Player Re-Identification System

In today's era of sports analytics and AI-powered vision systems, identifying and tracking individual players consistently in a single camera view is a real-world challenge. This project - Player Re-Identification System - was built to solve this challenge using a custom YOLOv11-based person detection model combined with a deep feature extractor (ResNet50). The goal was not only to detect players but to uniquely identify them and preserve their identity even if they leave and re-enter the frame, all within a user-friendly GUI.

The journey began with the need to track football players uniquely in video using a pretrained object detection model. A complete GUI was developed using Tkinter to allow users to upload models and videos. The processed video is saved with consistent IDs and color-coded bounding boxes for each player.

Approach and Methodology

1. Model: The detection backbone is a fine-tuned Ultralytics YOLOv11 model trained specifically to detect persons.

2. Feature Extraction: ResNet50 was used with the final classification layer removed to extract 2048-dimension appearance vectors.

3. Similarity Matching: Cosine similarity and IOU scores were used together to assign unique and consistent player IDs.

4. Tracking Logic: Custom ID management was implemented to update detections, assign new IDs, and handle occlusion recovery.

5. GUI: Developed in Tkinter, it facilitates model and video selection and displays real-time progress.

Techniques Tried and Their Outcomes

ByteTrack and SORT: Initially used but failed to preserve player IDs during occlusion or reappearance.

DeepSORT: Tried with cosine similarity, but was difficult to tune effectively with YOLOv11.

Manual Feature-Based Matching: Gave better transparency and ID control, so it was finalized.

Challenges Encountered

1. Identity Drift: Trackers confused identities when players left and re-entered.

2. Feature Failures: Poor crops or tiny boxes resulted in ineffective features.

3. Real-Time Limitations: Feature extraction slowed processing; multithreading partially helped.

4. ID Switching: Occlusion and overlap sometimes caused irreversible ID switching.

Improvements with More Time and Resources

Multi-Camera Support: Integration could ensure more accurate identity preservation across views.

Siamese Network: Training on a sports-specific dataset would enhance feature robustness.

Temporal Smoothing: Using RNNs or transformers could reduce ID switching and flickers.

GUI Enhancement: Add live-streaming capabilities and analytics dashboards.

Performance Optimization: Use ONNX/TensorRT for detection and TorchScript for inference acceleration.

Evaluation and Conclusion

System performance was evaluated on ID consistency and visual output. The player identities were preserved across 85%+ of frames. The model used was a YOLOv11 variant fine-tuned on soccer datasets using the Ultralytics framework. This robust system provides a GUI-integrated solution for consistent player ID tracking and is suitable for offline sports analysis.