Project Report: Player Re-Identification and Tracking in Football Matches

Objective

To develop a computer vision pipeline that can detect, track, and re-identify football players in a video even when occlusions or temporary exits occur using a combination of detection, tracking, and appearance-based re-identification.

Approach

1. Detection: YOLOv5

- Used a custom-trained YOLOv5 model (trained on a football dataset) for detecting:

  - Players (class 2)

  - Ball

  - Referees

  - Goalkeepers

- Outcome: Detected players with reasonable accuracy and bounding box precision.

- Confidence thresholding (≥ 0.6) helped reduce false positives.

2. Tracking: SORT

- Integrated Simple Online Realtime Tracking (SORT) using IOU-based matching.

- Maintains unique IDs across frames.

- Outcome: Worked well for short-term tracking with limited occlusion.

- IDs reset when players exited/re-entered the frame (limitation of basic SORT).

3. Re-Identification Module

- Implemented a lightweight ReID system using deep feature embeddings (CNN-based).

- Compared appearance features (e.g., color histograms, CNN features) to assign consistent IDs even after occlusions.

- Outcome: Partial success; early version works well on clear frames but can fail under heavy occlusion or similar jersey colors.

Challenges Encountered

- **Multiple detections**: Model sometimes detected duplicate or ghost players — handled by thresholding + NMS tweaks.

- **ID switching**: Basic SORT fails during re-entry; solved partially with appearance-based re-identification.

- **Heavy occlusions**: Still a limitation. Multi-camera setups or stronger temporal smoothing required.

- **Large model files**

- **Inference inconsistencies**: Some model outputs varied on different environments (fixed with consistent torch/yolo versions).

Current Status

- Detection and Tracking working reliably.

- ReID module integrated with partial functionality.

- Outputs can be saved and displayed.

What Remains

If given more time and resources, the next steps would be:

- Replace SORT with DeepSORT for better re-identification using cosine distance & Kalman Filter smoothing.

- Train a dedicated ReID model on player datasets for more robust appearance matching.

- Add a proper GUI for easier testing and demo.

Conclusion

This project lays the groundwork for player re-identification in sports analytics. While challenges like occlusions and re-entry remain complex, the current pipeline successfully demonstrates real-time tracking and ID consistency within single-camera setups.