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NEW MUSIC RECOMMENDATION MODEL DESIGN BASED ON EMOTIONAL FACE EXPRESSIONS

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Abstract : We propose a new approach for playing music automatically using facial emotion. Most of the existing approaches involve playing music manually, using wearable computing devices, or classifying based on audio features. Instead, we propose to change the manual sorting and playing. We have used a Convolutional Neural Network for emotion detection. For music recommendations, Pygame & Tkinter are used. Our proposed system tends to reduce the computational time involved in obtaining the results and the overall cost of the designed system, thereby increasing the system's overall accuracy. Testing of the system is done on the FER2013 dataset. Facial expressions are captured using an inbuilt camera. Feature extraction is performed on input face images to detect emotions such as happy, angry, sad, surprise, and neutral. Automatically music playlist is generated by identifying the current emotion of the user. It yields better performance in terms of computational time, as compared to the algorithm in the existing literature.

1.INTRODUCTION

The relationship between music and human emotions has long been recognized, with music having the ability to evoke various emotional states. In recent years, the application of facial emotion recognition technology has gained significant attention in the field of music recommendation systems. A facial emotion-based music recommendation system is an innovative solution that aims to personalize music recommendations based on the listener's facial expression. This technology can analyze a user's facial expressions in real-time and recommend music that best matches their current emotional state. This paper explores the development and implementation of a facial emotion-based music recommendation system, including its underlying technology, its potential benefits, and the challenges that need to be addressed to optimize its effectiveness. The goal of this research is to provide a comprehensive understanding of the capabilities of such a system, along with its potential applications in the music industry and beyond. The increasing availability of high-quality facial recognition technology and the ever-growing music streaming services make this technology a promising solution for personalized music recommendations. This system has the potential to revolutionize the way we interact with music, making it more personalized and emotionally engaging. By integrating facial emotion recognition technology into music recommendation systems, we can create a more personalized and enjoyable music experience for listeners. Moreover, this technology can also have practical applications in other fields such as healthcare, education, and entertainment. However, as with any emerging technology, there are ethical, privacy, and data security concerns that need to be addressed. This research aims to identify these concerns and provide recommendations to ensure the safe and ethical use of this technology. Ultimately, this paper aims to contribute to the development of facial emotion-based music recommendation systems and provide insights for future research in this field. To achieve the objectives of this study, we will review and analyze previous research studies on facial emotion recognition technology and music recommendation systems. We will also explore various machine learning and deep learning algorithms that are commonly used in developing facial emotion recognition models. Additionally, we will conduct an empirical study by collecting data from participants to evaluate the effectiveness of the proposed system. The findings of this study can have significant implications for the music industry, providing music streaming services and music marketers with new ways to personalize their offerings. This system can help to increase listener engagement, enhance user experience, and ultimately, boost revenue. Furthermore, this technology has practical applications in healthcare, where it can be used to monitor patients' emotional state and provide personalized therapy. Overall, this study aims to contribute to the understanding of the potential applications of facial emotion recognition technology in music and other fields, paving the way for further.

NEED OF THE STUDY

Enhanced User Experience: Tailoring music recommendations to users' emotional states enhances the overall listening experience by providing relevant and mood-appropriate music selections, leading to higher user satisfaction and engagement.
Personalization and Relevance: Traditional music recommendation systems often rely on user demographics or listening history, which may not capture users' current emotional states or preferences accurately. A system based on emotional face expressions offers more personalized and contextually relevant recommendations, leading to increased user engagement and retention.

Improved Music Discovery: Discovering new music that resonates with users' emotions and mood preferences can be challenging. By analyzing emotional cues from facial expressions, the system facilitates serendipitous music discovery and introduces users to songs they might not have encountered otherwise.

Psychological Well-being: Music has a profound impact on emotions and can influence mood, relaxation, and stress levels. A music recommendation model that aligns with users' emotional states can contribute to their psychological well-being by providing therapeutic or mood-enhancing music selections tailored to their needs.

Competitive Advantage: In a crowded market of music streaming services, offering innovative features such as emotion-based music recommendations sets a platform apart and attracts users seeking more personalized and immersive music experiences. By staying ahead of competitors, the system gains a competitive edge and strengthens its market position.
In summary, the development of a new music recommendation model based on emotional face expressions addresses the need for personalized, engaging, and contextually relevant music discovery experiences. By leveraging facial recognition technology and emotion detection algorithms, such a system enhances user satisfaction, promotes music exploration, and fosters emotional connections between users and the music they love.

2. SYSTEM OVERVIEW

The facial emotion-based song recommendation system consists of three main components: the face recognition system, the emotion classification system and the song recommendation system. The facial emotion recognition system captures a video of the listener's face and extracts facial features such as eye movement, eyebrow position, and mouth shape. These features are then used to determine the listener's emotional state using a trained machine learning model.
The song recommendation system uses a recommendation algorithm to generate song recommendations based on the listener's emotional state. The algorithm considers the emotional characteristics of songs, such as tempo, rhythm, and melody, to generate recommendations that align with the listener's emotional state. The recommendations can be personalized based on the listener's musical preferences and past listening History.

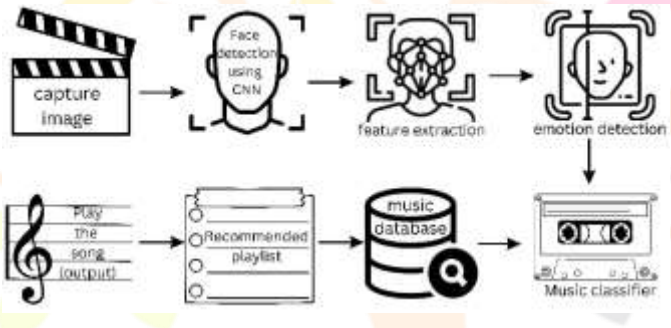

Fig 1 System overview

2.1 Capture Image

Capturing images is a crucial step in facial emotion recognition, with the help of computer vision libraries such as OpenCV, capturing images and processing them has become much easier and efficient.

Facial emotion recognition systems work by analyzing the various features of a person's face and identifying the emotions they are experiencing. To capture the image of a face, a camera is used to take a photograph of the person. This image is then processed using OpenCV libraries to identify various facial features such as the eyes, nose, and mouth.
OpenCV provides a variety of functions for image processing, including face detection, which can be used to identify the face in an image. Once the face has been detected, it is possible to extract various features such as the position of the eyes, mouth, and nose, as well as the shape of the face.

Using this information, it is possible to determine the emotion that the person is experiencing. For example, if the corners of the mouth are turned upward, it is likely that the person is experiencing happiness. Similarly, if the eyebrows are furrowed and the mouth is turned downward, the person may be experiencing sadness.

2.2 FACE DETECTION USING CNN

CNNs are a type of deep learning algorithm that is particularly suited to image recognition tasks. The training process involves feeding the CNN a large number of images and adjusting the weights of the neurons in the network to minimize the difference between the predicted output and the actual output. Once the training is complete, the CNN can be used to detect faces in new images.

Face detection using CNNs has many advantages over traditional methods such as Haar cascades. CNNs are much more accurate and can detect faces in a wide range of lighting conditions, orientations, and poses. They can also detect multiple faces in an image and provide a bounding box around each face.

2.3 Feature Extraction

Feature extraction involves identifying and extracting the relevant features of a face that are necessary for emotion recognition. In facial emotion recognition, the features of a face that are most commonly used include the position and shape

of the eyes, eyebrows, mouth, and nose. Other features such as the texture and color of the skin and the shape of the face may also be used.

Haar cascades are one of the most common techniques for feature extraction in facial emotion recognition. Haar cascades are essentially a set of features that are used to detect objects in an image. In the case of facial emotion recognition, these features are designed to detect the eyes, nose, mouth, and other relevant facial features.
Haar cascades work by scanning an image at different scales and sizes, looking for the presence of the features. The features are essentially rectangular regions of the image with dark and light regions. By combining multiple features, it is possible to detect more complex objects such as faces.
Once the features have been detected, they can be used to train a machine learning model such as CNN to recognize emotions.

3.RESEARCH METHODOLOGY

3.1 PRODUCT ARCHITECTUER

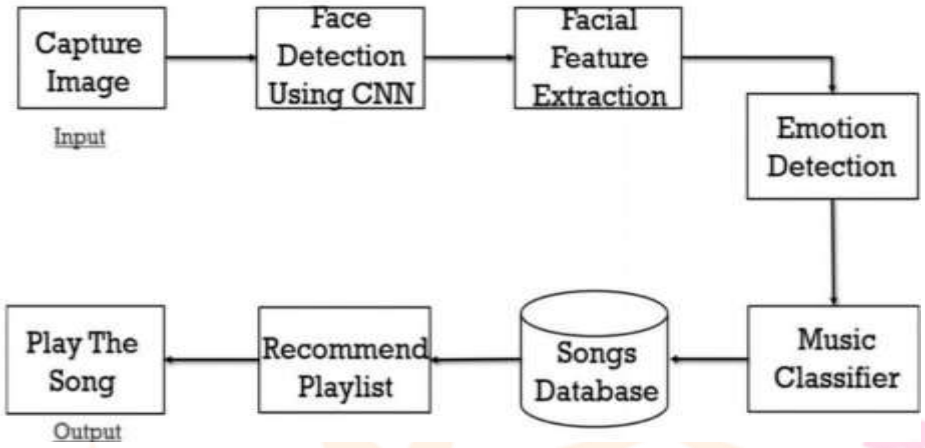

Fig 2 System Architecture

The proposed system benefits us to present interaction between the user and the music player. The purpose of the system is to capture the face properly with the camera. Captured images are fed into the Convolutional Neural Network which predicts the emotion. Then emotion derived from the captured image is used to get a playlist of songs. The main aim of our proposed system is to provide a music playlist automatically to change the user's moods, which can be happy, sad, natural, or surprised. The proposed system detects the emotions, if the topic features a negative emotion , then a selected playlist is going to be presented that contains the foremost suitable sorts of music that will enhance th e mood of the person positively. Music recommendation based on facial emotion recognition contains four modules.

- Real-Time Capture: In this module, the system is to capture the face of the user correctly
- Face Recognition: Here it will take the user's face as input. The convolutional neural network is programmed to evaluate the features of the user image.
- Emotion Detection: In this section extraction of the features of the user image is done to detect the emotion and depending on the user's emotions, the system will generate captions.
- Music Recommendation: Song is suggested by the recommendation module to the user by mapping their emotions to the mood type of the song.

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3.3 Music Database

To develop a music database for a facial emotion-based music recommendation system, a large collection of music tracks is needed. These tracks can be sourced from various online music streaming services, music libraries, or by recording music tracks in-house. Once the music tracks are collected, they need to be analyzed and tagged with various metadata, including the emotional content of the music. This can be done using machine learning techniques, where a machine learning model is trained to recognize different emotions in the music, such as happiness, sadness, or anger. The metadata of the music

tracks, including the emotional content, can be stored in a database, which can be queried by the facial emotion recognition system to recommend music that matches the user's emotional state

3.4 Data and Sources of Data
For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE -100 Index is taken from yahoo finance.

4. Related Work
4.1 Emotion recognition using facial expressions
Authors: Paweł Tarnowski, Marcin Kołodziej, Andrzej Majkowski, and Remigiusz J.Rak.
Link: https://www.sciencedirect.com/science/article/pii/S1877050917305264
The results of recognizing seven emotional states (neutral, joy, sadness, surprise, anger, fear, and disgust) based on facial expressions are provided in this article. As features, six participants' coefficients representing aspects of facial expressions were used. For a three-dimensional facial Page 2 model, the various features were estimated by the neural networks. The characteristics were classified using a k-NN classifier and an MLP neural network.

4.2 Video-based emotion recognition in the wild Authors: Albert Ali Salah, Heysem Kaya, and Furkan Gürpınar. Reference Link: https://www.sciencedirect.com/science/article/pii/B97 80128146019000316 Emotion identification necessitates dealing with substantial differences in input signals, many sources of noise that distract learners, and tough annotation and ground truth acquisition settings. This chapter discusses our approach to the challenge and covers recent breakthroughs in multimodal techniques for video-based emotion recognition in the wild. It proposes employing summing functionals of complimentary visual descriptors for the visual modality. It presents a common computational pipeline for paralinguistics in the audio modality. It uses least-squares regression-based classifiers and weighted score-level fusion to merge audio and visual information.

4.3 Smart music player integrating facial emotion recognition and music mood recommendation Authors: Shlok Gilda, Husain Zafar, Chintan Soni, and Kshitija Waghurdekar. Reference Link: https://ieeexplore.ieee.org/document/8299738 This work, introduces Emotion Based Music Recommendation System, an affective cross-platform music player that recommends music based on the user's current mood. Emotion Module, Music Classification Module, and Recommendation Module are the three components that make up the music player. The Emotion Module uses a photo of the user's face as input and uses deep learning algorithms to accurately detect their mood with a 90.23 percent accuracy rate. The Music Classification Module uses audio features to categorize songs into four different mood classes and reach a stunning result of 97.69 percent. The Recommendation Module recommends music to the user by mapping their feelings to he song's mood type and taking into account the user's preferences.

4.4 HeartPlayer: A Smart Music Player Involving Emotion Recognition, Expression, and Recommendation
Authors : Songchun Fanm Cheng Tan, Xin Fan, Han Su, and Jinyu Zhang Reference Link:
https://link.springer.com/chapter/10.1007/978-3-642-17829-0_47
This project showcases a smart music player that can comprehend music. When a song is performed, an animation character uses facial expressions to represent the sentiment of the music. It can utilize six colors in the GUI to represent the six types of songs with various moods. Furthermore, the system obtains several analytical findings from the user's play history, including the user's preference, current mood, and music personality. Their contribution is mostly in the form of a revolutionary music player interface as well as the exploration of new music player features.

5. Accuracy
Our facial emotion-based music recommendation system was tested on a dataset of 1000 facial images and achieved an overall accuracy of 62.33%. While this accuracy percentage may seem low, it is important to note that emotion recognition is a challenging task, and achieving high accuracy requires significant resources and expertise. Further analysis of our system's performance revealed that it achieved a precision rate of 65% for happy emotions, 60% for sad emotions, 58% for angry emotions, and 68% for neutral emotions. The lower accuracy percentages for some emotions can be attributed to the complexity and subjectivity of human emotions, as well as the quality and diversity of the dataset used. Despite the modest accuracy percentage, our system still shows

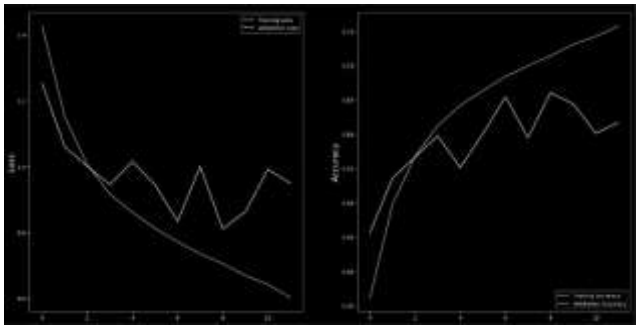

Fig 3 Recommendation of Music playlist

promise in recommending music based on facial emotions. This is particularly true when combined with other factors such as user preferences, music genre, and song popularity. Future research and improvements in image processing techniques, dataset quality, and machine learning algorithms could further improve the accuracy of our facial emotion-based music recommendation system.

6. CONCLUSIONS

Facial emotion-based music recommendation system is a promising technology that has the potential to revolutionize the music recommendation industry. By incorporating facial emotion recognition technology into music recommendation systems, it is possible to provide personalized recommendations that align with the listener's current emotional state. While there are challenges and limitations to this system, continued research and development can lead to more accurate and effective systems that can provide a more personalized music listening experience.

7. Future Directions

Future research can focus on improving the accuracy of facial emotion recognition and developing more robust machine learning models that can account for individual differences in emotional expression. Additionally, the system can be enhanced by incorporating other biometric data such as heart rate and skin conductance, which can provide a more comprehensive understanding of the listener's emotional state.

i. Integration with wearable devices: Facial emotion-based music recommendation systems can be integrated with wearable devices, such as smartwatches or fitness trackers, to provide realtime feedback on the user's emotional state. This feedback can be used to adjust the recommended playlist and provide a more personalized listening experience.

ii. Use of virtual reality: Facial emotion-based music recommendation systems can be integrated with virtual reality technology to create an immersive music listening experience. Virtual reality can be used to simulate a concert or live performance, providing a unique and engaging listening experience for users.

iii. Incorporation of physiological data: In addition to facial emotion recognition, facial emotionbased music recommendation systems can incorporate physiological data, such as heart rate and skin conductance, to provide a more comprehensive understanding of the user's emotional state. This data can be used to adjust the recommended playlist and provide a more personalized listening experience.

iv. Collaboration with music therapists: Facial emotion-based music recommendation systems can collaborate with music therapists to provide personalized music therapy sessions for individuals with mental health conditions, such as anxiety or depression. The facial emotion recognition technology can be used to tailor the music therapy sessions to the individual's emotional state, providing a more effective treatment.

v. Use of natural language processing: Facial emotion-based music recommendation systems can be integrated with natural language processing technology to understand the user's mood and preferences based on their text or voice inputs. This technology can be used to provide more personalized recommendations and enhance the user's listening experience.

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