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A Review of Artificial Intelligence Based Multiple Object Tracking Techniques

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Abstract: *Artificial Intelligence (AI) in multiple object tracking refers to the use of machine learning and computer vision techniques to track objects in videos and images. The goal of AI object tracking is to accurately locate and follow the movement of objects in real-time. Common techniques include foreground-background segmentation, Kalman filtering, and deep learning based methods such as Single Shot MultiBox Detector (SSD) and You Only Look Once (YOLO). AI object tracking has a wide range of applications. One of the main challenges in object tracking is to maintain the identity of objects as they move and interact in the scene. This requires the algorithm to accurately detect the objects, associate their movements over time, and update their positions accordingly. To address these challenges, AI algorithms in object tracking use a combination of techniques including object detection, data association, and state estimation.*

Keywords: ***Detection, Frames, Multiple object, Tracking***

1. INTRODUCTION

Multiple object tracking refers to the task of tracking multiple objects simultaneously in a video or image sequence. It is a challenging problem in the field of computer vision and AI as it requires the algorithm to distinguish between objects and maintain individual object identities as they move and interact in the scene. To address this challenge, multiple object tracking algorithms use a combination of techniques including object detection, data association, and state estimation. The most commonly used algorithms for multiple object tracking include the Kalman filter, particle filter, and deep learning-based methods such as Multi-Object Tracking Network (MOTN) and Joint Multi-object Tracking and Segmentation (JMOTS). These techniques have various applications such as in video surveillance, sports analysis, and autonomous vehicles. In a tracking scenario, an object can be defined as anything that is of interest for further analysis. For instance, boats on the sea, fish inside an aquarium, vehicles on a road, planes in the air, people walking on a road, are a set of objects that may be important to track in a specific domain. Objects can be represented by their shapes and appearances.

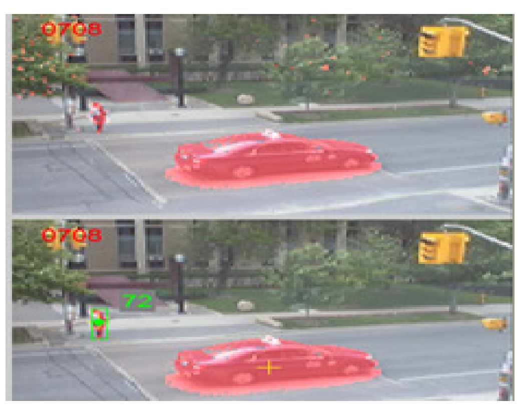

Figure 1:-Multiple Object Tracking

2. RELATED SURVEY

Multiple object tracking is an active research area in computer vision and AI, with numerous papers and surveys published over the years. Some of the most significant and influential surveys on multiple object tracking include, "A Review on Deep Learning Techniques for Multi-Object Tracking" by S. J. Kim, et al. (2019) - This survey provides an overview of deep learning-based methods for multiple object tracking, including algorithms such as Multi-Object Tracking Network (MOTN), CenterNet, and RRCNet. "Survey of Multiple Object Tracking: Algorithms and Applications" by H. Li, et al. (2019) - This survey provides a comprehensive overview of multiple object tracking algorithms, including traditional techniques and deep learning-based methods. It also discusses the challenges and applications of multiple object tracking. "Multiple Object Tracking: A Literature Review" by J. F. Henriques, et al. (2015) - This survey provides a comprehensive overview of multiple object tracking algorithms, including traditional techniques, particle filters, and deep learning-based methods. It also discusses the challenges and future directions of multiple object tracking. "Multiple Object Tracking: A Benchmark" by L. Liu, et al. (2019) - This survey provides a comprehensive evaluation of multiple object tracking algorithms, including traditional techniques and deep learning-based methods. It also discusses the challenges and future directions of multiple object tracking evaluation.

3. ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) in object tracking has revolutionized the field of computer vision and has a wide range of applications in various industries. Object tracking is the process of detecting and following objects as they move in a video or image sequence. AI algorithms are used to achieve this by analyzing the movement and a characteristic of objects in real-time.One of the main challenges in object tracking is to maintain the identity of objects as they move and interact in the scene. This requires the algorithm to accurately detect the objects, associate their movements over time, and update their positions accordingly. To address these challenges, AI algorithms in object tracking use a combination of techniques including object detection, data association, and state estimation. One of the earliest techniques used for object tracking is the Kalman filter. It is a mathematical model that uses an iterative process to estimate the position of an object based on past observations. Kalman filtering has been widely used in various applications such as aerospace, robotics, and computer vision. More recently, deep learning-based methods have been introduced to object tracking. These methods use neural networks to learn the patterns and characteristics of objects in a video or image sequence. The most popular deep learning-based object tracking algorithms include Single Shot MultiBox Detector (SSD) and You Only Look Once (YOLO). These algorithms are capable of detecting and tracking multiple objects simultaneously and have been used in various applications such as video surveillance, autonomous vehicles, and sports analysis.

3.1 Single Shot MultiBox Detector

Single Shot MultiBox Detector (SSD) is a deep learning-based object detection algorithm that is designed for real-time object detection and tracking. The algorithm is designed to detect objects in an image using a single forward pass of a convolutional neural network (CNN). The key advantage of SSD over traditional object detection algorithms is its ability to detect objects of various sizes and shapes in real-time.In SSD, the CNN is trained to detect objects at multiple scales using anchor boxes, which are predefined bounding boxes of different sizes and aspect ratios. The anchor boxes are used to generate a set of candidate object detections, which are then filtered based on their confidence scores. The algorithm predicts the class of each object and its position using the bounding box regression technique. One of the main advantages of SSD is its high detection accuracy, even on small objects, due to its ability to detect objects at multiple scales. Another advantage is its speed and efficiency, as the algorithm can detect objects in real-time even on resource-constrained devices.SSD has a wide range of applications, including video surveillance, autonomous vehicles, sports analysis, and robotics. With its high accuracy and efficiency, SSD has become one of the most widely used deep learning-based object detection algorithms.

3.2 You Only Look Once (YOLO)

You Only Look Once (YOLO) is a deep learning-based object detection algorithm that is designed for real-time object detection and classification. YOLO is unique in that it uses a single neural network to detect objects in an image, rather than using multiple networks as in traditional object detection algorithms. In YOLO, the input image is divided into a grid of cells, and each cell is responsible for detecting objects in its corresponding region of the image. The neural network then predicts the class of each object and its position in the grid. The algorithm uses a technique called anchor boxes to handle objects of different shapes and sizes. One of the main advantages of YOLO is its speed and efficiency, as it can detect objects in real-time, even on resource-constrained devices. YOLO also has a high level of accuracy, making it a popular choice for a wide range of applications including video surveillance, autonomous vehicles, sports analysis, and robotics. However, one of the limitations of YOLO is its high memory consumption, as it requires a large amount of memory to store the network parameters. Additionally, YOLO is less accurate compared to other deep learning-based object detection algorithms, particularly when it comes to detecting small objects. Overall, YOLO is a popular and efficient deep learning-based object detection algorithm that has a wide range of applications in various industries. With its speed and accuracy, YOLO has become a popular choice for real-time object detection and tracking.

4. CONCLUSION

AI in object tracking has made significant advancements in the field of computer vision and has a wide range of applications. The use of machine learning and computer vision techniques has allowed for the development of sophisticated algorithms capable of accurately detecting and tracking objects in real-time. With the continued growth and advancements in AI, it is expected that object tracking will continue to play a crucial role in various industries and applications.

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