Original Article

An Efficient Facial Expression Recognition System Using Novel Image Classification by Comparing CNN over Res Net

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Abstract

Aim: The aim of this research article is classification of facial expression recognition Convolutional Neural Network (CNN) compared with ResNet yielded better accuracy.
Materials and Methods: The data of the facial expressions is taken from the FER2013 available on kaggle.The convolutional neural network (CNN) is the most widely used algorithm for image analysis with best accuracy and ResNet is also an algorithm used 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 ResNet produces 78.01% accuracy. Convolutional neural network (CNN) is better than ResNet. With ($p<0.05$), there is a statistically significant difference between the research groups.
Conclusion : Convolutional Neural Network provides better outcomes in accuracy rate when compared to ResNet for predicting facial expressions.

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

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INTRODUCTION

Humans have always found it easy to recognise facial expressions for emotion recognition, but with computer vision and machine learning, it is now possible to discern facial expressions from photographs and videos.(Goodfellow et al. 2015) Because facial expressions connect to emotions, they are important identifiers for human feelings. (Chuanjie and Changming 2020)Face expression recognition is a technique to recognize expressions on human faces. A large number of intelligent processing techniques have been created for detect facial expressions like happy, fear, sad, neutral, surprise, angry, disgust(Li et al. 2018).Facial expressions recognition is a rather large subfield of machine learning that can be used almost anywhere.(Chuanjie and Changming 2020)The 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.The related idea behind facial recognition is that the software is able to recognize facial expressions by scanning the image and video to detect the human facial expressions.

For the Intelligent processing recognition of facial expressions, there have been many different types of traditional utilised.In Google Scholar, there are around 149 related articles published in IEEE Xplore 80 and related.("Facial Expression" 2018) For the geometric properties, the relationship among facial additives is used to assemble a characteristica training vector to extract geometric capabilities from the attitude and role of fifty two facial landmark points. (Yang and Yin 2017) Calculating the Euclidean distance and the attitude between each pair of landmark points is the first characteristic. (Kumar et al. 2021) The second involves finding the difference between the calculated distance/attitude and the equivalent distance/attitude within the video sequence's preliminary body. (Chuanjie and Changming 2020) A variety of facial attributes were retrieved from the facial image and utilized to train a variety of generalized and specialized neural networks. (Khopkar 2021) Based on the results of the initial testing, the best generic and specialised neural networks were recruited into decision-making committees, resulting in an integrated committee neural network system. (Zhong et al. 2020)The integrated committee neural

network system was then evaluated using data from participants who had not been trained or tested previously. (Kumar et al. 2021).

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). One of the fundamental issues in computer vision and image comprehension intelligent processing is extracting relevant information for a specific interpretation assignment. This is because explicit feature design necessitates domain knowledge. (Song 2021)This problem has been alleviated by recent improvements in neural networks and machine learning. It is commonly known that a well-developed CNN can find suitable representation of visual data through hierarchical layers (Chuanjie and Changming 2020).A CNN design is made up of a series of cascading layers that perform basic operations like convolution and subsampling, followed by a series of fully linked layers that function similarly to a traditional artificial neural network.

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 10 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 and0.2, pretest power of 80%, and enrollment ratio of 1.

The two algorithms of convolutional neural network have both definitions.Convolutional neural network are used mainly for intelligent processing, image processing, Novel Image classification, segmentation, and other auto-correlated data that have never been done before.Convolution is the process of sliding a filter over an input signal. ResNet, short for Residual Networks, is a well-known neural network that serves as the foundation for many computer systems.

Convolutional neural network (CNN)-Group 1

Inputs: FER2013 Dataset

Output: Selected features and Accuracy.

1. Load the dataset.
2. Remove the null values in a dataset
3. A dataset is randomly divided into training (80%) and testing (20%) datasets.
4. Make a variable that will be the target.
5. Train the model in a dataset.
6. Based on a training dataset, forecast the testing set.
7. Assess the model.
8. 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.

Convolutional neural network (Song 2021) is considered one of the best types ofOne or more convolutional layers employed in neural networks, which are primarily utilized for image processing and are widely used in practical applications. ((Liu, Zhang, and Pan 2016)).

ResNet-Group 2
Inputs : FER2013 Dataset

Output : Accuracy

1. Import the data and read it.
2. Features from the dataset are chosen at random.
3. Remove the null values
4. Set the target variable
5. Train the model in a dataset
6. Based on a training dataset, predict the testing set.
7. Analyze the model.
8. Accuracy of Return.

In this study(Ninad Mehendale,.) ResNet of a Tar file library was used.A dataset is randomly divided into training (80%) and testing (the remaining 20%). (20 percent). It randomly selects samples, and the ResNet was acquired for each sample in order to forecast the outcome.

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.

Initially, a data set was separated into two sections: the Sets for training and testing Next, an algorithm is tested on the Sets for training and testing. Depending on the size of the test set, training and testing sets are swapped 10 times. The accuracy of CNN and ResNet for 10 iterations is shown in Table 1. The following are some examples of how different parameters of an analysis can be calculated:

Accuracy :- It indicates how many instances were accurately classified as shows an following equation 1

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

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 ResNet. When comparing the accuracy of the two groups, CNN outperforms ResNet. The statistical analysis of CNN and ResNet with various test datasets is shown in Table 3. A CNN model appears to have a higher mean accuracy than the ResNet model. The performance of a CNN algorithm is superior to a ResNet algorithm. Between the two groups, there is no substantial difference. Hence CNN is better than ResNet. In Figure1, a statistical examination of two separate groups demonstrates that CNN is more accurate than ResNet. The mean of ResNet is little less than CNN.

DISCUSSION

The works prove that Convolutional neural network(CNN) is better than ResNet in recognition of face expression in terms of accuracy. Recognition of face expressions is a major issue in the real Novel image classification sector. (Anbarjafari et al. 2018)Experimental work was done on two groups CNN and ResNet by varying a test size. From an experimental analysis done in colab, the accuracy of CNN is 82.14% whereas ResNet provides an accuracy of 78.01%. This shows that CNN is better than ResNet. From a SPSS graph, a proposed Convolutional neural network offers better performance in terms of accuracy(82.14%) and accuracy (78.01%) compared to a ResNet algorithm.

Accuracy is the most essential factor in predicting facial expression recognition. In a study (Song 2021) 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. (Zhong et al. 2020)Based on the person's facial expression in the FER2013 dataset, the photos are categorized as anger, disgust, fear, happiness, sadness, surprise, and neutral expressions.

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. In our study we used the FER2013 database. (Elaiwat 2015)It includes more images and it is the latest dataset and it has labeled images (Mehendale 2020)with their person's expressions and it gives more accuracy when compared with other databases.

The size of the training and testing datasets affects the accuracy of the CNN algorithm (Xue, Mao, and Zhang 2006). The accuracy looks to be better than the ResNet algorithm in our research. However, the mean error in our proposed work appears to be larger, which must be reduced. (Park, Shin, and Kim 2008)Despite the fact that a study's outcomes are superior in both experimental and statistical analysis, the work has significant drawbacks. On larger data sets, accuracy evaluation cannot yield a better result. Furthermore, CNN appears to have a higher average error than ResNet. It would be preferable if the average mistake could be lowered greatly. However, by employing neural network algorithm methodologies, work can be improved in terms of accuracy and mean error. Feature selection algorithms can be used prior to Novel image classification to increase the classification accuracy of classifiers As a result of the feature selection techniques, it is possible to cut calculation time while improving recognition accuracy.

CONCLUSION

A convolutional neural network is an approach for increasing accuracy. The results reveal that the Convolutional neural network (CNN) method outperforms the ResNet algorithm in terms of face expression recognition accuracy. CNN is found to perform much better than ResNet in reliably recognising facial expressions, but the mean error is a little greater than ResNet. As a result, it is concluded that the CNN algorithm produces adequate accuracy when compared to ResNet.

DECLARATIONS

Conflict of interest

In this manuscript, there are no conflicts of interest.

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 ResNet for different iterations.

Iterations	**Accuracy**	
S.no	**CNN**	**ResNet**
1	82.14	78.01
2	82.07	77.99
3	81.98	77.82
4	81.88	77.71
5	81.76	77.51
6	81.53	77.32
7	81.34	77.14
8	81.12	77.02
9	81.02	76.99
10	81.00	76.87

Table 2. Experimental analysis in Colab for accuracy,CNN outperforms ResNet in terms of accuracy (82.14 percent) using mean, Std.Deviation, and Std.Error mean.

	Groups	**N**	**Mean**	**Std.Deviation**	**Std.Error mean**

Accuracy	CNN	10	81.5840	.44192	.13975
Accuracy	ResNet	10	77.4380	.42918	.13572

Table 3. Statistical analysis of the mean, standard deviation, and standard error of the CNN and ResNet algorithms' precision and accuracy. Between algorithms, there is a statistically significant difference in accuracy values. The best accuracy (82.14 percent) was achieved by CNN, while the lowest accuracy was achieved by ResNet (78.01 percent). With (p 0.05), there is a statistically significant difference between the research groups.

		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**	.022	.003	21.283	18	.001	4.14600	.19480	3.73673	4.55527
	Equal variances not assumed			21.283	17.985	.001	4.14600	.19480	3.73671	4.55529

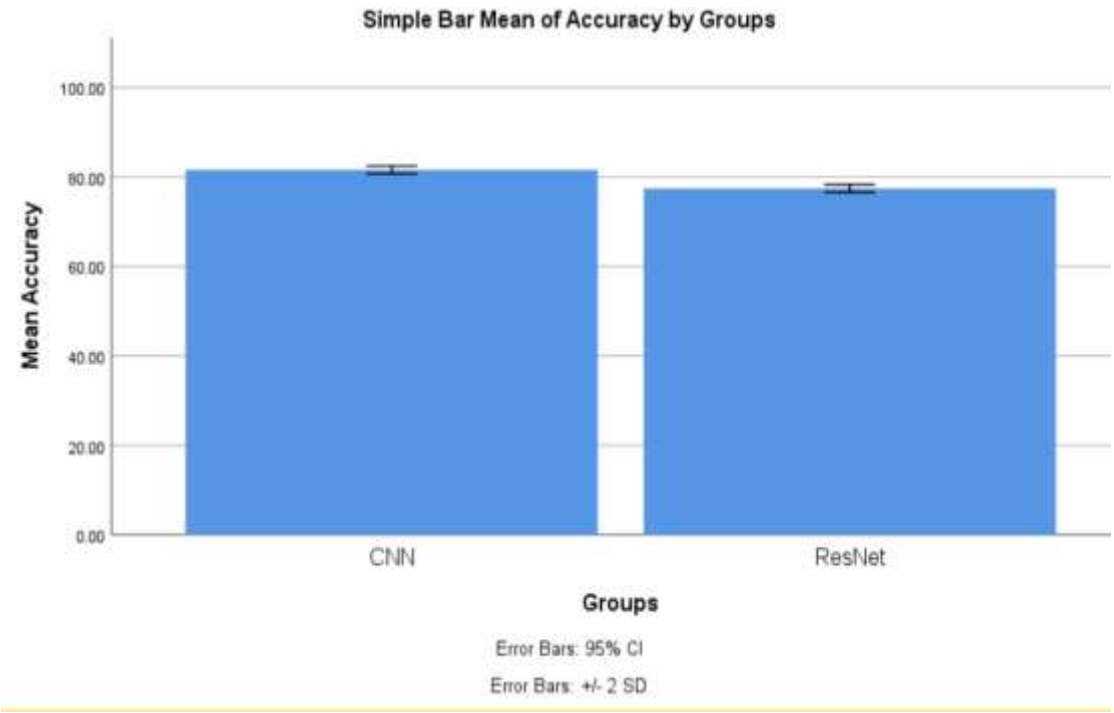

Fig. 1. The Mean Accuracy of CNN and ResNet algorithms is shown by a bar chart. CNN's average accuracy of 82.14 percent appears to be higher than ResNet's 78.01 percent. The X-axis shows CNN and ResNet algorithms, while the Y-axis shows mean accuracy ± 2 SD.