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 YOLOv11) combined with a DeepSORT-based tracking system.

Approach and Methodology:

Model Used

- YOLOv11-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:**
    - Drew bounding boxes and IDs on each frame.
    - Saved final annotated video using cv2.VideoWriter.

Techniques Tried & Outcomes:

Techniques	Purpose	Outcome
YOLOv11 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.