# Report

# Player Re-Identification in Sports Footage

**Company:** Liat.ai

**Overview:** To track and re-identify individual players from sports footage using a custom-trained object detection model (best.pt based on YOLOv5) combined with a DeepSORT-based tracking system.

## Approach and Methodology:

**Model Used**

- YOLOv5-based Custom Model (best.pt):
  - Trained to detect 4 classes: ball, goalkeeper, player, and referee.

**Pipeline Steps**

1. **Object Detection:**
   - Loaded the model using the Ultralytics YOLO class.
   - Applied detection on each video frame (imgsz=960, conf=0.25).

2. **Player Filtering:**
   - Filtered detections using if cls_id != 2: continue to track only class player.

3. **Bounding Box Refinement:**
   - Shrunk bounding boxes by 40% to exclude background and tighten player focus.
   - Restricted box height to a max threshold (e.g., 300px) to avoid large vertical boxes.

4. **Tracking with DeepSORT:**
   - Used deep_sort_realtime library to assign consistent IDs across frames.
   - Tracked bounding boxes with re-identification based on appearance and motion.

5.  **Result Saving:**

    o   Drew bounding boxes and IDs on each frame.

    o   Saved final annotated video using cv2.VideoWriter.

## Techniques Tried & Outcomes:

| Techniques | Purpose | Outcome |
|---|---|---|
| YOLOv5 Detection | Identify players | Worked well for most players |
| Bounding Box Shrinking | Reduce noise from surroundings | Helped stabilize DeepSORT |
| DeepSORT Tracking | Maintain consistent IDs | Effective but had some ID switching |
| Filtering by Class | Exclude non-players (e.g., referee) | Reduced misidentifications |
| Clipping Box Height | Avoid extra-tall boxes | Improved detection focus |

## Challenges Encountered:

- **Bounding Box Too Large:**
  - Initial YOLO output boxes included too much background → led to ID switching.
- **Colab GUI Limitations:**
  - cv2.destroyAllWindows() failed — had to wrap it in a try-except block.
- **Identity Switching in Crowded Scenes:**
  - DeepSORT struggled when multiple players overlapped or appeared similar.

## Incompleted Part:

**Improper Bounding Boxes**

- Many original YOLO boxes are too loose, often covering background.

**Extra or Phantom Boxes**

- Sometimes YOLO detects same player multiple times (especially if slightly turned).
- Non-player entities (e.g., shadows, partial players) still get detected due to class confusion or low-quality training.

**How to Improve This**

| Problem | Suggested Solution |
|---|---|
| Loose Bounding Boxes | Retrain YOLO model with **tighter labels** around players using better annotations (crop to torso and legs). |
| ID Switching | Use **stronger appearance embeddings** trained on sports datasets, or integrate **ByteTrack** for better object permanence. |
| Extra Boxes | Add **Non-Maximum Suppression (NMS)** post-YOLO manually if not handled well by model. Tune **confidence and IoU thresholds**. |
| Missing Players | Train model with **augmented viewpoints** and edge cases (e.g., back view, partial visibility). |
| Appearance Drift | Use **hybrid features** in DeepSORT (position + motion + visual cues with attention). |

**Future Steps**

1. **Improve Re-identification Module**

- Train or replace DeepSORT's default appearance model with ResNet-50 or transformer-based embeddings fine-tuned on sports footage.

2. **Quantitative Evaluation**

- Use metrics like **MOTA**, **IDF1**, and **ID Switches** to evaluate and tune the pipeline.

3. **Web Dashboard or Demo App**

- Provide a simple UI for uploading match footage and tracking players with visualization.