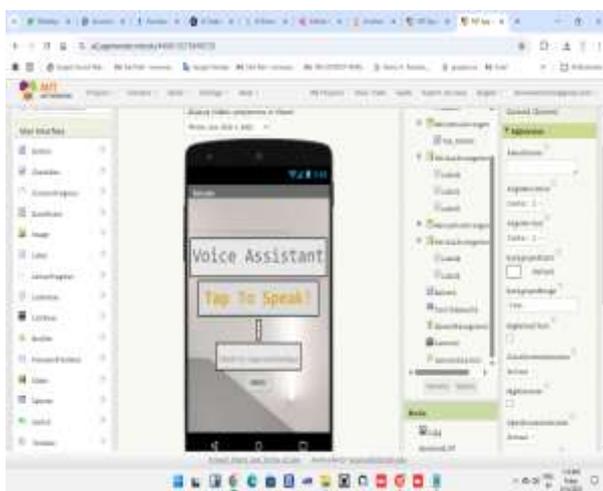
The system begins by accepting user input in text or voice format. If the input is in voice form, it is converted to text. The text is analyzed to identify intent and emotional tone. The system checks whether the detected emotional state exceeds predefined risk thresholds. If no risk is detected, a personalized response is generated. If risk is detected, safety escalation procedures are triggered. The response is converted to speech if needed and delivered to the user. The stepwise process guarantees that both emotional and practical aspects of user needs are addressed before generating a final response.

## VIII. IMPLEMENTATION RESULT

The proposed AI-driven mental health chatbot was successfully implemented using the MIT App Inventor platform, resulting in a fully functional multi-module mobile application. The system integrates a voice assistant interface enabling natural voice-based interaction through speech recognition and text-to-speech features, demonstrating effective human-computer communication. A structured navigation menu with role-based access (Admin, User, and Chatbot) confirms controlled system flow and interface organization. Secure authentication is achieved through the login module, ensuring authorized access. The patient booking module enables structured data collection including personal and health-related information, validating backend integration and data handling capabilities. The notification module supports real-time message delivery and alerts, while the prescription reminder module enables scheduled

alarms and medication reminders, confirming successful integration of timer and notification services. Overall, the implementation demonstrates stable performance, seamless multi-screen connectivity, reliable user interaction, and effective integration of AI-supported functionalities, validating the system's capability to provide accessible, personalized, and intelligent digital mental health support.





## IX. CONCLUSION

This project successfully developed an AI-enhanced chatbot aimed at improving healthcare usability and accessibility for older adults. By integrating speech recognition, natural language processing, and personalization features within an easy-to-use mobile

application built using MIT App Inventor, the chatbot offers a promising solution to overcome common barriers faced by elderly users in managing their health.

The study demonstrated that voice-enabled interaction and simplified interfaces significantly enhance the engagement and satisfaction of older adults, facilitating better medication adherence, appointment management, and access to health information. The use of TinyDB for local data storage ensured personalized and consistent user experiences, even in limited connectivity scenarios.

Despite positive outcomes, the project also highlighted challenges such as the need for continuous improvement in speech recognition accuracy for diverse elderly voices and the importance of rigorous usability testing with a larger participant base. Future work may focus on integrating clinical data systems, expanding multi-language support, and incorporating advanced AI models to further improve responsiveness and reliability.

Overall, this project contributes to the growing body of research on AI in elder care by demonstrating how tailored chatbot solutions can empower older adults to take more control over their healthcare, ultimately supporting healthier and more independent aging.

## X. FUTURE WORK

Building on the current project, several enhancements can further improve the functionality and real-world impact of the AI-enhanced chatbot for older adults. Integrating the chatbot with Electronic Health Records (EHR) would enable personalized health guidance, real-time medical updates, and seamless communication with healthcare professionals. Expanding multi-language and dialect support would make the system more inclusive and accessible to diverse populations. Incorporating advanced emotion recognition through voice tone and facial expression analysis would allow the chatbot to respond more empathetically to users' emotional states. Leveraging more powerful AI and machine learning models, such as transformer-based NLP and improved speech recognition systems, would enhance understanding accuracy and response quality. Integration with wearable health devices would support real-time monitoring of vital signs and enable automatic alerts and health recommendations. In addition, large-scale

and long-term usability testing across diverse demographics would provide valuable insights into user engagement, effectiveness, and areas for improvement, while developing offline functionality for core features would ensure accessibility even in regions with limited or no internet connectivity.

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