

Player Re-Identification – Mini Project Report

Name: Ayati Sonkar\ Email: ayati16j2003@gmail.com\ Date: 28th June,2025

Objective

To develop a real-time player re-identification system using a 15-second broadcast soccer video. The goal is to consistently assign unique IDs to players, even as they leave and re-enter the frame.

Tools & Technologies

- **Language:** Python 3.9
 - **Libraries:** PyTorch, Torchvision, OpenCV, scikit-learn, Ultralytics YOLO
 - **Model:** Custom YOLOv11 weights for object detection
 - **Feature Extractor:** ResNet18 (ImageNet pretrained)
-

Approach & Methodology

Step-by-Step Pipeline

1. **Detection (YOLOv11):** Used a custom-trained YOLOv11 model to detect all players in each frame. The model was fine-tuned to identify players, referees, and balls.
 2. **Class Filtering:** Only objects labeled as `player` (class ID = 0) were processed further to eliminate referees and the ball.
 3. **Preprocessing:** Detected bounding boxes of players were cropped and resized to a fixed shape (128x64), and normalized using standard ImageNet statistics.
 4. **Embedding Extraction (ResNet18):** Each player crop was passed through a pretrained ResNet18 (with the classification head removed) to extract a high-dimensional feature vector (embedding).
 5. **Similarity Matching:** Cosine similarity was computed between the current frame's embeddings and all stored embeddings in a player database.
 6. **Re-identification:** If a match exceeded a similarity threshold of 0.75, the same player ID was assigned; otherwise, a new ID was issued.
 7. **Output Generation:** The final output video included bounding boxes and unique IDs rendered on each detected player, frame by frame.
-

Techniques Tried & Outcomes

Technique 1: YOLOv11 + Raw ResNet18 Features (Final Version)

- Simple but effective.
- Achieved correct identity retention across most frames.
- IDs were mostly consistent even when players briefly exited the frame.

Technique 2: YOLOv11 + Euclidean Distance (Alternative Similarity Metric)

- Attempted but produced less consistent results than cosine similarity.
- Euclidean distance was more sensitive to illumination and scale variations.

Technique 3: ResNet34 (Heavier Backbone)

- Tried as an alternative to ResNet18.
- Increased computation time significantly with little accuracy gain.
- Eventually reverted to ResNet18.

Challenges Encountered

1. High Inference Time on CPU

2. YOLOv11 and ResNet18 both require significant computation, leading to ~1s/frame.

3. Real-time performance not achievable without GPU acceleration.

4. ID Switching for Visually Similar Players

5. Cosine similarity is sometimes insufficient when multiple players look alike (e.g., same jersey color).

6. No temporal smoothing causes instability during occlusions.

7. Referee/Ball Misclassification

8. The model occasionally detects referees or the ball as players.

9. Required manual class filtering in code (using class ID).

10. Input Video Format Issues

11. Certain video codecs weren't compatible with OpenCV's default `cv2.VideoCapture()`.

12. Required conversion to MP4 (H.264) in some cases.

Improvements

- Integrate DeepSORT or a Kalman filter for smoother tracking and temporal consistency.
 - Utilize a GPU for significant speed-up in both detection and feature extraction.
 - Fine-tune ResNet on domain-specific soccer player crops for higher embedding precision.
 - Incorporate OCR for jersey number recognition as an auxiliary cue.
 - Add spatial-temporal constraints to reduce identity switches.
-

Submission Contents

- `player_reid.py` : Main script
 - `README.md` : Project setup & instructions
 - `output_reid.mp4` : ReID output video
 - `requirements.txt` : Dependencies
 - `report.md` : This file
-

Conclusion

The system successfully demonstrates appearance-based player re-identification in a real-world sports video. While effective at assigning unique identities in a short broadcast segment, there is room for improvement using temporal information and optimized embeddings. It serves as a strong baseline for sports analytics and tracking systems.

Contact

For questions or suggestions, please contact ayati16j2003@gmail.com