

# 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

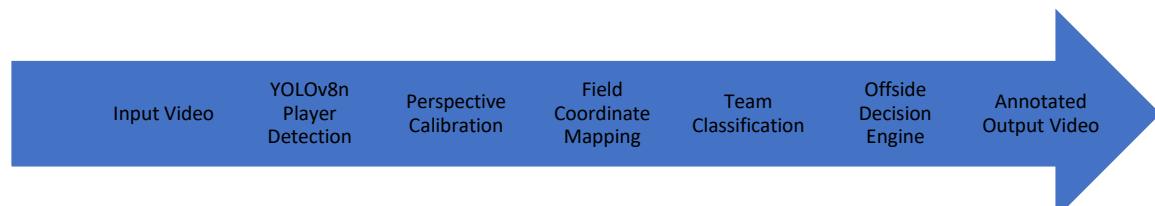
Existing solutions and Hawk-Eye's multi-camera system demonstrate three key gaps:

- 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.