Pitch Snitch

A Slow-Pitch Softball Officiary

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Agenda

Introduction

Background, Users, Requirements and Ethical Considerations

Project Plan

Developmental Styles and Timeline

Design

Modular Map, App Views, Technical Components

Demo

Demo Video

Testing

User Testing, Model Testing

Conclusion

Future Plans and Questions

Our Project

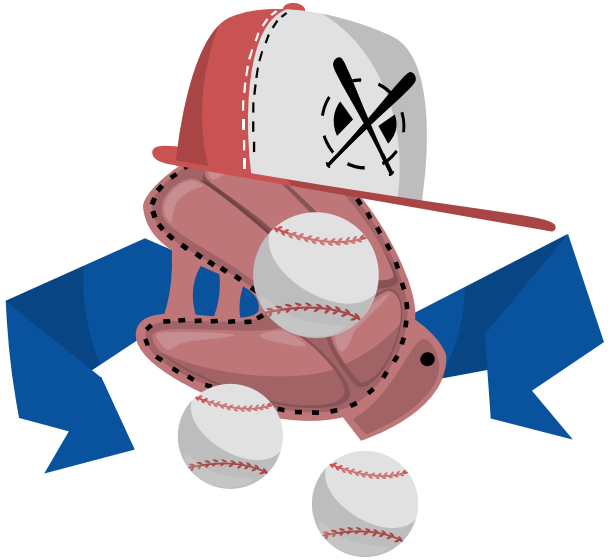
We have developed an **officiary tool**, for local **slow-pitch softball** leagues, that can track the height of a pitch to determine if it falls within a legal height range.

What is slow-pitch softball?

A variation of softball where a pitch must lie within a max/min height range.

If a pitch is called illegal, the batter has the choice to attempt a hit.

This modification allows for more amatuer games and leagues with slower pitches.

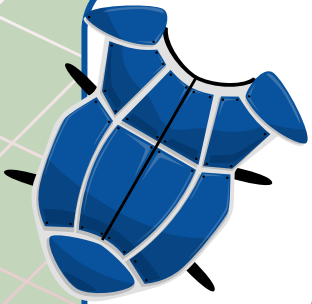


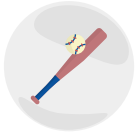
Where our project comes in...

Umpires visually measure the height of the pitch to determine if it is within the legal bounds.

This causes inconsistencies with illegal pitch calls and can mess up the timing of the batter if the call is made late.

Who Are Our Users?





Players

The players in local slow-pitch leagues

Needs

- Accurate “illegal” calls
- Fast “illegal” calls
- Non-interferent design

Umpires

The umpires officiating slow-pitch games

Needs

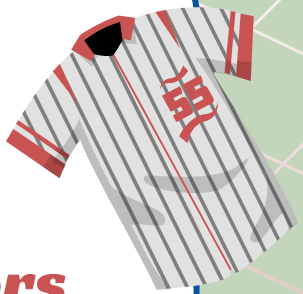
- Reliable detection
- Portable design
- Manageable cost
- Easy setup

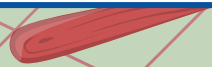
Spectators

The people and fans watching the games

Needs

- Preserves the integrity of the game
- Speeds officiary time





Requirements

Fast

- Detects illegal pitch faster than a normal umpire
- Within .2 seconds of reaching max height

Accurate

- Find max height of the softball
- Within ±4 inches of error

Non-Intrusive

- Cannot interfere with typical game operation

Portable

- Must be able to be taken to multiple fields

Adjustable

- Must be able to change height range

Audible

- Must output audible sound if pitch is illegal

Ethical Considerations

Social Responsibility

Keeping our user base in mind as local slow-pitch leagues, we must provide an affordable and accessible product

Security/Privacy

Our app does not collect or remotely store any videos taken, or any type of sensitive information

Accessibility

Choosing Flutter as a development platform allows us to use accessible widgets for all users and easy setup steps.

Project Plan

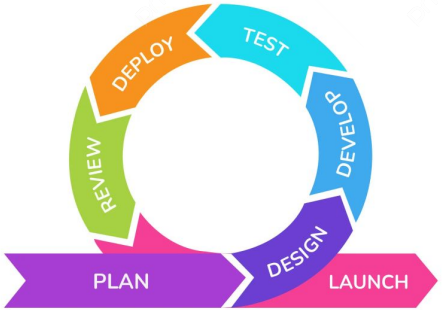
Our Management Style

AGILE

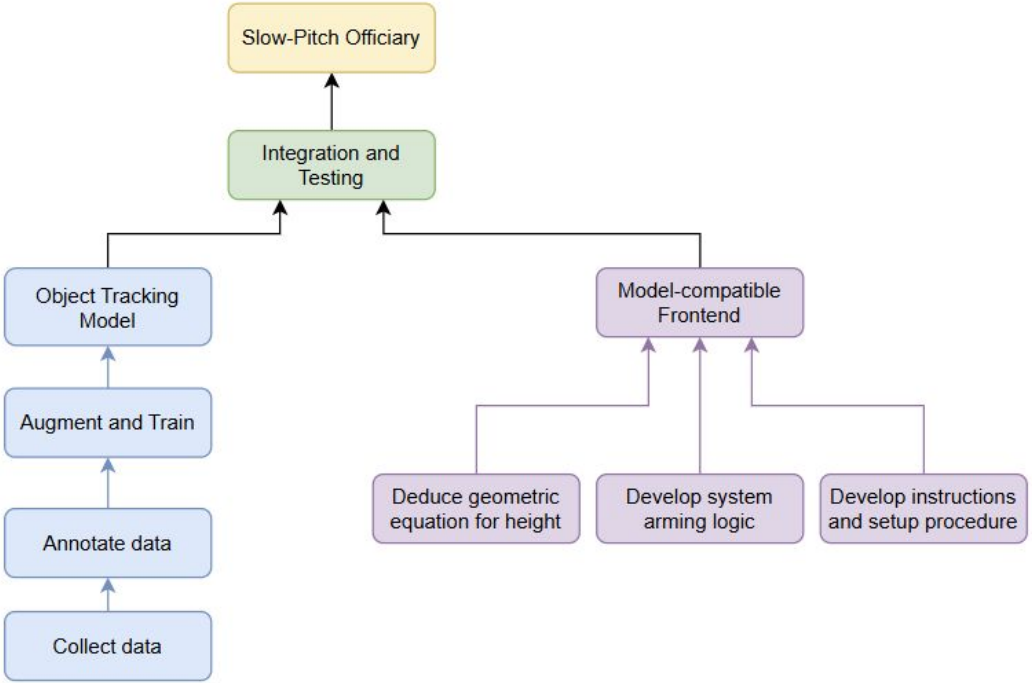
- Organize a weekly standup mentioning our progress, setbacks, and goals.

- Follow the AGILE workflow of Planning, Design, Implementation, and Testing

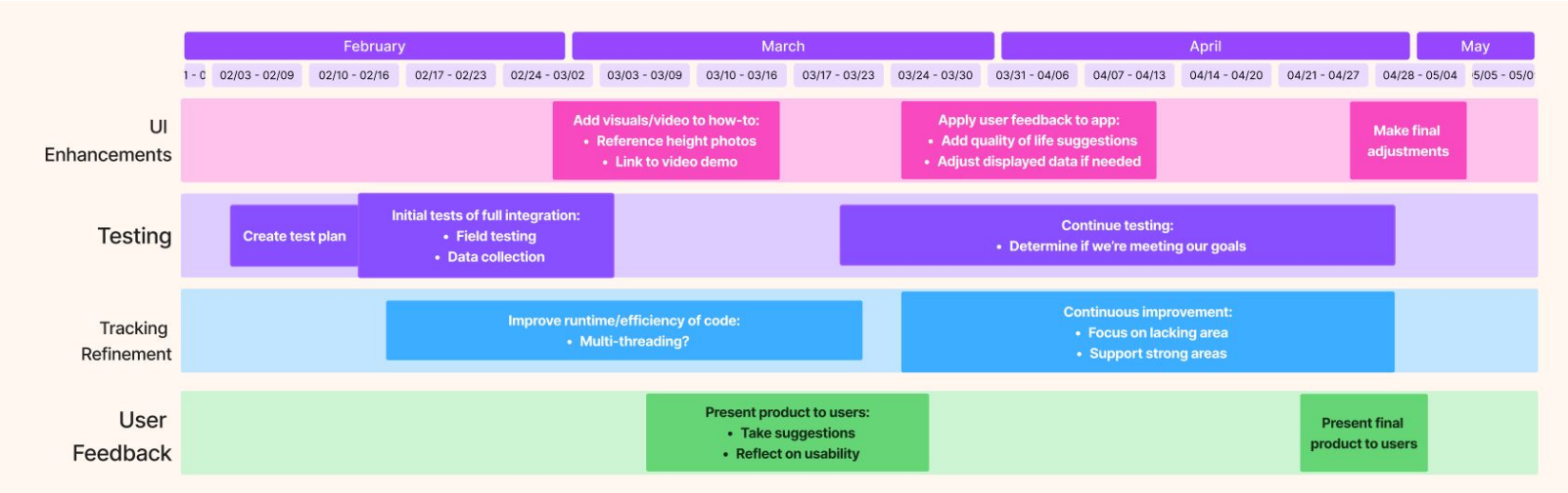
- Use GitHub branches and GitHub Issues board to showcase progress and individual work.



Task Decomposition



AGILE Gantt Chart



Design

Technical Needs

1 Object Detection

- YOLO (You Only Look Once) convolutional neural network model.
  - **Object Tracking,** classification, and segmentation abilities.
- High accuracy and speeds when trained on a variety of datasets.

ultralytics YOLO

Flutter

2 Mobile App

- Dart framework for app development
- Cross-platform for iOS/Android
- Works with an Ultralytics plugin that works with YOLO models

Our YOLO Model

1. Data Collection

- Parsed pitching videos

2. Roboflow Annotations

- Annotated 9062 Images of softball locations

3. Roboflow Augmentations

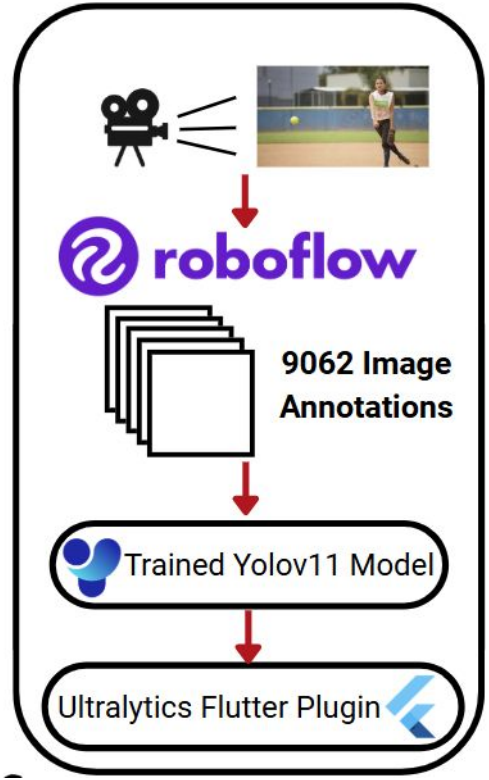
- Greyscale, mirror, and crop augmentations

4. Training with Ultralytics

- Trained through 100 epochs over several days

5. Inserting into Flutter interface

- Ultralytics provides a Flutter plugin to use a YOLO .mlmodel in an object detection system

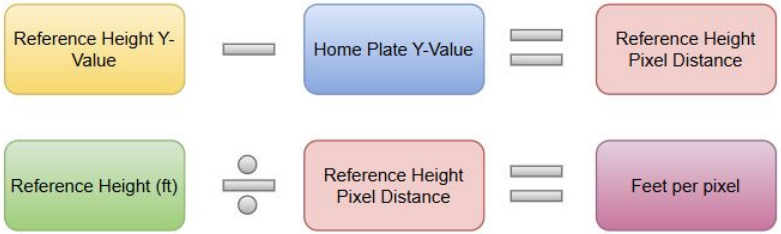


Height Determination Design

Field Calibration

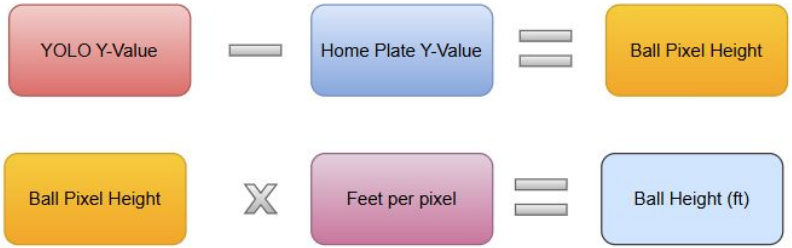
- Use YOLO model to track the ball and collect the coordinates of the home plate, a reference height, and the pitchers mound.

Pixel Conversion Factor



Height Calculation

- Use YOLO model to track the ball and collect the coordinates when pitched

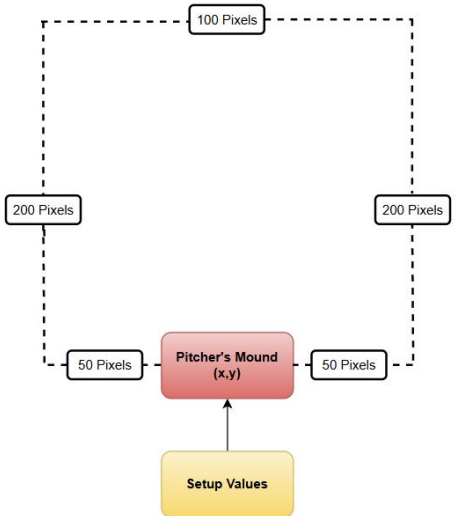


Armed System Design

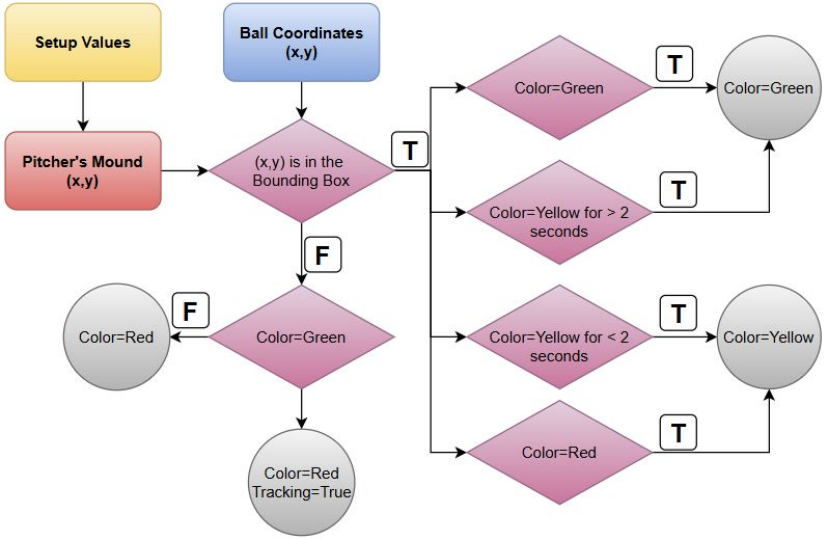
When should we track?

- We should only track the ball when it is thrown towards home plate from the pitcher's mound.

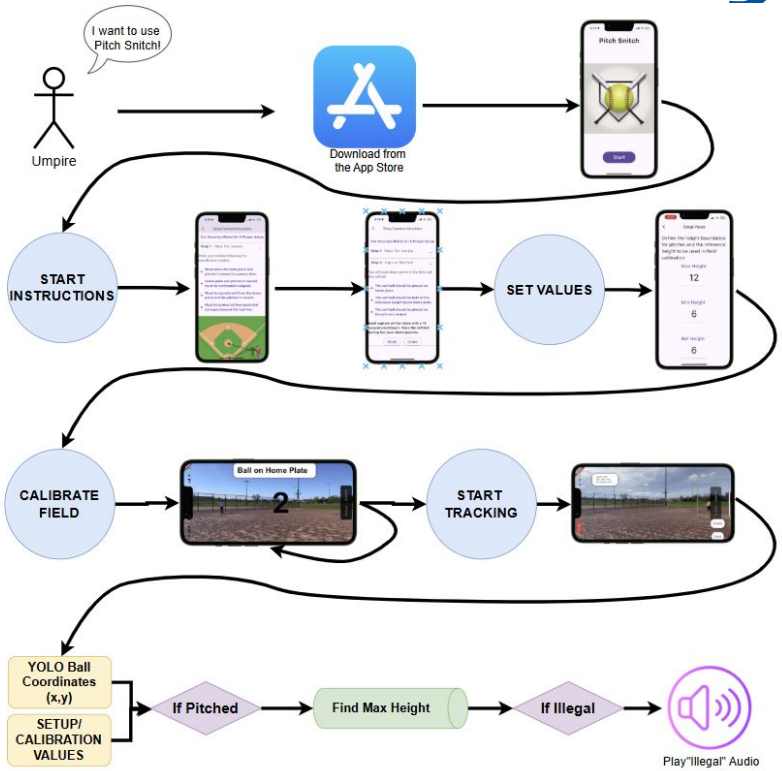
Mapping the Pitcher's Bounding Box



Red/Yellow/Green Arming

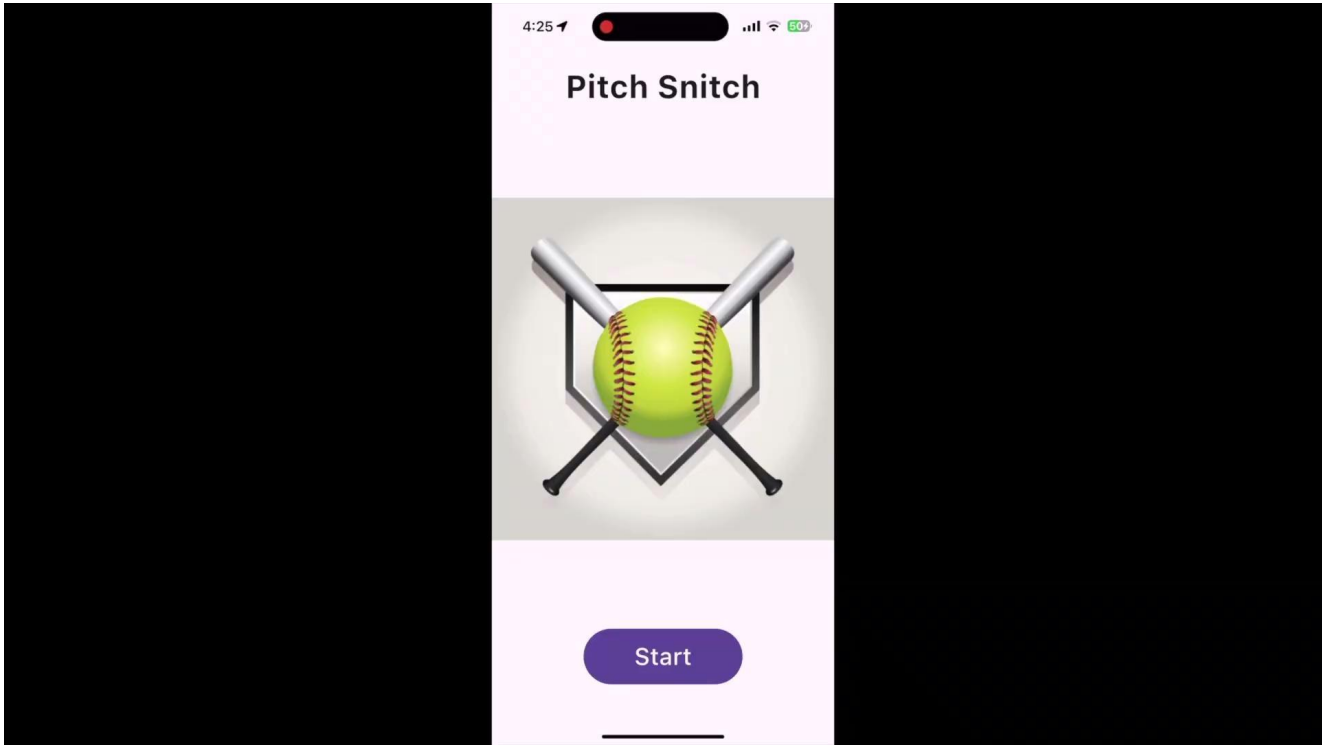


Our Modular Design



Video Demo

Video Demo

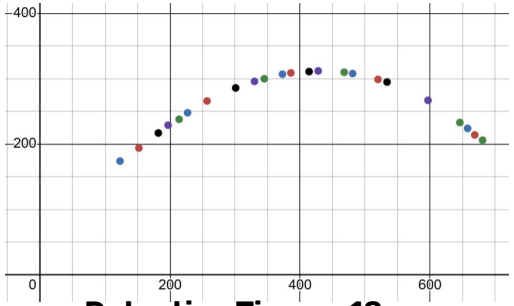


Testing

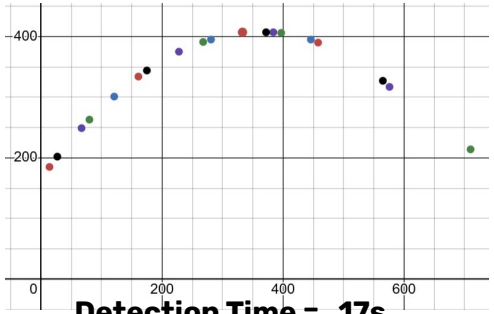
Model Testing

- Test pitches were conducted with tracking enabled when the ball left the pitcher's mound.
- The graphs show all points where the YOLO model detected the ball from the pitch (right→left).
- Graphs show consistent tracking with a perfect parabolic shape.

(Actual Max Height Time) - (Detected Max Height Time) = Detection Time



Detection Time = .18s



Detection Time = .17s

User Testing

Players of the **Iowa State Softball Club** volunteered to test out our application having played several slow-pitch games.

Each player was asked to read the instructions and set up the application to be “tracking ready”

- **The average setup time was 2 minutes and 15 seconds**

The players then threw several pitches to observe the illegal output. Player’s not throwing pitches observed the tracking screen.

Feedback was given after testing from the players.

- **“The setup was very simple”**
- **“Seemed pretty accurate”**
- **“The ‘illegal’ sound didn’t seem very loud”**
- **When the model loaded in, it couldn’t find the ball right away.**
- **More clear instruction of when to mount the phone would be helpful.**

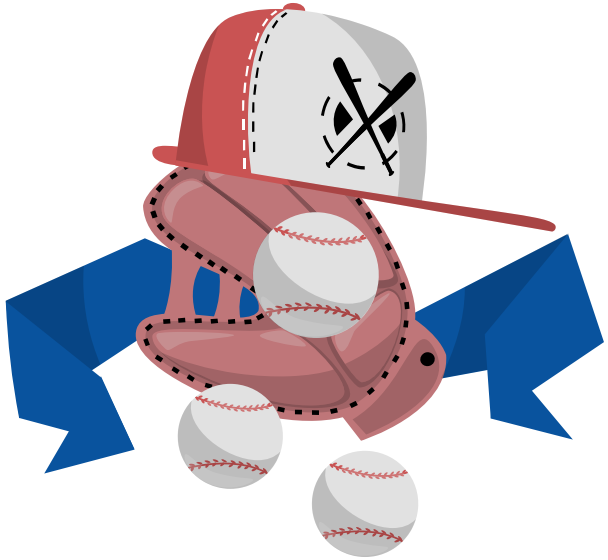
We asked: “Would you trust Pitch Snitch over an umpire?”

Unanimous “YES”

Plans for the future

The main components for our application are functional but not deployment-ready. Key considerations for the future contain.

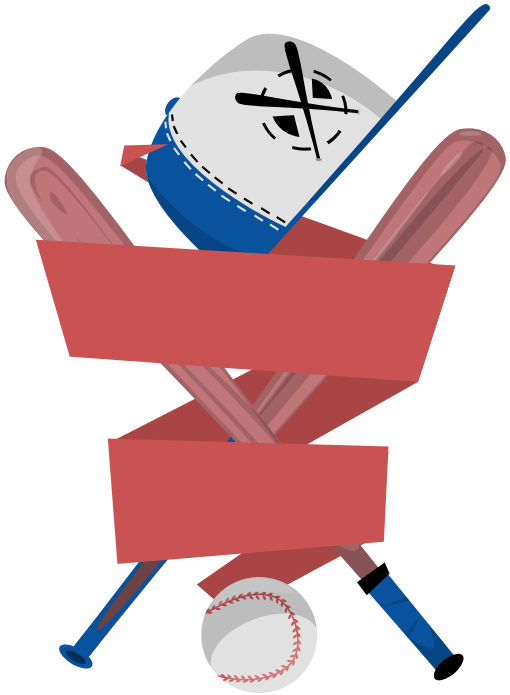
- Retrain a YOLO model on a variety of fields/lightings.
- Rigorously test the height accuracy.
- Stress test the system for faults and bugs.
- Add a ‘Review’ tool to analyze the past pitches



Conclusion

Our Solution Offers:

- Portable and affordable product available to all iOS users
- Simplistic, adaptable, and efficient setup process
- Detection of a **pitched** softball and deduction of its maximum height
- Responsive “Illegal” audio played within **.2** seconds of a pitch’s peak height
- **A product softball players trust to use as an officiary tool in games**



Questions?