

A Formal Facial Expression Recognition System Using Novel Scattered Image Classification by Comparing CNN over Alexnet

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Abstract

Aim: This study article's major goal is to classify facial expressions more accurately by utilizing Convolutional Neural Networks (CNNs) in contrast to AlexNet.

Materials and Methods: The data of the facial expressions is taken from the FER2013 available on kaggle. The Convolutional neural network (CNN) is the algorithm most common method of visual analysis with best accuracy and Alexnet is also an algorithm used here to compare the accuracy of novel image classification.

Results: The Convolution neural network (CNN) produces 82% accuracy in predicting facial expressions on the dataset, whereas AlexNet produces 76% accuracy. Convolutional neural network (CNN) is better than AlexNet. The study groups differ from one another in a statistically significant way ($p < 0.05$).

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

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

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INTRODUCTION

Based on non-verbal communication a facial emotion plays an important role in human interaction. In non-verbal conversation carried out daily, the important approach of expression and the best to take to look at is via facial emotions (Li and Oussalah 2010). Although facial expressions are especially pretty convenient for a character to discover and classify, for a machine, regardless of its complexity, detecting and recognizing facial expressions is indeed a challenge. (Datu and Rothkrantz 2008) The crucial component of communication that allows for the fusion of ideas is eye contact. (Rajesh and Naveenkumar 2016) Eye manages contributions, conversations, and links with others. Face expressions encompass the smile, sad, anger, disgust, surprise and fear. 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. This paper generally focuses on various Novel image classification of facial expression recognition intelligent processing methods with three crucial steps: function extraction, preprocessing, and classification. ("Human Face Processing: From Recognition to Emotion" 2013) This report also outlines the advantages of distinctive FER tactics and assesses the general effectiveness of distinctive FER techniques. Only the image-based FER approaches are selected for the literature evaluation in this research.

There are roughly 149 relevant articles that were published in IEEE Xplore 80 and similar sources that are available on Google Scholar. (Konar and Chakraborty 2014) To enhance the identification of facial expressions, a neural network technique is frequently utilized in various intelligent processing techniques. (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.

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 AlexNet algorithm is poor and provide less accuracy in predicting facial expression (Brownlee 2019). A study compares the accuracy of various neural network algorithms to offer more accuracy. The purpose of the work is to compare the accuracy of Novel Systematic and evolved CNN, ResNet, AlexNet, GoogLeNet and LeNet algorithms in recognition of Novel image classification of facial expressions.

MATERIALS AND METHODS

The research work was carried out at the Image Processing Lab, Department of Computer Science and Engineering, Saveetha School of Engineering, SIMATS. A total of 1001 records from the FER2013 dataset were used in this study. The accuracy of face expression recognition was tested using two groups. To improve accuracy, each group was subjected to a total of ten iterations. The Kaggle website was used to obtain the dataset. There are 1001 rows and 17 columns in 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. Clinical analysis was used to compute sample size, with alpha and beta values of 0.05 and 0.2, pretest power of 80%, and enrollment ratio of 1.

The two algorithms of convolutional neural networks have both definitions. The main applications of convolutional neural networks include novel image categorization, segmentation, and other autocorrelated data. In essence, a convolution is a filter that is dragged over the input. The computer vision field of machine learning and intelligent processing issues may benefit greatly from the use of AlexNet, a cutting-edge architecture for any object-detection task.

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. Choose a goal variable.
5. In a dataset, train the model. Using a training dataset, forecast the testing set.
6. Analyze the model.
7. Accuracy of Return

Convolutional neural networks are a type of supervised machine learning method that can be used to solve image intelligent processing problems. In this study, a Convolutional neural network of Tarfile library was used. Import an FER2013 data.csv dataset and load the dataset. The dataset is randomly divided into training (80%) and testing (20%) sets. A variable to be used as a target is chosen.

Then the Convolutional neural network based on a training dataset is generated. A training set is used to predict a testing set. The accuracy of the Convolutional neural network is calculated.

One of the best forms of neural networks, convolutional neural networks are used mostly for novel image processing and are frequently employed in real-world applications for intelligent processing. They have one or more convolutional layers. (Wu et al. 2021).

AlexNet-Group 2

Inputs : FER2013 Dataset

Output : Accuracy

1. Import the dataset, then read 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. Using a training dataset, forecast the testing set.
7. Review the model
8. accurate returns

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

In the Google Collaborative, a proposed work was tested. A Intel i7 processor, 512GB SSD, 8 GB RAM, Windows OS, and Python: colab are the hardware and software prerequisites for experimenting with the task.

A data set was first split into two sections: the training set and the test set. The algorithm is then put to the test using the training and test sets. Depending on the size of the test set, the training and test sets are switched 10 times. Table 1 compares the accuracy of CNN and AlexNet over a period of ten iterations. The following formulas can be used to determine various analytical parameters:

Accuracy :- It identifies the number of instances that were correctly classified as shows an 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). The mean, standard deviation, and mean standard error were calculated during the analysis. To compare parameters between two groups, an independent variable T test was used. Facial, face shape, and gender are independent factors in the analysis. The precision of a dependent variable has an impact on the result.

RESULTS

Table 1 depicts the various parameters of both groups. Table 2 shows the accuracy, mean, standard deviation, and standard error mean for CNN and AlexNet. An analysis of two groups shows that CNN has higher accuracy compared to AlexNet. The statistical analysis of CNN and AlexNet using various test datasets is shown in Table 3. A CNN model seems to have a higher mean accuracy than an AlexNet model. A CNN algorithm performs better than an AlexNet algorithm. Between the two groups, there is no discernible difference. CNN is therefore superior to AlexNet. According to a statistical comparison of two independent groups, CNN is more accurate than AlexNet in Fig. 1. CNN's mean is somewhat higher than AlexNet mean.

DISCUSSION

The works prove that Convolutional neural network(CNN) is better than AlexNet in recognition of face expression in terms of accuracy(Xu and Zhenhong 2020). Recognition of face expressions is a major issue in the real image classification sector. Experimental work was done on two groups CNN and AlexNet by varying a test size. (Liu, Zhang, and Pan 2016) From an experimental analysis done in colab, the accuracy of CNN is 82.14% whereas AlexNet provides an accuracy of 76.01%. This shows that CNN is better than AlexNet. From a SPSS graph, a proposed Convolutional neural network offers better performance in terms of accuracy(82.14%) and accuracy (76.01%) compared to a AlexNet algorithm.

Accuracy is the most crucial factor in facial expression recognition prediction. 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(Xu and Zhenhong 2020). 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(Sekaran, Lee, and Lim 2021). 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(Ali and Hughes 2021).

The quantity of the training and testing data sets affects how accurate the CNN algorithm is. Our analysis suggests that the accuracy is superior to the AlexNet method.(Song et al. 2022). 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. In addition, in CNN, the average error seems to be greater than AlexNet. (Xu and Zhenhong 2020) A large reduction 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, it is possible to speed up calculation and increase recognition accuracy with feature selection techniques.

CONCLUSION

An algorithm called CNN is employed to increase accuracy. The work shows that Accuracy of facial expression recognition using Convolutional neural network(CNN) is better than AlexNet algorithm. It is found that CNN performs significantly better than AlexNet in recognizing facial expression accurately, but it turns out that the mean error is a little greater than AlexNet. Thus, it can be said that the CNN algorithm performs better than AlexNet in terms of accuracy.

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 AlexNet for different iterations.

Iterations	Accuracy	
	CNN	AlexNet
S.no		
1	82.14	76.01
2	82.07	76.00
3	81.98	75.94

4	81.88	75.90
5	81.76	75.87
6	81.53	75.83
7	81.34	75.81
8	81.12	75.79
9	81.02	75.76
10	81.00	75.74

Table 2. AlexNet is outperformed by CNN in accuracy (82.14 percent) according to experimental study in Colab for accuracy, mean, standard deviation, and standard error mean.

	Groups	N	Mean	Std.Deviation	Std.Error mean
Accuracy	CNN	10	81.5840	.44192	.13975
Accuracy	AlexNet	10	75.8650	.09583	.03030

Table 3. Analysis of the CNN and AlexNet algorithms' means, standard deviations, and standard errors of precision and accuracy. The accuracy values between algorithms varied statistically significantly. CNN had the highest accuracy (82.14%) and AlexNet had the lowest accuracy (76.01%). There is a statistically significant difference between the study groups with ($p < 0.05$).

		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	25.931	.001	39.994	18	.001	5.71900	.14300	5.41858	6.01942
	Equal variances not assumed			39.994	9.845	.001	5.71900	.14300	5.39970	6.03830

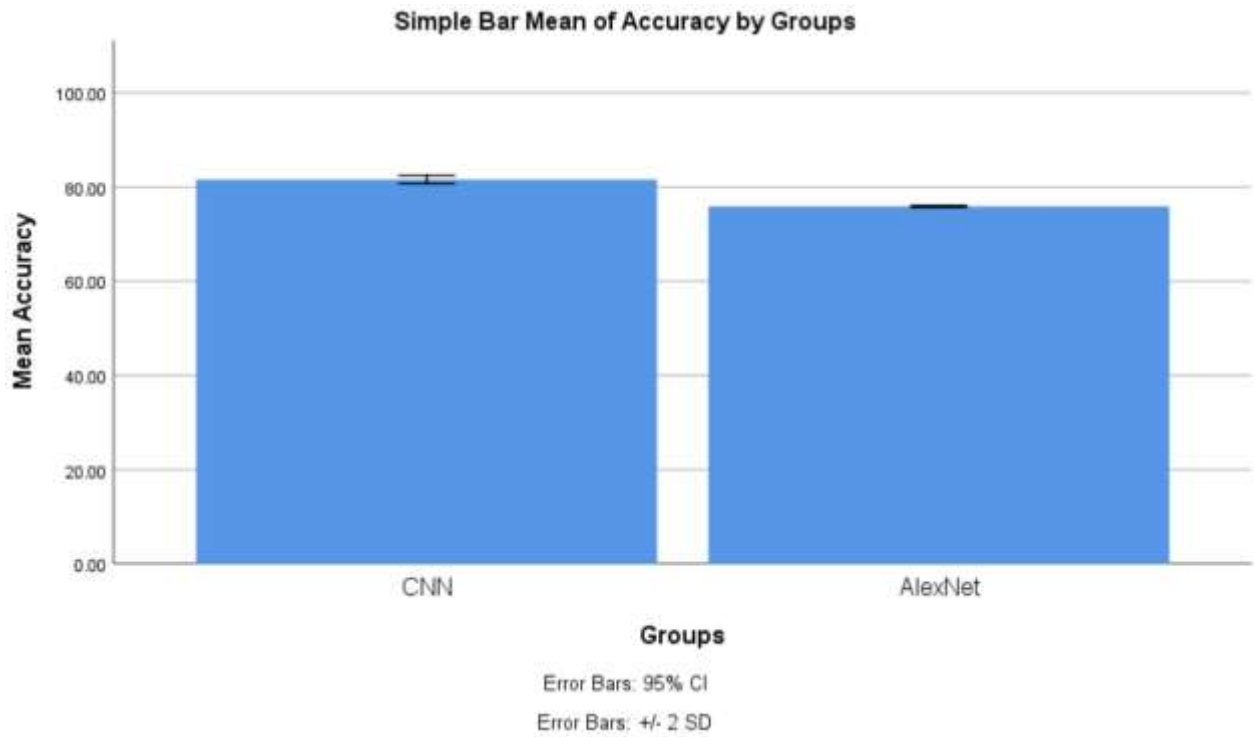


Fig. 1. Bar Chart representing the comparison of Mean Accuracy of CNN and AlexNet algorithms. Mean accuracy of CNN is 82.14% appears to be better than AlexNet which is 76.01%. The X-axis represents CNN and AlexNet algorithms and the Y-axis represents the mean accuracy \pm 2 SD.