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Facial Expression Based Music Recommendation System

Abutalib K[1], Amandeep Gautam[2], Aryan Khan[3], Manish Tiwari[4], Aditya Dayal Tyagi[5]
Students, Department of Computer Science and Engineering[1,2,3,4]
Assistant Professor, Department of Computer Science and Engineering[5]
ITS Engineering College, Greater Noida, India

Abstract: *The human face is a crucial organ for conveying an individual's emotional state and behavior. However, manually creating a playlist based on an individual's emotional features can be a labor-intensive and time-consuming task. To automate this process, several algorithms have been proposed, but they are often slow and inaccurate. To address this, a new system is proposed that utilizes facial expression extraction to generate an appropriate playlist automatically. This system can significantly reduce the computational time and overall cost of playlist generation while increasing accuracy. The system captures facial expressions using an inbuilt camera, and the emotion detection algorithm used has an accuracy of approximately 85-90% for real-time images and 98-100% for static images. By leveraging this high level of accuracy and performance, the proposed system outperforms existing algorithms used in the literature survey. Based on the detected emotion, the system creates a playlist that matches the individual's emotional state. This novel approach offers a more efficient and accurate way to generate personalized playlists, ultimately saving time and effort for users.*

Keywords: Music suggestion, Facial Recognition, SVM, OpenCV, Python

I. INTRODUCTION

Humans have a natural ability to gauge someone's mood by looking at their face. If electronic devices could learn this skill, it could have valuable real-world applications. Music, as a tool for evoking emotions and feelings, is more powerful than language. It has the ability to tap deeply into our emotional core, and listening to good music can help elevate our mood.

To simplify this problem, a proposed solution is to create an application that captures the user's emotions through facial expression recognition algorithms. Once the emotion is captured, a list of songs is suggested based on that emotion. This approach offers a convenient way for individuals to select music that aligns with their emotional state, potentially leading to improved emotional wellbeing.

Existing System: The current recommendation systems available in the market include Spotify, Musixmatch, Shazam, and others.

1.1 Existing System

Existing recommendation systems such as Spotify, Musix match, Shazam,etc.

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1.2 Problems of the Existing System

- Current recommendation systems offer a static user experience, as they provide recommendations based solely on historical data, without taking into account other parameters that may impact predictions, such as emotions or feelings.
- These systems may also fail to provide accurate recommendations if their suggestions are based on outdated input.
- Consequently, users may be dissatisfied with the system's output, as it fails to satisfy their emotional state.

III. PROPOSED SYSTEM

2.1 Benefits of the Proposed System

- These systems utilize facial recognition to determine the user's mood and select songs for creating a playlist that reflects the user's current emotional state.
- The aim of this approach is to improve the user's mood by suggesting music that aligns with their emotional state.
- Compared to traditional static recommendation systems, this approach is superior as it takes into account the user's emotions and helps to enhance their mood by suggesting appropriate music.

2.2 Methods

The software requirements for the proposed system include React JS for the front-end, Node JS and Firebase for the back-end. The system is compatible with Windows 10 or Windows 8 operating systems.

The hardware requirements for the system include a computer or laptop with a 32- or 64-bit operating system, an x-64-bit processor, and 4 or 8 GB RAM. The recommended processor for optimal performance is either an Intel i3, i5, or i7.

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III. LITERATURE SURVEY

The power of music to evoke emotions and influence mood has been well-established. Unlike other forms of media, music can quickly affect our emotional state, both positively and negatively. However, manually classifying songs based on mood to create playlists can be time-consuming and laborious. To address this challenge, our research proposes an Android application called EmoPlayer, which utilizes facial expression recognition to suggest a playlist of songs that align with the user's current emotion. By capturing the user's facial image through the camera, the system detects emotions using the Viola Jones algorithm for face detection and Fisher faces classifier for emotion classification. The proposed system not only plays music based on the recognized emotion but also suggests music that enhances the user's mood.

Our research highlights the importance of automated systems that can accurately recognize emotions and provide mood-based music recommendations. EmoPlayer integrates an emotion module, a music classification module, and a recommendation module to suggest songs that match the user's mood. The emotion module utilizes deep learning algorithms to identify the user's emotion with an accuracy of 90.23%. The music classification module uses audio features to classify songs into four different mood classes with a remarkable accuracy of 97.69%. The recommendation module then maps the user's emotion to the mood type of the song and suggests appropriate songs to enhance their mood.

Our research aims to improve the accuracy of emotion recognition and expand the range of recognized emotions. We also plan to develop an automatic music genre classification system and an automatic music emotion classification system to automate the existing system of emotion-based mood-enhancing music recommendations further. In summary, our research demonstrates the potential of automated emotion-based music recommendation systems to enhance users' mood and provide a personalized music experience. The first paper discusses a music recommendation system based on facial expressions. The system uses a convolutional neural network to recognize facial expressions and recommend music based on the corresponding emotion. The study shows promising results in recognizing four moods - happy, calm, sad, and angry - with an accuracy of 97.69%. The authors suggest expanding the study to include all seven basic emotions and adding songs from different languages and regions to make the system more robust. They also propose using collaborative filtering to collect user preferences and improve the overall system.

The second paper presents a music recommendation system based on a sentiment intensity metric, enhanced Sentiment Metric (eSM). The system uses a lexicon-based sentiment metric with a correction factor based on the user's profile. The authors conducted subjective tests in a laboratory environment to obtain the correction factor, which depends on age, educational level, and gender. The study shows that the eSM outperforms a randomly assigned song suggestion, reaching 91% user satisfaction in remote subjective tests. The authors also found that 78% of users preferred to listen to a musical genre similar to their current emotional state, while only 22% preferred a different genre. The paper highlights the importance of considering the user's profile in a sentiment metric and suggests applying the weight factor used in the eSM to other sentiment metrics.

3.1 Module Specification

We have divided our project in to 2 modules. They are:

1. **Facial Expression Recognition Module.**
2. **Music Suggestion module**

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A. Facial Expression Recognition Module

This module is designed to detect the emotions of a user. We have developed a model using the SVM supervised machine learning algorithm. When an image is uploaded, we use Python's OpenCV library to extract its features. These features are then applied to the SVM training model to predict the emotion of the user.

B. Music Suggestion Module

This module utilizes the output obtained from the Facial Expression Recognition module as its input. The emotion detected from the user's facial expression is used to suggest music. A list of music that is related to the user's emotion is displayed and the user is able to select the music and play it.

IV. ARCHITECTURAL DESIGN

Requirements of the software should be transformed into an architecture that describes the software's top-level structure and identifies its components This is accomplished through architectural design(also called system design),which acts as a preliminary 'blueprint' from which software can be developed IEEE defines architectural design as 'the process of defining a collection of hardware and software components and their interfaces .

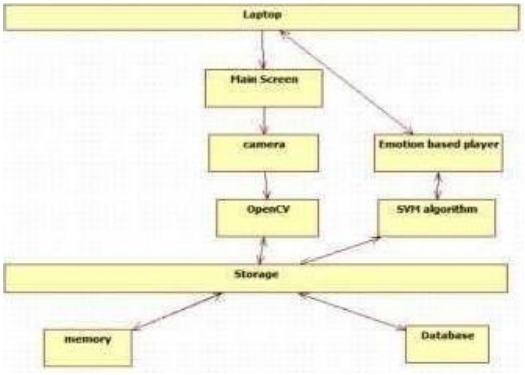
The software requirements document and designing a model for providing implementation details. These details are used to specify the components of the system along with their inputs, outputs, functions, and the interaction between them. An architectural design performs the following functions:

1. It defines an abstraction level at which the designers can specify the functional and performance behaviour of the system.
2. It acts as a guideline for enhancing the system(whenever required) by describing those features of the system that can be modified easily without affecting the system integrity.
3. It evaluates all top-level designs.
4. It develops and documents top-level design for the external and internal interfaces.
5. It develops preliminary versions of user documentation.
6. It defines and documents preliminary test requirements and the schedule for software integration.
7. The sources of architectural design are listed below.
8. Information regarding the application domain for the software to be developed.
9. Using data-flow diagrams.
10. Availability of architectural patterns and architectural styles.

4.1 Architectural

The sources of architectural design include information regarding the application domain, data-flow diagrams, availability of architectural patterns, and architectural styles. This step is crucial in software engineering as it deals with the essential requirements like reliability, cost, and performance. However, the paradigm shift from monolithic, stand-alone, built-from-scratch systems to componentized, evolvable, standards-based, and product-line-oriented systems makes this task cumbersome. To avoid these problems, designers adopt strategies such as reusability, componentization, platform-based, standards-based, and so on.

In this project, the application's architectural view is shown in the above figure, which uses the Tkinter module,



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OpenCV, SVM algorithm, and storage as a database.
The application is developed using Python 3.7, and all the screens are displayed according to the specified modules.
The software architecture is designed to ensure that all stakeholders are involved in the review process to minimize risks and errors.

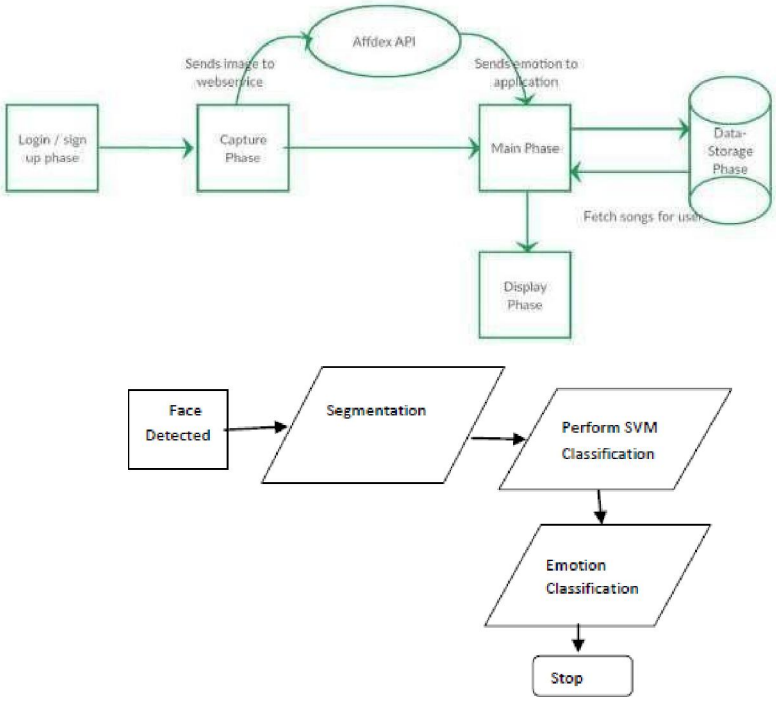
4.2 Design Concepts for Our Project

The software exhibits several design principles such as abstraction, modularity, and information hiding.
User data is abstracted from the interface through password protection, ensuring that only authorized users can access the information.
The project also adheres to a modular design approach by breaking down the system into distinct modules, making it easier to develop and maintain. Additionally, information hiding is employed to ensure that only the user with the password can view the protected file.
The software also demonstrates a well-defined architecture by following program modules and maintaining conceptual integrity throughout the system.

4.3 Algorithm Design

Step 1: Begin.
Step 2: Launch the Music Suggestion application.
Step 3: Prompt the user to upload an image containing a face.
Step 4: Pre-process the image and apply emotion detection to identify the emotion displayed on the face.
Step 5: Based on the identified emotion, display a list of songs that are suitable for that particular emotion.
Step 6: Allow the user to select a song from the list of suggestions.
Step 7: Stop the Music Suggestion application

4.4 Data Flow Process



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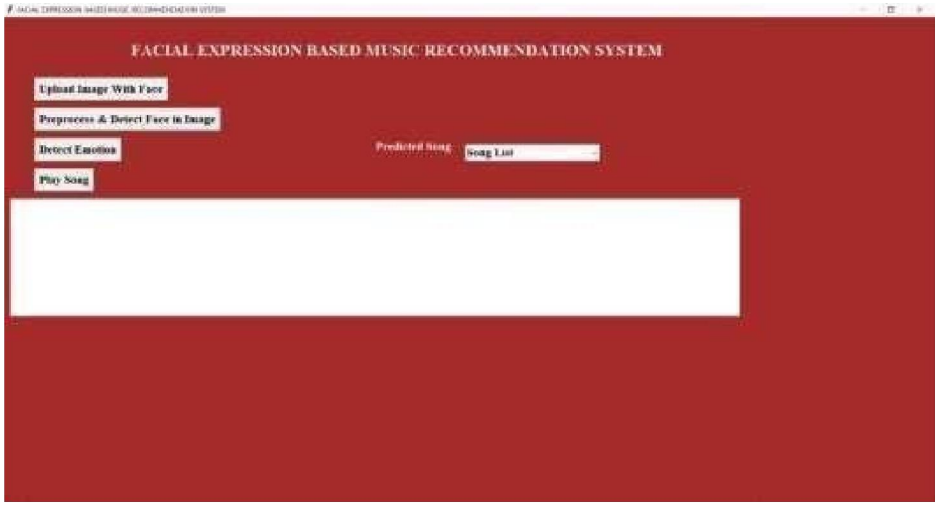
V. RESULTS

User Interface



Upload an Image

Image is uploaded

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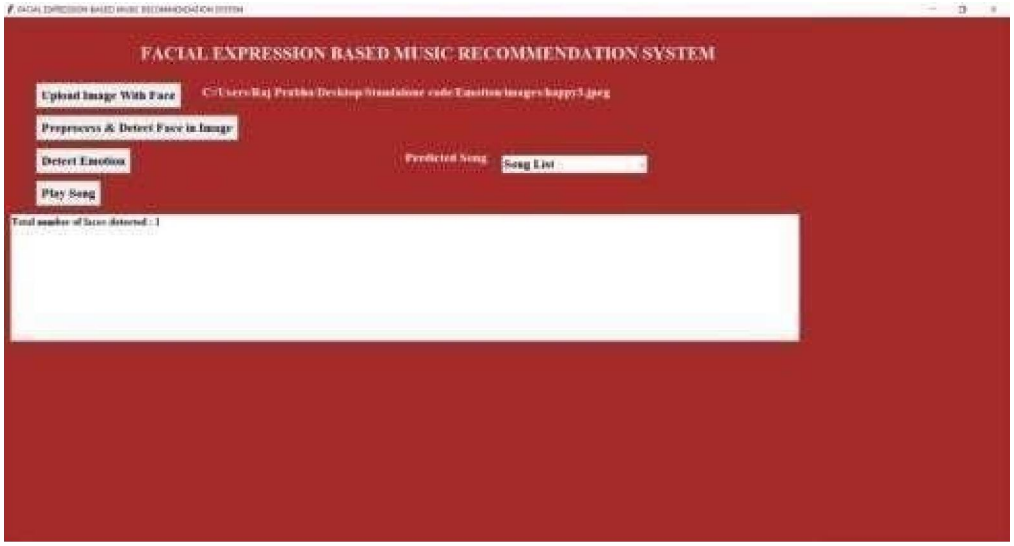
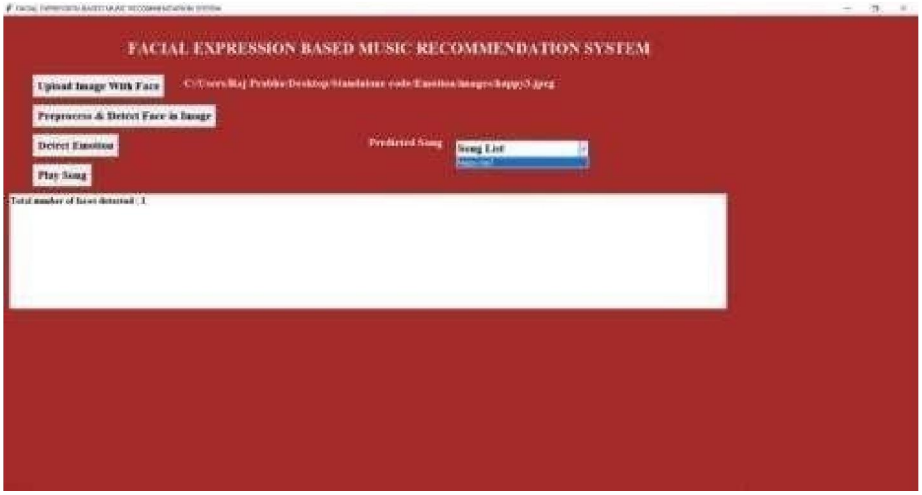
Pre-processing Image & Detecting number of faces



Detecting Emotion

Select a song from the list based on the emotion



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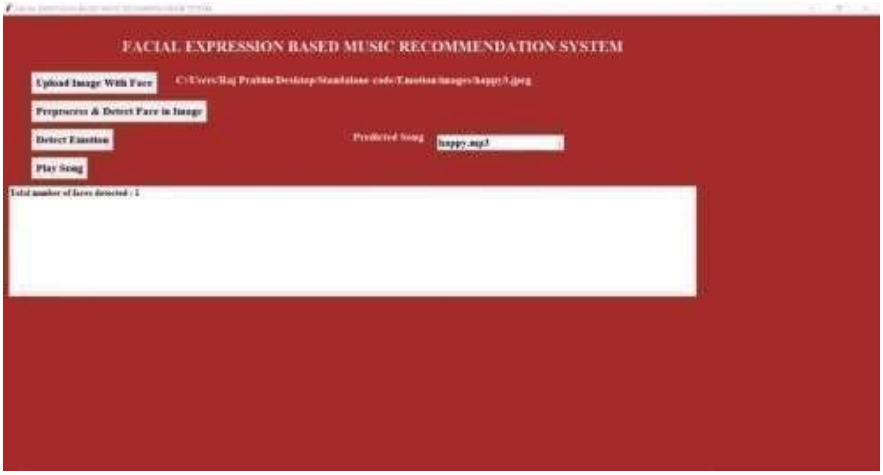
Play the Song



VI. USER MANUAL

To use this application, follow the steps below:

1. Download and install the application.
2. Use the webcam to capture an image containing your face before opening the application.
3. Open the application and upload the image you captured.
4. Perform the "Pre-process and detect faces" function, which will detect the number of faces in the image and display a message.
5. Perform the "Detect Emotion" function to detect your emotion. A message box will display the detected emotion.
6. A list of songs based on the detected emotion will appear in the song list field. Choose a song from the list and click the play button to play the song.
7. That's it! You can repeat the process with a different image to detect and play songs based on the emotions detected.

VII. CONCLUSION

This project aimed to create a model that recommends music based on the emotion detected from facial expressions.
An emotion-based music recommendation system was designed and developed using a face recognition system.
Music has the power to heal any stress or emotion, and this project capitalizes on recent developments in emotion-based music recommendation systems.
The proposed system utilizes a face-based emotion recognition system to detect emotions and plays music accordingly.

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