PROJECT REPORT

ON

EMOTION DETECTION AND MUSIC RECOMMENDATION SYSTEM BASED ON USER FACIAL EXPRESSIONS

BACHELOR OF ENGINEERING
INFORMATION TECHNOLOGY (6TH SEM)

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Declaration

We hereby declare that the project report entitled “Music Recommendation Based on Emotion Detection“submitted by us to University Institute of Information and Technology in partial fulfillment of the requirement for the award of the degree of B.E. in Information Technology Department is a record of bona fide project work carried out by us under guidance of M**r. Rajneesh Singla (IT)** Uiet , Pu. we further declare that the work reported in this project has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

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Acknowledgement

Whenever a module of work is completed successfully , a source of motivation and guidance is always there for student . This Project is Golden Opportunity for learning about upcoming new Technologies and Self Development . We hereby take the opportunity to thank all the wonderful people who provided this golden opportunity to us .

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----------Chapter-1----------

------Introduction to the Problem------

Idea / Motivation

It is often confusing for a person to decide which music he/she have to listen from a massive collection of existing options. It is well known that humans make use of facial expressions to express more clearly what they want to say and the context in which they meant their words. The main objective of our music recommendation system is to provide suggestions to the users that fit the user's preferences. The analysis of the facial expression/user emotion may lead to understanding the current emotional or mental state of the user. More than 60 percent of the users believe that at a certain point of time the number of songs present in their songs library is so large that they are unable to figure out the song which they have to play. Therefore by developing a recommendation system, it could assist a user to make a decision regarding which music one should listen to helping the user to reduce his/her stress levels.

Introduction

Music is a powerful language to express our feelings and in many cases is used as a therapy to deal with tough moments in our lives. Emotions and moods can be easily reflected in Music , when we are doing sports , we tend to listen energetic music , similarly when we are anxious or tired a nice relaxed song can help us to calm down . People tend to express their emotions, mainly by their facial expressions. Music has always been known to alter the mood of an individual. The project aims to capture the emotion expressed by a person through facial expressions. The user would not have to waste any time in searching or to look up for songs and the best track matching the user's mood is detected, and songs would be shown to the user according to his/her mood. A music player is designed to capture human emotion through the web camera interface available on computing systems. The software captures the image of the user and then with the help of image segmentation and image processing techniques extracts features from the face of a target human being and tries to detect the emotion that the person is trying to express. The project aims to lighten the mood of the user, by playing songs that match the requirements of the user by capturing the image of the user.

----------Chapter-2----------

---------Technology Stack----------

For App Designing:

- HTML/CSS - Frontend styling and web page design.
- Java-script - Frontend music player functions.
- Django - Backend integration of machine learning algorithms.

For Model Training:

- Python
- Artificial intelligence
- Open CV
- Colab / TensorFlow
- CNN

----------Methodology----------

- Face Detection
- Emotion Detection
- Music Recommendation
- Integration

----------Chapter-3----------

------Requirement Gathering------

To gather requirements for a music recommendation system based on face emotion recognition, it is important to consider the following factors:

1. Face Emotion Recognition: The system must be able to accurately detect and recognize facial expressions to determine the user's current emotional state.
2. Music Recommendation: The system should be able to recommend appropriate music based on the user's current emotional state.
3. Music Database: The system must have access to a large database of music that is properly categorized by emotions, genres, moods, and other relevant factors.
4. User Interface: The system should have an easy-to-use and intuitive user interface that allows the user to interact with the system and provide feedback on the recommendations.
5. Platform Compatibility: The system should be compatible with various platforms such as web, mobile, and desktop, to ensure accessibility and usability for the user.
6. Real-Time Analysis: The system should be able to perform real-time analysis of the user's facial expressions and provide recommendations accordingly.
7. Accuracy and Reliability: The system should be accurate and reliable in recognizing facial expressions and providing appropriate music recommendations to ensure a positive user experience.

We analysed the problem statement and found the feasibility of the solution of the problem. We read different research paper. After

checking the feasibility of the problem statement. The next step is the data- set gathering and analysis. We analysed the data set in different approach of training like negatively or positively trained i.e training the model with only fake or real photo's but found that it may lead to addition of extra bias in the model leading to inaccurate predictions. So after doing lot of research, we found that the balanced training of the algorithm is the best way to avoid the bias and variance in the algorithm and get a good accuracy.

We manually created dataset and after certain observation took mainly four emotions that are Happy, Sad, Neutral, Angry.

Overall, the system should be designed to provide a personalized and enjoyable music listening experience for users based on their current emotional state.

------Feasibility Study------

Technical Feasibility: To determine the technical feasibility, it is necessary to assess whether the technology required for the system exists and is capable of meeting the requirements. The face emotion recognition technology should be accurate and reliable to detect the user's emotions in real-time. The music recommendation system should also be capable of accessing a large database of music and providing accurate recommendations based on the user's emotional state. The system should also be compatible with various platforms and devices.

1. Accuracy: The accuracy of the emotion detection system is crucial to its success. It is essential to determine the system's accuracy rate and compare it to existing emotion detection systems to evaluate its effectiveness.

2. Data Availability: The availability of reliable data sets is critical to the development and training of the emotion detection system. It is essential to ensure that there is enough data available to train the system and to ensure its accuracy.

3. Hardware and Software: The hardware and software requirements for the emotion detection system must be assessed to ensure that they are feasible and meet the system's performance requirements.

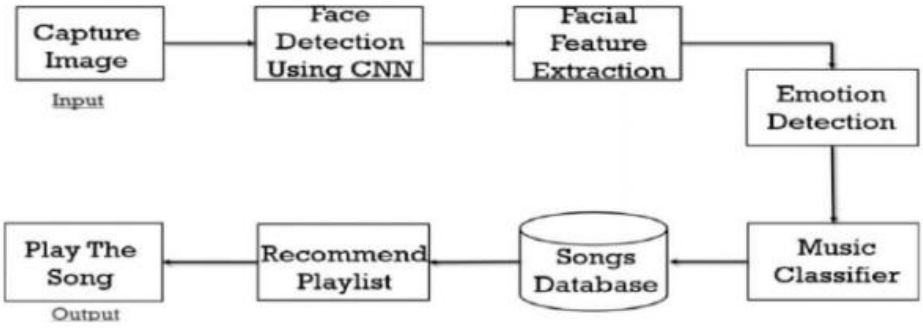
------Use Case Diagram/Flowchart------

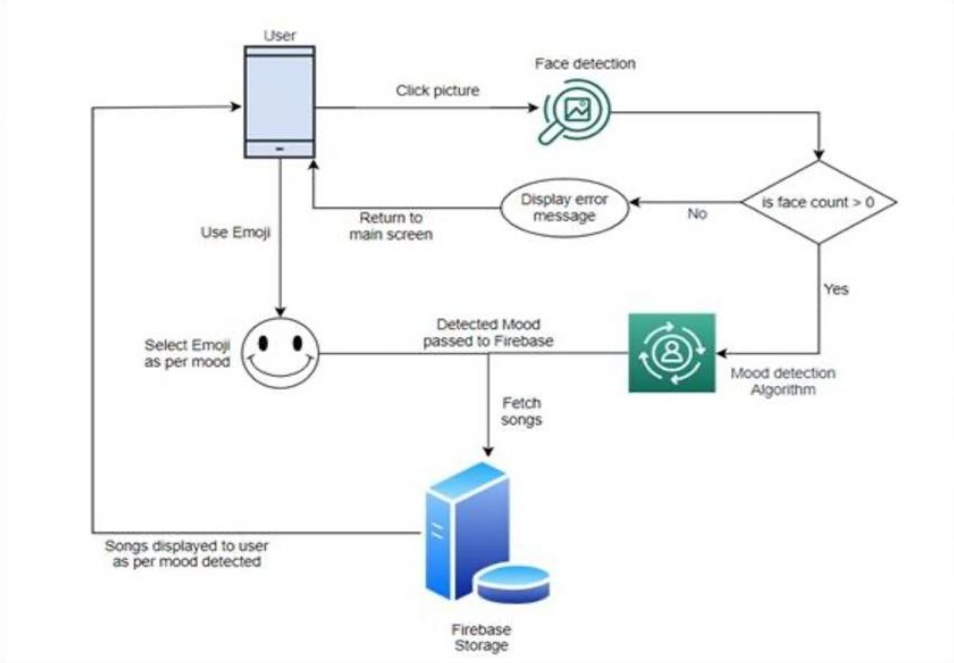
Here is a high-level data flow diagram for a Music Recommendation System based on Face Emotion Recognition:

1. User Interface:
    - The user interacts with the system through a web or mobile application.
    - The user interface allows the user to input their preferences and emotions and displays the recommended music.
2. Face Emotion Recognition:
    - The system captures the user's face through a camera and processes the image using an emotion recognition algorithm.
    - The emotion recognition algorithm analyses the facial expression to determine the user's emotional state.
3. Music Database:
    - The music database stores a large collection of songs with metadata such as artist, genre, tempo, and mood.
    - The database is queried by the recommendation algorithm to retrieve songs that match the user's preferences and emotional state.
4. Recommendation Algorithm:
    - The recommendation algorithm analyses the user's input and emotional state to generate a list of recommended songs.
    - The algorithm considers the user's music preferences, previous listening history, and the detected emotion to generate personalized recommendations.
5. Output:

- The system displays the recommended songs to the user through the user interface.
- The user can listen to the recommended songs and provide feedback to improve the system's recommendations.

This data flow diagram provides an overview of how the different components of the Music Recommendation System based on Face Emotion Recognition interact to provide personalized recommendations to the user.





------ Implementation------

Implementing a music recommendation system based on face emotion recognition involves several steps:

1. **Data Collection**: The system requires a large dataset of facial expressions and associated emotions to train the face emotion recognition model. The dataset collected is diverse in terms of age, gender, ethnicity, and emotions.
2. **Training the Face Emotion Recognition Model**: Once the dataset is collected, the face emotion recognition model is trained using Deep learning algorithm that is Convolutional Neural Networks (CNN) and Transfer Learning.
3. **Integration with Music Database**: The music database is integrated into the system, and the music is tagged with metadata such as genre, mood, tempo, and emotional content.
4. **Developing the Music Recommendation Algorithm**: The music recommendation algorithm is developed based on the emotional state detected by the face emotion recognition model and user preferences. The algorithm should be able to provide real-time recommendations.
5. **Developing the User Interface:** The user interface should be developed to enable users to interact with the system, provide feedback, and control the music playback. The interface should be intuitive, easy to use, and visually appealing.
6. **Testing and Evaluation**: The system should be tested and evaluated to ensure that it meets the requirements and functions correctly. Testing should be done with real users to assess the system's accuracy, reliability, and user satisfaction.

Model Details:

We firstly created CNN model for emotion detection and trained on dataset but accuracy we got was not satisfiable and time required for training model was very high. So, then we shifted to transfer learning technique.

Steps used in implementation of CNN model using Transfer Learning:

1. Preparing the Data:
    - Collect a large dataset of facial expression images with labelled emotions.
    - Pre-process the images, such as resizing and normalization, to make them compatible with the pre-trained model.
2. Choosing a Pre-Trained Model:
    - Choose a pre-trained model that was trained on a similar task, such as facial recognition or object detection.
    - Popular pre-trained models for image classification include VGG, Inception, and ResNet.
3. Modifying the Pre-Trained Model:
    - Remove the fully connected layers of the pre-trained model, leaving the convolutional layers intact.
    - Add new fully connected layers to the model, with the number of nodes in the last layer equal to the number of classes in the emotion detection task.
    - Freeze the weights of the pre-trained model to prevent them from being updated during training.
4. Training the Model:
    - Train the model on the emotion detection task using the pre-processed dataset.

- Use techniques such as data augmentation and dropout to prevent overfitting.
- Monitor the model's performance on the validation set and adjust hyperparameters as needed.
- Stop training when the model achieves satisfactory performance on the validation set.

5. Evaluating the Model:
   - Test the model on the test set to evaluate its performance.
   - Calculate metrics such as accuracy, precision, and recall to assess the model's performance.
6. Fine-Tuning the Model:
   - Fine-tune the model by unfreezing some of the layers of the pre-trained model and continuing training on the emotion detection task.
   - Consider using a smaller learning rate for the pre-trained layers to prevent them from changing too much.
7. Deploying the Model:
   - Deploy the trained model into a production environment, such as a web or mobile application.
   - Ensure that the model can handle real-time input and provide accurate predictions in a timely manner.

Implementing a CNN model for emotion detection using transfer learning can save time and resources compared to training a model from scratch. It can also provide better performance due to the pre-trained model's ability to extract useful features from images.

------Testing------

There are several types of testing that can be used to evaluate the performance of a CNN model for emotion detection using transfer learning:

1. Validation Testing: This is done during the training phase to validate the model's performance on the validation set. It involves measuring the accuracy and loss of the model on a separate dataset that the model has not seen during training.
2. Cross-Validation Testing: This is done to test the robustness of the model. It involves dividing the dataset into k-folds and training the model k times, each time with a different fold used as the validation set. The results are then averaged to obtain a more accurate estimate of the model's performance.
3. Test Set Evaluation: This is done to evaluate the performance of the model on a completely new dataset that it has not seen before. It involves measuring the accuracy, precision, recall, and F1-score of the model on the test set.
4. A/B Testing: This is done to compare the performance of different models or versions of the same model. It involves randomly assigning subjects to two or more groups, each using a different model or version of the model and measuring the performance of each group.

------Maintenance------

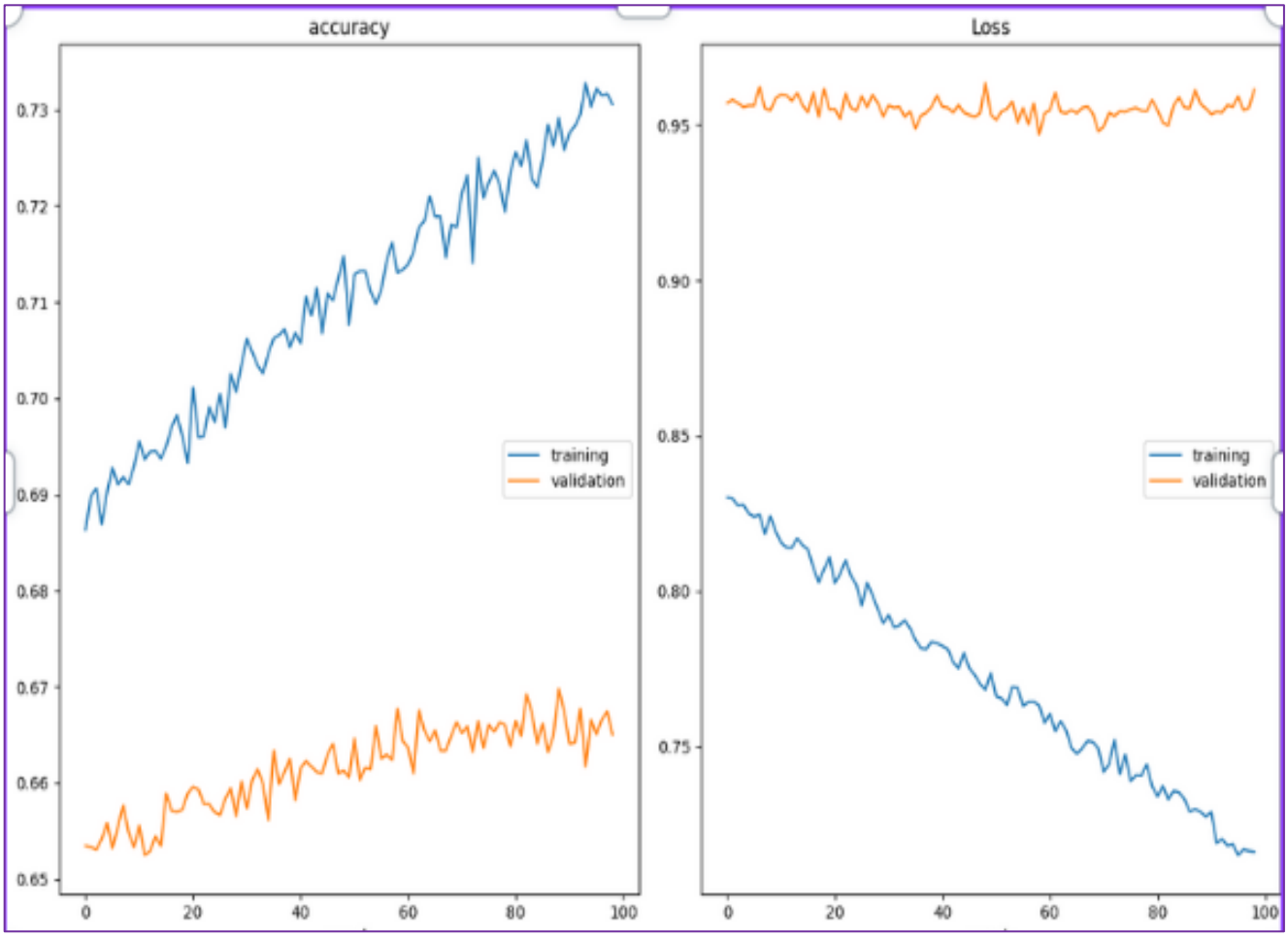
Maintaining a CNN model for emotion detection using transfer learning involves several steps to ensure that the model remains accurate and up to date:

1. Regular Updates: It is important to regularly update the model's pre-trained weights and update the software libraries used to implement the model. This helps to keep the model up-to-date and ensure that it is compatible with new technologies and updates.
2. Monitoring Performance: It is important to continuously monitor the performance of the model over time. This can be done by re-evaluating the model's accuracy and performance on new datasets or by using real-world data to measure its effectiveness.
3. Re-Training: If the model's performance begins to degrade or it is no longer accurate for new inputs, it may be necessary to retrain the model. This involves updating the model's architecture or training it with new data to improve its performance.
4. Data Cleaning: It is important to periodically clean the dataset used to train the model to ensure that it is accurate and unbiased. This may involve removing outliers, correcting mislabelled data, or adding new data to improve the model's accuracy.
5. Collaboration: It is important to collaborate with other experts in the field to stay up to date with the latest research and best practices. This can help to identify new techniques or approaches that can be used to improve the model's accuracy and performance.

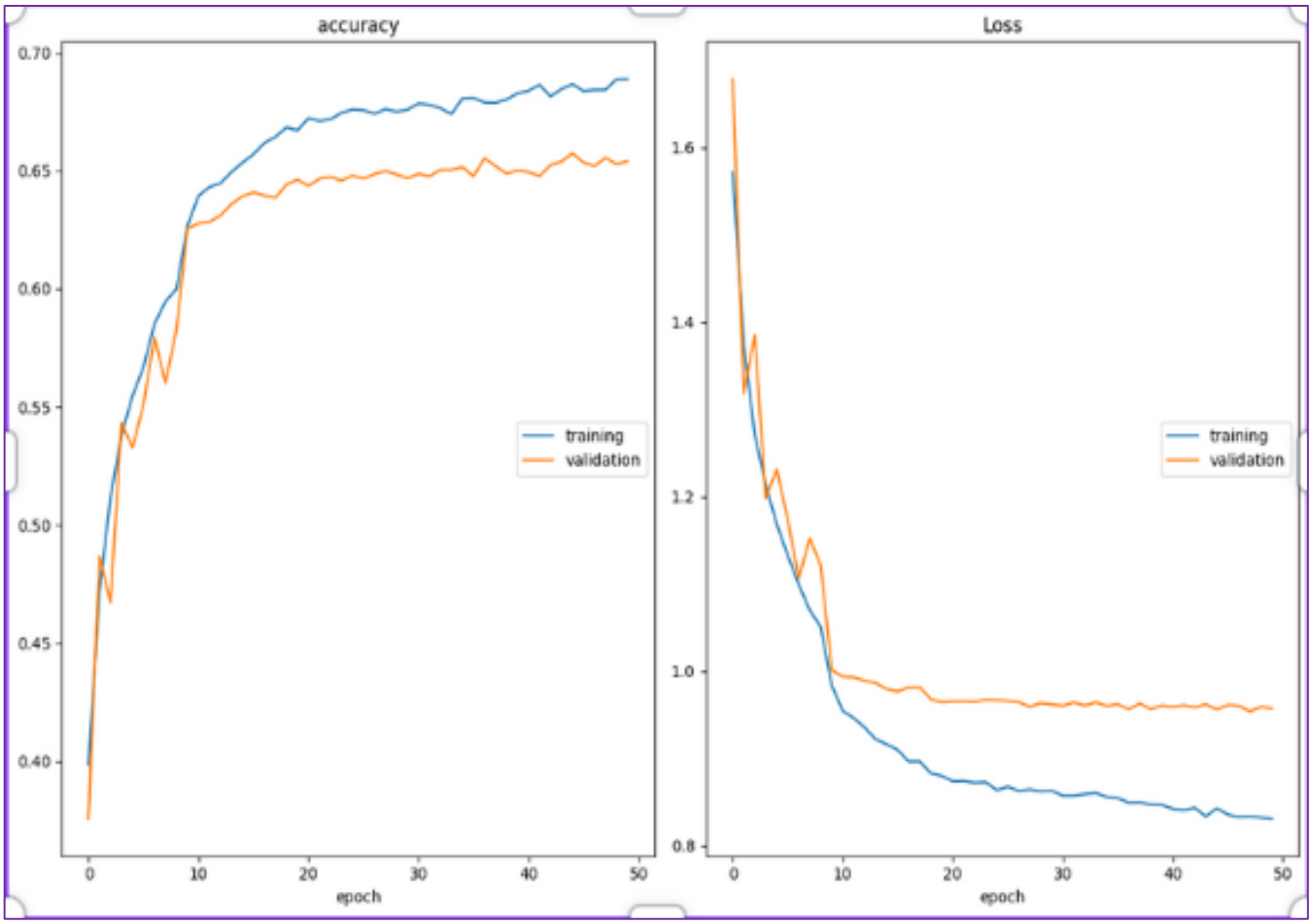
----------Chapter-4----------

------Project Snapshots------

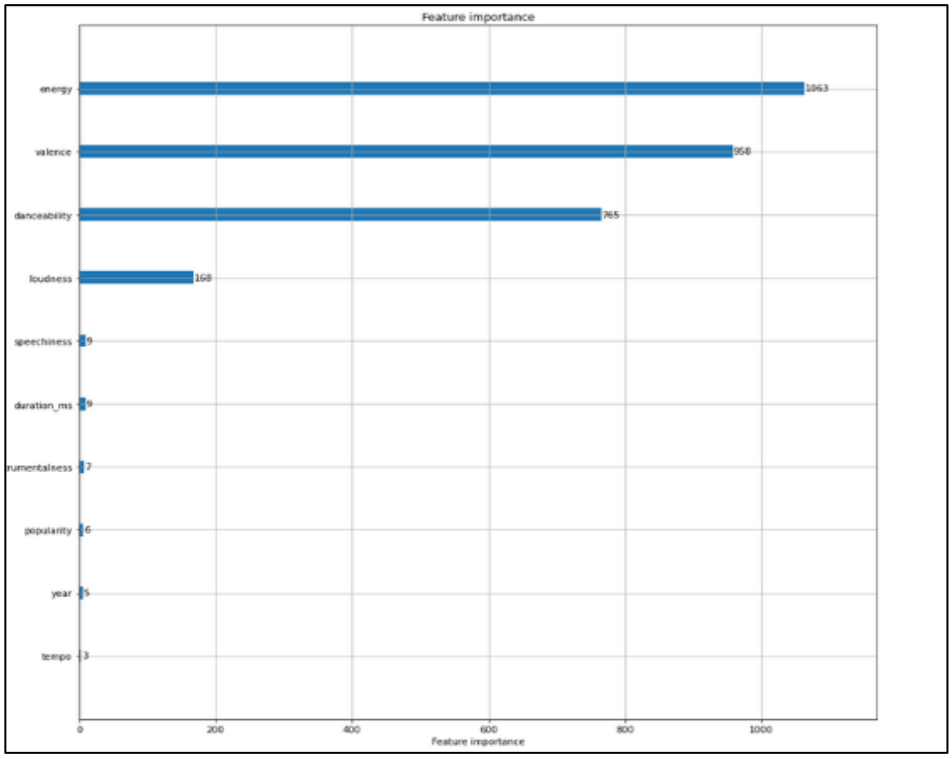
CNN Model for 100 epochs



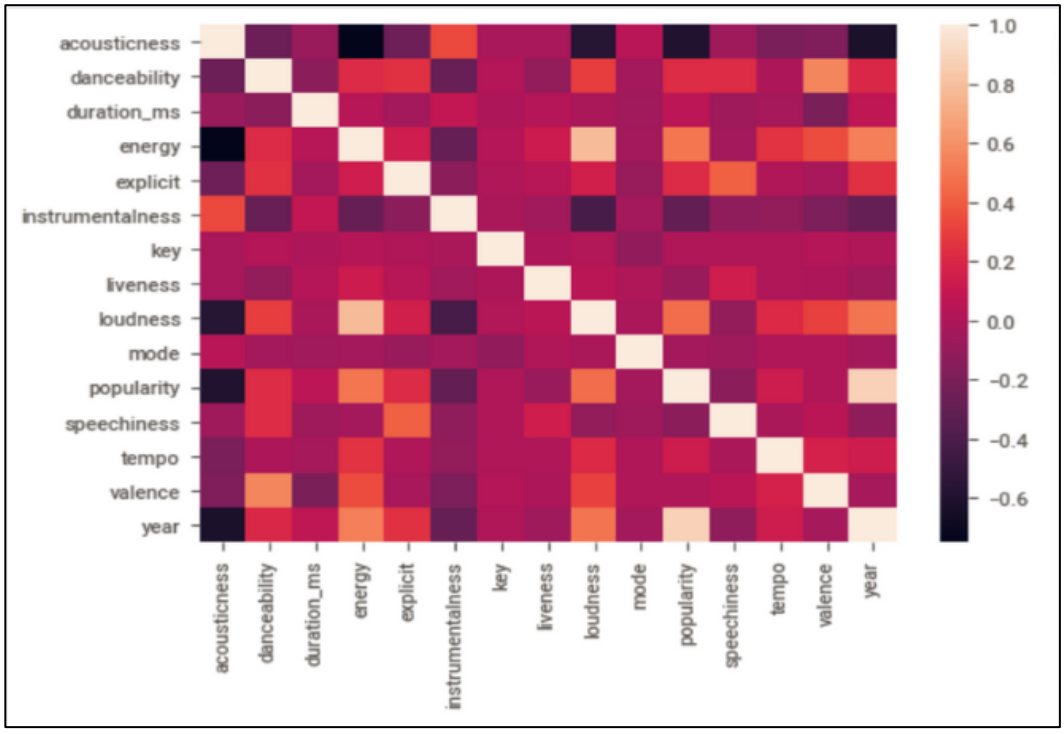
CNN Model Using Resnet50



Feature selection according to the Intensity of independent variable



Correlation Graph



Music Recommendation Model Output

```
    model.score(x_train,y_train)
[506] ✓ 0.6s
...  0.9999899704127175

    model.score(x_test,y_test)
[507] ✓ 0.2s
...  0.9866105009778847
```

Playlist of Songs For Happy Mood

```
                                song_name
87856                   Someone You Loved
87857                 everything i wanted
87955     Chicago Freestyle (feat. Giveon)
87752           rockstar (feat. 21 Savage)
88012                               Daisies
88039                 Lose You To Love Me
87968  Suicidal (Remix) [feat. Juice WRLD]
87978       Pain 1993 (with Playboi Carti)
87750              SLOW DANCING IN THE DARK
87544                  Say You Won't Let Go
emotion detected is HAPPY
```

Playlist of Songs For Angry Mood

```
                                        song_name
87851                          Watermelon Sugar
88029              I’m Ready (with Demi Lovato)
97669                          How Do You Sleep?
87768                                 STARGAZING
86140                          'Till I Collapse
87789                                Youngblood
85940                                In the End
83840                          Highway to Hell
126050                         Don't Call Me Up
97705   Good as Hell (feat. Ariana Grande) - Remix
emotion detected is ANGRY
```

----------Chapter-5----------

------Future Scope------

This project can be used in two ways:

Method-1) **Music Recommendation App**: Nowadays, music platforms provide easy access to large amounts of music. They are working continuously to improve music organization and search management thereby addressing the problem of choice and simplify exploring new music pieces. Recommendation systems gain more and more popularity and help people to select appropriate music for all occasions. However, there is still a gap in personalization and emotions driven recommendations. Music has a great influence on humans and is widely used for relaxing, mood regulation, destruction from stress and diseases, to maintain mental and physical work.

Method-2) **Mood Tracker App:** We can keep track of persons moods by maintaining data of facial expressions . Thus we can tracks person's mental health and can improve person's mental health . Also Research shows that mood tracker apps can help people better identify their moods and, in turn, understand them. Awareness of one's mood has been linked to better mental health outcomes. Additionally, apps can help people better communicate with mental health professionals by recording the data that someone can refer back to during an appointment.

----------Chapter-6----------

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