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A Survey on Traffic Object and Signal Detection

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ABSTRACT: Autonomous vehicles play an important role in modern days. As vehicles have become the most convenient modes of transport for most people, it will make the road traffic more and more complex, and people now desire to have automatic driving system which follows the traffic signals and takes care of road safety. These automatic vehicles can also help in reducing contamination, and they give a good fuel efficiency. The traffic object and sign detection have a high industrial potential in automatic vehicles and traffic density prediction. It is the use of vehicle cameras to get the real-time road images, then detect and recognize other vehicles and traffic signs for avoidance of obstacles and prevent any accident. An object detection system uses deep learning for images on road traffic which is accurate and fast will extract the features from the images, and the system detects and recognize the vehicles, traffic signs and signals. The object detection can be done by subtracting the background using the cameras and using the bounding box method for identify the location of the object [9]. This paper gives an overview of the recent advances in traffic object and sign detection approaches with applications for autonomous vehicles.

I.INTRODUCTION

The traffic signs and signals take a crucial part in the road traffic system and their work is to show the content on a particular road that gives driver the nature of the road environment and it ensures safety for everyone when followed. The vehicle should maintain a safe distance from each vehicle on road to avoid collision. Automatic vehicles use traffic object and sign detection models which keep improving and they are becoming more accurate and faster. Traffic Scene Perception (TSP) is the most important transportation system these days. They work on a three-phase environment which is detection, identification and tracking various objects on road. There are various methods to detect traffic signs which are local binary patterns (LPB) and histogram of oriented gradients (HOG) use colours and there are models which are efficient than the older models.

These various approaches are tested with Chinese and German dataset on traffic signs as they are the best available datasets. The vehicle detection is difficult when compared to sign detection as it has different patterns. The main objective of the detection system is to alert the driver of the road traffic conditions [10]. The autonomous driving system is mainly introduced for safe transportation because 90 percent of road accidents happen just because human reckless driving and there will be an improvement in fuel efficiency as automated cars can reduce the use of fuel by 20 percent. As the driverless cars follow the same rules and can find best routes to destination point there will be a decrease in traffic. As the vehicle does the driving on its own, while the vehicle is on move people can do other work and increase productivity.

II.LITERATURE REVIEW

There are multiple methods to detect and recognize the road traffic signs and objects. Wang Canyong [1] has proposed a new and efficient model to detect and identify the traffic signs and signals. This model works under a convolutional network with a new framework of traffic sign detection and identification that works with SSD algorithm which is difficult to extend into a new application of traffic sign detection. It uses deep learning which decreases the time and the training of negative samples in the dataset and the accuracy of SoftMax classifier will also be increased. The proposed model experimented on GTSRB got the latest results. GTSRB dataset contains multiple categories of data for classification and there are different looks for traffic signs around the world. GTSRB has more than 50,000 images with more than 40 classes and is multi-functional classification problem. This model can learn to recognize the text part of the traffic signs and can

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improve on a real-world traffic system. It divides the traffic signs in to two different categories which warns the driver and some signs which gives indication to the driver. It should be improved to integrate this model for automatic vehicles. This model is trained using Caffe which is an open-source framework, a new deep convolutional neural network algorithm is proposed for detecting traffic signs.

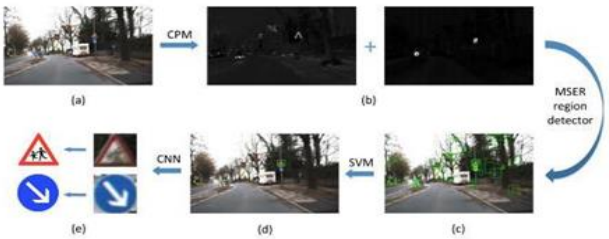

Figure 1: The pipeline of the proposed traffic sign recognition system. (a) Original image. (b)Probability maps (red + blue). (c) Proposals. (d)Detection result. (e) Classification [3]

Liu Wei et al [12] [13] introduced transfer learning to detect and identify the traffic signs and this model is trained on CIFAR-10 dataset. Transfer learning is research based on machine learning. It concentrates on gathering information while solving one problem and uses the information and knowledge to solve a different problem which is related to the first problem. CIFAR-10 is developed by the Canadian Institute for Advanced Research and it contains 60,000 images with 10 classes that contains airplanes, horses and different things. CIFAR-10 has low resolution images which is a benefit for researchers to try algorithms quickly. CIFAR-10 is used to train R-CNN on stop sign object detector.

Figure 2: GTSRB Dataset

To prove the efficiency of transfer learning, the most used dataset German Traffic Sign Detection benchmark (GTSDB) and other datasets are used. GTSDB is a single-image detection problem which contains 900 images dividing them into two categories with 600 training images and 300 images for evaluation. It has three divisions which is perfect for different detection approaches with different characteristics. Here, in this paper the transfer learning is used because the transfer learning algorithm work is based on some pre-trained networks and the learning will be transferred to the newly trained neural network and some adjustments will be made to the weights in order to get more accuracy. The model proposed on this paper can only detect stop signs and can be trained to detect other objects on the road traffic using deep learning.

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Figure 3: CIFAR-10 Dataset

Yi Yang et al [3] [14] details the problem of traffic sign identification. In this paper there are two fast algorithms that detects and classifies the traffic signs respectively. Here, a color probability model is developed to extract the colours from traffic signs and put away the background colours and to decrease time they used SVM and CNN to recognize the traffic signs and they tested it with the CTSD dataset. Support Vector Machines are a supervised machine learning model, it is used for both classification and regression analysis. It uses a hypervisor as a dividing plane between classified and unclassified objects by representing the points in space. They used the color probability model and MSER region detector to get the traffic signs from the model.

Figure 4: GTSDB Dataset

An SVM classifier will be used to take out the negatives and identify the remaining into the model's super classes which depends on the color HOG feature. The model is experimented on the classical dataset of Chinese and German roads and the model proved to achieve the state of art AUC values and the model recognizes the signs with good accuracy. This model's computational power can be improved with a good GPU.

Jing Tao et al [4] [15] proposed a model which works on Optimized YOLO (OYOLO) which is better than YOLO and it is 18% faster. This system has achieved an accuracy of 86.4% and when it is tested with R-FCN it resulted 67.7% which is less when compared. This method uses a new CNN that depends on YOLO and is faster when compared to another object detectors. The two object detection algorithms: YOLO and R- CFN are merged into one to get better accuracy for road traffic images. This model is more efficient with night images as it has been pre-processed.

Meng Wu et al [5] explained how to extract vehicles in motion on road traffic environment. This model is pre-processed to have a good computational efficiency on moving objects. This model needs a huge dataset of vehicle detection to train and when there are small changes in the new dataset the proposed model need not be updated which can work on real-time traffic scenes. In this paper they use Illumination Significance Measure (ISM) of each pixel of the entire picture to determine the object.

Xiong Changzken et al [6] [16] proposed a model based on deep convolutional neural network. By using this algorithm, they detected seven main categories of Chinese traffic signs. This model uses a faster R-CNN to detect and recognize the traffic signs. The model is experimented on real-time traffic and got 99% of accuracy and this can be considered as an over fitted performance by the proposed model. This model can detect the traffic signs in images and videos and generate a

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dataset for traffic signs with simple processing. This model can be improved to get more accurate details and data class of traffic signs automatically.

Qichang Hu et al [7] introduced a model based on fast detection of objects with a common detection framework which detects three classes of objects in road traffic which are important. This model is proposed to improve the Viola Jones framework for objects with a large difference.

It uses an object sub categorization model to increase the performance by representing the variation. This object detector gets the best result with state-of-art detecting models in vehicle detection, sign detection and cyclist detection. This model can improve on information to get vehicle detection in real-time traffic scenes and generate more features in it. Here, we use KITTI dataset. It contains images and text which is more than 100 GB of data. This dataset is mainly used for automatic driving system where the vehicles work with cameras and laser scanners. This type of model is used for faster detection of objects with comparable accuracy and it can be applied for real time traffic to get more features for object detection.

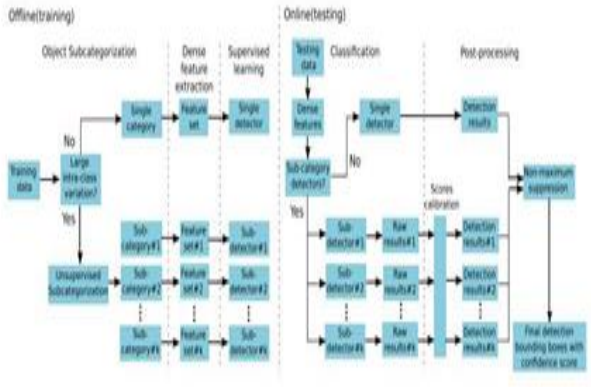

Figure 5: Overview of the proposed detection framework. Left diagram is the training section and right diagram is the testing section. [7]

Shuo Wang et al [17] built a model with region-based deformable fully convolutional neural networks to find 14 types of object classes in the images of traffic surveillance system to recognize cyclists, pedestrians, vehicles and traffic signals. They proposed this model because the cameras at the intersection have limited image processing. They built their model with the help of R-FCN and Deformable ConvNets as its main parts. This model also uses Transfer Learning and uses COCO dataset built by Microsoft. The outcome of this model differed from class to class and vehicles class had a better performance than other classes in the dataset as the other classes have fewer images compared to the vehicles class. The proposed model had bad results as there is a mislabelling in the dataset and the problems in the colours of the traffic signals and the for the feature work the model can be trained on better datasets for better output.

Mohit Bhairav Mahatmas et al [18] [19] proposed a unique method to detect and recognize the traffic signs. Traffic signs are made in a way that it can be easily read by humans and it is a main part for the automatic driving system. The proposed model is designed to perform to tasks that are detecting and recognizing the traffic signs. The algorithm made shows the RGB to Red conversion of the traffic sign images to get the red component and they filters do noise reduction and edge detection of the image for the neural networks for recognizing the traffic signs. The model uses a single layer perceptron neural network and an Indian dataset of traffic signs which is created for this model. In this model the image is taken at starting and pre-processing of the image which is part of the detection phase and they are followed by thresholding, segmentation and recognition. The model is successfully implemented on the MATLAB and it can recognize any number of images given to the system. The testing accuracy of the system is 93.25% and the network needs a time of 829.644 seconds to train on the database given and a test image given is recognized in 0.143 seconds. Because of the segmentation in the process, small amounts of data need to be handled. In the future the model can be used in parallel processing hardware such as GPU, FGPA for real-time usage.

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Julian Balcerek et al [20] proposed two vision systems mainly for improving the urban traffic system. The two systems proposed here uses a camera fixed on the vehicle and gets information from it. The first system detects the traffic signals and when the color changes from red to green the vehicle will start moving without any delay and the second system automatically detects the indicators of the vehicle which is going to change the lane, this information provided will be used for the merge scheme where two lanes are made into one lane. The initial experiment with this model showed high efficiency. Both the models proposed uses the video and convert them into frames and convert RGB colors to HSV (Hue, Saturation and Value) and two systems follow different methods as one system is for recognizing traffic signals and moving the vehicle and other is for detecting the indicators of the vehicle. Initial experiment on the traffic signals of the prepared video database shows that the detection rate is 50% as half of the frames generated the alerts correctly and other half didn't show any alerts and traffic signals maybe detected in them. Initial experiment on the indicator lights with prepared video database has the detection rate of 83.33% and that shows the efficiency is high. The outcome shows that these two methods can be used in the real-time environment and for future work the efficiency of the algorithm can be increased and a stereo camera to be used and extend the video databases.

III. CHALLENGES

The challenges to these present models are that they cannot detect objects in dense traffic in roads and traffic signs cannot be recognized and followed sometimes by the automatic vehicle system. Some of these proposed models are not complete and they can't be integrated into vehicles for automatic driving.

These models may not be able to work in all real-world conditions due to lack of variety in the datasets because there is a change in language on some of the traffic signs and the road conditions might be different and there will be differences in traffic conditions. Due to limited variations in the conditions of the images like light exposure and noise, these models cannot be applied to large scale applications. The traffic signs detection for real-time applications should be able to distinguish between similar traffic signs which is difficult process [8]. Detecting of vehicles in real time requires much larger datasets and training time to ensure better accuracy of the model. These models require more variations for providing better efficiency of the algorithms.

There is lack of computational efficiency which became a challenge for the proposed models to train and a model can only detect the stop signals as it is not trained for detecting other traffic signs. The lack of data for training a model is a challenge because it can't give more accurate result when it is tested. The other challenges faced in the proposed methods are due to the mislabelling of the images in a dataset which led to bad results.

IV.CONCLUSION AND FUTURE WORK

In this paper, we have presented the various methods to solve the problem of traffic object and sign detections that are OYOLO, RGB to RED conversion of traffic signs and detection of signs from video database and other methods. We discussed the latest works on the vehicle automation. The models proposed here are trained with different data sets like CIFAR-10, GTSRB, GTSDB, KITTI and other datasets are used on YOLO, Transfer Learning, Viola Jones and other algorithms for detecting vehicles and traffic signs. These models can be integrated in the automatic driving system and Future enhancements can be done to these proposed models and there will be a good improvement in automatic driving system. The automatic driving system will be helpful to people in many ways and it is mainly created for safety purpose

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