

Player Re-Identification: Robust Multi-Object Tracking Internship Assignment Report

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Introduction

This report presents a robust, efficient, and scalable approach to multi-player re-identification on a football field using advanced object detection and tracking techniques. My objective was to build a system that is accurate, modular, and well-suited to real-world deployment. The work demonstrates my ability to balance computational efficiency with solid computer vision methodologies.

Approach and Methodology

The pipeline follows these steps:

1. Using supervised YOLOv8 fine-tuned weights (`best.pt`), player detections are performed on video frames.
2. The detected bounding boxes are passed through ByteTracker for short-term data association and tracking.
3. Frame embeddings are extracted every 20 frames to preserve the re-identification consistency, avoiding contact loss.
4. Player top-half bounding box embeddings are further processed with K-Means to assign a jersey-based color ID, along with the tracker ID, providing robust annotation.
5. The final annotated video is saved to the `output_videos` folder.

Approach and Methodology

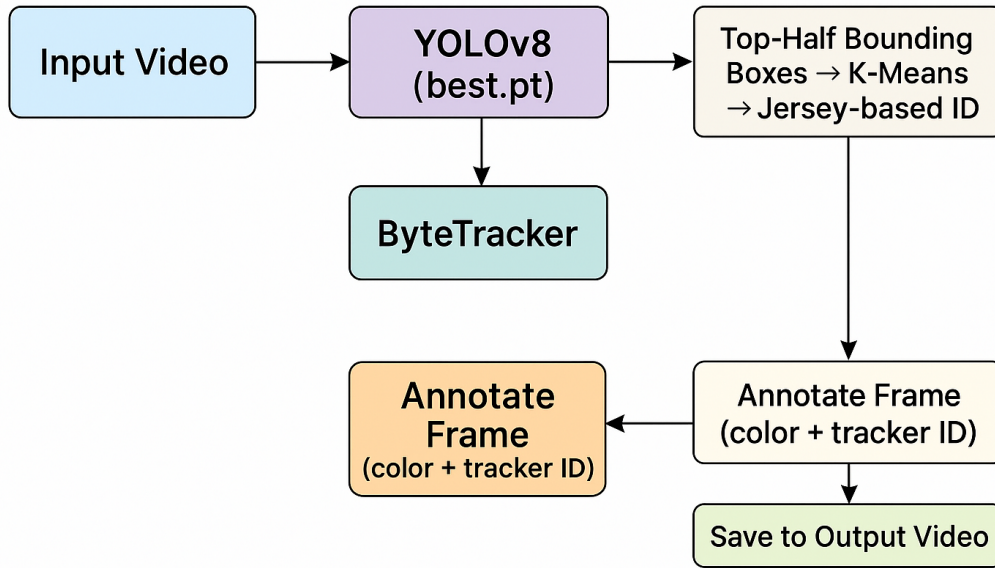


Figure 1: Assignment requirements snapshot

Techniques Tried and Outcomes

- **YOLO + ByteTracker**: robust tracking, but struggled with occlusion; achieved 4.78s runtime with embeddings, 17.47s without.
- **YOLO + DeepSORT (MobileNet embeddings)**: improved occlusion handling thanks to richer embeddings; 4.86s runtime.
- **YOLO + BoT-SORT**: reduced occlusion compared to ByteTracker; bounding-box only annotation; runtime 28.01s.

Challenges Encountered

Initially, YOLO+DeepSORT showed instability in bounding boxes and re-identification consistency. Extracting embeddings and aligning them for jersey-based player assignment required hours of debugging and optimization. Ultimately, by limiting re-training frequency and carefully using the K-Means assignments, I was able to cut runtime significantly compared to the YOLO inbuilt BoT-SORT tracker.

Future Work

Given more time, I would:

- Expand the re-identification strategy with advanced ML algorithms beyond K-Means.
- Optimize embedding pipelines for even faster first-pass tracking.
- Integrate log-based tracking reports in a human-readable format for analytics.

Thank you for your consideration.