MULTIMODAL EMOTION RECOGNITION BASED MUSIC RECOMMENDATION SYSTEM

B. Tech Project Stage-II Report

Submitted by

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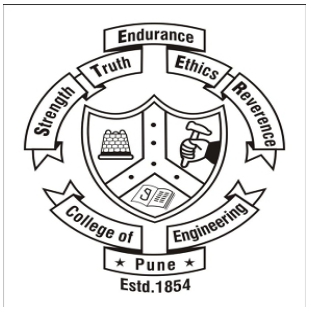

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CERTIFICATE

Certified that this project, titled "MULTIMODAL EMOTION RECOGNITION BASED MUSIC RECOMMENDATION SYSTEM" has been successfully completed by

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3	Aurobind V. Iyer, Viral Pasad, Smita R. Sankhe, Karan Prajapati. "Emotion based mood enhancing music recommendation", 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2017 Publication	2%
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Abstract

Music plays an awfully vital role in enhancing an individual‘s life because it is a crucial medium of recreation for music lovers and listeners and generally even imparts a therapeutic approach. Currently there are some music players where we have to select songs and make playlists manually to reduce that efforts we are proposing a music recommendation system which can recommend a playlist of songs based on users emotions/mood. As research into multimodal emotion recognition is one of the newest field in human-machine interaction, we are focusing on that approach which takes visual and textual input and detect emotion of user.

Contents

Chapter 1

Introduction

Multimodal emotion recognition has various applications such as in the field of various recommendation systems, to predict sentiment of customers based on product reviews and also in the healthcare systems to detect stress, anxiety or depression.As the music and emotions are very much interrelated user always tends to listen music according to their mood/emotions. It reduces stress and improves cognitive performance, also encourages an inspiring creativity.So we can realize that music has the power in an individual life. By understanding this importance we are applying multimodal emotion recognition for music recommendation system which will recommend songs based on the user's mood. Emotions can be detected from images, text and audio. We are using images captured by webcam and the text inputted by the user, further integrating the two modalities for emotion detection.

Chapter 2

Literature Review

Year	Title	Journal details	Methodology used	Advantages	Disadvantages	Result
2021	Real Time Emotion Based Music Player Using CNN [1]	2021 6th International Conference for Convergence in Technology,Pune, India. Apr 02-04, 2021	They have used the FER2013 dataset to build an emotion detection model.	This paper includes total five models to improve performance.	Need to add more music variety.	They have achieved accuracy of 76.12%.

2021	EMOTION BASED MUSIC PLAYER [2]	International Research Journal of Engineering and Technology (IRJTE) Issue: 07 — July 2021	They have used EMO algorithm to detect emotion of user. This application includes five phases : Login/Signup phase, Emotion capture phase, Affdes API, Emo phase,Display phase. They have used MERN stack approach to develop this system.	This is useful application for music listeners with a smartphone and an internet connection. This application provides the features of creating an account, adding songs, updating songs, removing songs, personalized playlist and capturing emotion using a camera.	This application can detect four emotions of the user. It can run only on internet connection. It uses Affectiva SDK that has a lot of limitations.	They have achieved accuracy of 90%.

2017	Smart Music Player Integrating Facial Emotion Recognition and Music Mood Recommendation[3]	IEEE WiSPNET 2017 conference	This music player contains three modules: Emotion Module, Music Classification Module and Recommendation Module. They have used FER2013 dataset and CNN algorithm to recognize emotion. Recommendation module recommends songs based on the user's perceived mood and user's preference.	This application provides high accuracy and quick response time. They have used EMP to generate playlists which reduces user efforts. Users can change the label of a song according to their taste of music.	This application can recognize only four emotions.	They have achieved an overall classification accuracy of 97.69%.

2017	An Intelligent Music Player based on Emotion Recognition[4]	2nd IEEE International Conference on Computational Systems and Information Technology for Sustainable Solutions 2017	This paper includes : Audio Feature Extraction and plotting on Thayer's Graph, Music Clustering, User Emotion Recognition and Music Recommendation. They have used K-means clustering to classify music based on emotion. They have used Cohn Kanade extended dataset for emotion recognition model.	This system captures multiple images using a video capture object which helps to predict emotion accurately.	There are restrictions due to number of clusters.	They have achieved accuracy of 72.3 % for emotion detection.

2019	A Machine Learning Based Music Player by Detecting Emotions[5]	Fifth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)	This paper includes: Facial Emotion recognition, Pre processing, Seg -mentation, Feature extraction, Emotion classification, Audio feature recognition, Emotion based music player. They have used point detection algorithm to detect feature points of image, CNN to classify emotion from image and SVM to classify songs.	This application is useful for physically challenged people and music lovers.	Nervous and excited emotions cannot be recognized.	Provides high accuracy which is around 80%.

2018	MULTIMODAL SPEECH EMOTION RECOGNITION USING AUDIO AND TEXT[7]	Dept. of Electrical and Computer Engineering, Seoul National University, Seoul, Korea	Given model encodes the information from both audio and text sequences. They have used dual RNNs to predict the emotion class. They have used the IEMOCAP dataset to evaluate models.	This model can detect emotion from speech and text simultaneously.	This model can detect only four emotions.	They have achieved accuracies ranging from 68.8% to 71.8%.

2017	Facial Expression Recognition and Emotion Classification System for Sentiment Analysis[6[]]	International Conference on Networks & Advances in Computational Technologies (NetACT) —20-22 July 2017— Trivandrum	This paper implements face detection, feature extraction and classification for image. They have used Japanese Female Facial Expression (JAFFE) database. They have used using SVM, RF and KNN classifiers.	In SVM classifier, dataset dimensionality has low dependency. Random Forest Classifiers are fast	In KNN, it becomes computationally expensive to find k nearest neighbours. Random Forest Classifier overfits the class	This system provides high accuracy, about 90.14%.

2020	MUSIC RECOMMENDATION USING FACIAL EMOTION DETECTION AND CLASSIFICATION[8]	Journal of CRITICAL REVIEWS ISSN-2394-5125	They have used FER2013 dataset for image classification and have used haar cascading and Adaboost algorithm for face detection.	Using this application user can create and manage playlists easily.	Provides high accuracy only for five emotions skipping disgust and fear.	This model gives accuracy of 81%.

2019	Multi -modal Mul- titask Emo- tion Recog- nition using Images, Texts and Tags[9]	WCRML- '19, June 10, 2019, Ottawa, ON, Canada	Given model consist three feature extrac- tors : three unimodal clas- sifiers, three bimodal clas- sifiers and one trimodal classi- fier. They used CNN for fea- ture extraction. Datasets used are Flickr Emo- tion dataset and VSO dataset.	This model is robust to one or two missing modalities at test time. It can efficiently handle im- age only or text only data.	Length of text is limited between 5 to 150.	The model has achieved accu- racy of 93.61%.

2020	Chatbot with Music and Movie Recommendation based on Mood-[10]	International Journal of Engineering Research & Technology (IJERT)	This application consists of three main modules: Chatbot, Mood detection and Music/Movie recommendation. They have used the Haar Cascade Algorithm for accurately detecting the user's face in the live webcam feed and the CNN Algorithm is used to detect the emotion being expressed by the user from the facial features. They have used FER2013 dataset.	This application helps to relax and relieve stress. It allows users to choose music and movies according to their mood.	They have designed a rule based chatbot which is incapable of interpreting complicated conversations	They have achieved an accuracy of 78%.

2021	Android based Emotion Detection Using Convolutional Neural Networks[11]	International Conference on Computational Intelligence and Knowledge Economy (ICCIKE)	They have used CNN and RNN for emotion recognition and both neural networks trained using the FER2013 dataset.	The end product can be changed and expanded according to user demand. This method can also be used in the cars where a camera can be placed in the rear view mirror and that can scan the emotion of the people in the car and play music automatically.	Accuracy of the RNN model is low compared to CNN model.	The accuracy of model trained using convolutional neural network is 65% and using recurrent the neural network is 41%.

2017	Emotion Based Mood Enhancing Music Recommendation[12]	IEEE International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT)	They have used Viola Jones Algorithm for face detection and Fisherfaces Algorithm for emotion recognition. Viola Jones algorithm uses the CascadeClassifier method provided by OpenCV library. They have used CK+ database.	This system can easily process the facial image and recognize basic emotions and then play music based on these emotions and also suggest music that enhances the mood of the user. It can work in both online and offline mode.	This system can detect only three emotions.	They have achieved accuracy of 91%.

2021	Emotion Based Music Playlist Recommendation System using Interactive Chatbot[13]	Proceedings of the 6th International Conference on Communication and Electronics Systems (ICCES-2021)	They have used three models: LSTM, Bidirectional LSTM and Convolutional 1D Neural Network. The models are trained on the Twitter dataset. They have used spotify web api for generating a playlist.	Bidirectional LSTM performed best among the three	User's emotion is classified into only three categories: positive,negative or neutral.	They achieved an accuracy of 79.64%.

2014	Face Detection and Facial Expression Recognition System[14]	International Conference on Electronics and Communication System (ICECS-2014)	The proposed system consists of three modules. Face detection, Facial feature extraction and emotion classification. They have used lighting compensation algorithm and morphological operations for face detection. Active Appearance Model is used for feature extraction. Emotion classification is done using simple Euclidean Distance method and Artificial Neuro-Fuzzy Inference System.	This system plays a communicative role in interpersonal relations because they can reveal the affective state, cognitive activity, personality, intention and psychological state of a person.	Change in the distance from the camera affects the recognition rate in Euclidean Distance method.	This system gives the recognition rate close to 100% for large number of training samples.

2021	Facial Emotion Recognition using Convolution Neural Network[15]	Proceedings of the Fifth International Conference on Intelligent Computing and Control Systems (ICICCS 2021)	This model consists of seven steps: Data Preprocessing, Splitting Dataset, Building the model using CNN,Feature Extraction, Generalization and Activation, Model Training and Evaluating and Testing the Model.	This model is useful for various real-life implementations such as health sectors, video game sectors and marketing industry.	This model can recognize only three emotions :Happy,Sad and Neutral.	This model has achieved accuracy of 82.52%.

2019	An Insight on Sentiment Analysis Research from Text using Deep Learning Methods[16]	International Journal of Innovative Technology and Exploring Engineering (2019)	This paper studied various deep learning methods for textual sentiment analysis .	CNN performs better than other models	Unable to handle complex sentences.	From this analysis, we can infer that CNN model was the predominantly used for textual sentiment analysis.

Above research papers show various approaches for detecting emotions. We will be using CNN for emotion detection from images and texts.

Chapter 3

Research Gaps and Problem Statement

3.1 Research Gap

1. Multimodal models are not explored in abundance in existing systems. Our system takes input in the form of images and text. Observing the facial expression and analyzing the text data allow us to identify the true affective states of the opinion holder.

2. Compared to single-modal emotion classification, multimodal data can express users' feelings and sentiments more vividly.For detection of emotion and sentiment ,multimodal analysis provides plenty of behavioral cues.

3.2 Problem Statement

To design a music recommendation system using multimodal emotion detection to make it easy for music lovers to find playlists of songs based on their current emotions. The system will take images captured by webcam and text from the user to detect emotion.

Chapter 4

Proposed Methodology/ Solution

4.1 Datasets

The proposed image analysis model is built using the FER-2013 dataset from Kaggle[17] has it publicly available. It contains gray-scale images of 48*48 pixels of faces with emotion labels. We have used 5 Emotions from this dataset :- (Angry, Fear, Happy, Sad, Neutral).

For textual analysis, a combined dataset from dailydialog, isear, and emotion-stimulus is used. It contains 5 labels: happy, sad, anger, fear, and neutral. The texts mainly consist of short messages and dialog utterances.

4.2 Image Analysis

4.2.1 Preparing Data

The pixel value is normalized when rescaled by dividing it by 255.

4.2.2 Model Architecture

In the CNN model for emotion detection blocks are created using Conv2D layer, Max-Pooling2D, Dropout, Flatten and at the end Dense Layer for output. The output level with 5 neurons has a softmax activation function

4.2.3 Compiling and Training

We compiled the model using Adam optimizer with a learning rate of 0.0001 and 25112 images representing 5 classes have been trained. Secured an accuracy of 63.5%

4.2.4 Real-time face detection using Webcam Feed

A haar cascade classifier in OpenCV Python is used to detect faces. The stages are:

- **Haar Feature Selection:** As a haar like feature, there are intensely dark and intensely light regions. By subtracting the two intensities, it produces a single value.
- **Creation of Integral Images:** With integral image, each pixel is composed of all the pixels to the left and above it. This makes the process of extracting haar-like features much simpler which involves calculating the difference between dark and light rectangular regions.
- **AdaBoost Training:** In this algorithm, the best features are selected. Multiple weak classifiers are combined into a single strong classifier by linearly combining weak classifiers.
- **Cascade Classifier:** Through this approach, complex classfiers like Adaboost can be cascaded together so that non-face containing negative inputs are quickly discarded while the positive inputs are given more computation time. Consequently, the computing time drastically decreases, and the process becomes much more efficient.

  After detecting the faces, the cropped image is given as input to the trained model.

4.3 Text Analysis

4.3.1 Preparing Data

1. **Tokenization** of Data: The process of splitting a text string into tokens. For example, a word is a token in a sentence, and a sentence is a token in a paragraph.

2. Padding: each input (sentence or text) is made of the same length.

3. The tokenizer class of keras is used for vectorizing a text corpus.

4.3.2 Model Architecture

The proposed model uses 300 dimensional w2v pre-trained on wikipedia articles. Word Embedding is a text representation in which words with related meanings are represented similarly. The input is the words of each text with proper padding . The first level creates embedding of words. The model consists of a 1D convolutional neural network. The output level has a number of neurons equal to the classes of emotions(5) and a "softmax" activation function.

4.3.3 Compiling and Training

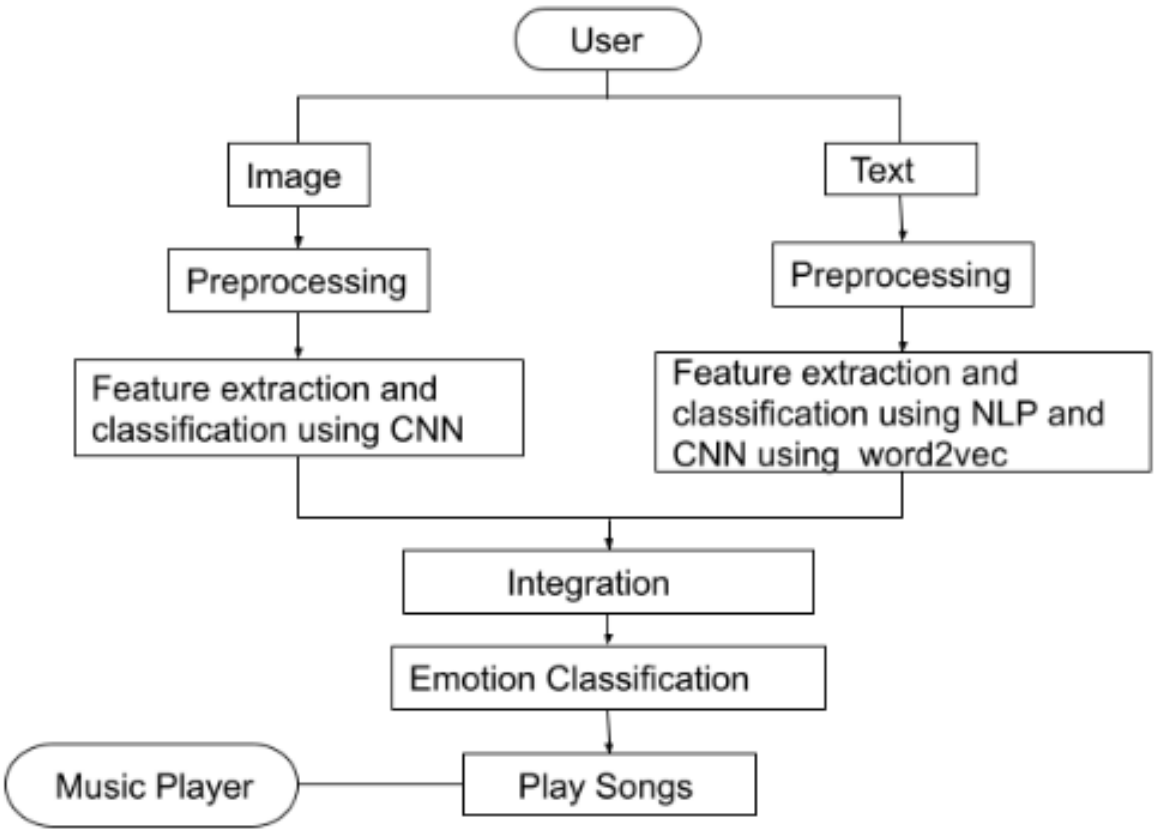
Based on 7934 text inputs representing 5 classes, the model was compiled and trained using Adam optimizer with 0.0001 learning rate. Secured an accuracy of 74.77%.

The text analysis model was tested by giving various sentences as input.

4.4 Integration of text and image modalities

We have used ensemble learning to combine the text and image modalities. The text and image models have been trained independently and then combined using voting ensemble. A soft voting ensemble involves summing the predicted probabilities for class labels and predicting the class label with largest sum probability. Weights were calculated as the reciprocals of mean squared error. Secured an accuracy of 82.83% using weighted ensemble learning.

4.5 Flowchart



Chapter 5

Experimental Setup

5.1 System Requirement Specification

According to system requirements a system must meet certain specifications before it is able to run certain hardware or software.

5.1.1 Hardware Requirements

Ensure that your system's specifications are close to those suggested optimal performance demands.

- Processor - Minimum 1GHz; Recommended 2GHz or more
- Hard Drive: Minimum 32GB; Recommended 64GB or more
- System - 4GB RAM or more

5.1.2 Software Requirements

It is the prerequisites that are needed to be installed on the system to provide desired functioning of an application.

- Operating System: Windows 8-11 or Linux-64 bit
- Space for the system: 15GB Free Disk Space

- CPU or Processor Speed: x86 64-bit CPU (Intel/ AMD Architecture)
- Minimum GPU: 4GB 5.1.3

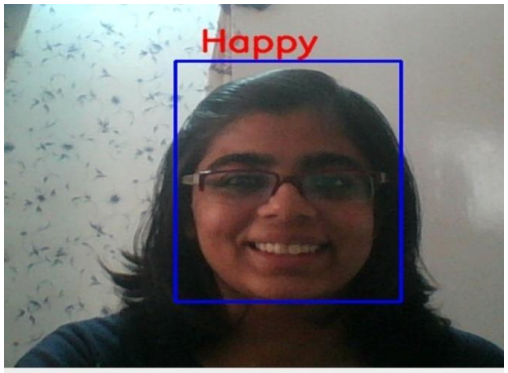
5.1.3 Developer Tools

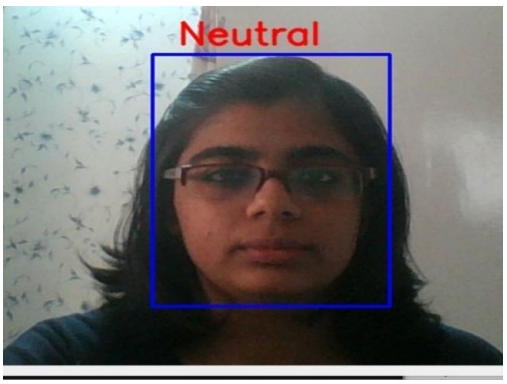
- Python3 IDE like Vscode or Kaggle Notebook or Google Colab Notebook
- Machine Learning Libraries(Keras, Matplotlib,Tensorflow) and Scikit Learn Libraries Numpy, SciPy, Pandas

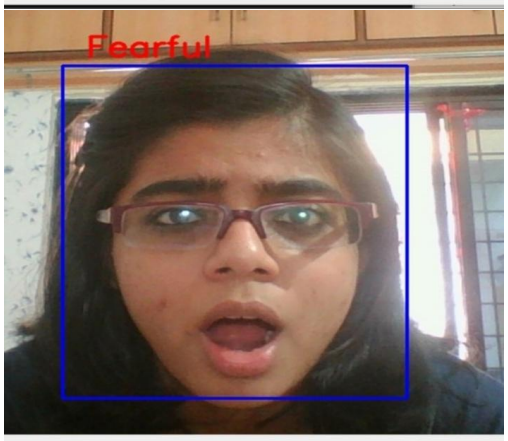
Chapter 6

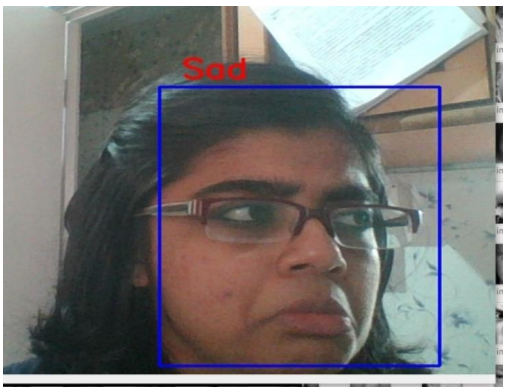
Results

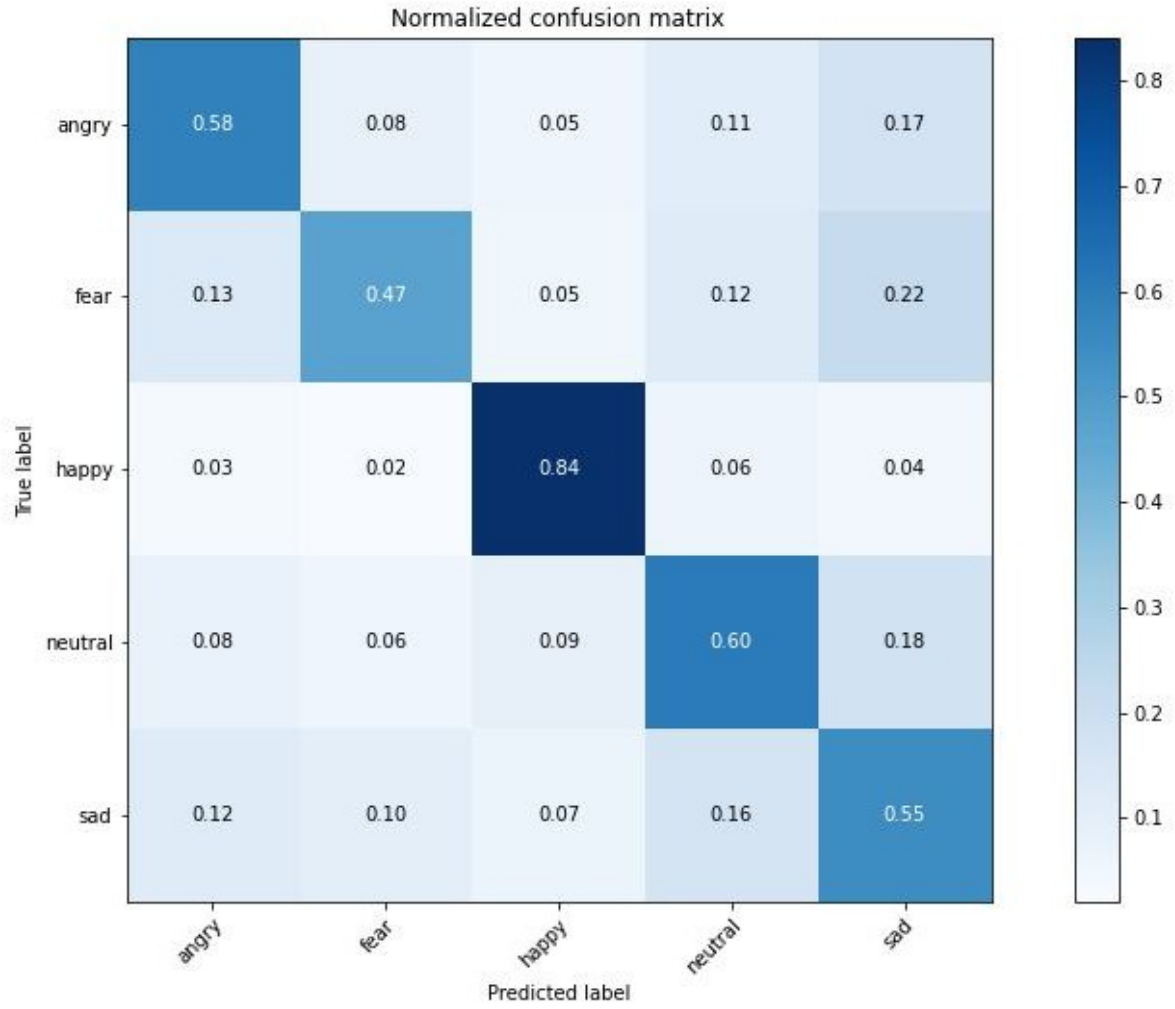
6.1 Image Analysis











Cofusion Matrix from Image Model

6.2 Text Analysis

```
message = input("")
msg =[]
msg.append(message)
seq = tokenizer.texts_to_sequences(msg)
padded = pad_sequences(seq, maxlen=max_seq_len)

start_time = time.time()
pred = predictor.predict(padded)

print('Message: ' + str(msg))
print('predicted: {} ({:.2f} seconds)'.format(class_names[np.argmax(pred)], (time.time() - start_time)))
```

```
It was an amazing day
Message: ['It was an amazing day']
predicted: joy (0.04 seconds)
```

```
message = input("")
msg =[]
msg.append(message)
seq = tokenizer.texts_to_sequences(msg)
padded = pad_sequences(seq, maxlen=max_seq_len)

start_time = time.time()
pred = predictor.predict(padded)

print('Message: ' + str(msg))
print('predicted: {} ({:.2f} seconds)'.format(class_names[np.argmax(pred)], (time.time() - start_time)))
```

```
I am missing her
Message: ['I am missing her']
predicted: sadness (0.04 seconds)
```

```
message = input("")
msg =[]
msg.append(message)
seq = tokenizer.texts_to_sequences(msg)
padded = pad_sequences(seq, maxlen=max_seq_len)

start_time = time.time()
pred = predictor.predict(padded)

print('Message: ' + str(msg))
print('predicted: {} ({:.2f} seconds)'.format(class_names[np.argmax(pred)], (time.time() - start_time)))
```

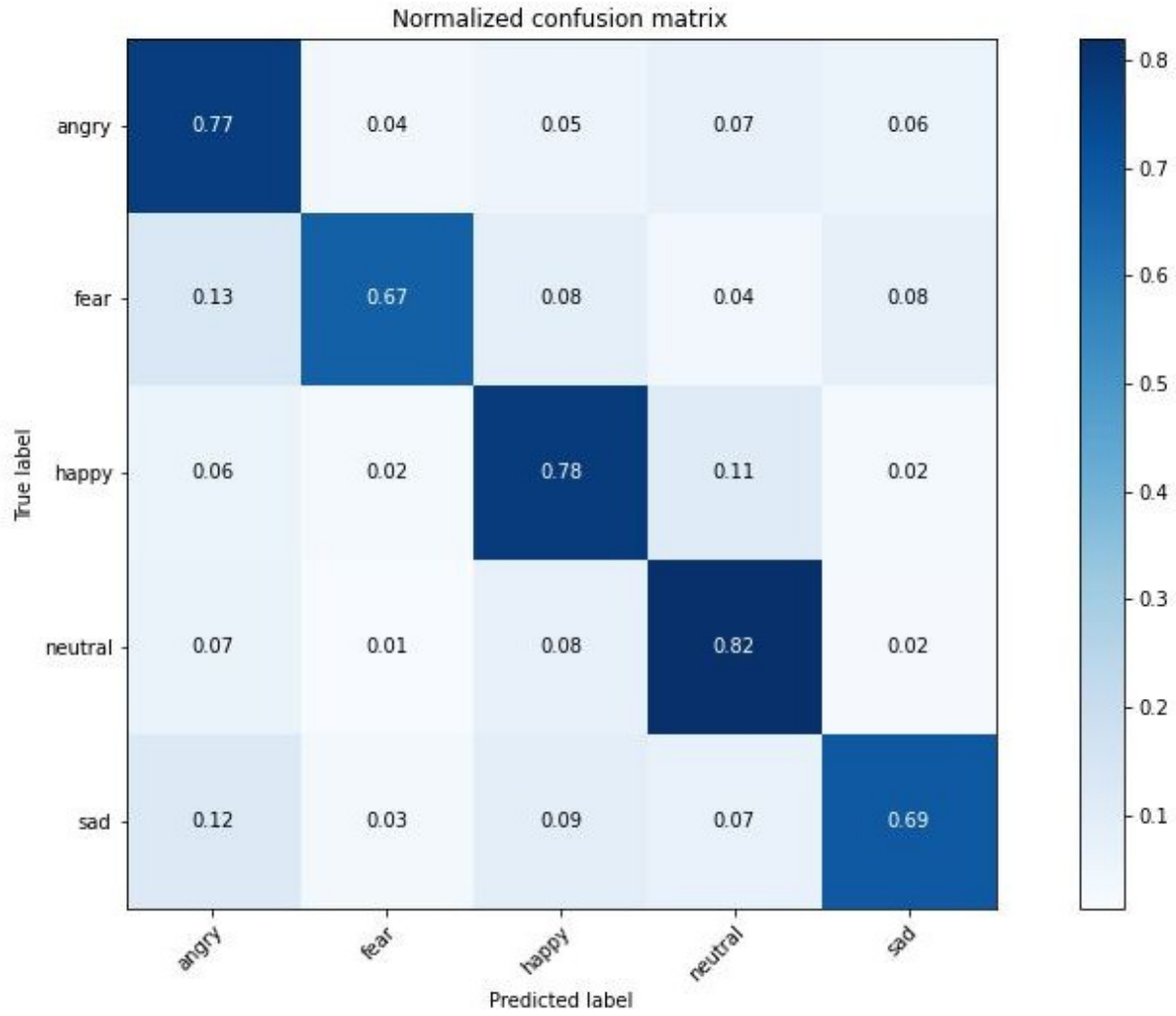
```
It is nice picture
Message: ['It is nice picture']
predicted: neutral (0.04 seconds)
```

```
message = input("")
msg =[]
msg.append(message)
seq = tokenizer.texts_to_sequences(msg)
padded = pad_sequences(seq, maxlen=max_seq_len)

start_time = time.time()
pred = predictor.predict(padded)

print('Message: ' + str(msg))
print('predicted: {} ({:.2f} seconds)'.format(class_names[np.argmax(pred)], (time.time() - start_time)))
```

```
she broke her promise
Message: ['she broke her promise']
predicted: anger (0.05 seconds)
```

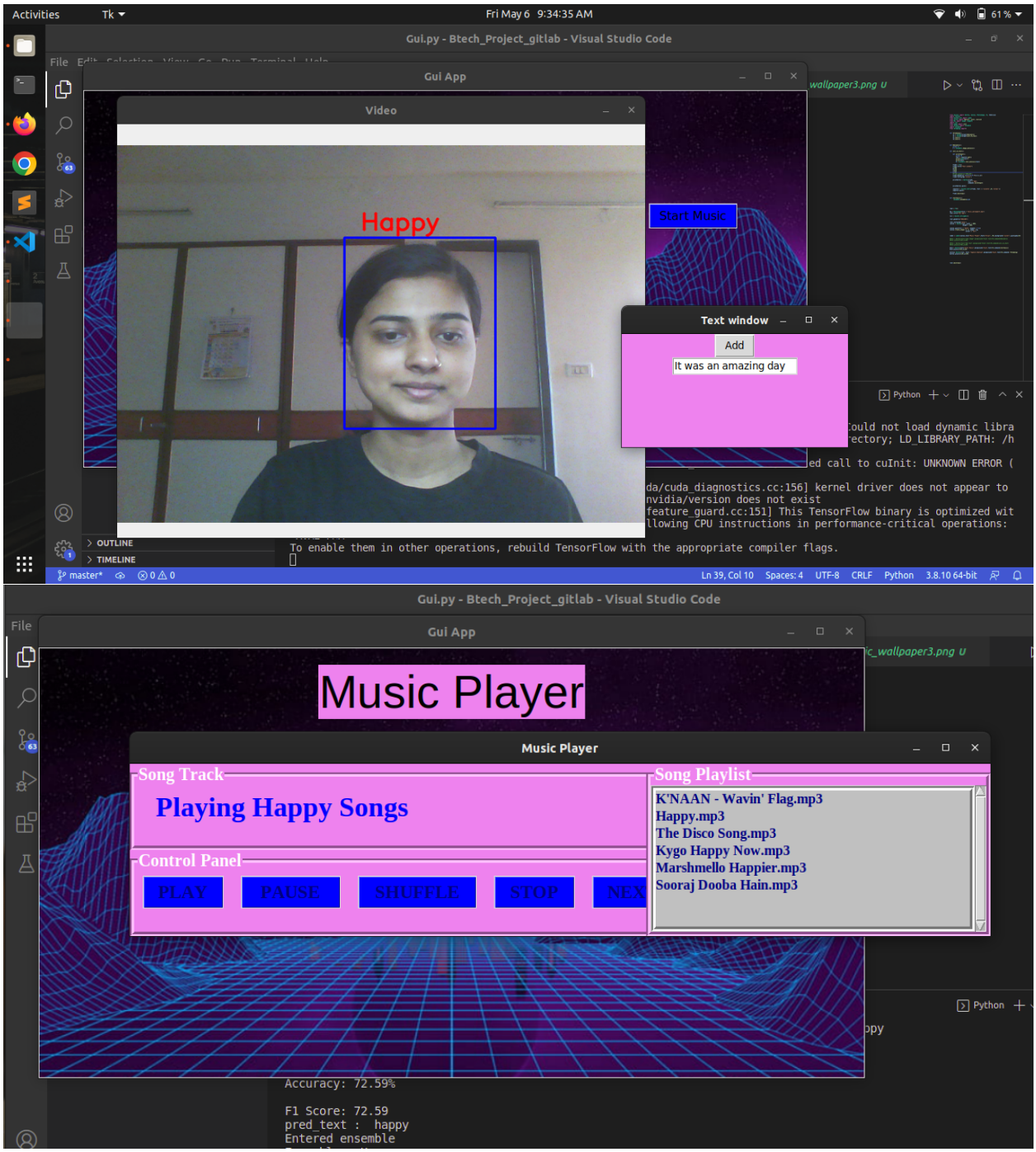
```
message = input("")
msg =[]
msg.append(message)
seq = tokenizer.texts_to_sequences(msg)
padded = pad_sequences(seq, maxlen=max_seq_len)

start_time = time.time()
pred = predictor.predict(padded)

print('Message: ' + str(msg))
print('predicted: {} ({:.2f} seconds)'.format(class_names[np.argmax(pred)], (time.time() - start_time)))
```

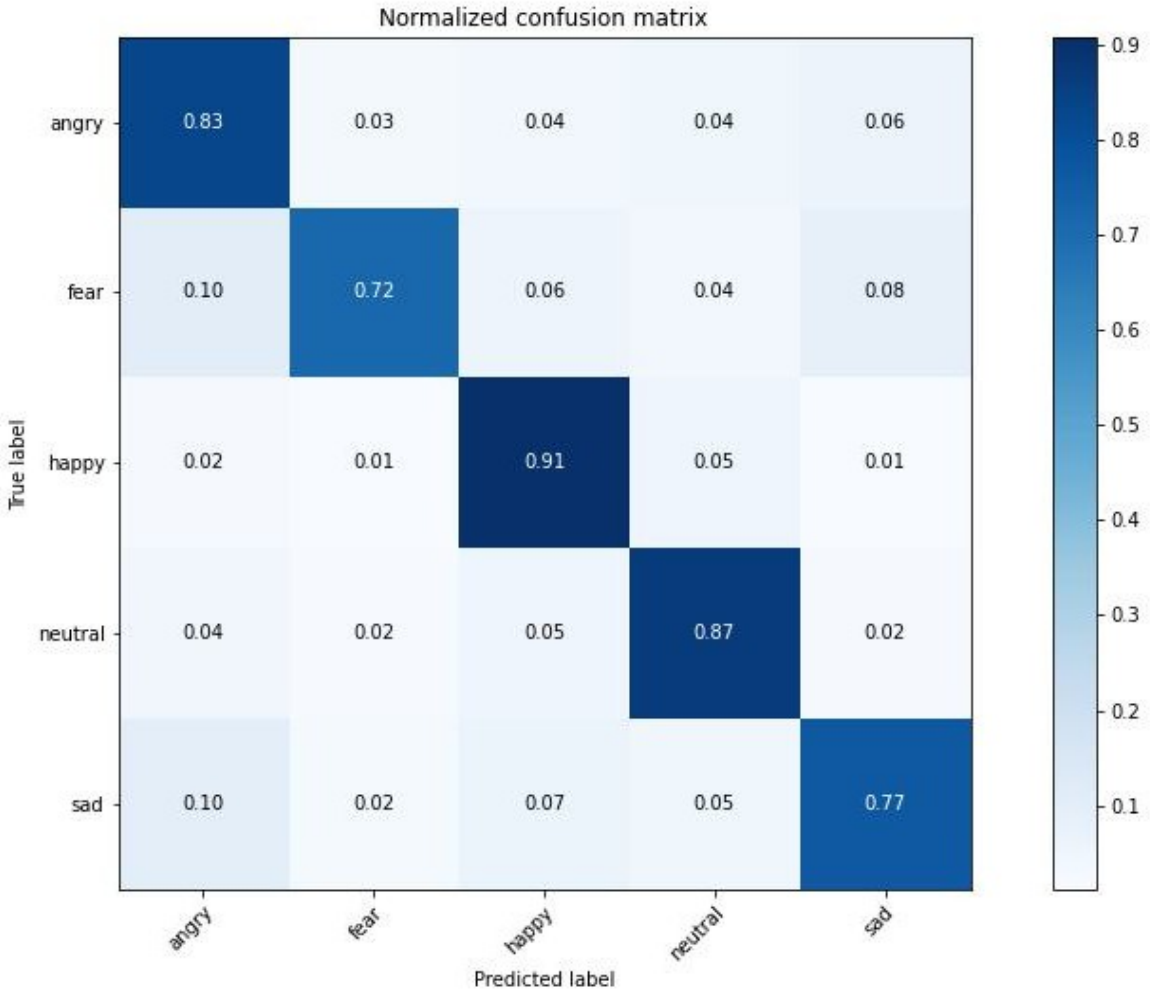
```
I was so scared at that time
Message: ['I was so scared at that time']
predicted: fear (0.05 seconds)
```



Confusion Matrix from Text Model

6.3 Final Results

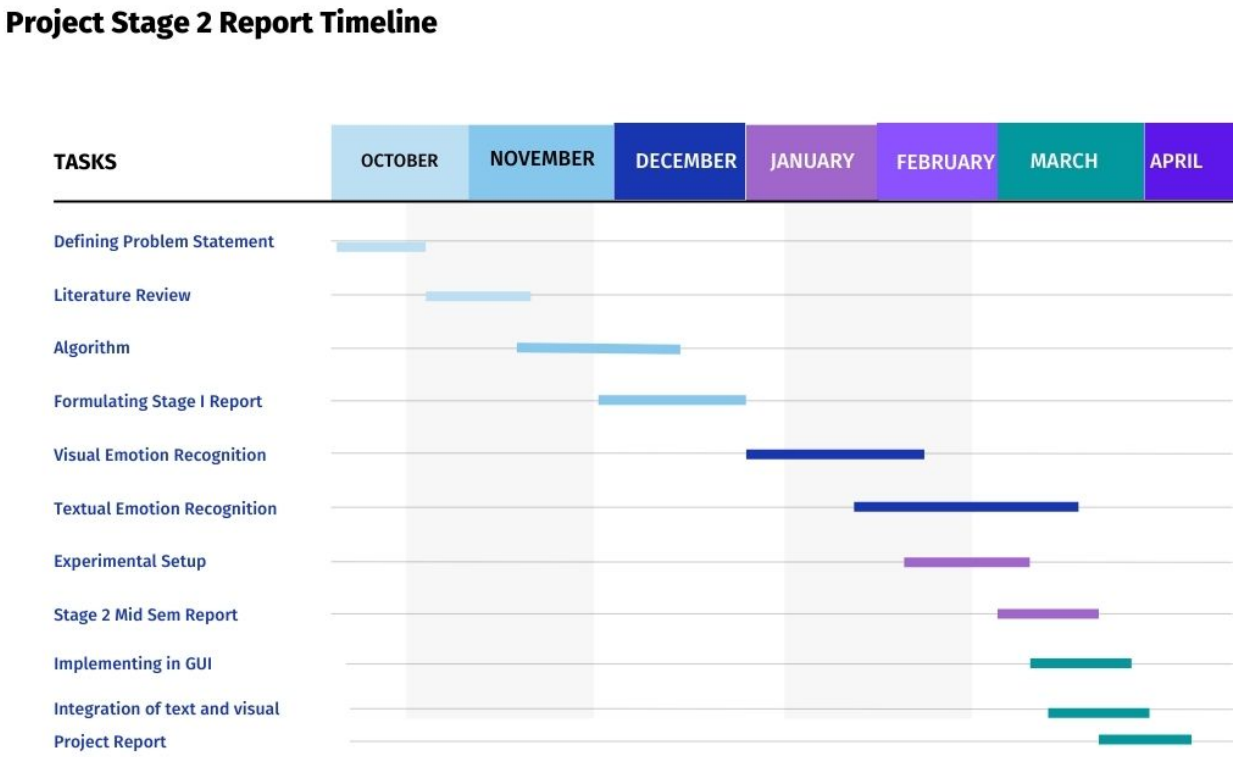




Confusion Matrix from Ensemble

Chapter 7

Timeline



Chapter 8

Conclusion

Our proposed multimodal model simultaneously utilizes text data as well as images to permit the better understanding of user emotions. Proposed system is able to process the facial image along with textual data and recognize basic emotions and then play music based on these emotions. The final product is of great scope as the end product can be changed and expanded according to user demand.

Chapter 9

Future Scope

The final product is of great scope as the end product can be changed and expanded according to user demand. It can be used in review systems to know how people respond to ads, products, in education applications to measure real-time learner responses and engagement with educational content.

Chapter 10

Bibliography

1. Sulaiman Muhammad, Safeer Ahmed, Dinesh Naik, Dept. of Information Technology NITK Surathkal Surathkal, India, "Real Time Emotion Based Music Player Using CNN Architectures", 2021 6th International Conference for Convergence in Technology (I2CT) Pune, India. Apr 02-04, 2021
   https://ieeexplore.ieee.org/document/9417949

2. Charu Agrawal, Meghna Varma, Anish Varshaney, Khushboo Singh, Chirag Advani, Dr. Diwakar Yagyasen, Department of Computer Science & Engineering, BBDNITM, LUCKNOW, "EMOTIONS BASED MUSICPLAYER" Volume: 08 Issue: 07 — July 2021
   https://www.irjet.net/archives/V8/i7/IRJET-V8I7457.pdf

3. Shlok Gilda, Husain Zafar, Chintan Soni and Kshitija Waghurdekar Department of Computer Engineering, Pune Institute of Computer Technology, Pune, India, "Smart Music Player Integrating FacialEmotion Recognition and Music Mood Recommendation", IEEE WiSPNET 2017 conference.
   https://ieeexplore.ieee.org/document/8299738

4. Ramya Ramanathan, Radha Kumaran†, Ram Rohan R‡, Rajat Gupta§

and Vishalakshi Prabhu ,Department of Computer Science and Engineering, R V College of Engineering Bangalore, India, "An Intelligent Music Player based on Emotion Recognition", 2nd IEEE International Conference on Computational Systems and Information Technology for Sustainable Solutions 2017
https://ieeexplore.ieee.org/document/8447743

5. S. Deebika, K. A. Indira, Dr. Jesline Dept. of CSE St. Joseph's College of Engineering Chennai,Tamilnadu, India,"A Machine Learning Based Music Player by Detecting Emotions", 2019 Fifth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)
https://ieeexplore.ieee.org/document/8918890

6. Jayalekshmi, Tessy Mathew, Department of Computer Science and Engineering Mar Baselios College of Engineering and Technology Trivandrum, India, "Facial Expression Recognition and Emotion Classification System for Sentiment Analysis", 2017 International Conference on Networks Advances in Computational Technologies 20-22 July 2017—Trivandrum
https://ieeexplore.ieee.org/document/8076732

7. Seunghyun Yoon, Seokhyun Byun, and Kyomin Jung Dept. of Electrical and Computer Engineering, Seoul National University, Seoul, Korea,"MULTIMODAL SPEECH EMOTION RECOGNITION USING AUDIO AND TEXT", 2018 IEEE
https://ieeexplore.ieee.org/document/8639583

8. Ameya Badve, Atharva Deshpande, Hitesh Kadu, Prof. Mrs. B.Mahalakshmi Computer Science,PCCOE Pune,India."MUSIC RECOMMENDATION

USING FACIAL EMOTION DETECTION AND CLASSIFICATION",VOL 7, ISSUE 19, 2020.
http://www.jcreview.com/fulltext/197-1594987978.pdf

9. Mathieu Pagé Fortin, Brahim Chaib-draa Laval University Québec, Canada, "Multimodal Multitask Emotion Recognition using Images, Texts and Tags", Workshop Presentation WCRM L'19, June 10, 2019, Ottawa,Canada. https://dl.acm.org/doi/10.1145/3326459.3329165

10. Shivani Shivanand,K S Pavan Kamini, Monika Bai M N, Ranjana Ramesh,Sumath H R,JSS Academy of Technical Education, Bangalore, India"Chatbot with Music and Movie Recommendation based on Mood"International Journal of Engineering Research Technology (IJERT) ISSN: 2278-0181,2020.
https://www.ijert.org/chatbot-with-music-and-movie-recommendation-b

11. Rabia Qayyum, Vishwesh Akre, Talha Hafeez, Hasan Ali Khattak, Asif Nawaz, Sheeraz Ahmed, Pankaj Mohindru, Doulat Khan, Khalil ur Rahman,"Android based Emotion Detection Using Convolutions Neural Networks", 2021 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE) : March 17–18, 2021, Amity University Dubai, UAE.
https://ieeexplore.ieee.org/document/9410768

12. Aurobind V. Iyer,Viral Pasad,Karan Prajapati,Department of Computer Engineering, K J Somaiya COE,"Emotion Based Mood Enhancing Music Recommendation"2017 2nd IEEE International Conference On Recent Trends in Electronics Information Communication Technology (RTEICT), May 19-20, 2017, India
https://ieeexplore.ieee.org/document/8256863

13. Amrita Nair, Smriti Pillai, Ganga S Nair, Anjali T,Department of Computer Science and Engineering Amrita Vishwa Vidyapeetham Amritapuri, India"Emotion Based Music Playlist Recommendation System using Interactive Chatbot"Proceedings of the 6th International Conference on Communication and Electronics Systems (ICCES-2021)
https://ieeexplore.ieee.org/document/9489138

14. Anagha S. Dhavalikar,Dr. R. K. Kulkarni,Department, Vivekanand Institute of Technology,Mumbai, India"Face Detection and Facial Expression Recognition System"2014 International Conference on Electronics and Communication System (ICECS -2014)
https://ieeexplore.ieee.org/document/6892834

15. Shrey Modi,Mohammed Husain Bohara,Devang Patel Institute of Advance Technology and Research(DEPSTAR),Charotar University of Science and Technology (CHARUSAT), CHARUSAT campus, Changa 388421, India."Facial Emotion Recognition using Convolution Neural Network" Proceedings of the Fifth International Conference on Intelligent Computing and Control Systems (ICICCS 2021)
https://ieeexplore.ieee.org/document/9432156

16. An insight on sentiment analysis research from text using deep learning methods Christy Daniel DShyamala L International Journal of Innovative Technology and Exploring Engineering (2019) 8(10)
https://www.mendeley.com/catalogue/13d3c33f-2689-345e-98a7-e7b16837

17. https://www.kaggle.com/deadskull7/fer2013