Traffic Sign Classification

REVIEW OF LITERATURE

Machine Intelligence

BACHELOR OF TECHNOLOGY

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REVIEW OF LITERATURE

[1] Ruta, A., Porikli, F., Watanabe, S. et al. In-vehicle camera traffic sign detection and recognition. Machine Vision and Applications **22**, 359–375 (2011). https://doi.org/10.1007/s00138-009-0231-x

In-vehicle camera traffic sign detection and recognition

This research paper sheds light on the models used by them such as Quad-tree RoI extraction, AdaBoost, Haar Cascade of boosting classifiers, and HT. They have also performed confidence weight mean shifts to refining the model's accuracy. They have mentioned the importance of independent object detectors. Further for validation, they have used Sim-Boost to verify similar-looking signboards. As per their conclusion, the Haar cascade had less miss rates than circular HT. But this cost them the pre-processing time to be increased. For further validations, they used the correlation matrix to see if similar-looking signs were wrongly classified but it wasn't as coefficients were too low. Their future enhancements suggest the need to recognize the signs present in non-contrasting backgrounds as that of the signboards.

[2] B. B. Shabarinath and P. Muralidhar, "Convolutional Neural Network based Traffic-Sign Classifier Optimized for Edge Inference," 2020 IEEE REGION 10 CONFERENCE (TENCON), 2020, pp. 420-425, DOI: 10.1109/TENCON50793.2020.9293767.

Convolutional Neural Network based Traffic-Sign Classifier Optimized for Edge Inference

This research paper tests and trained their data set on the German Traffic Sign Detection Benchmark using Google's TensorFlow. As per them their model and optimizations have resulted in less usage of memory. The local Histogram Equalizer technique is implemented to contrast the signs from the background. Their architecture is inspired by VGGNet. The CNN filters used are Re-LU, SoftMax. They have trained for 50 epochs and obtained 99 % accuracy. And via confusion matrix obtained 98% accuracy. Pruning was also applied. Their optimized model obtained 100 % accuracy. As per them, their future scope is to implement the same on the FPGA platform for enhanced results.

[3] F. Boi and L. Gagliardini, "A Support Vector Machines network for traffic sign recognition," The 2011 International Joint Conference on Neural Networks, 2011, pp. 2210-2216, doi: 10.1109/IJCNN.2011.6033503.

A Support Vector Machines network for traffic sign recognition

They have tried to describe an algorithm to solve the problem of Traffic signs. The procedure used – is “Combining the Results and Assigning the Labels”. Processing is done on the images – Image Normalization was implemented with 40X40 size of all images. Then the data set was normalized. The SVM structure is a multi-class SVM using different methods. E.g.: OVA- One Versus All. Also, another well-known – Augmented Binary (AB) was used. They have compared more than 1 SVM to comprehend the reliability of each machine. The classification algorithm used – are the “Hierarchical System Analysis Phase”, “Coherence test Phase”,” Direct Result System Analysis Phase”, and “Combining the results and assigning the Labels”. They have structured the SVM network to reduce misclassifications below 3.11 %. The SVMs with a smaller number of OVA perform better in terms of reliability. Future feasibility- Introduce a few features that focus on the energy analysis of the images. Following the same may result in quality improvement of the system.

[4] P. Garg, D. R. Chowdhury and V. N. More, "Traffic Sign Recognition and Classification Using YOLOv2, Faster RCNN and SSD," 2019 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2019, pp. 1-5, doi: 10.1109/ICCCNT45670.2019.8944491.

Traffic Sign Recognition and Classification Using YOLOv2, Faster RCNN, and SSD

This paper compares “Single Shot Detector (SSD)”, “Faster Region Convolutional Neural Network (Faster RCNN)” and “You Only Look Once (YOLOv2)” deep learning architectures by applying distinct pre-trained Convolutional Neural Network (CNN) models like Pets, Coco, Inception to enhance their performances. This paper claims that modern algorithms use CNN to extract features and Support Vector Machine (SVM) to classify the objects. From this paper, we can infer that SSD, Faster RCNN, and YOLOv2 are trained for 5 different object classes of traffic signs, and their outcomes are evaluated based on standard parameters: mAp (mean Average Precision) and FPS (Frames Per Second). They implemented these architectures on TensorFlow Environment with Anaconda 5.1.0 windows platform and the conclusions are appraised on Tensorboard. The German Traffic Sign dataset was used as it encloses different distortions like sunlight reflections, wind effects, barricades, and occlusions. Architectures as mentioned earlier were trained with 7832 images and 530 images were used for verification objectives. Based on the graph plotted between loss factor and number of iteration loops, it was concluded that SSD lags in accuracy as well as speed when compared with Faster RCNN and YOLOv2. Also, YOLOv2 is 68% faster than Faster RCNN and provides identical accuracy with lesser iteration loops. For determining the speed of the algorithm they have used FPS(Frames Per Second), which describes the number of frames grasped per second at the training time. The final results state that the average mAp of all five classes of SSD, Faster RCNN, and YOLOv2 are 68.35, 74.68, and 77.89 respectively. On an overall comparison, it was concluded that YOLOv2 is faster and more accurate than both Faster RCNN and SSD but in accuracy wise RCNN outperforms YOLOv2. This paper mostly focused on choosing an appropriate model based on the requirements.

[5] M. A. Vincent, V. K. R and S. P. Mathew, "Traffic Sign Classification Using Deep Neural Network," 2020 IEEE Recent Advances in Intelligent Computational Systems (RAICS), 2020, pp. 13-17, doi: 10.1109/RAICS51191.2020.9332474.

Traffic Sign Classification Using Deep Neural Network

The model used is Keras Sequential model (TS CNN model) and it comprises four convolutional layers, two pooling layers, one flatten layer, and four fully connected layers. The methodology implemented by them includes various phases as follows Data pre-processing which further includes Gray Scale conversion, Histogram Equalization, and Normalization. These were performed to improvise the contrast and resolution of images. Later on, Data augmentation was performed which increased no. of instances in training data to prevent overfitting. The dataset used was GTSRB, which consists of 34799 labelled images for the training set, 4410 labelled images for the validation set, and 12630 images for the training set. In Data augmentation, the original image is flipped, rotated, and zoomed. This was carried out by Keras ImageDataGenerator function. Inputted image is reshaped into 32*32*1 size, activation function used – ReLU but for last dense layers softmax was used, optimizer used – Adams and loss function applied is ‘categorical_crossentropy’. Their model underwent 50 epoch. This model has remarkably achieved an accuracy of 98.44% on test data. Further improvements can include the classification of traffic signs with different variants of the CNN model and enhancing accuracy.

[6] R. Kulkarni, S. Dhavalikar and S. Bangar, "Traffic Light Detection and Recognition for Self Driving Cars Using Deep Learning," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-4, doi: 10.1109/ICCUBEA.2018.8697819.

Traffic Light Detection and Recognition for Self Driving Cars Using Deep Learning

This paper mainly focuses on Traffic Light Detection alone. The dataset used by them is Indian-based (specifically Mumbai, Maharashtra). They have manually connected 1237 images of traffic lights using a 16 Megapixel camera which supports an image resolution of 4616 × 3464 pixels. Certain selective frames are used for pre-processing where images were re-sized to 600 x 800 pixels. In total the dataset has 5 classes (i.e red, yellow, straight, left and right) which are manually assigned to each image. This could cause errors in the dataset or results may be wrongly classified due to ignorance in labelling the images in the dataset. The model used by them was Faster R-CNN-Inception-V2 model (transfer learning based pre-trained method). The purpose of them using this model is to eliminate the extensive computational and time resources that are essential in developing neural network models by using pre-trained models. This model was trained on the NVIDIA GEFORCE 940M GPU using TensorFlow. Training duration was for nearly 12 hours which includes 120000 iterations and reported a loss of 0.01. Their ideology was to use transfer learning to improve the accuracy which makes the system reliable for real-time application. Further enhancement to this system can be to optimize the model for safer driving in unclear lane markings and can also be equipped with the ability to respond to spoken commands or hand signals from law enforcement or highway safety employees.

[7] Lightweight deep network for traffic sign classification Jianming Zhang1,2 & Wei Wang1,2 & Chaoquan Lu1,2 & Jin Wang1,2 & Arun Kumar Sangaiah3 Received: 15 December 2018 /Accepted: 18 July 2019 # Institut Mines-Télécom and Springer Nature Switzerland AG 2019

Lightweight deep network for traffic sign classification

This paper presents two lightweight networks for traffic sign classification. In the first model, which is referred to as the “teacher network”, which uses 1×1 convolutional layers and dense connectivity to learn features through parallel channels. Due to its large size of the neural networks involved, many models are difficult to deploy on mobile devices in traffic sign recognition systems. The second model, also referred to as the “student network”, is a simple end-to-end architecture which comprises only six layers. This paper also illustrates that a lightweight network is able to reduce the number of redundant parameters while retaining comparable accuracy. Moreover, they use channels for the student network, which yields a compact model. A lightweight network provides an effective solution for deploying CNN for traffic sign classification in a resource-limited setting.

[8] Saadna, Y., & Behloul, A. (2017). An overview of traffic sign detection and classification methods. International Journal of Multimedia Information Retrieval, 6(3), 193–210. doi:10.1007/s13735-017-0129-8

An overview of traffic sign detection and classification methods

This paper presents an overview of some of the efficient methods in traffic sign detection and classification. The detection methods are localizing regions of interest containing traffic signs, and divide detection methods into three main categories: (1) colour-based (classifies according to the colour space), (2) shape-based(in this approach, they do not solely consider color segmentation as a discriminative feature due to its sensitivity to various factors such as the distance of the target, weather conditions, time of the day, and reflection of the signs, detection of signs is made by the edges of the image analyzed either from structural or comprehensive approaches), and (3) learning-based methods (including deep learning). In addition, they also divide classification methods into two categories: (1) learning methods based on hand-crafted features and (2) deep learning methods. The detection methods have achieved a detection rate range from 90-100%.

[9] Traffic Sign Classification and Detection of Indian Traffic Signs using Deep Learning Manjiri Bichkar, Suyasha Bobhate, Prof. Sonal Chaudhari, doi: https://doi.org/10.32628/CSEIT217325 215

Traffic Sign Classification and Detection of Indian Traffic Signs using Deep Learning

This paper shows a solution to detecting traffic signs on road by classifying the traffic sign images using Convolutional Neural Network (CNN) on the German Traffic Sign Recognition Benchmark (GTSRB) and detecting the images of Indian Traffic Signs using the Indian Dataset. This system helps electric cars or self-driving cars to recognise the traffic signs correctly and efficiently. This system has two parts, (1) detection of traffic signs from the environment and, (2) classification based on CNN thereby recognising the traffic sign. It also involves detecting the traffic sign using BLOB detection and YOLO v3-v4. The Transfer Learning was used for the trained model for detecting Indian traffic sign images. The classification of traffic signs was done using CNN with filters that helped to improve the system by selecting the accurate model with an accuracy of 87% and to train the model using GTSRB dataset and test it with the Indian Dataset. The detection model also uses YOLO and BLOB analysis to detect the traffic signs from the environment and classifies the image according to class.

Contributions:

Shuvam: 1 to 3

Bavanika: 4 to 6

Siddhant: 7 to 9.