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Autism Detection Based on Facial Images Using VGG16 and VGG19

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Abstract: ***A mental disability called autism spectrum disorder exhibits specific difficulties with verbal and nonverbal communication, interpersonal skills, and obsessive activities. Around 1% of the total populace is impacted by it, and its side effects frequently show up during the formative stages, or during the initial two years following birth. Autism can be diagnosed at any stage in once life and is said to be a "behavioural disease" because in the first two years of life symptoms usually appear. There hasn't been a strong diagnosis method, though, because there aren't any discernible variations between the facial images of healthy people and those of people with ASD. Machine learning and Deep learning approaches are being used in conjunction with traditional diagnostic procedures to increase the accuracy and turnaround time for diagnoses. In this study, we are looking to build a deep learning model i.e. A Convolution Neural Network that can classify and detect Autism based on facial images. The algorithm involves several key steps, including data collection, pre-processing, model training, and evaluation. This project explores the potential of using deep learning models, specifically VGG16 and VGG19 convolution neural networks (CNNs), for the detection of ASD based on facial images.***

Keywords: Autism, ASD, Machine learning, Deep learning, CNN, VGG16, VGG19

I. INTRODUCTION

Autism is a mental disorder that is especially common in early childhood. It is a developmental disorder that affects interpersonal communication and relationships. Their names include autism spectrum disorder (ASD). Although the exact cause of autism is unknown, people with autism have behaviours that harm themselves and others. The severity of autism varies from person to person and can be difficult to diagnose. Autism spectrum disorder (ASD) affects more than 1% of children, so it's good to catch the condition early. According to statistics, men are more likely to develop autism spectrum disorder (ASD) than women. Individuals with autism spectrum disorder (ASD) experience abnormalities and social anxiety when viewing images of the external environment. But it is not clear how people see the world from a first-person perspective. One of the most important cognitive processes in humans is the ability to observe important objects in our environment. However, people with autism spectrum disorder have great difficulties with social problems such as face and social environment. ASD affects approximately 5-9% of children. Children with autism face many challenges, including learning disabilities, attention deficits, and psychological problems with thinking, movement, despair, and anxiety. Main symptoms may include decreased vision, unresponsiveness, and poor communication with the caregiver. These symptoms of autism are more evident between 18 and 24 months.



(a) (b)

Figure 1: Sample images from dataset (a) autistic (b) non-autistic

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II. RELATED WORKS

Front. Neurosci., 14 January 2020
Sec. Brain Imaging Methods
Volume 13 – 2019 | https://doi.org/10.3389/fnins.2019.01325

In this paper, they focused on the automated detection of autism spectrum disorder (ASD) using CNN with a brain imaging dataset. They detected ASD patients using the most common resting-state functional magnetic resonance imaging (fMRI) data from a multi-site dataset named the Autism Brain Imaging Exchange (ABIDE). This approach was able to classify ASD and control subjects based on the patterns of functional connectivity. Their proposed model was able to detect ASD correctly with an accuracy of 70.22% using the ABIDE I dataset and the CC400 functional parcellation atlas of the brain. Also, the CNN model developed used fewer parameters than the state-of-art techniques and is hence computationally less intensive.

III. PROPOSED METHOD

A. *Algorithms Used*

1) *Convolution Neural Network (VGG16):* VGG16 (visual geometry group), a convolution neural network (CNN), has been widely employed in various computer vision tasks, including image classification. In the context of autism detection based on facial images, VGG16 presents a robust framework for feature extraction and pattern recognition. As the name suggests, it is a 16-layer deep neural network. It consists of an input layer, convolution layers, pooling layers, fully connected layers and an output layer. VGG16's top layer can recognise up to 1000 distinct image classifications. Our study's main emphasis is the categorization of just two characteristics as autistic or not. As a result, we will reduce the output layer to a single dimension.

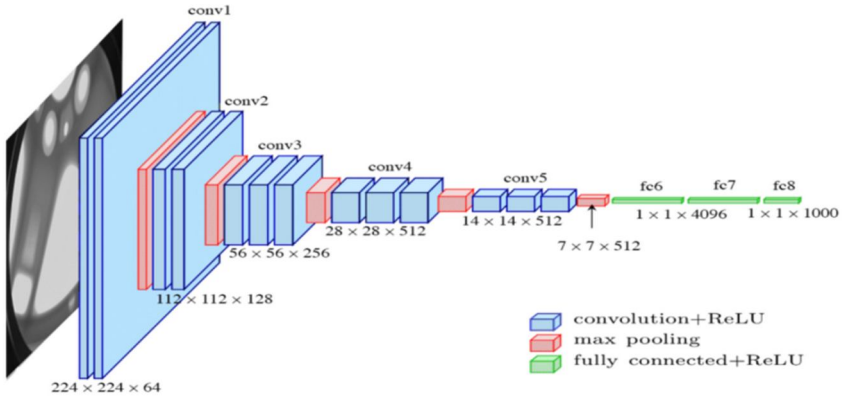


Figure 2: Block Diagram of VGG16

2) *Convolution Neural Network (VGG19):* The VGG-19 model is an improvement over the VGG-16. Convolution neural network model with 19 layers, in which 16 are convolution layers and 3 are fully connected layers. The top layer of VGG16 can identify up to 1000 various picture categories. The model is built by stacking convolutions together, however the diminishing gradient issue limits the model's depth. This issue makes deep convolution networks difficult to train. The model was trained on ImageNet to categorize 1,000 distinct types of objects, like the other models being considered. Though just two variables are employed in our study to determine whether a person is autistic or not. The output layer will then be reduced to a single dimension as a result.

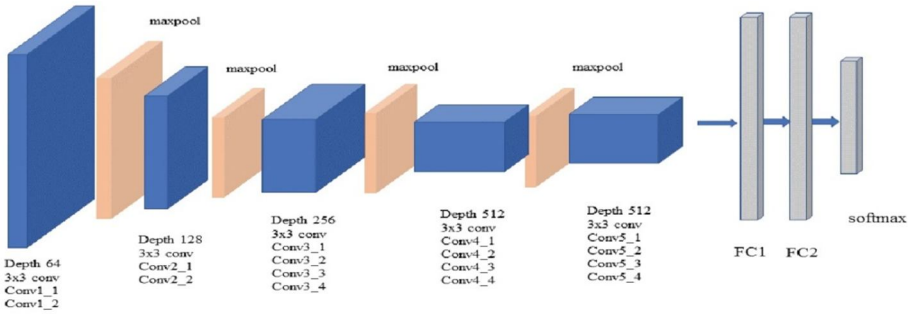


Figure 3: Block Diagram of VGG19

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IV. IMPLEMENTATION DETAILS

For this project, we have used a dataset of facial images from kaggle. The dataset was then divided into training and testing sets. During the training process, the images were classified into different categorical classes based on whether the person had autism or not. The height and width of each image were also displayed during the training process. The dataset has 2450 train images, with 1225 images for each 'Autistic' and 'Non-Autistic' category. Our dataset is well balanced among the 2 classes. We have used VGG16 and VGG19 convolutional neural networks as the base models for our deep learning model. Throughout the training phase, the weights of the VGG16 model were fine-tuned to facilitate the classification of facial images into two distinct categories: autism and non-autism.

V. RESULTS

Evaluation metrics are used to assess how effectively a statistical or machine learning model is functioning. The machine learning models or algorithms employed in each project must be evaluated. A model may be assessed using a variety of different assessment metrics. These consist of measurements such as classification accuracy, logarithmic loss, confusion matrix, and others. A confusion matrix creates a matrix for us and provides a summary of the model's overall performance.

	precision	recall	f1-score	support
0	0.70	0.80	0.75	150
1	0.77	0.66	0.71	150
accuracy			0.73	300
macro avg	0.73	0.73	0.73	300
weighted avg	0.73	0.73	0.73	300

Figure 4: Final results of model based on VGG16

	precision	recall	f1-score	support
0	0.73	0.63	0.67	150
1	0.67	0.77	0.72	150
accuracy			0.70	300
macro avg	0.70	0.70	0.70	300
weighted avg	0.70	0.70	0.70	300

Figure 5: Final results of model based on VGG19

VI. CONCLUSION

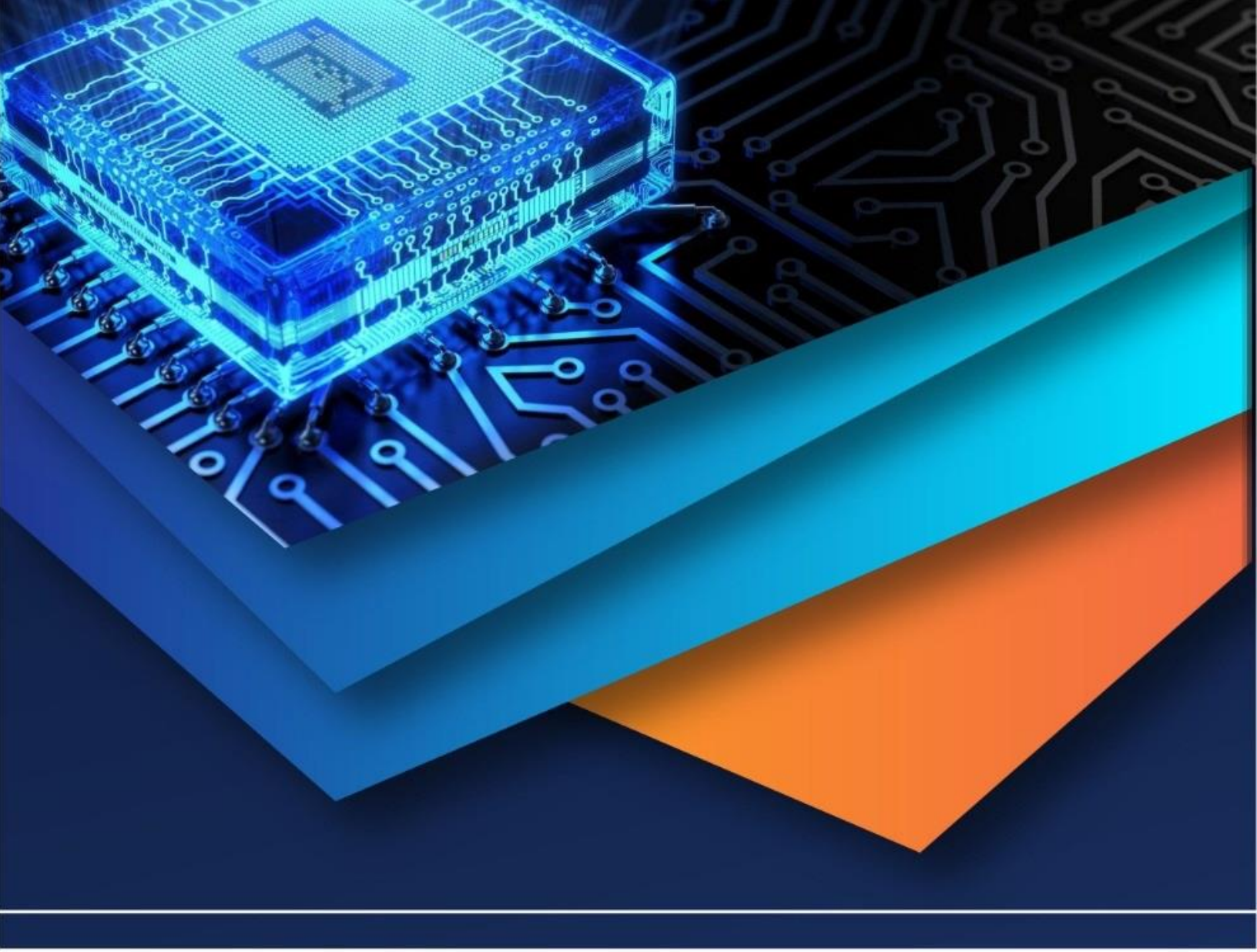
We used both VGG16 and VGG-19 based models in this investigation to divide face image categories into autistic and non-autistic groups. In our study, the VGG16-based model performed better than the VGG19-based model. In this study, we suggested a comprehensive computerized approach for face image-based autism identification. This study used a Convolutional Neural Network with transfer learning to create a deep learning-based online interface for identifying autism. The CNN architecture has the right models to extract the facial landmarks, which can classify faces into autistic and non-autistic types. This is done by producing sequences of facial characteristics and calculating the distance between facial features. Parents and doctors will find it easier to identify autism spectrum disorders in children with the help of this software**.**

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