Player Tracking Report

Approach & Methodology

The goal was to detect and uniquely identify players in a 15-second video clip using object detection, then track them consistently even if they leave and re-enter the frame. To achieve this, we followed a two-step pipeline:

1. Player Detection:

- Used a custom fine-tuned YOLOv11 model from Ultralytics, trained specifically to detect players and the ball. The model was loaded from pretrained weights in 'best.pt'.

2. Player Re-Identification & Tracking:

- Implemented a lightweight Centroid Tracker to assign and persist unique IDs based on spatial proximity of detected centroids.

Techniques & Their Outcomes

Technique: YOLOv11 (Ultralytics, fine-tuned)

Description: Used to detect bounding boxes of players and ball in each frame

Outcome: Accurate detection of both classes with real-time speed

Technique: Centroid Tracking

Description: Assigned and updated IDs based on centroid proximity

Outcome: IDs remained consistent even when players re-entered

Technique: Bounding Box + ID Overlay

Description: Drew bounding boxes with assigned ID labels on each frame

Outcome: Enabled visual verification of consistent tracking

Challenges Faced

- Re-identification Accuracy: Without appearance-based features, ID assignment relies purely on position, which can fail if players cross paths.

- Multiple Close Objects: When players are close or overlapping, the tracker may mismatch identities.

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- No Embedding or Deep Sort: Due to resource constraints, heavier trackers like Deep SORT were avoided.

Incomplete or Possible Enhancements

- Replace CentroidTracker with Deep SORT or StrongSORT for robust tracking using ReID embeddings.

- Fine-tune YOLO model further to differentiate between teams or player roles.

- Improve assignment logic using IoU and appearance vectors.

- Add trajectory smoothing and visualization (lines/arrows for each ID path).

Current Status

- Successfully detects and tracks players.

- Maintains consistent IDs even with brief occlusions or exits.

- Exported final video with annotated bounding boxes and IDs.