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EFFICIENT FACIAL EMOTION BASED MUSIC RECOMMENDATION SYSTEM

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Abstract

key component of AI development systems is image processing. The capture of an efficient facial emotion using an image processing system was intended for recommendation-based preface systems. A significant amount of investigation is being carried out with the help of a number of different technologies, including computer vision (CNN) and deep learning (DL), also known as machine learning, in order to identify the various human emotions. Music has a remarkable capacity to convey ideas. In spite of differences in income, political leanings, preferences, and languages, it brings us together., backgrounds, ages, and markets. In daily activities, sports, and travel, people prefer to listen to music, and there are high-demand apps such as music players and other streaming services that enhance the requirement of music-recommended system which is based on imaging. Human emotions and music are connected to one another. In the proposed work, with the help of the CNN model, real-time emotions like happy, sad, disgust, surprise, neutral, angry, fear are detected and an emotion-based music player suggests songs per detected emotions. This emotion detection method can be adapted for mobile phones to the traditional preinstalled music player apps as an additional feature. Customer satisfaction is one of the benefits of incorporating emotion, which can be mapped to illiterate people as well. This paper objective is to evaluate the user's face, forecast their expression, and recommend a song that fits their mood**.**

Keywords- *Face detection, Music Recommendation, Computer Vision, Image Processing, CNN model, Face Emotion Recognition***.**

1. INTRODUCTION

Applications that make use of artificial intelligence in the present day include the emotion recognition system as one of their essential components. The study of emotions also provides suggestions for strategies that are intended to be offered to the user in order to achieve emotional equilibrium. In the paper that is being submitted, there should be an attempt to recommend music that corresponds to the facial expressions of the individuals. It is possible that the study of facial expressions can lead to a better understanding of the mental state or the current emotional condition of the user. Artificial intelligence is software that is designed for people who require assistance

but are unable to articulate their emotions. This is due to the fact that music has the potential to be an effective agent in treating depression. In order to achieve the greatest possible impact, each piece of music evokes a certain feeling, which is then sought to combine with the feeling that the listener is experiencing.

Users receive recommendations for music from the algorithm or technology that is used for suggestions for music. These recommendations are based on the user's performance, relevant data, and listening history. The fundamental objective of the system is to improve the experience of discovering new music by tailoring it to the preferences of the user and providing tailored recommendations for various types of music. The recommendation system that is often used is utilized on a variety of streaming services and platforms in order to engage users, assist them in discovering new artists or songs that they might appreciate, and maintain their attention. The generation of recommendations is accomplished by the examination of a combination of more general trends and user-specific data that has been observed across a number of users. The application of face expression recognition by CNN allowed recognize and detect emotions throughout the process of producing personalized music suggestions.

CNN's categorization and image recognition capabilities are effective when it comes to determining whether or not music is emotionally relevant. Through the utilization of the CNN model, the suggested method allows for the identification of emotions through the generation of a feature map consisting of convolution layers of facial expressions. An emotion will be classified, and then music that corresponds to the user's emotion will be played once the classification is complete. There has been a concerning rise in the proportion of Thais who are affected by stress over the course of the past few years. These are the result of a variety of factors, including excessive living expenditures, a poor economy, rising product prices, and debts. Additionally, we have the ability to alleviate stress through a variety of activities, such as listening to music, watching movies, meditating, and working out. According to a study, a significant number of people listen to music in order to alleviate stress. There are a wide variety of music player applications available; however, none of them provide you with the ability to select music based on the emotions that you are experiencing. This research makes use of a CNN model that is able to recommend music to users depending on their emotions in order to overcome these restrictions.

Facial expression is one of the essential components of human communication, which can be categorized as nonverbal communication [1]. Expressions on the face are very important. Within the realm of music information retrieval through the use of computers, the newly emerging prospect of automatic analysis and comprehension of music will be discussed. There have been significant advancements in the field of information retrieval, such as querying using signing humming, audio-to-score alignment, audio artist identification, music similarity computing, and audio mood classification. One use that is viable is the provision of content-based music

recommendations, which can be obtained.

As a result of the advent of the digital age, music recommendation systems have become an essential component of the experience of streaming music. These systems assist users in discovering new songs that are customized to their own likes and inclinations. For a long time, these systems have relied on the listening history of the user, playlists, and collaborative filtering approaches. On the other hand, there is a growing interest in improving these recommendations by adding the emotional aspects of the experiences that consumers have had.

Study aims to give a fresh approach to music selection by combining techniques from machine learning with facial expression identification. In the method that has been proposed, a FEMRS recommends music by facial emotion makes use of convolutional neural networks (CNNs) to identify emotions based on the facial expressions of users and then matches music to the appropriate face expression.

This investigation has been divided up into two separate sections: Section II includes a description of the literature survey, and Section III provides an explanation of the approach that is being presented.

2. LITERATURE SURVEY

In the field of pattern recognition, facial emotion recognition (FER) is a relatively new sector of research that is becoming increasingly important. The function of non-verbal communication is significant in day-to-day life, and its involvement in communication as a whole range from approximately 55% to 93%. Detecting falsehoods, psychoanalysis, paralinguistic communication, detecting operator tiredness, and robotics are all examples of applications that make effective use of facial emotion analysis. Other applications include surveillance films, expression analysis, gesture recognition, smart homes, computer games, depression treatment, patient monitoring, anxiety, and paralinguistic communication. The purpose of this study is to provide a comprehensive evaluation of FER. The literature is compiled from a variety of reputable research that was published during the course of the current decade. The standard machine learning (ML) and the numerous deep learning (DL) methodologies are the foundations around which this review is built. Additionally, a variety of FER datasets for evaluation metrics that are accessible to the general public are addressed and compared with the findings of benchmark examinations. The purpose of this study is to highlight the future gap in this domain for new researchers by providing a comprehensive evaluation of FER that makes use of classic machine learning and deep learning approaches. Finally, this review study is a guidebook that is very helpful for both experienced researchers who are seeking for productive routes for future work as well as young researchers who are beginning their careers in the field of FER. It offers a general understanding

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and fundamental knowledge of the methodologies that are now considered to be state-of-the-art [1].

A comparison of the effectiveness of three different algorithms for facial emotion recognition (FER) is presented in FER. There is one machine learning model known as Support Vector Machine (SVM), and there are two deep learning models known as Convolutional Neural Network (CNN) and VGG16. These are the methods that have been selected. Python was used to implement all three algorithms, and the FER2013 dataset was used to evaluate their performance. The testing accuracy, the amount of time spent training, and the size of the weights file were the parameters that were looked at for comparison. For the purpose of implementing FER in real time on a live video stream, the algorithm that performed the best in the study is utilized. Following the presentation of the implementation specifics, a discussion of the results follows [2].

Both the actions of the teacher and the reactions of the students are part of classroom communication. While a great deal of research has been done on the examination of students' facial expressions, less is known about the influence of teachers' facial expressions. It may be possible to forecast how a teacher's emotions may affect the classroom climate through facial expression detection. In addition to potentially enhancing the learning environment, intelligent evaluation of an instructor's behavior during a lecture could also save the time and costs associated with manual assessment techniques. We suggest an instructor's facial expression recognition method in a classroom utilizing a feed-forward learning model to overcome the problem of manual assessment. Initially, Following the identification of the face from the lecture recordings that were collected, the frames that are significant are selected, and all of the frames that are not necessary are removed.

A person's face is a valuable tool for determining their unique mood. With the help of a camera, the suggested approach can directly obtain the necessary input from a face. Using this information, a list of songs that correspond to the mood created by the preceding input can then be created. It helps create relevant playlists based on emotional characteristics, saving time and removing the laborious process of manually organizing music into different lists. Using facial expression analysis, Music Player analyzes and interprets data to create a playlist tailored to your preferences. For the purpose of developing a music player that is based on emotions, the system is primarily concerned with recognizing human feelings. It goes over current methods for detecting emotions in music players. In [4]

This research proposes a neural network-based solution for music recommendations where facial expressions assess a person's mood. This strategy is more efficient than previous ones and simplifies users' work by allowing them to create and search for a specific playlist. Facial expressions are essential in determining a person's mood. A camera or in the webcam captures a face from which input is retrieved. A face is captured using a camera or webcam, and information is retrieved from the image. A determination of the individual's disposition is made with the help of this input [5].

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For music recommendation systems, most existing systems use content- or collaborative-based recommendation engines. Since users' choice depends on music contents or historical preferences, a music recommendation framework based on emotion learns a user's emotion from wearable physiological sensors via a signal obtained. As supplementary data, fee content or a collaborative-based recommendation engine provides that information about emotion. The performance of the by utilizing these data, the currently available recommendation engine can be enhanced. Within the scope of this work, the valence and arousal prediction problem regarding the emotion detection problem from multi-channel physiological information is taken into consideration. Through the utilization of k-nearest neighbor, support vector machine, RF, and decision tree algorithms, the results are obtained by utilizing PPG and GSR signal data from 32 participants, either with or without feature fusion. The method of emotion categorization that is used in this work, when combined with actual data, certifies the accuracy of the findings of a comprehensive experiment provided to any recommendation engine [6].

Taking the time to listen to music is an important exercise for relieving stress. In order for it to be successful, the music must be able to convey the feelings of the listener. A further point to consider is that no music player can select songs based on the feelings of the user. Anger, neutrality, happiness, and sadness are all possible states of mind for users. A music player that is based on emotions and makes recommendations for songs based on those emotions is presented in this study as a solution to this problem. A facial image or heart rate can be obtained by the camera on a smartphone or through an application on a smart band. An strategy based on classification is utilized in order to ascertain the feelings of the user. Two different types of classification algorithms are discussed in this article: approaches that are based on heart rate and methods that are based on facial images. As a result of the large heart rate range that the suggested method encompasses, the results of the studies reveal that it is capable of accurately classifying satisfied feelings. [7]:

In the COVID-19 scenario, when the lockdown began, people were compelled to remain inside the confines of their quarters, which inadvertently fostered mental disorders like desperation and anxiety. All music has a potential empathetic companion in challenging situations. Using facial expressions or direct input from the user, the user's emotions are used as input by the suggested emotion-based music recommendation system to suggest specific songs. The model employs the Random Forest and XGBoost classifiers to determine the emotion of the music. It takes into account several aspects like liveliness, energy, acoustics, instrumentals, etc. and uses Term frequency times inverse document frequency (TF-IDF) among the songs that have comparable lyrics. [7]

Over the past few years, human emotion has been an extremely important factor. The basis for emotion is human feelings, regardless of whether or not they are expressed. There are many different ways in which emotions can be used to describe the conduct of individuals. Identifying the emotional states that influence each individual's behavior in order to extract characteristics from detected emotions and the human face is the primary purpose of the technique paper that has

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been proposed, and according to the emotion that is seen, music will be played. Other algorithms that are used are typically slow, less precise, and even require additional equipment such as physiological sensors or EEG. Many of the systems that are currently in use make music recommendations based on information that has been collected in the past. For the purpose of identifying the feature, facial expressions were extracted from the acquired image using either an integrated camera or a local capture device. It is going to be captured by the technology that is being suggested, and it will play music automatically depending on facial expression [8].

Within the context of a program recommendation system, techniques are applied to make suggestions to consumers regarding products that they would like to favor. It is the primary objective of that study to demonstrate that the music recommendation system is effective. The proposed method has the potential to be used across a wide range of domains and platforms, including but not limited to Amazon (commerce), Netflix (movies), YouTube (videos), and others. Once additional factors are incorporated, the effectiveness of the mechanisms that are currently in place needs to be enhanced. An accurate recommendation system is constructed by the Tunes Recommendation System (T-RECSYS), which is part of the proposed method approach. This system uses collaborative filtering and a hybrid content-based technique to construct an accurate recommendation system that uses real-time prediction as input to a deep learning classification model. Within the framework of the proposed way methodology, they utilized data obtained from the Spotify Recsys Challenge. As a result, they were able to get precision scores of up to 88% at a balanced discrimination threshold [9].

Using the feelings that are communicated by each song, this research develops an intelligent agent that can organize a collection of music and present the user with a playlist that is suitable for their preferences. The user's local music collection is originally grouped together according to the feeling that is sent by a song, which indicates the mood that the song is intended to convey. This is established by taking into consideration the melody as well as the lyrics of the song. In order to build a mood-based playlist that is tailored to the user's immediate desires, the user must take a picture of themselves during the process. A number of approaches, including facial detection and emotion identification, are utilized in order to identify the user's facial expressions and emotions. Once this is done, the user is presented with a playlist recommendation that contains the songs that most effectively convey this feeling [10].

3. PROPOSED METHOD

The strategy that has been suggested involves the creation and evaluation of a Convolutional Neural Network (CNN) model by making use of a dataset obtained from Kaggle itself. By taking into account a wide range of inputs, this model intends to identify and categorize feelings. This

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section will provide a comprehensive explanation of the database that was utilized as well as the module that was responsible for emotion recognition.

3.1 A Description of the Database

The model that is being provided is constructed and validated with the help of a Kaggle dataset, more precisely the FER2013 database. There are a huge number of labeled photos of facial expressions contained inside this database, which is frequently utilized for tasks involving the detection of emotions. Two sections make up the dataset, which are as follows:

Among the 24,176 JPEG photos that make up this training dataset are images. The CNN model is trained with these photos, which enables it to learn and recognize a variety of facial expressions that are connected with a variety of emotions.

The Testing Dataset includes a total of 6,043 different pictures. The performance of the CNN model while it is being trained is evaluated with the help of these photos. We are able to evaluate the correctness of the model as well as its capacity to generalize to data that has not been seen before by testing it on a different set of photos. Due to the fact that the FER2013 collection contains photos that span a wide variety of facial expressions, it is an excellent option for the construction of a reliable emotion recognition model.

3.2 Emotion Detection Module

The emotion detection module is a key component of the proposed method. It leverages artificial intelligence and machine learning techniques to analyze and interpret emotional states from various types of inputs. The module can process inputs such as facial expressions, speech patterns, text inputs, and physiological signals to detect emotions. Here's a detailed look at how each input type is analyzed:

- ***Facial Expressions (via Computer Vision):*** Using computer vision techniques, the module analyzes images or video frames to identify facial expressions. By detecting key facial landmarks and features, the module can classify emotions such as happiness, sadness, anger, fear, surprise, disgust, and neutrality.
- **Speech Patterns (via Audio Signals):** By analyzing audio signals, the module can detect emotions based on speech patterns, tone, pitch, and other vocal characteristics. This aspect of emotion detection is crucial for applications involving voice interactions, such as virtual assistants and customer service chatbots.
- **Text Inputs (via Natural Language Processing):** Natural Language Processing (NLP) techniques enable the module to analyze text inputs for sentiment and emotional content.

By processing the text data, the module can identify emotions conveyed through written words, which is useful for sentiment analysis in social media, reviews, and customer feedback.

- **Physiological Signals (via Wearable Devices):** The module can also analyze physiological signals collected from wearable devices, such as heart rate, skin conductance, and other biometric data. These signals provide insights into the emotional states of individuals, making the module applicable in healthcare and mental health support.

The emotion detection module has a wide range of applications, including:

- ***Sentiment Analysis:*** Understanding public sentiment in social media posts, reviews, and other text data.
- ***Emotion Recognition:*** Identifying emotional states in images and videos for various applications.
- ***Mental Health Support:*** Providing insights into emotional well-being and offering support based on detected emotional states.
- ***Customer Service Chatbots:*** Enhancing Chabot interactions by understanding and responding to customer emotions.
- ***Human-Computer Interaction:*** Improving user experience by adapting responses based on detected emotions.
- ***Market Research:*** Analyzing consumer emotions to gain insights into product preferences and trends.
- ***Healthcare:*** Monitoring patient emotions and providing support in clinical settings.

By integrating these capabilities, the proposed method aims to create a comprehensive emotion detection system that can be applied across multiple domains.

The proposed model integrates facial emotion detection with a music recommendation system using Convolutional Neural Network (CNN) techniques. The following explanation provides a step-by-step description of the flow chart illustrated in Fig. 1.

1. Input Image Capture:

The process begins with capturing an input image of the user's face using a camera. This image serves as the primary input for the facial emotion detection module.

2. Preprocessing:

The captured image undergoes preprocessing steps, such as resizing, normalization, and noise reduction. These steps are crucial to ensure that the image is in a suitable format for analysis by the CNN.

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3. Feature Extraction Using CNN:

A Convolutional Neural Network (CNN) is employed to extract features from the preprocessed image. The CNN is trained on a large dataset (FER2013) to recognize and learn the various facial features associated with different emotions. The network includes multiple convolutional layers, pooling layers, and fully connected layers to accurately capture the relevant features.

4. Emotion Classification:

The extracted features are then passed through a classifier, which assigns a probability to each emotion category. The classifier outputs the detected emotion based on the highest probability. Common emotion categories include happiness, sadness, anger, fear, surprise, disgust, and neutrality. The fig.1.represents the proposed facial emotion detection using music recommendation system

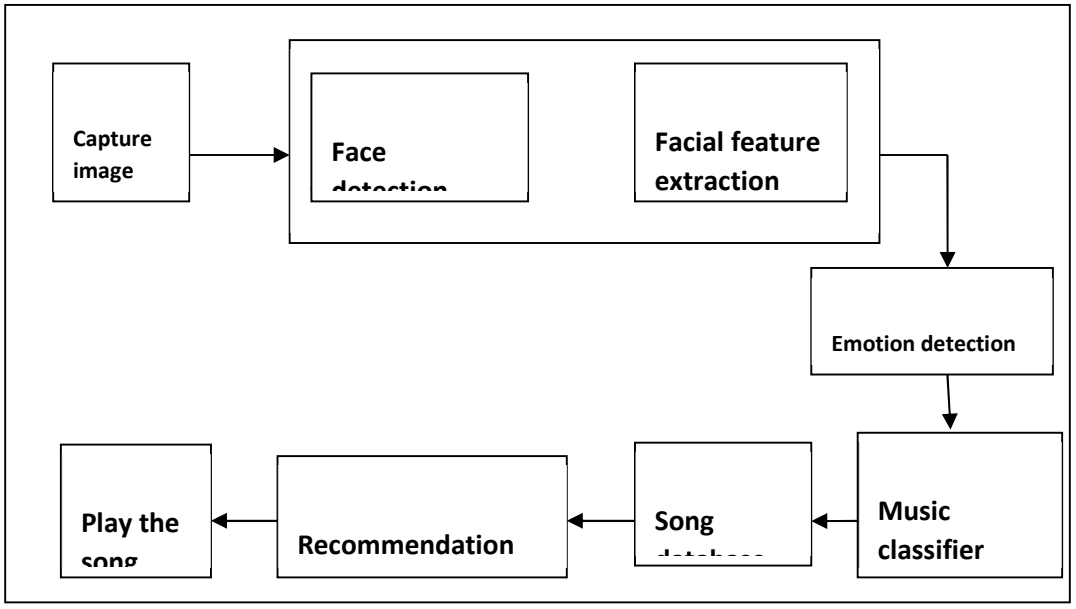

Fig.1. Flow chart of proposed model

5. Emotion Mapping to Music Preferences:

Once the emotion is detected, it is mapped to predefined music preferences. Each emotion is associated with specific music genres or playlists that are likely to enhance or complement the user's emotional state.

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6. Music Recommendation System:

Based on the detected emotion and the corresponding music preferences, the system generates a music recommendation. This recommendation can include specific songs, playlists, or genres that align with the user's current emotional state.

7. Music Playback:

The recommended music is then played back to the user through a connected device, such as a smartphone or a music player. The system may also provide options for the user to customize their music preferences further.

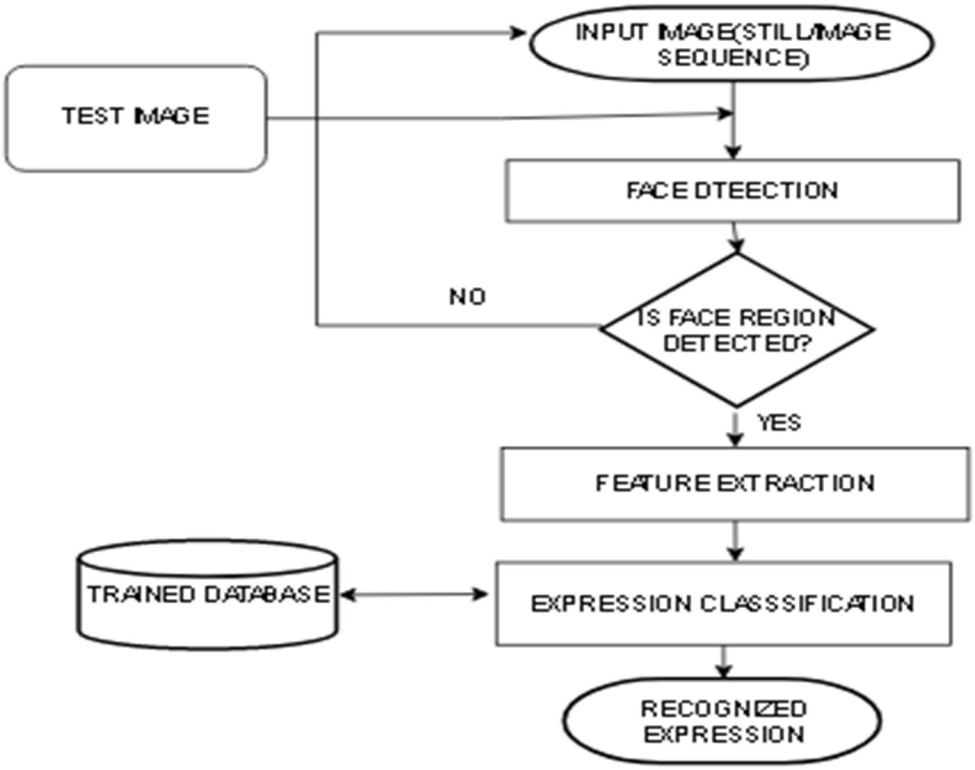

Fig.2. Flow chart of feature extraction

The proposed design of emotion has two CNN models, where the first with a max pooling layer and the Relu algorithm is used for face recognition and feature extraction, and the second CNN model is used for emotion detection.

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3.2.1 Face Detection

Face detection isolates the face inside the frame by minimizing background noise and other elements which is adopted by using max pooling layer.

3.2.2Feature Extraction

In the emotion detection module, the CNN model is trained with train data set where using max pooling layer for face detection is done Relu activation function is used for feature extraction and feature mapping. An arbitrary feature extractor, Similar to the already trained the network, the sequential model allows the input picture to continue before halting at the pre-specified layer and taking the output of that layer. This happens before the model takes the output of the layer. Test set and train set for feature extraction. 80% for to train the data and 20% for to test the data as shown in fig.2

3.2.3 Emotion Detection

After feature mapping the CNN architecture applies a feature or filter detector to the input image. The most common application of a Convolutional Neural Network, often known as a CNN, is in the field of deep neural networks, specifically for the purpose of interpreting visual information.

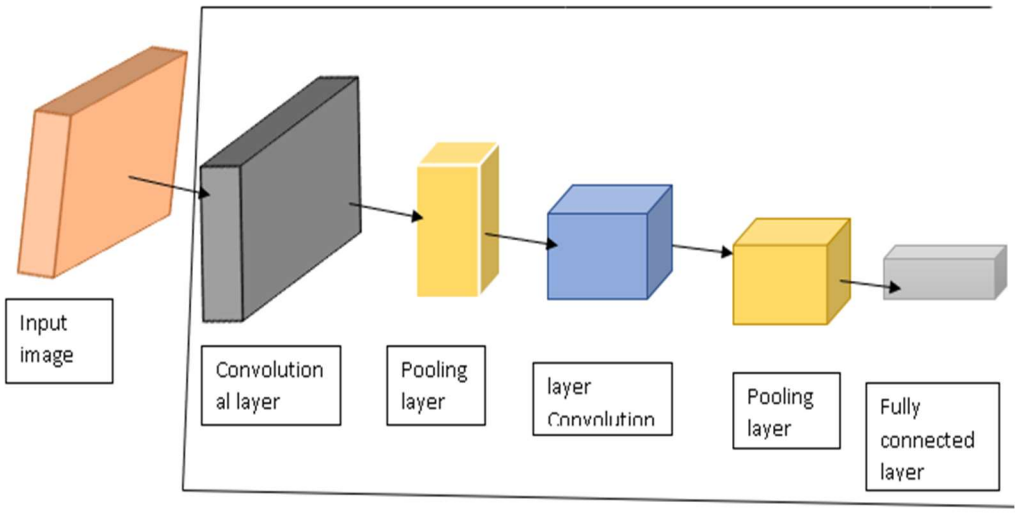

Fig.3. CNN model of proposed method

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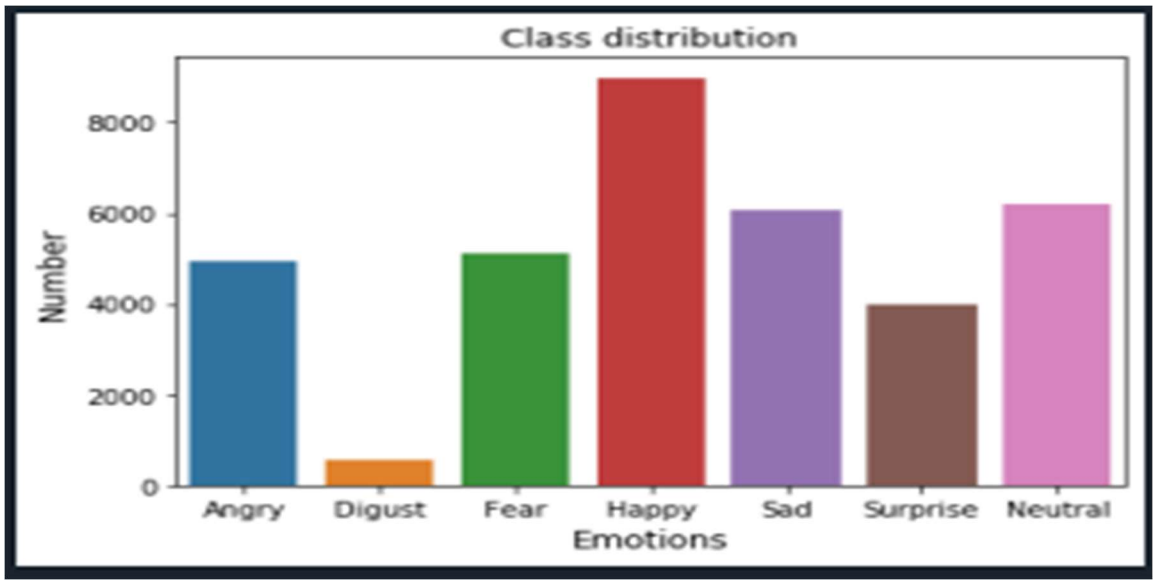

Fig.4. Class distribution of emotion

The primary use of a Convolutional Neural Network, which is also commonly referred to as a CNN, is in the field of deep neural networks, primarily to process visual information. The different phases of CNN steps are shown in fig.3 The seven categories of music are annoyed within corresponding emotion lobe. In the preprocessing of music based on the music classifier categorized features into melody, rhythm, tempo, spectral features. Extraction relevant audio features from the preprocessed songs using technique Fourier transform. The Fourier transform feature for different moods like are used for train CNN model to classify the representation of emotion categorizes based on moods. In the emotion detection module after feature mapping the CNN architecture applies feature of filter detector on the images and estimate the emotion by using fully connected layers of CNN. In the proposed model the emotion detection phase is trained into seven different types of emotions the like angry, disgust, fear, happy, sadness, surprise, neutral and classification is also done on these different emotions.

The classifications of emotions are shown in fig 4. The proposed model of emotion estimation is also compared with different classifiers like SVM and random forest.

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3.3 Music Recommendation Module

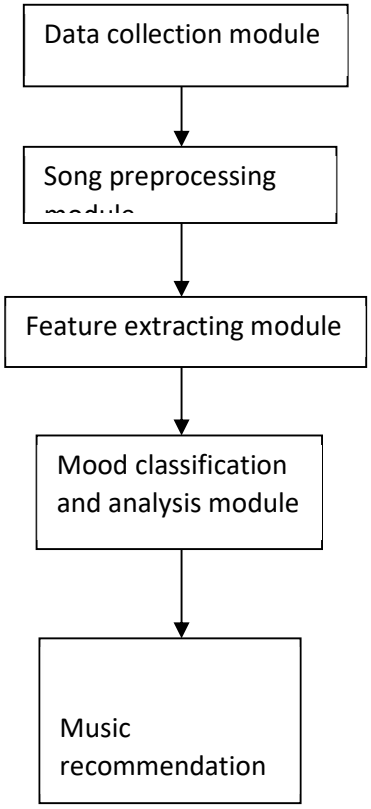


Fig.5. Music Recommendation Module

3.4 Music Playlist Recommendation

The emotion module allows for real-time user emotion detection. This will result from labels like Neutral, Surprise, Angry, Sad, and Happy. The music playlist recommendation system leverages the real-time emotion detection capabilities of the emotion module to provide personalized music suggestions. The system works by analyzing the user's facial expressions and mapping detected emotions to specific music playlists that match or complement their current emotional state. The emotion detection module uses a Convolutional Neural Network (CNN) to analyze facial expressions and detect emotions in real time. The CNN is trained on a dataset that includes various facial expressions corresponding to different emotional states.

The module outputs one of several emotion labels based on the detected facial expression. The common emotion labels include:

- Neutral: The user’s face shows no strong emotion.
- Surprise: The user’s face shows signs of being surprised.
- Angry: The user’s face shows signs of anger.

- Sad: The user's face shows signs of sadness.
- Happy: The user's face shows signs of happiness.

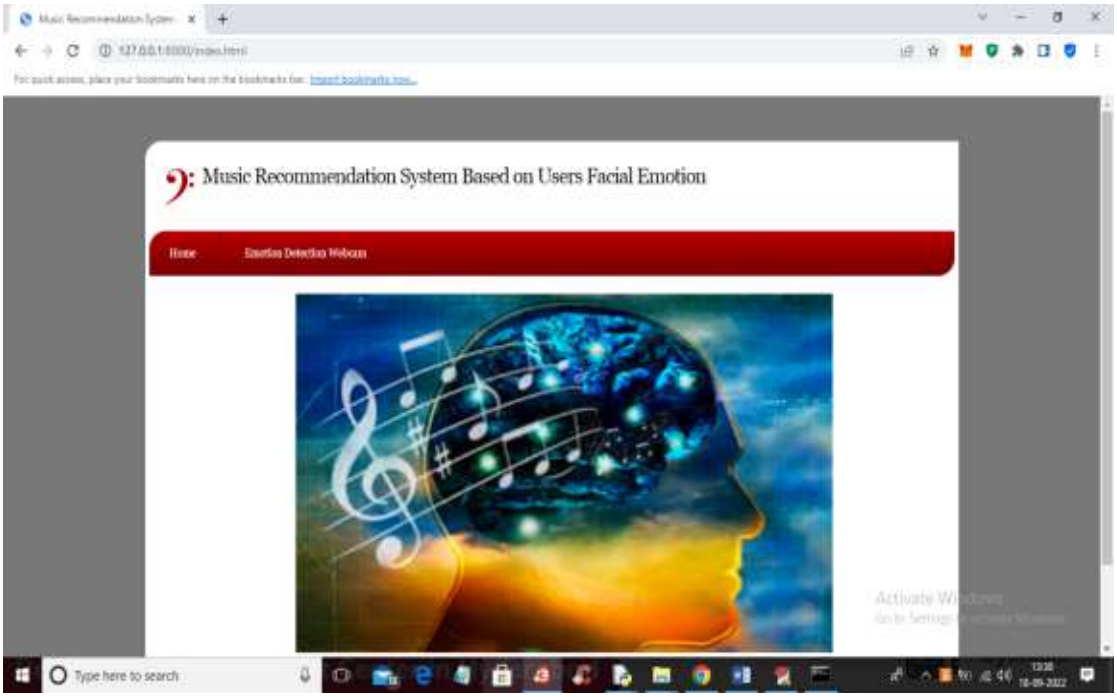


Fig 6: GUI based web page

4. RESULT AND ANSYSLSIS

The proposed model has two phases of classification methods

- Emotion Detection
- Music Recommendation

In emotion detection the comparison of different classifiers like SVM, random forest, CNN is done on seven different emotion classifications. From table-1 it shows that CNN model is giving better accuracy of 96.5where it can be used for the unsupervised learning also. So this research proposal is that CNN model is best preferable for emotion detection.

To enhance the classification of emotion detection to user friendly applications. A music recommendation module is proposed where CNN is used for classification and mapping of music to the esteemed motion.

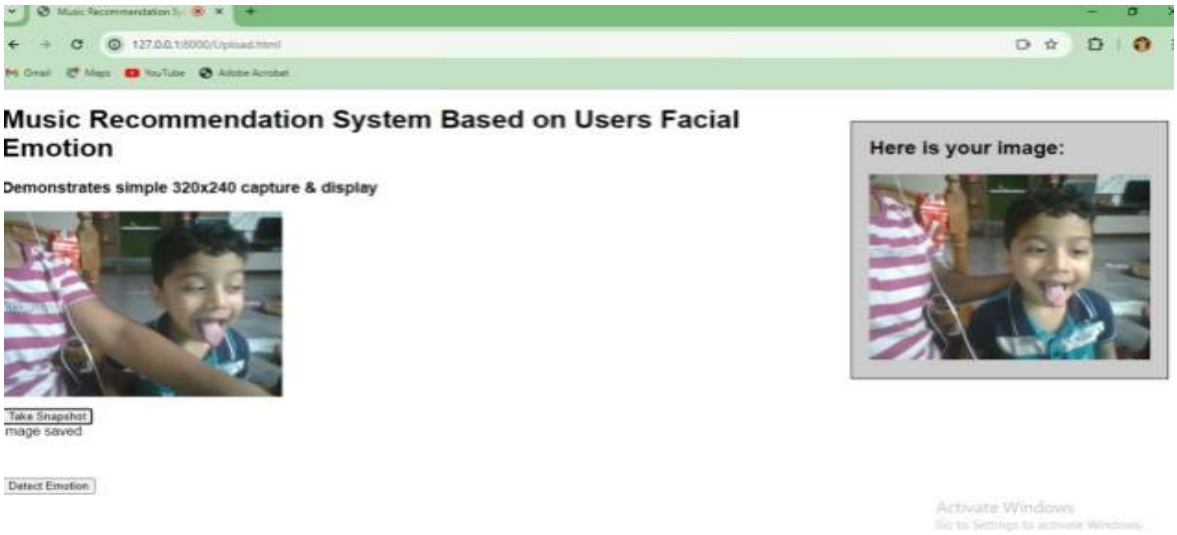
In the proposed work to make it user friendly and adopt it to web page applications a GUI model is developed where capture image recognition of feature and recommendation of music are shown in different phases in GUI. In this work seven types of emotions are considered. for disgust emotion displayed in figure 7, for the happy emotion displayed in figure 8, for the neutral feeling displayed in figure 9, for the sad emotion displayed in figure 10, for the anger

emotion displayed in figure 11, for the scare emotion displayed in figure 12, and for the surprise emotion displayed in figure 13.

Table 1: Performance of Comparison Annyslsis

Machine learning methods	**Accuracy**	**Seven different Emotions**
SVM	68.2	7
Random forest	87	7
CNN	96.5	7

Table 1. as shows the accuracy results for the comparison over SVM, random forest, CNN. By this CNN gives better results when compared to previous methods.



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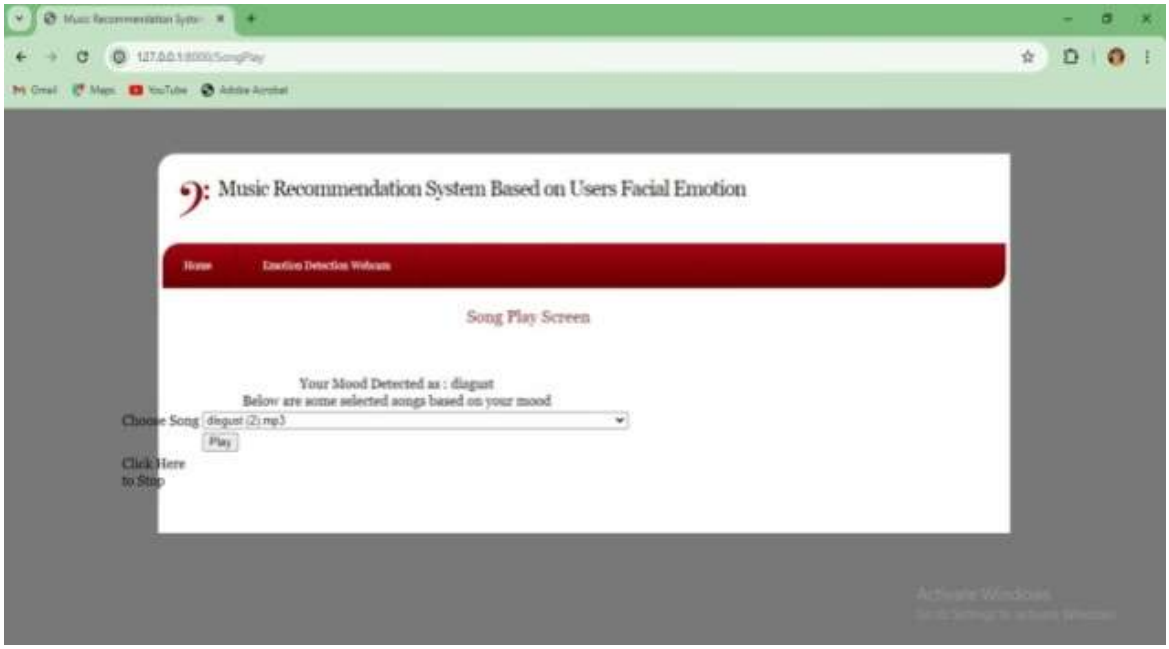
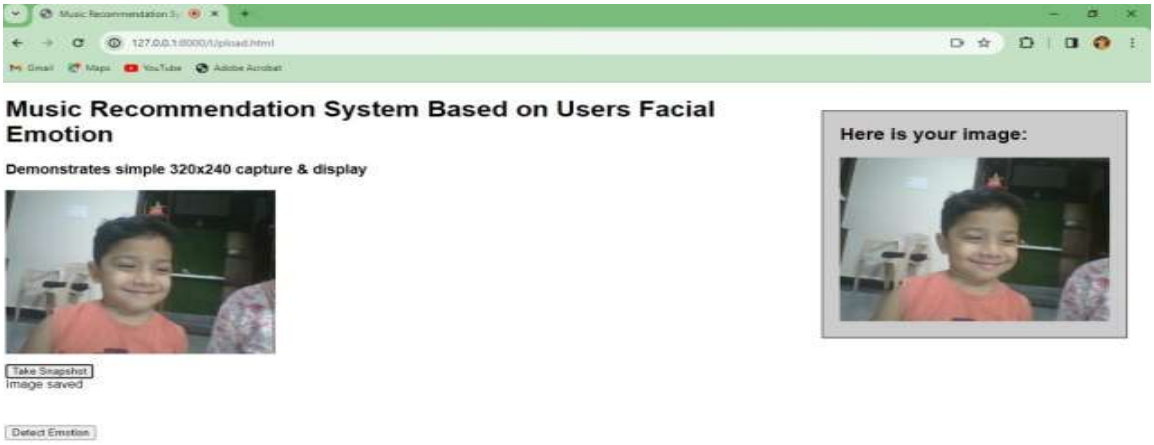


Figure 7: disgust emotion detection



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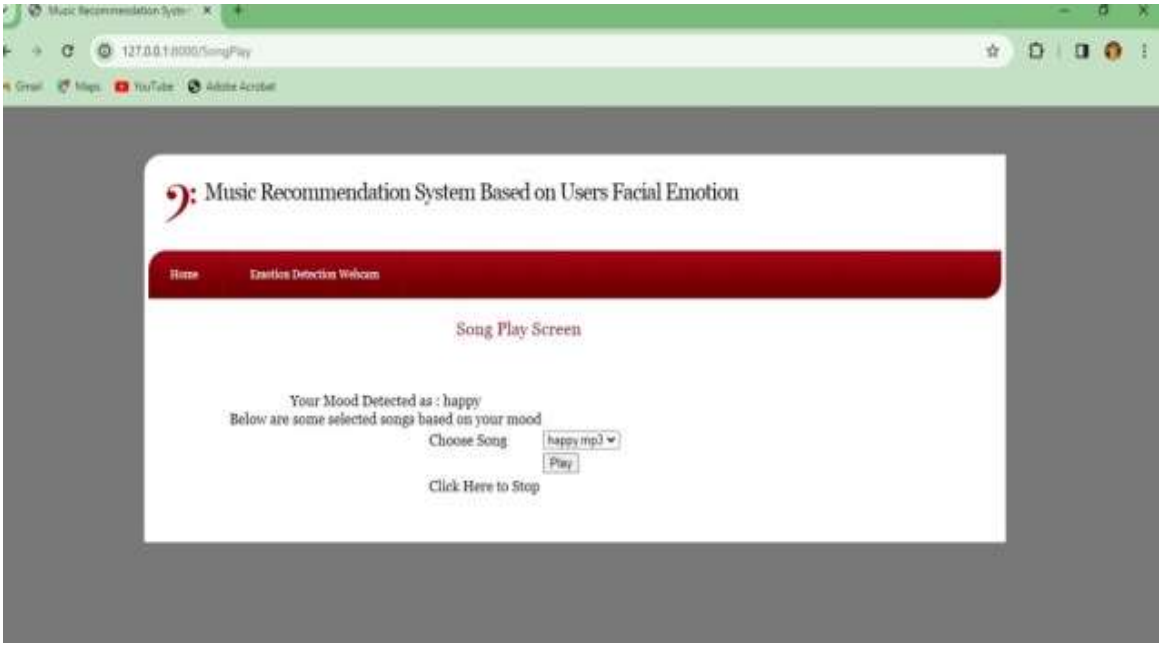

Fig 8: happy emotion detection

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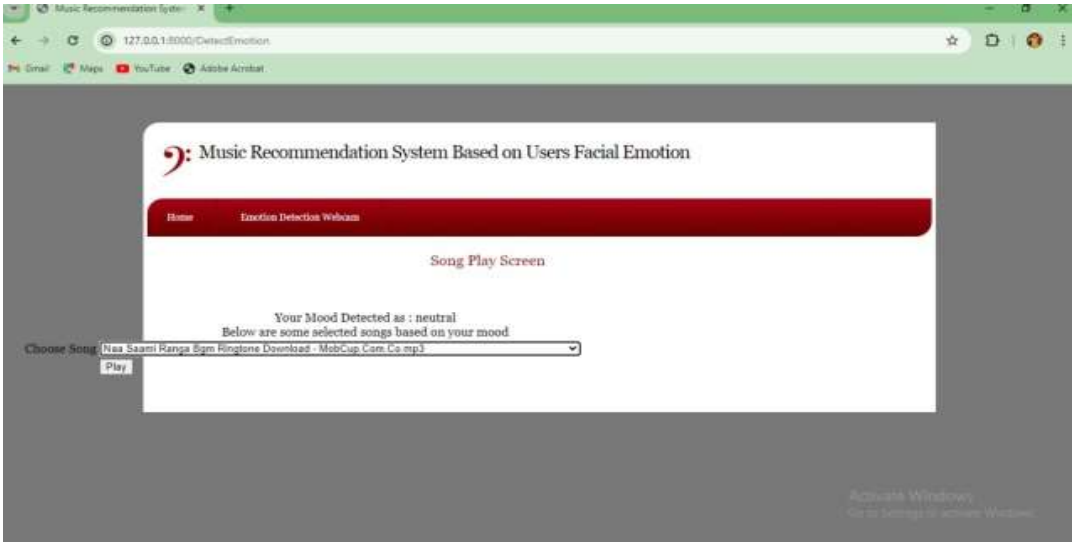
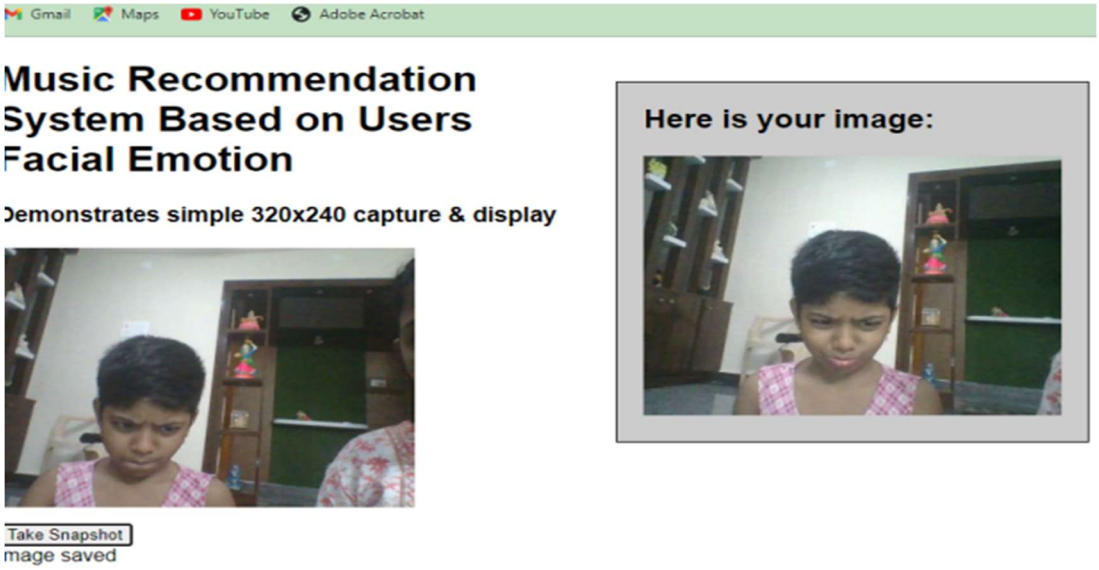


Fig 9: nutral emotion detection



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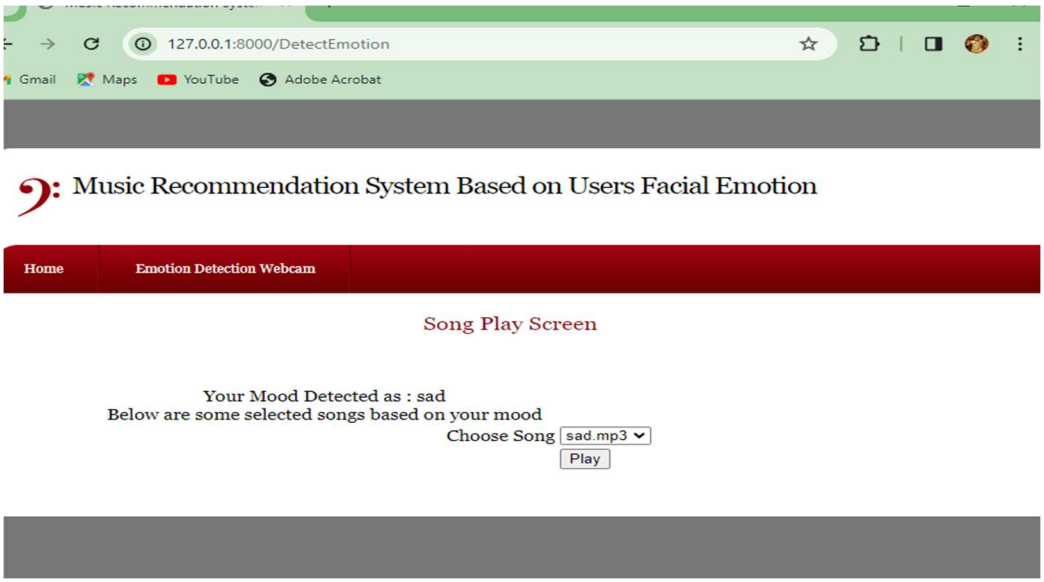
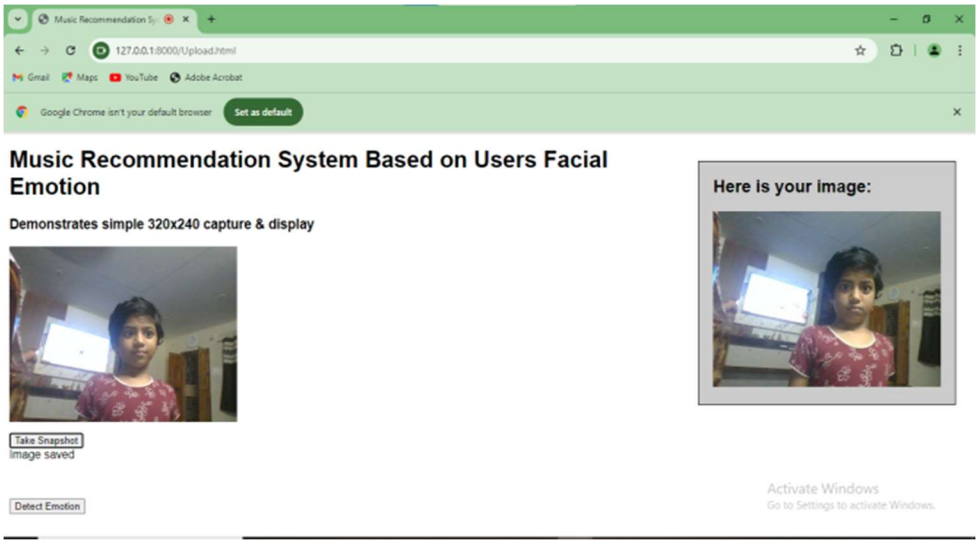


Fig10: sad emotion detection



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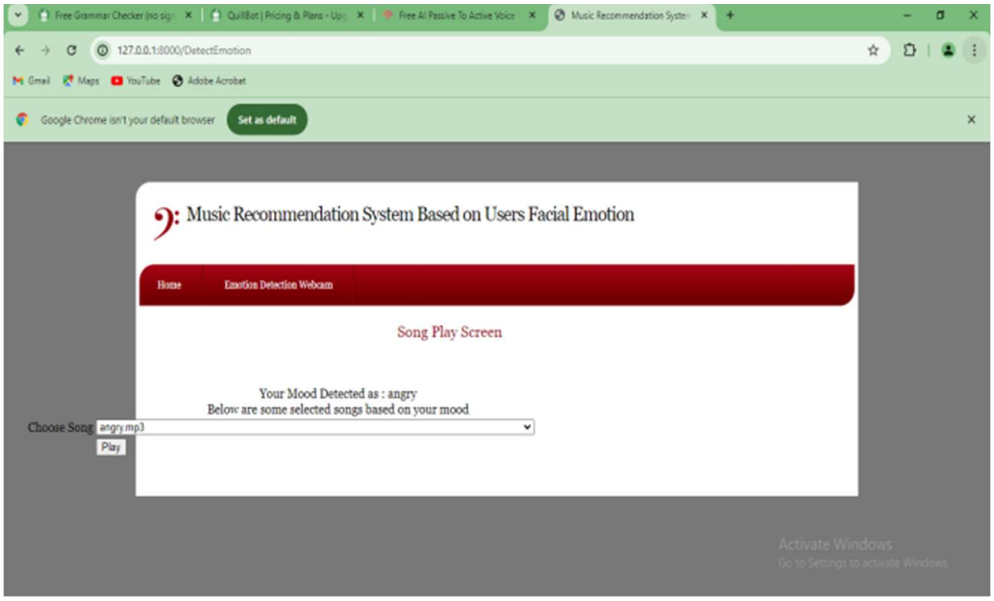
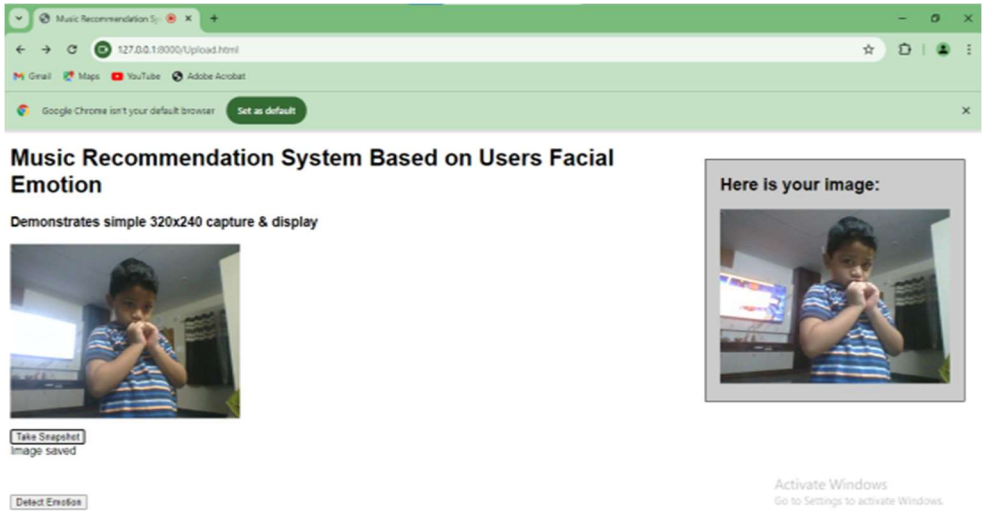


Fig11: anger emotion detection



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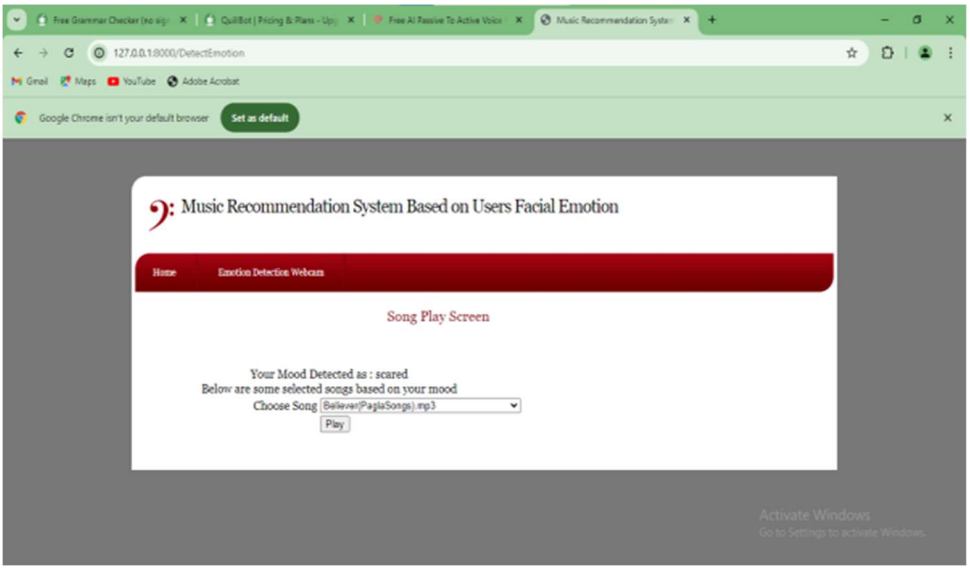

Fig12: scared emotion detection

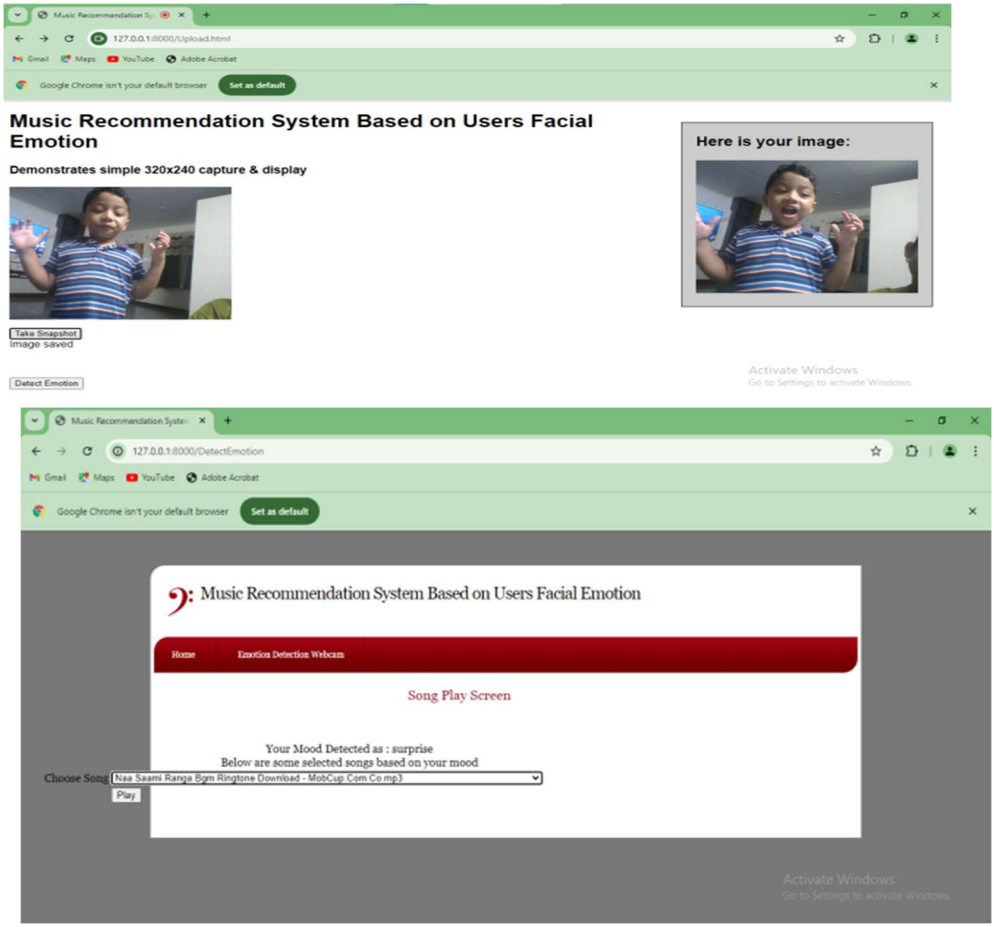

Fig13: surprise emotion detection

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5. CONCLUSION AND FUTURE WORK

Machine learning and digital image processing are two approaches that play a vital role in every application that is considered to be state of the art. It is proposed that a Facial Emotion Based Music Recommendation System be included as a component of it. Two distinct phases are carried out in the work that is being presented for the purpose of emotion recognition and music recommendation. In the I phase of emotion detection three different classifiers are used like face detection, feature extraction, emotion detection. Accuracy is observed that CNN giving better performance that 96.5%. Enhancing the advantage of CNN model it is also developing on the real-time system to make it as additional feature for existing music players on the mobile applications. This type of GUI model approachable for illiterates, children, and adults also. In future such type of emotion classification methods and music mapping methods can be used for developing data acquisition methods without man inter mention.

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