IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 4, April 2026

DOI: 10.17148/IJARCCE.2026.154314

AI-Based Mental Health Chatbot using LangChain and LangGraph

Sachin saini[1], Yashika Rathi[2],Yash Kumar[3],Shweta Rani[4],Dr Brijesh kr. Gupta[5]

Student, MCA, Department of Master of Computer Applications,

Meerut Institute of Engineering and Technology (MIET), Meerut, Uttar Pradesh, India[1]

Student, MCA, Department of Master of Computer Applications,

Meerut Institute of Engineering and Technology (MIET), Meerut, Uttar Pradesh, India[2]

Student, MCA, Department of Master of Computer Applications,

Meerut Institute of Engineering and Technology (MIET), Meerut, Uttar Pradesh, India[3]

Student, MCA, Department of Master of Computer Applications,

Meerut Institute of Engineering and Technology (MIET), Meerut, Uttar Pradesh, India[4]

Professor, Department of Master of Computer Applications,

Meerut Institute of Engineering and Technology (MIET), Meerut, Uttar Pradesh, India[5]

Abstract: Mental health disorders such as depression, anxiety, and stress are increasing at an alarming rate worldwide, while access to professional mental healthcare remains limited due to cost, stigma, and resource constraints. Artificial Intelligence (AI)-based mental health chatbots have emerged as scalable and accessible solutions to address this gap. This paper presents a comprehensive study and proposed architecture for an AI-based mental health chatbot using LangChain and LangGraph frameworks. LangChain enables modular, context-aware conversational capabilities with memory and knowledge integration, while LangGraph introduces multi-agent workflows, state management, and human-in-the-loop control for improved safety and decision-making. The proposed system integrates Natural Language Processing (NLP), Cognitive Behavioral Therapy (CBT), sentiment analysis, and Retrieval-Augmented Generation (RAG) to deliver personalized and context-aware responses. The paper also reviews existing literature, discusses system architecture, methodology, evaluation techniques, and highlights challenges such as ethical concerns and safety risks. The results from existing studies demonstrate that AI chatbots significantly improve mental well-being, although further clinical validation is required.

I. INTRODUCTION

Mental health has emerged as one of the most critical aspects of human well-being in the modern world, significantly influencing an individual's emotional, psychological, and social stability. With the rapid pace of technological advancement, urbanization, and increasing socio-economic pressures, the prevalence of mental health disorders such as anxiety, depression, stress, and burnout has risen dramatically. According to global health organizations, mental health conditions are among the leading causes of disability worldwide, affecting people across all age groups, cultures, and professions. Despite this growing concern, access to mental health care remains limited due to various barriers, including high treatment costs, social stigma, shortage of trained professionals, and lack of awareness. . [1] This deployment variant robustly leverages on the chaining framework provided by LangChain to enable chaining of prompt templates, utilizes the LLM model that uses the Llama3 language model, and fully exploits other NLP methods.Artificial Intelligence (AI) has shown immense potential in transforming healthcare systems by providing automated, intelligent, and scalable solutions. [2]Therefore, the rule-based system is migrated to a generative model that integrates both algorithms of machine learning for effective enhancement of both understanding and generating In particular, AI-based chatbots have gained attention for their ability to simulate human-like conversations and provide emotional support.[4] AI-powered chatbots are an emerging intervention option that offers available, accessible, and confidential services. The study below describes the development of an AI chatbot to support people in distress. Recent advancements in Large Language Models (LLMs) have significantly improved chatbot performance. [5] Mental health

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support dataset was sourced from Kaggle and preprocessed it using tokenization, text cleaning, and named entity recognition, generating feature vectors that represent the contextual relevance of phrases.Frameworks such as LangChain and LangGraph further enhance these capabilities by enabling modular design, memory integration, and multi-agent decision-making systems through graph-based architectures. Traditional mental health counselling systems primarily rely on face-to-face interactions between patients and licensed therapists. While effective, these approaches are often constrained by time, location, and availability. In many regions, particularly in developing countries, the ratio of mental health professionals to patients is critically low, making it difficult for individuals to receive timely support. Furthermore, many individuals hesitate to seek help due to fear of judgment or lack of privacy, resulting in untreated conditions that may worsen over time.In recent years, Artificial Intelligence (AI) has emerged as a transformative technology capable of addressing complex real-world challenges, including those in healthcare. The integration of AI into mental health care has opened new avenues for providing scalable, accessible, and cost-effective solutions. AI-powered systems can simulate human-like conversations, analyze emotional patterns, and provide personalized responses, thereby acting as virtual counsellors. These systems leverage advancements in Natural Language Processing (NLP), machine learning, and deep learning to understand user inputs and generate context-aware responses.Modern conversational AI frameworks such as LangChain and LangGraph have significantly enhanced the development of intelligent chatbot systems. These frameworks enable developers to design complex workflows, manage conversational memory, and integrate large language models (LLMs) for generating human-like interactions. By combining these technologies, AI-based mental health counselling systems can provide continuous support, track user emotions over time, and offer tailored coping strategies.The proposed AI-Based Mental Health Counselling and Management System aims to bridge the gap between the growing demand for mental health services and the limited availability of traditional resources. The system is designed to interact with users through a conversational interface, analyze their emotional state using sentiment analysis techniques, and provide empathetic and supportive responses. Additionally, the system can recommend relaxation techniques, mental wellness exercises, and professional help when necessary.One of the key advantages of AI-driven mental health systems is their ability to provide 24/7 support without geographical constraints. Users can access the system at any time, ensuring immediate assistance during moments of distress. Moreover, the anonymity offered by such systems encourages individuals to express their thoughts and feelings more openly, reducing the impact of social stigma. The scalability of AI solutions also allows them to serve a large number of users simultaneously, making them highly suitable for widespread deployment.However, the integration of AI in mental health care also raises important ethical and technical challenges. Ensuring data privacy, maintaining user confidentiality, and preventing harmful or inappropriate responses are critical concerns that must be addressed. Additionally, while AI systems can assist in providing support, they cannot fully replace human therapists, particularly in severe or complex cases requiring professional intervention. Therefore, AI-based systems should be viewed as complementary tools that enhance, rather than replace, traditional mental health services.This research focuses on the design and implementation of an AI-based mental health counselling system that utilizes advanced NLP techniques and conversational AI frameworks to deliver effective and empathetic user interactions. The study explores system architecture, emotion detection mechanisms, response generation strategies, and practical implementation using modern AI tools. The objective is to create a reliable, efficient, and user-friendly platform that can contribute to improving mental health support accessibility and quality.

II. LITERATURE REVIEW

AI-based mental health chatbots have evolved significantly over the years. Early systems were rule-based and relied on predefined scripts, limiting their ability to handle complex conversations. With the introduction of machine learning, chatbots became capable of performing sentiment analysis and classification tasks.

Recent studies indicate that AI chatbots can significantly reduce symptoms of depression and anxiety. For instance, conversational agents based on Cognitive Behavioral Therapy (CBT) have demonstrated effectiveness in improving users' mental well-being.

LangChain has been widely adopted for building AI applications due to its modular architecture and support for Retrieval-Augmented Generation (RAG) as shown in table 1. It allows chatbots to access external knowledge bases, improving response accuracy.

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Study / Approach	Technique Used	Key Limitation
Li et al. (2023)	Rule-based + Machine Learning	Limited personalization and flexibility
Zhang et al. (2025)	Generative AI Chatbots (LLM-based)	Safety and ethical concerns
Nyakhar& Wang (2025)	Student-focused AI chatbot	Limited scalability
Feng et al. (2025)	AI for mental distress support	Lack of contextual understanding
CBT-based Systems	Cognitive Behavioral Therapy (CBT) Techniques	Requires structured input; limited adaptability to diverse users
RAG-based Systems	Retrieval-Augmented Generation (RAG)	Depends heavily on quality of knowledge base; latency issues
NLP-based Systems	Natural Language Processing (NLP)	Struggles with deep emotional context and ambiguity
LLM-based Systems	Large Language Models (LLMs)	Risk of hallucination and bias
LangChain-based Systems	LangChain Framework for AI pipelines	Complexity in chain design and debugging
LangGraph-based Systems	LangGraph for multi-agent workflows	Requires careful state management and orchestration
Proposed Work	LangChain + LangGraph + RAG + LLM + CBT Integration	Improved safety, context-awareness, scalability, and multi-agent coordination

Comparison table.1

III. PROPOSED SYSTEM ARCHITECTURE

A. System Overview

The proposed system integrates LangChain and LangGraph to develop a scalable and intelligent mental health chatbot capable of providing personalized support.

System Components

1.1 User Interface

The User Interface (UI) provides an interactive platform for users to communicate with the system. It can be implemented as a web or mobile application with features such as chat windows, voice input, and dashboards. The UI ensures a user-friendly experience and supports real-time interaction between the user and the AI system.

1.2 NLP Module

The Natural Language Processing (NLP) module processes user inputs in textual or voice form. It performs tasks such as:

1. Tokenization and text preprocessing.
2. Intent recognition.
3. Sentiment and emotion detection.
4. This module enables the system to understand user concerns and emotional states accurately.

1.3 LangChain Module

The LangChain module is responsible for managing interactions with large language models. Its key functionalities include:

1. Prompt chaining for structured conversations
2. Memory management to retain context across sessions
3. Retrieval-Augmented Generation (RAG) for accessing external knowledge
4. This ensures coherent, context-aware, and informative responses.

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1.4 LangGraph Engine

The LangGraph engine manages multi-agent workflows within the system. It allows:

1. Coordination between different AI agents
2. State-based conversation flow control
3. Decision-making based on user input and system context
4. This component enhances modularity and scalability of the chatbot system.

1.5 Knowledge Base

The Knowledge Base stores domain-specific information, including:

1. Cognitive Behavioral Therapy (CBT) techniques
2. Mental health coping strategies
3. Frequently asked questions and guidance resources
4. It supports the RAG mechanism to provide accurate and evidence-based responses.

1.6 Safety Module

The Safety Module ensures ethical and secure operation of the system as shown in figure.1:

1. Detecting crisis situations (e.g., self-harm or suicidal intent)
2. Triggering alerts or escalation protocols
3. Providing emergency resources and helpline suggestions
4. This module is critical for user safety and responsible AI deployment.

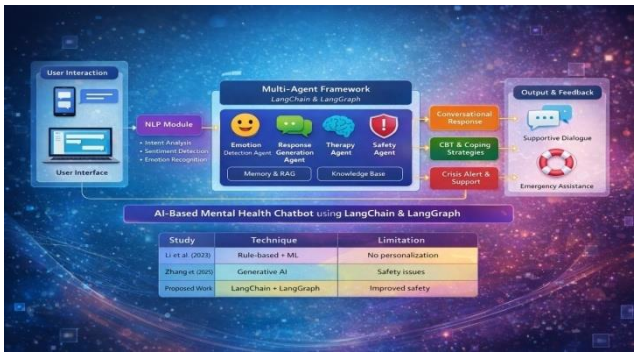

Figure.1

B. Intelligent Agent Modules

2.1 Emotion Detection Agent

The Emotion Detection Agent is responsible for identifying the emotional state of the user based on their input (text or speech). It uses Natural Language Processing (NLP) and machine learning techniques to analyze patterns in language.

Key Functions:

1. Detects emotions such as sadness, anxiety, stress, anger, or happiness
2. Performs sentiment analysis (positive, negative, neutral)
3. Identifies emotional intensity (mild, moderate, severe)

Techniques Used:

1. Pre-trained transformer models (e.g., BERT-based classifiers)
2. Keyword and context-based emotion recognition
3. Sentiment analysis algorithms

Importance:

This agent helps the system understand the user's mental state, enabling personalized and empathetic responses.

2.2 Response Generation Agent

The Response Generation Agent creates meaningful, context-aware replies to the user. It ensures that conversations feel natural, supportive, and human-like.

Key Functions:

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1. Generates conversational responses based on user input
2. Maintains context using memory (via LangChain)
3. Adapts tone based on detected emotions

Techniques Used:

1. Large Language Models (LLMs)
2. Prompt engineering and chaining
3. Context memory handling

Importance:

This agent is the core communication layer, ensuring smooth and engaging interaction between the user and the system.

2.3 Therapy Agent

The Therapy Agent provides mental health support by suggesting evidence-based therapeutic techniques, especially Cognitive Behavioral Therapy (CBT) methods.

Key Functions:

1. Suggests coping strategies (e.g., breathing exercises, journaling)
2. Guides users through CBT techniques
3. Recommends activities to improve mental well-being

Examples of Interventions:

1. Thought reframing (changing negative thinking patterns)
2. Relaxation and mindfulness exercises
3. Behavioral activation (encouraging positive actions)

Techniques Used:

1. Retrieval-Augmented Generation (RAG) from a knowledge base
2. Rule-based + AI-assisted therapy suggestions

Importance:

This agent transforms the chatbot from a simple conversational system into a supportive mental health assistant.

2.4 Safety Agent

The Safety Agent ensures user protection by continuously monitoring for high-risk situations such as self-harm or suicidal thoughts.

Key Functions:

1. Detects crisis-related keywords and emotional patterns
2. Assesses risk levels (low, medium, high)
3. Triggers alerts or escalation protocols

Actions in Critical Situations:

1. Provides emergency helpline information
2. Suggests contacting trusted individuals
3. Escalates to human support (if integrated)

Techniques Used:

1. Keyword detection and classification models
2. Risk scoring algorithms
3. Rule-based safety checks

Importance:

This agent is crucial for ethical AI deployment and ensures that the system responds responsibly in sensitive situations as shown in figure 2.

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Figure.2

IV. METHODOLOGY

These are some methods used Data Collection, Mental health datasets (e.g., depression, anxiety text datasets) ,CBT-based therapy guidelines, Public conversational datasets.

4.2 Model Development

1. Use LLM (e.g., GPT-based model)
2. Integrate with LangChain for:
3. Memory
4. Prompt templates
5. RAG

4.3 LangGraph Implementation

1. Define nodes (agents)
2. Create graph-based workflow
3. Enable state persistence
4. Add human-in-the-loop checkpoints

4.4 Techniques Used

1. Natural Language Processing (NLP)
2. Sentiment Analysis
3. Cognitive Behavioral Therapy (CBT)
4. Retrieval-Augmented Generation (RAG)

V. RESULTS AND DISCUSSION

Previous studies show:

1. Moderate to high reduction in depression symptoms
2. Improved user engagement and satisfaction
3. Better results with personalized chatbot systems
4. The integration of LangGraph improves:
5. Decision-making accuracy
6. Safety through multi-agent validation
7. Long-term interaction via state tracking
8. However, challenges such as hallucination, ethical concerns, and lack of real-world validation persis

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VI. CHALLENGES AND LIMITATIONS

1. Data Privacy Concerns: The system handles sensitive user data, raising risks related to data security, confidentiality, and potential misuse if not properly protected.

2. Ethical Issues: AI-based mental health systems must ensure fairness, transparency, and avoid bias, while respecting user autonomy and emotional well-being.

3. Risk of Incorrect Advice: The system may sometimes generate inaccurate or inappropriate responses, which could negatively impact the user if not carefully monitored.

4. High Computational Cost: Running advanced AI models and multi-agent systems requires significant computational resources, increasing operational costs.

5. Limited Handling of Severe Cases: The system is not a substitute for professional therapists and may not effectively handle critical or complex mental health conditions.

VII. FUTURE WORK

1. Integration with Wearable Health Devices: Future systems can connect with wearable devices to monitor real-time physiological data like heart rate and sleep patterns, enabling more accurate mental health assessment.

2. Multilingual and Culturally Adaptive Chatbots: Enhancing the chatbot to support multiple languages and cultural contexts will improve accessibility and provide more personalized and relevant interactions for diverse users.

3. Improved Safety using Advanced AI Alignment Techniques: Incorporating advanced AI alignment methods will ensure the system behaves ethically, reduces harmful responses, and improves reliability in sensitive situations.

4. Clinical Trials for Validation: Conducting clinical trials will help evaluate the system's effectiveness, accuracy, and safety, ensuring it meets healthcare standards and builds user trust.

VIII. CONCLUSION

Early research in AI-based mental health systems primarily focused on **rule-based chatbots** and **classical machine learning models**, which provided structured yet limited interactions. While these systems contributed significantly to the initial development of digital mental health support, they were constrained by **lack of contextual understanding, minimal personalization, and rigid conversational flows**. Subsequent advancements introduced **natural language processing (NLP)** techniques and early intelligent agents, improving response generation but still falling short in handling complex emotional dynamics and long-term user engagement.

The proposed AI-based mental health counselling and management system builds upon these foundational studies by integrating advanced frameworks such as **LangChain** and **LangGraph**, thereby addressing key limitations identified in earlier research. LangChain enhances conversational intelligence through **context retention, prompt orchestration, and memory-driven interactions**, enabling more human-like and adaptive communication. In parallel, LangGraph introduces a **graph-based multi-agent workflow architecture**, allowing dynamic decision-making, conditional branching, and iterative reasoningcapabilities that were largely absent in traditional systems.

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