Institute Technical Summer Project
Offside detection in Football

Electronics and robotics Club IITB

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Code Repository: https://github.com/kparth98/ITSP-Project **Documentation:** https://tinyurl.com/TechTitansdoc

OBJECTIVE

- The offside rule in Football is notorious for being mishandled. Error of judgement, however, is a **human limitation** and beyond control. Our aim was to create a mechanism by which the **problem of incorrect offside decisions** made by referees in football can be addressed

INTRODUCTION

- Our project takes in a video feed, **analyses each pass** and takes a call on whether the situation was an offside
- The implementation involves two separate modules that track the ball and the players. The **integration of the modules** leads to the desired goal of offside detection
- The ball in play and the players are tracked using **separate algorithms** found to be most suitable for their respective purpose
- The project is implemented in **Python** and uses the **OpenCV library**
- This choice reflects the **intuitive nature** of the Image processing library when implemented in Python
- The project still has certain shortcomings which are highlighted in the section titled **Future Scope**
- Be sure to stick around for **a live presentation!** You can read through this less-lively poster in the meantime!

CHALLENGES

- Since our project was software based, we were fortunate in being able to forego the road-blocks that are inherent in procuring suitable components, nevertheless each step had its own complications
- Numerous approaches for ball detection were tested, namely **Colour Thresholding**, **Histogram Back-projection**, **Hough circle transform** and **dlib library's correlation tracker**
- None of these approaches were perfect. After much deliberation we **finalised on Colour Thresholding**
- Colour Thresholding generates significant **noise** if the colour of the ball and background are similar, this was solved using **background subtraction**
- We discovered that dlib library's correlation tracker is unsuitable for tracking more than 3 players in real time
- Our final choice for player tracking was **Histogram Back-projection**
- Another candidate was the **HOG descriptor with SVM** which is a method of detecting persons using machine learning but this turned out to be disappointing, both in terms of speed and accuracy

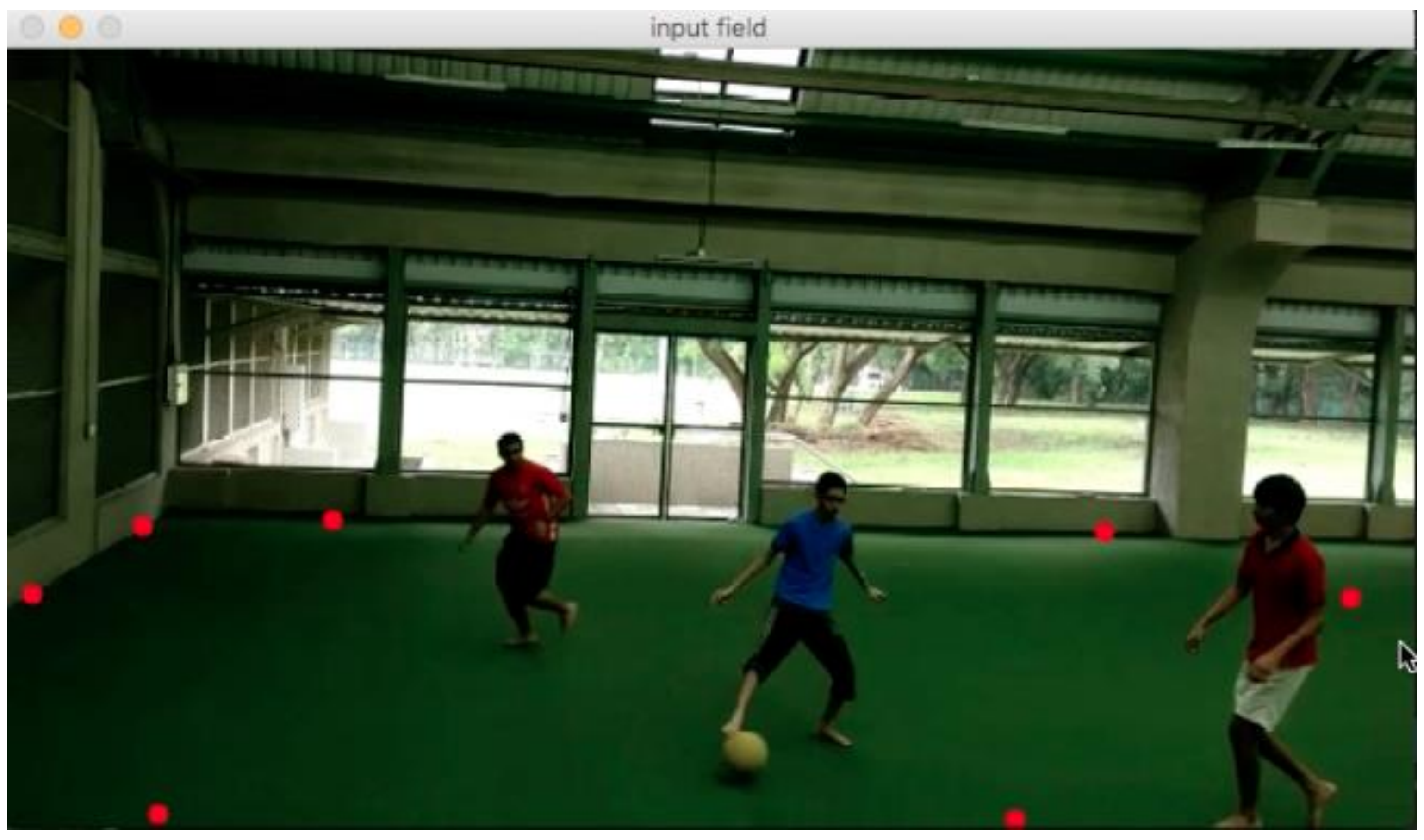


Figure 1: Demarcating the playing area, a one time activity

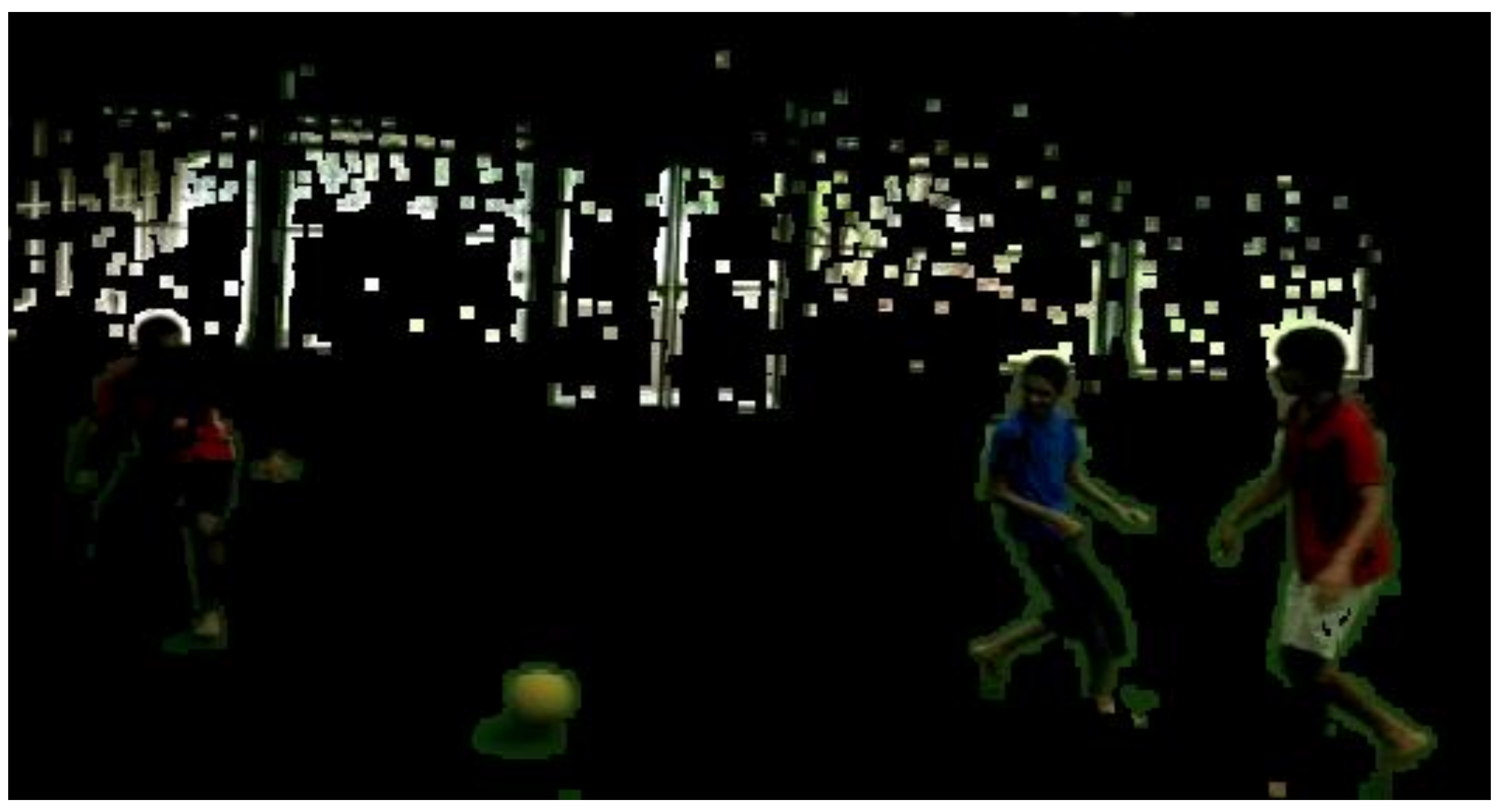
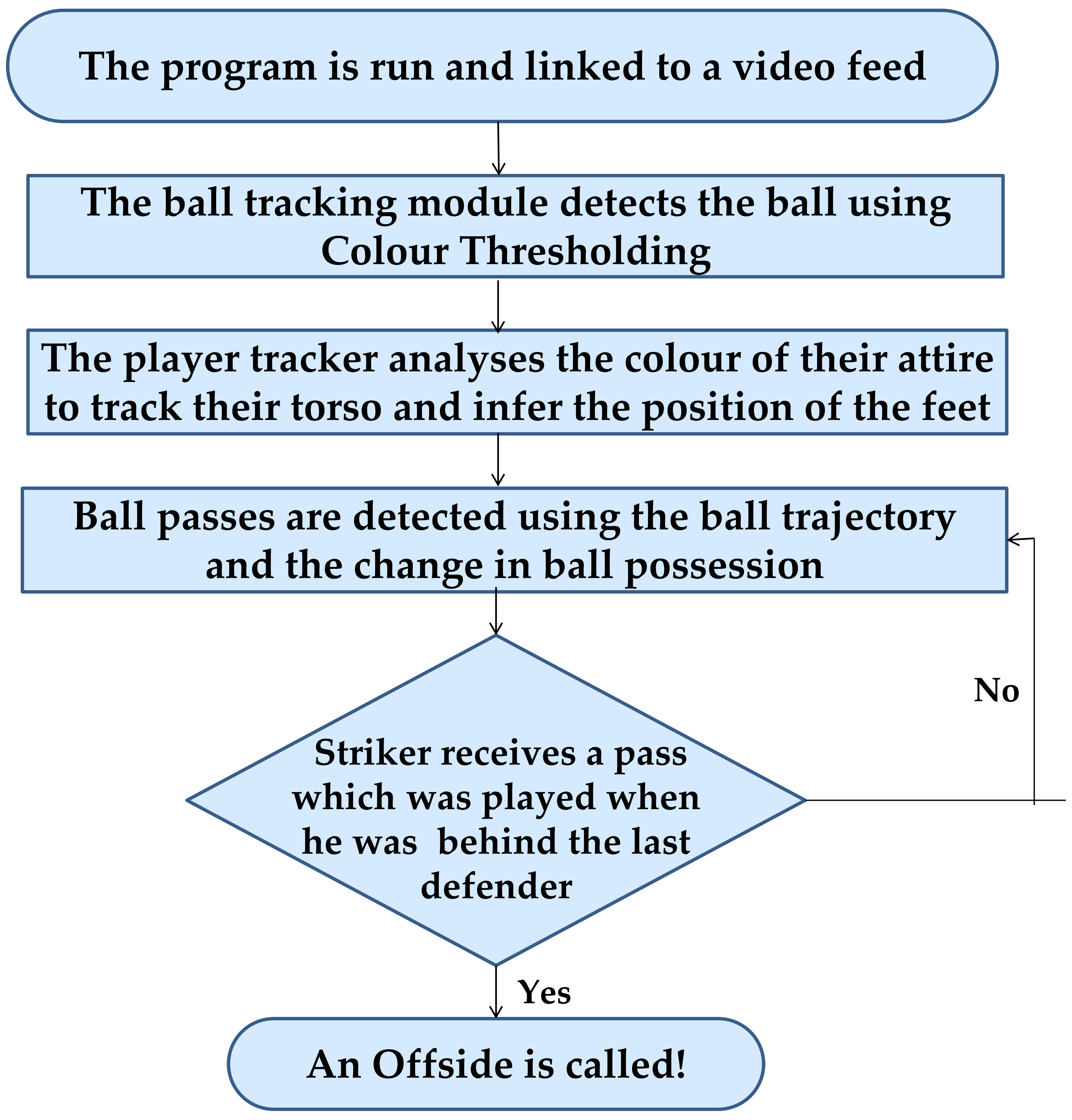


Figure 2: Image Processing in action! Seen here are the tracked elements with the pesky background subtracted

WORKING MECHANISM



The program is run and linked to a video feed

The ball tracking module detects the ball using Colour Thresholding

The player tracker analyses the colour of their attire to track their torso and infer the position of the feet

Ball passes are detected using the ball trajectory and the change in ball possession

Striker receives a pass which was played when he was behind the last defender

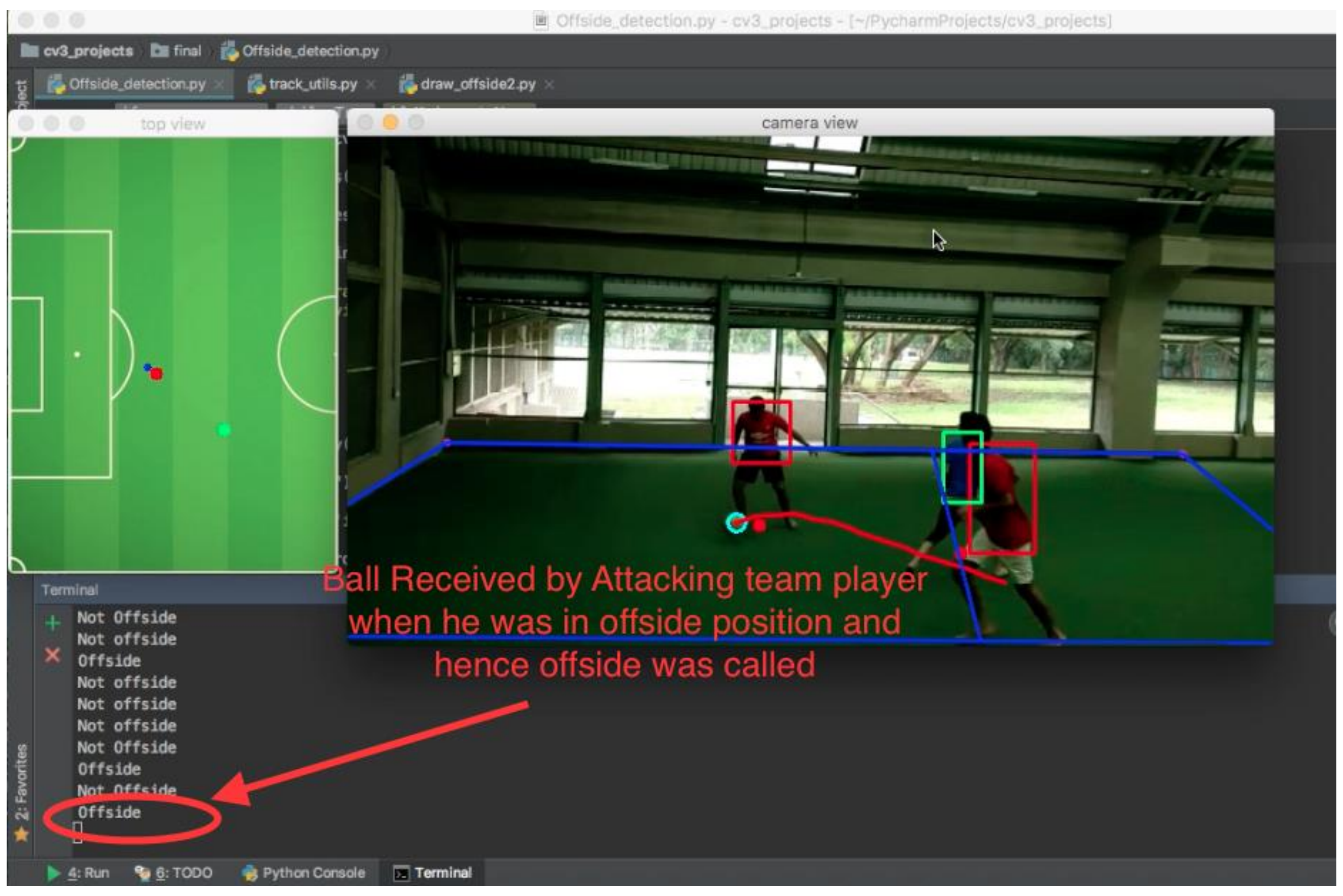
No

Yes

An Offside is called!

FUTURE SCOPE

- Some of the ideas for improving the project are:
- Increasing accuracy by **combining video feed from multiple camera**s A problem with our current model is **occlusion**, that is, when one player blocks the image of another player. This can be solved using multiple camera angles
- **Increasing the field of view** of our video feed to cover the entire playing field. This will allow us to jump to the region of interest faster in case of a sudden long pass across the length of the playing field
- Our current algorithm heavily employs the use of jersey colour to distinguish between teams. This may prove to be a shortcoming in certain cases and may be resolved by **using better algorithms** which are **not as dependent upon jersey colour**



```
Not Offside
Not offside
Offside
Not offside
Not offside
Not offside
Not Offside
Offside
Not Offside
Offside
```

Ball Received by Attacking team player when he was in offside position and hence offside was called

Figure 3: Finally it all comes together and delivers the expected results

ACKNOWLEDGEMENTS

- Our Mentors **Arunabh Ghosh and Ritik Madan** were of great help and support. Web Resources and online tutorials were essential towards completing our project. Some specific Web resources were
- https://tinyurl.com/techtitans1 **<For Tutorials>**
- https://tinyurl.com/academicPaper **<Earlier attempt at this problem>**
- https://tinyurl.com/IOTbased