

Detailed Comprehensive Study Analysis of Object Detection Using Deep Learning Models – Case Study

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Abstract— This paper Many applications in computer vision they need precise and efficient detection systems. This demand coincides with the rise of the application of deep learning techniques in almost all areas of machine learning and artificial vision. This work presents a study that encompasses different detection systems based on deep learning, providing a unified comparison between different frameworks in order to carry out a technical comparison of the performance measures of the studied methods Many applications in computer vision they need precise and efficient detection systems. This demand coincides with the rise of the application of deep learning techniques in almost all areas of machine learning and artificial vision. This work presents a study that encompasses different detection systems based on deep learning, providing a unified comparison between different frameworks in order to carry out a technical comparison of the performance measures of the studied methods

Keywords: *Object Detection, Computer Vision, OpenCV*

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I. INTRODUCTION

Object detection is one of the most researched computer vision tasks, where Convolutional Neural Networks (CNNs) are currently showing very high performance. CNNs are built from many layers of intrinsically connected neurons in a model inspired by the hierarchical organization of the human cerebral cortex. Neurons act as a basic unit in learning and extracting features from input. The performance of the learning and the extraction of characteristics of the input is improved with the increase of the complexity of the networks which is mainly caused by the depth of the neuron layers. Deep learning techniques or Deep Learning (DL) in general, and particularly CNNs, They are capable of automatically learning, from generic input images, data with multiple levels of abstraction due to the deep architecture that facilitates the model's capture and generalization process of the filtering mechanism by performing convolution operations in the image domain. In the literature you can find many high performance CNNs such as AlexNet [1], VGG [1], GoogleNet [2], ResNet [3], etc. Some like [2], have been shown to exceed the precision of the human eye in certain object recognition tasks. Despite the popularity of other methods, DL-based methods are outperforming other traditional computer vision techniques by a wide margin in terms of precision and sometimes even efficiency [4]. However, the changing state of the DL produced by a lack of unifying works and reviews of the state of the art, make Getting started in this field tedious and difficult to keep up

to date. Consequently, the below are the elaboration about frameworks which is regressively used for object detection. A. Tensor flow Tensorflow is an open source library developed for high performance in numerical computation. It has a flexible architecture and allows easy development fast computing for platforms such as CPUs, GPUs or TPUs. And it's easily scalable which allows it to function from computers to server clusters. It originates from the developers, researchers, and engineers at Google Brain with Google's artificial intelligence organization. This provides great support Strong for Machine Learning and Deep Learning, although the flexibility that this brings Computing is used in many other scientific fields [6]. B. Pytorch Pytorch is an open source library based on the Torch architecture, being thus a scientific computing package based on python, with special emphasis on the use of GPU. Since this library was launched in 2016 by Facebook, many researchers have opted to use it because it provides this ability to perform complex calculations of tensors with great GPU acceleration support and ease of cementing deep neural network of enormous complexity [7]. C. Darknet-YOLO Darknet is a framework developed in C ++ language oriented to the design, training and execution of deep neural networks destined to the detection and classification of objects in 2D images [8]. The main advantages of this system are its simplicity in terms of use, small size, ease of compilation, and clear and concise online documentation. All of them make Darknet-YOLO an easy system to use as

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II. RELATED WORKS

A. Computer Vision Computer Vision is an engineering discipline which is used to obtain Useful information from captured images. The way to do it is by through the use of different techniques to acquire, process, analyze and understand the information that is in an image. [11- 13]. One of the most used attributes in computer vision systems is the detection of objects. the detection by means of characteristics of objects and, more recently, the use of neural networks or systems of learning. Of the three methods mentioned above, the background removal method is the only one that does not require prior training to determine which objects should detect. Next, we will see an overview of the operation of each of the methods, as well as the advantages and disadvantages that each of these present.

B. Object Detection by Background Elimination. This method of object detection is one of the most famous due to the simplicity in which works and because this method is able to detect objects moving precisely. The operation of this method is to provide or generate which is the background of the image to detect, for example, if the camera to be used is static, it is possible to obtain an image of the captured scene that does not contain any of the objects to be detected, otherwise the program must be able to generate and identify which is the background of the image of the objects that move through it. However, this method presents several problems, such as that the program is not able to differentiate between the detected objects, in addition to changes in light and the slightest change on the position of the image may affect the way of detection. [14] [15] [16] differentiate between detected objects, as well as changes in light and the slightest change on the image position may affect the way of detection. [14][15] [16]. C. Object Detection by means of HAAR Classifiers. The detection of objects by means of HAAR classifiers consists mainly in the use of recognition cascades of the HAAR characteristics to learn to detect the edges and corners of a specific type of object. The HAAR characteristics are obtained by using a pair of adjacent rectangular geometric shapes of the same size to obtain the difference in the contrast between both,

this difference is obtained by adding the contrast of each of the pixels contained in each of the rectangles and then simply the difference between the two is obtained. This process is performed on the entire image by moving the used rectangles pixel by pixel and reanalyzing the image by changing the size and shape of the used rectangles, in this way it is possible to detect objects of different sizes and shapes. Finally a filter is applied which limits the minimum value to eliminate the possibility of obtaining noise. [17] [18] [19].



Fig. 1: Example of object detection by background removal

In fig 1, the original image is seen in the upper left before going through the object detection algorithm. In the upper right image the result is shown after comparing the original image with the previously defined image as the background of the image, in this it can be seen that the detector has found several subjects, however one of them is not completely defined, the result of this is the lower right image in which you can see a more defined image of the objects detected and with a significantly lower amount of noise than in the previous images.

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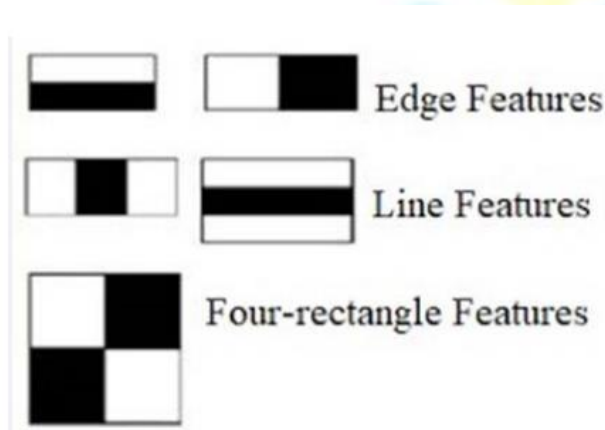


Fig. 2: Examples of HAAR Characteristics

This type of object detector has the advantage that the detection becomes more accurate, in compared to background removal method, because the HAAR method will only identify those objects that you want to detect. The reason for this is that a previous training using hundreds or thousands of images containing only the objects that necessary, which significantly reduces the number of objects that are detected at the time to run the algorithm. However, one of the disadvantages of using this method is in the fact that the use of this algorithm is susceptible to changes in the illumination of the image to be analyzed, since this can cause false detections or that it is incapable of detect objects. This is mainly due to various factors related to the images used during training (quality of the image used, contrast, luminosity, position of the object, among

others) establish which are the patterns that define the most prominent characteristics of each of the object classes and, once obtained these class patterns, use the patterns obtained during training to be able to identify in any other image to see if there is a match between these and the image. [17] [18]. Fig. 3: Recognizing HAAR Features in an Image D. Object Detection using YOLO (You Only Look Once) YOLO is an object detection and classification method which involves the use of convolutional neural networks, or CNN for its acronym in English (Convolutional Neuronal Network), to perform the detection. Compared to other types of methods which use convolutional neural networks, YOLO only requires a single layer neural network, instead of using several layers as in the case of the RCNN (Region with Convolutional Neural Network) system and its derivatives, which makes the operation of this much faster. The operation of YOLO is as follows, each frame of the video is divided into a grid of size $S \times S$, where each of the divided regions is subjected to an analysis to the neural network, where each neuron of the single layer corresponds to each member of the classes in which the system has been previously trained, this in order to know to which class each detected object belongs in each of the cells, how exact the detected classification is and at the same time determines the detection box of each of the objects. [19] [20] [21] [22] [23] [24].

III. BACKGROUND OF STUDY

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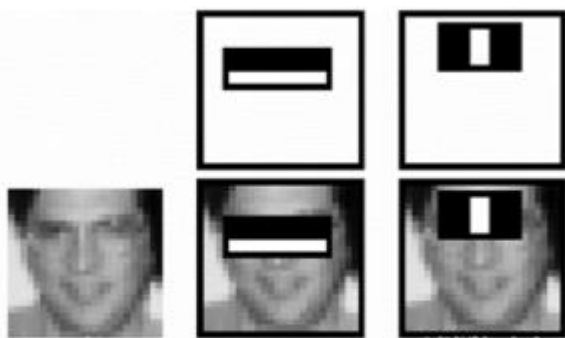


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achieved since the system gives an accuracy value to each detected object which corresponds to the classes with which it finds similarities, so it is possible to reduce the number of detections incorrect when setting the desired accuracy limit value. The disadvantages of this method can be several, one of which involves the training part, since if a training is carried out with a poor image set, the detection is likely to fail, in addition to this, if the number of classes used in the training is very long, this can cause the system to take longer to perform the detection. On the other hand, as the system uses each of the regions in which it is initially divided to perform the detection and the creation of the detection box, if the size of the object is too small

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IV. CONCLUSION

Theoretical considering the existence of various types of neural networks and their use in various professional fields, the systematization and consolidation of theoretical information has been carried out from the necessary approach to be able to design a predictive model for the early detection of various objects and entities using Deep Learning and Computational Vision. Currently there are many investigations for the detection of various objects using neural networks, the present work seeks to obtain the best theoretical / practical knowledge of works already carried out, to obtain the best results and be the basis for future research that can expand the general purpose. Likewise, it is considered that the analyzes carried out based on the images obtained by international and national data sets offer a higher precision index, in order to obtain better results in the early detection of various objects using Computer Vision.

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