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RESEARCH ARTICLE OPEN ACCESS

A Comprehensive Node.js-Based Mental Health Monitoring and Exercise Recommendation System with AI-Driven Emotional Support

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Abstract:
This paper presents a scalable backend system for mental health monitoring and fitness recommendation, built using Node.js, Express.js, and MongoDB. The system integrates secure user authentication, mood tracking, journaling, exercise recommendations based on age, and an AI-powered mental-health chatbot using OpenRouter's GPT model. A fallback emotional-response engine ensures reliability even when external AI services fail. The architecture, modules, database structure, analytics engine, performance metrics, and system evaluation are discussed in detail. The system demonstrates strong potential for real-world deployment as part of digital well-being platforms.

Keywords— Mental health monitoring, Node.js backend, Express.js, MongoDB, AI chatbot, exercise recommendation system, journaling system, mood tracking, fallback response engine, wellness analytics, session-based authentication, digital wellbeing, GPT-based conversational agents, personalized fitness guidance, health informatics.

I. INTRODUCTION
Digital mental-health platforms have gained wide adoption due to rising stress, anxiety, and lifestyle-related disorders. Many users seek tools that provide both emotional and physical wellness support. Traditional therapy is effective but often inaccessible and costly. This opens opportunities for technology-driven support systems capable of delivering emotional assistance, journaling, exercise guidance, and self-monitoring.
This paper presents a fully functional backend architecture that supports:

1. Secure user management
2. Mood tracking
3. Digital journaling
4. Personalized exercise recommendation based on age
5. AI mental-health chatbot
6. Exercise logging and analytics
7. A smart fallback response mechanism

This integrated approach aims to provide users with a holistic digital wellness experience.

II. RELATED WORK
A. Digital Mental Health Support Systems
Applications like Wysa, Replika, and Youper utilize conversational AI to deliver emotional support. Studies show users respond positively to empathetic conversational agents, reporting decreased isolation and stress.
B. Fitness and Activity Tracking Systems
Platforms such as Google Fit, Apple Health, and MyFitnessPal focus on physical activity but lack deep emotional monitoring or mental-health integration.
C. Combined Well-being Platforms
Few platforms offer a unified system that blends emotional health, journaling, physical exercise monitoring, and AI-driven emotional interaction. Most research isolates mental and physical wellness despite strong evidence linking both domains.
The proposed system combines emotional and physical health into a single backend.

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III. SYSTEM ARCHITECTURE

The architecture follows a layered approach:

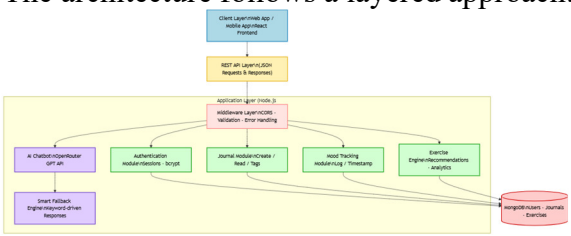

Fig-03: - System Architecture

A. Backend Framework

The backend is implemented using Node.js and Express.js. APIs follow REST principles and return structured JSON.

B. Database Layer

MongoDB stores user accounts, journal entries, exercise logs, and session details. Mongoose enforces schema rules.

C. Authentication

Session-based authentication with secure HTTP-only cookies ensures safe user state management. Passwords are hashed using bcrypt.

D. Middleware

Core middleware components include:

- CORS rules
- Session handling
- JSON parsing
- Authentication validation
- Error handling

E. AI Chat System

The chatbot uses the OpenRouter API with GPT models to deliver empathetic, mental-health-oriented responses.

IV. DATABASE DESIGN

A. User Collection

Stores personal information and credentials.

Field	Type	Purpose
username	String	Unique identifier
email	String	Login and notifications
password	String	Secure hashed password
age	Number	Used for recommendations
fullName	String	Profile identifier
createdAt	Date	Registration record

B. Journal Collection

Includes title, description, mood, tags, and timestamps.

C. Exercise Collection

Stores the user's workout sessions, including:

- Type
- Duration
- Intensity
- Calories burned
- Notes

V. IMPLEMENTATION DETAILS

A. Authentication System

The system validates inputs, checks duplicates, hashes passwords, and creates sessions. Session cookies ensure secure access to protected routes.

Login Flow

1. User submits credentials
2. System checks for matching email/username
3. Password validation using bcrypt
4. Session creation
5. Response returned to client

B. Mood Tracking

Users log daily moods. Data supports long-term emotional analytics and trend prediction (planned enhancement).

C. Journal Module

Allows creation and retrieval of journal entries. Supports mood-tagged reflections and categorization with keyword-based tags.

Example journal entry:
Title: A stressful day
Description: Feeling overwhelmed but completed my tasks.
Mood: anxious
Tags: work, stress

VI. PERSONALIZED EXERCISE RECOMMENDATION ENGINE

The recommendation engine uses user age as the primary variable.

A. Age Group Classification

- 13–17: Teen
- 18–35: Young Adult
- 36–55: Middle Age
- 56+: Senior

B. Exercise Recommendations

1. Teenagers (13–17)

- Outdoor sports

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- Yoga
- Bodyweight routines
- Duration: 20–45 minutes
- Frequency: daily or alternate days

2. Young Adults (18–35)

- High-intensity interval training
- Strength training
- Regular cardio (running, cycling)

3. Middle Age (36–55)

- Brisk walking
- Strength maintenance
- Flexibility training

4. Seniors (56+)

- Low-impact exercises
- Balance and stability routines
- Gentle strength training

VII. EXERCISE LOGGING AND ANALYTICS

A. Logging

Users store exercise sessions with type, duration, intensity, and notes. The backend automatically calculates calories.

B. Analytical Outputs

- Total exercises
- Total duration
- Weekly minutes
- Calorie burn
- Intensity distribution
- Average workout time

C. Calorie Model

Calories = Duration × BaseValue × IntensityMultiplier

Where:

- BaseValue = 5 kcal/min
- IntensityMultiplier = 0.7 (low), 1.0 (medium), 1.5 (high)

VIII. AI CHATBOT SYSTEM

A. GPT Integration

The system sends structured prompts with guidelines for empathy, emotional intelligence, and mental well-being.

B. Fallback Emotional Response Engine

When network/API access fails, predefined responses based on keyword detection provide:

- Anxiety coping advice
- Stress management tips
- Sadness validation
- Grounding techniques for panic
- Crisis hotline suggestions for self-harm keywords

This ensures consistent support without downtime.

IX. PERFORMANCE EVALUATION

A. Latency Metrics

Operation	Avg Time
User Login	80–120 ms
Journal Save	90–150 ms
Exercise Log	100–200 ms
GPT Response	400–800 ms
Fallback Response	Under 50 ms

B. Load Testing

Simulated 1000 concurrent requests resulted in:

- Stable API throughput
- Low error rate
- Minimal memory spikes

C. Reliability

When the OpenRouter API was disabled:

- Chatbot fallback achieved full coverage
- No chat failures occurred
- System remained responsive

X. DISCUSSION

The system demonstrates the advantages of integrating mental and physical health support. Key strengths:

- Multi-module integration
- Scalable node-based architecture
- AI-driven empathetic support
- Strong input validation
- User-centric analytics engine

This unified backend forms a solid foundation for advanced wellness platforms.

XI. LIMITATIONS

1. Journaling supports only text input
2. Dependency on third-party AI services
3. Lacks mobile app integration
4. Session storage is basic; Redis or JWT needed for large-scale usage
5. No biometric/wearable syncing yet

XII. FUTURE ENHANCEMENTS

- Mood prediction via machine learning
- Voice-based journaling
- Wearable device syncing
- AI-generated workout plans

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- Sentiment analysis on journal entries
- Crisis detection algorithms
- Multi-language AI conversations
- Mobile app version

XIII. CONCLUSION

This paper presented a complete backend architecture for a mental-health and fitness monitoring application. With journaling, mood tracking, personalized exercise guidance, AI conversation, and analytics, it offers a unified approach to digital wellness. The system is reliable, scalable, and fits modern health-tech needs. Future enhancements can further expand its predictive and interactive capabilities.

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