International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

Emotion Based Music Recommendation System

M. Harshitha, *UG Student, Department of CSE Sreenidhi Institute of Science and Technology, Hyderabad. India*

S. Vinya Sri, *UG Student, Department of CSE Sreenidhi Institute of Science and Technology, Hyderabad. India.*

A. Mahith Reddy, *UG Student, Department of CSE Sreenidhi Institute of Science and Technology, Hyderabad. India.*

Mrs. B. Vyshali, *Assistant Professor, Department of CSE Sreenidhi Institute of Science and Technology, Hyderabad. India.*

Manuscript Received: Apr 12, 2025; Revised: Apr 24, 2025; Published: Apr 24, 2025

Abstract: To make it even better, the system lets users give feedback in real-time, so they can help the app suggest songs they like. It also learns over time, getting better at guessing what music someone might enjoy based on how their feelings change and what they listen to. The system can work on different music streaming services too. Today, music plays a big role in how we feel and can make our days better. Usually, music apps suggest songs based on what people like or what they've listened to before. But these methods often don't really understand how our feelings change. This paper introduces a new idea called the Emotion-Based Music Recommendation System (EMRS), which picks songs based on how we feel right at that moment. Tests show that EMRS makes people happier and more engaged with their music compared to regular music recommendation systems. This new idea could really help with mental health, stress relief, and make music more personal and enjoyable. This system uses special technology to understand our emotions. It looks at our facial expressions, the tone of our voice, and even things like our heart rate to figure out how we're feeling. It uses smart computer programs called deep learning models to sort our feelings into groups like happiness, sadness, anger, or calmness. Then, it connects these feelings to music that fits those emotions using a special method that combines different ways of finding song recommendations.

Keywords: Emotion-based music recommendation, affective computing, mood-based playlist generation, real-time emotion detection, facial expression recognition, deep learning, CNN-RNN hybrid model, AI-driven music recommendation, collaborative filtering, content-based filtering, personalized music experience, multimodal emotion recognition, human-computer interaction.

1. Introduction:

This smart system can thus create a Emotion Based Music Recommendation System (EMRS) whereby a person's current mood can be understood by this technology and a piece of music will subsequently be suggested to the person that may fit better with their mood. If anything, it can do this by looking at things like facial expressions, tone of voices or even physical signs of something such as heart rate. These clues will allow the system to get to know whether someone is happy or sad or angry, or relaxed. Not only is such a system entertaining, but it can also be used to address points such as mental health and stress relief. EMRS can play music which coincides with how someone is feeling in order to silence the anxiety, bring up the spirits, and put a smile on someone's face. With more and more people looking for personal experiences online, EMRS is a big step forward to building music platforms that really understand our changing mood. After knowing how someone feels, the EMRS applies special computer methods to suggest music that correlates to someone's emotion. First of all, EMRS can adjust in real time. Unlike regular systems that only look at what someone liked before, EMRS keeps learning from how users react, making sure the music suggestions are always fitting and enjoyable. Users can also adjust what they want to hear, making it a more fun and interactive experience. With so many music apps available, it can be hard to find songs that match how we feel at the moment. To help with this, special systems have been created that suggest music based on our personal preferences and emotions. The report that follows describes how this system was designed, built, and tested, showing how it can make users happier and change the future of how we find music. These emotion-based music recommendation systems are a great step forward because they understand the link between music and how we feel. They can suggest songs that fit our mood by looking at things like our facial expressions, how we talk, or even what we type. Whether we want to feel happier, calmer, or more excited, these smart systems can help us find the right music. This project is all about creating a music recommendation system that uses the latest technology, like machine learning and emotional analysis. The goal is to connect our feelings

International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

with the music we love, making it easier and more enjoyable to discover new songs. By combining our emotions with advanced technology, this project hopes to change the way we enjoy music, turning it not just for fun, but also a way to feel better.

2. Literature Review

Today, one can identify emotions better using advanced computer techniques such as deep learning. What they did was, they found out that they give better guesses for the moods of people by watching their facial expressions, and therefore, they can give suggestions for the kind of music. Furthermore, they also study how people speak to learn what their feelings are through special methods. Even, they play with tools that measure the activity of the brain and heartrates when music impacts our feeling. This can be very accurate, but these technologies aren't easy to use where you have since they can be expensive or hard to get. Music recommendation is all about making the users enjoy the songs. For the start, they would suggest music depending on the type of music people like (or what others with the same taste listened to). However, sometimes, these suggestions didn't give the person feelings of feeling the exact way they did feel at the time. And similarly, a very exciting idea of combining different kinds of methods to make music recommendations even better. Using those things — things people like and the features of the songs, as well as things people feel about them — researchers have found ways to come up with systems of music that would fit a person's mood. In some of these systems, users train them on what to say, making them smarter. Researchers then took a look at how emotions were associated with music choices as a means of making things better. But they learnt from it that we may read how someone feels from their face, their voice, or, even, by checking their heartbeat. To this end one of the scientists named Picard helped to demonstrate how computers can tell when someone is emotional, then combine that emotion reading capacity with music recommendations. Nonetheless, there are some improvements yet to be made. The only way to do this work quickly and securely is sometimes not always easy to tell how the individual is feeling. The future research is to make these music recommendations even better by recognizing the emotions in a different way and personalizing the music experience even further. These days, ongoing research has shifted to multimodal emotion recognition systems which include facial expressions, speech and physiological signals to increase precision and user's satisfaction. All of which have enabled recent advancements in deep learning/deep learning-based architecture and hybrid recommendation techniques to add a great flexibility to emotion driven music recommendations. In addition, sentiment aware AI model coupled with collaborative filtering and content-based filtering have been further advanced to cope with the mechanisms measuring the real time response, which provides the learning and personalized approach. Despite the existence of these obstacles, emotion ambiguity and real time limitations become areas of problems where users can experience synthesized emotions that are not easily categorized, and require the real time processing to recommend music, which may take some time. Moreover, privacy related to emotion recognition data constitutes ethical and security issues that require building privacy protecting AI models usable by the public at large. Despite these challenges, the coming of artificial intelligence, human computer interaction and music psychology into one may offer great potential in the future of emotion centric music recommendation systems. These systems have been the focus of researchers fueling their desire to understand methods of making these systems both adaptable, responsive, and emotionally aware.

3. Problem Statement

Most traditional music recommendation systems tend to see what songs you liked previously or usually listen to. They sometimes fail to understand how you feel right now, and thus it's difficult to look for songs that are the best according to your mood at the moment. To fix this, an Emotion Based Music Recommendation System attempts to play songs depending on the state of the music consumer's mind at the moment. It can read your emotions, prospect your voice and also what you write. That being said, you need to take care of your own personal information as well as respect your privacy. This kind of technology can be used in music apps, smart speakers or on your phone to further improve your music listening. This system will provide you with songs to listen to by suggesting the model for your mood making their experience with music fun and more personal. It saves you time hunting and the time you should be spending listening to music that makes you happy. It is a system that assigns feelings, i.e., happiness, sadness, or just excitement to different kinds of music, beats, and lyrics. Image a friend who knows what you're going to say. But over time technology even becomes smarter, and special computer programs that enable the music technology to figure out what you feel more easily and to choose what it thinks is

International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

appropriate for you to listen to. Also, it maintains its song list while you are shifting from one song to another. It's so easy to explore new music that you'll certainly love.

4. Proposed System

Proposed System

By looking at the face of a person, our system can tell what emotions are in that person. Then, it can suggest songs that fit into someone's mood after it learns how they feel. A person can take a picture of himself, and through a live camera, an emotion will be detected and a relevant song suggested in a main webpage. Our program then sends that picture to find out their emotion. Second, when we know how they feel we use another tool, the Spotify API, to find and show music that will fit that emotion. Here we are working on a system, which can find out how a person feels by looking at his face, and it is based on special computer programs which understand what such people feel. Deep Neural Networks — which are smart computer tools that can recognize faces and many other things in pictures — are what we use. This tool is generally good for determining images and there is one specific instance of this tool, Convolutional Neural Networks, which is excellent at understanding images.

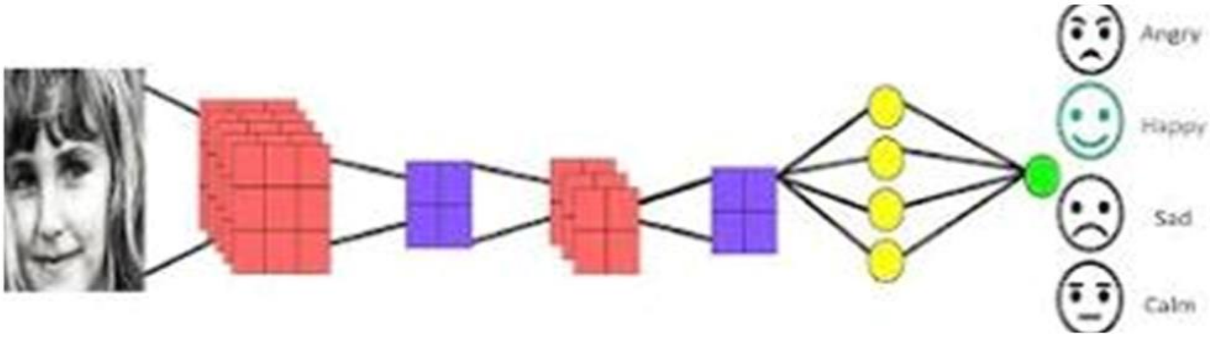

Figure-1 Convolutional Neural Network (CNN) designed for facial emotion recognition

Modular Design

User Input Module

Purpose: Captures the user's current emotional state using different input methods.

Role:

- Collects facial expressions, voice tone, or text-based inputs.
- Ensure smooth interaction with the user.
- Sends raw emotion-related data to the Emotion Detection Module for processing.

Emotion Detection Module

Purpose: Processes the input and determines the user's emotional state.

Role:

- Uses machine learning (ML) and deep learning (DL) models to analyze emotions.
- Identifies emotions like happy, sad, excited, relaxed, angry, etc.
- Passes the detected emotion to the Recommendation Engine for personalized music selection.

Music Database & Preprocessing Module

Purpose: Stores and categorizes songs based on features like genre, tempo, and emotion tags.

Role:

- Collect songs from Spotify API, Last.fm API, or local databases.
- Extracts feature such as BPM (tempo), lyrics, mood, and energy levels using Librosa.

International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

- Maps songs to specific emotions for better recommendations.

Recommendation Engine

Purpose: Matches the detected emotion with suitable songs and recommends them.

- **Role:**
- Uses Content-Based Filtering (analyzing song features) to suggest relevant music.
- Uses Collaborative Filtering (analyzing user behavior and feedback) for better personalization.
- Implements a Hybrid Model that combines both approaches for accurate results.
- Send the recommended playlist to the User Interface Module.

User Interface Module

Purpose:

It provides an intuitive interface for end users to use with the system.

Role:

It has a modern HTML/CSS/JavaScript front end that allows you to upload multiple files in batches, view progress on them as they upload, view detailed display of their results as they come in, and it offers the option to download results in different formats

Architecture of Emotion based music recommendation

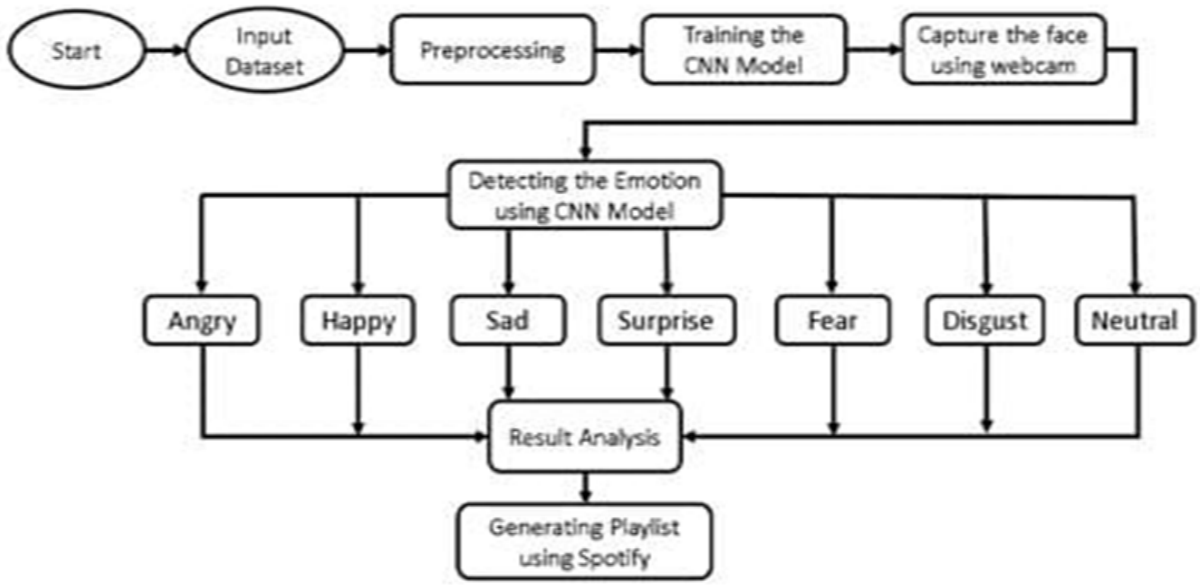

Figure-2 Facial Emotion Recognition and Music Playlist Generation Workflow

Project Components.

Spotipy Module: A Python library for interacting with the Spotify API, used to retrieve music tracks based on recommendations.

Haarcascade: A pre-trained model for detecting faces in real-time video streams, used to identify faces for emotion analysis.

camera.py: Processes the streaming video, captures frames, predicts emotions, and suggests songs, passing the results to main.py.

International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

main.py: The main Flask application that integrates emotion detection with music recommendations and serves the web interface.

index.html: A simple web page with HTML and CSS that provides the front-end interface for the application.

Technology Stack:

Keras: A deep learning framework running on TensorFlow, used to build and train the emotion detection model.

TensorFlow: A machine learning library that provides a backend for Keras, allowing for efficient deep learning computation.

Spotipy: A lightweight Python library for accessing the Spotify Web API to retrieve music recommendations.

Tkinter: A Python GUI toolkit used for testing before integrating a full web application.

Flask: A lightweight web framework for running a backend server and serving a web application.

HOW IT WORKS:

Capturing User Input (Face Detection & Emotion Recognition)

- Face Detection using Haarcascade The webcam is accessed by the system and frames are captured with OpenCV. Haarcascade model identifies faces in the frame and identifies the Region of Interest (ROI). The face is cropped and preprocessed for emotion analysis after detection.
- Image Preprocessing: The face is transformed to grayscale (simplifying complexity). Resized to 48×48 pixels (size required by the CNN model). Normalized (pixel values range from 0 to 1) for improved performance of neural networks.

Emotion Prediction with CNN Model

Architecture of Convolutional Neural Network (CNN)

- The CNN model is of Sequential Architecture: Conv2D Layers (Feature Extraction)
- Filters: 32, 64, 128 (depth increasing) Kernel Size: 3×3 Activation Function: ReLU MaxPooling2D Layers (Down sampling)
- Pool size: (2,2) Reduces the spatial dimensions, making the model efficient. Dropout Layer (Regularization)
- Dropout Rate: 0.25 Prevents overfitting by disabling some neurons randomly. Flattening and Dense Layers
- Transforms the extracted features to a 1D array. Fully connected Dense layer uses Softmax Activation for classifying 7 emotions: Happy, Sad, Angry, Disgust, Fear, Neutral, Surprise

Model Prediction Output

The model makes an emotion prediction in real-time per frame. The predicted emotion is passed to the music recommendation module.

Music Recommendation Process

Emotion-to-Music Mapping

The target emotion is mapped onto particular music genres.

Example emotion-music mappings:

- Happy → Happy, peppy songs (Pop, EDM, Dance)
- Sad → Slower, gentle music (Blues, Acoustic, Classical)
- Angry → Fast-paced tracks (Rock, Metal)
- Calm → Calming, instrumental tracks (Lo-Fi, Jazz, Ambient)

International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

Fetching Songs from Spotify using Spotipy API

The system accesses Spotify Web API through Spotipy. Depending on the detected emotion, it fetches relevant songs from the Spotify database. Spotipy gives a playlist of suggested songs with metadata like: Track Name Artist Genre Mood Tags Tempo, Key, Energy Level, Danceability

Web Application Interface (Flask & HTML/CSS)

- Flask Backend (main.py) Gets the predicted emotion from camera.py. Makes a call to the Spotify API to retrieve music suggestions. Sends information to the HTML frontend to display results.
- Frontend (index.html & CSS) Shows: User's Webcam Feed Detected Emotion Recommended Songs with Playable Links

Real-Time Processing & Feedback Loop

The system constantly monitors the emotions of the user and dynamically updates song suggestions. Users can like/dislike songs, which assists in refining future suggestions through adaptive learning.

Key Features and advantages of proposed system:

- **Multi-Modal Classification:** Combines the analysis of image and text to deliver complete content moderation.
- **Deep Learning-Based Feature Extraction**: Employs CNNs for image classification and CNN/LSTM-based architectures for natural language processing.
- **Personalized Recommendations**: Continuously adapts based on user feedback, preferences, and listening history for tailored experience.
- **Real-Time Emotion Tracking**: Dynamically updates song recommendations as the user's mood changes over time.
- **Scalability & Real-Time Processing:** For cloud deployment, used for real time inference and better to handle larger scale applications.
- **Robust Preprocessing & Augmentation**: It normalizes, resizes and augments the data to help generalize the model.
- **Adaptive Learning:** Fine tuning on the domain specific dataset is supported for further improvement in the classification accuracy via transfer learning**.**

Advantages:

User Rating System:

Promotes Positive Behavior: Favors positive behavior by rewarding users with high ratings, creating a more decent online community.

Identifies Potential Offenders: Empowers the platform to flag or track users with persistent low ratings, which enables early intervention and moderation**.**

Data-Driven Insights:

Analytics for Improvement: Empowers the platform to study user ratings data to determine trends and patterns, which results in ongoing improvement in anti-bullying mechanisms.

Fosters Responsibility:

Encourages users to be responsible for their online activity, as their ratings may influence their position within the community.

International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

5. Results

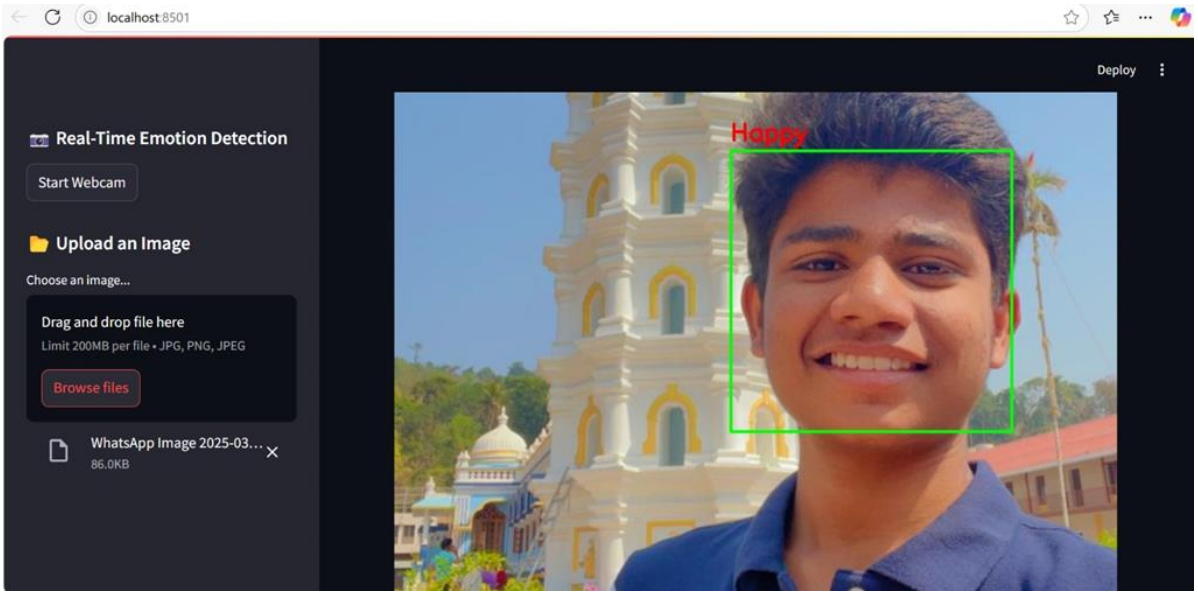

Figure-3 Upload Image

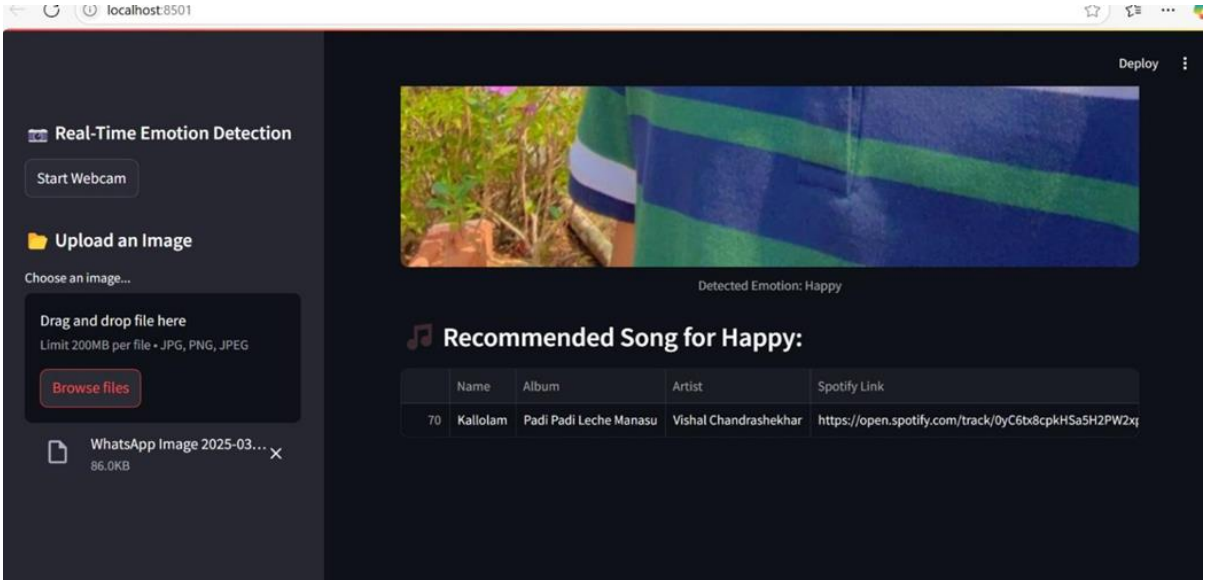

Figure-4 Recommendation of Song Based on Emotion - Happy

International Journal of Current Research and Techniques (IJCRT)
E-ISSN: 2349-3194 (Online) | P-ISSN: 2348-4446 (Print)
UGC Approved Journal No: 47722 [No: 2616]
DOI: https://doi.org/10.5281/ZENODO.15277333

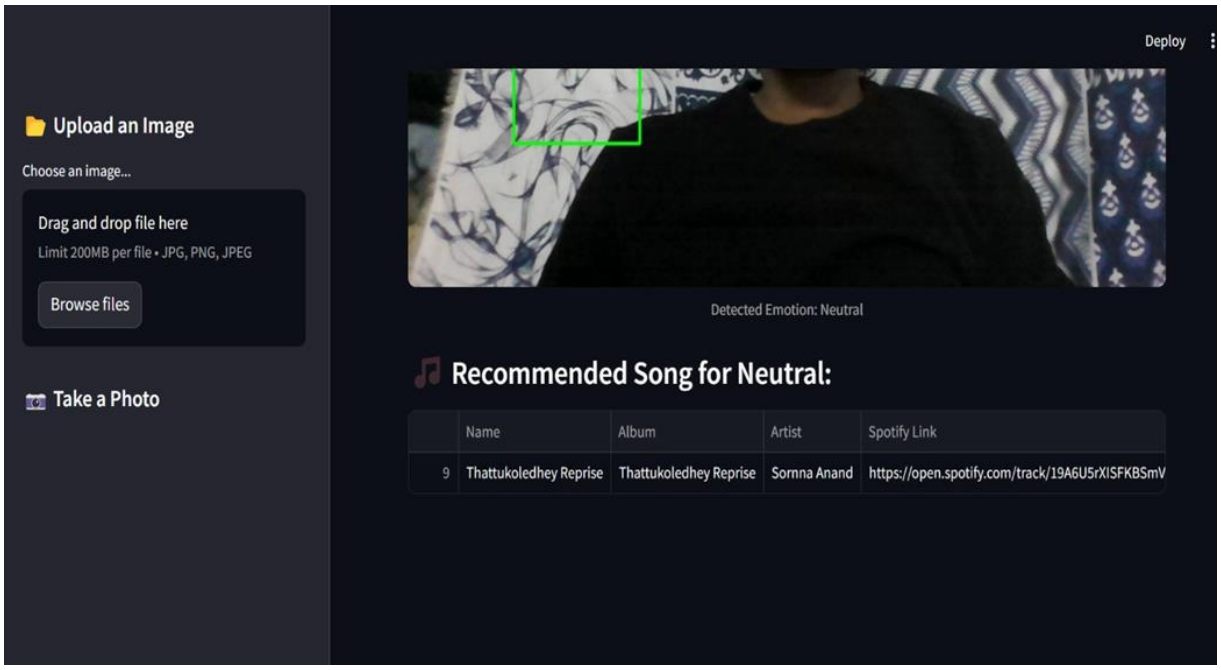

Figure-5 Recommendation of Song Based on Emotion - Neutral

6. Conclusion

As the Emotion Based Music Recommendation System closes the gap between human emotions to technology by making available real-time personalized listening experience. The system is based on deep learning and computer vision and then it identifies facial expressions, processes emotions and suggests music depending on user's mood. In contrast to standard recommendations in the crowd, this project goes further in adaptive, contextually aware and dynamic recommendations. In addition to enhancing the experience of our users, it is also a way of increasing emotional IQ over AI powered music selection. Flask, Spotipy, OpenCV, and CNNs applications make the system efficient, scalable and robust so that it can be used on all platforms like Web, Mobiles and smart Assistant. Additional terms that may be included in the mood detection process include speech analysis, text sentiment detection, and wearable technology to make the system even more intelligent. This system has the potential to reteach people to engage with music in their daily life via upgrades such as offline mode, wearable and more AI that focuses on privacy. Today's music streaming services could have an industry norm of emotion driven suggestions with advancing technology. In a nutshell, this project combines music, emotions, and AI to build a smooth, pleasant, and extremely personalized musical experience due to the fact that music should always be felt right.

7. Future Scope

Although the Emotion Based Music Recommendation System has a lot of scope for its further development, it has a great possibility of making the system smarter, adaptative and more immersive. Another important aspect of improvement is how to introduce expansion of emotion detection by supporting more than one mode of detecting emotion, for instance voice tone analysis can be added and text sentiment detection during the interaction as it is richer as source of emotion than just seeing the text of the conversation. Besides, there is the possibility of integrating wearable into smartwatches and fitness trackers, providing real-time feedback on heart rate, stress level, and physiological response, making the suggestions of mood more precise. We extend the system further to the AR/VR environment so that music can adapt in real time according to people's current emotional status in context of gaming, meditation, or virtual reality. Smart home and IoT compatibility: This system also becomes smart home compatible and can change the atmosphere as you change the mood made by Alexa, Google Home and smart speakers.

Customer listening habits can be used by adaptive AI to adapt recommendations over time, based on an adaptive AI who can learn continuously from its behavior. User interaction would also be increased with features like

playing different music at different times of day, different activities, weather etc., all this being context aware features. Many users might find offline mode useful for downloading mood-based playlists to enjoy the music well. The platform can also do social mood-based playlists, where listeners can share the emotions on the playlist and distribute it with others for social listening experience. Additionally, AI-generated music suggestions can serve as a future application to serve mental health and therapy to aid in stress reduction, relaxation and emotional comfort. Thus, if an individual wants music therapy at home, using the therapeutic tool with personalization can go further to autism, depression and anxiety patients. These upcoming innovations make it possible for the system to possibly evolve into something as a next generation AI based music assistant, that would foster the change in the way people interact with music by being more intuitive, responsive as well as being emotionally intelligent.

8.References:

[1] TensorFlow. (n.d.). TensorFlow Transfer Learning Tutorial. Retrieved from https://www.tensorflow.org/tutorials/images/transfer_learning
[2] Analytics Vidhya. (n.d.). Understanding CNNs for image classification. Retrieved from https://www.analyticsvidhya.com/blog/2018/12/guide-convolutional-neural-networks-cnn/
[3] GeeksforGeeks. (n.d.). Word2Vec Implementation. Retrieved from https://www.geeksforgeeks.org/word2vec-implementation/
[4] GeeksforGeeks. (n.d.). Implementation of convolutional neural network in Keras. Retrieved from https://www.geeksforgeeks.org/implementation-of-convolutional-neural-network-in-keras/
[5] Abdat, F., Maaoui, C., & Pruski, A. (2011). Human-computer interaction using emotion recognition from facial expression. In 2011 UKSim 5th European Symposium on Computer Modelling and Simulation (pp. 344-349). IEEE.
[6] Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press. https://www.deeplearningbook.org