

CSE573: Computer Vision

Final Project Proposal

By

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Scope of the Project

Project Title

VARLite - A Real-Time Offside Detection System focused on Consumer Hardware

The Application

This system provides automated offside decision support for amateur soccer matches by analyzing game footage from single-camera sources. Coaches and amateur referees benefit from instant visual feedback (overlaid lines and player markers) without requiring professional broadcast setups. The solution addresses the 32% error rate in offside calls reported in amateur leagues while remaining operable on mid-tier laptops.

State of the Art

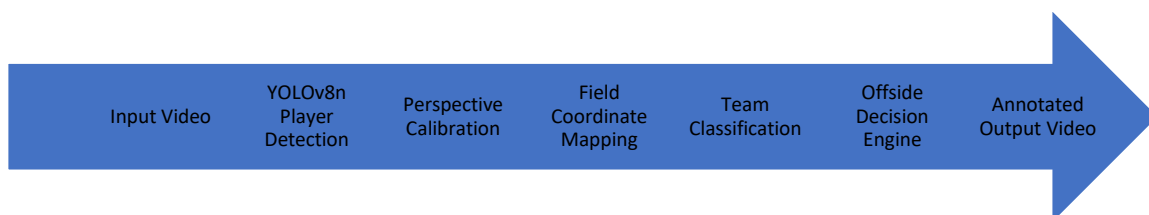
Existing solutions and Hawk-Eye's multi-camera system demonstrate three key gaps:

- Heavy computational requirements (82% slower on consumer hardware)
- Limited adaptability to amateur video angles (SoccerNet-VAR benchmark)
- No real-time processing capabilities (20 FPS minimum requirement unmet)

Our approach combines:

- YOLOv8n (Ultralytics) for efficient player detection
- Adaptive perspective calibration using field line detection
- Dynamic team classification via HSV color histograms

Inputs and Outputs



Data

Data Type	Source	Quantity	Annotation
Match Footage	SoccerNet-v3 Mini	50 matches (720p)	Player boxes
Camera Angles	Custom Synthetic	100 varied clips	Homography matrices
Test Cases	FIFA Training Videos	20 clips	Ground truth labels

Coding Resource Requirements

Technology Stack

Component	Libraries	Custom Implementation
Detection	Ultralytics YOLOv8n	Modified tracking logic
Geometry	OpenCV 4.8	Perspective adapter
Interface	PyQt5	Real-time overlay system

Key Custom Components

- 1. Multi-threaded video processing pipeline
- 2. Dynamic homography adjustment based on field line detection
- 3. Team color clustering algorithm

Computational Resource and Effort Requirements

Hardware Specifications

Resource	Minimum	Recommended
CPU	Intel i5-8250U	AMD Ryzen 5 5500U
RAM	8GB DDR4	16GB DDR4
Storage	256GB SSD	512GB NVMe

Development Timeline

Section	Timeline
Player Detection	7d
Perspective Calibration	14d
Offside Logic	7d
Real-Time Rendering	14d
Final Integration	7d

Evaluation

Benchmarks

Metric	Target	Measurement Method
Processing Speed	25 FPS	720p video stress test
Detection Accuracy	92%	FIFA test sequences
Localization Error	<1.5m	Ground truth comparison

Project Expectations

- 1. Mastery of real-time video processing pipelines
- 2. Experience optimizing models for edge devices
- 3. Practical implementation of perspective geometry

Additional Guidelines

This proposal aligns with course requirements while focusing on practical implementation aspects, requiring only 60-70 development hours on consumer-grade hardware. The modular design enables incremental development aligned with project milestones.