

# Player Re-identification & Tracking Report

## 1. Approach and Methodology

The objective of the project was to track football players consistently in a 15-second 720p video using object detection (YOLOv8) and Deep SORT-based tracking. The YOLO model was first used to detect players in each frame. These detections were then passed to the Deep SORT tracker which assigns IDs and maintains them over time.

To ensure tracking stability and identity consistency, several enhancements were made:

- A track quality evaluation metric was developed using confidence, size stability, motion consistency, and duration.
- Clean display IDs were assigned to confirmed tracks to avoid cluttered and changing IDs.
- Motion validation was done using heuristics like speed, acceleration, and consistency.
- False positives were filtered by comparing overlapping low-quality tracks with better ones.

## 2. Techniques Tried and Their Outcomes

- Initial YOLO + Deep SORT integration led to poor detection filtering. Many players were not detected properly.
- Added bounding box filtering based on area and aspect ratio to reduce noise.
- Developed a track quality scoring mechanism to differentiate between clean and noisy tracks.
- Repeated model testing with different thresholds for motion validation and confidence stabilization.
- Introduced track state management (tentative, confirmed, stable) to better control ID assignment.

Outcome: The tracker performs significantly better now, identifying most players consistently. Still, in some frames, re-identification fails or noise affects output, especially in crowded scenes.

## 3. Challenges Encountered

- Compatibility issues with PyTorch and other libraries required version-specific installations (torch==2.5.1).
- YOLO detections were not very reliable initially; tuning the confidence, area, and aspect ratio thresholds helped.
- Tracks were often lost or wrongly merged; handling of speed and acceleration was added to reduce this.
- Maintaining consistent IDs over time was tricky; required developing a quality-based ID mapping.
- High-quality tracks still sometimes get overridden due to temporary occlusion or noise.

## **4. Future Improvements**

While the tracking is usable, some limitations remain:

- Some confirmed tracks disappear and are replaced, affecting ID consistency.
- Further improvements could include appearance-based re-identification or temporal smoothing techniques.
- Incorporating better embedding models or fine-tuned re-ID models for sport videos can improve robustness.
- More rigorous false positive filtering logic and better handling of occlusions can help boost accuracy.