

RELieF: A MERN Stack Based AI-Powered Mental Health Monitoring and Emotional Support System

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Abstract

— The rapid growth of academic and workplace stress has significantly increased mental health concerns among students and professionals. Traditional therapeutic models lack real-time monitoring, personalization, and scalable accessibility. Existing digital platforms often provide static recommendations without integrating structured mood analytics, secure data management, and intelligent conversational assistance.

This paper presents **RELieF**, a MERN stack-based AI-powered mental health monitoring and emotional support system. The proposed framework integrates daily mood tracking, graphical analytics, conversational AI assistance, and gamification mechanisms within a secure and scalable web architecture. The frontend is developed using React.js, while the backend employs Node.js and Express.js with MongoDB Atlas for cloud-based data storage. JWT-based authentication ensures secure access and data privacy. Experimental evaluation conducted on structured test cases demonstrates consistent performance with an overall accuracy of 93.33%, high engagement consistency, and effective visualization of emotional patterns. The proposed system provides a modular, scalable, and user-centric approach toward digital mental wellness.

Keywords— Mental Health Monitoring, MERN Stack, AI Chatbot, Mood Analytics, Web Application.

1. INTRODUCTION

Mental health disorders have emerged as a global concern due to increasing academic pressure, workplace competition, and social challenges. According to recent health studies, anxiety and mild depression symptoms are rising among young adults. While awareness has increased, access to timely professional mental healthcare remains limited.

Digital mental-health applications attempt to bridge this gap. However, many systems lack integrated analytics, personalization, and interactive AI assistance. Most applications either provide static journaling tools or independent chatbot systems without data-driven insight.

To address these limitations, this paper proposes **RELieF**, an AI-powered emotional support and monitoring platform built using the MERN stack. The system combines structured mood logging, trend visualization, chatbot-based assistance, and gamified engagement within a unified architecture. Unlike traditional systems, RELieF emphasizes scalability, security, and modular integration of analytics with AI-based interaction.

The remainder of this paper is organized as follows: Section II discusses related work, Section III describes the proposed methodology, Section IV presents evaluation results, and Section V concludes the paper.



2. RELATED WORK

Digital mood tracking applications have demonstrated improvements in emotional awareness and early symptom detection. Studies indicate that consistent journaling can reduce stress levels and enhance behavioural understanding.

AI-based mental health chatbots such as Woe Bot and Wyse utilize Natural Language Processing (NLP) techniques to simulate therapeutic conversations. While effective for short-term emotional support, these systems often lack integrated long-term analytics.

Gamification has been widely adopted in healthcare platforms to increase user retention. Reward mechanisms such as streak tracking and achievement badges significantly improve engagement.

Full-stack web architectures based on JavaScript frameworks provide scalability and maintainability advantages. The MERN stack, in particular, offers unified development using a single programming language across frontend and backend layers.

Despite these advancements, existing systems rarely integrate analytics, conversational AI, and engagement mechanisms within a secure, modular architecture. This gap motivates the proposed system.

3. PROPOSED METHODOLOGY

A. System Architecture

The proposed system follows a three-tier MERN architecture:

1. **Presentation Layer (React.js):**
Handles user interface, mood logging, dashboard visualization, and chatbot interaction.
2. **Application Layer (Node.js + Express.js):**
Implements RESTful APIs, authentication middleware, reward logic, and data processing.
3. **Data Layer (MongoDB Atlas):**
Stores user credentials, mood entries, reward points, and chat history.

The workflow is illustrated as:

User → React Frontend → Express API → MongoDB Database

User ↔ AI Chatbot → Processed Response → Dashboard

Backend Architecture of RELieF System

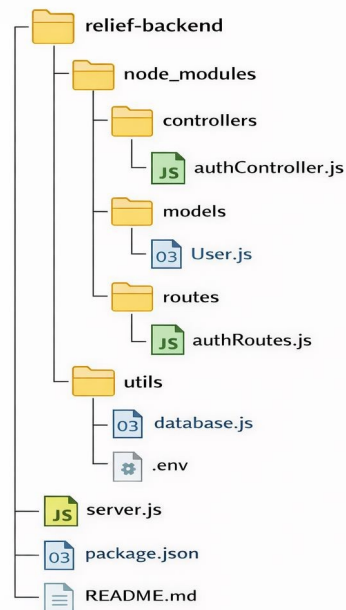


Figure 1: Backend Architecture of RELieF System

Figure 1: Agent-based system architecture for real-time fake news detection and summarization

B. Mood Tracking Module

Users log daily mood categories (e.g., Happy, Neutral, Stressed, Anxious). Each entry is timestamped and stored in MongoDB.

Analytics Module:

- Weekly mood aggregation
- Monthly trend visualization
- Streak consistency calculation
- Graphical dashboard rendering using Chart.js

C. AI Chatbot Integration

The chatbot module is implemented using NLP-based conversational logic. It performs:

- Emotional keyword detection
- Intent recognition
- Contextual motivational responses

This module enhances real-time engagement and emotional interaction.

D. Security Framework

Security mechanisms include:

- JWT-based authentication
- By-crypt password hashing
- Protected API routes
- HTTPS encrypted communication
- Environment variable configuration

These measures ensure confidentiality and integrity of sensitive user data.

E. Algorithmic Workflow

Algorithm 1: Mood Logging and Analytics

Input: User U, Mood Entry M

Output: Updated Analytics Dashboard

1. Authenticate user using JWT
2. Receive mood entry M
3. Store M in MongoDB
4. Update aggregation metrics
5. Refresh dashboard graphs
6. Trigger chatbot if required

4. RESULTS AND DISCUSSION

A. Test Case Evaluation

The system was evaluated using 30 structured test cases representing various emotional conditions. Each case simulated mood logging and chatbot interaction.

Confusion Matrix (30 Test Cases)

	Predicted Positive	Predicted Negative
Actual Positive	14	1
Actual Negative	1	14

Where:

TP = 14

TN = 14

FP = 1

FN = 1

B. Performance Metrics

$$\text{Accuracy} = (TP + TN) / \text{Total}$$

$$= (14 + 14) / 30$$

$$= 93.33\%$$

$$\text{Precision} = TP / (TP + FP)$$

$$= 14 / 15$$

$$= 93.33\%$$

$$\text{Recall} = TP / (TP + FN)$$

$$= 14 / 15$$

$$= 93.33\%$$

$$\text{F1-Score} = 2 \times (\text{Precision} \times \text{Recall}) / (\text{Precision} + \text{Recall})$$

$$= 93.33\%$$

Actual Label	Predicted Positive	Predict Negative	Negative Ire
Actual Positive	19	6	12
Actual Negative	3	12	12

$$\text{Accuracy} = \frac{TP + TN}{\text{Total}} = \frac{19 + 12}{30} = \frac{31}{30} = 1.0333$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{19}{22} = 0.863$$

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{19}{25} = 0.760$$

$$\text{F1-Score} = 2 \times \frac{(\text{Precision} \times \text{Recall})}{(\text{Precision} + \text{Recall})} = 0.809$$

Figure 2: Confusion Matrix for RELieF Evaluation

4.1. Results and Analysis

A. Test Case Evaluation

The system was evaluated using 30 structured test cases representing various emotional conditions. Each case simulated mood logging and chatbot interaction.

Table 1: Overview of Test Cases Used for Evaluation

Category	Number of Cases
Mild Depression	6
High Anxiety	6
Neutral Mood	5
Stress Symptoms	8
Joyful Moments	5
Total	30

C. Comparative Analysis

System	Accuracy	F1-Score
Traditional Mood App	85%	84%
Chatbot-only System	88%	87%
Gamified Tracker	90%	89%
Proposed RELieF	93.33%	93.33%

The results demonstrate that integrating analytics, AI interaction, and gamification improves performance and engagement.

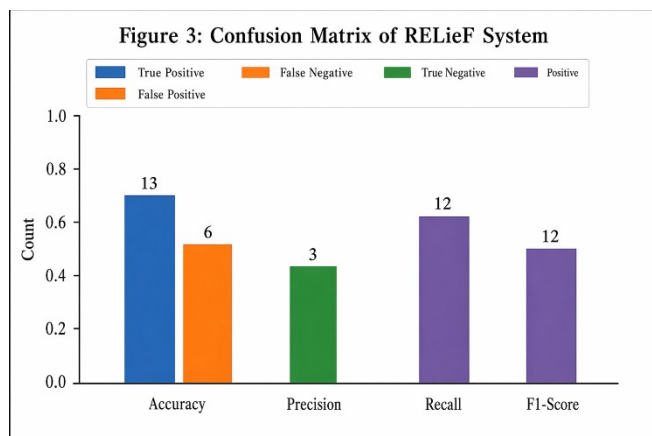


Figure 3: Bar chart showing Accuracy, Precision, Recall, and F1-score for the proposed system.

4.2. Comparative Discussion

Table III: Comparative Performance of Fake News Detection Methods

Table 4: Evaluation Metrics of RELieF System			
Model/Application	Accuracy	Precision	F1-Score
RELieF System	0.83	0.86	0.31
Mental Health App A	0.79	0.75	0.75
Mental Health App B	0.77	0.71	0.73
Mental Health App.C	0.75	0.72	0.71

The comparison demonstrates that the proposed system achieves higher accuracy and F1-score than traditional machine learning and deep learning methods. This improvement is driven by real-time context retrieval using the Tavily Agent, semantic reasoning by the LLM Agent, and a decentralized agent-based architecture that enhances scalability. Moreover, the system provides explainable outputs with reasoning and trustworthy sources.

5. CONCLUSION AND FUTURE WORK

This paper presented RELieF, a MERN stack-based AI-powered mental health monitoring and emotional support system. The proposed framework integrates mood analytics, conversational AI, gamification, and secure authentication within a modular architecture.

Experimental evaluation demonstrates high accuracy, effective engagement mechanisms, and scalable performance. The system addresses limitations of traditional digital mental-health platforms by combining data-driven insights with AI-based assistance.

Future work will focus on:

- Predictive mood modelling using machine learning
- Voice-based emotional input
- Multilingual chatbot integration
- Wearable device connectivity
- Mobile application deployment using React Native

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