COMP790-58 Project Proposal

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1 Goal

- To produce a synchronized dataset of top-down view and front-rear view camera images of a moving vehicle.
- To annotate the dataset automatically.
- To train a CNN to detect lane changes using front view cameras. (Future Work)

2 Introduction

Lane changing and car merging are two of the the major causes of traffic accident [1]. In order to detect lane changing of other vehicles, that would affect a car, researchers has been mostly relying on simulation[2], RADAR [3] or a combination of RADAR and cameras [4]. There are also other works that detects the driver's intention to switch lanes [5].

In most of these works, one major concern to address is regarding false alarm. False alarm would cause users tend to neglect the system when true danger occurs. Humans drivers can determine whether or not a car is attempting to lane change and whether or not it's going to affect himself/herself or not. However, state-of-the-art approaches detecting other vehicles that attempt to change lane are still not reliable, and strongly relying on combination of multiple sensors. The cost of the autonomous system would increase significantly when multiple sensors are embedded.

Deep learning approaches has been showing promising results in the Computer Vision community in object detection, semantic understanding, image classification, etc. [6] proposed an end-to-end deep network to guide a car to drive on an unmanned area, and followed the road successfully. The training input in this work is the front-view camera images and the steering view angle of the driver. However, using cameras to track other vehicle's trajectory is not a trivial task.

In order to train a CNN to learn to sound alarm when there is a car affecting the user, sufficient number of annotated videos are required. There exist datasets [7, 8] that has annotated vehicles, but they are front-view cameras, which cannot capture the movements of cars behind. Federal Highway

Administration of the United States published a top-view real traffic dataset but annotations are not provided. Tracking cars in top views are a easier task. [9, 10] use a background subtraction algorithm to track the cars, [11] uses corner features, and [9] uses probabilistic features. These approaches can reliably track the cars in a top-view image.

3 Proposed approach

Current front/rear view datasets are manually annotated, and there are no reliable automatic annotating methods available. If one can collect a dataset of a moving vehicle that includes a synchronized view of both top-down and front-rear view camera images, the reliable top-down tracking approaches can be applied to annotate the top-down set of image. By figuring out the transformation between the top-down camera and front/rear view camera, the front/rear camera can be annotated automatically. The annotate can include both the location of tracked vehicle in the image and the 3D location of these vehicle with respect to the user's car.

With the annotated dataset, one can use the labeled front/rear camera images to feed into the CNN and output a alarm score to determine whether or not there is another car attempting to change lane and affecting the user. Another approach can also be investigated: first train a CNN to convert front/rear images to a set of trajectories of tracking vehicles, and use this set of trajectories to train an alarm system.

4 Milestones

Oct 20: Study existing approaches and select a top-view tracking algorithm and a dataset to perform training
Nov 3: Implement the selected approach to track cars in top-view
Nov 17: Investigate the results and propose approaches to improve it
Dec 1: Design an algorithm to synchronize top-view and front/rear images
Dec 8: Compile the results into a report

References

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