SOCCER OFFSIDES DETECTOR

RYAN KULSIC, ANDREW MOORE, ETHAN PALLIPAMULA
INTERNET ENGINEERING COHORT, UNIVERSITY OF NEW HAMPSHIRE

University of New Hampshire
Interoperability Labs

Introduction

Currently, automation of sports through technology is only available to professional leagues. Even for limited technology available to the average consumer, it is still extremely expensive.

The goal of our project was to bring professional-level technology to a wider audience, with a lower budget and being more accessible to obtain and use. Most traditional approaches use a wide relay of cameras; however, these have an extremely high cost and are exclusive to professional leagues.

Methods

For our project, the system can be divided up into three parts: The Frontend, The Backend, and the sensors.

- The front end consists of a webpage, implemented using HTML, CSS, and JavaScript.
- The frontend has you configure your team information (what sensors are part of your teams) and displays penalties on-screen when one occurs..
- The backend was programmed using a Java server, that sends messages via WebSocket to the frontend.
- The back end takes in the players locations and runs tests to determine if each player has committed an offsides.
- The sensors consistently sends each players location to the backend to process. These use Ultra-Wideband, waves that only go a short distance (just enough to cross a soccer field), but allow for extremely precise distance tracking by calculating how long they take to travel.
- These would be running C code that talk over Wi-Fi and a TCP socket to communicate to the backend. Alternatively, they could communicate over Bluetooth Low Energy to a device that does have WiFi to send data or use cellular data.

Contacts

Andrew Moore: Andrew.B.Moore@unh.edu

Ryan Kulsic: Ryan.Kulsic@unh.edu

Ethan Pallipamula: Ethan.Pallipamula@unh.edu

Results

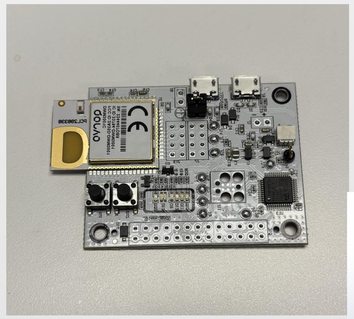
We created a prototype for what the ball would look like, and we found a way to mount a tracker inside the ball.

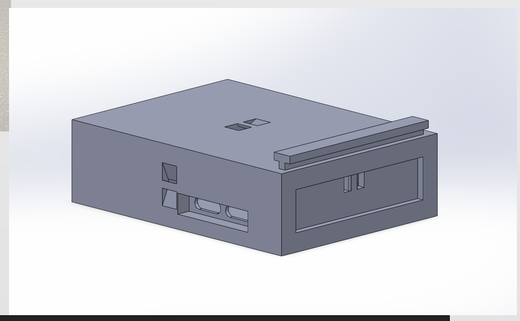
For our prototype, we have successfully made the algorithm for detecting the offsides rule. In the future, we could connect the UWB sensors to the backend and start processing live real-time data.

We were only able to get three of the trackers for the project, so we ended up creating dummy data for our code to see if it would successfully detect when an offsides penalty occurred.

There are a few trials for the dummy data to test different scenarios and outputs of the code. So far, all of our trials pass in the detector as we expect.

We have a front end to display what the result of the violations is. You can enter in team and player data, and it will store the info in the backend. Your data is preserved between page switches.





References

"| Details | Hackaday.io." Hackaday.io, 2025, hackaday.io/project/204260-building-a-dead-simple-uwb-indoor-tracker/details. Accessed 10 Apr. 2026.

"CircuitDigest." Circuitdigest.com, 6 Oct. 2025, circuitdigest.com/microcontrollers-projects/diy-indoor-uwb-positioning-system-using-esp32-and-qorvo-dwm3000.

Discussion

```
DummyDataHandler.testForOffsides(
        List.of(
                new DummyDataHandler.DummyDataPlayer( id: 1, TeamKind.A, PLAYER_A_A_POINTS),
                new DummyDataHandler.DummyDataPlayer( id: 2, TeamKind.B, PLAYER_A_B_POINTS),
                new DummyDataHandler.DummyDataPlayer( id: 3, TeamKind.B, PLAYER_B_B_POINTS)
        ),
        offendingPlayer: 2,
        List.<Class<?>>of(
                ViolationResult.Ok.class,
                ViolationResult.Ok.class,
                ViolationResult.Ok.class,
                ViolationResult.Ok.class,
                ViolationResult.Ok.class,
                ViolationResult.PlayersFault.class,
                ViolationResult.PlayersFault.class
        ),
        BALL_POSITIONS
);
```

Our results indicated that the algorithm is accurate and is consistent in detecting penalties.

- While working on this project, we also found that we could extend this technology further, by adding more rules into the backend. We could detect simpler penalties, and things such as fouls.
- One suggestion that made to us throughout the process was that the technology could also be used as a fitness tracker, and if we had more time, we could also implement features that also help players keep track of their own performance. The info collected by our system could allow coaches to better inform their players on how to play and allow players to get quick feedback on how they played.
- We could also add a birds-eye view map of the field to the frontend, so referees can see all positions of all players on the field. The map may be slightly delayed due to internet delays, though.

Throughout this experience, we learned:

- the great value of utilizing the resources that are at our disposal, such as our mentors and locations throughout campus.

One thing we prioritized was consistent meetings communication between our team. While the Innovation Scholars had standard meetings at 2-5pm, we found it helpful to also meet for an hour or two on Mondays and Wednesdays.

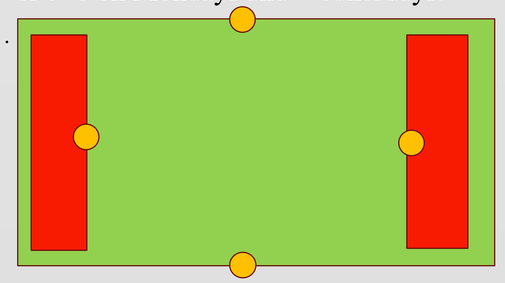


Figure to left: Layout of field and where each of the anchor would be located