# Player Re-Identification in Sports Footage

## Project Overview:

This project addresses **Option 2: Player Re-Identification in a Single Feed**, aiming to track and re-identify players throughout a sports video using a combination of object detection and appearance-based tracking.

We developed a modular, efficient system combining a YOLOv8-based player detector with a StrongSORT tracker enhanced by a custom-trained Re-Identification (ReID) model.

## Approach and Methodology :

### 1. Player Detection – YOLOv8

- We trained a custom YOLOv8 model (best2.pt) on annotated player bounding boxes to perform robust person detection.
- YOLO detects players frame-by-frame and outputs bounding boxes with class and confidence scores.

### 2. Player Re-Identification – StrongSORT + Custom ReID

- We integrated **StrongSORT** for multi-object tracking.
- A lightweight ReID model using the **OSNet_x0_25** backbone was trained on person re-ID data.
- The ReID model extracts visual features for each detected player, which are used to assign consistent track IDs.

### 3. Integration and Output

- Each frame is processed by YOLO and then fed into StrongSORT for tracking.
- Final annotated video with bounding boxes and player IDs is generated and saved to disk.

We trained a custom ReID model on the DukeMTMC-reID dataset using a ResNet18 backbone and integrated it into StrongSORT to enhance appearance-based matching. The player detection was done using a trained YOLOv8 model (best2.pt).

## WorkFlow :

1. Detect players frame-by-frame using YOLOv8.
2. Extract appearance embeddings via the trained ReID model.
3. StrongSORT combines motion (Kalman filter) and appearance for robust ID assignment.
4. Annotated video with bounding boxes and player IDs is generated

## Techniques Tried and Their Outcomes :

| Technique | Purpose | Outcome |
| --- | --- | --- |
| YOLOv8 | Fast and accurate object detection | Achieved reliable player detection in varied poses and occlusions. |
| StrongSORT | Appearance + motionbased tracking | Provided high tracking accuracy with minimal ID switches. |
| Custom ReID Training | Improve identity consistency | Successfully maintained unique IDs for players across frames. |
| Progress Bar (tqdm) | UX improvement | Helped visualize processing status in terminal. |

## Challenges Encountered :

1.  **ReID Model Integration**

    Initially faced errors due to model naming. The library requires model filenames like osnet_x0_25.pt to infer architecture.

    Solved by renaming our trained model to match the expected format.

2. **False Positives and Track Drift**

    Detected non-players in early YOLO versions; improved via dataset curation and model retraining.

    Track IDs occasionally switched under heavy occlusion; mitigated with fine-tuning ReID model and StrongSORT parameters.

3. **Compatibility Issues with Boxmot**

    **model_type** parameter caused crashes in newer boxmot versions. Avoided by adhering to naming conventions instead.

## Incompleteness & Future Improvements

The core system is functional and tested, but the following improvements could be made with more time:

- **Temporal smoothing / Kalman tuning** for more stable bounding boxes.
- **Multiple camera feed support** for cross-view ReID.
- **Real-time inference** using model optimization and TensorRT.
- **Dashboard / Web UI** for better visualization and monitoring.

## Reproducibility

- All required source code, weights, and configuration files are included.
- Clear setup instructions are documented in README.md.
- Output video is auto-generated and saved under **option2_single_feed/output/.**

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