Traffic Sign Classification

REVIEW OF LITERATURE

Machine Intelligence

Section H

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REVIEW OF LITERATURE

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- F. Boi and L. Gagliardini, "A Support Vector Machines network for traffic sign recognition," The 2011 International Joint Conference on Neural Networks, 2011, pp. 22102216, 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.

- 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.

- S. Song, Z. Que, J. Hou, S. Du and Y. Song, "An efficient convolutional neural network for small traffic sign detection"

Convolutional neural network for small traffic sign detection

An efficient convolutional neural network for small traffic sign detection. In this paper, researcher focused on issues for small object detection and proposed efficient convolutional neutral network for small traffic sign detection and compared accuracy against R-CNN and Faster R-CNN.CNN model is explained in detail along with forward propagation, back word propagation, loss functions. They increased the number of convolutional kernels per Conv layer from the start and implemented Max-pooling layers with a stride of 2 to down-sample the network in the feature extraction phase. To optimize this model further three strategies used convolution factorization, redundant layer cropping and fully connected transformation. The Tsinghua-Tencent data set is used for evaluation. Proposed model is not only efficient but also consumed less GPU memory and save the computation cost.

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- 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.

- 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 preprocessing 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.

- Vennelakanti, S. Shreya, R. Rajendran, D. Sarkar, D. Muddegowda and P. Hanagal, "Traffic Sign Detection and Recognition using a CNN Ensemble," 2019 IEEE International Conference on Consumer Electronics (ICCE), 2019, pp. 1-4

Traffic Sign Detection and Recognition using a CNN Ensemble

Proposed system in this paper is divided into two modules detection and recognition and it is evaluated on Belgium Data Set and the German Traffic Sign Benchmark. Detection involves capturing images of traffic sign and locating object from image and in recognition stage convolutional neural network ensemble is used which will assign label to detected sign .In first phase Hue Saturation Value(HSV) color space is used instead of RGB because HSV model is more similar to the way human eye process image and it has wide range of colors .After that color based detection and shape based detection is implemented , in color based detection red values of sign are checked if they fall under particular threshold then that part is examined to see if sign is present or not . Douglas Peucker algorithm is then used for shape based detection .Authors focused on only 2 shapes circle and tringle .This algorithm found area from no of edges detected in image and bounding boxes are used to separate ROI .Now sign inside bounding box is validated by applying image thresholding and inversion filter .In the second phase detected sign is classified using feed-forward CNN network with six convolutional layers and As they used ensemble method ,aggregated result of 3 CNN is a final output . They achieved 98.11% accuracy for triangular traffic signs and 99.18% for circles. Two data sets used for evaluation and CNN Ensembles are used to improve accuracy Good accuracy is achieved but only triangular and circular shapes are considered for detection

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- 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 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 BLOB analysis to detect the traffic signs from the environment and classifies the image according to class.

- W. Haque, S. Arefin, A. Shihavuddin and M. Hasan, " lightweight CNN architecture for traffic sign recognition without GPU requirements", Expert Systems with Applications, vol. 168, p. 114481, 2021.

Lightweight CNN architecture for traffic sign recognition

Author focused on Main challenges in detecting traffic signs in real time scenarios includes distortion of images, speed factor, motion effect, noise, faded color of signs. Training only on grayscale images gives average accuracy. So authors proposed DeepThin architecture which is divided into 3 modules input processing, learning, and prediction. Architecture is deep and thin at the same time. Thin because they considered small number of feature maps per layer and deep because 4 layers used. And since they considered small input images, a small number of feature maps, and large convolution strides, it has become possible to train without a GPU. use of overlapping max pooling and sparsely used stride convolution made training faster and reduced overfitting issue. Data augmentation is performed in order to achieve robustness. For augmentation they used operations such as original random shearing of training images, zoomed-in/zoomed-out, horizontally- shifted, vertically-shifted during training. For experimentation German Traffic Sign Recognition Benchmark and Belgian Traffic Sign Classification dataset is used. hyper parameter tuning is done for kernel size and feature map and During training phase CNN model is used with backpropagation learning algorithm, cross-entropy, stochastic gradient descent (SGD) as the optimizer.

- 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.