This is a summary for the research paper titled “Road Sign Recognition System for Autonomous Vehicle using Raspberry Pi”, published in ICACCS, 2019. In this paper, the authors implement road sign detection using Haar Cascade classifier and use the classification results to control the movement of an autonomous vehicle (AV).

The paper starts by bringing the readers’ attention to the importance Advanced Driver Assistance Systems play in road safety. An integral part of such systems is their ability to detect and understand traffic signs on the road to then convey that information to the driver for safety and comfort. To quantify the performance of these systems and their underlying models, the authors prototype a vehicle and experiment with different classification models and hardware, taking note of relevant metrics.

On hardware side, the prototype vehicle is controlled by two DC motors connected to the Raspberry Pi, which acts as the control unit for the whole system. The motors are battery powered. Raspberry Pi has an ARM processor and runs the Raspbian OS. The prototype vehicle is mounted with a web camera to capture road sign images.

The images are passed to the Raspberry Pi which has OpenCV running. OpenCV uses the Haar Cascade classifier to detect and classify road signs in the images. The classifier works using integral image concepts to compute features detected by the Viola Jones algorithm, and then using the Adaboost learning algorithm selects a small number of important features from a larger feature set for producing efficient classifiers.

The model consists of detection and classification stages. The detection module segments captured images and extracts areas containing road signs and then passes it to the classification module. The classification module, previously trained using multiple road sign datasets, is then able to classify the various road signs into their right types and passes that information to the Raspberry Pi which in turn controls the DC motors for movement.

Three different metrics are used in the performance analysis of the Haar Cascade classifier; Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE), and execution time. PSNR is used to determine the quality of compressed images with respect to original images. Higher PSNR values indicate higher quality of reconstructed images. MSE represents the cumulative squared error between the compressed and original images. Lower MSE values indicate lower errors. The classifier is noted as showing excellent performance for images with complex background by the authors. It correctly identifies road signs in multiple angles and sizes. The authors describe the performance of the Haar Cascade classifier as more robust to illumination changes than the method of using color histograms.

Results of the experimentation in the paper, initially carried out using MATLAB software, show that the proposed Haar Cascade Classifier beats the existing Hough Transform Classifiers when comparing PSNR and MSE values acquired over the same images. Execution times were close for both classifiers. The results were mirrored when the researchers repeated the experiments using OpenCV on the Raspberry Pi’s Arm processors. Results showed better execution times and PSNR values compared to using MATLAB.

The authors conclude that GPUs can be used to increase performance of the models and reduce execution times further for the proposed Haar Cascade classifier used for real-time road sign detection and classification.