Detection of Face Emotion and Music Recommendation System using Machine Learning

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Abstract: **Face emotion detection has recently attracted a lot of interest because of its uses in computer vision and the field of human-computer interaction. Various methods and applications were suggested and put into use as a result of the ongoing research in this area. In this study, we present an emotion-recognition recommender system that can identify a user's feelings and offer a selection of suitable songs that might lift his spirits. To gather information and enable us to give the users a selection of music tracks that are effective at lifting the users' spirits, a quick search was undertaken to learn how music may impact the user mood in the short term. The suggested system recognizes emotions, and if the individual is feeling down, a special playlist including the best kinds of music will be played to lift his spirits. On the other hand, if a favorable mood is recognized, an appropriate playlist will be offered that contains several genres of music that will amplify the pleasant feelings. Principal Component Analysis (PCA) methods and the Fisher Face algorithm are used to implement the suggested recommender system.**

***Keywords*: Machine Learning, Face Emotion Recognition, Music Recommendation System, CNN, Deep Learning, Classification**

I. INTRODUCTION

Around the world, there are different kinds of face expressions such as fear when the inner eyebrows are curved upward and are elevated and drawn together [1]. The eyes are vigilant and tense. Disgust, when there is relaxation in brows and eyelids. Additionally, the top lip is lifted and curled, usually asymmetrically [2]. When someone is happy, they have relaxed brows, an open mouth, and lips that are drawn back toward their ears. Astonishment, when the brows are lifted [3]. The lower eyelid is relaxed, while the upper eyelid is open widely [4]. The jaw is also opened. When treating depression, music therapy is seen as a beneficial addition to regular care [5]. There is a wide range of music that is available, along with a wide range of tempos, amplitudes, and moods [6]. Additionally, there have been significant improvements in emotional intelligence [7]. Geometric-based and appearance-based feature extraction techniques are the two most well-known methods [8]. For the same, there are several methods and techniques accessible. However, the issue is still unresolved since the two tasks are carried out in distinct ways [9]. In order to improve technology and even our daily lives, we must attempt to merge the two technologies [10]. In our modern life, we spend a lot time in front of mobiles and computers [11]. While working with these technologies, we get tired and frustrated after sometime. So, the motivation for this project is to get the face emotion, to relax the user, to entertain the user, to fresh the mood of the user. A person wants to listen music according to the environment, emotions and situation but he or she can't decide so it will help a person to choose the best music according to emotions [12]. It is recommended that the greatest option for solving the issues would be a computer-based system, which will be more effective, quick, dependable, and user-friendly than the current method [13]. In the suggested system, accuracy improvement is crucial. The project's performance will rise if precision is raised. The leading role of this project is to recognize the face emotion with the help of computer vision. The application is based on facial emotion where the user can show his/her face to the camera. Then this web application detects his/her facial emotion in real-time and recommends the list of music according to the detected facial emotion. This list includes song name, singer, album, and we can search for the song and listen to it on the internet.

II. RELATED WORK

First, James et al., (2019) proposed the work on emotion-based recognition system [14]. In order to create music players that are based on human emotions, they have devised a system that focuses on emotion detection. They used Image Pyramid, Histogram of Oriented Gradients, Linear Classifier, Multiclass SVM With A Linear Kernel, Hidden Markov Model. On the webcam, the person's face is captured. Frames from the captured video are created [15]. Preprocessing is used to extract the facial expression from the webcam image and turn it into a series of Action Units (AUs) [16]. Using combinations of the 64 AUs, the Face Action Coding System (FACS) characterizes every facial emotion [17]. Following feature extraction, the faces' emotions—such as happiness, anger, sadness, and surprise—are categorized. They are connected with the online services. These might be SAAS, IAAS, or PAAS. The music is played based on the emotions that are sensed and communicated. The classifier's efficiency is about 90-95% model, and the neural networks estimated the various features. The characteristics were classified using a k-NN classifier and an MLP neural network.

Vijaykumar et al., (2017) proposed a research study on the music player on the basis of detected emotions through facial expression [18]. It offers the user an interactive approach to complete the work of making a playlist. The working relies on several systems doing their duties in a certain order to get the intended results. Here, ellipse, RIO, and Histogram equalization are used in a genetic algorithm for optimization to

play music that corresponds to the emotion. Similarly, another project was done by Gilda et al., (2017) on intelligent music player that incorporates face expression recognition and music mood suggestion [19]. They used CNN, Haar Cascades with AdaBoost, Rectified Linear Unit (ReLU), Max Pooling, Forward and Backward Propagation, Softmax Activation Function. The Music Classification Module categorizes music into four different mood groups, and it does it with an impressive accuracy of 97.69% by using audio attributes. By tying a user's emotions to a song's mood type while taking their preferences into account, the recommendation module proposes music to them. The model successfully classifies emotion into four moods, namely, happy, sad, angry and neutral, with an accuracy of 90.23%.

III. METHEDOLOGY

The project is a software system for detecting facial emotions and music recommendations. Using this application, the user can get the music list according to his/her mood. For this web application, we trained a CNN model with the dataset of fer2013 by using Python. After training our model, we developed a web application using HTML and CSS and deployed our trained model using the Flask framework. Thus, by using this web application, users can quickly get a song according to his/her mood. As shown in "Fig.1" here is an overview of full project.

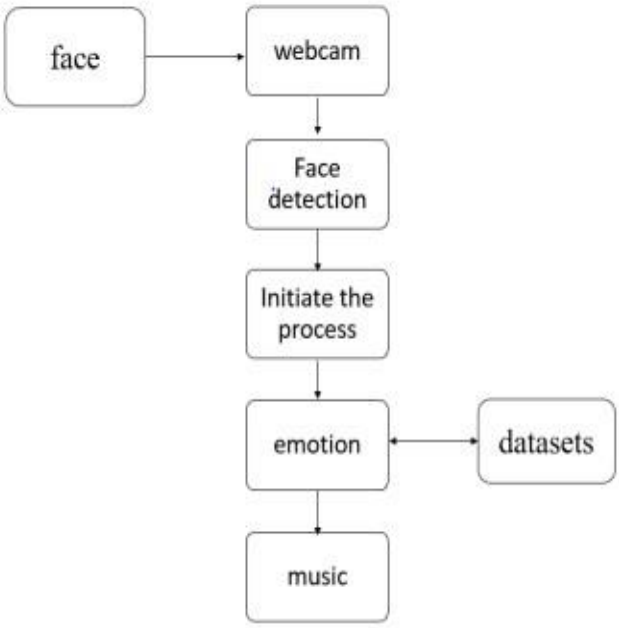

Fig.1 Project Overview

a. Face Capturing

We used the library for computer vision. It is usually used as a real-time computer vision, thus this makes it simpler to combine with other libraries that can also utilize NumPy. When the first process begins, the camera stream is accessed and roughly 10 photos are taken for further processing and emotion recognition. We utilize an algorithm to categorize the photographs, and in order to do so, we need a lot of positive images that only include images of people's faces, as well as negative images that only contain images of people without faces. to instruct the classifier. The model is built using the classified photos. As shown in "Fig. 2"

Fig. 2 Capturing of Face

b. Face Detection

The principal component analysis (PCA) method is used to reduce the face space dimensions. After that, the fishers linear discriminant (FDL) or the LDA method is applied to obtain the feature of the image characteristics. We use this method specifically because it maximizes the training process classification between classes. While using the minimal Euclidean approach for matching faces, this algorithm aids in picture recognition processing and helps us categorize user expressions that suggest emotions.

c. Dataset

For this system, there will be one image dataset and a music dataset will be used. For facial expression recognition part, we user the fer2013 dataset for our project, and the input images to the system will be real time images and the songs will be selected according to the user or user interest. There are many other datasets with images of more emotions like disgust, neutral and all. The dataset used here contains the images of different facial expressions like Happy, Sad, Surprised, Fearful, Angry, Sad and Neutral. The dataset has at least 1 images of each emotion in it. After the dataset will be split into the moods specified. Giving label to the dataset. It will classify the moods accordingly by recognizing the facial expressions of a person. Like Happy, Sad, Surprised, Fearful, Angry, Sad and Neutral.

Here are some images of the different types of emotions from the dataset as shown in "Fig.3".

Fig.3 Pictures from dataset

d. Design of Proposed Model

The design for the system was proposed to make a better, efficient, less space-consuming product so that it can be applied and used efficiently by the users and can be tested and configured easily. Figure 4. shows the components that our project uses to accomplish the desired job/jobs and the structure of the project model.

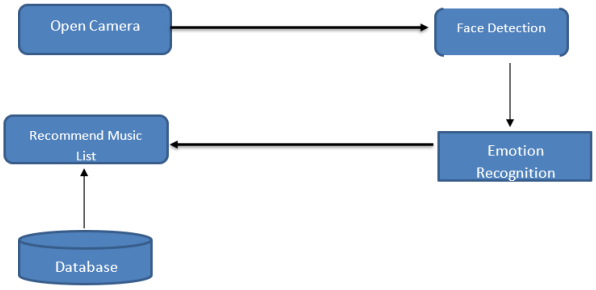

Fig. 4 Structure of Proposed Model

e. Tools used in Project

Technologies that will be used in this project are HTML and CSS for frontend design in web. Python for training a CNN model for the detection of facial emotion. Flask framework for deploying the model on web application.

IV. RESULTS

When the application software is executed, the dashboard screen will appear, containing the project's title, and the screen will be divided into two portions.

The left side is for "Emotion Detector" in which the computer vision will be opened and detect the user's facial emotion. On the right side, the "Music Recommendations" part exists where the user can see the Recommended Music along with the "Name", "Album" and "Artist" of the music. Figure. 5 shows the dashboard screen of the system.

Fig. 5 User interface

When we run the web application, the dashboard and computer vision will be opened to detect the emotion of the user's face i.e., here the emotion detector is detecting the “Surprised” emotion. Figure. 6 shows the Emotion Detector part of the application.

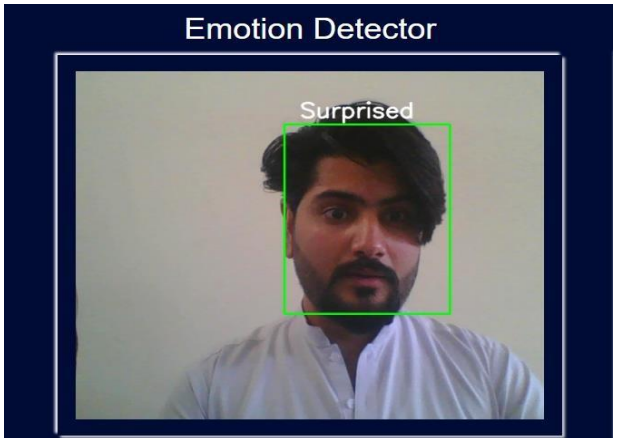

Fig.6 Emotion Detector Part of the Application

After scanning the face of the user and detecting the emotion, a list of songs will be recommended and shown based on the emotion detected. Figure 7 shows Music recommendations.

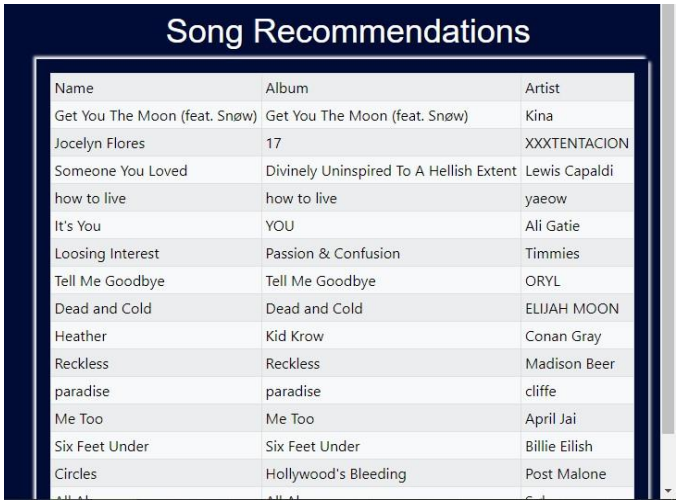

Fig.7 Music Recommendations

V. CONCLUSION

This research focuses on real-time facial emotion detection, namely the detection of angry, disgusted, afraid, pleased, neutral, startled, and sad facial expressions. Along with the "Name," "Album," and "Artist" of the music, it recommends a list of the songs. Implementation of the proposed recommender system is performed using Fisher Face algorithm and Principal Component Analysis (PCA) techniques. Several changes and modules can be added to our project in the future. Along with a list of songs, it can be the link to play the song. Another improvement in the project is the improvement in the accuracy of the model trained. Moreover, the list of recommended music can be improved.

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