Object Detection Under Rainy Conditions for Autonomous Vehicles: A Review of State-of-the-Art and Emerging Techniques

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Motivation: Object detection is the task of detecting instances of objects of a certain class within an image. The state-of-the-art methods can be categorized into two main types: one-stage and two-stage methods. One-stage methods prioritize inference speed, and example models include YOLO, SSD and RetinaNet. Two-stage methods prioritize detection accuracy, and example models include Faster R-CNN, Mask R-CNN and Cascade R-CNN.

However, object detection methods' performance could degrade significantly in challenging weather scenarios, including rainy conditions. Despite major advancements in the development of deraining approaches, the impact of rain on object detection has largely been understudied, especially in the context of autonomous driving.

Model/Method: Faster R-CNN and YOLO.

Use: This paper proposes-

- To survey and present a tutorial that describes the influence of rainy conditions on an autonomous vehicle's ability to detect objects.

- Includes surveying and analyzing the performance of object detection methods trained and tested using visual data captured under clear and rainy conditions.

- Briefly describe the underlying architectures for Faster R-CNN and YOLO as representatives of two major classes of object detection algorithms.

Drawbacks:

- There were a few limitations of the surveyed techniques in handling and mitigating the impact of rain for visuals captured by moving vehicles.
- The generative models should have played a crucial role in training object detection methods to be more robust and resilient in challenging conditions(Examples: different sizes and shapes of raindrops, flow of rain etc).

- There should have novel deep-learning architectures and solutions that have adequate capacity for handling object detection under diverse conditions.

Future Scope:

- We can work on other challenging weather scenarios such as fog, snow, haze etc.
- After making a few changes it can be worked on moving vehicles without any limitations.
- Other detection models can be used for better accuracy.

Keyword :

Faster R-CNN

Faster R-CNN is arguably the most popular of the object detection algorithms that are based on a two-stage deep learning architecture; one stage is for identifying region proposals (RPs), and the second is for refining and assigning class probabilities for the corresponding regions.

RPN(Region Proposal Network)

The main goal of RPN is to predict the offsets of anchor boxes to obtain final bounding boxes.

YOLO

YOLO stands for You Only Look Once. It is the integration of the entire object detection and classification process in a single network.