

# FOOTBALL DETECTION AND TRACKING PROJECT

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## Problem Statement

Manual tracking in football analytics presents significant challenges, demanding extensive time and resources. The process is prone to human error, especially when dealing with fast-paced action, varying camera angles, and occlusions. Accurately detecting and tracking small objects like the football across diverse video conditions (lighting, weather, resolution) is particularly difficult. Therefore, an **automated**, **accurate**, and **robust** object detection and tracking system is crucial to enhance football analytics and provide valuable insights.

## Solution

Our solution is an end-to-end computer vision system designed for real-time football detection and tracking. Key components include:

- **YOLO-based Models:** We leverage state-of-the-art YOLO models, including YOLOv8m, YOLOv11l, and a specialized model fine-tuned for precise ball detection.
- **Optimization Techniques:** We employ various optimization techniques to enhance model performance, speed, and accuracy. Techniques may include transfer learning, data augmentation, and model pruning.
- **Streamlit Web App:** The system is deployed as a Streamlit web application, providing a user-friendly interface for real-time video analysis and visualization of tracking results. This allows for interactive exploration of game footage and immediate access to analytics.

# Future Work

The following enhancements are planned for future development:

- **Model Accuracy Improvement:**

Enhance the detection model's accuracy by expanding and diversifying the training dataset. Improved detection precision will directly enhance the tracking stability, reducing player ID switching and misidentification issues during matches.

- **Multi-Camera Integration:**

Integrate data from multiple cameras to provide a comprehensive view of the field and improve overall tracking accuracy and coverage.

- **3D Tracking:**

Implement 3D tracking algorithms to capture depth information and enable more advanced spatial and positional analysis.

- **Event Detection:**

Develop algorithms to automatically detect and classify key game events, such as passes, shots, tackles, and fouls, in real time.

- **Analytics Dashboards:**

Create interactive dashboards to visualize key performance indicators (KPIs) and provide actionable insights for coaches and analysts.

- **Model Generalization:**

Extend the system's capabilities to other sports by adapting models and algorithms to new datasets and domain-specific challenges.

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