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PSY-VOICE: AI-ML Powered Mental Health Care, Secured by Block chain

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Abstract - *The Psy Voice system integrates Artificial Intelligence (AI), Machine Learning (ML), and Block chain technologies to provide a secure and intelligent mental healthcare platform. Traditional mental health assessments rely on manual evaluations, often lacking real-time accuracy and scalability. Psy Voice introduces a voice-enabled AI chat bot that leverages Retrieval-Augmented Generation (RAG) and Seq2Seq models to analyze emotions from user interactions. Block chain ensures privacy and immutability of mental health records. The system also includes sentiment analysis, community engagement, therapist dashboards, and journalism tools for analyzing public sentiment on mental health. Results demonstrate improved accuracy in emotion detection, secure data management, and enhanced user engagement, suggesting that Psy Voice can transform the future of digital mental healthcare.*

Key Words: **Block chain , AI-ML , Healthcare , Therapy , Digital , LLM**

1. INTRODUCTION

Mental health plays a vital role in determining an individual's overall well-being, productivity, and quality of life. However, despite growing awareness, mental health disorders remain one of the most underdiagnosed and undertreated issues globally. Traditional methods of therapy and diagnosis largely depend on manual evaluation by therapists, which can be subjective, time-consuming, and inaccessible to individuals in remote or resource-limited areas. The absence of real-time monitoring and emotional support between therapy sessions often leads to delayed interventions and reduced treatment effectiveness. These challenges have created a pressing need for technology-driven systems that can provide continuous, personalized, and secure mental health assistance.

Recent advancements in Artificial Intelligence (AI) and Machine Learning (ML) have significantly transformed digital mental healthcare. By employing Natural Language Processing (NLP), AI-powered systems can interpret user emotions, detect sentiment patterns, and provide empathetic conversational responses. Chatbots and virtual assistants are now capable of simulating human-like dialogue to support users experiencing stress, anxiety, or depression. Models such as Retrieval-Augmented Generation (RAG) and Seq2Seq have enhanced the contextual understanding and generative accuracy of AI systems, allowing them to deliver meaningful and emotionally aware interactions in real time. These innovations have laid the groundwork for intelligent systems that can complement human therapists by providing round-the-clock emotional assistance.

However, the digitization of psychological data raises serious concerns about privacy, security, and ethics. Since mental health records are highly sensitive, they risk misuse or unauthorized access. Blockchain technology addresses these issues by providing a decentralized, tamper-proof system that ensures transparency, authenticity, and user control. Through smart contracts and distributed ledgers, patients can securely share emotional data only with verified professionals, creating a trustworthy AI-powered digital mental health ecosystem.

The proposed project, PsyVoice, integrates these cutting-edge technologies to deliver an AI-ML powered mental health care platform secured by blockchain. It features a voice-enabled AI chatbot that conducts real-time emotional conversations with users, providing personalized feedback and support. The system also includes sentiment analysis tools, daily journaling, therapist dashboards, and a community support chat to promote holistic well-being. Additionally, blockchain ensures the integrity and privacy of all medical records, while decentralized storage through IPFS safeguards user data from central authority control.

In essence, PsyVoice aims to bridge the gap between emotional intelligence and technological innovation. By combining AI-based emotion recognition, ML-driven analytics, and blockchain-enabled security, it offers a comprehensive approach to modern mental health care. The system not only enhances accessibility and user trust but also contributes to the broader goal of building a secure, scalable, and empathetic digital mental health platform for individuals, therapists, and researchers alike

2. LITERATURE SURVEY

The integration of AI-powered chatbots into mental health care has revolutionized emotional support and therapeutic interventions. These digital agents offer

scalable, accessible, and personalized care through natural language processing and intelligent dialogue systems. Recent advancements in AI, machine learning, and block chain enhance their reliability and user trust. This literature review explores key developments, evaluation methods, and challenges in deploying chat bots for mental health support.

2.1 AI Chat bots for Emotional Regulations

Conversational agents, or chat bots, have emerged as significant tools in digital mental healthcare, particularly in regulating emotions and managing thought processes through cognitive behavioral therapy (CBT)-based interventions. A prominent example is SERMO, evaluated by K. Denecke, S. Vaaheesan, and A. Arulnathan, which was specifically designed to assist users in emotional self-regulation. The study highlighted that while the overall enjoyment score was neutral, users found the system efficient, user-friendly, and intuitive. These findings underscore the potential of such digital agents to complement human therapists by providing timely emotional support, especially in regions with limited access to mental health professionals.

2.2 AI-ML and Block chain Integration in Mental Health

A growing number of mental health solutions are now integrating AI, ML, and block chain technologies to deliver holistic, secure, and personalized care. In the 2024 study by Gujarathi et 5 al., the platform Neuro Safe utilized BERT (Bidirectional Encoder Representations fromTransformers) for accurate emotion recognition from user-generated text. This level of insight promotes emotional awareness and allows for more tailored therapeutic responses. Block chain technology, in parallel, was employed to safeguard patient privacy, data transparency, and ownership—crucial in sensitive healthcare environments. Furthermore, generative AI models such as LSTM (Long Short-Term Memory) and Seq2Seq (Sequence-to-Sequence) architectures enhanced the system's capacity to simulate empathetic, real-time dialogue.

2.3 Evaluation Metrics for Healthcare Chat bots

The effectiveness of mental health chat bots depends largely on how they are assessed. review by Abd-alrazaq et al. (2020) identified 27 key technical metrics for chat bot evaluation. These included dimensions such as usability, response relevance, dialogue coherence, user engagement, and visual appeal. The study emphasized the lack of standardized evaluation frameworks across various implementations, which poses a challenge to consistent performance benchmarking. As mental health bots are deployed in more clinical and personal settings, it becomes essential to develop universal metrics tailored to therapeutic contexts. Establishing such standards would ensure the reliability, safety, and long-term effectiveness of chat bot-based mental health interventions.

2.4 Opportunities and Challenges of AI Chat bots in Mental Health

AI-powered chat bots bring both exciting possibilities and critical challenges to the field of mental health. On the positive side, they offer scalable services for psychoeducation, early detection, and routine monitoring, supporting users in maintaining emotional well-being and following therapeutic recommendations. According to research by Denecke, Abd-alrazaq, andHouseh(2021), these tools also help reduce stigma by offering anonymous interaction. However, challenges such as data privacy, misinformation, lack of contextual understanding, and the risk of emotional dependency are significant concerns.

2.5 Conversational Agents in Health Care

A systematic review by Laranjo et al. (2018) explored the use of healthcare chatbots that can process unconstrained natural language input. The majority of these systems employed finitestate or frame-based dialogue management, enabling structured yet flexible interactions for activities such as self-care guidance and emotional check-ins. Notably, one randomized controlled trial in the review revealed that chatbot use led to a measurable reduction in symptoms of depression, 6 showcasing the clinical relevance of such technologies. However, the authors stressed the need for more robust experimental methodologies.

2.6 Literature Summary

Table -1: Literature Summary

SN	Paper	Advantages and Disadvantages
1.	K. Denecke, S. Vaaheesan, & A. Arulnathan [1]	Advantages: SERMO chatbot aids emotion regulation using cognitive behavioural therapy. Found efficient and easy to use. Disadvantages: Fun of use rated neutral, indicating limited engagement.
2.	Gujarathi, P., Menon, K., Patel, J., & Halbe, A. [2]	Advantages: BERT-based emotion analysis improves self-awareness. Blockchain ensures secure records. Disadvantages: Complexity in implementation and integration with existing

		services..
3.	Abd-alrazaq AA, Safi Z, Alajlani M, Warren J, Househ M, Denecke K [3]	Advantages: Identifies 27 metrics for chatbot evaluation, improving standardization. Disadvantages: Lack of uniform evaluation framework limits chatbot advancement.
4.	Denecke, Kerstin & Abd-alrazaq, Alaa & Househ, Mowafa [4]	Advantages: AI chatbots enhance psychoeducation and mental health support. Disadvantage: Ethical concerns, bias, and trust issues remain challenges.
5.	Laranjo L, Dunn AG, Tong HL et al. [5]	Advantages: Conversational agents assist self- care and reduce depression symptoms. Disadvantages: Few controlled trials, need for better experimental designs.

3. PROPOSED METHODOLOGY

3.1 Overview

The System Overview is presented in this section. The Classification of various techniques and domains is given in figure 3.1 “Psy Voice” which appears to be an AI-powered voice enabled mental health platform for mental health or emotional well-being. The System consist of following components

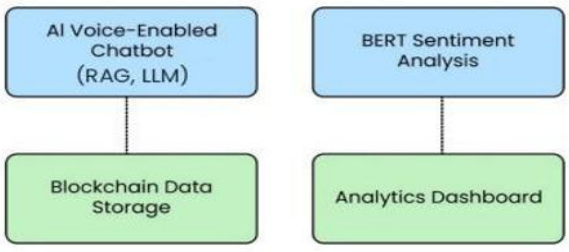

Fig - 3.1 Overview of Project

3.1.1 Recursive RAG Pipeline

This is the core conversational system, integrating Recursive Retrieval-Augmented Generation (RAG) logic to deliver context-aware responses. It utilizes the Groq API, which enables high-speed, low-latency inferencing essential for real-time conversational AI. The RAG structure efficiently retrieves highly relevant information from the knowledge base, ensuring accuracy, contextual understanding, and reliability in the mental health assistance provided.

3.1.2 NLP & ML Emotional Analysis

The system uses Natural Language Processing (NLP) to process user text and detect emotional patterns, ensuring accurate context comprehension. It employs Machine Learning (ML) techniques such as UMAP and GMM clustering on embeddings (e.g., BAAI/bge-small-en-v1.5) to structure the knowledge base and enable real-time emotional analysis. This deep analytical approach powers the Lang Chain conversational retrieval logic, resulting in more empathetic and highly personalized user interactions.

3.1.3 Block chain Data Storage

The system ensures secure, tamper-proof storage of mental health records using block chain technology, providing the data integrity and security essential for clinical applications. It also protects user privacy by allowing controlled and auditable access for healthcare providers, meeting the standards required for handling sensitive Electronic Health Records (EHR).

3.1.4 Analytics Dashboard

The system collects and presents insights from conversational flows, including rich contextual details, real-time sentiment trends, and engagement metrics. It provides valuable analysis for mental health professionals, researchers, and administrators to monitor system performance and evaluate the effectiveness of conversational retrieval.

3.2 Proposed System Architecture

To overcome the limitations observed in the existing mental health support systems and to ensure more reliable, interactive, and intelligent user experiences, a hybrid architecture has been proposed. This architecture integrates AI, NLP, emotion detection, block chain security, and therapist interaction layers to create a comprehensive mental health monitoring and recommendation system. The design seeks to incorporate the advantages of multiple technologies while mitigating individual shortcomings. Depending on user needs and the domain complexity, the system modules collaborate dynamically to deliver real-time, secure, and adaptive mental health support.

3.2.1 User Interaction and Access

The system begins with a robust Login and Signup mechanism, ensuring that only authenticated users gain

access. User privacy is a key pillar, with end-to-end encryption and fine-grained access to safeguard sensitive mental health data. This layer establishes a secure environment for users to engage with the platform without fear of breaches or misuse of personal data.

3.2.2 AI Powered Chat bot & Interactive

An AI-powered chat bot serves as the primary interface for user interaction. Users can communicate via text or voice, and the embedded Recursive RAG Pipeline engine processes conversations to detect emotional cues, contextual concerns, and mental health triggers. The core functionality is powered by the Groq API for ultra-low-latency inferencing, ensuring real-time response generation. The conversational flow is managed by Lang Chain logic, which orchestrates the retrieval process.

3.2.3 Daily Journals

The system supports personal journaling, enabling users to document their thoughts, emotions, and experiences regularly. In addition, community forums offer a space for peer-to-peer support, where individuals can share stories, advice, and encouragement. These social engagement features help reduce isolation and promote a sense of belonging among users facing mental health challenges.

3.2.4 Emotional and Mental Health Analysis

AI algorithms are employed to perform emotion and mental health detection by analyzing journal entries, chatbot conversations, user interactions, and objective assessment data. These insights help the system recognize behavioral patterns and detect potential red flags. The analysis utilizes 11 advanced ML techniques (UMAP, GMM clustering, and BAAI/bge-small-en-v1.5 embeddings)to efficiently structure the knowledge base and conduct real-time emotional analysis. Through trend analysis and long-term tracking, users and professionals gain valuable perspectives on the evolution of an individual's mental health.

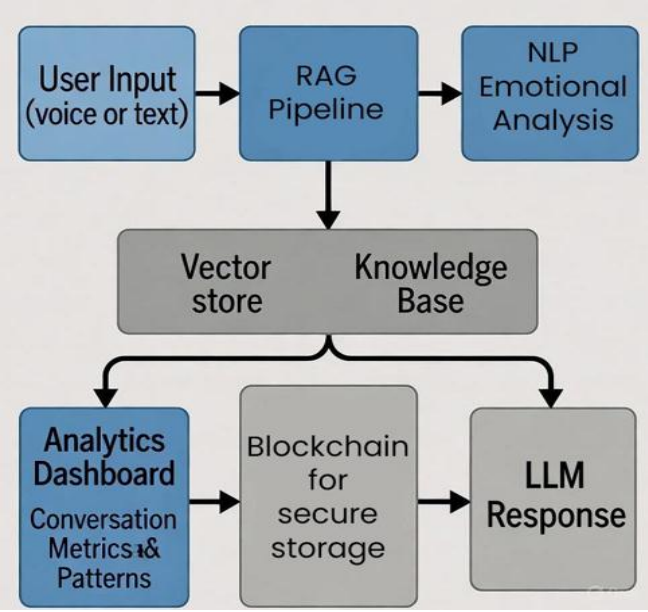

Fig - 3.2 Analysis pipeline

3.2.5 Secure Data Storage with Block chain

To enhance data security, the system integrates block chain technology for storing sensitive emotional and interaction data. All emotional records and session logs are encrypted and logged in tamper-proof distributed ledgers, ensuring that unauthorized changes are impossible. This promotes transparency, accountability, and user trust in the system, serving as a secure Electronic Health Record (EHR) layer.

3.2.6 Mental Health Assessment

Implements features for user self-assessment, including validated questionnaires (e.g., PHQ-9, GAD-7) to analyze stress, depression, and anxiety levels. The results provide objective data on the user's current mental state, which is fed back into the Recursive RAG Pipeline and the Therapist Support Portal to enhance personalized care and track treatment effectiveness

3.2.7 Implement Guided Breathing Practices

Integrates an interactive feature where users can practice various guided breathing techniques (e.g., 12 box breathing, 4-7-8 method, diaphragmatic breathing). This feature is used for meditation, immediate stress reduction, and training in emotional self-regulation, directly leveragingtheconnection between controlled breathing and the parasympathetic nervous system.

4. IMPLEMENTATION AND RESULTS

4.1 Technologies

To bring the proposed mental health monitoring system to life, a robust technology stack has been employed. The architecture combines modern frontend frameworks, secure backend services, intelligent AI models, and decentralized data storage. Each component is carefully selected to ensure scalability, responsiveness, and data privacy.

4.1.1 Frontend and Backend

Framework and Styling: The system is built using the Next.js framework with Tailwind CSS for styling. It features a responsive web dashboard and an intuitive user interface designed for ease of use. Additionally, it includes secure patient and therapist portals, along with real-time emotion tracking for seamless and secure mental health interaction.

4.1.2 Database

The primary database used is IPFS (Inter Planetary File System), ensuring decentralized and secure data handling. Data management includes encrypted patient records, secure session management, and decentralized storage options to enhance privacy, reliability, and data integrity across the system.

4.1.3 AI-Ml

The system integrates Recursive RAG, a framework that enables multi-step retrieval and reasoning for handling complex, deep-context queries. It utilizes Groq LPU, specialized hardware designed for low-latency large language model (LLM) inference, ensuring fast and efficient responses. Additionally, UMAP and GMM clustering algorithms are employed to organize the knowledge base's semantic embeddings for superior structure and performance.

4.1.4 Hardware and Software Specifications

Hardware: The system requires an Intel Core i5/i7 processor (3.0 GHz or higher), with a minimum of 8 GB RAM and 256 GB SSD storage to ensure smooth operation. A high-speed internet connection is essential for real-time data processing and communication between components. Software: The system runs on Windows 10/11 and is developed using Python (for Tensor Flow and PyTorch) and JavaScript (for Next.js). The IPFS database is used for decentralized storage, while Groq LPU, Lang Chain, and BAAI/bge-small-en-v1.5 embedding's power the AI/ML components. UMAP and GMM clustering are applied for NLP-based semantic analysis. The chat bot is built on the Recursive Retrieval-Augmented Generation (RAG) architecture, with Ethereum block chain and smart contracts ensuring secure data transactions. JWT-based authentication safeguards user access and Next.js serves as the backend API framework.

4.1.5 Sample Dataset Used

To train and evaluate the system effectively, diverse and well-established datasets were utilized. These datasets span various modalities such as text, speech, and conversational data to cover a wide range of emotional expressions.

Table 4.1 : summarizes the key datasets adopted for experimentation and model development.

Dataset	Users	Items	Interaction	Type
GoEmotions	58,000+	27 emotions	411,000 + labels	Emotion Classification
Sentiment140	1,600,000	Tweets	1,600,000 labels	Twitter Sentiment Analysis
Daily Dialog	13,118	Conversations	102,979 utterances	Chatbot/ Dialog System
IEMOCAP	10 speakers	12 hours speech	10,000+ emotion labels	Speech-based Sentiment Analysis

4.1.6 Performance Evaluation Parameters

To assess the effectiveness and reliability of the proposed system, several performance parameters were considered across different modules:

i. Emotion Analysis

The system's emotion analysis evaluates the accuracy of emotion classification, determining how effectively the model identifies emotional states from user inputs. Precision, recall, and F1 scores are calculated for each emotion category to balance sensitivity and specificity. The model's performance is also compared with baseline models such as Convolutional Neural Networks (CNN) to benchmark improvements in emotion detection.

ii. Chat bot Performance

Chat bot performance is assessed based on response accuracy and relevance, ensuring the generated replies are contextually appropriate. The contextual understanding metric measures the chat bot's ability to maintain coherent, meaningful dialogue throughout conversations. Additionally, user satisfaction ratings are gathered to evaluate the system's usability, empathy, and overall interaction quality.

iii. Block chain Integration

The block chain integration is evaluated through mining speed and transaction time, which indicate the efficiency of block chain operations. IPFS upload and download latency measure the responsiveness of decentralized data storage. Finally, security breach resistance assesses the block chain's robustness against unauthorized access or data tampering, ensuring reliable and secure mental health data management.

4.2 Software Implementation

The PsyVoice system was implemented using suitable hardware and software to ensure smooth execution and reliable performance. The chosen configuration supports AI processing, block chain integration, and secure data management for efficient system operation.

4.2.1 Patient Dashboard

The Patient Dashboard offers users a simple and interactive space to track their emotional well-being. It includes features like mood tracking, journaling, and AI chatbot interaction for daily support. Patients can view progress insights, schedule therapy sessions, and securely share data with verified therapists through block chain-based access control, ensuring privacy and trust in all interactions.

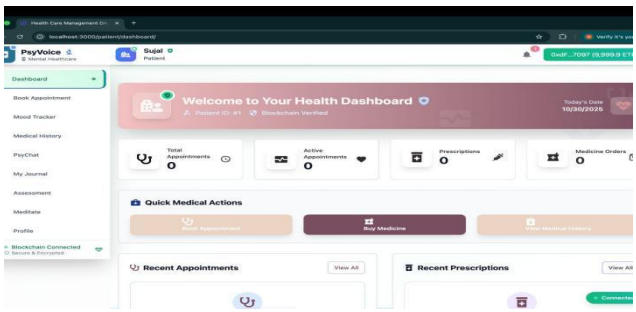

Fig - 4.2.1 Patient Dashboard

4.2.2 Doctor Dashboard

The Doctor Dashboard provides therapists with secure access to patient records, emotional analytics, and assessment results. It allows doctors to monitor progress, manage appointments, and offer personalized care based on AI-generated insights. Through blockchain verification, only authorized professionals can access sensitive data, ensuring privacy and authenticity in every interaction within the PsyVoice platform.

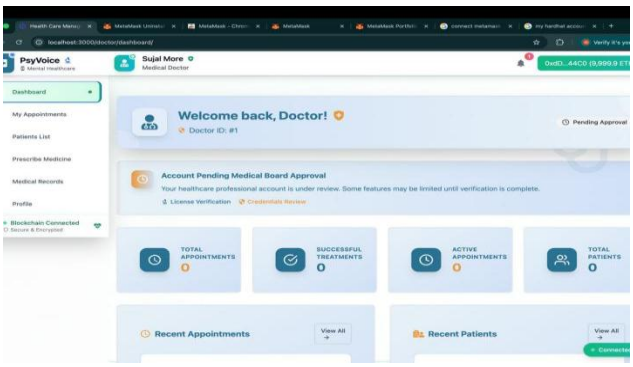

Fig - 4.2.2 Doctor Dashboard

4.2.3 Assessment Page

The Assessment Page allows users to evaluate their mental well-being through clinically validated questionnaires such as PHQ-9, GAD-7, and PSS. Based on user responses, the system analyzes emotional patterns and generates personalized reports on stress, anxiety, and depression levels. These insights help users monitor progress and seek timely professional guidance. All assessment data is securely stored and verified through block chain, ensuring accuracy, privacy, and authenticity for both patients and therapists.

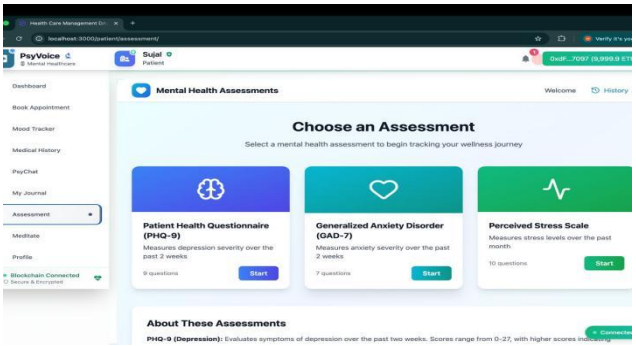

Fig - 4.2.3 Assessment Page

4.2.4 Chat bot

The AI-powered Chat bot is the core interactive feature of the Psy Voice system. It engages users in real-time conversations to provide emotional support, guidance, and self-care recommendations. Using Retrieval-Augmented Generation (RAG) and Seq2Seq models, the chat bot understands user emotions and responds empathetically with context-aware dialogue. It also tracks conversation history to personalize future interactions. Integrated with voice and text input, the chat bot ensures accessibility,

offering users an always-available virtual companion for mental health assistance.

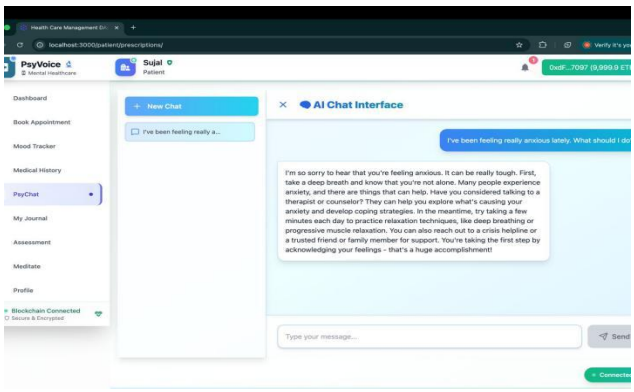

Fig - 4.2.4 Chat bot

4.2.5 Mood Tracker Page

The Mood Tracker Page allows users to record and visualize their daily emotions, helping them recognize patterns and triggers that affect their mental health. It uses AI-driven sentiment analysis to interpret mood trends over time, presenting them through easy-to-read charts and summaries. Users can reflect on their emotional progress and share insights with therapists if needed. This feature promotes self-awareness, emotional balance, and consistent mental health monitoring within the Psy-Voice platform.

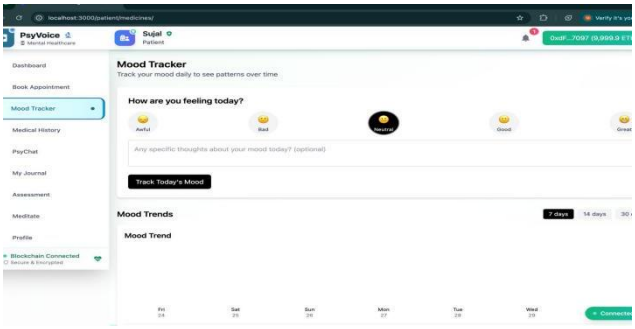

Fig -4.2.5 Mood Tracker Page

4.2.6 Journal Page

The Journal Page provides users with a personal and secure space to express their thoughts, emotions, and daily experiences. It supports both text and voice entries, allowing users to record their feelings conveniently. The system analyzes journal content using NLP-based emotion detection to offer insights into mood patterns and mental well-being over time. All entries are securely stored through block chain and IPFS, ensuring complete privacy and authenticity. This feature encourages self-reflection and emotional awareness for better mental health management.

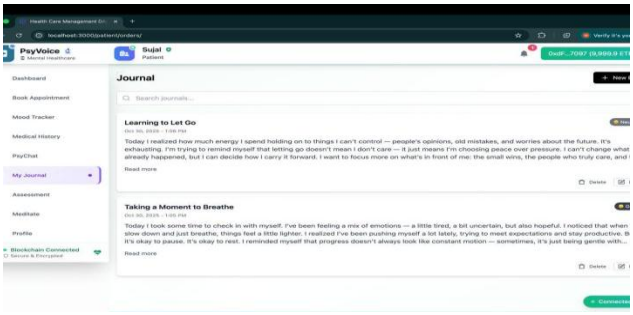

Fig - 4.2.6 Journal Page

4.2.7 Activity Diagram

The Activity Diagram illustrates the step-by-step workflow of the PsyVoice system, showing how users interact with different modules and how data flows between them. It visually represents the dynamic behavior of the system, beginning from user authentication and proceeding through the various functional activities like chatting, mood tracking, journaling, assessment, and report generation. This diagram helps in understanding the sequence of actions, decision points, and parallel processes within the platform. The process starts when a user logs in to the system, after which the control flow branches according to the user type — Patient, Doctor, or Admin. A Patient can perform activities such as interacting with the AI chatbot, updating the mood tracker, filling out self-assessments, or maintaining a daily journal. Each interaction triggers emotion analysis using NLP and ML algorithms, generating emotional insights that are stored securely on the blockchain. Meanwhile, the Doctor can view patient records, check emotional analytics, and provide personalized feedback or therapy recommendations. The Admin monitors all transactions, verifies user accounts, and maintains the blockchain ledger to ensure transparency and data integrity.

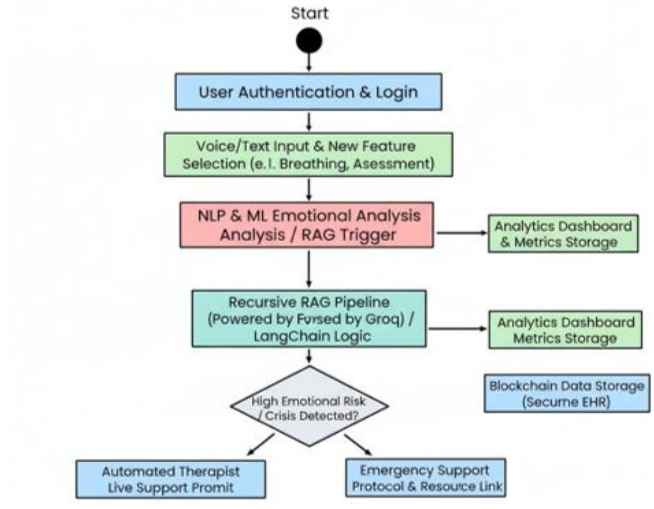

Fig -.4.2.7 Activity Diagram

4. CONCLUSION

The PsyVoice project represents a significant advancement in digital mental healthcare through the integration of Artificial Intelligence (AI), Machine Learning (ML), and Blockchain technologies. The system successfully addresses major limitations of traditional therapy—such as subjectivity, inaccessibility, and lack of real-time support—by providing an intelligent, voice-enabled chatbot capable of emotion-aware conversations. Utilizing models like Retrieval-Augmented Generation (RAG) and Seq2Seq, PsyVoice enhances emotional understanding and enables continuous, empathetic engagement with users.

A key innovation of PsyVoice lies in its blockchain-secured data architecture, which ensures privacy, immutability, and user-controlled access to sensitive mental health information. This decentralized approach builds trust and transparency while protecting user confidentiality—an essential factor in healthcare applications. Additionally, the platform integrates features such as emotion tracking, journaling, therapist dashboards, and community interaction, fostering holistic mental well-being.

The project's evaluation demonstrated improvements in emotion classification accuracy, user satisfaction, and data security. Its modular design and decentralized infrastructure make it scalable and adaptable to future technological developments. In the future, PsyVoice can be expanded to incorporate multimodal emotion analysis, wearable device integration, and cross-platform interoperability to further enhance real-time psychological insights.

Overall, PsyVoice exemplifies how AI and blockchain can work together to create a secure, empathetic, and intelligent digital mental health ecosystem, transforming the way emotional care and therapy are delivered.

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