**Real time Object Detection and Tracking in Autonomous Vehicle**

**Abstract:**

This paper presents a comparative analysis of advanced object detection algorithms within the context of autonomous driving systems. The study integrates a custom-built Region Proposal Network (RPN) and Fast R-CNN model with the well-known YOLO (You Only Look Once) model, evaluating their performance in real-time object detection tasks. The RPN framework is designed to generate high-quality object proposals by leveraging convolutional layers, regression, and classification components, while the Fast R-CNN refines these proposals and performs object classification and bounding box regression using fully connected layers and Region of Interest (RoI) pooling. In contrast, YOLOv8, a state-of-the-art object detection model, performs end-to-end object detection by predicting bounding boxes and class labels directly from the input image. The evaluation highlights the modular and adaptable nature of the RPN-Fast R-CNN pipeline, which benefits from its ability to operate under varied sensor configurations and handle individual sensor failures effectively. YOLOv8 is assessed for its real-time performance, offering a comparison in terms of speed and accuracy. Results indicate that while the RPN-Fast R-CNN combination provides flexibility and robustness, YOLOv8 achieves an accuracy of 95.2%, offering superior real-time detection capabilities. The study underscores the strengths and trade-offs between modular object detection frameworks and unified end-to-end models.

**Keywords:** Autonomous driving, Fast R-CNN, , Modular framework, Object detection, Real-time detection, Region Proposal Network (RPN), Sensor fusion, YOLOv8.

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