Cricket Ball Tracking System – Technical Report

1. Problem Statement
The objective was to build a robust cricket ball tracking system capable of handling broadcast footage with clutter, occlusion, and visually similar distractors such as white shoes. The system needed to work reliably in batch mode and produce stable visualizations and annotations.

2. System Overview
The final pipeline combines YOLO-based detection, color-based fallback, Kalman filtering, spatial gating via a fixed ROI, and motion-based validation. The tracker outputs a clean trajectory visualization and frame-level annotations.

3. Detection Strategy
YOLOv8 is used as the primary detector for sports balls. Due to missed detections under motion blur and small object size, HSV-based color detection is used as a fallback. This hybrid approach significantly improves recall.

4. Kalman Filter Design
A constant-velocity Kalman Filter models ball motion using state [x, y, vx, vy]. It smooths detections, predicts motion during occlusion, and enables physics-based rejection of implausible detections.

5. ROI Design
Early versions used ratio-based and dynamically resizing ROIs, which caused jitter. The final system uses a fixed-size ROI that only moves based on Kalman predictions and is never visualized. This stabilized tracking significantly.

6. False Positive Mitigation
White shoes were frequently mistaken for the ball. This was addressed using: Strict area constraints High circularity thresholds Motion gating using Kalman velocity Temporal consistency checks These physics-based filters eliminated most false positives without retraining models.

7. Visualization
The system draws: Blue dots for all past detected ball positions A green dot for the current frame position No bounding boxes or ROIs are shown, resulting in a clean and professional visualization.

8. Batch Processing
Videos are processed sequentially. Outputs are keyed by video stem, not extension. Supported inputs include MP4, MOV, MKV, and AVI. Each video produces a tracked output, CSV annotations, and contributes to a batch summary JSON.

9. Parameter Tuning
An interactive parameter tuning script was developed to explore YOLO confidence thresholds, HSV color ranges, and contour filters. This allowed rapid empirical refinement and improved detection stability across datasets.

10. Assumptions
The system assumes a single ball, approximate spherical shape, and that the ball moves faster

than background objects. These assumptions hold for broadcast cricket footage.

11. Conclusion

The final system demonstrates a production-grade approach to sports ball tracking using a combination of deep learning, classical vision, and physical reasoning. Most performance gains came from engineering decisions rather than model complexity.