Deep convolutional neural network for enhancing traffic sign recognition developed on Yolo V5

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Abstract:	In today's era, deep learning neural networks with multiple hidden layershave been widely used in many fields. The deep learning method hasmore powerful features that enhance the method's performance by alearning process. With the development of the logistics industry and theprevalence of autonomous driving, traffic sign recognition has gainedrising attention. This paper proposes an implementation of a YOLOConvolutional Neural Network (CNN) to solve the problem of traffic signclassification. In the pre-processing stage, we implemented imageenhancement through the MSRCR algorithm to further improve theperformance of the proposed model. As for the improvement stage, weimplemented the automatic classification of traffic signs based onYOLOv5 from the perspective of training methods and network structure.The proposed approach was tested on the standard datasets for thetraffic sign problem (GTSRB, and CCTSDB). Experimental results showthat the proposed YOLOv5 outperforms other approaches with anaccuracy of 99.8% in GTSRB and 98.4% precision in CCTSDB.

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***Abstract*—In today's era, deep learning neural networks with multiple hidden layers have been widely used in many fields. The deep learning method has more powerful features that enhance the method's performance by a learning process. With the development of the logistics industry and the prevalence of autonomous driving, traffic sign recognition has gained rising attention. This paper proposes an implementation of a YOLO Convolutional Neural Network (CNN) to solve the problem of traffic sign classification. In the pre-processing stage, we implemented image enhancement through the MSRCR algorithm to further improve the performance of the proposed model. As for the improvement stage, we implemented the automatic classification of traffic signs based on YOLOv5 from the perspective of training methods and network structure. The proposed approach was tested on the standard datasets for the traffic sign problem (GTSRB, and CCTSDB). Experimental results show that the proposed YOLOv5 outperforms other approaches with an accuracy of 99.8% in GTSRB and 98.4% precision in CCTSDB.**

***Index Terms*—Deep learning, YOLO algorithm, Traffic signs, Object recognition, CNN.**

I. Introduction

THIS As early as the 1960s, researchers have already shown high interest in conducting research in the field of vision-based target inspection. Early researchers achieved robust detection of targets through cascade classifiers, Support Vector Machines (SVM), etc. These models were limited by technology restrictions [1]. Meanwhile, the traditional feature extraction method was not efficient. This could affect the quality of the model which leads to obtaining low-accuracy results. Therefore, the generalization ability of the model is relatively poor, and it is difficult to apply in the industrial and even commercial fields.

In 2006, Geoffrey Hinton and Ruslan Salakhutdinov published an article entitled "Reducing the dimensionality of data with neural networks" in Science [2], which marked the beginning of deep learning [2], [3]. This kind of deep learning neural network with multiple hidden layers has a very powerful feature learning function, which can extract features from the original input data by training the model to have a more abstract and essential representation. This method of training neural networks through deep learning was first applied to the field of speech recognition [4]. Compared with the traditional method, the accuracy, precision, and recall have been greatly improved. The improvement was significant reaching a 20%-30% improvement. Just less than a year later, Convolutional Neural Networks (CNN) have attracted the attention of researchers. This has drawn the interest of Internet giants such as Google and Microsoft who have also invested a significant amount of resources to deploy deep learning.

Transportation is considered an important pillar in the basic industry of a country. At present, with the rapid development of autonomous driving technology and the improvement of living standards, automobiles have become an important means of transportation for people's daily travel. This led to the development of intelligent transportation which received more and more attention [5]. Traffic signs play a vital role in intelligent transportation networks, and these signs show drivers the current traffic conditions of the road segment with words and symbols. Imagine you are driving on a highway and you see a sign that says "Exit 2 Miles". Without knowing the location of the sign, you may not know how much time you have to get off the highway or which lane you need to be in to exit.

However, due to the diversity of traffic signs, as well as the diversity of roads and weather conditions, the problem becomes more challenging. Furthermore, brightness, color, occlusion, and other issues, complicate the problem even further. Traffic lights are usually recorded in small images by occupying a very small part of the picture. In some cases, the weather conditions are very complex due to clouds, rain, sunny and other conditions. On the other hand, images might be blocked by billboards, which has brought considerable difficulties [5], [6]. Recognition of traffic signs through deep learning technology is a very challenging field [4].

At present, most related algorithms are only developed to detect a small number of categories, and it is difficult to overcome the influence of natural environment factors such as nature, lightning, wind, rain, etc. In addition, the quality of the picture captured by the camera is not taken into account, which is seriously inconsistent with the actual situation [7], [8]. Moreover, some algorithms only focus on the classification problem and ignore the problem of predicting the location of traffic signs, which is difficult to apply to industry and even commerce.

This paper conducts a series of empirical analyses on the application of deep learning YOLO (You Only Look Once). We propose the application of YOLOv5 in traffic detection and establish a CNN-based traffic sign recognition model. It also makes corresponding measures to improve the efficiency and accuracy of real-time detection. This research aims to develop a deep learning neural network that can effectively recognize traffic signs. In order to achieve this goal, we have developed a fine-tuned model in GTSRB (German Traffic Sign Recognition Benchmark), CCTSDB (Changsha University of Science and

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