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IJIEMR Transactions, online available on 06th Feb 2023. Link :http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=ISSUE-02

DOI: 10.48047/IJIEMR/V12/ISSUE 02/34

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Volume 12, Issue 02, Pages: 218-223

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Enhanced Face Detection using Convolutional Neural Network Algorithm in comparison with Multi-Task Cascaded Convolutional Neural Network Algorithm

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Abstract
Aim: The study's objective is to create an intelligent system that can distinguish between human faces using the innovative Convolutional Neural Network (CNN) in comparison with the Multi-Task Cascaded Convolutional Neural Network**. Materials and Methods:** To recognise faces utilising an intelligent system, a machine learning technique for face identification that contrasts Cascaded Multi-Task Convolutional Neural Network with new Convolutional Neural Network was already presented and developed. The G Power calculators utilized to estimate the size of the sample which came out to be 319. There are 638 samples used in total, and G Performance is 95%. **Result:** When compared to Multi-Task Cascaded Convolutional Neural Network, the accuracy for face recognition utilising innovative Convolutional Neural Network was at its highest (91.50%), with the lowest mean error at 61.00%, and the significance level at 0.001**. Conclusion**: When it comes to face detection, Convolutional algorithm is more accurate than Cascaded Multi-Task Convolutional Neural Network.

Introduction

Because the roles of the human face and eyes are key point for some applications, such as mental analysis, eye recognition, face recognition and look analysis, and clinical diagnostics, face and eye detection have recently emerged as important research topics in pattern identification and computer vision. (Dinh, Nguyen, and Tran 2018). (Wang, Yang, and Liu 2021). Nevertheless, face and eye identification are highly challenging in many beneficial applications. For these techniques to be used in certifiable applications, the amazing visual fluctuations of appearances, such as occlusions, significant changes in posture, and remarkable brightness, present enormous challenges(Dinh, Nguyen, and Tran 2018). When getting face detection and looks recognition from CNN in light of MTCNN, CNN has likely achieved the highest level of accuracy in both areas (He et al. 2017). The MTCNN framework uses Cascaded CNN model and facial element point prediction. and facial layout (Zhang, Wang, and Chen 2021). The reduction in size of the computational method enhanced the computation's prediction (Lu and Li 2020). The terms "face recognition" and "posture prediction" in the context of computer vision describe the process of identifying all faces in a picture and determining each face's orientation as expressed by 3 orientations points: yaw, pitch, and roll (Madarkar and Sharma 2020). Due to MTCNN's excellent detection rate and ability to distinguish between different human faces under occlusions and diverse lighting situations, it is used as the face detection method (Ma and Wang 2018).

There have been fifteen papers on this topic produced through Google Scholar and Science Direct in the last five years. The literature survey shows the comparison of different machine learning models that give good performance compared to others (Bilgilioğlu and Yılmaz 2021). Even though face detection and posture estimation have both seen

significant advancements, creating a quality system that is robust in complicated contexts and has good continuous performance remains a challenging task. Notwithstanding, most face detection calculations in light of profound learning disregard the harmony between model size and precision. The Viola-Jones calculation could detect favourable and minimal deflection spots in faces (Luh 2014). In any case, complex circumstances, such as the disposition point, light conditions, occlusion, expression, and so on, can easily upset the face when it is in reality. People use their appearances to convey their feelings and are important in facial expressions and body language. People can express their emotions clearly through their facial expressions, and they can also read one other's viewpoints and internal thoughts through facial movements(Sawyer, Williamson, and Young 2012). The approaches that consolidate worldwide and neighbourhood highlights to work on the performance of face recognition. For sure, neighbourhood characteristics and worldwide characteristics have very different properties (Chen, Chen, and Chen 2013).

Convolutional Neural Network, the current approach, performs poorly in discovering the best accuracy for face detection. So, this paper is about the proposed system convolutional neural network that has better performance and accuracy than Multi-Task Cascaded CNN in facial recognition using the shape_predictor_68_face_landmarks.dat file. In contrast to Multi-Task Cascaded Convolutional Neural Network, the objective of this research is to create a unique CNN approach that performs more effectively in terms of accuracy.

Materials and Methods

Multi-Task Cascaded and Convolutional Neural Network utilised for evaluation, Convolutional Neural Networks were used. By setting the threshold to 0.005 and the G Factor to 95%, the sample size was determined using the findings of the prior study.

Convolutional Neural Network (CNN)

An algorithm for deep learning, a convolutional neural network may use an image as input. These "deep learning" algorithms can rank the value of distinct characteristics of an image and distinguish between them. When compared to previous classification algorithms, a convolutional neural network requires substantially less preparation.

Pseudocode:
Input: Trained Data Model and an input image/video
Output: Accuracy

Begin
Convolutional neural system detector initialization.
reading the source file or image and detecting the human face.
When a face is seen draw the bounding boxes and outline the faces with these boxes.
Iterating through the video frames until a human face is found.
Calculate the accuracy.
Return the Accuracy
End for

Multi-Task Cascaded Convolutional Neural Network Algorithm (MTCNN)

MTCNN, is used to recognise faces and other facial characteristics in pictures.

Pseudocode:
Input: Trained Data Model and an input image/video
Output: Accuracy

Begin
Import the required modules.
Create the model.
Input the image/video file and iterate through each frame until a face is found.
If the frame found is a face using a facenet detector.
Then, don't draw a rectangle around it.
Show the result and display the output frame.
Return the Accuracy
End for

The hardware requirements for the testing setup and procedure are an Intel i3 processor, 256GB SSD, and 8Gb of ram. The required software specifications are a Windows OS and Python 3.9(IDLE) for x86 (64-bit architecture).

The dataset used to find the accuracy of face detection is obtained from GitHub website (https://github.com/opencv). The

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work was carried out using a pre-trained face detection model downloaded from OpenCV repository available in GitHub.

For statistical analysis, the research team used the SPSS statistical package. The experimental data were subjected to group statistics and independent sample t-tests, and a graph was created for two groups and two parameters. The Independent Variables used is the pre-trained face detection model dataset and the dependent variables are face detection such as recognizing human face and accuracy.

Results

The Proposed algorithm CNN and the existing algorithm Multi-Task Cascaded CNN were run at a time in Microsoft Visual Studio Code for an approach to recognize face detection. The bar chart represented by Fig. 1 shows the mean accuracy between unique Multi-Task Cascaded Convolutional Network and Neural Network with Convolutions with the error bars. The face detection accuracy of CNN and MTCNN algorithms varies as the sample sets are run through a number of iterations.

Table 1 shows detailed data on accuracy for the Multi-Task Cascaded CNN and their associated algorithms New convolutional neural networks have an accuracy mean of 91.50%, according to group survey results compared to just 61.00% for multi-task cascaded convolutional neural networks. Calculations are done for standard deviation and mean errors (Standard error mean for Convolutional Neural Network is 0.640 and Multi-Task Cascaded Convolutional Neural Network is 0.707).

Table 2 presents an independent test analysis and comparison of the significance level for the CNN and MTCNN algorithms with a value of p = 0.001 and a significance value of 0.312. The results show unequivocally that CNN outperforms Multi-Task Cascaded CNN in terms of performance.

Table 1. Group Statistics outcomes (Mean of Convolutional Neural Network is 91.50 which is greater when compared to Multi-Task Cascaded Convolutional Neural Network Algorithm is 61.00 and Standard error mean for Convolutional Neural Network is 0.640 and Multi-Task Cascaded CNN is 0.707)

		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	0.027	0.312	30.295	8.00	.001	28.900	0.954	26.700	31.100
	Equal variances not assumed			30.295	7.923	.001	28.900	0.954	26.696	31.104

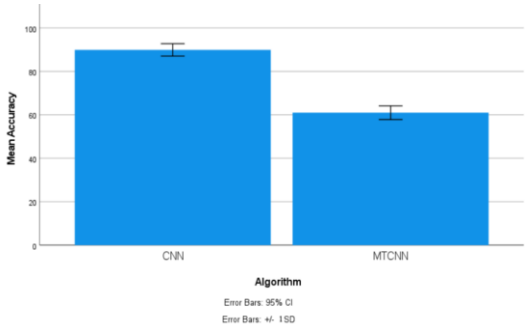
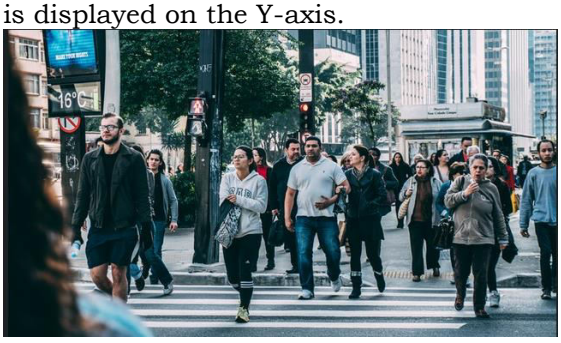


Fig. 1. Convolutional neural network (CNN) and multi-task cascaded convolution neural network techniques' mean accuracy is compared in a bar chart. Convolutional Neural Network (CNN) has a mean accuracy of 91.50%, which is higher than Multi-Task Cascaded Convolutional Neural Network's accuracy of 61.00%. Neural network with convolutions and multi-task cascaded convolutional neural networks (MTCNN) are depicted on the X-axis, and the mean is displayed on the Y-axis.



Input Image – 1

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Output image using CNN

Output image using multi-task cascaded convolutional neutral networks

Input Image -2

Output image using CNN

Output image using multi-task cascaded convolutional neutral networks

Advantages and disadvantages of convolutional neural networks and multi-task cascaded convolutional neural networks

• Convolutional neural networks are particularly suited to processing photos and videos because they can automatically and adaptively learn spatial hierarchies of information from incoming images.

• Multi-task cascaded convolutional neural network can recognise and align faces in an image while also recognising facial landmarks like the eyes, nose, and mouth.

• In contrast to training distinct networks for each job, it may be trained end-to-end using a cascaded architecture, which allows for quicker convergence and better performance.

• The fundamental drawback of CNNs is their need for a lot of labelled training data and computer power to train properly. The computational cost of MTCNN is likewise high.

• Additionally, it is important to note that MTCNN is only intended to be used for the task of facial alignment and detection, hence it is less adaptable than a typical CNN algorithm.

Discussion

Convolutional neural networks and multi-task cascaded convolutional neural networks are the subjects of novel experiments in this publication. According to the results of the performed cutting-edge experiments, the proposed unique Convolutional Neural Network performs better in face detection. The IBM SPSS tool was used to evaluate the data. Data analysis can be done to perform independent sample T-tests and group statistics. In order to improve accuracy, experiments were carried out between the study groups CNN and Multi-Task Cascaded Convolutional Neural Network.

In comparison to CNN Algorithm, Multi-Task Cascaded Convolutional Neural Networks (MTCNN) recently shown excellent performance on concurrently face detection and alignment. The benefit of cascade-based approaches is their runtime effectiveness (Wechsler 2009). It is not advised to use a single CNN with a very great depth to scan the entire image for faces instead of the MTCNN. When using our dataset, MTCNN obtains an accuracy rate of 98%, outperforming other methods for identifying the face and eye in an image (Wechsler 2009; Li 2022). Additionally, this paper includes a study of various techniques for tabulating faces and eyes in films. Higher real-time applications require an improved unique method (Song et al. 2022). Convolutional Neural Network (CNN) experiment is carried out for face detection, and it outperforms other machine learning methods in terms of accuracy (Kong et al. 2018). MTCNN can detect faces and facial landmarks with excellent accuracy on the FDDB benchmark and the AFLW benchmark, respectively (Ranjan, Patel, and Chellappa 2019). The Multi-Task Cascaded Convolutional Neural Network achieves accuracy of only 61.00%, whereas CNN achieves accuracy of 91.50%. CNN is therefore the best for detecting faces.

Although the proposed methodology attained satisfactory results, there are some limitations on Convolutional Neural Network as they cannot be performed on larger data sets. In future Face detection becomes easier as the human computer interaction increases hence the machine learning algorithms are best accurate for face detection.

Conclusion

In this paper two algorithms were used to find better accuracy in face recognition namely, Convolutional Neural Network and Multi-Task Cascaded Convolutional Neural Network. The suggested Convolutional Neural Network has produced findings that algorithm shows greater accuracy of (91.50%) when compared to the Multi-Task Cascaded Convolutional Neural Network(61.00%).

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