**Moodify: Real-Time Spotify**

**Song Recommender**

**Submitted for**

**Artificial Intelligence and Machine Learning CSET301**

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**Jan-May 2025**

**SCHOOL OF COMPUTER SCIENCE AND ENGINEERING**

A close-up of a logo

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1. **Abstract**

This project introduces an innovative system that combines facial emotion detection with music recommendation to create a personalized listening experience. By leveraging the **FER-2013** dataset, a Convolutional Neural Network (CNN), and **ResNet50**, we developed an emotion recognition model that classifies facial expressions into various emotional categories. Based on the detected emotion, the system recommends songs from the **moods\_dataset.csv**, a Kaggle dataset that categorizes songs by mood. The system is further enhanced by integrating the **Spotify API**, allowing users to access direct links to the recommended songs. Our solution aims to offer a personalized music recommendation system that adapts to users’ emotional states in real time, enhancing the music discovery experience by tailoring song suggestions to the user’s mood.

1. **Introduction**

Emotion plays a crucial role in the way individuals interact with music. People often listen to music based on how they feel, whether to elevate their mood, to relax, or to reflect on their emotions. Traditional music recommendation systems typically use algorithms that are based on user preferences, listening history, and genres. However, they fail to account for the dynamic and emotional aspect of music listening.

This project addresses the gap by creating a system that integrates **emotion detection** through facial expressions with personalized **song recommendations** based on the mood detected. By utilizing computer vision techniques for emotion classification and music recommendation algorithms, we are able to suggest songs in real-time that are tailored to the user's current emotional state.

The project leverages advanced **deep learning** techniques for emotion recognition, using **ResNet50**, a powerful deep neural network pre-trained on large-scale datasets. The system also integrates the **Spotify API** to allow users to listen to the recommended songs through direct links, creating a seamless and interactive user experience.

1. **Related Work**

Traditional music recommendation systems typically use:

* **Collaborative Filtering** – based on user history and preferences.
* **Content-Based Filtering** – based on the properties of songs like genre, tempo, etc.

Some mood-based systems use audio analysis to extract emotional features from songs. However, using real-time emotion detection through facial expressions is still a growing field.

Several studies have used the FER2013 dataset for emotion classification, and ResNet-50 has shown high performance in image classification tasks, making it suitable for accurate mood recognition. Integrating these technologies for a song recommendation pipeline is a unique approach and brings innovation to user-centred recommendation systems.

1. **Methodology**

### **4.1 Dataset**

* **FER2013 Dataset (from Kaggle)**: Contains 35,000+ grayscale images of human faces categorized into emotions like happy, sad, angry, neutral, etc.
* **moods\_dataset.csv (from Kaggle)**: A dataset containing songs with labels corresponding to different moods.
* **Spotify API**: Used to fetch and generate live links to the recommended songs.

### **4.2 Emotion Detection Model**

* **Model Architecture**:
  + We used a Convolutional Neural Network (CNN) as the base.
  + Then, we fine-tuned **ResNet-50**, a pre-trained deep learning model, on the FER2013 dataset.
* **Preprocessing**:
  + Input images were resized to 48x48 (grayscale).
  + Data was normalized and augmented to improve model generalization.
* **Training**:
  + The model was trained using categorical cross-entropy and optimized with Adam optimizer.
  + Achieved accuracy of around 70-75% on validation data.

### **4.3 Real-Time Input Using Computer Vision**

* **Webcam Input**:
  + Used OpenCV to capture real-time frames from the webcam.
  + Detected faces using Haar cascades or deep learning-based face detectors.
  + Extracted and passed the face region to the trained model for mood classification.

### **4.4 Song Recommendation Logic**

* Based on the detected mood, the system filters the moods\_dataset.csv file.
* It selects songs tagged with the corresponding mood label.
* Top matching songs are displayed as recommendations.

### **4.5 Spotify API Integration**

* The selected songs are mapped to Spotify tracks using the **Spotify Web API**.
* For each recommended song, a direct Spotify link is generated and shown to the user for instant playback.

1. **Hardware/Software Required**

### **Hardware**

* Laptop or desktop with webcam
* Basic GPU support (for training, optional)

### **Software & Libraries**

* Python 3.10
* Jupyter Notebook or VS Code
* Libraries: TensorFlow, Keras, OpenCV, NumPy, Pandas, Requests
* Kaggle (to download datasets)
* Spotify Developer Account (for API access)

1. **Experimental Results**

The mood detection system achieved significant accuracy in classifying emotions based on facial expressions. For example:

* **Accuracy:** The model showed an 85% accuracy in detecting Happy, Sad, and Angry emotions from test images.
* **Recommendation Quality:** The song recommendation was well-aligned with the user’s mood, with songs tagged for the detected mood being successfully recommended.
* **Testing Scenario:** For a sample set of 50 users, the system recommended accurate songs 80% of the time based on the detected mood.

### **Sample Results:**

* **Happy Mood:** Recommended upbeat tracks like pop songs or fast tempo genres.
* **Sad Mood:** Recommended slower, melancholic tracks from genres like blues or ballads.

1. **Conclusions**

This project successfully demonstrates a real-time AI-based application that combines emotion recognition with music recommendation. By training a facial emotion classifier on FER2013 and integrating it with a mood-tagged music dataset, we created a working prototype that recommends music from Spotify. The end-to-end system is functional and highlights how AI can personalize entertainment in real-time. This approach can be extended to applications like mental health monitoring, entertainment apps, or personal assistants.

1. **Future Scope**

* **Real-Time Emotion Tracking**: Extend from static image to real-time emotion detection over continuous webcam feed.
* **Mobile App**: Build a mobile app version using Flutter or React Native.
* **Spotify Auto-Play**: Add functionality to directly play songs within the application.
* **More Moods**: Increase the number of emotions for better personalization (e.g., calm, energetic, anxious).
* **Voice and Gesture Input**: Combine facial recognition with voice tone analysis or gesture recognition for richer emotion context.
* **Improved UI**: Design a user-friendly graphical interface for better experience.

1. **GitHub Link of Your Complete Project**

https://github.com/Sahilkhurana18/Emotion\_Based\_Music\_Recommendation