FACIAL EXPRESSION RECOGNITION USING FEATURES EXTRACTION BASED ON CNN AND RNN ALGORITHMS

POTHULA SRI LAKSHMI [#1], L. SOWJANYA [#2]

[#1] MCA Student, Master of Computer Applications,

D.N.R. College, P.G.Courses & Research Center, Bhimavaram, AP, India.

[#2] Assistant Professor, Master of Computer Applications,

D.N.R. College, P.G.Courses & Research Center, Bhimavaram, AP, India.

Abstract

Emotion is an important topic in different fields such as biomedical engineering, psychology, neuroscience and mental health. This emotion recognition is very important aspect which is used for diagnosis of human brain and psychological disorders. In a recent survey, deep learning have gained a lot of users attention in the field of image classification. These emotions is used for not only diagnosis of human brain but also used as a recommender systems to assist users in finding items that match their needs and preferences. This motivated us to develop a system which can effectively and efficiently recognizes emotions from the facial expressions of the user. In this proposed work we try to design an application which can be used for prediction of expressions of both still images and then check the performance of CNN along with recurrent neural network(RNN) model. Once the image is captured from the video sequences the system will automatically detects face using HAAR cascade then its crops it and resize the image to the specified dimension and give to the model for prediction. The model will generate seven probability values corresponding to seven expressions. By comparing the two models we try to conclude which model gives more accuracy for facial expression recognition for that image dataset.

1. INTRODUCTION

Although there are many studies in the literature on emotion, till now there is no proper definition in the literature about emotion [1]. Emotion is basically which defines as an appearance or reflection of a feeling. This can be appeared in two ways either real or sham. For example, one side of emotion can be expressed at the case of feeling of pain, which is very real. But these emotions are not felt exactly, some emotions will be always present inside the human and this will be present inner situations psychologically [2, 3]. In recent days this emotion recognition has become one of the important, research topic in the fields

of biomedical engineering [4], psychology [5], neuroscience [6] and health [7]. This is mainly focused on the ability to predict the human emotion and try to provide assistance for the computer to diagnosis of psychological disorders. In general there are several types of emotions in literature which can be used to detect emotional states such as electroencephalography (EEG), galvanic skin response (GSR), speech analysis, and a lot more.

In this current work we try to use the ability of deep learning algorithms or models to detect the emotion of human and try to find out the inner feeling of the human based on the emotions. In recent days there was a lot of deep learning work that is going on in the process of image classification. One of the best deep learning method is Convolutional neural networks (CNNs) which is proposed by YannLeChun in 1988 [11]. This is widely used for image classification, recognition and image segmentation.This CNN is mainly built on the top of artificial neurons and consist of hierarchical multiply hidden layers. This CNN mainly take input from a sample image, multiply weight, add bias and then apply activation function. So that, artificial neurons can be used in image classification, recognition, and segmentation by perform simple convolutions.

AIM OF THE PROJECT

Classification of users emotions have proven to be very important and find applications in many fields. There are systems which do the work with few emotions anger, happiness, fear and sadness. This system can be made to work with more emotions which have not been included earlier and use deep learning for improved efficiency. If this type of model is designed we can use this model as recommendation model for the end user to recommend different types of applications which operate mainly based on emotions.

In this project we are presenting the real time facial expression recognition of seven most basic human expressions like Anger, Disgust, Fear, Happy, Neutral, Sad and Surprise. Here we try to use RNN and CNN models and then compare the models on 7 types of emotions and find out which image is having which state of expression. Finally we try to conclude the one which is giving more accuracy in order to detect the facial emotion based on expressions and try to suggest that model for the end users in order to deploy in several applications.

In this proposed work we try to design an application which can be used for prediction of expressions of both still images and then check the performance of CNN along with recurrent neural network (RNN) model. Once the image is captured from the video sequences the system will automatically detects face using HAAR cascade then its crops it and resize the image to the specified dimension and give to the model for prediction. The model will generate seven probability values corresponding to seven expressions. By comparing the two models we try to conclude which model gives more accuracy for facial expression recognition for that image dataset.

In this report we try to organize the project into chapter wise and arranged as per software development life cycle. The chapter 1 contains the introduction about the project and in chapter 2 we try to discuss about the literature survey. In chapter 3 we try to arrange the design aspects which are discussed

about this project. In chapter 4,we discuss about implementation aspects present in our application. In chapter 5,we discuss about experimental results and finally end with reports and conclusion and references as last topics

2. LITERATURE SURVEY

INRODUCTION

Literature survey is the most important step in software development process. Before developing the tool, it is necessary to determine the time factor, economy and company strength. Once these things are satisfied, ten next steps are to determine which operating system and language used for developing the tool. Once the programmers start building the tool, the programmers need lot of external support. This support obtained from senior programmers, from book or from websites. Before building the system the above consideration r taken into for developing the proposed system.

RELATED WORK

1) Automated Facial Expression Recognition System Using Neural Network Classifiers

Creators: Jyh-Yeong et al.

In this proposed paper the author proposes automated facial expression recognition system using neural network classifiers. The author used Rough Contour Estimation Routine (RCER) technique for extracting the features from a human face like eyebrows, eyes, mouth with the help of Point Contour Detection Method (PCDM) [16] in order to improve and detect the precision of eye and mouth. In this proposed paper the author try to find out a novel method like Action Units (AU) [17] in which we can able to see the basic movements of face muscles.

2) A real time face emotion classification and recognition using deep learning model

Creators: Dr. ShaikAsifHussain, AhlamSalimAbdallah Al Balushi

The proposed authors try to discuss about face emotion classification and recognition under real time manner by using deep learning model. In this paper the authors try to extract the main features with deep learning, Haar cascade and VGG 16 model to recognize face and try to build the classification and recognition[18]. From the experimental results the authors clearly prove that the network architecture which was designed for this current paper has better advancements than compared with existing algorithms. Here the proposed deep learning models are comparatively having more improvement than compared with several other models which were used in the literature of facial expression detection.

3) A Real-Time Recognition System for User Characteristics Based on Deep Learning.

Creators: Dan Duncan

This author proposes a real time recognition system for user characteristics based on deep learning models. In this paper the author try to design a VGG is an innovative object-recognition model that supports up to 19 layers. This is mainly built on the top of CNN and based on this CNN we can able to outperform baseline on many tasks and datasets outside of ImageNet. This proposed system is designed by overcoming the pre-processing difficulties [19]which is present in the CNN and this proposed system we can able to prove much larger dataset in order to improve the model's generality. The proposed system can able to provide accuracy in perfect manner and prove straight angle.

4) Multimedia Recommender System using Facial Expression Recognition

Creators: Prateek Sharma, et al.

In this paper the author try to design a CNN, logistic regression for image and emotion classification and HAAR cascade for feature extraction and web automation. This is mainly built on the top of CNN and based on this CNN we can able to outperform baseline on many tasks and datasets outside of ImageNet. The proposed system is able to find good accuracy for the end users in designing the proposed application. The main limitation of this proposed application is this can only train only **3** expressions and but this is failed to identify the remaining expressions.In this proposed system is unable to recognize all the human expressions and hence this is having an future work to detect other expressions which are present in human face[20].

3. EXISTING SYSTEM

In the existing system, there was no concept like classification of all the various classes if expressions and emotions from human faces. In the existing system there are no method which can classify all the 7 classes or emotions from the human face. Also in the existing system there is a great limitations in classifying the human faces accurately without any disturbances.

LIMITATION OF EXISTING SYSTEM

The following are the limitation of the existing system :

1. All the existing schemes are limited to the few classes classification only.
2. All the existing systems are failed to classify the facial images and then try to find out the emotions based on different types of poses.
3. There is no accurate model to classify the real time facial detection.

4. The current application is limited with only certain type of classifiers and this couldn't give accurate classification from human faces.

5. In the existing system there is only ML classifications to classify the images based on few trained images. But no application is designed to verify all the 7 emotions and calculate the accuracy of the model.

4 . PROPOSED SYSTEM

In this proposed work we try to design an application which can be used for prediction of expressions of both still images and then check the performance of CNN along with recurrent neural network(RNN) model. Once the image is captured from the video sequences the system will automatically detects face using HAAR cascade then its crops it and resize the image to the specified dimension and give to the model for prediction. The model will generate seven probability values corresponding to seven expressions. By comparing the two models we try to conclude which model gives more accuracy for facial expression recognition for that image dataset.

ADVANTAGES OF THE PROPOSED SYSTEM

The following are the advantages of the proposed system :

1. The proposed scheme is very accurate in classification of images
2. The proposed system gives accurate results when compared with different models. I.e CNN & RNN.
3. The proposed system is capable of classification of facial expressions accurately and try to recommend in efficient manner.

The proposed model can able to distinguish all the 7 classes of human emotions accurately and   then classify the emotions accurate manner

5. SOFTWARE PROJECT MODULES

Implementation is the stage where the theoretical design is converted into programmatically manner. In this stage we will divide the application into a number of modules and then coded for deployment. We have implemented the proposed concept on Python programming language. The Application is mainly divided into 6 modules. They are as follows:

1. Upload Facial Emotion Dataset
2. Data Pre-Processing
3. Training the Deep Learning Module
4. Training RNN Module
5. Accuracy Comparison Graph
6. Predict Facial Expression

Now let us discuss about each and every module in detail as follows:

5.1 Upload Facial Emotion Dataset

The majority of the images were augmented by OpenCV. We have conducted experiments on FER_2013 Data set which we collected from KAGGLE website and try to train the system to detect the emotions accurately. Here in this dataset there are almost 28709 images and before applying feature extraction algorithm total images features/pixels are 3072 and then after applying features reduces to 2352 as PCA remove unimportant pixels and used only important pixels/features.

5.2 Data Pre-Processing Module

In this module we try to pre-process all the images into two categories : One is for test phase and another is : Train Phase. Once the images are divided into test and train phase, now we can able to train the system with all trained dataset and then we can learn the CNN and RNN models with these trained facial expression images.

5.3 Training the Deep Learning Module

Once the data is preprocessed, now we try to construct a CNN model and then apply the CNN model to training data. In this current application when we use CNN model to train the current dataset, we got an accuracy of 48 and this is almost less than 50 percent of accuracy for detecting facial expressions in accurate and efficient manner.

5.4 Train the RNNModule

Once the data is preprocessed, now we try to construct a RNN model and then apply the RNN model to training data. In this current application when we use RNN model to train the current dataset, we got an accuracy of 88 and this is almost greater than 80 percent of accuracy for detecting facial expressions in accurate and efficient manner.

5.5 Accuracy Comparison Graph Module

In this module we try to find out the accuracy comparison graph which contains x-axis represents epoch/iteration ad y-axis represents accuracy and in above graph orange line represents RNN accuracy and green line represents CNN accuracy and from above graph we can see with further epoch/iteration both algorithm accuracy get better and better and from above graph we can conclude that RNN is giving better result.
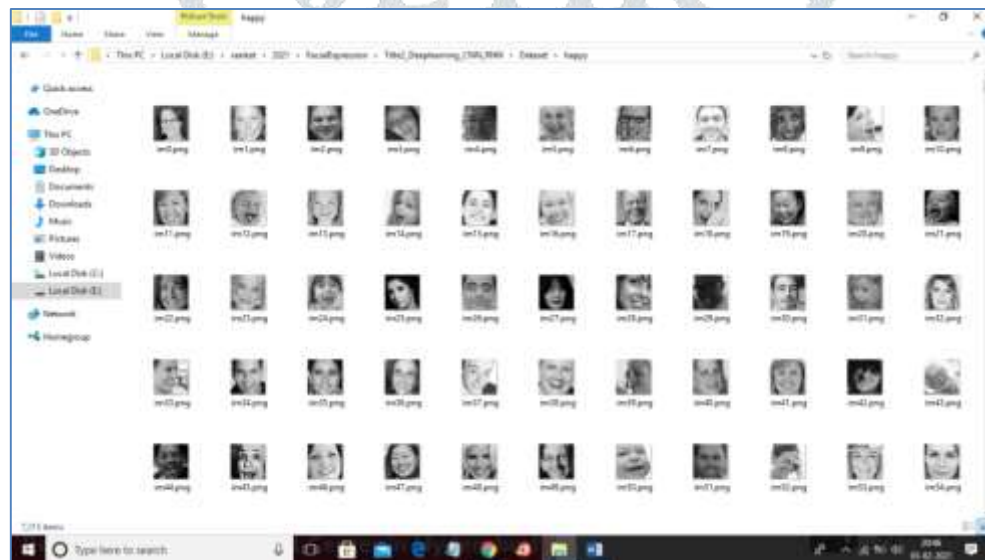
5. 6 Predict Facial Expression Module

Now click on 'Predict Facial Expression' button to upload new test image and the application predict emotion from it.Here we can take any image which contain facial part as input and then check the expression of that image based on the corresponding features.

6. RESULTS (OUTPUT SCREENS)
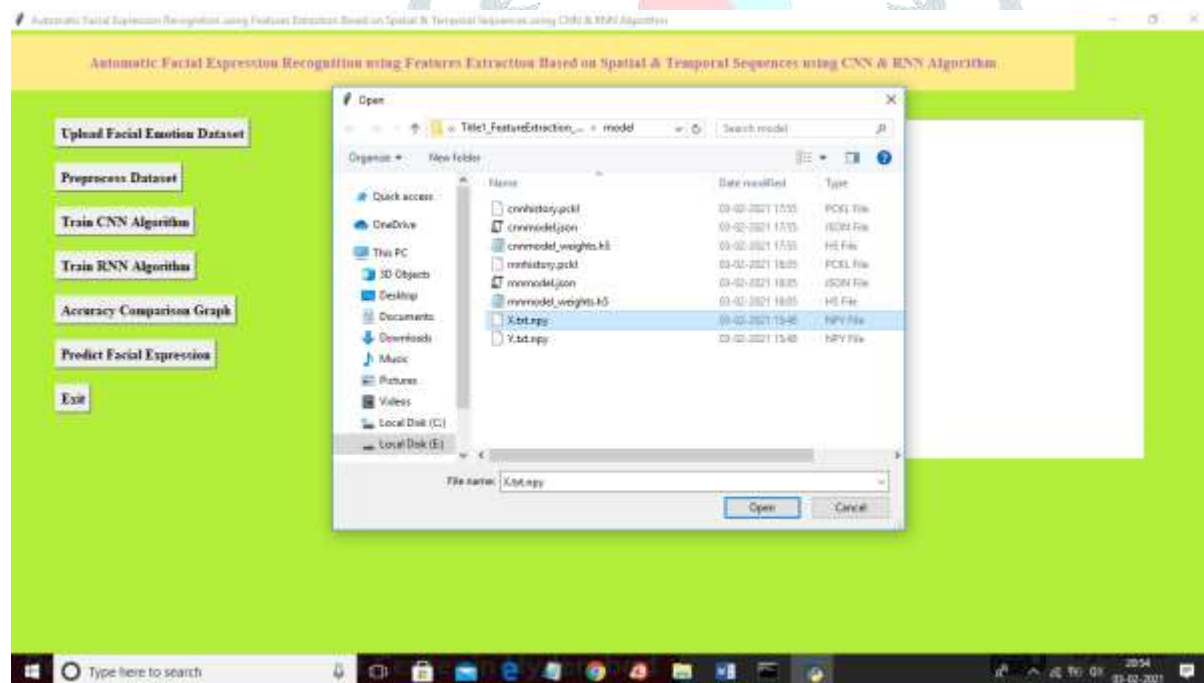
MAIN WINDOW
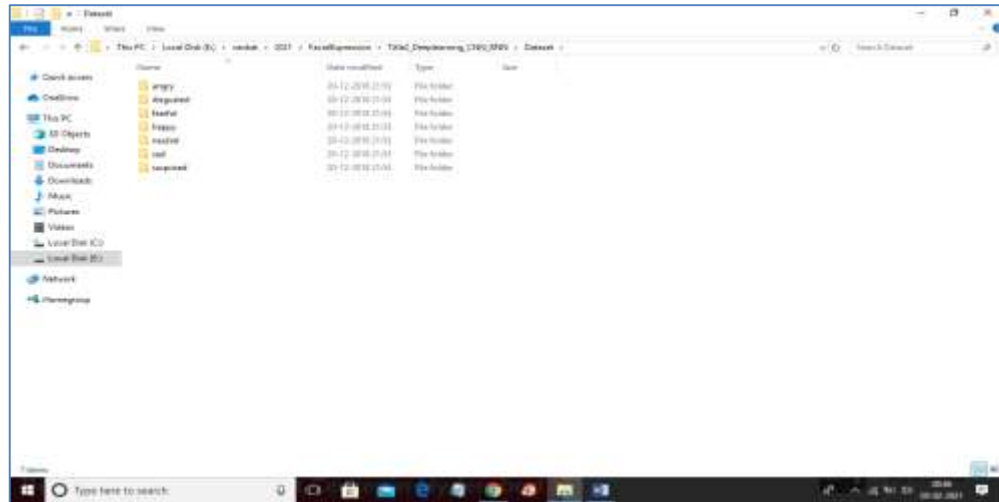
DETAILED VIEW OF FOLDERS

MAIN WINDOW

In above screen click on 'Upload Facial Emotion Dataset' button to upload dataset

UPLOAD FACIAL EMOTION DATASET

In above screen selecting and uploading 'X.txt.npy' file which contains images of all emotion faces and then click on 'Open' button to load dataset and to get below screen

APPLICATION LOADED

In above screen dataset loaded and now click on 'Preprocess Dataset' button to read all images and then apply feature extraction algorithm called PCA to read important features from dataset and to get below screen. This module may take 5 to 8 minutes time to give output so please wait till process complete like below screen

PRE-PROCESSING OF IMAGES
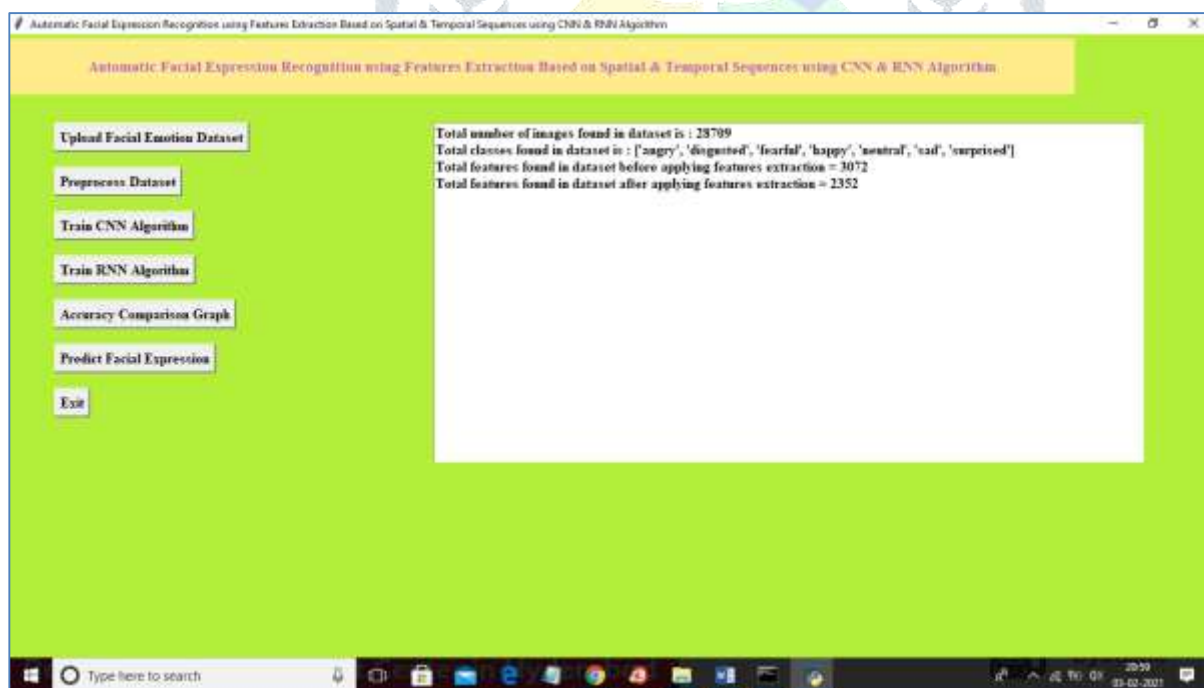
In above screen we can see dataset contains total 28709 images and before applying feature extraction algorithm total images features/pixels are 3072 and then after applying features reduces to 2352 as PCA remove unimportant pixels and used only important pixels/features. Now image data is ready and now click on 'Train CNN Algorithm' button to train CNN with process image features
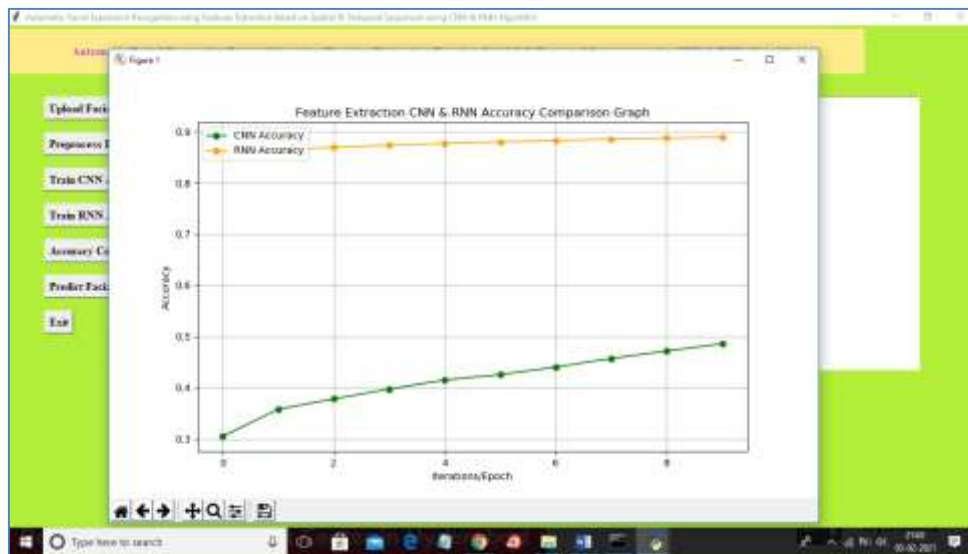
CNN ACCURACY

In above screen CNN accuracy is 48 and now click on 'Train RNN Accuracy' button to train dataset with RNN

TRAIN RNN ACCURACY

In above screen RNN accuracy is 88% and now click on 'Accuracy Comparison Graph' to get below graph of both algorithms

Accuracy Comparison Graph

In above screen x-axis represents epoch/iteration ad y-axis represents accuracy and in above graph orange line represents RNN accuracy and green line represents CNN accuracy and from above graph we can see with further epoch/iteration both algorithm accuracy get better and better and from above graph we can conclude that RNN is giving better result. Now click on 'Predict Facial Expression' button to upload new test image and the application predict emotion from it

PREDICT FACIAL EXPRESSION
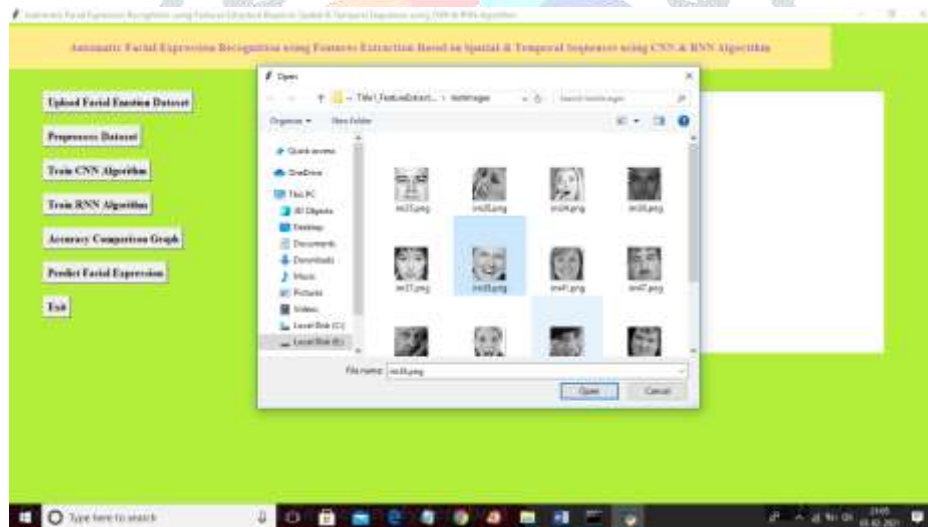
In above screen selecting and uploading im38.png image and then click on 'Open' button to get below result

TEST THE SAMPLE IMAGE

In above screen we got detected emotion as 'happy' and similarly you can upload any image and then predict emotion. So this is the output of TITLE 1.Now run title 2 project by double click on 'run.bat' file from 'Title2_Deeplearning_CNN_RNN' folder to get below screen

7. CONCLUSION

The conclusions of our study suggest that proposed model RNN is more efficient and accurate in order to retrieve the expression based on facial images and also this RNN model gives more accuracy compared with all primitive ML models. Hence this is mostly suitable for various applications which try to use this Facial expression technique.In future we want to extend the same feature on some more models which can increase the accuracy of our proposed model and in future we want to improve the CNN efficiency by adding some additional functionalities.

8. REFERENCES

1) Prateek Sharma (2020), International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181 ,Vol. 9 Issue 05.

2) Dr.ShaikAsifHussain, AhlamSalimAbdallah Al Balushi (2020), A real time face emotion classification and recognition using deep learning model, J. Phys.: Conf. Ser. 1432 012087.

3) Dan Duncan, Gautam Shine, Chris English (2019), Facial Emotion Recognition in Real Time, Institute of Electrical and Electronics Engineers (IEEE).

4) AyaHassouneh, A.M. Mutaw, M. Murugappan (2020), Development of a Real-Time Emotion Recognition System Using Facial Expressions and EEG based on machine learning and deep neural network methods,Elsevier, Volume 20, 2020,100372.

5) Rahul MahadeoShahane, Ramakrishna Sharma.K, Md.SeemabSiddeeq (2019), Emotion Recognition using Feed Forward Neural Network & Naïve Bayes, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Vol-9 Issue-2.

6) Mehmet Akif OZDEMIR ,ELAGOZ, AysegulALAYBEYOGLU, Reza SADIGHZADE and Aydin AKAN (2019), Real Time Emotion Recognition from Facial Expressions Using CNN Architecture, Institute of Electrical and Electronics Engineers (IEEE).

7) Nithyaroopa (2019), Emotion Recognition from Facial Expression using Deep Learning, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-6S.

8) NianyinZenga, Hong Zhanga, Baoye Song, WeiboLiuc, Yurong Li, Abdullah M. Dobaief (2017), Neurocomputing, Elsevier.

9) DweepnaGarg, ParthGoel, SharnilPandya (2018), A Deep Learning Approach for Face Detection using YOLO, Institute of Electrical and Electronics Engineers (IEEE).

10) H. Immanuel James, J. James Anto Arnold, J. Maria MasillaRuban, M. Tamilarasan, R. Saranya (2019), Emotion based Recommendation System, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056, Volume: 06 Issue: 03.

11) AvigyanSinha, Aneesh R P (2019), Real Time Facial Emotion Recognition using Deep Learning, (IJIIE) International Journal of Innovations & Implementations in Engineering ISSN 2454- 3489, Edition Volume 1.

12) MalyalaDivya, R ObulaKonda Reddy, C Raghavendra (2019), Effective Facial Emotion Recognition using Convolutional Neural Network Algorithm, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-4.

13) Yang Lu, Shigang Wang and Wenting Zhao (2018), Facial Expression Recognition Based on Discrete Separable Shearlet Transform and Feature Selection, College of Communication Engineering, Jilin University, Changchun 130022, China, Algorithms 12(1), ; doi:10.3390/a12010011.

14) IshaTalegaonkar, Kalyani Joshi, ShreyaValunj, RuchaKohok, AnaghaKulkarni ,(2019), Real Time Facial Expression Recognition using Deep Learning, International Conference on Communication and Information Processing.

15) RituparnaHalder, SushmitSengupta,Arnab Pal, SudiptaGhosh, DebashishKundu (2016), Real Time Facial Emotion Recognition based on Image Processing and Machine Learning, International Journal of Computer Applications, Volume 139 - Number 11.

16) ZixiangFei , Erfu Yang, David Li , Stephen Butler , Winifred Ijomah , Huiyu Zhou (2019), Combining Deep Neural Network with Traditional Classifier to Recognize Facial Expressions, Proceedings of the 25th International Conference on Automation & Computing, Lancaster University, Lancaster UK, 5-7.

17) Dr.SunilBhutada,CH.sadhvika, Gutta.Abigna, P.Srinivasreddy (2020), Emotion based Music Recommendation System, International Journal of Emerging Technologies and Innovative Research, ISSN:2349-5162, Vol.7, Issue 4, page no. pp2170-2175.