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Emotion-based Music Recommendation System

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Abstract: Understanding how someone is feeling through their facial expressions is essential. By employing a camera, the necessary information can be taken directly from the subject's face and used to calculate data that can be used to ascertain their mental state. This information can then be used to create a list of songs that are appropriate for the "mood" inferred from the input. This greatly reduces the time-consuming and difficult job of manually organizing music into different playlists, enabling the construction of a playlist that matches a person's emotional qualities. This data will be examined and understood by the Facial Expression Depending Music Player, which will then create a playlist depending on the required parameters. In order to create a music player that is based on emotions, our system's main goal is to recognize human emotions. The methods utilized by current music players to identify emotions are discussed in the paper, along with our strategy for doing so and the reasons why our system is better. We give a brief description of the operation of our algorithm, playlist generation, and emotion classification. Our system uses a number of approaches to assess and ascertain a person's emotional state, including emotion identification, linear classifiers, facial landmark extraction, and SVM classification. Our system can create an emotion-based music player that can identify a person's feelings and create playlists in accordance by fusing facial expression recognition technology with music classification. Our approach greatly reduces the laborious and time-consuming job of manually classifying songs, creating a useful and tailored musical experience that matches a listener's emotional state.

IndexTerms - Facial Landmark Extraction, SVM Classification, Linear Classifier, Emotion Recognition.

I. INTRODUCTION

In recent years, the field of music information retrieval has introduced a new prospect for computers to automatically analyze and comprehend music. Due to the vast and intricate nature of music material, researchers in this area explore a diverse range of issues that encompass computer science, digital signal processing, mathematics, and statistics, as well as musicology. These issues include automatic audio genre/mood classification, music similarity computation, audio artist identification, audio-to-score alignment, query-by-singing/humming, and other advancements in music information retrieval. Music suggestion based on content is one of the practical applications that can be offered. Using context information, we can create more sophisticated music recommendations based on the content. Developing a content based music recommendation system necessitates multidisciplinary efforts, such as emotion description, emotion detection/recognition, feature-based categorization, and inference-based recommendation. An emotion descriptor has been employed to efficiently characterize music taxonomy. Emotions can be represented as a

set of continuous values mapped onto a set of real numbers, which is a fundamental assumption for emotion representation. A groundbreaking approach to describing human emotions was presented by researchers in the form of a circumflex model, in which each affect is displayed over two bipolar dimensions: pleasant unpleasant and arousal-sleep. As a result, each affective word can be characterized as a combination of pleasurable and arousing elements. Another researcher later applied Russell's model to music. The analysis of emotions in music has gained momentum in recent times, leading to a variety of approaches being developed for this purpose. Thayer's approach involves the two fundamental dimensions of "arousal" and "valence," where emotions are classified on a continuum ranging from passive to intense along the arousal level and from negative to positive along the valence dimension. The emotional plane formed by these two dimensions is divided into four quadrants, with each quadrant comprising a set of eleven emotion adjectives. In contrast, Xiang et al. proposed a "mental state transition network" to describe the evolution of emotions through different states, such as joyful, sad, angry, disgusted, afraid, surprised, and calm. However, other emotions like anxiety and excitement are not accounted for in this approach. With the development of efficient feature extraction techniques and digital signal processing, automatic identification and recognition of emotions in music have become feasible. These advancements have led to the rapid expansion of research on emotion recognition in music, with potential applications in music entertainment and human-computer interaction systems. Feng's study was among the first to use the Computational Media Aesthetics (CMA) 3 point of view for emotion recognition in music. The study examined two variables, tempo and articulation, which were mapped onto four mood types: joy, rage, sadness, and fear. Despite the progress made in the field of music emotion recognition, there is still much to be explored. Emotions are complex and multifaceted, and existing approaches may not capture all the nuances of emotional experiences. Future research can focus on developing more comprehensive models of emotion recognition in music that consider a broader range of emotions and factors that influence emotional experiences.

II. LITERATURE REVIEW

There are numerous tools and servicesavailable for creating music playlists and playing songs, but the majority of them needhuman labor. Different strategies and approaches to classifying human emotional states have been presented and developed byresearchers [5]. These approaches, however, have mostly concentrated on a limited number of basic emotions while applying complicated procedures [2]. Several research papers on the issue have been published:

1. One study deal with the issue of matching music to the listener's current feelings. It proposes an emotion-based music player that recommends songs based on the user's emotions, such as grief, happiness, anger, or neutrality. The player recognizes the user's facial image with a smart bond or a cameraon a mobile device or laptop and

2. In another paper, an intelligent agent organizes a music collection depending on the emotions given by each song. It then recommends a playlist to the user based on their current mood. The user's local music library is initially clustered based on the mood of the song, which is determined by evaluating the lyrics and melody. When a user requests a mood-based playlist, they take a picture of themselves, which is then subjected to facial detection and emotion recognition systems toidentify their emotion. As a playlist, the system suggests music that corresponds to this emotion.

3. Individuals' ownership of recorded music has increased significantly dueto the convenience of recording, playing, processing, and managing digital audio [2]. Affection, a system for organizing enormous music collections, has been developed. Itorganizes pieces of music that communicate similar feelings and provides each group a correspondingicon. These icons make it simple for listeners to choose music based on their feelings.

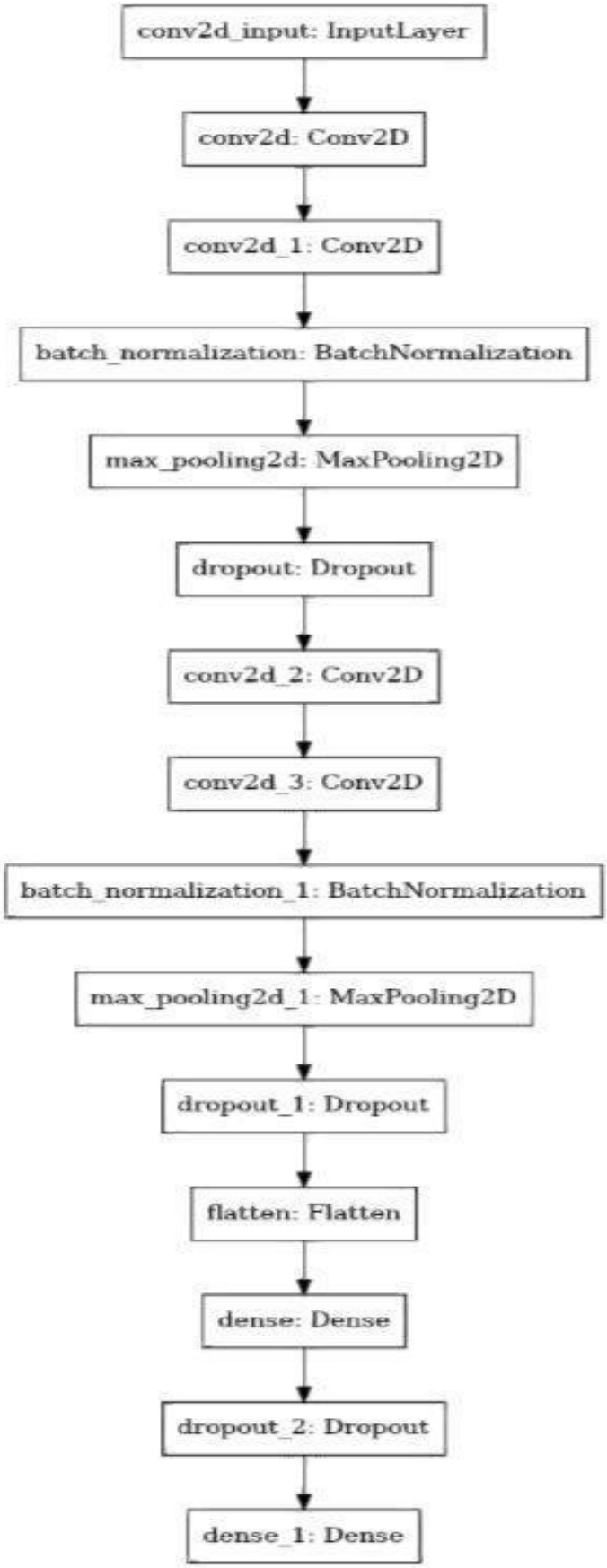
4. A complete discussion of numerous methodologies for determining moodbased on human emotion facial expressions is offered. face structure extraction enables the identification of important face characteristics suchas the eyes, mouth, and nose, as well as the detection of facial motions. The SVM algorithm is used in emotion recognition. Furthermore,the work investigates and describes multimodal

deep learning algorithmsfor human emotion identification, suggesting that incorporating biological inputs in a multimodal approach improves emotion recognition accuracy.

The publications cited above offer a music player that produces playlists based on user- captured photos [5]. Manually selecting playlists and music based on current feelingscan be time-consuming and uninteresting [8]. Many people choose songs at random from their playlist, resulting in mismatched music choices that do not match their present mood.

- Sadness causes the eyes to droop and the inner corners of the brows to rise.
- Surprise: The upper eyelids and brows both show surprise, while the jaw drops open and the shoulders lift.
- Anger causes both the lower and upper eyelids to enlarge, narrowing and pressing together. The jaw clenches forward, and the lips press together forcefully.
- Contempt: A contemptuous expression isdisplayed when one side of the upper lip is tightly lifted upwards.
- Disgust: The person's nose wrinkles in disgust, accompanied by the upper lip rising and the bottom lip dropping and protruding.
- Fear causes the upper lids to rise and thepupils to dilate. The brow furrows, and the lips purse and expand horizontally.
- Joy: The corners of the mouth raise to form a smile. The cheekbones raise, and the brows' outer edges pull down.

BLOCK DIAGRAM/ MODEL OF OUR SYSTEM



II **TECHNIQUES**

Several strategies and methodologies have been investigated in the subject of emotion- based music recommendation systems in order to properly capture and analyze the emotional content of music. These strategies are critical in presenting consumers with individualized and contextually relevant music recommendations based on their emotional preferences. We explore some of the prominent strategies used in emotion-based music recommendation systems in this research study.

One method is to analyze several auditory aspects of music, such as tempo, pitch, timbre, and rhythm, in order to extract emotional cues. These characteristics can be used to create models that categorize music based on its emotional content. Signal processing, spectral analysis, and machine learning methods are frequently utilized for this purpose

Lyrics Analysis: Understanding the emotional content of a song requires the analysis of lyrics. To extract semantic and sentiment information from the lyrics, Natural Language Processing (NLP) techniques are used. The emotional features of a song can be discovered by evaluatingthe words, phrases, and feelings portrayed inthe lyrics.

Collaborative filtering: Collaborative filtering is a popular technique in recommendation systems, particularly emotion-based music recommendation. It entails evaluating comparable users' interests and activities in order to create customized recommendations. The algorithm may recommend music that matches the emotional tastes of individuals with comparable profiles by leveraging theirlistening history and emotional preferences.

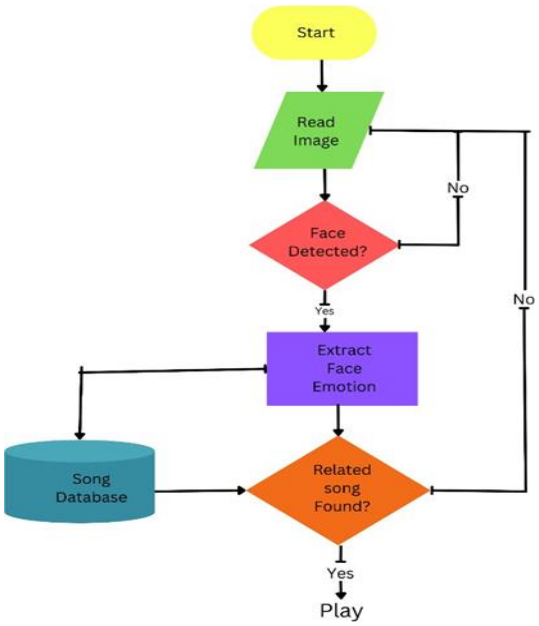
User Ratings and Feedback: User feedback is a vital source of information for refining and upgrading music suggestions. To understand the emotional responses of users to different music tracks, techniques such as implicit and explicit feedback, ratings, and reviews can be used. This feedback can be included into the recommendation system to improve its accuracy and relevance.

Contextual Information: Taking into account contextual aspects such as time, place, weather, and activities can increase the accuracy of emotion-based music selections greatly. The system may modify and deliver recommendations based on the user's current emotional state and situational environment by adding contextual information.

Many emotion-based music recommendation systems use hybrid approaches, which incorporate different techniques. A system, for example, may combine audio feature analysis, lyrics analysis, and collaborative filtering to produce comprehensive and individualized recommendations that take both musical andemotional factors into account.

It is important to note that these techniques are always improving, and academics areinvestigating novel methodologies such as deep learning, sentiment analysis, and affective computing to improve the effectiveness of emotion-based music recommendation systems. The combination of these techniques has considerable potential for generating music recommendations that are emotionally relevant to people and improve their overall music listening experience

III **SYSTEM WORKFLOW**



VI. IMPLEMENTATION RESULTSAND ANALYSIS

The proposed music recommendation system utilizes a camera attached to the computing platform to capture the image of the user, which is then processed to detect the user's emotion and select an appropriate song from their playlist. The system was tested in a real-time environment to evaluateits performance.

The classifier algorithm, trained on the FER 2013 dataset consisting of over 35000 images, demonstrated robustness in extracting facial landmarks from new and unknown images. It successfully detected the position of facial landmarks and returnedthe coordinates of the detected landmarks in real-time. This indicates that the classifier was able to generalize its knowledge from the training set to accurately identify facial landmarks in different images.

For emotion classification, the system employed a trained network using the CK extensive dataset. The classifier demonstrated an accuracy of over 80 percentfor most test cases, which is considered a good accuracy level in the field of emotion classification. This suggests that the system was effective in detecting the expressed emotion of the user based on the extracted facial features.

The system's ability to accurately predict theuser's expression in a real-time scenario further validated its performance. Byanalyzing the user's emotion, the music player selected and played an appropriate song from the user's playlist that best matched their mood. This automated processeliminated the need for the user to manually search for songs, providing an enhanced user experience.

Although the system performed well in real- time testing, further evaluation is required todetermine its robustness under different lighting conditions. Testing the system in various lighting scenarios would provide insights into its reliability and identify potential limitations or areas forimprovement.

In conclusion, the proposed music recommendation system successfully captured the user's emotion, selected suitable songs from their playlist, and demonstrated high accuracy in real-time emotion classification. The integration of facial landmarks extraction and emotion detection algorithms contributed to the system's effectiveness and enhanced the user's overall experience

6.2. Results Analysis

6.2.1. Experiment Results-

Emotion Prediction and User Instructions. Throughout the experiment, participants were given precise instructions on how to express and portray certain emotions. The emotion prediction accuracy was assessed using the participants' facial expressions andtheir intended emotions. The results, as shown in Table 6.1, indicate the system's accuracy in identifying and matchingemotions.

User	Emotion	Facial Expression	Accuracy
1	Happy	Happy	100
2	Sad	Sad	100
3	Happy	Surprised	80
4	Sad	Neutral	90
5	Surprised	Neutral	90
6	Surprised	Surprised	100
7	Sad	Angry	90
8	Neutral	Sad	85

FIG. 6.1 SYSTEM ACCURACY

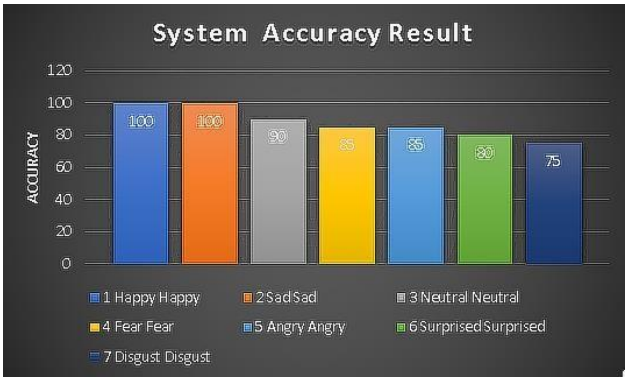


Fig. 6.2 System Accuracy Graph

It is worth noting that the algorithm attained a high accuracy rate of 100% when participants expressed happiness or sadness. However, the algorithm had difficulty properly detecting emotions when subjects presented a shocked facial expression while feeling cheerful, resulting in an accuracy of 80%. Similarly, 90% accuracy was achievedwhen participants displayed a neutral facial expression while feeling sad or astonished. Overall, with an average accuracy of 90%, the system demonstrated promising accuracyin identifying a wide range of emotions based on facial expressions.

5.2.2. Experiment Results-

The Emotion-Based MusicRecommendation System was evaluated using train and test classes consisting of various emotions labeled with correspondingaccuracy values. The train dataset compriseda total of 7,000 samples, while the test dataset contained 1,750 samples. Each emotion class was represented in both the train and test datasets

The train classes included surprise, fear, angry, neutral, sad, disgust, and happy. The accuracy values for these train classes is specified in the graph. Emotions are represented on the y-axis of the graph and accuracy is represented on the x-axis of the graph.then uses classification methods todetermine the user's emotions.

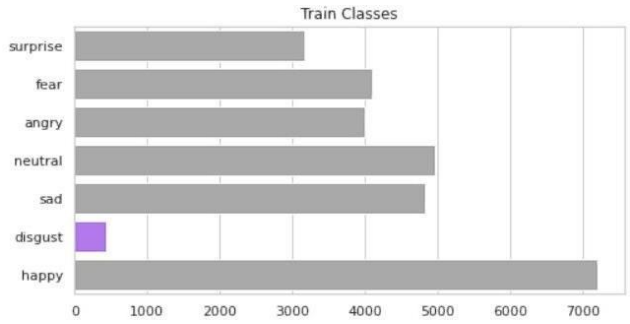


FIG. TRAIN CLASSES

The test classes consisted of surprise, fear, angry, neutral, sad, disgust, and happy, with sample counts of 850, 1,000, 950, 1,200,1,250, 120, and 1,750, respectively.

FIG. TEST CLASSES

VII ADVANTAGES OF THE APPROACH

Traditional music recommendation systems that rely on user preferences or collaborativefiltering have various advantages over emotion-based music recommendation systems. Here are some of the approach's benefits:

1. Improved User Experience: The technique creates a more personalized and engaging user experience by introducing emotions into the music recommendation system. Users can find and listen to music that matches their present emotional state, resulting in a more gratifying and immersivemusic listening experience.

2. Increased Music Discovery: Emotionsinfluence how we perceive and connect withmusic. The technology assists users in discovering new music that matches with their intended emotional context by employing emotion-based recommendations. This encourages the exploration of a wider range of music genresand artists, resulting in a more diverse and entertaining music discovery process.

3. Highly tailored suggestions: Theemotion-based approach enables highly tailored suggestions. The algorithm can give music choices that are more relevant and meaningful to individual interests by taking into account each user's emotional preferences and mood. Because the recommendations are linked with the user's intended emotional experiences, this level ofpersonalization promotes user engagementand happiness.

4. Adaptive and DynamicRecommendations: Emotions are not fixed;they can shift over time and between circumstances. The emotion-basedrecommendation system can adjust to these changes and provide real-time recommendations depending on the user's current emotional state. This adaptability ensures that the system remains relevant and sensitive to the changing emotional requirements of the user.

5. Enhanced Engagement and Retention: Music is frequently associated with emotions and has the ability to elicit powerful emotions in listeners. The technology can boost user engagement and retention by leveraging this emotional connection. Users are more likely to interact with the system for longer periods of time, explore recommended music, and discover new emotional experiences through music

6. General Applicability: The emotion- based approach to music recommendation is not restricted to any particular genre or cultural environment. feelings are universal human experiences, and music has the ability to elicit feelings from people of all cultures and musical styles. As a result, the technique may be adapted to a variety of music platforms and cater to a diverse spectrum of people, regardless of cultural or musical background.

7. Music Therapy and Well-Being Possibilities: Music has long been acknowledged for its therapeutic value, and the emotion-based recommendation system can help with music therapy and overall well-being. The method can help people manage their emotions, reduce stress, and improve their mental and emotional well- being by recommending music that corresponds to specific emotional requirements or goals.

8. Future Research Prospects: Emotion- based music recommendation systems offer interesting new areas for research and development. The field provides chances to investigate the complex interaction between music and emotions, to develop more sophisticated emotion recognition systems, and to refine recommendation algorithms in order to produce ever more accurate and individualized recommendations.

Overall, the emotion-based music recommendation system approach improves user experience, music discovery, and tailors recommendations to individual emotional preferences. The approach, which harnesses the power of emotions, provides a unique and personalized way to navigate the wide world of music, boosting engagement, contentment, and well-being.

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VIII CONCLUSION

This project represents a significant advancement in the field of machine learning technology. The Emotion based music recommendation system offers a unique solution for organizing music based on the user's emotions, whether they are feeling happy or sad. Our main objective is to develop a music player that caters to the specific needs of users, providing a rejuvenating experience during free or leisure time when we desire music that suits our current state of mind.

Through this initiative, we anticipate substantial progress in the realm of machine learning technology. The music recommendation system effectivelycategorizes songs according to the user's emotional state, enabling us to discover music that resonates with our happiness or sadness. Ultimately, our aim is to create a player that prioritizes user preferences and enriches our leisure moments by delivering music that perfectly complements the situation.

Within this study, we extensively explored the Facial Emotion Recognition Technique, which relies on the Viola and Jones algorithm in combination with principal component analysis. This powerful technique allows us to swiftly and accuratelydetect emotions, providing a robust framework for emotion recognition.

The methodologies employed in this research enable the identification of facial expressions in individuals, further contributing to the advancement of emotion detection.

This project not only holds the promise of enhancing the music listening experience forusers, but it also signifies a notable stride forward in the realm of machine learning. By leveraging innovative technologies and methodologies, such as the Facial Emotion Recognition Technique, we are paving the way for more sophisticated and nuanced

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