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(Research Article)

A novel approach for grouping of autism by using convolutional neural network

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Abstract

Autism Spectrum Disorder (ASD) is a complicated neurological disease marked by difficulties in social communication, restricted interests, and repetitive activities. The disorder's spectrum nature reflects its vast range of symptoms, skills, and impairment levels. ASD usually develops in early childhood, often before the age of three, and lasts throughout a person's life. Although the specific etiology of ASD is unknown, it is thought to be a combination of genetic and environmental factors. Early identification and intervention are critical in improving outcomes for people with ASD, allowing them to acquire social, communicative, and adaptive skills. The condition affects each person differently, with some requiring extensive care and others living independently. Research is continuing to better understand the underlying mechanisms and enhance diagnostics. Deep neural networks function well in a variety of applications. In this method, a convolution neural network is proposed to detect young children with ASD at an early age. The photos of Autism spectrum disorder are separated from normal controls using the Convolution Neural Network (CNN) ResNet-50 architecture.

Keywords: Autism spectrum disorder (ASD); Convolutional Neural Network (CNN); Logistic Regression (LR); Residual Network (ResNet50)

1. Introduction

The human brain is the most complex organ, with up to 100 billion neurons and trillions of connections. Although technology has advanced, people are still discovering the mysteries of the brain and are unable to prevent or treat brain diseases such as Autism Spectrum Disorder (ASD), stroke, and so on. Autism spectrum disease (ASD) begins in childhood and causes problems in society, schools, and at work, according to the study of Autism Disabilities Monitoring Network. As a result, it will be difficult to identify and accurately screen children with ASD. Early diagnosis of ASD can be beneficial for youngsters. The entire ASD estimation requires the judgment of an ASD specialist, who are not available in remote locations. Several procedures were developed to determine whether the youngsters had ASD or not. These tools are highly helpful in diagnosing the ASD in earlier stages and screening the efficiency of the ASD treatment. In recent years, deep learning has demonstrated exceptional performance in a wide range of computer vision and image analysis applications. In this paper, a convolution neural network (CNN) is presented to achieve the ASD classification as the first computer program.

The deep learning framework LeNet-5 was utilized to classify MRI images of Autism spectrum disorder vs normal ones. The goal of this method is to launch a deep learning-based framework with ResNet-50 architecture and conduct research on face picture categorization of ASD. This effective deep learning method will give us with insights into the neural pathophysiology of autistic children, as well as aid in the identification of early-stage autism in youngsters. Convolution Neural Network is made up of two essential parts: feature extraction and classification. Feature extraction

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consists of many convolution layers, max-pooling layers, and eventually an activation layer. Classification using only fully connected layers. Dataset for feature extraction. The dataset for feature extraction contains 39 faces in thermal images, including 19. The photos were trained for 1.5 minutes and attained an accuracy of 89.2 percent. Memory limits will be a hurdle when applying the notion with more photographs in a large data set. The greater the quantity of photos, the longer the training period for the acceptable system capabilities work. The objective is to classify instinctually identify young children with possibilities of ASD in premature age. Utilizing the Convolution Neural Network (CNN) ResNet-50 architecture, the images of Autism spectrum disorder is arranged from normal controls. The method exhibit that the effective results for both sensitivity and specificity are acquired.

2. Related work

Yang X, Ling Shyu M, Han - Qi Yu, Nian-Sheng Yin, and Wei Chen., et al. (2019) discovered Integrating image and textual information in human –robot interactions for children with ASD. In this paper, a novel multimodal picture book recommendation framework that combines textual information and image information to calculate the similarity between the picture books and the conversation topics is proposed and evaluated using a testing dataset.

H. Duan, G. Zhai, X. Min, Z. Che, Y. Fang, X. Yang, J. Gut ierrez, et al. (2019) explained Social impairments are characteristic of Autism Spectrum Disorder (ASD) and might result in aberrant visual attention to stimuli. Eye movements encode substantial information about an individual's attention and psychological aspects, which may assist characterize the features of ASD.

Mohd Azfar Miskam, Nur Fareeza S. Masnin, Mohd Hazwan Jamhuri, Syamimi Shamsuddin, Abdul Rahman Omar, Hanafiah Yussof(2014) Encouraging Children with Autism to Improve Social and Communication Skills through the Game-based Approach. he abilities of the humanoid robot NAO in voice and vision detection recognition give a game more attractive and socially assistive human-machine interaction.

The advent of deep learning has revolutionized the field of machine learning, enabling the analysis of complex, high-dimensional data. Acharya et al. (2018) applied Convolutional Neural Networks (CNNs) to electroencephalogram (EEG) data for the detection of mental disorders, achieving superior performance compared to traditional machine learning models.

Rawat W and Wang Z(2017) in Deep convolutional neural networks for image classification: A comprehensive Neural computat ion. In this review, which focuses on the application of CNNs to image classification tasks, we cover their development, from their predecessors up to recent state-of-the-art deep learning systems Lytridis, Chris, et al. (2019) "Social engagement interaction games between children with Autism and humanoid robot NAO. Explained Children with autism are characterized by impairments in communication, social interaction and information processing.

3. Methodology

Neural networks have three main layers: convolution layer, pooling layer, and fully linked layers. The convolutional layer retrieves features from the original input images [1]. In the supplied image, it recognizes the same characteristic at every point. Different types of feature detectors in the layer may extract various types of local features [2]. A feature map is the result of analyzing local features [3]. Once the traits have been identified, the precise position is not as critical. Pooling layers are used to lower the spatial resolution of feature maps and hence the number of parameters in the network [8]. The pooling layer reduces the feature map dimensions in the convolution layer [4]. It has advantages like Resolves Vanishing gradient problem, less error rate and Strengthen feature propagation [9].The residual network is known as ResNet50, and the picture categorization is performed by deep convolution neural networks [5]. Deep networks and classifiers are used to extract low, middle, and high-level features in an end-to-end multi-layer fashion, and the "levels" of features can be upgraded by stacking a number of layers [6]. ResNet-50 is a deep residual network. The "50" refers to how many layers it has. It is a subclass of convolutional neural networks, with ResNet50 most commonly employed for image categorization [11].

3.1. Data acquisition

The video is recorded using a webcam, and the frames are retrieved and processed on a laptop. Following the extraction of the frames, image processing techniques are performed to the 2D pictures [7]. Presently, FER data has been generated [10]. The users were expected to glance at the webcam with varying emotions. The footage was collected for 30 minutes [12]. Following frame extraction, human faces are discovered initially. After training, the classifier is evaluated on labeled data, and the false positive sample feature values are reused for training purposes. The fixed-size window is translated over the test image, and the classifier computes the output at each window location [15]. Finally, the largest value generated is taken as the identified face, and a bounding box is formed around it. This non-maximum suppression step eliminates duplicate and overlapping bounding boxes [13].

3.2. Facial landmark marking

After identifying the face, the following step is to locate various facial features such as the corners of the eyes and mouth, the tip of the nose, and so on. Prior to that, the facial photographs should be normalized to mitigate the effects of distance from the camera, uneven illumination, and changing image resolution [14]. As a result, the facial image is reduced to a width of 500 pixels and converted to grayscale. Following picture normalization, an ensemble of regression trees [11] is used to estimate landmark positions on the face using a sparse selection of pixel intensities [17]. This method uses gradient boosting learning to maximize the sum of square error loss. Different priors are used to identify various structures [16].

3.3. Feature extraction

To apply for FER in video groups, a hybrid deep learning model was used, which included a spatial CNN structure, a global CNN structure, and a deep combination structure [20]. As far as we can tell, this is the first attempt to use a crossover profound learning model to learn video highlights for FER in video arrangements [19]. Without devoting additional time and effort to using deep learning capabilities in the feature extraction process. Because it just requires one pass over the training images, it is very useful if you do not have a GPU. To utilize a network to eliminate learned picture features, which are then used to train a classifier. Convolutional neural networks are used for feature extraction [18].

3.4. Classification

Neural networks have three main layers: convolution layer, pooling layer, and fully linked layers. The convolutional layer retrieves features from the original input images [21]. In the supplied image, it recognizes the same characteristic at every point. Different types of feature detectors in the layer may extract various types of local features [22]. A feature map is the result of analyzing local features. Once the traits have been identified, the precise position is not as critical. Pooling layers are used to lower the spatial resolution of feature maps and hence the number of parameters in the network [23]. The pooling layer reduces the feature map dimensions in the convolution layer. The residual network is referred to as a ResNet50, and the picture classification is done [24].

3.5. Resnet50

The residual network is known as ResNet50, and the picture categorization is performed by deep convolution neural networks. Deep networks and classifiers are used to extract low, middle, and high-level features in an end-to-end multi-layer fashion, and the "levels" of features can be upgraded by stacking a number of layers. ResNet-50 is a deep residual network. The "50" refers to how many layers it has. It is a subtype of convolution neural networks, with ResNet50 being the most widely used for image categorization.

4. System Architecture

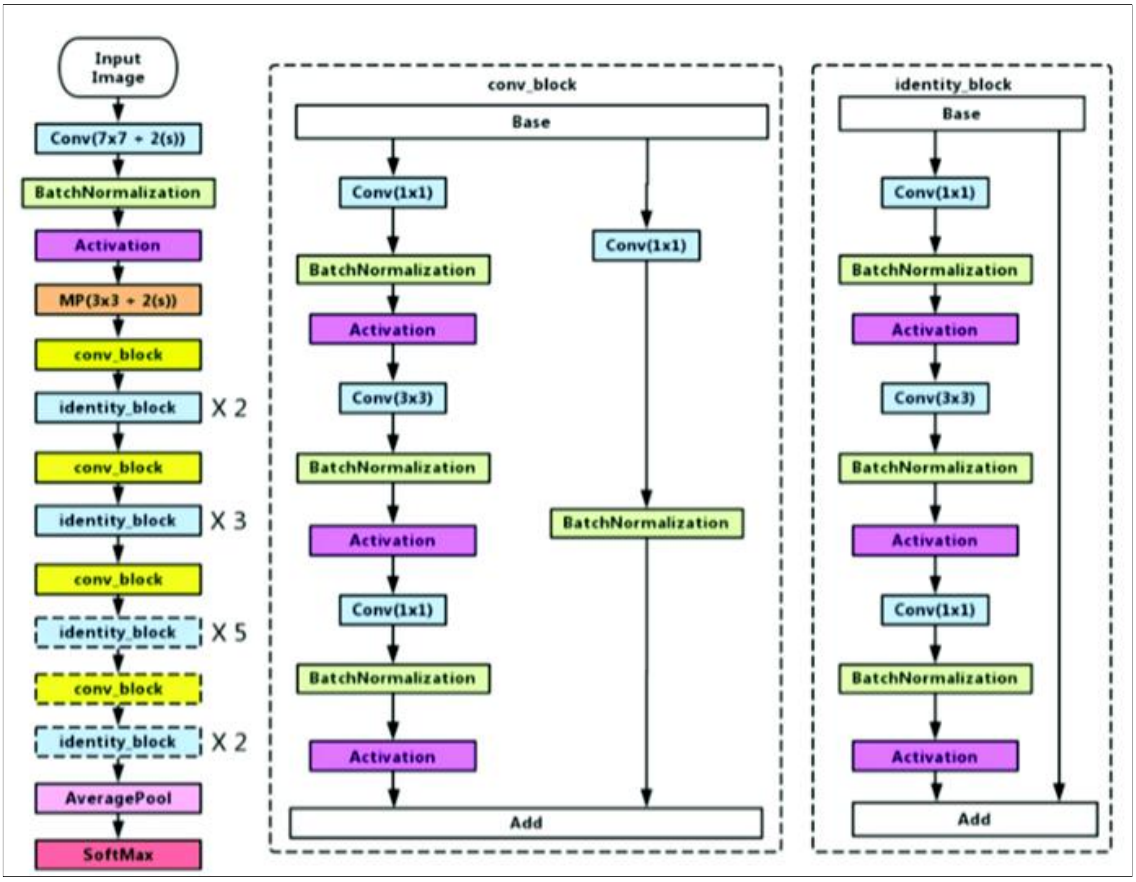

Figure 1 System Architecture

The architecture depicts the classification of image and which finally produces the results.

5. Experimental results

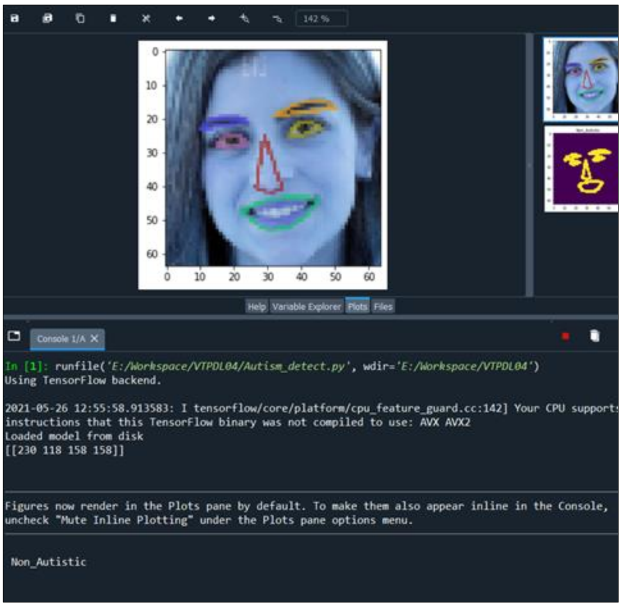

Figure 2 Non Autistic

Figure 3 Non Autistic

Test Case	Test Design	Input Data	Expected Result	Actual Result	Pass	Fail
1	Select the boy Input Image From country 1		AUTISTIC	AUTISTIC	Yes	No
2	Select the girl Input Image From country 1		NON -AUTISTIC	NON -AUTISTIC	Yes	No
3	Select the boy Input Image From country 2		AUTISTIC	AUTISTIC	Yes	No
4	Select the girl Input Image From country 2		NON -AUTISTIC	NON -AUTISTIC	Yes	No

Figure 4 Autistic or Non Autistic

6. Conclusion

The primary focus of this article was on distinguishing children with Autism spectrum disorder from those without it. The implemented method, known as ResNet50, used deep learning to extract the necessary patterns for the classifier. Using the Convolution Neural Network ResNet50 architecture, practical thermal images of ASD were successfully identified from normal controls.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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