

Advancements in Object Detection: From Traditional Methods to Deep Learning-Based Approaches

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Abstract: Object detection, a fundamental task in computer vision, has witnessed significant advancements over the past few decades. This paper provides a comprehensive review of the evolution of object detection techniques, from traditional methods to modern deep learning-based approaches. Traditional methods, such as Haar cascades and Histogram of Oriented Gradients (HOG), laid the groundwork for object detection by leveraging handcrafted features. However, the advent of deep learning has revolutionized the field, with Convolutional Neural Networks (CNNs) and architectures like Faster R-CNN, YOLO (You Only Look Once), and SSD (Single Shot Detector) achieving state-of-the-art performance. This paper explores the methodologies, techniques, and comparative analysis of these approaches, highlighting their strengths and limitations. Additionally, we discuss the applications of object detection in various domains, including autonomous driving, surveillance, and medical imaging. Finally, we outline future research directions, emphasizing the need for more efficient, robust, and interpretable models.

Keywords: Object Detection, Deep Learning, Convolutional Neural Networks, Faster R-CNN, YOLO, SSD, Traditional Methods, Computer Vision