Contextualization Design Check-In

Slow-Pitch Softball

SDMAY25-11
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Project Overview

Slow-pitch softball has specific specifications for a legal pitch with maximum and minimum height requirements.

Our deliverable for this project is a portable and user interactive application to call illegal pitches with three main requirements:

- Accurately detect a softball's maximum height on a pitch
- Trigger an audible "Illegal" if the pitch is outside of the max/min range
- Acts as a faster and more accurate height officiary than umpires

Our Client / Advisors

Dr. Nicholas Fila

Client / Advisor

Dr. Phillip Jones

Technical Advisor

Our Current Design

The **environment** in which the game is played needs to be calibrated.

The **object and height detection** will be done through OpenCV in C++.

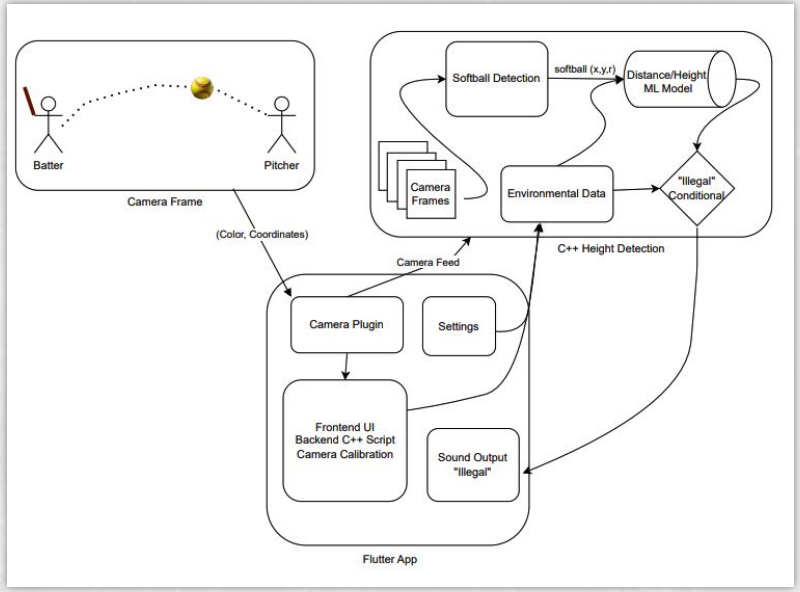
The **user interface** of the mobile application will be built in Flutter.

Current Design Pros/Cons Table

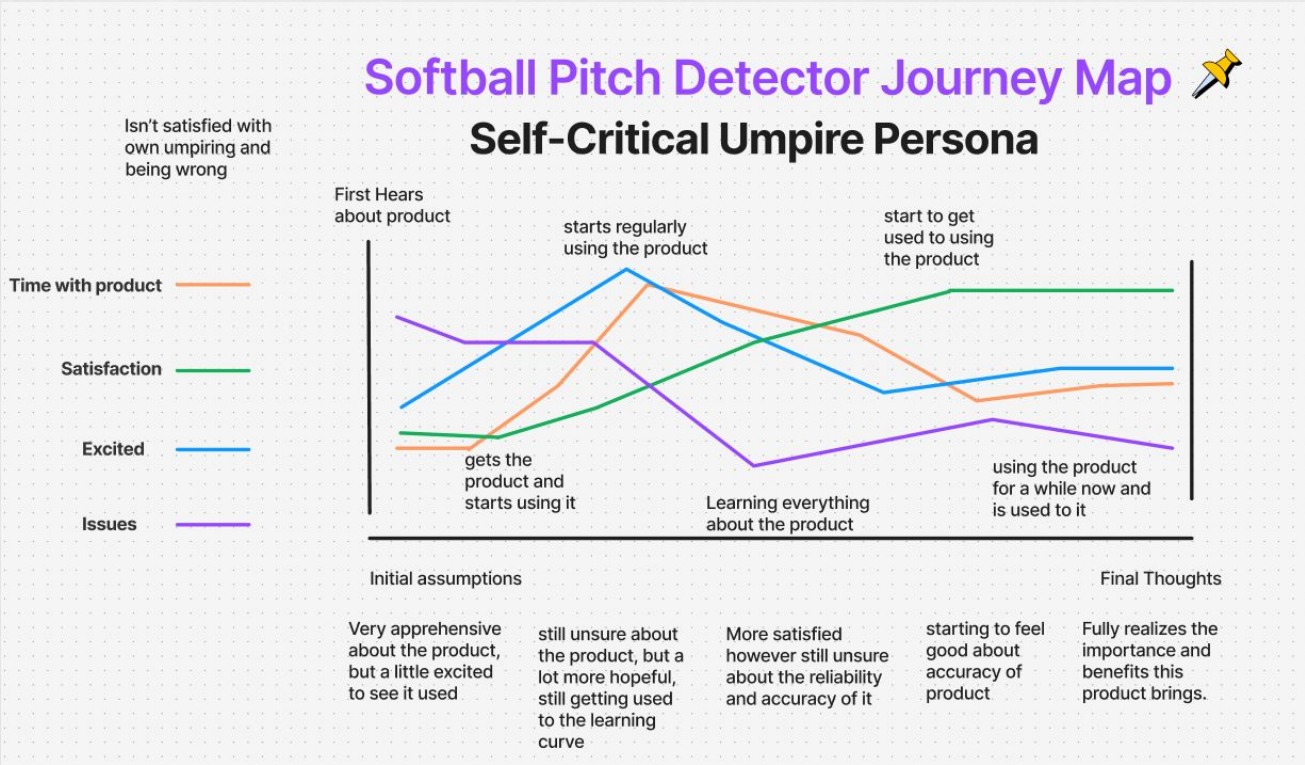
Pros	Cons
• Portability/ease of access (mobile application) • Simultaneous iOS & Android development (Flutter) • Real-time analysis	• Mobile processing limitations • Accuracy in variable conditions (e.g. lighting, camera position)

Technical Complexity Analysis

- Real-time image processing, object detection, and height calculation with OpenCV
  - ML + Non-ML approach
- Integration with Flutter app, finding a way to bridge C++ to Dart
- Optimizing image processing to accommodate for mobile device capabilities



Journey Map


Softball Pitch Detector Journey Map
Self-Critical Umpire Persona
Isn't satisfied with own umpiring and being wrong
Time with product
Satisfaction
Excited
Issues
First Hears about product
starts regularly using the product
start to get used to using the product
gets the product and starts using it
Learning everything about the product
using the product for a while now and is used to it
Initial assumptions
Final Thoughts
Very apprehensive about the product, but a little excited to see it used
still unsure about the product, but a lot more hopeful, still getting used to the learning curve
More satisfied however still unsure about the reliability and accuracy of it
starting to feel good about accuracy of product
Fully realizes the importance and benefits this product brings.

User Needs

What do our users need and how is our current model accommodating them?

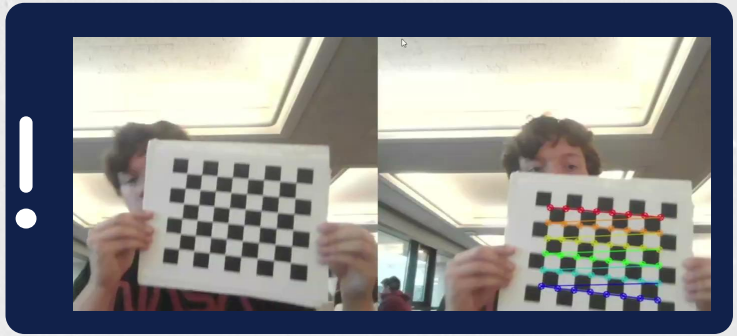
Human Needs

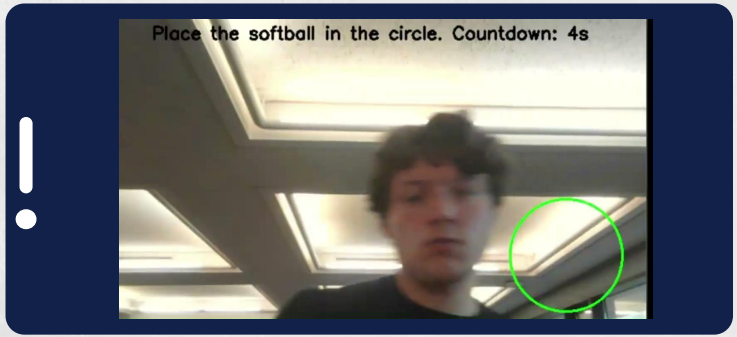
Adaptive Detection

Users need a system that can be used with a variety of fields, phones, and lighting conditions

Calibration

We offer a one-time lens distortion calibration.
Each tracking session calibrates field and lighting conditions





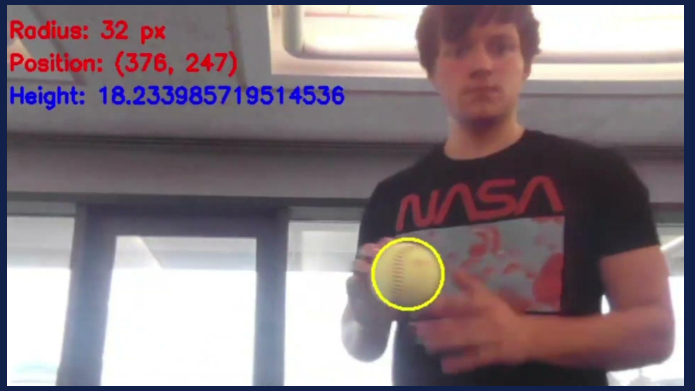
Human Needs

Reliable Calls

Players, fans, and umpires need a system to reliably make accurate calls.

ML + NML

Integrating both machine learning and non-machine learning ensures accurate object detection and preserves the integrity of the game.



Human Needs

Simple Design

Users need a system that can be easily and efficiently set up for officiating games

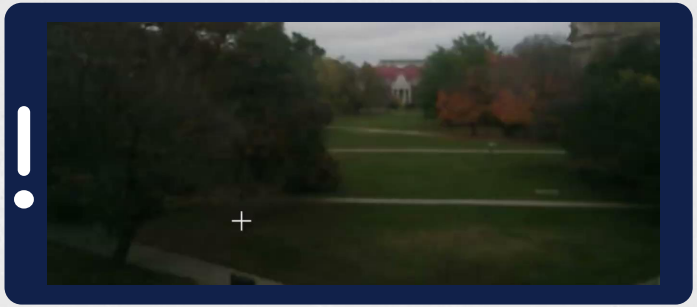
Guided Set-up

Step-by-step guided messages help users calibrate and place the application for continuous officiating.

1

Lens/Color Calibration

2



3

Constant tracking

“ILLEGAL”

Economic Needs

Pricing

+ Free

Availability

+ Available on iOS and Android
- May need to restrict based on device specs

Convenience

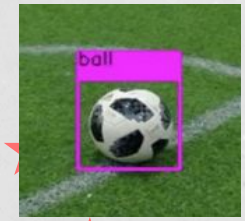
+ No external camera or sensors
- Increases difficulty of development

Technical Needs

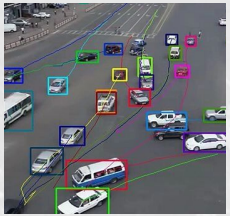
01 Height Calculation

1. OpenCV Calibrations
2. Combination of YOLO, KCF, and OpenCV for object detection.
3. Calculates height based on known distances.
4. Alerts "Illegal" when height is outside the min and max range

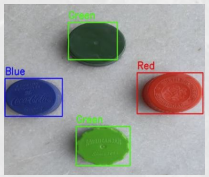
YOLO (ML)



KCF (NML)



OpenCV (NML)



Flutter

02 Mobile App

- Accessible to almost anyone.
- Runs height calculation programs on local device from main screen.
- Contains screens for settings and pitch history.

Conclusion

- Our design prototypes are beginning to meet our user's needs.
- We must continue refining and integrating our detection techniques into our mobile application.
- The user experience should continue to be our greatest influence on our Flutter application.

Questions?