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EMOTION-BASED MUSIECOMMENDATION SYSTEM USING FACIAL EMOTION RECOGNITION

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Abstract: ***This paper presents the design and implementation of an Emotion-Based Music Recommendation System using Facial Emotion Recognition. The system is developed to provide personalized music recommendations based on the user's real-time emotional state. Traditional music recommendation systems mainly depend on user history, playlists, and search preferences, but they do not consider the user's present mood. To overcome this limitation, the proposed system uses facial emotion recognition to detect the user's emotions and recommend suitable songs automatically. The system captures the user's facial image through a webcam and processes it using OpenCV for face detection. A pre-trained deep learning model built using TensorFlow/Keras is used to classify emotions such as happy, sad, angry, surprised, and neutral. Based on the detected emotion, the system recommends music from a song dataset and provides a user-friendly interface through Streamlit. The system also includes SQLite-based user authentication for login and registration functionality. The proposed system improves user experience by reducing manual song searching and creating a more intelligent and interactive music listening platform. The implementation demonstrates the practical use of machine learning, computer vision, and recommendation systems in entertainment applications.***

Keywords: ***Emotion Recognition, Facial Emotion Detection, Music Recommendation System, Machine Learning, Deep Learning, Computer Vision, CNN, OpenCV, Streamlit, Personalized Music Recommendation.***

1. INTRODUCTION

Music is an important part of human life and is closely connected with emotions. People often listen to music based on their mood, feelings, and mental state. In many situations, users prefer songs that match their emotional condition, such as happy songs during joyful moments or calm songs during stressful situations. However, in most existing music applications, users need to manually search for songs or playlists according to their mood.

With the advancement of **Artificial Intelligence (AI)**, **Machine Learning (ML)**, and **Computer Vision**, it is possible to create systems that automatically understand human emotions. One of the most effective methods of detecting emotions is through **facial expression recognition**, where the system analyzes the user's face and identifies emotional states.

The proposed **Emotion-Based Music Recommendation System** is designed to detect the user's facial expression through a webcam and recommend songs based on the detected emotion. The system uses **OpenCV** for face detection and a **deep learning model** for classifying emotions. After emotion recognition, the system suggests songs from a music dataset that match the user's mood.

This project aims to improve the music listening experience by making it more **personalized, automatic, and intelligent**. It combines emotion recognition with recommendation techniques to build a smart entertainment system.

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2. LITERATURE SURVEY

The development of intelligent music recommendation systems has gained significant attention in recent years due to the increasing demand for personalized entertainment. Researchers have focused on combining **emotion recognition, facial expression analysis, and machine learning** to improve music recommendation systems.

Several studies have proposed **facial emotion-based music recommendation systems** in which a webcam is used to capture the user's facial expressions. These expressions are analyzed using image processing and deep learning techniques to identify emotions such as happiness, sadness, anger, surprise, and neutrality. Based on the detected emotion, songs are recommended from predefined datasets or online music sources.

Research in **facial emotion recognition** has shown that **Convolutional Neural Networks (CNNs)** provide high accuracy in identifying emotions from facial images. Many systems use facial datasets such as FER2013 and CK+ for training emotion classification models. These models are effective in recognizing basic human emotions and can be integrated into real-time applications.

Traditional music recommendation systems generally rely on **user preferences, listening history, and ratings**. However, such systems fail to understand the user's real-time emotional state. To overcome this limitation, researchers introduced **emotion-aware recommendation systems**, which improve personalization by considering the user's current mood.

From the reviewed literature, the following key observations can be made:

- Emotion recognition improves personalization in recommendation systems.
- Deep learning models are effective for facial emotion classification.
- Real-time emotion-based recommendation systems provide better user experience.
- Existing systems often lack a simple interface and real-time implementation.

The proposed system is developed to address these limitations by integrating **real-time facial emotion recognition with music recommendation** in a user-friendly web application.

3. PROPOSED SYSTEM

The proposed system is an **Emotion-Based Music Recommendation System** that recommends songs according to the user's facial emotions. The main objective of the system is to automatically identify the emotional state of the user and suggest suitable music without requiring manual song selection.

The system consists of the following major modules:

- User Interface Module
- Face Detection Module
- Emotion Recognition Module
- Music Recommendation Module
- Music Playback Module
- User Authentication Module

The user first accesses the application through a **Streamlit-based web interface**. The webcam captures the facial image of the user. The system then detects the face using **OpenCV Haar Cascade Classifier**. After detecting the face, the image is passed to a pre-trained **deep learning model (model.h5)**, which predicts the emotion.

The recognized emotion is used to fetch suitable songs from the music dataset (muse_v3.csv) and multilingual song recommendations (multilingual_songs.py). The recommended songs are then displayed to the user, and the selected song is played.

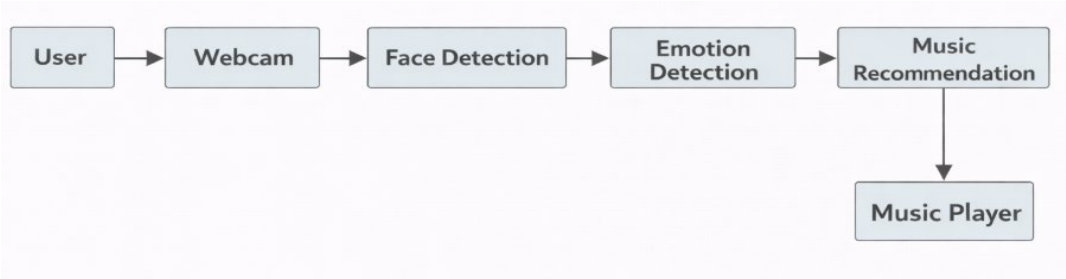

Fig 1: Proposed System

The system also includes a **SQLite database (users.db)** for user login and registration functionality, making the application more secure and user-oriented.

4. METHODOLOGY

The methodology of the system is organized into the following steps:

1. User Login / Access:

The user opens the application and accesses the system through the Streamlit interface.
If authentication is enabled, the user can register and log in using credentials stored in SQLite.

2. Image Capture:

The webcam captures the user's facial image in real time.

3. Face Detection:

The captured image is converted into grayscale and processed using the **Haar Cascade face detection algorithm** provided by OpenCV. This helps in locating the face region from the input frame.

4. Emotion Detection:

The detected facial image is resized and passed to the trained **deep learning model (model.h5)**. The model predicts the user's emotion among classes such as:

- Happy
- Sad
- Angry
- Surprise
- Neutral
- Fearful
- Disgusted

5. Music Recommendation:

Once the emotion is identified, the system searches the music dataset and maps the detected emotion to suitable songs.

6. Song Display and Playback:

Recommended songs are displayed to the user through the Streamlit interface.
The user can then play the selected song.

7. User Experience Improvement:

The system aims to create a more natural and personalized music recommendation environment by combining emotion detection and automated recommendation.

5. PROPOSED SYSTEM HARDWARE RESULTS

The proposed system was successfully implemented and tested under different conditions. The application effectively captured facial images, detected emotions, and recommended music accordingly.

Implementation Results

- The **Streamlit interface** provided a simple and interactive environment for users.

- The **OpenCV Haar Cascade classifier** successfully detected user faces in real-time.
- The **deep learning model (model.h5)** classified emotions correctly for common expressions.
- The **music recommendation module** successfully mapped emotions to songs from the dataset.
- The **SQLite database** worked properly for user registration and login.

Files Used in Implementation

The project was implemented using the following files:

- **app.py** → Main application file
- **model.h5** → Trained facial emotion recognition model
- **haarcascade_frontalface_default.xml** → Face detection file
- **muse_v3.csv** → Music recommendation dataset
- **multilingual_songs.py** → Multilingual song suggestions
- **users.db** → SQLite database for user accounts
- **requirements.txt** → Required dependencies

Advantages of the Implemented System

- Real-time emotion detection
- Personalized music recommendation
- Reduced manual song searching
- User-friendly interface
- Integration of AI and entertainment

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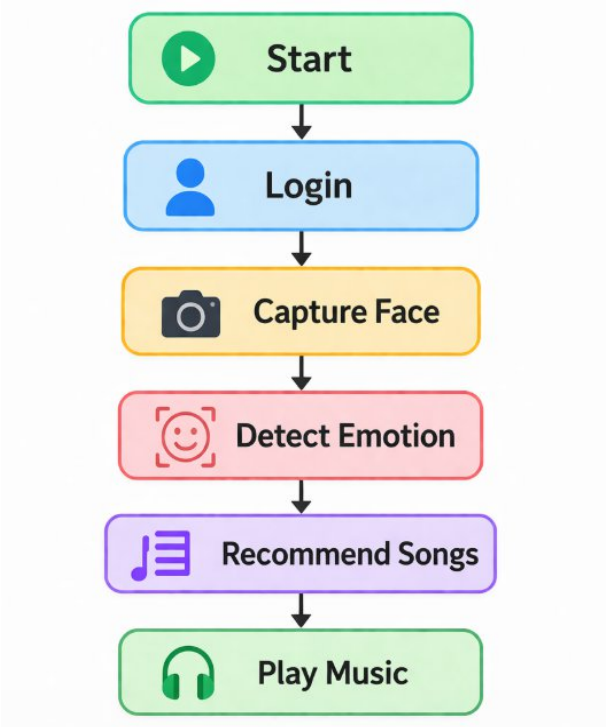

Fig 2. Application Workflow

6. CONCLUSION

This work successfully developed an **Emotion-Based Music Recommendation System using Facial Emotion Recognition**. The system effectively captured facial expressions, identified emotions using a deep learning model, and recommended songs based on the detected emotional state.

The proposed system provides a **smart and personalized music listening experience** by automatically understanding the user's mood. Unlike traditional music recommendation systems, this system considers the user's current emotional condition rather than depending only on previous listening history.

The project demonstrates the practical use of **machine learning, computer vision, and recommendation systems** in real-world entertainment applications. Overall, the system proved to be effective, interactive, and useful for mood-based music recommendation.

7. FUTURE SCOPE

The proposed system can be improved further in several ways. More advanced **deep learning architectures** can be used to improve emotion recognition accuracy. The system can also be integrated with online music platforms such as **Spotify, YouTube Music, or JioSaavn** to provide a wider range of recommendations.

In the future, the system may also use **voice emotion analysis, text sentiment analysis, and physiological signals** along with facial expressions for better emotion detection. Another enhancement is to convert the system into a **mobile application** for wider accessibility.

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