The Literature Review of SLDNet

Zhanke Zhou*, Ruiqi Li*, Yayu Gao(✉), Chengwei Zhang and Xiaojun Hei
Huazhong University of Science and Technology, Wuhan, China
{zhankezhou, rlee, yayugao, zhangcw, heixj}@hust.edu.cn

***Abstract*—Solid line driving is known as one of the major driving violations in China. In our work, we proposed a branched, spatio-temporal convolution neural network (SLDNet) to recognize these violations acts from photographs captured by surveillance camera and trained it on Pingxiang solid-line-driving dataset. SLDNet can achieve 0.92 in accuracy and 0.91 in recall, which both outperform the current human review. Our method will be implemented in smart traffic systems in Pingxiang city, Jiangxi Province in near future.**

I. INTRODUCTION

A vast number of traffic accidents happened every year in China. To maintain road traffic order and prevent these traffic accidents, the law of China on road traffic safety has specified a number of forbidden driving behaviors of vehicles, one of which is known as solid line driving. In the past few years, more and more surveillance cameras are set up in city transportation systems, to monitor road traffic status. These cameras capture images of vehicles with suspicious violation, and send these images to the traffic control center for policemen to review, while in practice it is hard to review these suspicious violation image manually. Thus it is necessary to design a method to recognize solid line driving violation from image information captured by camera. We design a branched deep learning network integrating different neural network architectures to solve this question, and achieve 91% in accuracy with 92% in recall. Our algorithm pipeline is shown in *Fig. 2* and will practically come into service in near future. Full paper of SLDNet can by accessed in [10].

II. PROBLEM DESCRIPTION

Discussion above indicates that it is necessary to design an accurate and steady method to decide whether an image captured by surveillance camera contained solid line driving vehicle or not, and our work use deep learning method to design such an algorithm. *Fig. 1* shows a typical positive labeled image in Pingxiang solid-line-driving dataset, captured by surveillance cameras of Pingxiang city, Jiangxi province. An image in dataset contains four photographs. The photo in bottom right is a zoom-in of suspicious vehicle, and the rest three photo form a time sequence. To our knowledge, the general idea for solving the problem is that the location of vehicle and lane line should be detected. Specifically, we addressed the problem by determining which pixels composed vehicle and which pixel composed lane line in the image. Combining the location information of both vehicle and lane line, it could be inferred that whether the vehicle is violating or not.

Fig. 1 Original Image from Dataset

III. RELATED WORK

To our acknowledgement, [1] proposed a solid line driving detection system using feature points detection in 2013, when deep learning technology have not dominated computer vision area. In the rest of this section the existing studies of deep learning method that solving image classification problem and semantic segmentation problem for vehicle and lane line will be overviewed.

Image classification task is considered as one of the fundamental challenges in computer vision area, the goal of which is to determine which category an image belongs to. [2] firstly introduced convolution neural network (CNN) in image classification task and obtain state-of-the-art result at that time. [3] expanded the depth of such CNN, and [4] solved problems of training such deep neural network to some extent.

Another elementary task in computer vision is the image segmentation task. [5] build a fully convolutional neural network that take input of arbitrary size and produce correspondingly-sized output, while showing that convolutional networks trained end-to-end, pixels-to-pixels can improve the result of semantic segmentation. [6] extend [7] by adding a branch for predicting an object mask and achieve significant result on instance level segmentation. In our work, the pipeline of [6] is adopted in generating the mask of vehicle.

Nowadays lane line detection is treated as a special case of semantic segmentation problem mainly for two reasons. Firstly, lane annotation has a long and narrow shape. Secondly, the lane pixels annotation is sparser comparing to general object semantic segmentation. Such form of data raise challenge for detection task. [8] try to enhance the learning of such sparse label by importing transfer learning and self attention method. [9] cast the lane detection problem as an instance segmenta-

* *indicates equal contributions.*
✉ *indicates corresponding authors.*

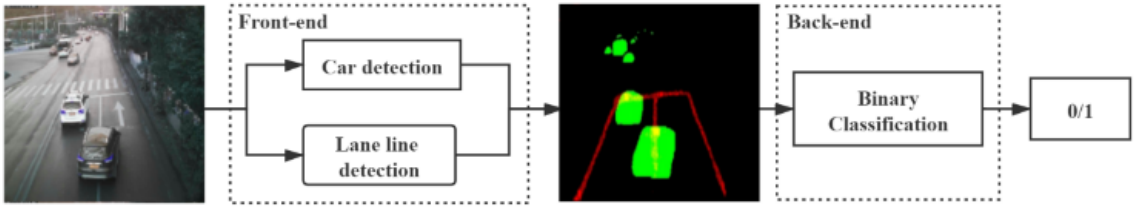

Fig. 2 Pipeline of the proposed SLDNet

tion problem and achieve competitive results with an inference speed of 50 fps, and is adopted in the lane detection branch of our work.

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