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AI-Powered Mood Adaptive Music Player

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ABSTRACT: In today's fast-paced digital environment, music serves as a vital medium for enhancing emotional well-being and relaxation. Conventional music applications rely on manual selection, which may not correspond to the listener's current emotional state. This work presents an AI-powered Emotion-Based Music Player that automatically detects user emotions through facial expressions or voice input and delivers contextually relevant music recommendations in real time.

The proposed system employs a Convolutional Neural Network (CNN) for facial emotion recognition, achieving approximately 80% accuracy, and a Recurrent Neural Network (RNN) for speech-based emotion classification, achieving approximately 72% accuracy. Detected emotions are mapped to curated playlists by interfacing with external music platforms, including Spotify and YouTube, via their APIs.

A cross-platform Flutter-based frontend ensures seamless user interaction, while a Flask backend hosts the AI models and manages streaming requests. Technical challenges such as low voice-input accuracy, user interface instability, and model bias were mitigated using noise reduction, exception handling, and dataset augmentation techniques. The system offers low-latency, real-time predictions with a minimalistic interface, representing a step toward emotionally intelligent multimedia applications.

I. INTRODUCTION:

Music is a universal medium capable of influencing and reflecting human emotions. With recent advancements in Artificial Intelligence (AI), machines can now interpret and respond to emotional states, enabling highly personalized and context-aware user experiences. This integration of AI with emotional intelligence opens new opportunities in intelligent multimedia applications.

The proposed Emotion-Based Music Player is a mobile application that detects a user's emotional state through facial expression analysis or voice input and recommends music accordingly. The system employs advanced deep learning models to bridge the gap between emotion recognition and music recommendation, creating an adaptive and engaging listening experience.

Unlike traditional music applications that require manual playlist selection, this solution responds instantly to real-time emotional cues. Whether the user is happy, sad, angry, or relaxed, the application analyses multimodal inputs to deliver mood-specific playlists.

The project aims to achieve high-accuracy emotion detection, ensure seamless music playback via API integrations, and maintain efficient mobile performance through a clean, user-friendly interface, thereby demonstrating AI's potential to enhance everyday human-technology interaction.

II. LITERATURE SYRVEY

Mahadik et al. [1] developed EMOSIC, an Android-based music player that detects facial features using the Viola–Jones algorithm and Face API. The extracted mappings were classified with an SVM and processed via Microsoft Emotion API. Song categorization was performed using Zero-Crossing Rate (ZCR) to determine frequency and tempo.

Kim et al. [2] proposed a hierarchical deep neural network (DNN) for facial expression recognition. One network analyzed action units using Local Binary Patterns (LBP), while the second extracted geometric landmark changes. A dynamic weighting function integrated both outputs, improving classification accuracy.

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Van der Zwaag et al. [3] validated an affective music player by monitoring skin temperature and Skin Conductance Level (SCL) in real time. Results demonstrated a link between physiological responses and mood regulation through music.

In another approach, Mahadik et al. [4] employed a lightweight MobileNet-CNN model with datasets such as KDEF and VGG, achieving ~80% accuracy for mood classification.

Agrawal et al. [5] introduced a heart rate–based emotion recognition system integrated with Firebase. While effective in static conditions, accuracy decreased during user movement due to sensor variability.

EXISTING SYSTEM

Current emotion-based music recommendation systems typically use either facial recognition or physiological signal monitoring to detect user emotions. Vision-based methods employ algorithms such as Viola–Jones with FaceAPI for facial feature extraction, followed by classifiers like SVM or CNN for emotion categorization. Lightweight architectures such as MobileNet enable on-device processing for mobile platforms, often trained on datasets like KDEF and VGG to recognize basic emotions.

Physiological approaches, such as continuous heart rate monitoring, analyze variations in heart rate to infer mood and recommend suitable playlists. While these systems can provide real-time suggestions, they often suffer from reduced accuracy during physical activity or under varying environmental conditions. Overall, existing solutions demonstrate the potential of emotion-aware music players but face limitations in accuracy, robustness, and multimodal integration.

PROPOSED SYSTEM

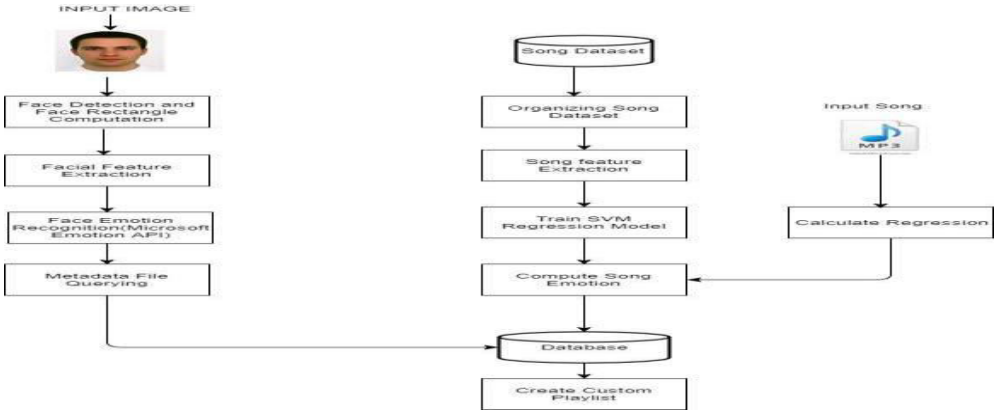
This project aims to develop a real-time music player that recommends songs based on the user's facial expression detected via a digital camera. The system utilizes data augmentation to enhance the training dataset and applies model compression techniques to reduce computation time and enable offline usage, making the application portable and efficient.

Users can personalize song selections within each emotion category to suit individual preferences, with no limit on the number of songs stored per category. Upon launching the application, users may either select songs manually or allow the system to detect their current emotional state automatically.

Following emotion recognition, the system plays a curated playlist matching the detected mood. Users can update their emotional state at any time by reinitiating the image capture process, allowing dynamic and adaptive music recommendations tailored to their real-time emotions.

III. SYSTEM ARCHITECTURE

The system architecture integrates facial emotion recognition with music recommendation by combining a Flutter frontend, a Flask backend, and AI models. It ensures real-time emotion detection, efficient processing, and seamless interaction with external music APIs to deliver personalized playlists based on user emotions.



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IV. METHODOLOGY

The proposed emotion-based music player employs a multimodal approach combining facial expression and voice-based emotion recognition. For facial emotion detection, images captured via the device's camera are processed through a Convolutional Neural Network (CNN). The CNN extracts hierarchical features through convolutional and max-pooling layers, followed by classification using fully connected layers with a softmax output. Data augmentation techniques are applied during training to enhance model generalization and reduce overfitting.

For speech emotion recognition, audio inputs undergo preprocessing, including noise reduction and feature extraction using Mel-Frequency Cepstral Coefficients (MFCCs). A Recurrent Neural Network (RNN) architecture, specifically Long Short-Term Memory (LSTM) units, models temporal dependencies in speech signals for accurate emotion classification.

Once the user's emotional state is identified from either modality, the system interfaces with external music services such as Spotify and YouTube via their APIs to retrieve and curate personalized playlists matching the detected mood. The Flutter frontend provides a seamless user interface, while a Flask backend manages AI model serving and communication with music APIs. Rigorous testing, including unit and integration tests, ensures robustness, low latency, and responsiveness in real-time scenarios.

V. DESIGN AND IMPLEMENTATION

The proposed emotion-based music player system integrates several components to deliver real-time, personalized music recommendations. The design follows a modular architecture comprising a Flutter-based frontend, a Flask-powered backend, and AI models for emotion detection.

The frontend provides a clean, minimalistic interface, dynamically adapting its theme based on detected user emotions through CSS color gradients. User interactions such as music playback controls are handled via JavaScript functions, ensuring responsiveness and smooth navigation.

Emotion detection is achieved by combining computer vision and deep learning techniques. Face detection utilizes the Haar Cascade classifier from OpenCV to identify and localize faces in images captured via the device camera. The detected face regions are processed by a Convolutional Neural Network (CNN) implemented with Keras and TensorFlow, which classifies emotions into categories such as happy, sad, calm, and angry.

The backend, developed using Flask, manages AI model inference and communicates with external music services like Spotify and YouTube through their APIs. This enables dynamic playlist generation aligned with the user's emotional state. Rigorous testing and optimization ensure low latency, offline capability through model compression, and seamless frontend-backend integration, resulting in a robust and user-centric application.

VI. RESULTS AND DISCUSSION

The system was evaluated to determine its effectiveness in detecting user emotions and providing appropriate music recommendations. Facial emotion recognition, a critical component, achieved an accuracy of approximately 65% to 70% in well-lit conditions where the user's face was clearly visible. This accuracy reflects the model's robustness under controlled lighting but indicates potential limitations in varying environmental conditions. The reliance on a pre-labeled music dataset allowed for seamless retrieval and playback of mood-aligned songs once the emotion was classified.

The user interface performed reliably, with all music player controls responding promptly to user interactions. The facial recognition module demonstrated low latency, ensuring real-time responsiveness without perceptible delays. Webcam access requests at application launch functioned correctly, respecting user privacy by disabling access when inactive.

To validate classification performance, the system compared live user images against a curated dataset representing distinct emotions such as happy, sad, angry, and calm. The comparative analysis confirmed consistent recognition

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results, supporting the system's efficacy in real-time emotion-driven music recommendation. Overall, the results validate the feasibility of integrating emotion recognition with adaptive music playback in a mobile environment.

VII. CONCLUSION

This project successfully developed an AI-powered emotion-based music player capable of detecting user emotions through facial expression analysis and providing personalized music recommendations in real time. The integration of convolutional neural networks for emotion classification and seamless backend API connectivity enabled an adaptive and interactive user experience. Testing demonstrated satisfactory accuracy in emotion recognition under controlled lighting conditions, with a responsive and user-friendly interface.

By automating mood-based song selection, the system offers an intuitive alternative to conventional music players, enhancing user engagement and emotional well-being. Although the model performs well within its current scope, future improvements could focus on increasing robustness under varied environmental conditions and expanding emotion categories. Overall, the project represents a meaningful advancement toward emotionally intelligent multimedia applications, bridging the gap between human affect and digital entertainment.

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