

The background of the entire graphic is a green field with white grid lines. Various baseball and softball equipment is scattered around the central text box: a pinstriped jersey and pants on the left, a baseball at the top center, a bat at the top right, a catcher's mask at the top right, a glove on the right, a catcher's chest protector at the bottom right, a baseball at the bottom center, and a cap at the bottom left.

# ***Pitch Snitch***

## ***A Slow-Pitch Softball***

### ***Officiary***

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SDMAY25-11 – 492

# 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

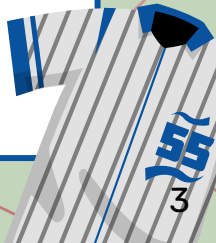
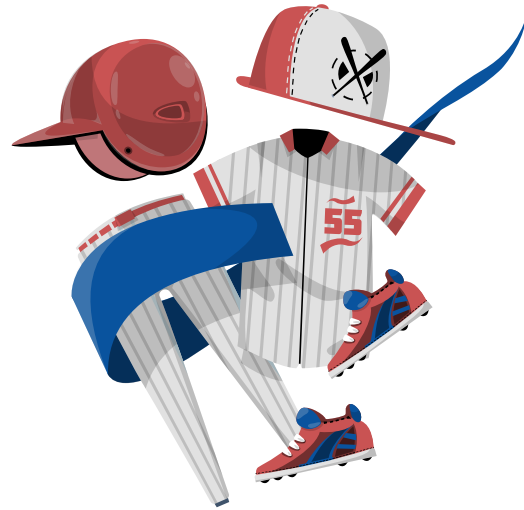


## **Conclusion**

Future Plans and  
Questions

# ***Our Project***

We have developed an **officially 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.

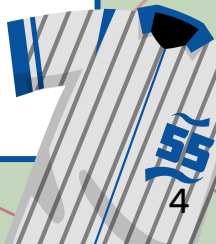
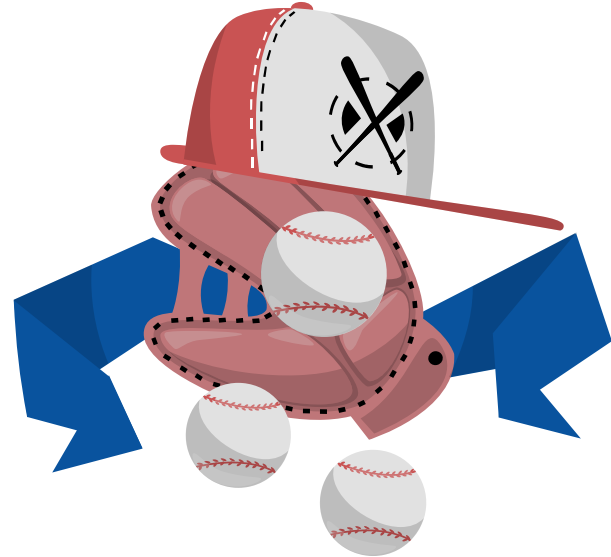
If a pitch is called illegal, the batter has the choice to attempt a hit.

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

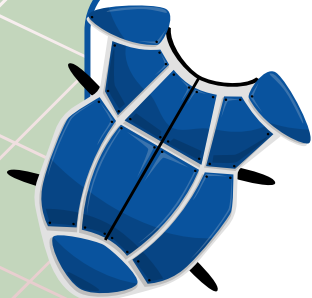
## ***Where our project comes in...***

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

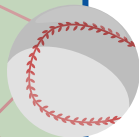


## Spectators

The people and fans watching the games

### Needs

- Preserves the integrity of the game
- Speeds officary 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  $\pm 4$  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
- Can be used on a variety of fields



## ***Audible***

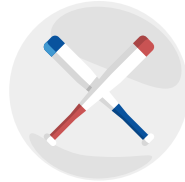
- Must output audible sound if pitch is illegal

# ***Ethical Considerations***



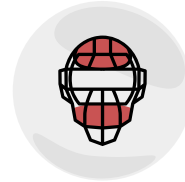
## ***Social Responsibility***

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. Every video is stored on the local device to protect user privacy.



## ***Accessibility***

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



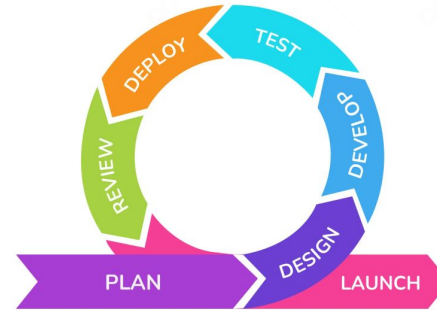
# ***Project Plan***



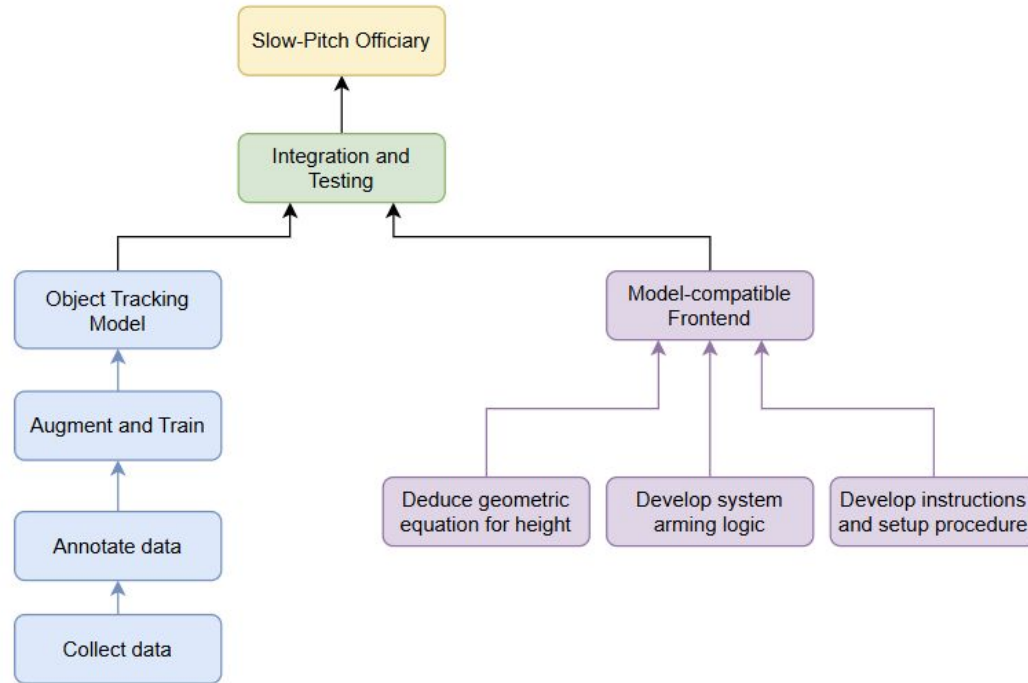
# ***Our Management Style***

## ***AGILE***

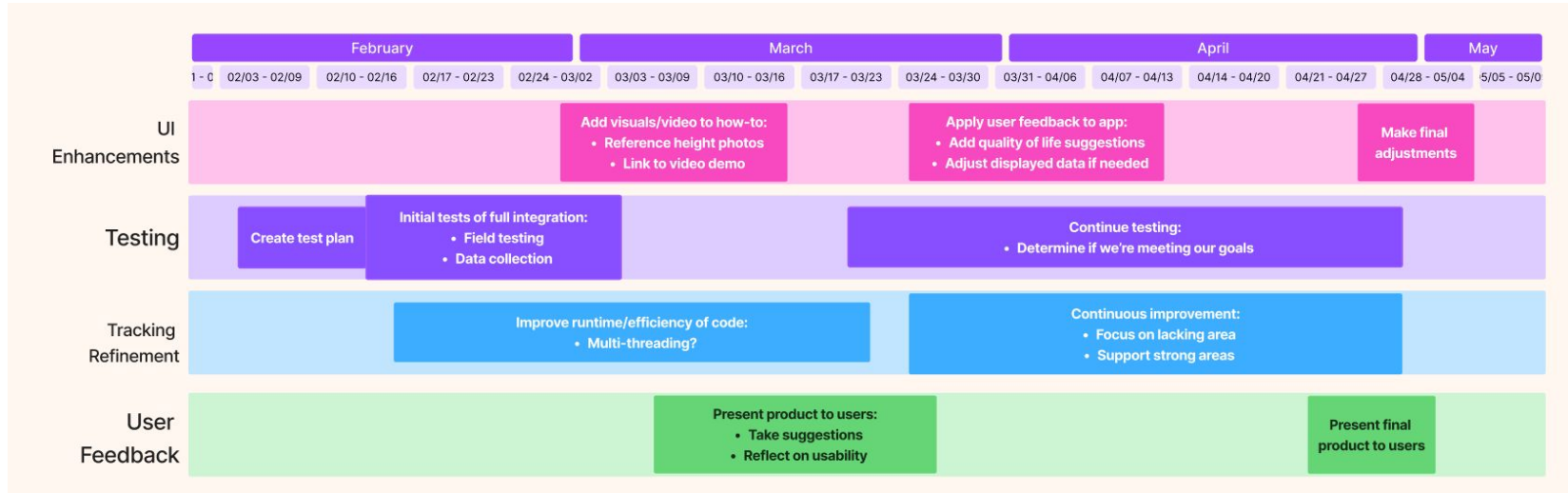
- Organize a weekly standup mentioning our progress, setbacks, and goals.
- Follow the AGILE workflow of Planning, Design, Implementation, and Testing
- Use GitHub branches and GitHub Issues board to showcase progress and individual work.



# 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.



## 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**

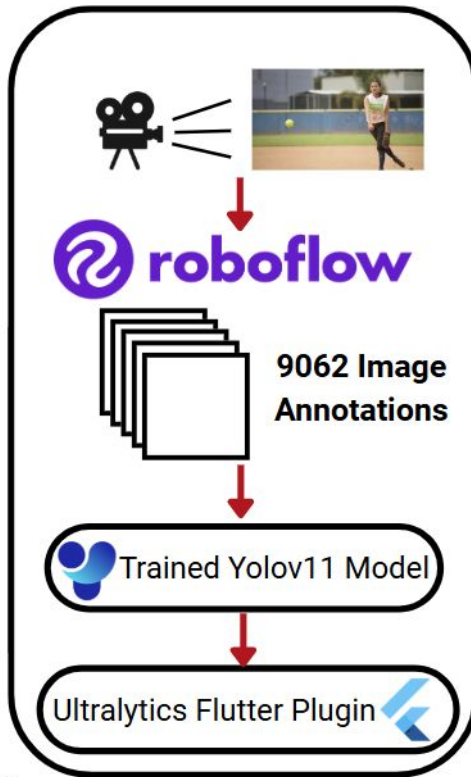
- Greyscale, mirror, and crop augmentations

## 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

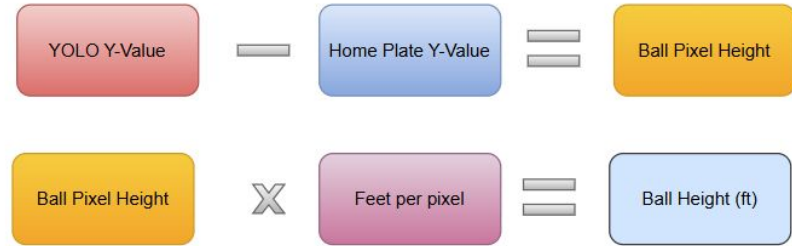
- Use YOLOv8 model to track the ball and collect the coordinates of the home plate, a reference height, and the pitchers mound.

## Pixel Conversion Factor



## Height Calculation

- Use YOLOv8 model to track the ball and collect the coordinates when pitched

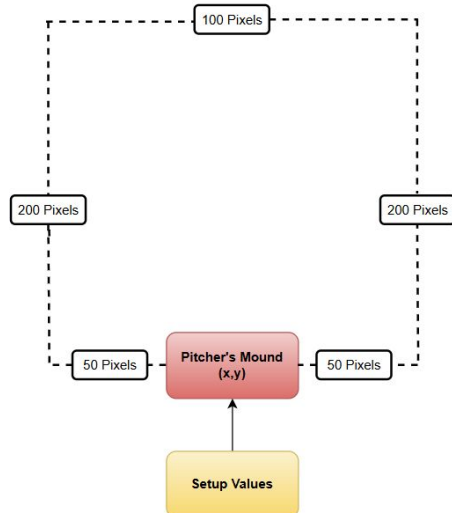


# Armed System Design

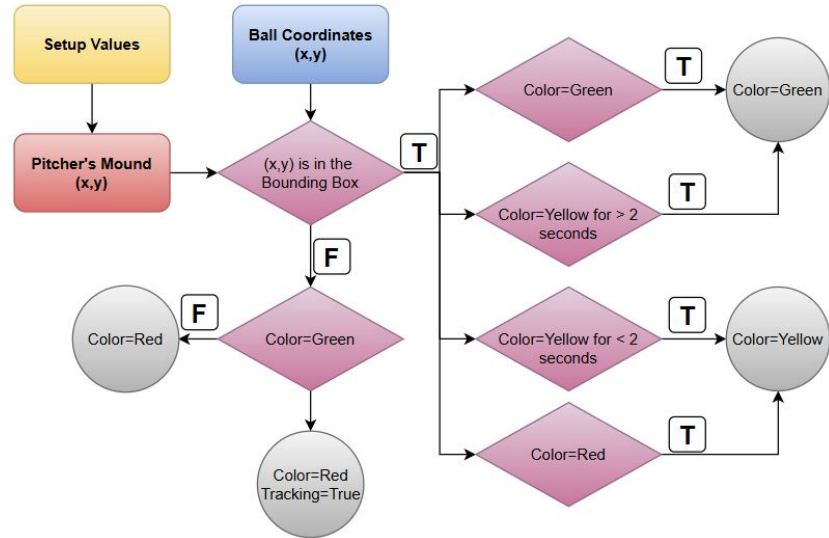
## When should we track?

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

## Mapping the Pitcher's Bounding Box

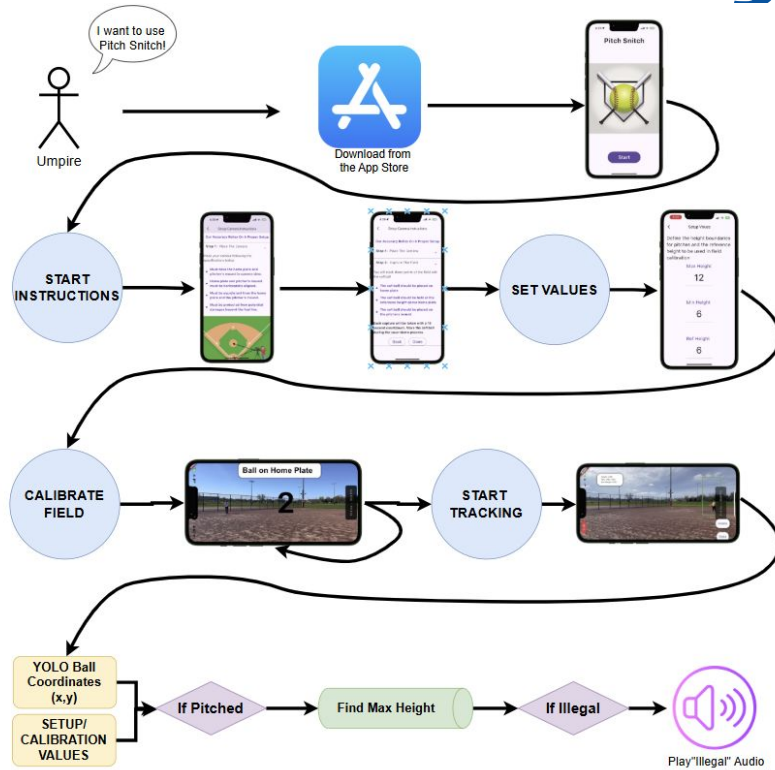


## Red/Yellow/Green Arming

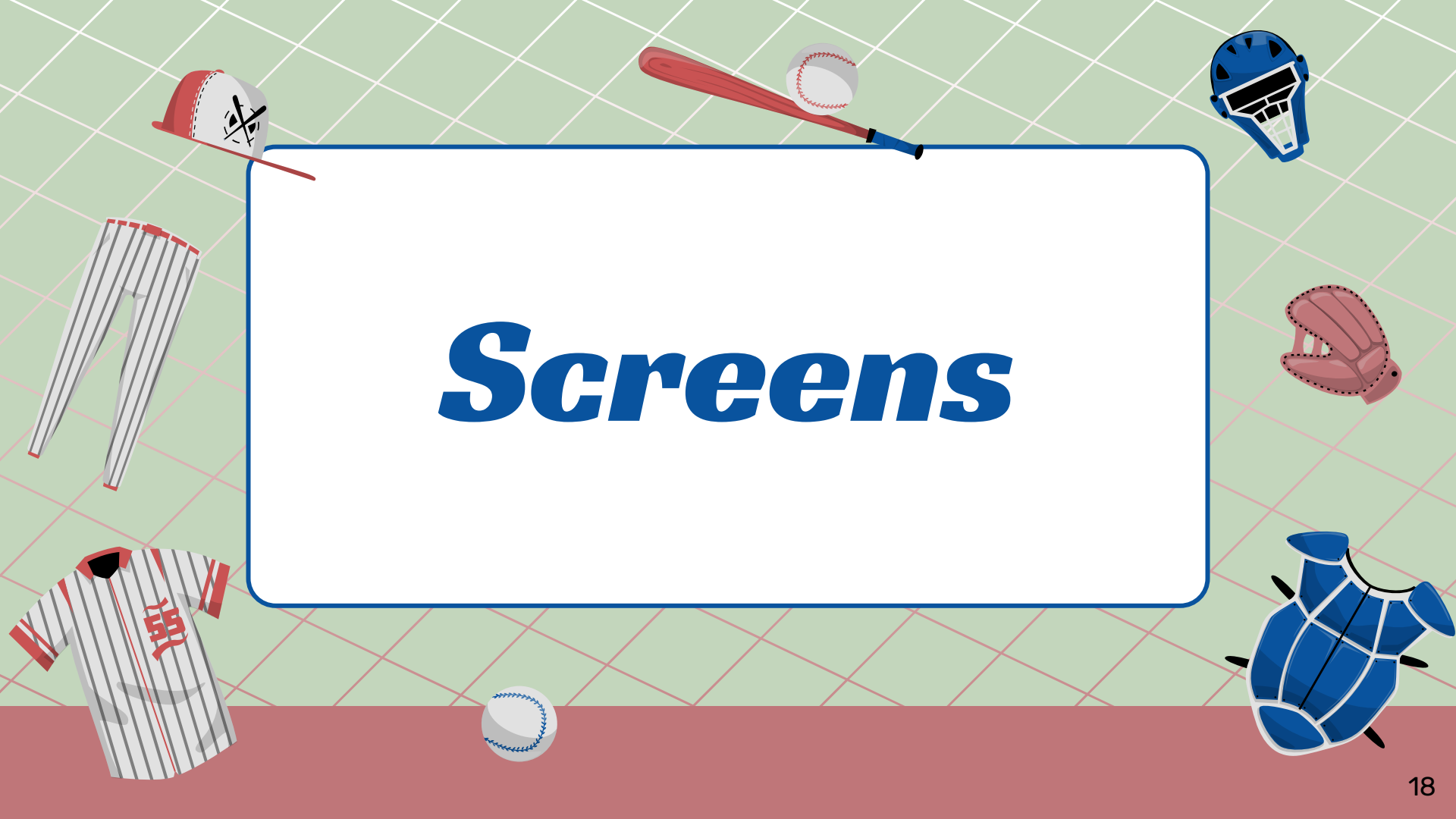




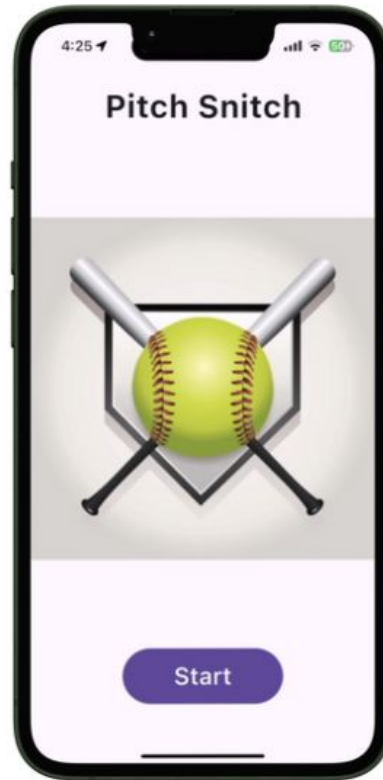
# Our Modular Design



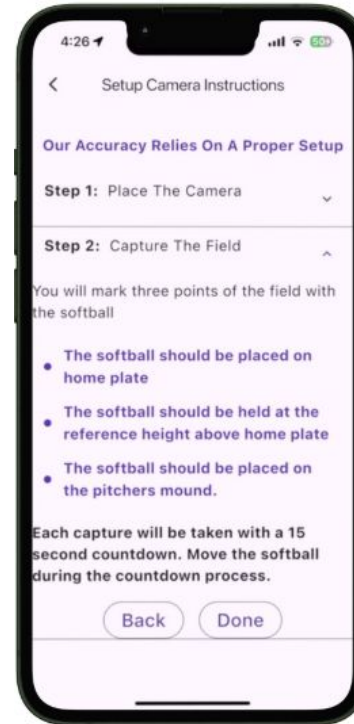
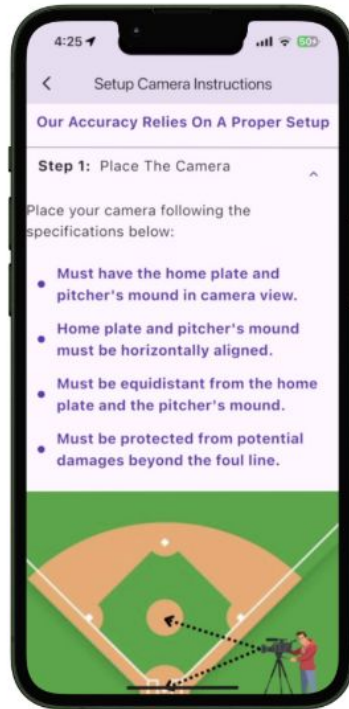
# ***Screens***



# ***Pitch Snitch***



# Screen Design - Setup Instructions



# Screen Design - Setup Values

5:33

< Setup Values

Define the height boundaries for pitches and the reference height to be used in field calibration

Max Height

12

Min Height

6

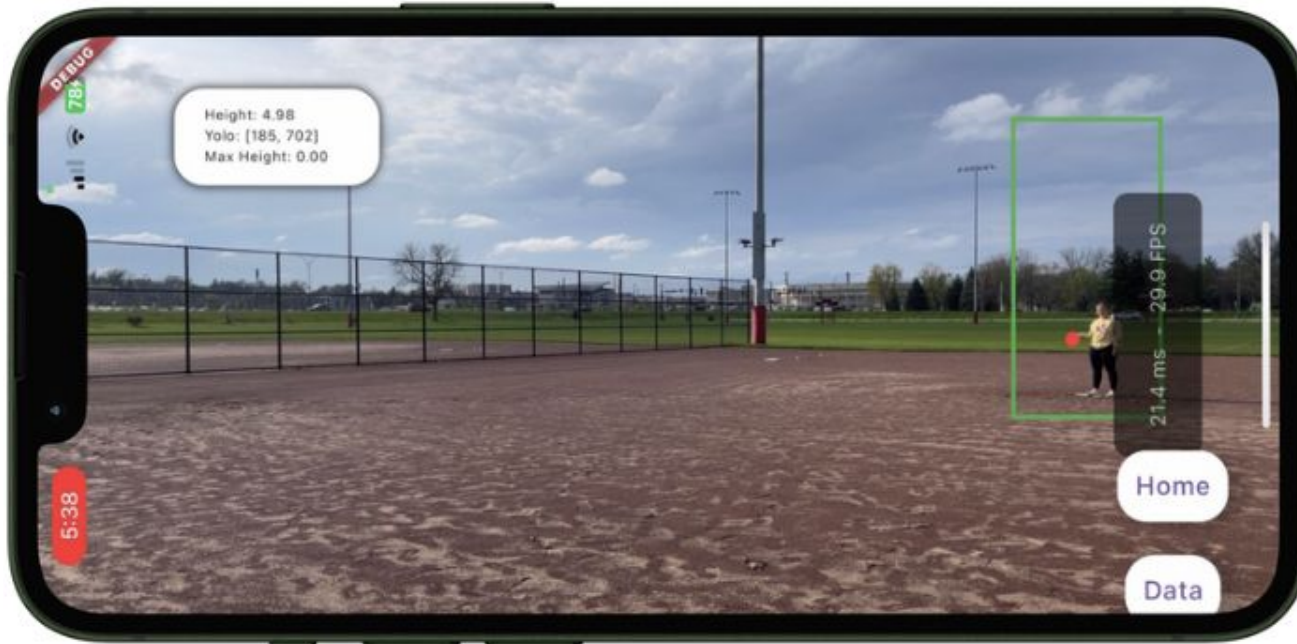
Ref Height

6

# ***Screen Design - Field Capture***



# Screen Design - Tracking Screen

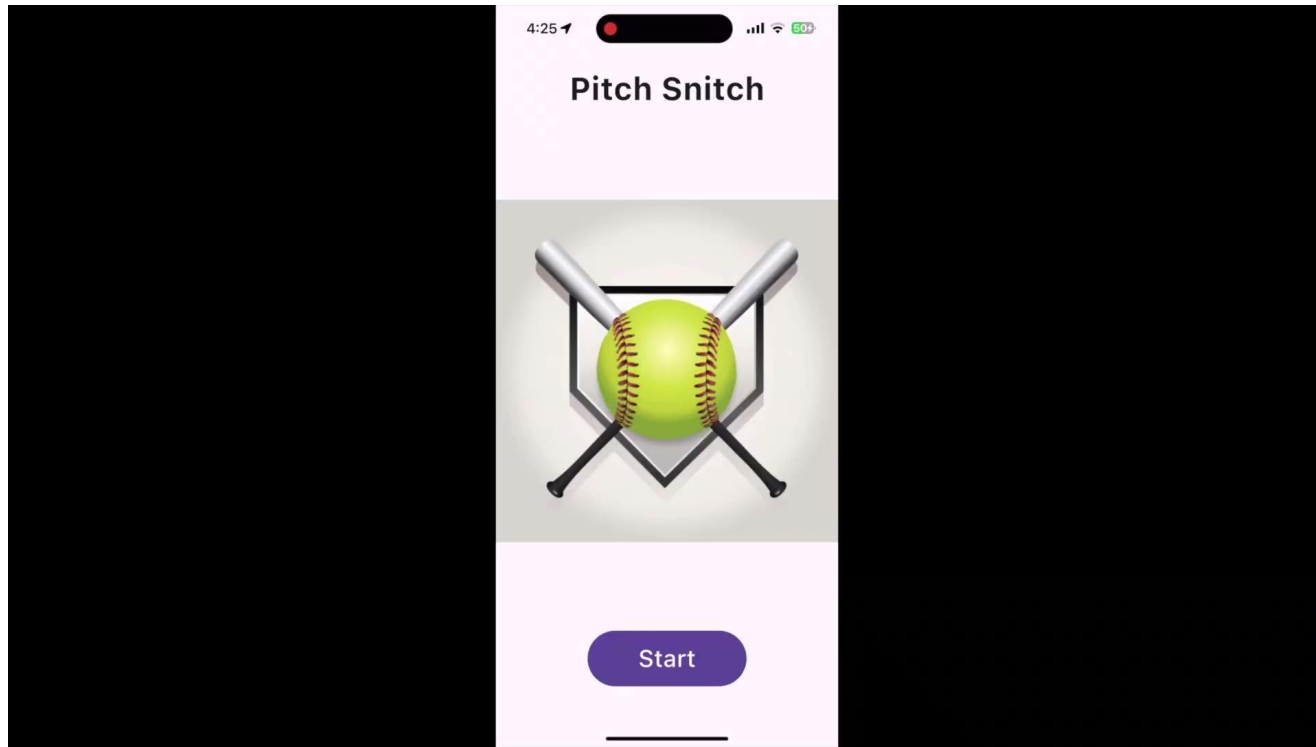




# ***Video Demo***



# Video Demo



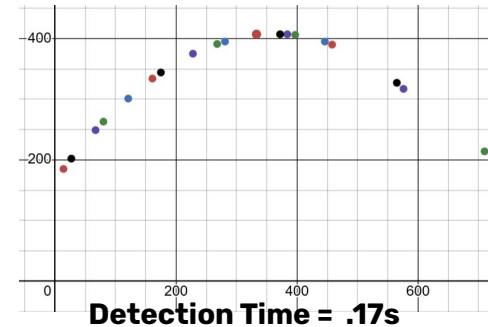
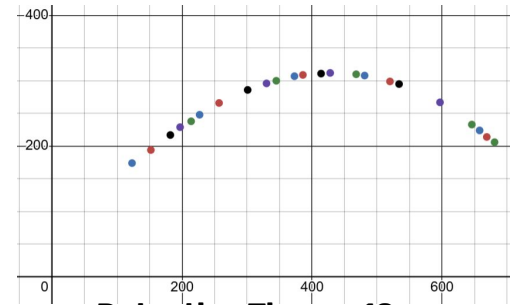


# ***Testing***

# 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.

$$\begin{aligned} &(\text{Actual Max Height Time}) - (\text{Detected Max Height Time}) \\ &= \text{Detection Time} \end{aligned}$$



# User Testing

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

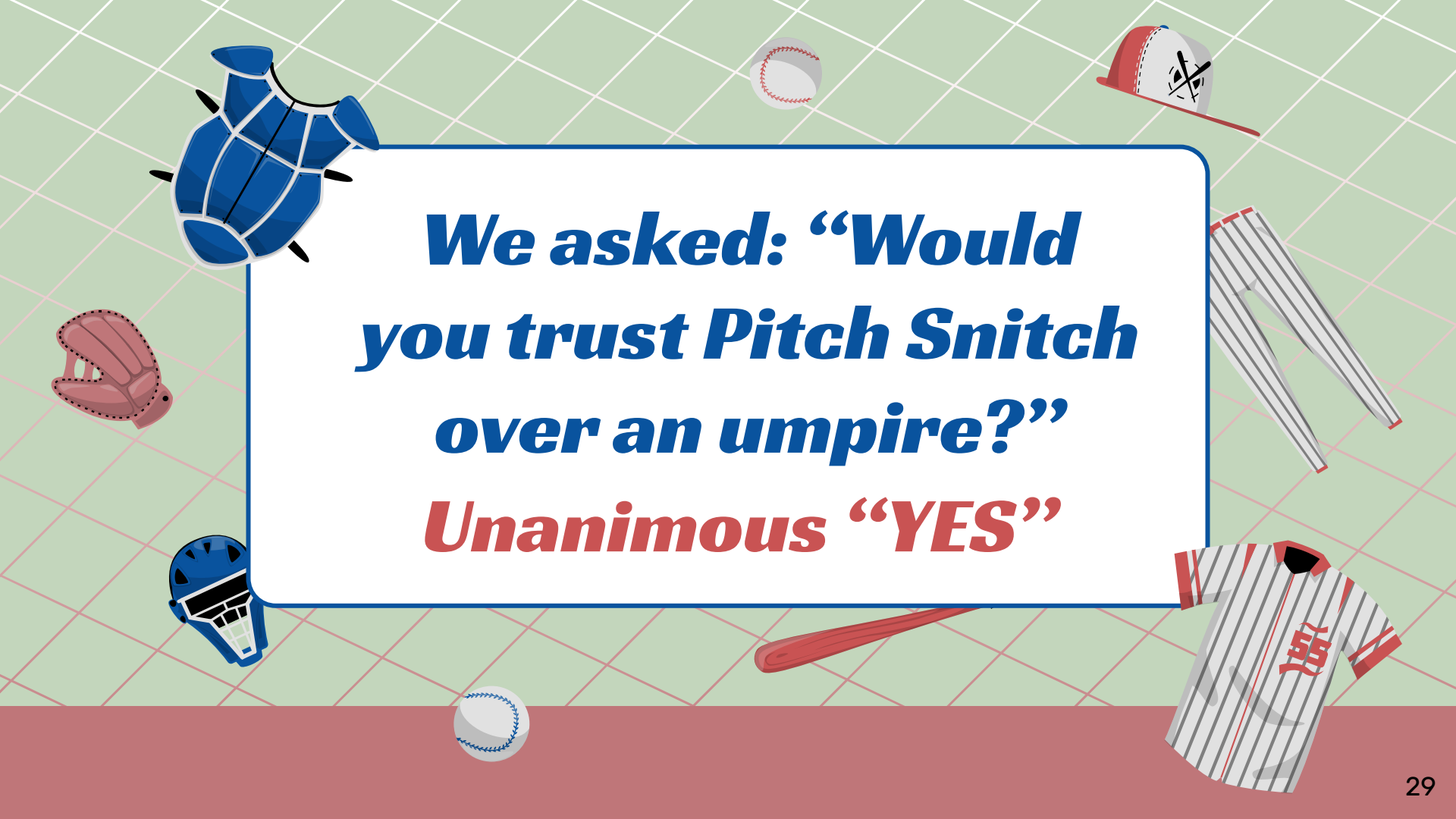
Each player was asked to read the instructions and set up the application to be “tracking ready”

- **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.**

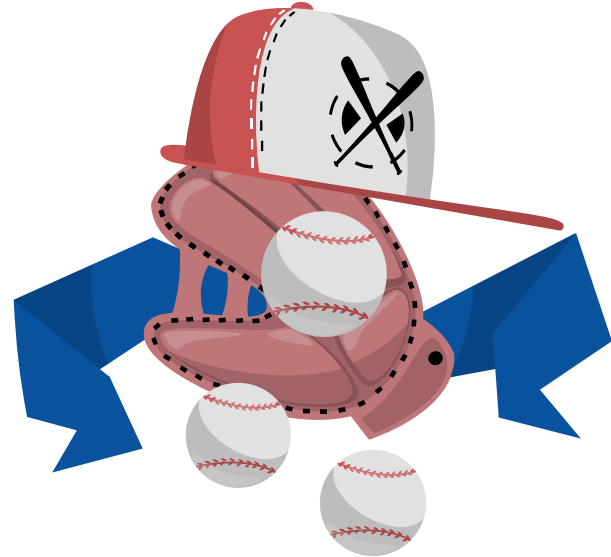
The background is a green field with white grid lines. Various baseball-related items are scattered around a central white text box with a blue border. These items include a blue catcher's mitt in the top left, a red and white baseball in the top center, a red and white baseball cap in the top right, a red and white striped baseball bat in the middle right, a red and white striped baseball jersey in the bottom right, a red and white baseball in the bottom center, a red and white baseball glove in the middle left, and a blue catcher's mask in the bottom left.

***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 officary tool in games**

