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Department of CSE (Data Science)

UG –Project/Mini-Project

Project Review -1

MENTAL HEALTH-CARE CHATBOT

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Introduction

The rapid growth of artificial intelligence (AI) in recent years has paved the way for innovative solutions in various domains, including healthcare. One of the most impactful applications is the development of AI-driven mental healthcare chatbots. These chatbots aim to provide mental health support, counseling, and therapy while overcoming the limitations of traditional mental healthcare systems.

The increasing prevalence of mental health issues worldwide, combined with the shortage of mental health professionals, has led to a growing demand for accessible and affordable mental health services. AI mental healthcare chatbots can bridge this gap by offering 24/7 support, personalized responses, and data-driven insights to enhance mental well-being.

LITERATURE SURVEY

Ref. No.	Author, Publication [Year]	Title of the paper	Contribution	Inferences
1	Harini V K; Bhavadharini R M; Charvi Upreti; Libin Alex	Mental Health Chatbot	chatbot using a retrieval-based approach with text data. The maximum accuracy of 91.48% was achieved in the LSTM model.	This chatbot will serve as a valuable tool for individuals seeking support and information regarding mental health issues
2	L. Athota, V. K. Shukla, N. Pandey and A. Rana	Chatbot for Mental health support using NLP	AI-based chatbot for disease diagnosis using n-gram, and similarity.	Improves healthcare access and reduces costs.
3	Adithi K V Abhigna G Harusha R	Health Care Bot	enhance patient support, medical education, and professional performance.	Improves healthcare efficiency and patient decision-making.

Challenges & Motivation

Challenges

- Developing emotionally intelligent responses that accurately detect users' emotions and states.
- Addressing cultural and linguistic diversity to cater to a global audience.
- Integrating evidence-based therapeutic techniques in chatbot responses.
- Mitigating the risk of chatbot misuse or the potential for harmful responses.

Motivation:

1. To provide instant, round-the-clock mental health support to users globally.
2. To reduce the stigma around seeking mental health care by offering anonymous assistance.
3. To make mental health support more accessible and affordable.
4. To incorporate therapeutic techniques that aid in the well-being of users.

Objectives

- To develop an AI chatbot that offers real-time mental health support through natural language processing and machine learning techniques.
- To ensure that the chatbot can detect emotions and respond empathetically to users.
- To integrate established therapeutic approaches like CBT and DBT (Dialectical Behavioral Therapy).
- To evaluate the chatbot's effectiveness through user feedback and clinical testing.

Proposed Methodology

1. Document Loading
Mental health-related documents (PDFs, NIMH datasets) are loaded and split into manageable text chunks.

2. Embedding Generation
Each text chunk is converted into a vector (embedding) using HuggingFace models (e.g., all-MiniLM-L6-v2 or BAAI/bge-small-en-v1.5).

3. Clustering
Embeddings are clustered using UMAP for dimensionality reduction and Gaussian Mixture Models (GMM) for grouping similar content.

4. Summarization
Each cluster of text is summarized using a Large Language Model (LLM) such as Groq (Llama3) or Azure OpenAI (GPT).

5. Vector Store Creation
All text chunks and their summaries are stored in a FAISS vector database for fast similarity search and retrieval.

6. User Query Processing
When a user asks a question, the system:
Converts the query into an embedding.
Searches the FAISS database for relevant document chunks and summaries.
Uses LangChain's retrieval and conversational chains to generate a response using the LLM.

Hardware/Software/Frameworks

- Hardware: Servers with high processing power (GPUs for deep learning models).
- PDF loading: langchain_community loaders (PyPDFLoader, DirectoryLoader)
- Software:
  - Python (for NLP and model training)
  - FAISS (for deep learning models)
  - scikit-learn GaussianMixture (clustering)
- Frameworks:
  - Natural Language Toolkit (NLTK)
  - UMAP(for text processing)
  - Hugging Face Transformers (for pre-trained models)

Applications

- Outcomes:
  - An AI-powered chatbot capable of delivering real-time mental health support.
  - Improved user mental well-being through personalized conversations.
- Applications:
  - Therapy assistance for mental health professionals.
  - Personal mental health companion for individuals.
  - Crisis intervention and support for those experiencing emotional distress.

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References

1. H. V K, B. R M, C. Upreti and L. Alex, "Mental Health Chatbot," 2024 IEEE Students Conference on Engineering and Systems (SCES), Prayagraj, India, 2024, pp. 1-6, doi: 10.1109/SCES61914.2024.10652390. keywords: {Training;Accuracy;Mental health;Medical services;Chatbots;Transformers;Data models;Long short term memory;Research and development;chatbot;closed domain;mental health;task oriented model;bag-of-words;word2vec;RoBERTa},

2. V. Gupta, V. Joshi, A. Jain and I. Garg, "Chatbot for Mental health support using NLP," 2023 4th International Conference for Emerging Technology (INCET), Belgaum, India, 2023, pp. 1-6, doi: 10.1109/INCET57972.2023.10170573. keywords: {Deep learning;Sentiment analysis;Anxiety disorders;Mental health;Chatbots;Depression;Natural language processing;Chatbots;Mental Healthcare;Conversational Agents;Psychotherapy},

3. V. Dhanasekar, Y. Preethi, V. S, P. J. I. R and B. P. M, "A Chatbot to promote Students Mental Health through Emotion Recognition," 2021 Third International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2021, pp. 1412-1416, doi: 10.1109/ICIRCA51532.2021.9544838. keywords: {Emotion recognition;Social networking (online);Pandemics;Memory;Mental health;Chatbots;Internet;Text-based Emotion Recognition;DialogFlow;Rule-based Grammar Matching;Natural Language Processing;Intent Processing;Entity Extraction;Artificial Intelligence;Flutter;Google Cloud Platform;Python;Web Scraping},

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