Robust Lane Detection from Continuous Driving Scenes Using Deep Neural Networks-

Qin Zou, Hanwen Jiang, Qiyu Dai, Yuanhao Yue, Long Chen, and Qian Wang
IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, 2019

In this article a hybrid deep neural network is proposed for lane detection by using multiple continuous driving scene images.
The proposed hybrid deep neural network combines the DCNN and the DRNN.
In a global perspective, the proposed network is a DCNN, which takes multiple frames as an input, and predict the lane of the current frame in a semantic-segmentation manner. A fully convolution DCNN architecture is presented to achieve the segmentation goal. It contains an encoder network and a decoder network, which guarantees that the final output map has the same size as the input image.
A long short-term memory (LSTM) network is employed to handle the time-series of encoded features. The output of DRNN is supposed to have fused the information of the continuous input frames, and is fed into the decoder network of the DCNN to help predict the lanes.

The main contributions of this paper:
1. Fixing the problem in which lane cannot be accurately detected using one single image in the situation of shadow, road mask degradation and vehicle occlusion, a novel method that using continuous driving scene images for lane detection is proposed.
2. Seamlessly integrating the DRNN with DCNN, a novel fusion strategy is presented.
3. Two new datasets are collected for performance evaluation.

EXPERIMENTS AND RESULTS:
1. The model avoided two major errors in predicting lanes:
    a. missing detection, which predicts the true lane objects in the image as the background.
    b. excessive detection, which wrongly predicts other objects in the background as the lanes.

The experiment has shown that our networks achieve these two targets above and defeat other frameworks in visual examination.

the proposed networks show a much more time consumption than the models that process only one single image, such as SegNet and U-Net. However, the proposed methods can be performed online, where the encoder network only need to process the current frame since the previous frames have already been abstracted, the running time will drastically reduce.

Robutness:
In the robustness testing, a brand-new dataset with diverse real driving scenes is used.
The Testset, as introduced in the dataset part, contains 728 images including lanes in rural, urban and highway scenes. This dataset is captured by data recorder at different heights, inside and outside the front windshield, and with different weather conditions. It is a comprehensive and challenging test dataset in which some lanes are hard enough to be detected, even for human eyes.
also show strong adaptation for different camera positions and angles. As shown in Table V, UNetConvLSTM outperforms other methods in terms of precision for all scenes with a large margin of improvement, and achieves highest F1 values in most scenes, which indicates the advantage of the proposed models.

ince UNet-ConvLSTM outperforms SegNet-ConvLSTM in the most situations in the experiments, we recommend UNet-ConvLSTM as a lane detector in general applications. However, when strong interference is required in tunnel or occluded environments, SegNet-ConvLSTM would be a better choice.

conclusions:
Compared with other models, the proposed models showed higher performance with relatively higher precision, recall, and accuracy values. In addition, the proposed models were tested on a dataset with very challenging driving scenes to check the robustness. The results showed that the proposed models can stably detect the lanes in diverse situations and can well avoid false recognitions.

What we can derive from this article:
As we can see the model that was proposed was more successful compared to the other models mentioned in the article which are used to identify the Lane lines, we can use this model in our ADAS application to detect lanes with fast end to end network.

Link to article: https://arxiv.org/pdf/1903.02193.pdf
Link to github: github
Date Of reading: 07/01/2021