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Real-Time Facial Emotion Detection Using Deep Learning

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ABSTRACT
Most of the existing music recommendation systems use collaborative or content-based recommendation engines. However, the music choice of a user is not only dependent to historical preferences or music contents. But also dependent on the mood of that user. This project proposes an emotion-based music recommendation. In this project
we are using CNN and digital image preprocessing. This emotional information is fed to any collaborative or content- based recommendation engine as supplementary data. The results of comprehensive experiments on real data confirm the accuracy of the proposed emotion classification system that can be integrated to any recommendation engine. The system uses computer vision techniques to analyze the user's facial expressions and map them to emotional states. The emotional state is then used to select songs from a database that match the user's current mood. The system is designed to adapt to the user's preferences over time by utilizing machine learning algorithms that continuously learn from the user's feedback. A user study was conducted to evaluate the effectiveness of the proposed system, and the results demonstrate that the system is able to accurately recommend songs that match the user's emotional state.

Keywords: Facial Emotion Detection, Deep Learning, Convolutional Neural Network, Real-time Emotion Recognition, Affective Computing.

INTRODUCTION

Music has the power to evoke emotions and influence human behavior Music streaming services have become increasingly popular in recent years, providing users with access to a vast library of songs from various genres and artists. However, the sheer volume of music available can be overwhelming for users, and finding the right song to match their current emotional state can be challenging. This has led to the development of automatic song recommendation systems, which aim to provide personalized music suggestions based on the user's preferences and behavior.
One approach to developing such systems is to use human facial expressions as a means of detecting the user's emotional state. Facial expressions are a non-verbal form of communication that can reveal a person's emotions, and recent advancements in image processing and digital image processing techniques

made it possible to detect and analyze facial expressions automatically. By using computer vision algorithms to analyze facial expressions, it is possible to determine the user's emotional state and recommend music that matches their current mood.

LITERATURE SURVEY

This chapter describes the research literature relevant to the primary aspects of this thesis. The core aspects of this thesis are machine learning applications to natural language processing and classification techniques. Both these fields have received a lot of attention in the past years and there are a number of popular texts with relevant background material. As there is an enormous amount of literature available on both these aspects, these works can be described along several dimensions. Review of Research Work in image processing and digital image processing Here are some relevant research papers that have explored the topic of automatic song recommendation systems based on human facial expressions using image processing and digital image processing: • "Emotion Recognition Based on Facial Expression Analysis for Music Recommendation System" by D. N. Yoon et al. (2014). This paper proposed a system that utilizes facial expression analysis to recognize emotions and recommend music to users. The system uses a combination of facial feature extraction, emotion recognition, and music retrieval techniques to generate personalized music recommendations based on the user's emotional state. •

EXISTING SYSTEM

Existing techniques were using collaboration techniques which will use previous user data to recommend music to user, if there is no input from previous user then this technique will not useful. This existing technique requires lots of manual work to arrange different music to different categories such as happy, sad or angry etc. Recommendation engines may discover data patterns in the data set by learning user's choices and produce the outcomes that co-relates to their needs and interests. Most of the recommender systems do not consider human emotions or expressions. Previously they have used galvanic skin response(GSR) and photoplethysmography (PPG). Traditional recommendation engines use content – based or collaborative filtering methods and do not consider user emotion state. However, using human emotion state with recommendation engines may increase recommendation engines performance.

DRAWBACKS OF EXISTING SYSTEM

The first limitation is we can extend the corpus to include emoticons (i.e., ":-)") and expressions, which often correlate to strong emotions. This approach is limited by its known vocabulary, which can be mitigated by context analysis and the introduction of synonyms. The second limitation is sarcasm, which is prevalent in twitter feed analysis.

PROPOSED SYSTEM

Overcome from the music recommendation problem regarding user current status and then this application we Proposed a framework that involves using CNN and Digital Image Preprocessing to predict the emotion and recommend songs accordingly and will classify/predict the mood by extracting features from face. Based on detected user mood song list will be display/recommend to the user. It compares the emotions in the given list of emotions like happy, sad, angry, surprised, scared, disgust and neutral. Emotional effects of the past recommendations on the user are stored in the system's database

and used in future recommendations, as the same musical track's effects can be varied between different users. The proposed system for an automatic song recommendation system based on human facial expressions using image processing and digital image processing techniques consists of three main components: facial feature extraction, emotional state recognition, and song recommendation. The first component is facial feature extraction, which involves detecting and tracking facial features such as eyes,nose.

Use Case Diagram

SYSTEM DESIGN

SYSTEM ARCHITECTURE

Below diagram depicts the whole system architecture of an "Automatic song recommendation system based on human facial expressions".

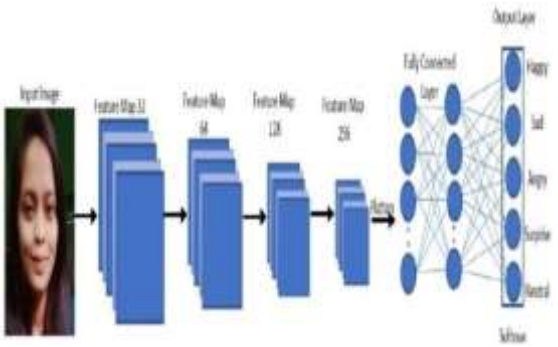
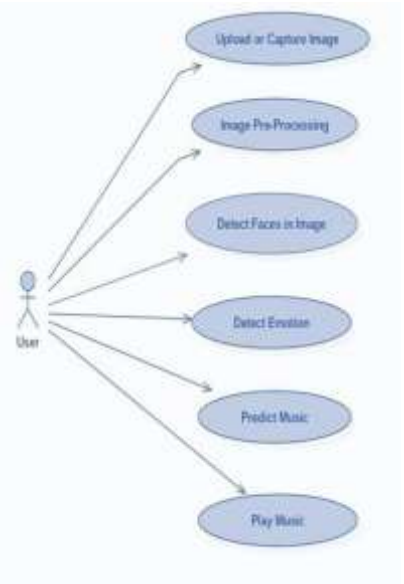


Fig.4.1.1. System Architecture

Use Case Diagram

The use case diagram visualizes imagines the conduct of a frame work,subsystem, or class with the goal that clients can appreciate how to
utilize those components thus that
engineers can execute that component. Below is the representation of the project, on which the system is developed.



Use Case Diagram

Sequence Diagram

Sequence diagram is a construct of the Message Sequence Chart, and conjointly it's a sort of interaction diagram that shows however processes operate with each other and in what order.

Sequence Diagram

Activity Diagram

A graphical representation of work process of stepwise exercises and activities with support for decision, emphasis and simultaneousness, used to depict the business and operational well-ordered stream of parts in a framework furthermore demonstrates the general stream of control.

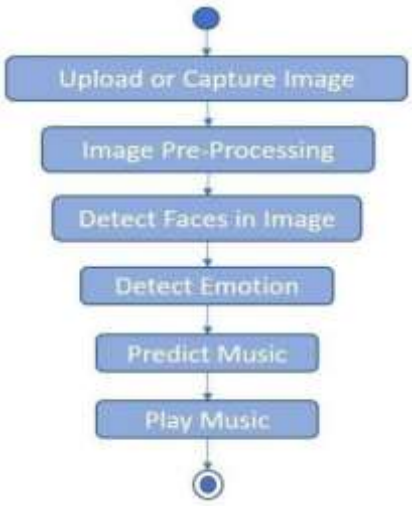


Fig.4.2.3 Activity Diagram

Class Diagram

A class diagram is an illustration of the relationships and source code dependencies among classes in the

unified modelling language (UML). In this context, a class defines the methods and variables in an object, which is specific entity in a program or the unit of code representing that entity.

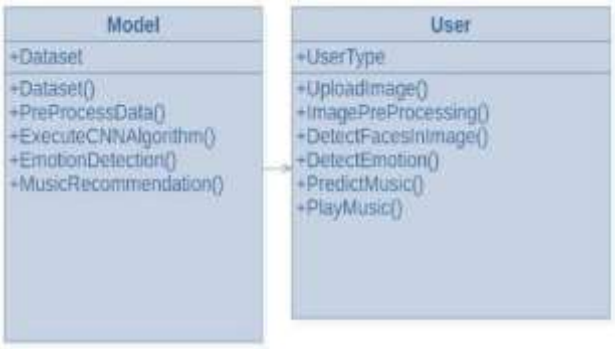


Fig.4.2.4 Class Diagram

SYSTEM IMPLEMENTATION

Modules

IMAGE DETECTION IMAGE RECOGNITION EMOTION DETECTION MUSIC RECOMMENDATION

Image Detection

In this module an image is the input through camera or file selection process.
This module detects images of people and displays its count.

Image Recognition

In this module image with faces will be recognized using image processing and haar cascade image classifier, which classifies image into positive and negative.

4.1.1 Emotion Detection

In this module emotions from the input image are detected like happy, sad, angry, surprise,scared and disgusted.

Music Recommendation

In this module music is recommended by the application based on the emotion detected.

TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub- assemblies, assemblies and/or a finished product It is the process of exercisingsoftware with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in and unacceptable manner. There are various types of tests. Each test type addresses a specific testing requirement.

TYPES OF TESTS

Unit Testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. There are 4 units in the application and each unit is tested individually. The units are Image detection, Image Recognition, Emotion Detection, Music recommendation. After conducting unit testing for each and every individual module, all the given

testcases are functionally passed. All the 4 modules are connected with each other and the same has been verified as well as validated with valid inputs. In this way, integration testing is successfully conducted for the project.

ADVANTAGS

Enhanced Human-Computer Interaction

Real-time emotion detection can make systems more responsive and personalized, improving user experience in applications like gaming, virtual assistants, and customer service.

Improved Customer Insights

In retail and marketing, it helps businesses understand customer reactions to products or services, enabling better-targeted
strategies.

Mental Health Monitoring

Emotion detection can aid in identifying emotional distress or changes in mental states, assisting therapists and health apps in providing timely interventions.

Smart Surveillance

In security and surveillance, it can detect suspicious or unusual emotional behavior (e.g., fear, anger) and raise alerts in critical situations.

Education and E-Learning

Teachers or e-learning platforms can assess student engagement and understanding in real-time, allowing dynamic adjustment of teaching strategies.

APPLICATIONS

Healthcare & Mental Health

Therapy support: Detect emotional states in patients during therapy sessions.

Education & E-Learning

Student engagement analysis: Monitor attention and interest levels in real-time.
Personalized learning: Adapt content based on students' emotional feedback.

Retail & Marketing

Customer feedback analysis: Understand real-time emotional response to products or ads.

Human-Computer Interaction (HCI)

Emotion-aware virtual assistants: Adjust responses based on user mood.
Interactive gaming: Games that adapt based on player emotions.

EXPERIMENTAL RESULTS

The sequence of interactions between the user and the system begins when the user uploads an image. The system then loads the image and proceeds to perform preprocessing on the image. After preprocessing, the model detects faces in the image and displays the number of faces detected. Following this, the model continues to detect emotions present in the image. Once emotion detection is complete, the system proceeds to predict suitable music based on the detected emotions. The model then recommends music to the user and finally plays the selected music. This sequence ensures a smooth flow from image input to emotion-based music output, enhancing user experience through intelligent automation.

Fig. 9.1 Home page

Fig. 9.2 Emotion detected

Fig. 9.3 Song recomended

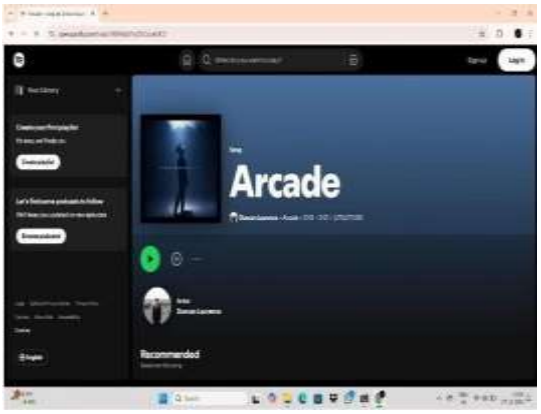


Fig. 7.4 Click on „Play Song" to play song

FUTURE SCOPE

The sequence of interactions between the user and the system begins when the user uploads an image. The system then loads the image and proceeds to perform preprocessing on the image. After preprocessing, the model detects faces in the image and displays the number of faces detected. Following this, the model continues to detect emotions present in the image. Once emotion detection is complete, the system proceeds to predict suitable music based on the detected emotions. The model then recommends music to the user and finally plays the selected music. This sequence ensures a smooth flow from image input to emotion-based music output, enhancing user experience through intelligent automation.

CONCLUSION

In this project, a framework for enhancing music recommendation engines performance via physiological signals has been introduced. Emotion recognition from multi-channel physiological signals was performed, data fusion techniques were applied to combine data from GSR and PPG sensors and FLF has been implemented. Considering emotion state of the listener improves the performance of recommendations. Recognizing arousal and valence values directly from only GSR and PPG signals is a challenging task. We have showed that there is relationship between GSR and PPG signals and emotional arousal and valence dimensions. For GSR only signal, we have obtained 71.53% and 71.04% accuracy rate for arousal and valence prediction respectively

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