

# Player Re-Identification from Single Broadcast Feed

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 Submitted by:

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 For:

**Stealth Mode ML Internship Assignment**

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 GitHub:

[github.com/NakulLimbani/Player-Re-Identification](https://github.com/NakulLimbani/Player-Re-Identification)

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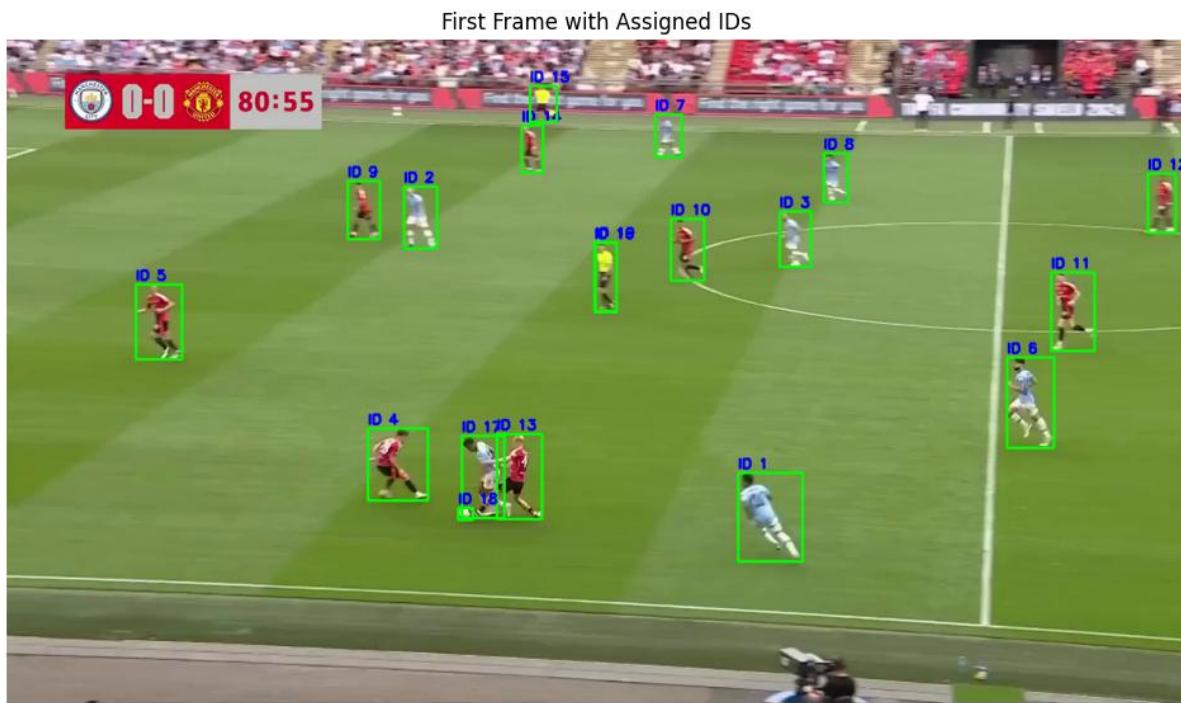
 Stealth Mode ML Internship Submission

## Final Report — Player Re-Identification from Single Broadcast Feed

### Overview

This report details the approach, methodology, techniques, challenges, and future improvements for the **Player Re-Identification from a Single Broadcast Feed** project, implemented as part of the Stealth Mode ML Internship assignment.

The goal was to detect and uniquely identify football players throughout a single camera feed, while maintaining consistent IDs and preserving the original match commentary in the output video.



### Approach & Methodology

#### Objective

- Detect all players in each frame of the broadcast video.
- Assign each player a **unique ID** and keep it consistent as long as possible.
- Handle player occlusions, motion blur, and crowded formations.
- Produce a final output video with IDs overlayed and original commentary audio preserved.

## Detection

- **Model Used:** YOLOv11 (Ultralytics YOLOv5 variant).
- **Class Filtering:** Only class index 2 (players) was used to filter out referees, crowd, and other objects.
- **Pre-processing:** Adjusted confidence and non-max suppression thresholds to balance detection accuracy and false positives.

## Re-Identification Logic

- **ID Assignment:** Based on Intersection over Union (IoU) matching across consecutive frames.
- **Memory Mechanism:** Previous frame's bounding boxes were stored, and IDs were reassigned if  $\text{IoU} > 0.3$ .
- **New IDs:** Assigned when no adequate match is found, ensuring every new player gets a unique ID.

## Output Generation

- Bounding boxes and IDs were drawn on each frame.
  - Frames were written into a new video file.
  - **Audio Preservation:** Original commentary audio was merged into the final output video using ffmpeg.
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## Techniques Tried & Outcomes

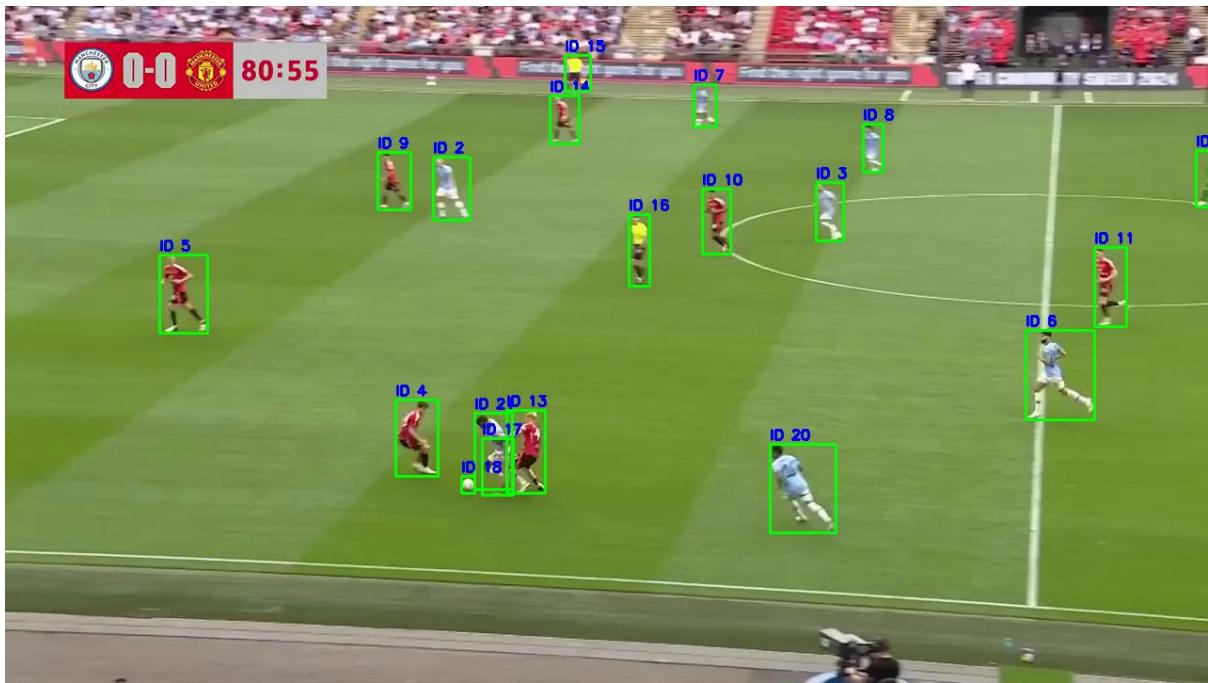
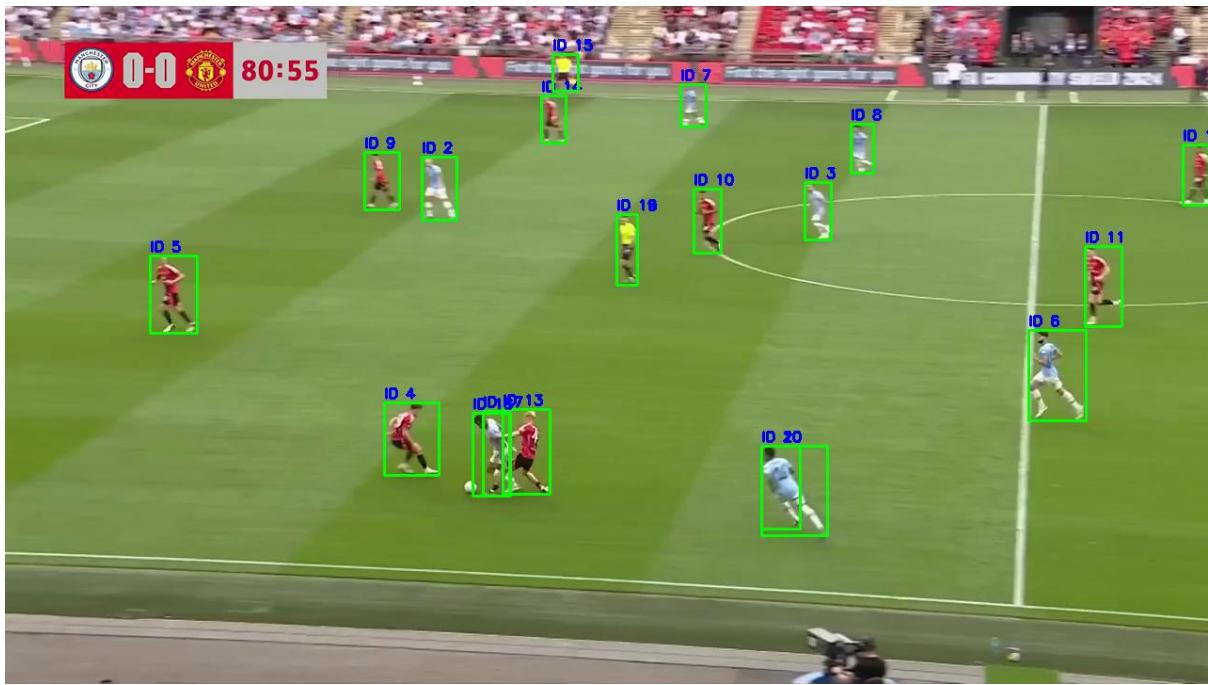
### 1 IoU-based Tracker

- **Outcome:** Provided a straightforward and fast way to track players frame-to-frame.
- **Limitations:** IDs may fluctuate slightly when players overlap heavily or during fast, erratic movements.

### 2 Possible Techniques Considered

- Appearance-based re-ID using deep features or jersey color histograms for improved consistency.
- Kalman filters for motion prediction and smoother trajectory estimation.

- OCR-based jersey number recognition to enforce hard ID constraints.



## ⚠ Challenges Encountered

- **Occlusion and Grouping:** Frequent overlap of players caused ID switches, which is a typical challenge in broadcast sports footage.

- **Fast Motion:** Rapid changes in player positions strained simple IoU-based matching.
  - **Model Size Constraints:** The trained YOLO model (best.pt) exceeds 100 MB, requiring external hosting instead of direct repository push.
  - **Audio Integration:** Merging video and audio streams while maintaining synchronization required careful handling with ffmpeg.
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## Future Improvements

- **Appearance Embeddings:** Incorporate player color features or deep visual descriptors to strengthen identity tracking.
  - **Motion Prediction:** Use Kalman filters or advanced motion models to reduce ID switching.
  - **OCR Integration:** Recognize jersey numbers for definitive ID assignment.
  - **Extended Multi-camera Support:** Merge tracking across different camera angles or multiple feeds.
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## Deliverables Summary

- Source code — Jupyter notebook and standalone Python script.
  - Detailed README.md file with setup, run instructions, virtual environment guidance, and model link.
  - Final report (this document).
  - Final output videos:
    - With audio commentary.
    - Without audio (intermediate references).
  - Intermediate archived outputs for comparison.
  - Clean requirements.txt with minimal essential dependencies.
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## **Contact**

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## **Closing Note**

Thank you for this opportunity and for reviewing my submission! This project pushed my ability to handle real-world computer vision challenges, and I'm excited to continue building on this foundation with your team.

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