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The Customized Convolutional Neural Network of Face Emotion Expression Classification

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ABSTRACT

Expressions are that phenomena of human behavior which can help us to understand the human nature and sometimes feeling they are going through. Feelings relate to human behavior but it comes from your expressions. Face, migrate these expressions to the user level interactions. These interactions may use to act back for humans but not for machines. In this paper, Convolutional Neural network (CNN) are used to understand the seven different human face expressions. The seven classes are fear, angry, disgust, sad, happy, surprise and neutral. The dataset consisted is consisted upon almost 36,000 gray scale images. Our customized proposed CNN model of 4 convolutional and 2 fully connected layer is achieved 64.3 % accuracy of test data.

Keywords
Convolutional Neural Network, Facial expression, Human behavior, deep learning

Introduction

Few years back face expressions have been promoted to the detecting phase and the face Expressions reading using different techniques. Different researchers has discovered that our facial expressions show our emotions and behavior (Diano et al., 2017). The across genders, races and cultures, there are seven universal facial expressions. These facial expressions you can discover and detect the hidden emotions under the words. The disgust face is related to smell something bad or don't really like something. The second one is anger where in the face two vertical lines appear between your eyebrows. The sadness is hardest micro-expression in the face. The fourth one is the happiness related to smile when upward chick muscles are engaged. The next expression is fear in which we try to protect over self. The surprise expression is closest with fear, generated when your eyebrow as far up your forehead as you can. The last one is neural or contempt powerful micro-expression it is simply one sided mouth raise looks like a smile either side of the mouth (Ekmann, 1973; Waller, Cray Jr, & Burrows, 2008).According to his theory every expression had a movement by head so further more according to this theory in 19th century on of the important work was done on the working of automatic facial expression analysis that is also directly connected to the modern day science of detection of facial expression recognition (Ryan et al., 2009).

The facial analysis his work was very important and was latest according to the latest era. The information retrieval is the field to extract relevant data from text as well as images (Rehma, Awan, & Butt, 2018). As information is growing in the form of structured and unstructured data so the domain of information extraction has also been demanded (Alam & Awan, 2018) from facial expression. The fake expression detection is also as important as fake news or fake profile (Abdullah, A, Awan, Shehzad, & Ashraf, 2020).

Our study aim is to detect the facial expression emotion efficiently from the huge datasets. The major contributions are predicted facial expression through customized model of CNN, evaluated through multiple evaluation metrics and constructed various visualizations.

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The remaining section II is our related work background, section III is dataset and methodology, Section IV is result and last section is conclusion.

Related Work

But in 1990's automatic facial expression recognition has become an active technique. It was being active used by other researchers. It have been give the plat form and published there research from 1990 to 2001 (Adolphs, 2002).The Neural Network technique was being used by researcher when they start using automatic facial expression recognition for that purpose researchers use different type of expressions some of them use 6 type of expression but other have used 7 type of expression, most commonly used expressions by different researchers are (happy, sad, disgust, fear, surprise and anger) these expressions are commonly used by the different researchers. Using deep learning and neural networks are most commonly used technique now in this modern ways (Yu & Zhang, 2015).

A. Machine Learning Methods

The machine learning techniques were recently applied in various domain (Ali et al., 2019) , (Gupta et al., 2021),(Anam et al., 2021). It is important to interact machine with human, with the help of HCI technologies human facial expression can be identified more easily than a human can recognize it. Most of the past researchers tend to work on AAM (Active Appearance Model) technology which helps researchers to recognize the emotion expression. Machine learning techniques were used in study of emotions in human computer interaction which take place in research area since a very long time. Machine with human, with the help of HCI technologies human facial expression can be identified more easily (Samara, Galway, Bond, & Wang, 2019). Some of the work in the past, the researchers provided results by applying the fuzzy rules based on the different type of rules (Liliana, Basaruddin, Widyanto, & Oriza, 2019). The other studies related to various models of machine learning proposed the support vector machine with multiple complex features (Tsai & Chang, 2018), decision tree (Salmam, Madani, & Kissi, 2016), Naïve bayes classifier for distress detection (Nair & Subha, 2018) and K-nearest neighbor algorithm (Ou, 2012). There are numerous models that shows the most appropriate values discuss on the bases of the recent studies so the other model that can also find exact indications can be the part of polynomial regression. So that in this paper the regression analysis will elaborates the values of different expressions which are based on the human faces (Zhou, Kong, Fowlkes, Chen, & Lei, 2020).

B. Deep Learning Methods

Deep learning with neural network approached has recently done significant performance in medical science of unbalanced data of various disease prediction(M. J. Awan, Rahim, et al., 2021; Javed, Saba, Humdullah, Jamail, & Awan, 2021). The study recognized the facial expression was applied the face action unit technique will be used and ACNN algorithm for recognizing the face action units, face action units is a proposed technique which is directly refers to as the FACS (face action coding system) according to this technique the expressions are easily recognize and the deep neural network technique (Khorrami, Paine, & Huang, 2015; Nagi, Awan, Javed, & Ayesha, 2021). Deep learning methods have change the apparent behaviors of working on technology because it makes it more helpful to show the real time values. CNN is the part of deep learning methods and it balance the

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real time data values Recently expression was determined through hand- gesture based technique through Yolo v3 model performed 97 % accuracy (Mujahid et al., 2021).

Dataset and methodology

A. Datasets

In this section we used datasets created by Jonathan Oheix in the kaggle in year 2019 (Oheix, Jan 3, 2019). The data consists of 48x48 pixel grayscale images of faces. The faces have been automatically registered so that the face is more or less centered and occupies about the same amount of space in each image. Each image corresponds to a facial expression in one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral). The dataset contains approximately 36K images. Below is the chart of face unit recognition which have been used in this research for research purpose. Table 1 describe the face expression which is simple to detect and understand by CNN.

TABLE I. EXPRESSION AND THEIR ACTION UNITS

Expressions	No of samples
Happiness	7164
Sad	4938
Surprise	3205
Fear	4103
Anger	3993
Disgust	436
Neutral	4982

The below figure 1 is the bar graph of quantity of seven classes where it clear shown that happy images are much higher than the disgust images.

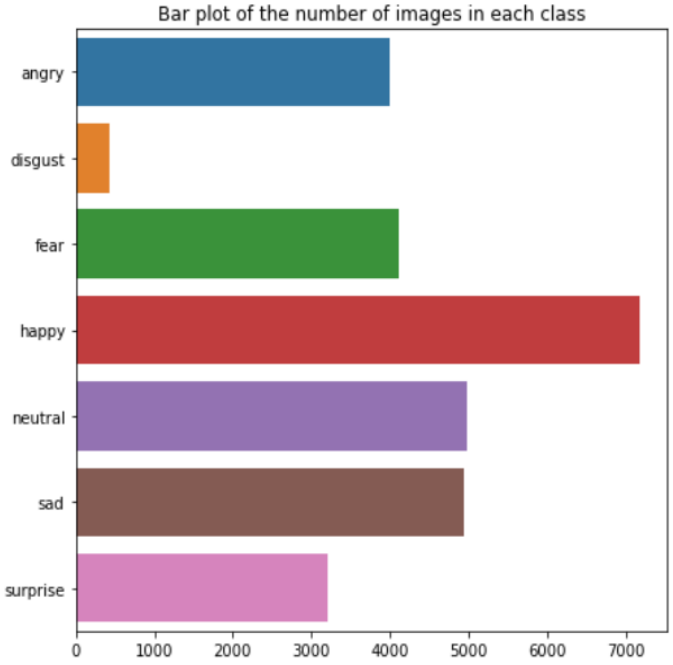

Figure 1: The seven universal facial expression volume of bar plots

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The figure 02, are the images of all seven images extracted from the datasets.

Figure 02: The samples of seven classes

B. METHODOLOGY

Our system methodology is discussed as below

Customized Convolutional Neural Network

CNN (Erik & Alexander) presented an approach to find the abstract of personality features from the state of consciousness which use CNN. He experienced five different types of networks. In which all of that five types of networks which have an equal building for the five distinctive personality features. All that particular networks are designed with binary classifier that forecast the interrelated personality characters which have positive or negative impact. We define our CNN with 4 convolutional layers and 2 fully connected layers. The numbers of filters we are used [64, 128,512, 512] in the 4 convolutional layers. We used data augmentation to balance the datasets with no of batch sizes are 128. The activation function Rectified linear is used between convolutional and dense layers.

Experimental Setup

We used Google Colab as acceleration for our experiments under keras library and Python language (M. Awan, Rahim, Salim, Ismail, & Shabbir, 2019). we divided our datasets of 80 % for training and 20% for validation. The training data are 28821 and for test set are 7066. We tuned our model with Adam optimizer with learning rate of 0.001and loss function is categorical cross entropy.

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Results

Most of the pattern matching systems had been made and worked a lot good, but in our method, we are not just do matching we go beyond the match patterns. Our best model managed to obtain a validation accuracy of approximately 64%, which is quite good given the fact that our target class has 7 possible values. The validation loss value is 1.1002 whereas training accuracy is 79 % after 50 epochs. At each epoch, Keras checks if our model performed better than during the previous epochs. If it is the case, the new best model weights are saved into a file. This will allow us to load directly the weights of our model without having to re-train it if we want to use it. The figure 03 is the comparison between the loss value of training and test.

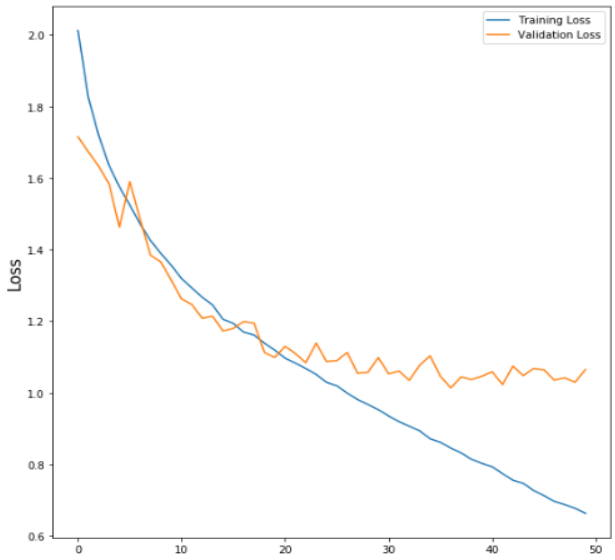

Figure 3: The training and test loss comparison

The figure 04 is shown the accuracy of training and test after 50 epochs. Our model is not over-fitted because after 50 epochs the accuracy of test data is not improved.

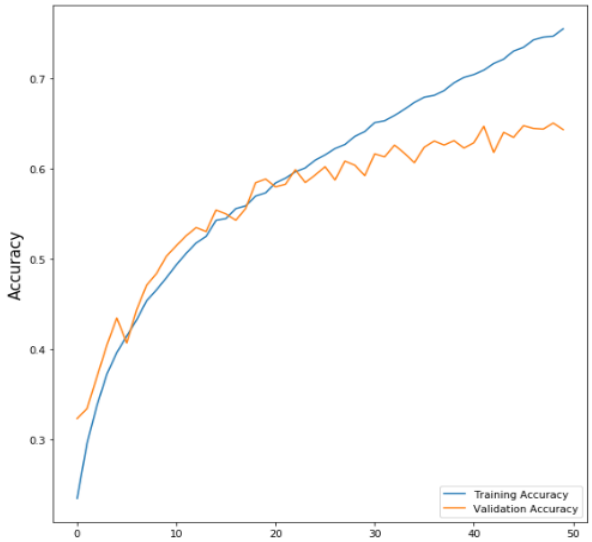

Figure 4: variation of training and test

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The other evaluation metrics we used the confusion matrix of each class with predicted label vs true label of seven classes in the figure 5 below.

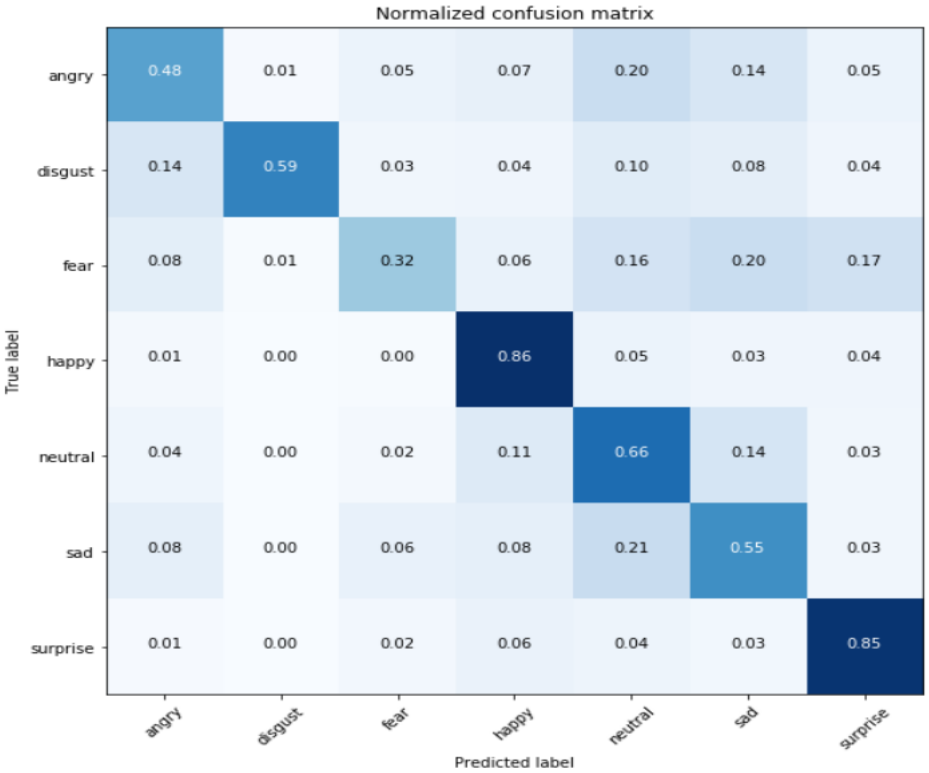

Figure 05: The confusion matrix of seven classes

Discussion

Our model is very good for predicting happy and surprised faces. However, it predicts quite poorly feared faces because it confuses them with sad faces. The samples of some sad images is shown in the figure 06.

Figure 06: The Sad facial expression

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The figure 07 is shown the facial expression of surprise images.

Figure 07: The Surprise Images of Faicial Expression

With more research and more resources this model could certainly be improved, but the goal of this study was primarily to focus on obtaining a fairly good model compared to what has been done in this field. Now recently variety of datasets structured and unstructured data like images were analyzed through big data approaches through spark and Big deep learning Framework(Aftab, Awan, Khalid, Javed, & Shabir, 2021; Ahmed, Awan, Khan, Yasin, & Shehzad, 2021; M. J. Awan, Khan, et al., 2021; Javed Awan, Shafry Mohd Rahim, Nobanee, Munawar, et al., 2021; Javed Awan, Shafry Mohd Rahim, Nobanee, Yasin, et al., 2021). In future we can work on fake facial expression as well inspired with work.

Conclusion

Human expressions are very difficult to define because everyone has its own expressions and values by which they express their emotions and show expressions so that in that way expressions are most important part of any human to find out the state of a person. This research of facial emotion images is significant importance now a day to detect the human behavior. For this we used seven categories Angry, Disgust, Fear, Happy, Sad, Surprise, Neutral. mages are trained on the convolutional neural network to defining the expressions recognitions. In this paper images are used to trained on customized convolutional neural network of 4 convolutional layer, batch normalization to reduce overfitting, Relu activation function between layers and find the expression by using the Keras deep learning approach. Our model predicted almost 65% accuracy for test data. In future we can apply big framework and bimodal as well.

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