WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Facial Expression Recognition Using Convolutional Neural Networks

J. Deepika[1], Hariharan S[2], Mownish SPM[3], Jawahar J[4], Madhan kumar A[5]

[*1]Assistant Professor, Department of Information Technology, Sona College of Technology, Salem, Tamil Nadu, India

[2,3,4,5]UG Final year student, Department of Information Technology, Sona College of Technology, Salem, Tamil Nadu, India

A B S T R A C T

Emotion is very important in communication and a method that humans show their emotions is through their facial expressions. One of the most difficult tasks in social communications is facial features recognition, as in non-verbal communication, facial expressions are key. In the field of Artificial Intelligence, Facial Expression Recognition (FER) is an extensive research space, with many recent studies involving Convolutional Neural Networks (CNNs). The different models differ considerably in terms of CNN architectures and different factors. Based on the reported results alone, the performance impact of those factors is unclear. In this system, the classification of FER is done with the help of static pictures, using CNNs. Feature extraction is used to extract the most important landmarks of the face including the jaw, mouth, eyes, nose, and eyebrows etc. to detect the expression. The accuracy of the model is 80.5% on test data.

.

Keywords: – Facial Expression Recognition, CNN – Convolutional Neural Networks.

1. Introduction

A person's emotion is recognized by the movements of muscles in face. In non-verbal communications facial expressions plays a crucial role in finding the person's emotion and how he feels. .Due to the indispensable role of facial expressions in human computer interaction, the ability to perform *Facial Expression Recognition* (FER) automatically via computer visionenables a wide range of applications in fields such as mental disease diagnosis, lie detection, intelligent tutoring etc. Fluctuation in recognition rate among the categories is one of the problems for many of the analysis since they have lower accuracy The purpose of this project is to develop a facial recognition system that can classify 5 types of emotions (Happy, Sad, Neutral, Angry, Surprise) that can be used to monitor students in online classes. This system is implemented using CNN with combined dataset collected from several datasets that leads this analysis to higher validation accuracy likewise as higher and nearly equal recognition rates compared to the prevailing models.
The leftover areas comprises of related work on outward appearance acknowledgment, an outline of the procedure of this analysis, information assortment and preprocessing, how the current framework has been carried out.

* *Corresponding author.*
E-mail address: harisanth07@gmail.com

Figure 1: Sample images from FER-2013 dataset

2. Literature Survey

In this research, RNN (Recurrent Neural Network) designs using LSTM(Long Short Term Memory) has been used to detect facial expressions. RNN with LSTM increased the efficiency of the feature extraction and the performance was improved by 5% compared with traditional neural networks [1].

Presently, computer game is one of the applications that utilize outward appearance location to build normal communication. Kinect is movement sensor for game regulator that can follow the distinguished face utilizing Active Appearance Model (AAM).In this model facial expression is detected by observing the changes in the key features of AAM using fuzzy logicFuzzy Logic is utilized to decide the current feelings dependent on earlier information. [2].

This model detects fatigue from face expression for medical diagnosis. Face painting is used to determine the feature points where changes can be observed in facial expression. Eyes and their slopes, and face slopes are found to be important [3].

This model involves the building and validating of a face expression database and a face expression recognizer. The face expression recognizer utilizes a mathematical based strategy that calculates distances between the essential spots on the face and other 68 facial focuses.These measures are transformed into features to train a support vector machine [4].

Generally to detect drowsiness only eye states are used. But in this model facial expressions are used. Important facial components were detected using feature extraction. The challenges are the person's beard, glasses, change of intensity due to interference of light. Apart from software hardware system based on infrared light were used [5].

The framework aims to recognize expressions by analyzing the facial features extracted based on the Active Shape Model (ASM). The proposed framework initially recognizes the face locale from the input picture. From there on, a model based methodology called ASM is applied to distinguish the significant spots on the face that has been recognized. [6].

A modified method of deep learning system has been proposed in this system, which can be considered as an effective and efficient tool for monitoring the patient. The proposed framework presents a mix of some cutting edge NN strategies, CNN and LSTM-RNN. Every procedure in the proposed framework was prepared and assessed to recognize and arrange human body stances (standing, sitting, lying, and so on) alongside outward appearances (miserable, upbeat, irate, and so on) with different datasets.[7].

This provides an insight of the challenges, pros and cons of difference Facial recognition algorithms [8].

Examples: Classifications of emotions as primary emotions and secondary emotions, Feature based vs model based algorithms, use of facial animation, image databases, facial landmarks for extracting facial information etc.

In this model they used some method/techniques such as Principal Component Analysis (PCA), Linear Discriminate Analysis (LDA), Gabor Filter/Energy, Line Edge Mapping (LEM), Neural Network, Independent Component Analysis (ICA) which will directly or/and indirectly used to recognize human expression in various condition [9].

This model uses main action units, composed of facial characteristic point movements, as the input vectors of two different neural network-based expression classifiers including a radial basis function network and a multilayer perceptron network. After using these two networks, the recognition rates increased to 92.1% in categorizing the facial expressions neutral, anger, or happiness. Recreation results by the PC exhibit that PCs are fit for extracting undeniable level or unique data like people.[10].

3. Existing System

Facial expression recognition can be identified using three basic steps.

1. Face Detection

2. Features Extraction

3. Expression Recognition

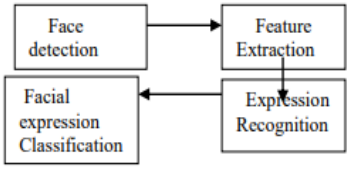

Figure 2: Flowchart of the Facial Expression Recognition system.

Face detection: Face detection determines the presence and location of a face in an image, by identifying the face from all other patterns. This requires appropriate face modeling and segmentation. The approach should also be taken into account the sources of variation of facial appearance like viewing geometry, illumination, the imaging process (Resolution, Noise), Alternatively face detection can be carried out by using the entire face, making difficult to handle. Face detection procedures are grouped based on the picture data used to help in Color discover, Geometric shape, movement data.

Features Extraction: Feature Extraction is used to extract the important features that are helpful in identifying face and expression. Face recognition is a developing zone, changing and improving continually. Highlight extraction strategies can be classified dependent on whether they center around movement or distortion of appearances and facial highlights, separately, regardless of whether they act locally or comprehensively. Various methodologies of face recognition can be arranged in three fundamental gatherings like holistic methodology, feature based methodology, and hybrid approach.

1) Local Feature Method: Local Features such as eye, nose, mouth are extracted first and then their local statistics. Local feature method includes geometric feature method and Elastic bunch graph method etc.

2) Holistic feature Method: In Holistic feature method the whole face region is used a raw input to the expression recognition system. Holistic feature method includes PCA(Principal Component Analysis), Fisher face, Gabor Feature method etc.

3) Hybrid Method: In Hybrid method both holistic and local features are used for facial expression recognition.

Expression Recognition: Facial expression investigation frameworks are to perceive outward appearances dependent on the extricated highlights. Two Types of Expression Recognition are there.
1.Frame based
2.Sequence based.
Frame based expression recognition doesn't utilize transient data for the input pictures. It utilizes the data of current information picture with/without a reference outline. The input image can be static image or frame of a sequence that is treated independently, whereas sequence based system uses the temporal information of the sequence to recognize the expression of one or more frames.

Expression classification: Finally expression is classified based on its probability. (The class which has the highest probability will be the resultant class).

Limitations

1. **Low quality pictures affects Facial Recognition's Effectiveness:**
   Image quality affects how well facial-recognition algorithms work**. The quality of the web camera is very low contrasted than that of a digital camera. Indeed, even top quality video is, best case scenario, 1080p (reformist output); typically, it is 720p. These qualities are comparable to about 2MP and 0.9MP, separately, while a modest advanced camera accomplishes 15MP.** [11].

2. **Pictures with small sizes make facial recognition more challenging:** At the point when a face-recognition system finds a face in a picture or in a still from a video catch, the overall size of that face contrasted and the enlisted picture size influences how well the face will be perceived. A generally little picture size, combined with an objective removed from the camera, implies that the identified face is simply 100 to 200 pixels on a side. Further, examining a picture for differing face sizes is a processor-concentrated movement. [11].

3. **Distinctive facial points can lose facial recognition's unwavering quality: The relative angle of the target's face influences the recognition score profoundly.** At the point when a face is taken on the FER system, typically different points are utilized. Anything short of a front facing view influences the calculation's ability to create a layout for the face. The more direct the image (both enrolled and probe image) and the higher its resolution, the higher the score of any resulting matches [11].

4. **Processing of data and storage can reduce facial recognition's efficiency:** Even though high-definition video is quite low in resolution when compared with digital camera images, it still occupies significant amounts of disk space Preparing each frame of video is a gigantic endeavor, so normally just a small portion (10% to 25 percent) is really gone through the FER system. To limit complete handling time, organizations can utilize groups of PCs. Be that as it may, adding PCs includes significant information move over an organization, which can be limited by input-yield limitations, further restricting processing speed.Unexpectedly, people are incomprehensibly better than innovation

with regards to facial recognition. However, people can possibly search for a couple of people when watching a source video. A computer can compare many individuals against a database of thousands [11].

4. Proposed System

In this proposed system, CNN model is built and an user interface is created and deployed as a web application. A Graphical User Interface (GUI) to show yields of the proposed model has been created utilizing HTML, CSS, JavaScript.

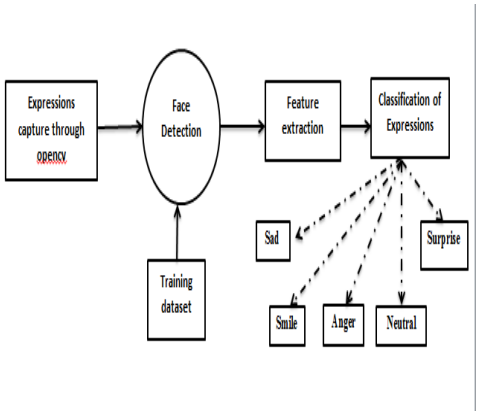

Figure 3: Architecture of the Facial Expression Recognition system.

5. Implementation

The program has been written in python programming The libraries required in this experiment are Keras,Tensor flow, numpy, PIL, Open CV and matplotlib.Tensor flow was used assystem backend where as keras helped the system by providing built-in functions like activation functions, optimizers, layers etc.

OpenCV was principally utilized for picture preprocessing, for example, face location (Cascade Classifier), grayscale transformation, image standardization. Data augmentation was performed by kerasAPI.Matplotlib has been used to generate confusion matrix.

Whenever a user provides aopencv video as input in the system, itpreprocesses the video in the same way when the model has been trained.That mean satthe beginning when ever an video image of an arbitrary size is given by the user, the system converts itto48*48sizedimage.ThenwiththehelpofCascadeClassifier, the model detects the face from the image. As the model has been prepared on grayscale pictures, the framework changes over the rgb picture that contains 3 channels red, green and blue to dim picture which comprises of just 1 channel. At that point to facilitate the grouping task the framework has applied standardization on the picture. At that point it is shipped off to the Convolutional Neural Network for classification.

6. Results and Discussion

Even though the proposed model has been trained on combined data set,it has been successful to achieve validation accuracy of 80.5%. This model has prevailing to keep up higher and almost equivalent recognition rate for each class also as it can group mathematically uprooted face pictures.The proposed system delivers a firm classification output. In spite of the fact that there exists a little change recognition rate among the seven classes, it is still better contrasted with the other existing models couldn't foresee mathematically dislodged face pictures. This research has overcome these limitations. The proposed model, convolutional neural network with data augmentation,has been successful to achieve validation accuracy of 80.5% which isthe highest accuracy so far in facial expression recognition. This model has prevailing to keep up higher and almost equivalent recognition rate for each class too as it can detect mathematically dislodged face pictures.

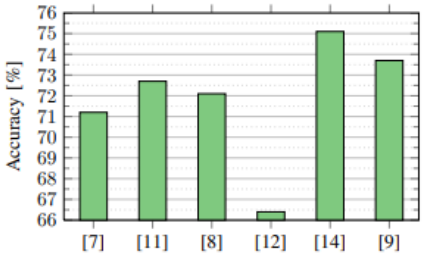

Figure 4: Reported results of FER 2013.

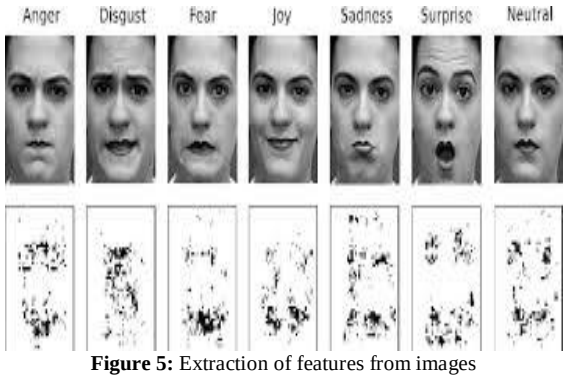

Figure 5: Extraction of features from images

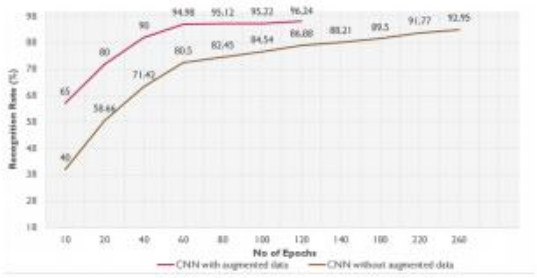

Figure 6: Learning curve before and after data augmentation

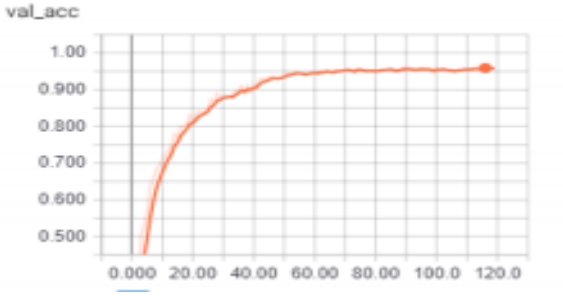

Figure 7: Evaluation of the training model

7. Conclusion

In this system, the main aim was to find out the improvement opportunities for the existing facial expression recognition system, finding out their limitations and applying probable solutions to overcome the limitations were the objectives. The Convolutional Neural Network strategy with information increase has been end up being more effective contrasted with other AI approaches in the event of picture handling. The proposed model has accomplished higher approval precision than some other existing system. The Graphical User Interface allows users to do real- time validation of the system. Seven discrete emotions have been considered (angry, disgust, fear, happy, neutral, sad and surprise) for emotion classification. As various issues would require distinctive organization models it is needed to sort out which method is the best suitable for a specific issue.

8. Future Enhancements

In spite of the fact that the proposed model has accomplished an admirable outcome, it needs a few enhancements in certain regions like adding more information in each class to get more precise outcome as it is realized that profound learning is an information driven methodology and getting higher acknowledgment rate in glad. Later on, analysts can attempt to build up the model more proficiently so a more standard FER system can be built.

REFERENCES

[1] https://www.researchgate.net/publication/338447628_Deep_Learning_for_Face_Expressions_Detection_Enhanced_Recurrent_Neural_Network_with_Long_Short_Term_Memory

[2] https://www.researchgate.net/publication/283162070_Face_Expression_Detection_on_Kinect_Using_Active_Appearance_Model_and_Fuzzy_Logic

[3] https://www.researchgate.net/publication/317787918_Detection_of_Fatigue_from_Face_Expression

[4] https://www.researchgate.net/publication/318974895_Building_a_Face_Expression_Recognizer_and_a_Face_Expression_Database_for_an_Intelligent_Tutoring_System

[5] https://www.researchgate.net/publication/221295991_Driver_drowsiness_detection_using_face_expression_recognition

[6] https://www.researchgate.net/publication/282955524_Vision_Based_Face_Expression_Recognition

[7] https://www.researchgate.net/publication/340133751_Modification_of_Deep_Learning_Technique_for_Face_Expressions_and_Body_Postures_Recognitions

[8] https://www.mdpi.com/2076-3417/9/18/3904/htm

[9] https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.645.5162&rep=rep1&type=pdf

[10] https://ir.nctu.edu.tw/bitstream/11536/29674/1/000168922800007.pdf

[11] https://fedtechmagazine.com/article/2013/11/4-limitations-facial-recognition-technology