

An Efficient Facial Expression Recognition System Using Novel Supervised Machine Learning by Comparing CNN over Google Net

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Abstract

Aim: The main aim of this research article is classification of facial expression recognition with improved accuracy by using Convolutional Neural Network(CNN) comparison with GoogleNet.

Materials and Methods: The data of the facial expressions is taken from the FER2013 available on kaggle. The most widely utilized technique for accurately assessing photos is the convolutional neural network (CNN), and GoogleNet is also employed here to compare the accuracy of Novel image classification.

Results: The Convolution neural network(CNN) produces 82.14% accuracy in predicting facial expressions on the dataset, whereas GoogleNet produces 75.09% accuracy. Convolutional neural network(CNN) is better than GoogleNet. Between the study groups, there is a statistically significant difference ($p < 0.05$).

Conclusion: Convolutional Neural Network provides better outcomes in accuracy rate when compared to GoogleNet for predicting facial expressions.

Keywords: Facial Expression Recognition, Convolutional Neural Network, GoogleNet, Novel Image Classification, Machine Learning, Intelligent processing.

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INTRODUCTION

Facial expressions are part of human language and are often used to convey emotions (Triyanti, Yassierli, and Iridiastadi 2019). With the improvement of human computer interplay technology, human beings pay greater and more interest in facial expressions focus (FER) technology (Dutta and Barman 2020). Besides, in the domain of FER, human beings have made some progress (Zhao 2012). With advancements in computer vision, high emotion recognition accuracy has been executed in image captured under controlled prerequisites and consistent environments, rendering this a solved problem (Melinte and Vladareanu 2020). Developments in computer vision continuously aim to enhance classification accuracy on such problems. (Jia et al. 2020) In picture classification, convolutional neural network (CNN) and GoogleNet have proven great achievable due to their computational efficiency and characteristic extraction capability of intelligent processing. (Management Association and Information Resources 2018) They are the most widely used deep models for intelligent processing FER. One particular emotion focus dataset that encompasses the challenging naturalistic prerequisite and challenges is FER2013. The Applications of Facial Expression Recognition (FER) can be broadly utilized to more than a few lookup areas, such as mental diseases diagnosis and human social interaction detection. It used to be brought at the international level conference on machine learning in 2013 and grew to be a benchmark for comparing model performance in emotion recognition (Farhoumandi et al. 2021).

Google Scholar has around 175 linked articles that were published in IEEE Xplore 68 and related journals. (Konar and Chakraborty 2014) The recognition of facial expressions in various approaches is greatly improved by the application of a neural network algorithm. (Wu et al. 2021) A system's performance is measured in terms of accuracy and results reveal that it has the potential for forecasting the expression of face more accurately in CNN (Manaswi 2018).

Our institution is passionate about high quality evidence based research and has excelled in various fields (Parakh et al. 2020; Pham et al. 2021; Perumal, Antony, and Muthuramalingam 2021; Sathiyamoorthi et al. 2021; Devarajan et al. 2021; Dhanraj and Rajeshkumar 2021; Uganya, Radhika, and Vijayaraj 2021; Tesfaye Jule et al. 2021; Nandhini, Ezhilarasan, and Rajeshkumar 2020; Kamath et al. 2020). Several works demonstrate that performance of GoogleNet algorithm is poor and provide less accuracy in predicting facial expression (Tian, Han, and Wu 2021). A study compares the accuracy of various neural network algorithms to deliver more accurately. Due to this, the work compares the effectiveness of the Novel Systematic and developed CNN, Resnet, AlexNet, GoogLeNet, and LeNet algorithms in recognising facial expressions.

MATERIALS AND METHODS

The research was conducted in the Image Processing Lab at the Saveetha School of Engineering's Department of Computer Science and Engineering, SIMATS. 1346 records from a FER2013 dataset were worked on. accuracy of facial expression recognition as measured by two groups. To improve accuracy, each group underwent a total of 10 iterations. The Kaggle website's download page was used to get the dataset. 1001 rows and 17 columns make up the dataset.

Using G power, a sample size of 188 was calculated for each Group. In facial expression recognition there should be some null values and missing values remove the null and missing values. With alpha and beta values of 0.05 and 0.2, pretest power of 80%, and enrollment ratio of 1, clinical analysis was utilised to calculate sample size.

Both definitions apply to the two convolutional neural network methods. Convolutional neural networks are mostly utilized for the intelligent processing of images, as well as for data segmentation, classification, and autocorrelation. In essence, a convolution is a filter that is dragged over the input. A neural network 22 layers deep is called GoogleNet. We can import a neural network that has already been trained to classify Novel images.

Convolutional neural network (CNN)-Group 1

Inputs: FER2013 Dataset

Output: Selected features and Accuracy.

1. Activate the dataset.
2. Remove the null values in a dataset
3. Divide a dataset into a training dataset (80%) and a testing dataset (20%) at random.
4. Decide on a target variable.
5. Train the model in a dataset.
6. Make a prediction about the testing set using the training dataset.
7. Make a model evaluation.
8. Accuracy of Return

A controlled machine learning algorithm that can be used to image processing problems is the convolutional neural network. (Arsenault 2016) In this study, a Convolutional neural network of Tarfile library was used. Load a FER2013 data.csv file by importing it. Training (80%) and testing (20%) portions of the dataset are randomly selected (20%). It chooses a target variable. Then, using a training dataset, a convolutional neural network is created. Based on a training set, a testing set is projected. Accuracy is measured and evaluated for the Convolutional neural network.

one of the top neural network models, convolutional neural networks are mostly utilized in practical applications for picture intelligent processing and have one or more convolutional layers (Wu et al. 2021).

GoogleNet-Group 2

Inputs : FER2013 Dataset

Output : Accuracy

1. Open the dataset and import it.
2. Pick random features from the dataset

3. Remove the null values
4. Set the target variable
5. Train the model in a dataset
6. Make a prediction about the testing set using the training dataset.
7. Analyze the model.
8. Accuracy of Return

In this study(Ninad Mehendale,.) GoogleNet of a Tar File library was used(Sekaran, Lee, and Lim 2021).A dataset is randomly split into training (80%) and testing (20%) parts. It chooses samples at random, and to forecast the outcome, the GoogleNet was gathered for each sample.

A planned project was tested in the Google Collaboratory. A Intel i7 processor, 512GB SSD, 8 GB RAM, Windows OS, Python: colab are the hardware and software prerequisites for experimenting with the task.

The training set and the test set were initially separated from a data set. The training and test sets are then used to put the algorithm to the test. The training and test sets are switched 10 times, depending on the size of the test set. Table 1 compares the accuracy of CNN and GoogleNet over a period of ten iterations. The following formulas can be used to determine various analytical parameters:

Accuracy :- It indicates the number of examples that were correctly categorized by displaying the following equation 1.

$$\text{Accuracy} = \frac{\text{True positive} + \text{True Negative}}{\text{True Positive} + \text{True Negative} + \text{False Positive} + \text{False Negative}} \quad (1)$$

Statistical Analysis

The work was statistically examined in addition to an experimental analysis utilizing the statistical package for social sciences (SPSS). During the analysis, the mean, standard deviation, and mean standard error were calculated. An independent variable T test was applied to compare parameters between the two groups. Facial, face shape, and gender are independent factors in the analysis. The precision of a dependent variable has an impact on the result.

RESULTS

The various parameters for both groups are shown in Table 1. Accuracy, mean, standard deviation, and standard error In table 2, the error mean has been computed for CNN and GoogleNet. A comparison of the two groups reveals that CNN and GoogleNet are more accurate than the other. The statistical analysis of CNN and GoogleNet using various test datasets is shown in Table 3. The mean accuracy of a CNN model appears to be higher than the GoogleNet model. The performance of a CNN algorithm is superior to an GoogleNet algorithm. The two groups don't significantly differ from one another. Hence CNN is better than GoogleNet. In Fig. 1, a statistical comparison of two separate groups reveals that CNN is more accurate than GoogleNet. GoogleNet's mean is somewhat lower than CNN's.

DISCUSSION

The works prove that Convolutional neural network(CNN) is better than GoogleNet in recognition of face expression in terms of accuracy(Xu and Zhenhong 2020). Recognition of face expressions is a major issue in the real Novel image classification sector. Experimental work was done on two groups CNN and GoogleNet by varying a test size. From an experimental analysis done in colab, the accuracy of CNN is 82.14% whereas GoogleNet provides an accuracy of 75.09%. This shows that CNN is better than GoogleNet. From a SPSS graph, a proposed Convolutional neural network offers better performance in terms of accuracy(82.14%) and accuracy (75.09%) compared to a GoogleNet algorithm.

The most important aspect in intelligent processing novel image classification predicting facial expression recognition is accuracy. In a study (Liu, Zhang, and Pan 2016) a machine learning based algorithm for facial expression recognition by using the FER2013 dataset was proposed. A (Singh 2019)study used popular machine learning algorithms, a dataset FER2013, used libraries are Tarfile, os, numpy as np, pandas as pd, tensorflow as tf , from matplotlib import pyplot and sklearn. Based on the subject's facial expression in the FER2013 dataset,

the photos are classified as showing expressions of anger, disgust, fear, happiness, sadness, surprise, and neutrality.

In a study(Mehendale 2020) the author used different databases of caltech faces, the CMU database and NIST database to compare with each other to find the accuracy and the NIST database got the highest accuracy with (96%) and other databases got the least accuracy(Mohseni et al. 2015). In our study we used the FER2013 database. It includes more images and it is the latest dataset and it has labeled images with their person's expressions and it gives more accuracy when compared with other databases.

The quantity of the training and testing data sets affects how accurate the CNN algorithm is According to our research, the accuracy seems to be higher than that of the GoogleNet algorithm.Our proposed work appears to have a higher mean error, which needs to be reduced. There are some restrictions on the work even though the outcomes of a study are improved in both experimental and statistical analysis. On larger data sets, accuracy assessment cannot produce a better result. Additionally, the average error in CNN appears to be higher than in GoogleNet. A large decrease in the average error would be preferable. To attain better accuracy and a lower mean error, work can be enhanced by using neural network algorithm techniques. Prior to classification, feature selection techniques can be employed to increase the classification of classifiers' accuracy. Thus, by using feature selection techniques, it is possible to speed up and decrease the computation time.

CONCLUSION

CNN is an algorithm novel image classification that is used to improve the accuracy. The work shows that Accuracy of facial expression recognition using Convolutional neural network(CNN) is better than GoogleNet algorithm. It is found that CNN performs significantly better than GoogleNet in recognizing facial expression accurately, but the mean error is found to be little higher than GoogleNet. In light of this, it is concluded that GoogleNet performs less accurately than CNN's algorithm.

DECLARATIONS

Conflict of interest

No conflict of interest in this manuscript

Author Contributions

Author TEP was involved in data collection, data analysis, algorithm framing, implementation and manuscript writing. Author RPL was involved in designing a workflow, guidance and review of manuscript.

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TABLES AND FIGURES

Table 1. Accuracy achieved during evaluation of Facial expression recognition using a test dataset with Convolutional neural network (CNN) and GoogleNet for different iterations.

Iterations	Accuracy	
	CNN	GoogleNet
S.no		

1	82.14	75.09
2	82.07	75.05
3	81.98	75.02
4	81.88	75.00
5	81.76	74.98
6	81.53	74.97
7	81.34	74.94
8	81.12	74.91
9	81.02	74.89
10	81.00	74.85

Table 2.For accuracy, mean, standard deviation, and error mean, experimental analysis in Colab shows that CNN performs better (82.14%) than GoogleNet.

	Groups	N	Mean	Std.Deviation	Std.Error mean
Accuracy	CNN	10	81.5840	.44192	.13975
Accuracy	GoogleNet	10	74.9700	.07424	.02348

Table 3. Analysis of the CNN and GoogleNet algorithms' means, standard deviations, and standard errors of precision and accuracy. The accuracy values between algorithms varied statistically significantly. The most accurate source was CNN (82.14%), while GoogleNet was the least accurate source (75.09%). The study groups differ from one another in a statistically significant way ($p < 0.05$).

		Levene's test for Equality of Variances		T-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence interval of the difference	
									Lower	Upper
Accuracy	Equal variances assumed	30.054	.001	46.674	18	.001	6.61400	.14171	6.31629	6.91171
	Equal variances not assumed			46.674	9.508	.001	6.61400	.14171	6.29603	6.93197

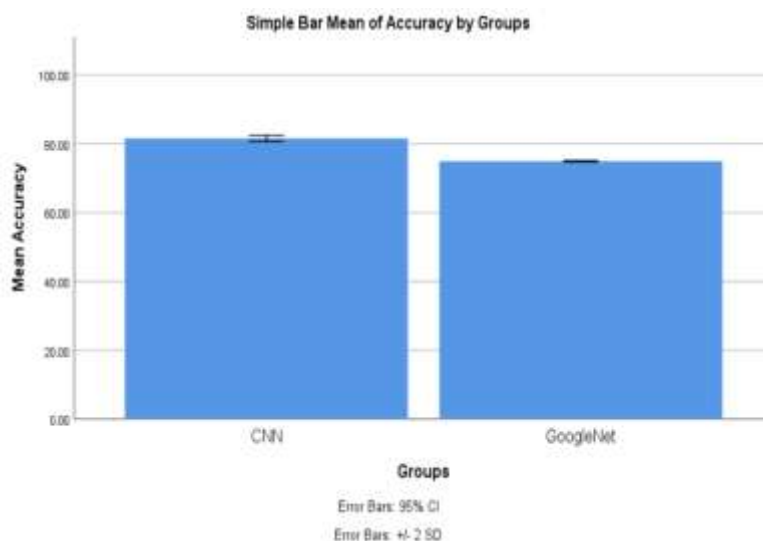


Fig. 1. Bar Chart representing the comparison of Mean Accuracy of CNN and GoogleNet algorithms. Mean accuracy of CNN is 82.14% appears to be better than GoogleNet which is 75.09%. The X-axis represents CNN and GoogleNet algorithms and Y-axis represents the mean accuracy ± 2 SD.