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ASD Automatic Detection by Using Yolo V3 and Yolo V4 Method

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***Abstract*— In this paper, we proposed a deep learning model to classify children as healthy or with autism, accurately (MAP = 88%). Autistic children suffer from social skills and repetitive behaviors in communicating with people or the outside world, although autism is often classified as hereditary, autistic patients have facial features, allowing researchers to analyze children's photos to determine whether they have the disease or not. Where the image is translated into words and numbers using YOLO v3, v4. YOLO is one of the modern methods used in detecting things, especially by using convolutional neural networks, which are considered the basis of work especially because of its high speed and accuracy. In this paper, we worked on a data set containing pictures of children with and without autism. This data set contains 2936 number of pictures. After dividing and processing them in terms of intensity of lighting and dimensions, which allows the model to distinguish between images. After training for several times and using the data set, we got good results. were MAP = 88% as an accuracy and current average loss=0.91% and recall=0.85 and F1=0.77.**

Keywords*— *Autism Spectrum Disorder, YOLO, YOLO v3, v4, CNN, Deep learning, Machine learning

I. INTRODUCTION

Communication disorders that occur in the nervous system are called autism spectrum disorders (ASD). It causes many problems, including difficulty in social and intellectual communication, and repetitive behaviours, all of which affect the overall performance of the patient [1][2]. It can also be classified as a developmental disorder, so most symptoms appear in the first or second year of a child's life [3]. Therefore, early detection is an essential and important part of reducing symptoms or controlling them later [4]. There are a number of factors that must be taken into account when classifying autism, the most important of which are:

A. Males are more likely to have autism than females

B. Having a brother or sister with autism

C. Parents may be elderly (mother over 35 years old) or (father over 40 years old)

Genetics are also important in the risk of developing autism [5].

Machine learning and deep learning are used to diagnose disorders not only autism, but also ADHD. This rapid development of algorithms saves a lot of time to obtain the required services.

Here, a model of the convolutional neural network of deep learning CNN will be implemented, especially because this algorithm has the possibility of classifying neurological diseases [6]. We will use the object detection technology called YOLO. This technique detects objects through images or video clips. This algorithm depends in the nature of its work on the principle of regression, that is, it analyzes and predicts the categories in the entire image [7]. YOLO is characterized by the speed of detecting objects or objects, in order to bypass the work of R-CNN in terms of artwork [8]. The classification of the autism spectrum was based on questionnaires previously, and this may be incorrect in most cases, so here we suggest using a set of images of children with and without autism, using CNN deep learning algorithms, and applying object detection technology, which is the best in detecting autism[9][10]. We now have a set of pictures of children with and without autism. There are many features that we have to consider when applying the algorithm, especially with regard to facial features. A child with autism has a wide upper face and wide eyes, and also the middle area is shorter than the face to include the cheeks and nose [11].

II. THEORY

A. Object Detection

A scientific field that contains many disciplines, the main work of which is the processing and understanding of computers, i.e. images and video clips, the possibility of facial recognition, as well as image retrieval [12]. It not only detects the object, but also determines its location. It is used in many areas, including facial recognition systems in mobile phones, as well as traffic lights and car movement, etc. [13].

B. Convolutional Neural Networks (CNN)

One of the deep learning techniques that are used to build models to solve a specific problem similar in its operation to the human brain, it is fed from the front and contains one input and one output layer, and also contains many layers such as the bypass layer, the assembly layer and other connected layers [14]. The convolutional neural network is the important part of the CNN that is used in the model to extract the required features and train the layer on basic features such as edges and lines to then extract squares and features to include the face, eyes and nose [15]. Below, as shown in Figure 1 there is a simple architecture of CNN and its structures.

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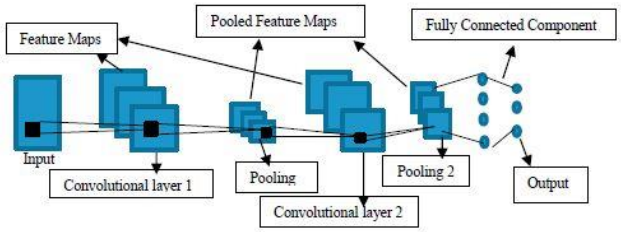

FIG.1. BASIC STRUCTURE OF A CNN MODEL[14]

C. You Only Look Once

This algorithm is used in the field of computer vision, where it can classify objects within the image (dogs, cats, cars, etc.) and also determine the location of the object within the image[7] YOLO. You are only looking at once. A convolutional network is making predictions many times at the same time.

YOLO trains on the full image so that the object is detected directly. The most important characteristic of this algorithm is the speed and accuracy in detecting objects[16]. Figure 2 is a simple architecture of the YOLO structure.

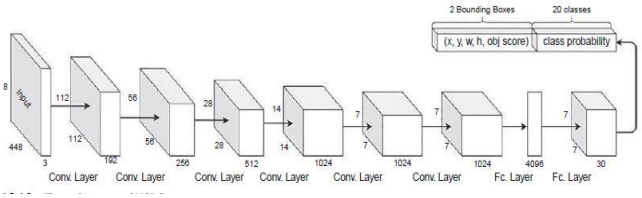

FIG.2. THE ARCHITECTURE OF YOLO[17]

D. Yolov4

This model is used to detect objects. It was developed in 2020 to become more rapid and accurate in its work. Its work depends on the CNN convolutional neural network, where the network divides the image into a number of regions and then predicts the boundary boxes for each region.

YOLO v4, what happens here is the fragmentation of the model that is used in the research into three parts.

- The part of the spine, which is responsible for extracting the features in the input images
- The part of the neck that generates the pyramid of discrimination
- The header part, which is the last and gets its features from the previous part. It also predicts the bounding box area and the category associated with it [10][18].

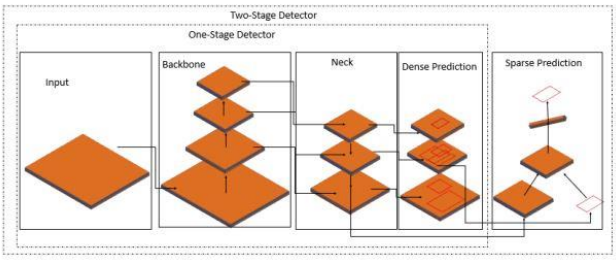

FIG.3. YOLOV4 NETWORK STRUCTURE [19]

III. DESIGN

Children with autism are characterized by special facial features and also the difference between the distance between the features of the face.

Here, we propose a model based on extracting autism through the precise features of the face. The basis of this study is the CNN convolutional neural network and the YOLO algorithm, i.e. object detection.

The most important characteristic of a convolutional neural network is its ability to extract features through CNN layers [20].

FIG.4. SAMPLE INPUT DATA SET

A. Dataset

- *Image Collecting*

In this research, we have used a data set that everyone can use. We obtained it from the Git Hub website. This data consists of 2936 images divided into children with autism and children without autism.

TABLE I. DATASET SPECIFICATION

SPECIFICATION	VALUE
Resolution	1920*1080
Extension	.JPG
Number of Images	2936
Number of class	2
Image size	900-1000 kb

- *Image labelling*

We give each image or category a user name or a so-called(label image)through the (Labelling) program Who draws a square around the object to be discovered and gives five values for this object divided into A value or number for the class and two values X and Y represent the location of the object and the rest of the values are for the size of the object

These values will then be saved to the (XML) folder. As in the Figure 3, this process continues for each image used and for all class.

FIG 5. IMAGE LABELLING USING LABELIMG

B. Model Training and Results

- *Platform*

In the presented study, it is used Windows 11 system, and PyCharm environment, also python 3.7. is used under the Darknet framework, the YOLOv4 algorithm is applied. NVIDIA RTX 3070 graphic card is used to accelerate training and the processor is Ryzen 7 5800H.

- *Training*

The form is used a number of times to get the best results. The model is trained on 2000 times of repetition. More steps of iteration does not mean better results. In the beginning, the training was done directly on the data, but this was not good, so we made some adjustments to the data set In the first training for 1000 times. Of the repetitions, the accuracy was 19% to reach 85%, with a lower loss rate, as shown in the figure below.

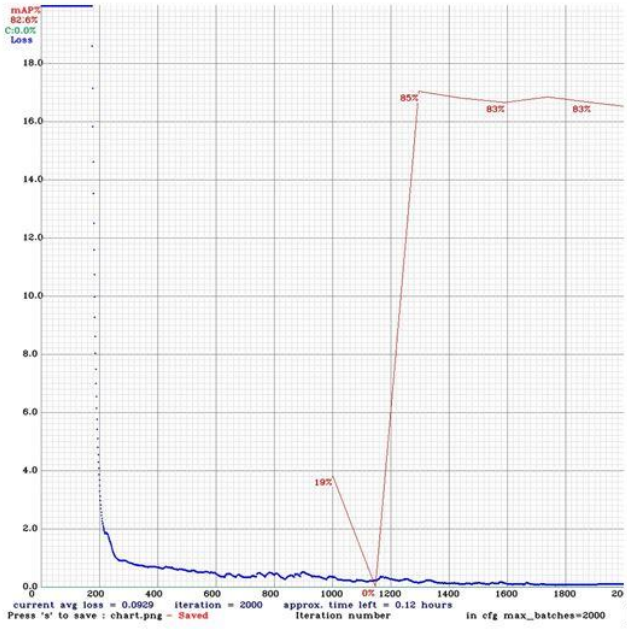

FIG.6. FIRST TRAINING

Then we used Yolo 4 and with the same number of repetitions 2000 times, we will notice an increase in accuracy and a decrease in the average where the accuracy reached 89% and the percentage of the average loss 0.915 as shown in the figure below.

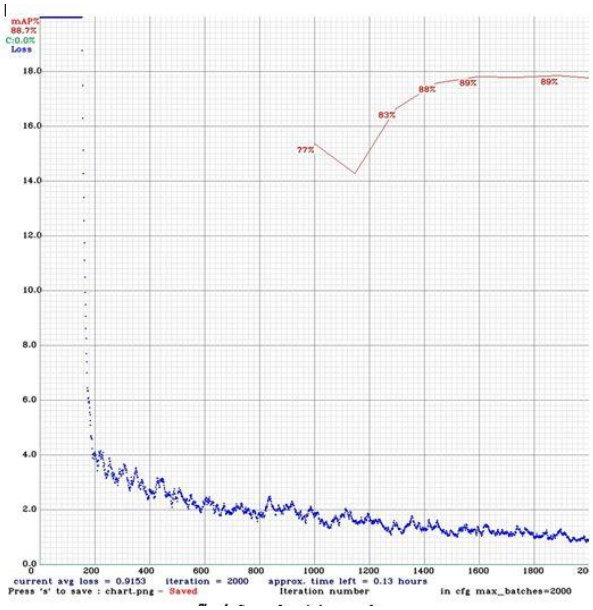

FIG.7. SECOND TRAINING

C. Result

We can say that we have obtained satisfactory results, and the classifier that we trained can be used in diagnosing children with autism, meaning that it was able to identify children's faces and determine the possibility of autism or not.

As in the pictures below, which shows the affected child and the child without autism.

FIG.8. AUTISM CHILD

FIG. 9. NON-AUTISM CHILD

We can summarize the results that appeared to us in the first and second training and display them here through the Table II.

TABLE II. Last Trainings Results

Results	First training	Second training
precision	0.69	0.70
recall	0.88	0.85
F1-Score	0.77	0.77
TP	234	214
FP	106	32
FN	31	39
Average IOU	56.85%	63.90%
MAP	85.19%	85.49%

IV. CONCLUSION

In this research, a model was made to identify children with autism by using a data set of facial images using Yolo v4. The model got 89% MAP As a very good accuracy and average loss 0.91% In the future, we will work on using more data set, and we will also use video clips, and we will also be keen to increase the accuracy of the images used in the data set.

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