**Player Re-Identification in Sports Footage Report**

**My Approach and Methodology**

This project addresses the "Option 2: Re-identification in a Single Feed" task, aiming to identify players in a 15-second video clip and maintain consistent IDs when they re-enter the frame. The solution leverages a fine-tuned Ultralytics YOLOv11 model for player detection, integrated with OpenCV for video processing. The methodology involves:

* Initial ID assignment based on detections in the first 2 seconds (60 frames at 30 FPS).
* Re-identification using spatial proximity (distance < 100 pixels) for players re-entering the frame.
* Real-time simulation with frame-by-frame processing, saving outputs to an "outputs" folder for review.

**Techniques Tried and Their Outcomes**

* **Distance-Based Re-Identification**: Implemented a 100-pixel threshold to match re-entering players to their original IDs. This approach successfully maintained consistency across the video, with minimal ID swaps observed during testing.
* **Frame Saving**: Added functionality to save each processed frame as a JPEG in the "outputs" folder, enabling post-analysis. This resulted in 450 frames for a 15-second clip, confirming the pipeline's operation.
* **Model Integration**: Used the ultralytics library to load the provided YOLOv11 model, adapting its output to fit the ID assignment logic.

**Challenges Encountered**

* **TypeError Resolution**: Encountered a TypeError: unhashable type: 'dict' when using dictionaries as keys in the player\_ids dictionary. Resolved by switching to tuples of (x, y, w, h) as hashable keys.
* **Model Loading Issues**: Initial errors due to incorrect file paths were fixed by ensuring the model.pt file was correctly placed in the project directory.
* **Performance Limitations**: The current implementation processes frames sequentially, leading to noticeable latency. Real-time performance was not fully achieved due to frame saving overhead.

**If Incomplete, Describe What Remains and How You Would Proceed with More Time/Resources**

The solution is functional but incomplete in terms of real-time optimization and full accuracy. With more time and resources:

* **Optimization**: Implement multi-threading or GPU acceleration to improve frame rate and reduce latency.
* **Accuracy Enhancement**: Tune the re-identification threshold and incorporate temporal features (e.g., motion vectors) to improve ID consistency.
* **Additional Features**: Add ball tracking and cross-frame validation to enhance the system's robustness, pending access to the full model capabilities.

**Conclusion**

This submission provides a working prototype for player re-identification, meeting the assignment's core objectives. The code is documented in README.md, and outputs are saved for evaluation. Further development could address performance and accuracy, aligning with real-world constraints.