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Emotion Detection through Facial Expressions Based Music Recommendation System

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ABSTRACT: Music has the power of healing an individual as quoted by Ray Charles. Music plays a very important role in recognizing an individual's emotions and state of mind; it is a great way for people to express themselves as well as it is an important medium of entertainment for music lovers and listeners. Listening to music helps us relax and calm down. Music is also considered to be the most effective medium as it can induce deep feelings with some kind of message in it. With the advancement in technology, the number of artists, their music, and music listeners all are increasing, and here comes the problem of manually browsing and choosing the music according to their mood or choice. This is where our project comes into the role, as we all know to face an organ of the human body which plays a vital role in extracting human behaviours and their state of mind. Our project detects the mood of the user and recommends a song or playlist according to his mood. The project uses a web camera to capture the image of the user, it then classifies the facial expression as happy, sad, neutral,disgust, fearful, surprised or angry and then recommends the song according to the input image. The major advantage of this project is that the user doesn't need to implement and choose songs manually.

KEYWORDS: Face detection, Face identification, Face verification, Facial expression, Music classification, Music Recommendation

I. INTRODUCTION

Facial expression is an important form of emotional state and mental state. Psychologist Mehrabian's research shows that only 7% of the total information is passed by language, and 38% is transported by language auxiliary, such as the rhythm of speech, tone, etc. But the Ratio of information which passed by facial expression has reached 55% of the total. Therefore, a lot of valuable information can get by facial expression recognition that gives an effective way to the perceive person's consciousness and mental activity. Because of this, facial expression recognition, showing important theoretical research value, practical value and the life application value, has become an important research topic.

Roughly thirty years ago, music listeners have to listen to the radio, go to musical events, or buying cassettes to listen to their favourite music. At that time, music listeners did not have direct ability to decide which piece of music is going to be played next or music composition in a playlist (in a cassette or other media). In the 2000s, music listeners can listen to music digitally using devices such as computers or mp3 players and finally have a direct ability to create playlist and decide which music is going to be played.

Music listeners have a tough time creating and segregating the playlist manually when they have hundreds of songs. It is also difficult to keep track of all the songs: sometimes songs that are added and never used, wasting a lot of device memory, and forcing the user to find and delete songs manually. Users have to manually select songs every time based on interest and mood. User's also have difficulty to reorganize and playing music when playstyle varies. So, we have used Machine Learning concept which involves facial scanning and feature tracking to determine the user's mood and based on it gives a personalized playlist.

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BASIC TERMINOLOGIES

- **Face Detection**: Face detection is to determine that a certain picture contains a face weneedtobeabletodefinethegeneralstructureofface.Luckilyhumanfacesdonotgreatlydifferfromeachother;weall have noses,eyes,foreheads,chinsandmouths.allofthesecomposethegeneralstructureofaface.Itisaconceptoftwo-classclassification: face versus nonface. Face detection can be regarded as a specific case ofobject-class detection. In object-class detection, the task is to find the locations and sizesof all objects in an image that belong to a given class. It can be understood as shownbelow:

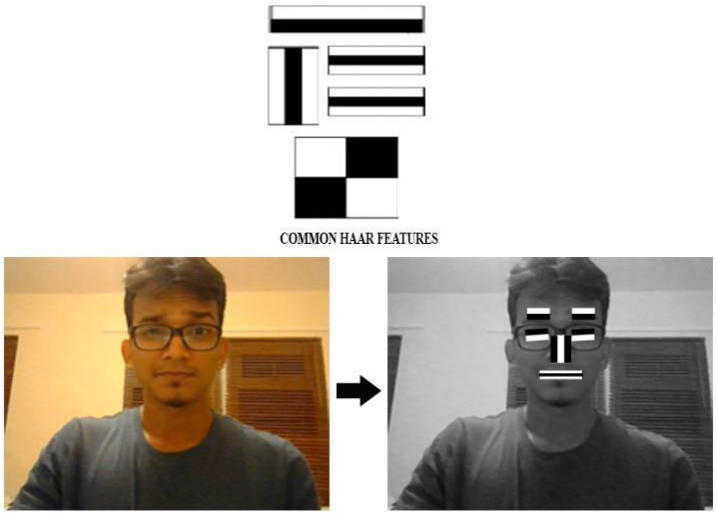

Fig-1:ObjectDetection

1 **Face Identification:** In this the system compares the given individual to all the otherindividualsin the databaseandgives a rankedlistof matches.

2 **Face Verification:** In this the system compares the given individual with who thatindividualsays theyareand givesayes orno decision.

3 **FacialExpressions:**Facialexpressionisoneormoremotionsorpositionsofthemusclesbeneaththeskinoftheface. Thesemovementsexpresstheemotionalstateofthepersontoobservers.Itisaformofnon-verbalcommunication.Itplaysacommunicativerolein interpersonalrelations. The commonones are:

Fig-2:Facial Expressions

- **Music Recommendation:** In this the system, according to the features extracted from the music we

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recommend the song matching with the emotion extracted from facial expression. Details of it will be mentioned in the following chapter, where we will also see how we plan on implementing the approach.

II. LITERATURE SURVEY

- **Sushmita G. Kamble and A. H. Kulkarni [1]**, they proposed a system in which they used PCA (Principal component approach) for feature extraction. To classify and recognize the expression Euclidean distance classifier was used. Then, the user's corresponding emotional state is recognized. When the user's expression is recognized, songs belonging to that category are then played. They used the database with 7 expressions of 4 individual's persons that results into 112 trained images.
- **Anuja Arora; Aastha Kaul; Vatsala Mittal [2]**, they submitted a program in which the DEAM data set was used to classify the emotions. It has more than 2800 songs with 4 emotions annotated: Happy, Sad, Angry and Relax, and with their values of valence and excitement. The idea behind this article is to pay attention to predicting emotions of an audio file as to how good audio elements are used in the music player.
- **H. Immanuel James, J. James Anto Arnold, J. Maria Masilla Ruban, M. Tamilarasan (2019) [3]** proposed "Emotion Based Music Recommendation" which aims at scanning and interpreting the facial emotions and creating a playlist accordingly. The tedious task of manually Segregating or grouping songs into different lists is reduced by generating an appropriate playlist based on an individual's emotional features. The proposed system focuses on detecting human emotions for developing emotion-based music players. Linear classifier is used for face detection. A facial landmark map of a given face image is created based on the pixel's intensity values indexed of each point using regression trees trained with a gradient boosting algorithm. A multiclass SVM Classifier is used to classify emotions Emotions are classified as Happy, Angry, Sad or Surprise. The limitations are that the proposed system is still not able to record all the emotions correctly due to the less availability of the images in the image dataset being used. Diverse emotions are not found. Handcrafted features often lack enough generalizability in the wild settings.
- **S. L. Happy and A. Routray [4]**, image from database is passed to the facial landmark detection stage to remove noise by applying Gaussian Filter or mask. Here itself they used Viola Jones technique of Haar-like features with Adaboost learning for face detection.The feature detection stage consists of Eyebrow corners detector, Eye detector, Noise detector, Lip corner detector. After this active facial patch are extracted, the classification of features is done by SVM (Support Vector Machine). While testing it will take the hundreds of images from the database and extract the features and classifies accordingly. They used CK+ (Cohn-Kanade) dataset and JAFEE dataset for training and testing the database. The training database consist of 329 images in total.
- **KrittrinChankuptarat,Raphatsak,Sriwatanaworachi, Supannada Chotipant [5]**,proposes a mobile music player application which is able to recommend songs based on the user emotion.When the application receives a user heart rate from a smart band or a face image from a mobile camera, it analyses what the user emotion is. Then, it suggests songs whose moods are relevant to that user emotion. The user and song emotions in this paper are divided into four types namely: neutral, happy, sad, and angry. The experimental results present that detecting the happy emotion is the most precise with around 98%, while the accuracy of the sad mood detection is the lowest with 40%.

III. METHODOLOGY

The generalized procedure to determine the facial expression has three major steps. Once the image having a human face is given as an input to the system, the first step is the detection of the face in the give input image that is done by extracting important features and then the face is recognized. Secondly, the facial feature are extracted from the input image. Finally, these facial features will be given asinput to the classifier for identifying the respective expression which is the final output.

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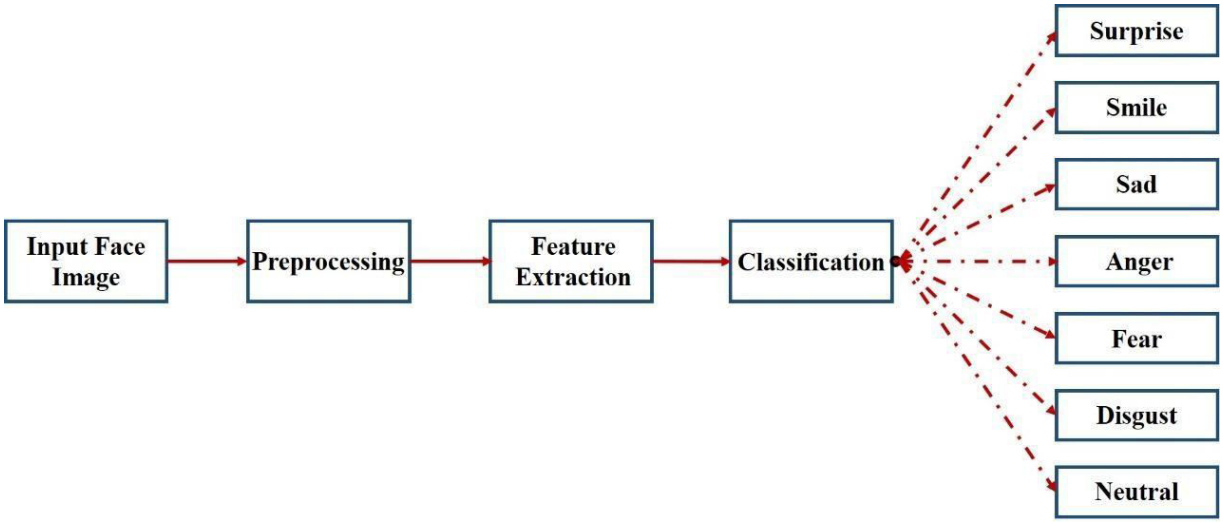

Fig-3: Inner Workflow

STAGES INFACIAL EXPRESSION RECOGNIZER

The three essential steps in the expression recognizer are explained below:

Step 1: FACE DETECTION

This step is to find out that whether the particular input image has a face that we require to explain the basic facial structure. Here, we extract the face from the background because images with background illuminations can make the identification of the facial expression difficult. Fortunately, human faces do not differ from each other, as all humans have eyes, nose, chins, mouth; and all of these together form the structure of a face. Face detection one of the special cases of object detection. Various methods of face detection is shown below.

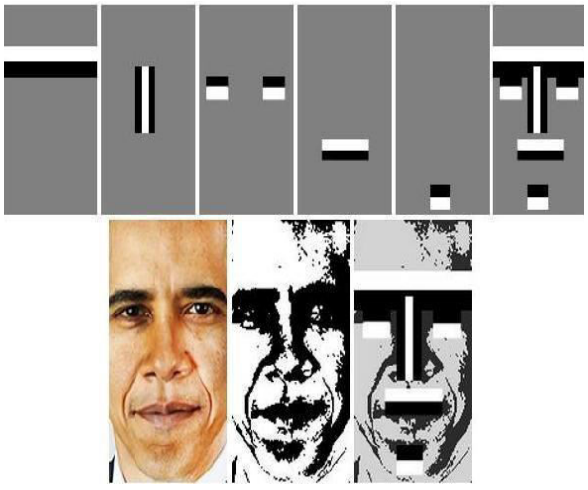

Fig-4:HAAR- likeFeaturedetection

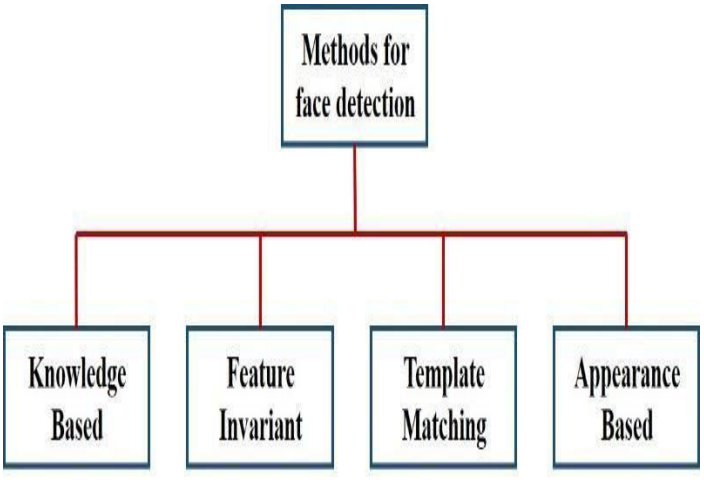

Fig-5: Face Detection Methods

Step 2: IMAGE PREPROCESSING

Raw input images may contain noise with various unwanted effects. Recognition of face fails when the test image has a different lighting pattern than that of the training images. Hence, facial points will detected

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incorrectly. The main goal of pre-processing the input image is to get an image having intensity that is normalized such that the changes in the environment shall not have anyeffects.

Step 3: FEATURE EXTRACTIONS

The procedure of converting an input image to some sets of feature is known as feature extraction which will help in the reduction of the great amount of data into small data which can help in making the model computationally efficient. Some set of points are selected representing the features of a human face such as eyes, lips, cheeks, etc., through pixel intensities. There are various techniques for feature extraction as shown below:

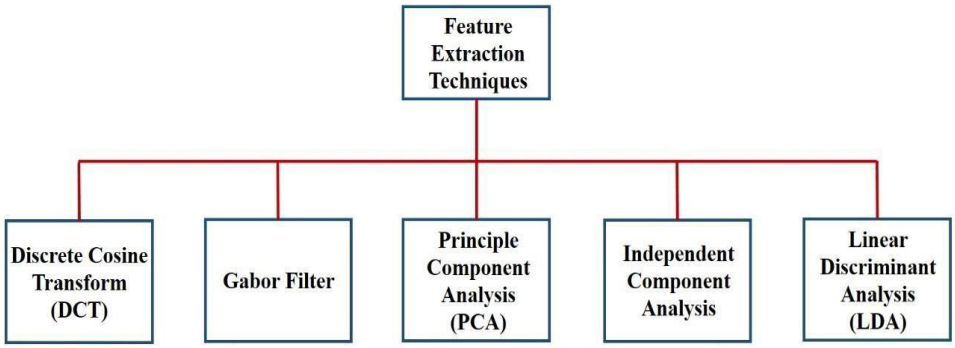

Fig-6: Feature Extraction Techniques

Step 4: CLASSIFICATION

The final stage of the FER System is the classification of the expressions into various categories like happy, sad, angry, et c. The facial expression classification is done using supervised learning. Using the training data set the classifier will first be trained and will then be tested on the test data to recognize the facial expression of the images. There are various classification techniques that can be used to extract expressions from an image and is shown in Fig.7.

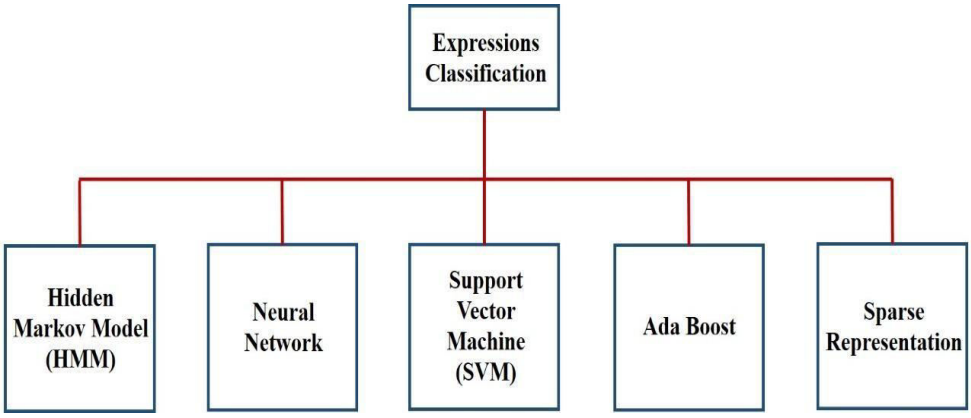

Fig-7: Expression Classification Techniques

MUSIC RECOMMENDATION

Now after we get the emotion the user is currently experiencing through the input image; our next task is to link the music APIs to the recommender section so that we can make the system suggest us songs. For each detected emotion a customised list of songs gets displayed, updated to the latest music in Spotify.

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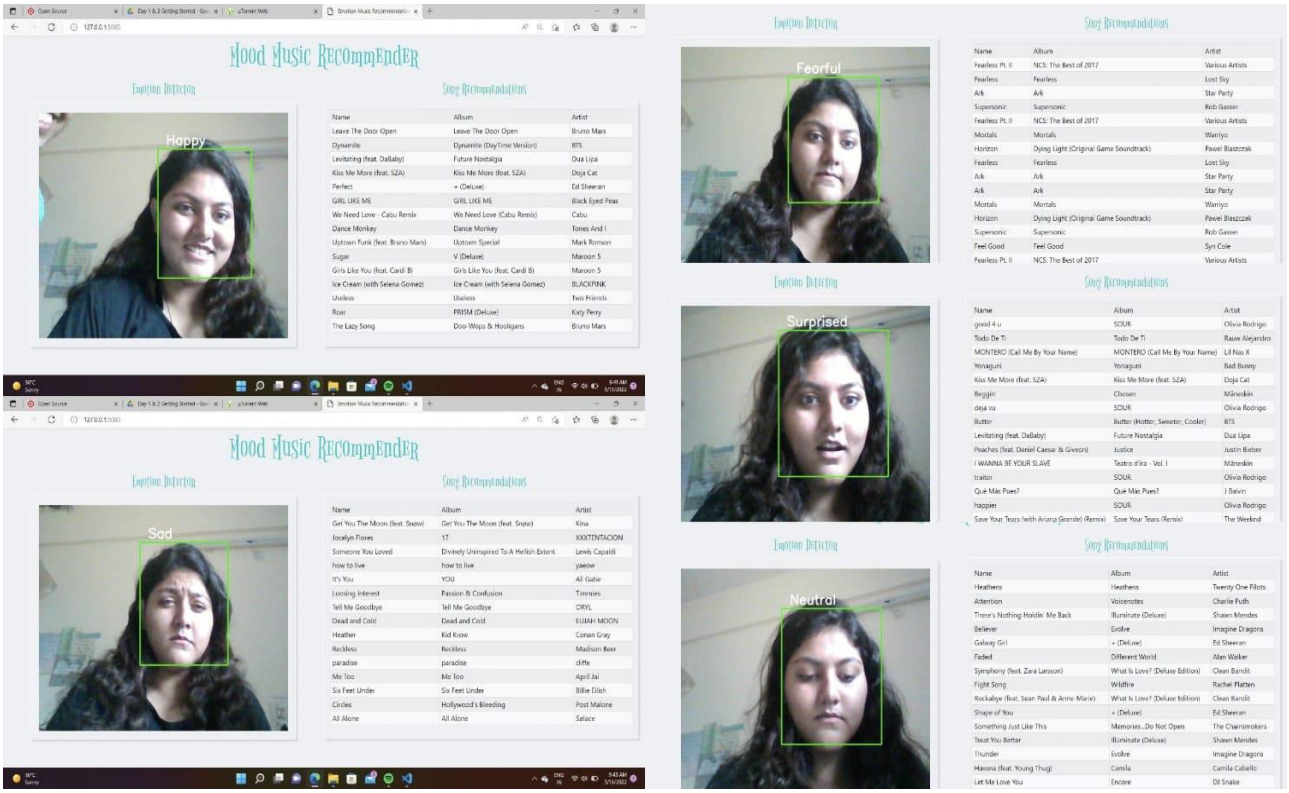
IV. RESULTS

In our implemented system, we used Flask to deploy the model. The model architecture is a sequential model consisting of Conv2d, Maxpool2d, Dropout and Dense layers. The model was trained onFER2013 dataset, resulting in an accuracy of 66% at best. The results of the working prototype has been shown below:



V. CONCLUSION

The project presents a generic model to recommend music based on the user emotions. The core of our proposed approach is to construct the recommendation model from music, for music plays an important role in conveying emotions of the users.The aim of this paper was to explore the area of automatic facial expression recognition for implementation of an emotion based music recommendation system. Beginning with the psychological motivation for facial behavior analysis, this field of science has been extensively studied in terms of application and automation.

The Emotion Based Music System will be of great advantage to users looking for music based on their mood and emotional behavior. It will help reduce the searching time for music thereby reducing the unnecessary computational time and thereby increasing the overall accuracy and efficiency of the system. The system will not only reduce physical stress but will also act as a boon for the music therapy systems and may also assist the music therapist to therapize a patient. Most of the media player provide list of songs in users music library and option to select or search the song but it becomes increasingly difficult task. System will provide better enjoyment to the music listeners by providing the most suitable or appropriate song to the user according to his current mood.

In this paper, we present a proposed system and an approach for recomendation of mood basedplaylist. The proposed system will reduce the efforts of user in creating and managing playlist it will not only help user but also the songs are systematically sorted. The fundamental purpose of the system was to change or maintain the emotional state of the user and boost up the mood of the user by exploring music tracks or providing motivational quotes with specific attributes.

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