SoulSync

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Abstract : SoulSync is a wellness platform that uses artificial intelligence and facial expression analysis to promote mental health and emotional well-being. The platform is designed for students, working professionals, and seniors. The platform uses facial emotion analysis to determine the user's mood in real time. According to the user's emotional state, the platform provides personalized music therapy to help the user reduce stress, improve sleep quality, and increase focus. The platform also helps the user monitor their emotional patterns over time and provides the user with an opportunity to analyze their emotional progress and well-being. SoulSync is developed as a responsive web application to ensure seamless accessibility on various devices. The platform is also integrated with platforms such as Jamedo to enable real-time music streaming. SoulSync is a health technology, artificial intelligence, and music technology solution for emotional wellness

***IndexTerms* -** Artificial Intelligence, Facial Emotion Recognition, Music Therapy, Emotional Wellness, Deep Learning, Emotion Tracking

I. INTRODUCTION

The increasing stress, anxiety, and mental health problems among students, working professionals, and senior citizens have led to a growing need for technology-based wellness solutions. Currently, most music streaming and wellness apps available in the market are more focused on entertainment than therapy. These apps are not emotionally intelligent, adaptive, or able to change content based on the mental state of the user.

Most of the current systems available are not continuously analyzing emotional responses or emotional progress over time. Moreover, the lack of real-time emotion analysis and adaptive music therapy makes them less effective in terms of supporting long-term emotional well-being. Another challenge in the adoption of emotion-aware systems is the issue of privacy and data security.

To overcome the above challenges, this project proposes SoulSync, an AI-based music therapy system that aims to improve emotional well-being using camera-based facial emotion recognition. The system analyzes the facial expressions of the users through real-time camera inputs to identify their emotional state and suggest personalized music therapy accordingly. Additionally, the system also provides insights into the emotional changes and progress over time.

SoulSync is built as a responsive Progressive Web Application (PWA) using the latest web technologies. The SoulSync system uses HTML, CSS, JS for the frontend and Python for the backend, along with AI/ML models for facial emotion detection, and Jamedo APIs for real-time music streaming. The system focuses on usability, personalization, and secure management of user data.

Key Contributions

- An integrated emotional wellness system that incorporates facial emotion detection, music therapy,and progress tracking
- Real-time emotion detection through camera-based facial expression analysis
- Personalized music suggestions that dynamically change based on the identified emotional state
- Secure and scalable web design for cloud hosting
- Responsive and user-friendly interface for mobile and desktop devices

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II. RELATED WORK

Recent studies have shown various methods of creating emotion-aware music systems and wellness apps using AI. Huang et al. [4] suggested a text-based sentiment analysis method for music recommendation based on user mood. Although successful in a controlled environment, the method was limited to processing only text input, which was not sufficient for accurately analyzing real-time emotional expressions. Koelstra et al. [5] presented the DEAP dataset, which facilitated emotion analysis through EEG and physiological signal processing. Although this method increased the accuracy of emotion analysis, it was not feasible for use in real-world settings due to the need for hardware support.

Some studies have focused on speech emotion recognition (SER) methods for affective computing. El Ayadi et al. [6] presented a review of SER methods, pointing out the challenges of SER, including background noise, speaker variability, and language dependence, which affect the reliability of SER in real-world settings. Similarly, Li and Deng [7] presented a review of facial emotion recognition systems based on deep learning architectures. The authors concluded that, although these systems have high accuracy in controlled settings, they may not perform well under varying lighting conditions, camera quality, and facial poses.

Emotion-aware music recommendation systems have also received interest in recent years. Yang et al. [8] developed a mood-driven playlist recommendation system based on audio features like tempo, energy, and valence. However, this system did not have the capability to adapt to changes in emotions in real-time. Park et al. [9] combined online music services to provide emotion-driven music recommendations but did not have the capability to monitor emotional progress over time.

Recent wellness apps focus on stress relief and mindfulness using music therapy [10]. Although beneficial, most of these systems are static and entertainment-focused, providing very little personalization and emotional feedback. Moreover, the privacy and ethical issues associated with the use of facial and biometric data in emotion recognition systems have been pointed out in recent research works [11], underlining the importance of secure data handling and responsible AI use.
Unlike previous solutions, SoulSync differs in that it uses camera-based facial emotion recognition to provide real-time adaptive music therapy capabilities within a single web-based solution. The solution combines the capabilities of continuous emotion tracking, personalized music suggestions, secure data management, and tracking emotional progress over time. This specific and scalable approach is designed to address the identified technological, usability, and therapeutic limitations of previous solutions.
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III. PROPOSED WORK

The SoulSync system is built using a three-tier architecture, which includes the presentation layer (frontend), application layer (backend and AI services), and data layer (database and cloud storage).

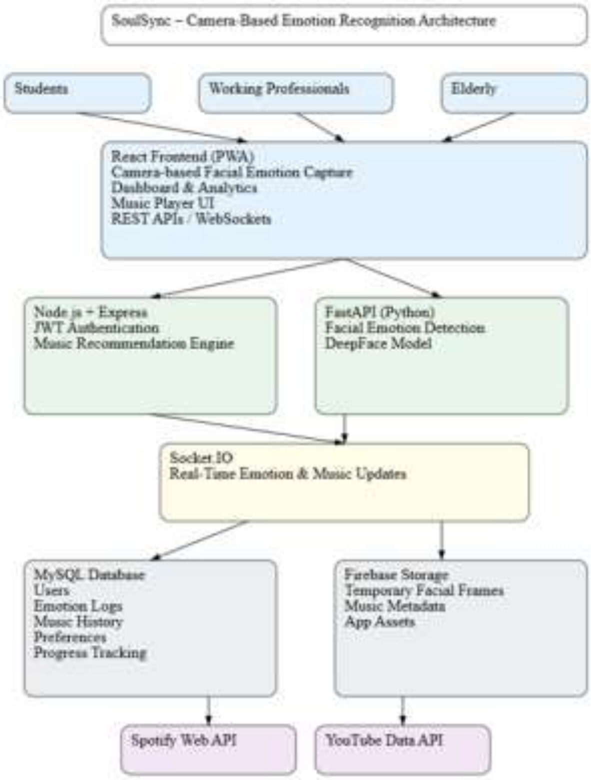


Fig 4.a: System Architecture

As shown in Fig 4.a , the system has a React-based Progressive Web Application (PWA) that communicates with backend services via RESTful APIs and WebSocket connections. The backend handles application logic, authentication, music suggestions, and interaction with AI services.

Python is utilized for backend application logic, while Fast API is used for AI-based facial emotion analysis. MySQL is the main relational database for structured data.

B. Technology Stack

The technology stack was chosen to provide scalability, performance, real-time functionality, and compatibility with AI-assisted emotion analysis.

- Frontend: HTML, CSS, JS
- Backend: Python
- Jamedo API
- AI Services: Deep face
- Database: MySQL for structured user and emotion data

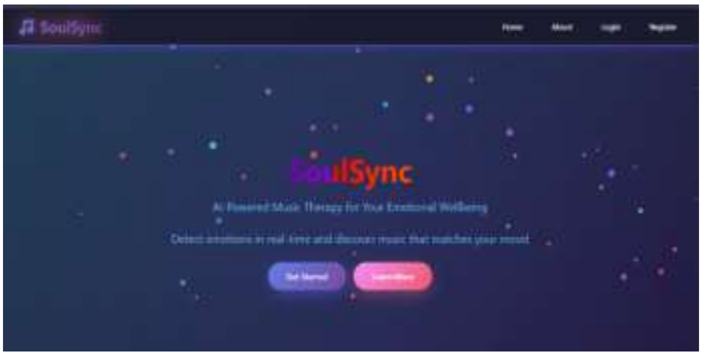
Fig 4.b: About

C. Frontend Design

The frontend is built as a HTML, CSS, JS Progressive Web Application utilizing Vite and Tailwind CSS. The design is completely responsive and mobile-friendly.

Major Functionalities

- Authentication Pages: Secure user login and registration
- Emotion Input Interface: Camera-based facial emotion recognition
- Dashboard: Shows identified emotional state, music suggestions, and emotional analysis
- Music Recommendation System: Emotion-driven song and playlist suggestions
- Analytics Page: Visualization of emotional trends and progress using charts



4.c: Login Page

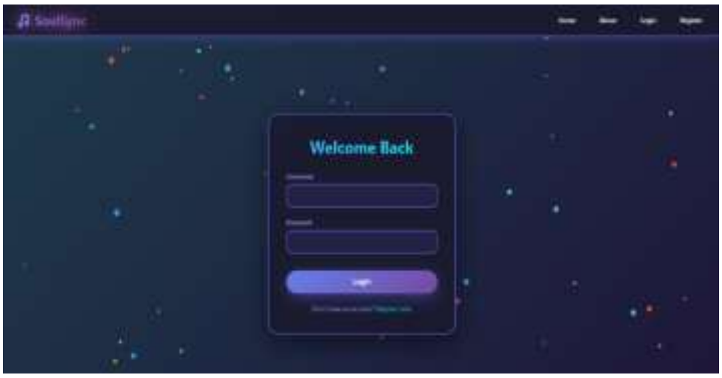


Fig 4.d: SoulSync User Registration Page

D. Backend Services

The backend is developed using Python with Express.js, coupled with Fast API for AI-assisted facial emotion recognition.

Major Functionalities

- JWT Authentication: Secure token-based user session management.
- Emotion Detection Services
- Facial expression analysis using deep learning algorithms (Deep Face)
- Music Recommendation System: Dynamic music suggestions according to identified emotional states
- Socket.IO Server: Facilitates real-time synchronization of emotion updates and music suggestions
- File Handling Services: Integration with Cloud Storage for secure media handling

E. Database Schema (MySQL)

The MySQL database holds relational data necessary for personalization and emotional progress analysis.
Major Tables

- Users: User accounts, credentials, and preferences
- Emotion_Logs: Identified facial emotions with timestamps
- Music_History: Previously suggested and played music tracks

Fig 4.e: Database Tables

F. Real-Time Communication

Socket.IO facilitates two-way real-time communication between the client and server.
Supported Features

- Real-time updates for emotion detection
- Dynamic music adaptation based on emotional transitions
- Real-time UI feedback and dashboard updates
- Real-time synchronization between emotion analysis and music playback

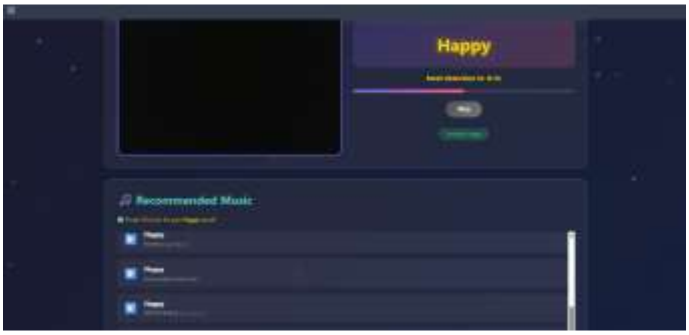


Fig 4.f: Music Recommended

G. Cloud Integration

Cloud Storage is employed for secure and scalable cloud storage, which supports:

- Temporary facial emotion input data (video frames or images)
- Music metadata caching
- Application assets and static resources

A local processing fallback system is implemented for uninterrupted functionality during temporary network conditions

IV. IMPLEMENTATION

Authentication and Security

SoulSync adopts a secure authentication system through the usage of JSON Web Tokens (JWT) with access and refresh tokens for secure sessions. The system adopts a single primary role for users, where personalization is based on individual preferences as opposed to role-based hierarchies.
Users can:

- Securely register and log in
- Access facial emotion analysis functionality
- Access personalized music therapy suggestions
- View emotional progress analytics
- The security framework adopts a multi-layered approach for protection, which includes:
- Client and server input validation
- Authorization through JWT for protected APIs
- Password hashing through bcrypt with salting
- CORS setup to prevent unauthorized cross-origin requests
- Rate limiting for authentication endpoints to prevent brute-force attacks

- All sensitive emotional and biometric information is transmitted through HTTPS and processed in accordance with privacy guidelines and ethical AI practices.

A. Emotion Detection Module

The emotion detection module is the central module of SoulSync and is solely dependent on camera-based facial expression analysis. The system adopts deep learning models (such as DeepFace) to analyze facial expressions captured through the user's device camera and provide real-time emotional classification.
Each identified emotion is time-stamped and safely recorded in the database for longitudinal study. To maintain user privacy, the raw facial images are processed temporarily and deleted immediately after the emotion identification. Users must give explicit consent before enabling camera access, and no raw biometric data is stored permanently

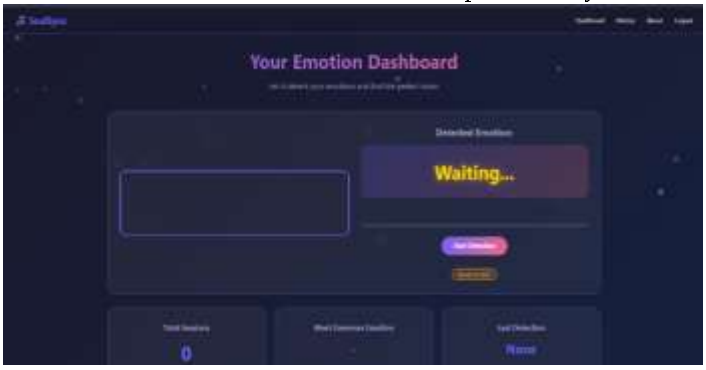


Fig 5.a: Emotion Detection Interface

B. Music Recommendation & Therapy Module

With the identified facial emotional expression, SoulSync utilizes an intelligent music recommendation engine that provides therapeutic music experiences designed to:

- Reduce stress
- Improve mood
- Enhance focus and productivity
- Improve sleep

The module is integrated with Jamedo APIs to facilitate real-time music streaming. Music recommendations take into account emotional expression, energy, tempo, and user preferences. The music recommendation engine automatically updates recommendations with every identified change in emotional expression.

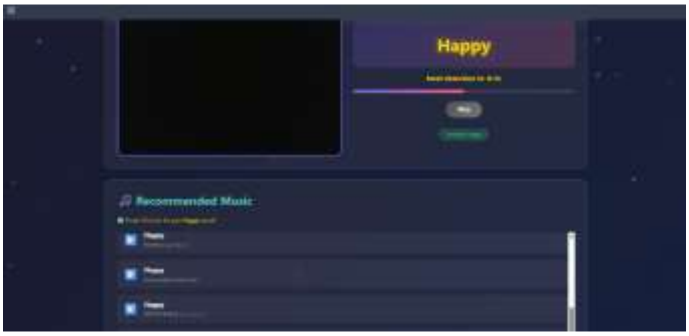


Fig 5.b: Emotion based Song

C. Real-Time Adaptation System

SoulSync utilizes Socket.IO to facilitate real-time, two-way communication between the frontend and backend. The real-time system enables:

- Immediate updates of facial emotions
- Dynamic music adaptation without page reloads
- Real-time UI feedback and user notifications

The real-time system provides a seamless and engaging therapeutic experience, setting SoulSync apart from traditional static or rule-based playlist systems.

Fig 5.c: Analyzing Emotion

E. Cloud Storage and Media Handling

- The system utilizes Storage for secure and scalable cloud storage of:
- Temporary facial emotion snapshots (processed and immediately discarded)
- Music metadata caching
- Application assets and configuration files

V. RESULTS

A. Functional Testing

The SoulSync system was functionally tested for all major modules to ensure correctness, usability, and real-time functionality. Users were able to register, login, and access the system successfully using the Progressive Web Application interface from web and mobile devices.

The facial emotion input captured from the device camera was processed correctly by the AI-based emotion detection module. Users received personalized music recommendations based on their detected emotional state. Real-time functionality was ensured by monitoring the dynamic playlist update based on the detected changes in facial emotions.

The emotional progress dashboard was able to display the users' historical emotion logs, trends, and analytics correctly, enabling users to monitor changes in their moods and stress levels over time. Navigation through the application was seamless, and UI functionality was consistent across various devices and screen sizes.

Responsiveness of the application interface was tested using browser developer tools. The initial page load time was approximately 1.3 seconds, and subsequent interactions took 300-400 milliseconds.

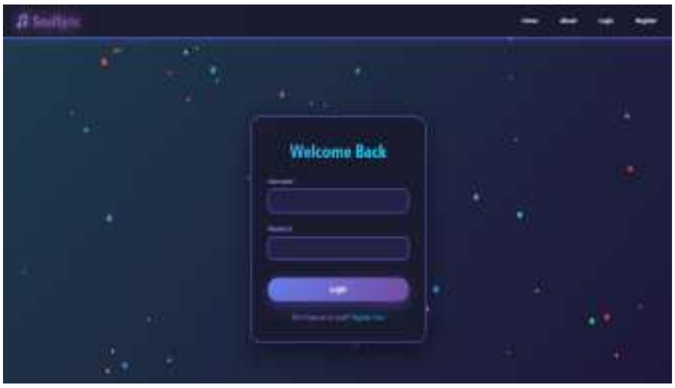


Fig 6.a: Login Page

B. *Performance Metrics*

Performance testing was performed to assess the system's responsiveness and robustness when used concurrently. Simulated user sessions proved that the backend system was functioning well even when concurrent facial emotion analysis and music recommendation requests were made.
The most important performance metrics are as follows:

- Facial emotion analysis API response time averaged 180 ms per request
- Music recommendation generation averaged 150 ms
- Real-time updates of emotions to music using Socket.IO had latency below 100 ms
- Database queries for emotion logs and progress updates averaged 120 ms

Performance of cloud storage was also tested.

C. Deployment and Testing

The SoulSync system was deployed on contemporary cloud infrastructure to provide scalability, availability, and reliability:

- Frontend: Html, CSS , JS
- Backend: Python
- Database: SQLite

End-to-end system testing was performed to verify that the system was working well with seamless communication between the frontend, backend services, AI emotion detection module, and external music streaming APIs (Jamedo).

D. Security Analysis

The security features were analyzed to ensure the protection of user data and adherence to privacy policies.
The major security features are:

- Secure authentication using JWT with valid token verification
- Password hashing using bcrypt with salting
- HTTPS enforced communication for all APIs
- Emotion data and user records with restricted access
- Facial biometric data with proper user consent and temporary processing

There were no attempts at unauthorized access, data leakage, or security vulnerabilities.

Fig 6.b: History

VI. CONCLUSION

This paper introduced SoulSync, an AI-based music therapy and emotional wellness platform developed using contemporary web and AI technologies. The platform seamlessly combines camera-based facial emotion recognition, real-time adaptive music recommendation, and emotional progress tracking into a single, intuitive application. By utilizing HTML, CSS, JS, Python, FastAPI, MySQL and real-time communication capabilities, SoulSync provides a scalable, secure, and responsive solution for mental health and emotional wellness support.

The platform showcases the capabilities of AI-based personalization in improving music therapy by adapting to users identified emotional conditions in real-time, as opposed to static or generic music playlists. The real-time emotion analysis and adaptive music playback provide an engaging and therapeutic experience for users. The cloud-native and modular design enables the platform to scale efficiently with low latency and optimal performance even under concurrent usage.

Experimental results have verified that SoulSync functions correctly and provides fast response times, smooth user interaction, and secure processing of sensitive emotional information. As mental health awareness continues to grow, SoulSync showcases the capabilities of integrating artificial intelligence, music technology, and emotional intelligence to provide accessible and data-driven wellness solutions for everyday use.

Future Scope:

Although SoulSync is able to accomplish its primary tasks, there are still some improvements that can be made to further enhance its functionality:

- Use of Advanced AI Models: Implementation of more reliable deep learning models to enhance the accuracy of facial emotion recognition in different lighting and environmental settings
- Wearable Device Integration: Integration of biometric data from smartwatches and fitness trackers (such as heart rate or stress alerts) to add more depth to emotional analysis
- Therapeutic Chatbot: Implementation of an AI-powered chatbot to assist users with emotional support and strategies
- Personalized Wellness Plans: Creation of long-term emotion-responsive music therapy and mindfulness plans
- Mobile Application: Development of native Android and iOS applications using React Native to provide an improved mobile experience
- Clinical Integration: Implementation of controlled dashboards for therapists or counselors to view emotional trends with user consent

These future works will enable the expansion of SoulSync into a full-fledged digital wellness platform while maintaining user privacy, ethical AI usage, and trust.

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