Sprinter Data

Team S21

Enhance performance, maximize potential.

Team Introductions

Dylan Cedeno
Project Manager

Marc Griffiths
Design Engineer

Jordan Noyes
Quality Engineer

Handy A Pierre
Research Engineer

Edwin Ulysse
Data Engineer

Sponsor and Advisor

<u>Sponsor</u>
FAMU-FSU College of Engineering
Academic Institution

<u>Academic Advisor</u>
Jonathon Clark, Ph.D.
Associate Professor

Project Background

Marc Griffiths

Motivation

- Every athlete wants to reach their full potential
- There is no wholistic way for sprinters to accurately measure their performance
  - 1080 sprint only focuses on speed and assistance/resistance
  - Trackman can only be used in golf
- There is also no way for sprinters to predict their performance

Objective

The objective of this project is to create a desirable product that will objectively measure and predict a sprinter's performance

Assumptions

- Range of sprinter heights from 5’6” to 6’4”
- User has prior experience with sprinting
- Sprinter starts in a standard starting block
- Device is used in fair weather
- User will not have access to a power outlet
- Device used on a collegiate approved track
- Consumer is more concerned about accuracy than price

Markets

- Collegiate Track Teams
- Highschool Track Teams
- Fans/Parents
- Professional Running Teams
- Masters Sprinters
- Other Sports

Key Goals

A product that will be desirable for purchase
- Cost effective
- Self-contained
- Minimal hinderance to performance

Predict a sprinter's performance
- Personalized inputs
- Creating trends based on inputs

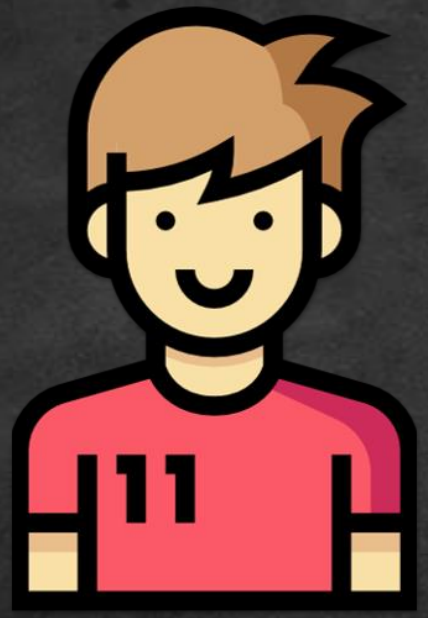
Objectively measure a sprinter's performance
- Takeoff form
- Instantaneous velocity

Needs, Functions, and Targets

Jordan Noyes

Customer Background

Personas



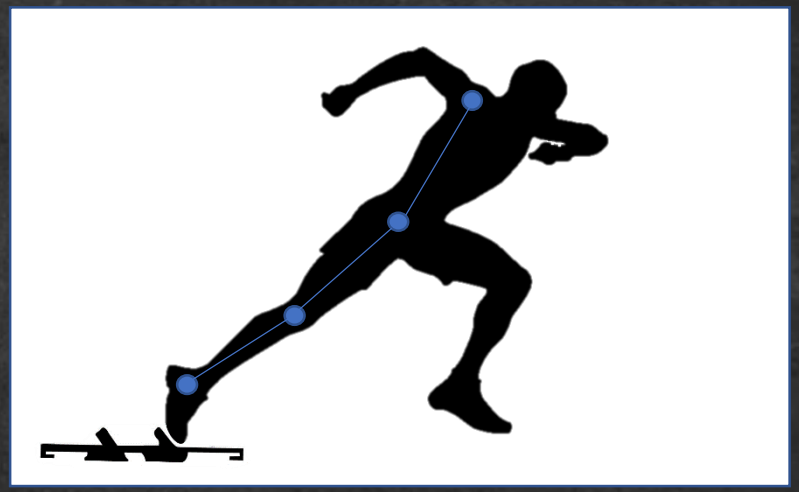
Sprinter

Coach

Scout

Functions and Targets

- Function: Gauge the line of attack
- Target: Accurate within 2%

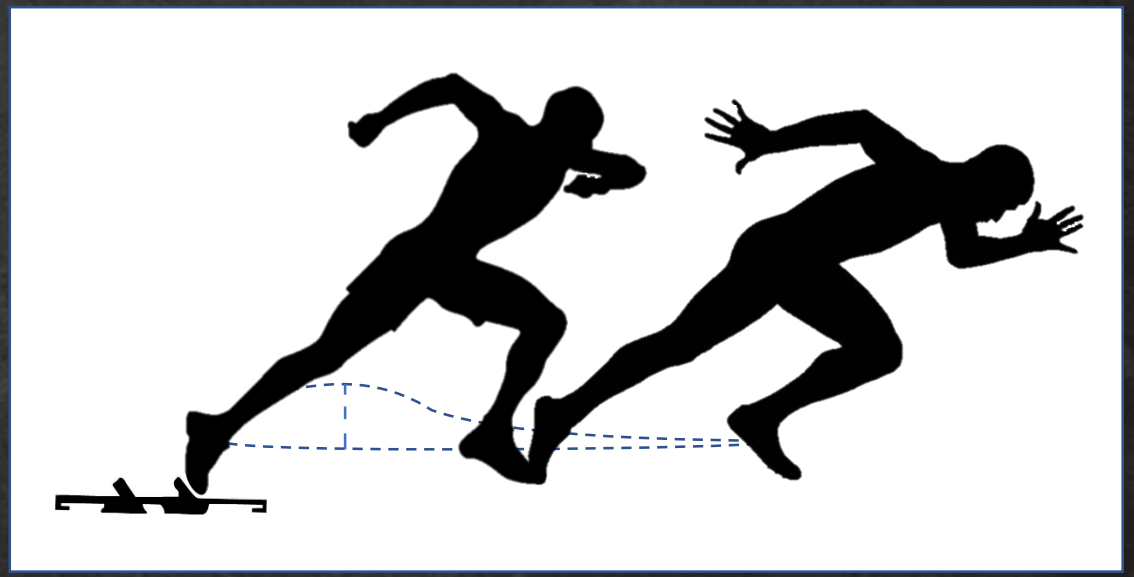


Angle between joints (degrees)

Jordan Noyes

Functions and Targets

- Function: Observe the second step and associated stride length
- Target: Accurate within 2%



Length of stride and height of second step (meters)

Jordan Noyes

Functions and Targets

- Function: Calculate the impulse out of the block
- Target: Accurate within 2%

Impulse = Force*time (kg*m/s)

Jordan Noyes

Functions and Targets

- Function: Record the starter gun reaction time
- Target: Accurate within 2%

Time it takes to react (seconds)

Jordan Noyes

Functions and Targets

- Function: Track the average velocity throughout the race
- Target: Accurate within 2%

Velocity = length*time (m/s)

Jordan Noyes

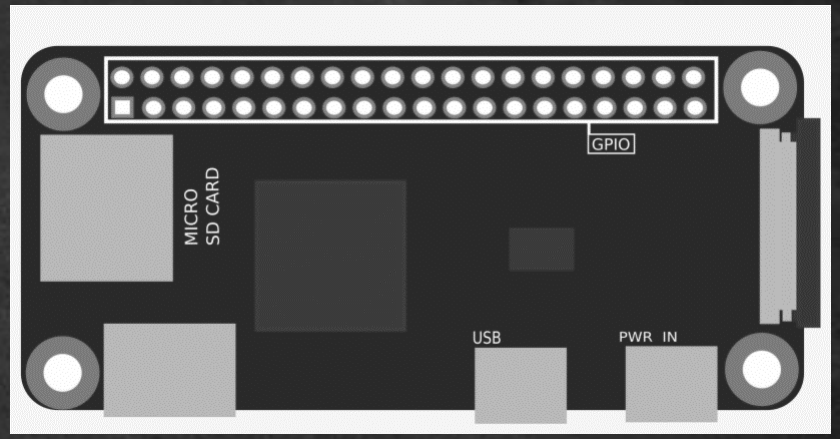
Functions and Targets

- Function: Create trends
- Target: Deliver results within 15 seconds of request time

32 trials for accurate prediction

Functions and Targets

- Function: Store data
- Targets:
  - Video quality of 720 pixels at 60 frames per second
  - Storage uses a maximum of 10 megabytes per trial



Keep user's laptop storage usage to a minimum

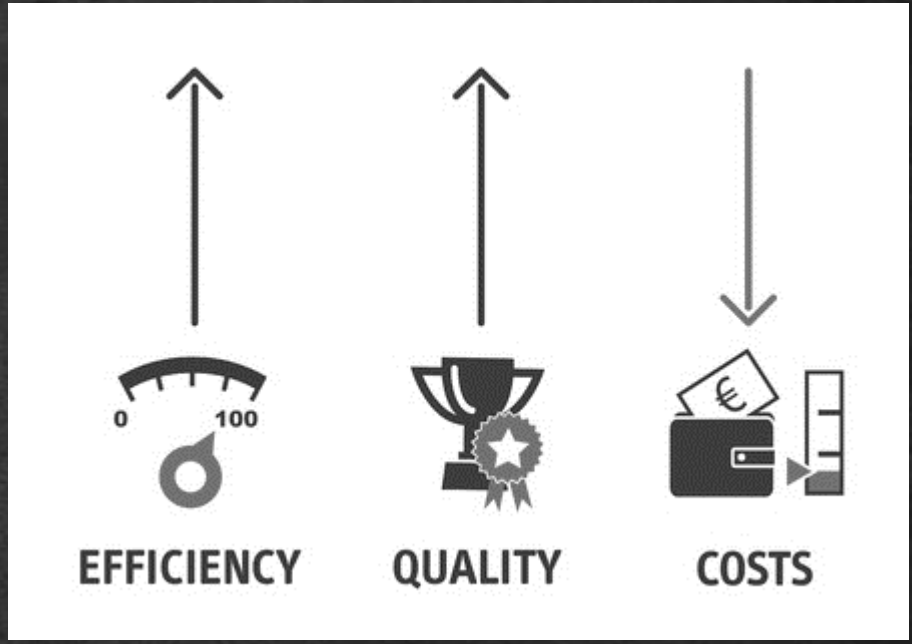
Functions and Targets

- Function: Retrieve personalized inputs
- Target: Inputs stored in under 5 seconds

User's input their weight and height for customized results

Functions and Targets

- Function: Make product cost-effective
- Target: Keep purchase price under $15,000



Affordable for high school and university track teams

Jordan Noyes

Functions and Targets

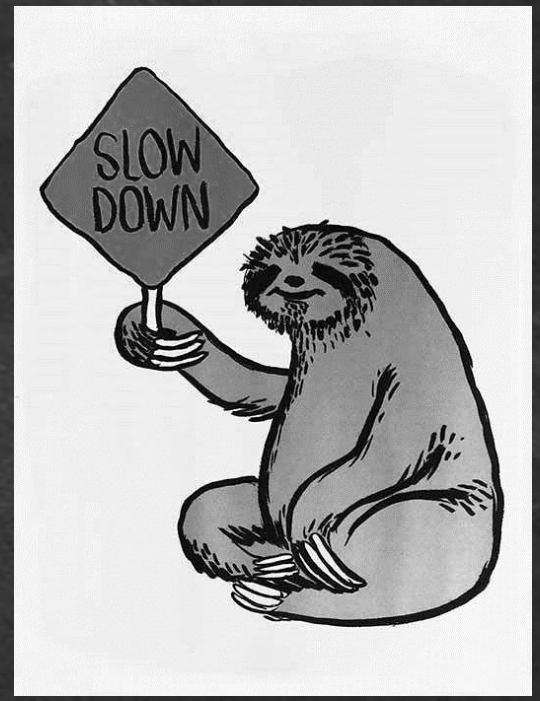
- Function: Product is self-contained
- Target: $0.00 spent outside of product purchase

User does not need to purchase anything outside of product

Jordan Noyes

Functions and Targets

- Function: Product has low hinderance on performance
- Target: Wearable must weigh less than 1 kilogram

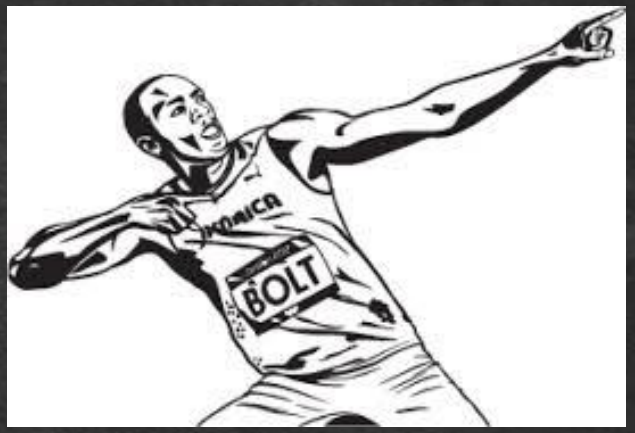


The wearable must not slow down the sprinter

Jordan Noyes

Functions and Targets

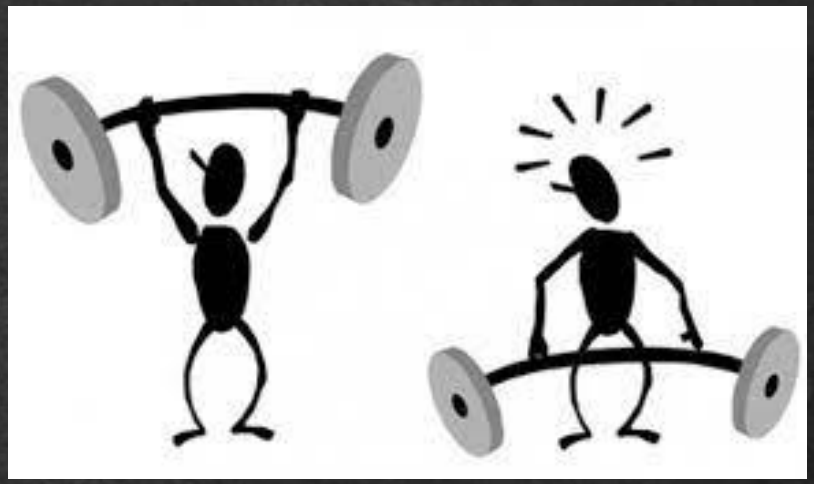
- Need: The tool incorporates professional sprinters for comparison
- Target: At least 5 different professionals



Professional sprinters of different sizes for custom comparison

Functions and Targets

- Need: Product exposes users' weaknesses
- Target: A measurement greater than 5% difference from professional is a potential weakness

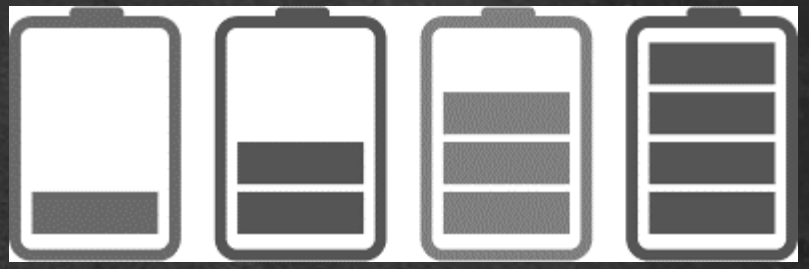


Coaches and sprinters make final decision on how to analyze results

Jordan Noyes

Functions and Targets

- Need: Technology has sufficient battery life
- Target: Device has a battery life of at least three hours



Device will be used daily for at least two hours at a time

Concept Generation and Selection

Handy A Pierre

Concept Generation

Generated over 100 different ideas using
- Biomimicry
- Morphological Flow Chart
- Randomization

Selected 8 total concepts
- High Fidelity
- Medium Fidelity

Selected the best 3
- Tension Cord Training Mechanism
- All Inclusive Technology
- Launch Monitor Pro

Tension Cord Training Mechanism

Functions	Solutions
Average velocity	Tension cord and encoder
Gauge the line of attack	Analyze frames
Product has low hinderance on performance	Lightweight tension cord
Store data	Server
Create trends	Line graphs
Make the product cost effective	Compare to other markets & lay-away

Handy A Pierre

All Inclusive Technology

Functions	Solutions
Average velocity	Laser sensor
Gauge line of attack	Dots on the sprinter
Starter gun reaction time & kickoff force from the blocks	Force sensor on the blocks
Collect data & create trends	Personalized inputs & line graphs
Store data	Compressed folder
Make the product cost effective	Cheaper parts & renting option
Product is self-contained	All parts included
Product has low hinderance on performance	Lightweight wearable

Handy A Pierre

Launch Monitor Pro

Functions	Solutions
Average velocity	Infrared sensor
Gauge line of attack	Dots on the sprinter & take a video
Kickoff force from the blocks	Impulse sensor on the blocks
Observe the second step	Measuring tape
Store data	User's device
Make the product cost effective	Cheaper parts & renting option
Product is self-contained	Default apps on phone/laptop
Product has low hinderance on performance	Lightweight wearable

Handy A Pierre

Concept Selection

Objectively analyzed the concepts

- House of Quality
- Pugh Chart
- AHP

Selected the final concept

House of Quality

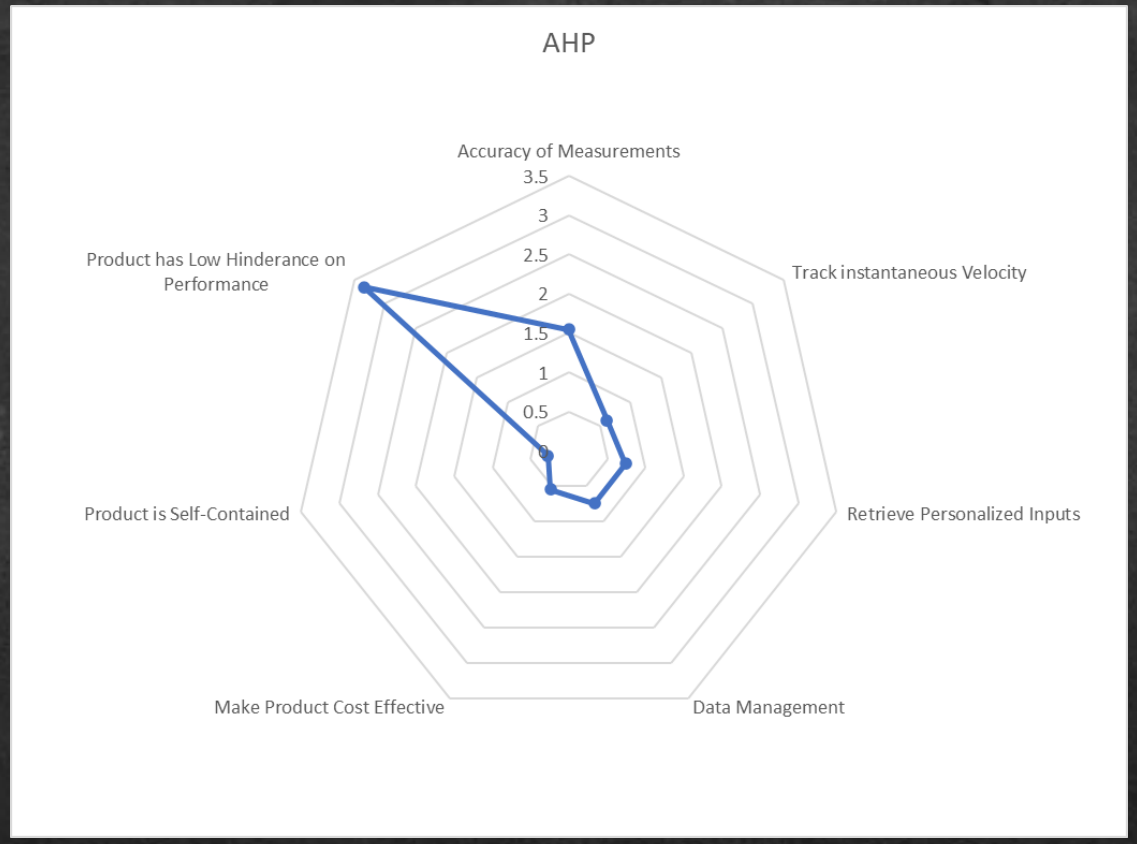
-

Pugh Chart

Pugh Chart 3				
Selection Criteria	4	6	7	8
Gauge Line of Attack	DATUM	-	S	S
Observe Second Step		S	S	S
Calculate Kickoff Force from the Block		S	S	S
Record Starter Gun Reaction Time		S	+	+
Track Instantaneous Velocity		-	S	S
Retrieve Personalized Inputs		+	S	S
Collect Data		S	S	S
Store Data		S	-	-
Create Trends		-	S	-
Make Product Cost Effective		+	+	-
Product is Self-Contained		S	S	S
Product has Low Hinderance on Performance		-	S	S
# of pluses		2	2	1
# of Minuses		4	1	3

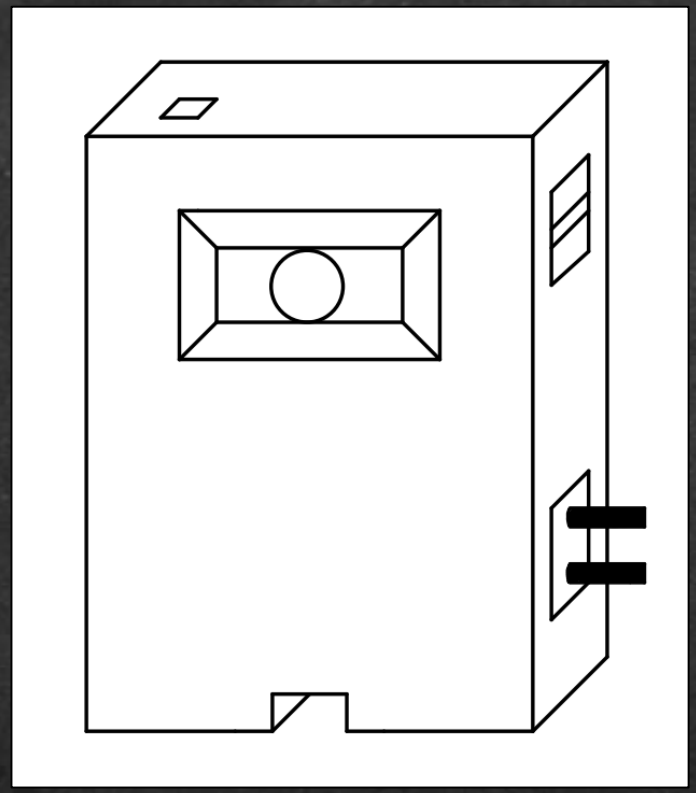
Handy A Pierre

AHP


AHP
Accuracy of Measurements
3.5
3
2.5
2
1.5
1
0.5
0
Track instantaneous Velocity
Retrieve Personalized Inputs
Data Management
Make Product Cost Effective
Product is Self-Contained
Product has Low Hinderance on Performance

Selected Concept

Launch Monitor Pro

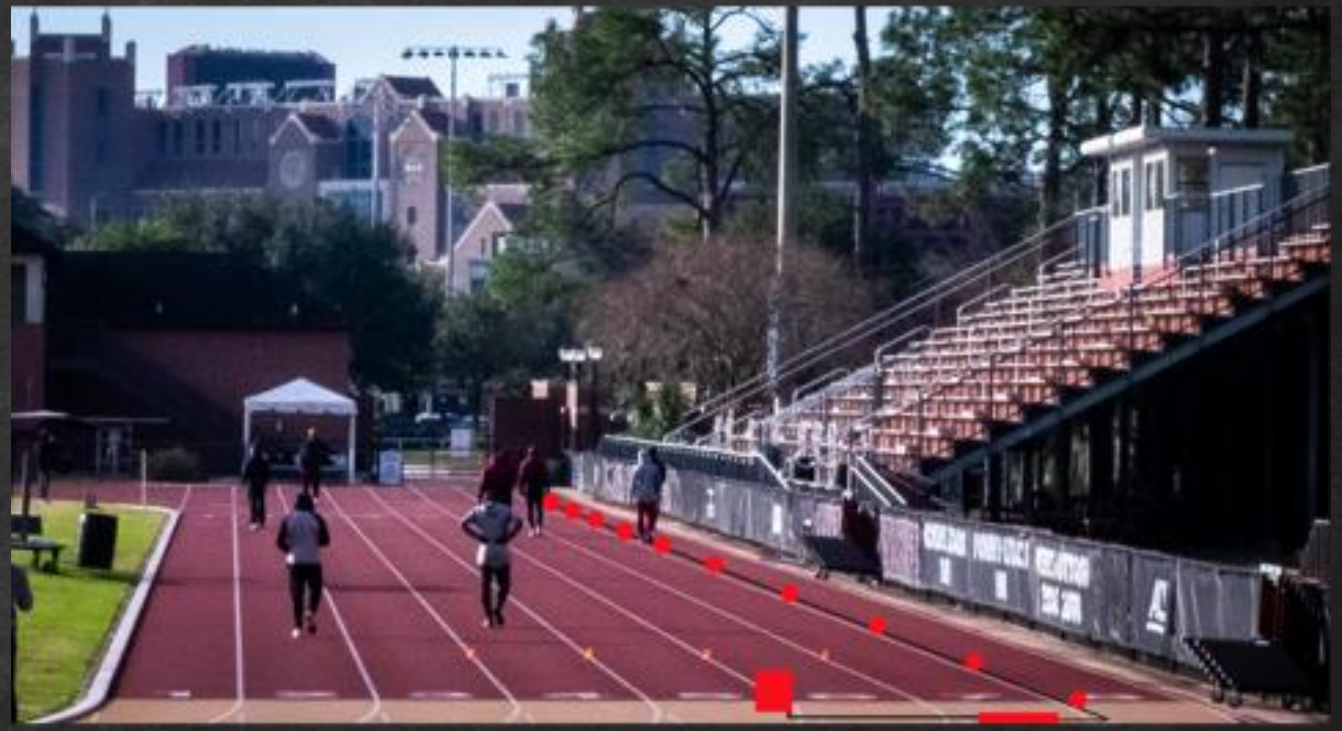


Detailed Design

Dylan Cedeno and Edwin Ulysse

Track Overview

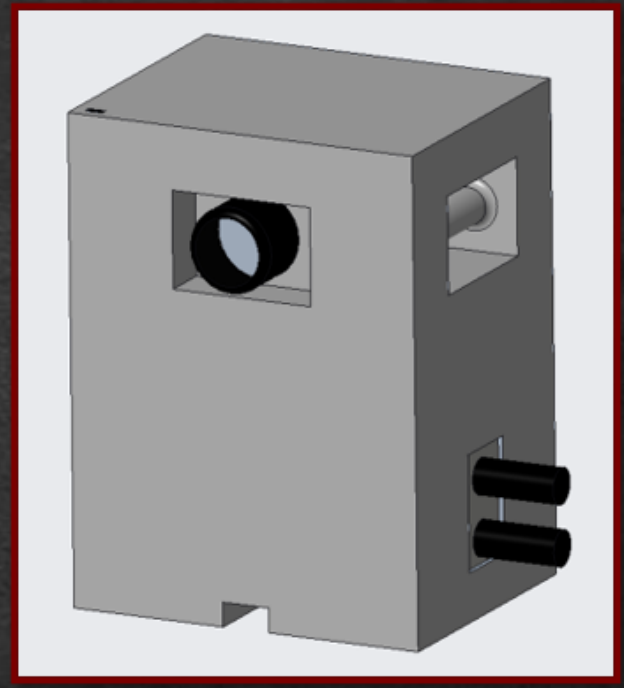
- Base Station
  - High Speed Camera
  - Processor
  - Power Supply
- Impulse Sensors
- Infared Sensors



Dylan Cedeno

Base Station

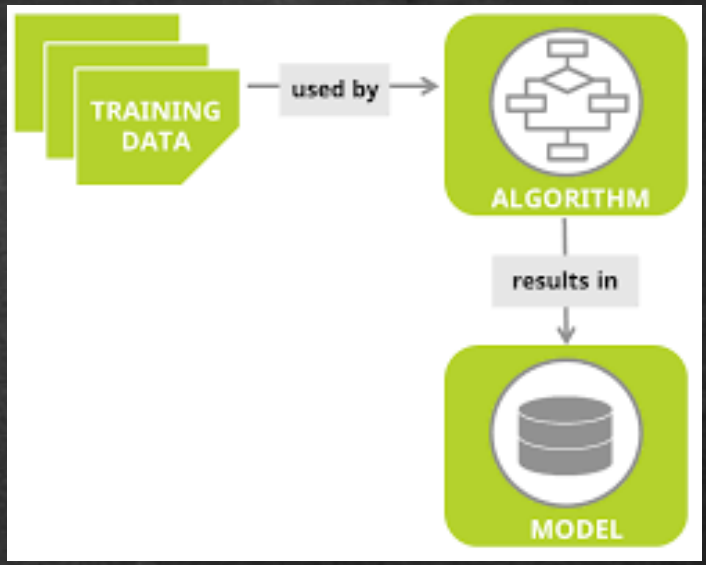
- High speed camera
  - Line of Attack
  - Second Step
- Processor
  - Readings from IR Sensors
  - Readings from impulse sensors
- Power supply
  - No power drain from user laptop



Dylan Cedeno

Prediction Model

- Personalized inputs
- Access and explore data
- Preprocess data
- Develop model
- Integrate analytics with systems



Edwin Ulysse

Prediction Model

Personalized Inputs

- Manual personalized inputs
    1. Personal database
    2. From sensors
    3. Take measurements
- Saved to user profile

Prediction Model

Access and Explore Data

- Import data
- Historical data
- Database or spreadsheets

Prediction Model

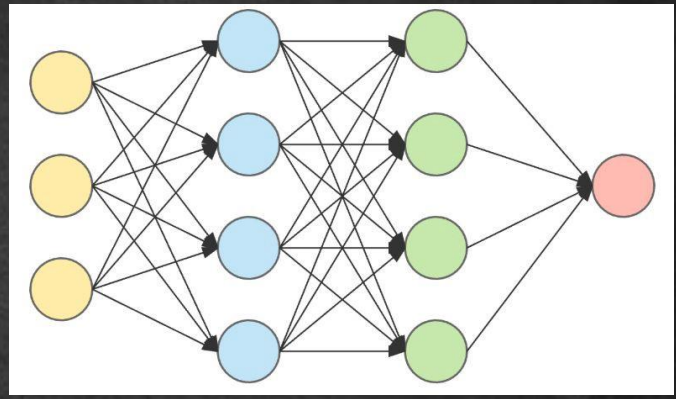
Preprocess Data

- Clean data & remove outliers
- Combine data sources
- ANOVA testing
  - Correlation between independent variables
  - Line of attack, stride length, etc.

Prediction Model

Develop Model

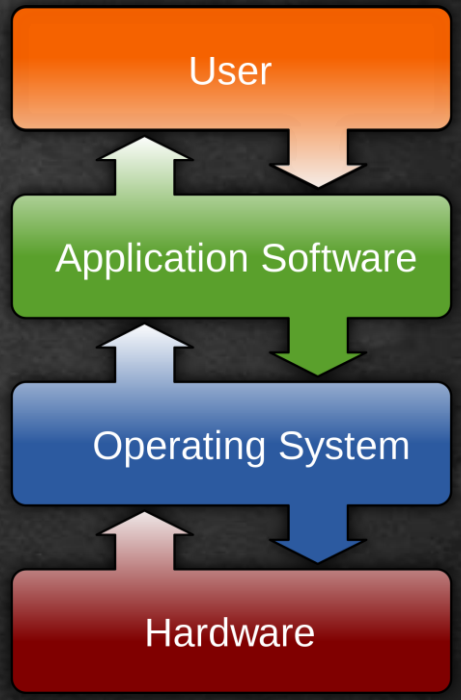
- Statistics software (Power BI, Minitab, Python)
- Access historical data
- Train model with neural networks



Prediction Model

Integrate Analytics with Systems

- Python
- Software application (UI/UX)
- Hardware (Raspberry Pi)



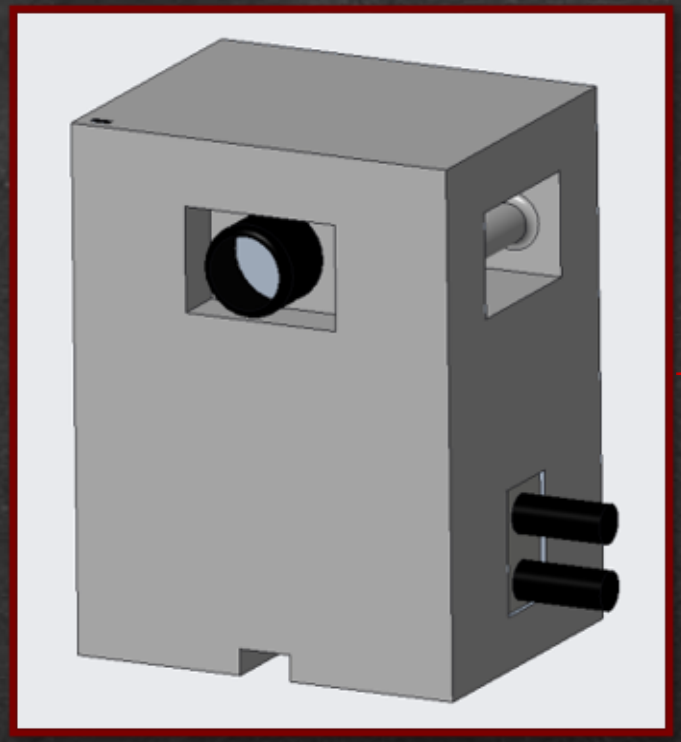
Concept Validation

Dylan Cedeno, Handy A Pierre, and Edwin Ulysse

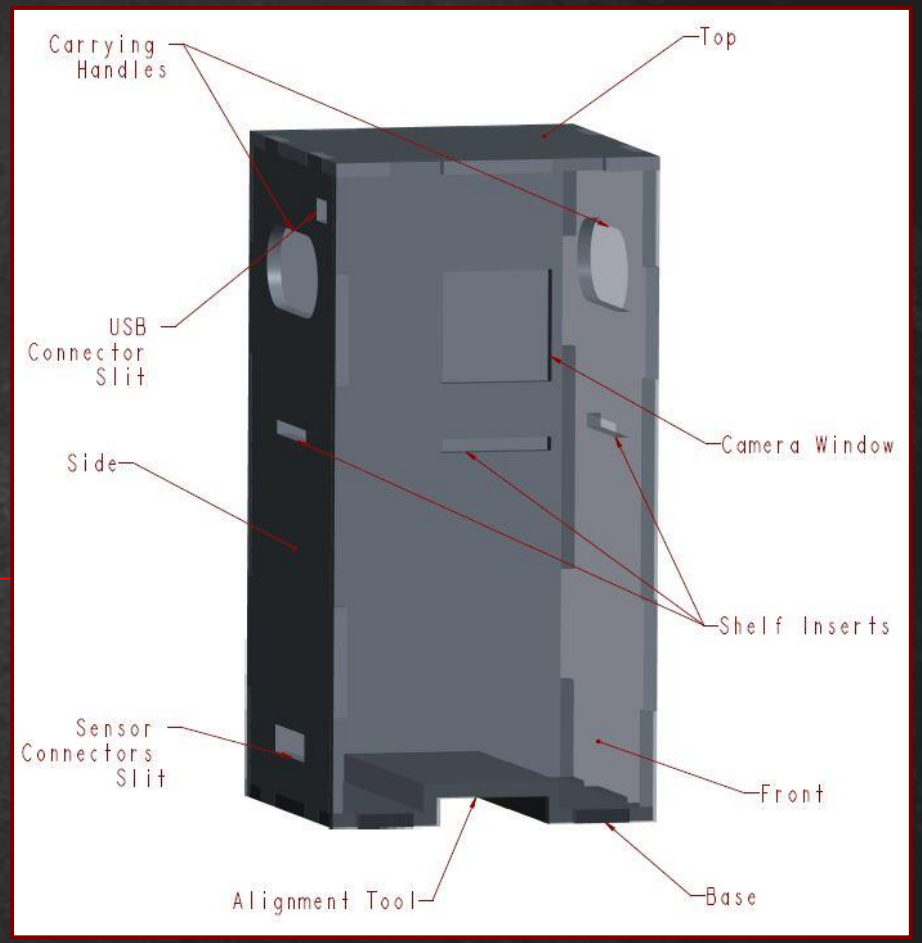
Base Station

CAD Model

- Maintained same basic principles with small changes for functionality
- Main Changes
  - Proportions
  - Carry Handles
  - USB locations



Preliminary Rendering



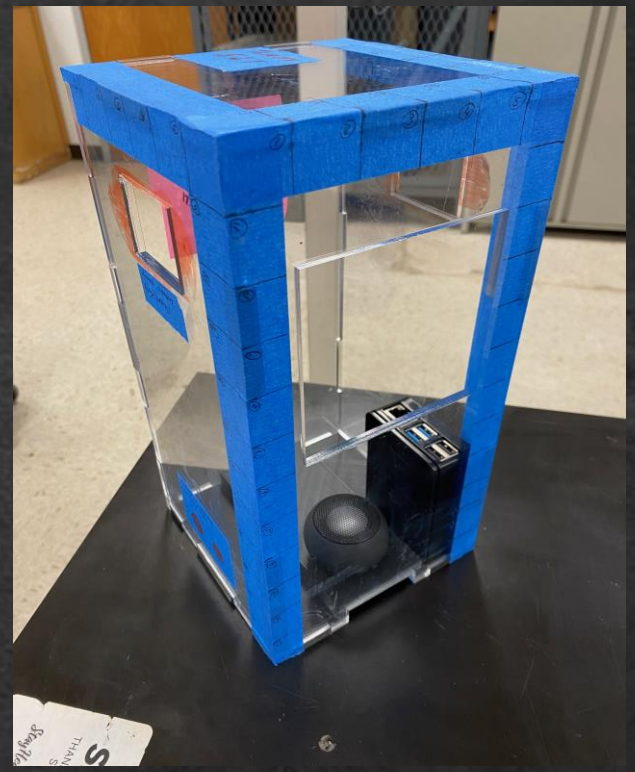
Final CAD Assembly

Dylan Cedeno

Base Station

Modular Prototype

- Created to get an idea of dimensions
- Modularity allowed for movement of shelves
- After tinkering, allowed for a more optimized final concept



Dylan Cedeno

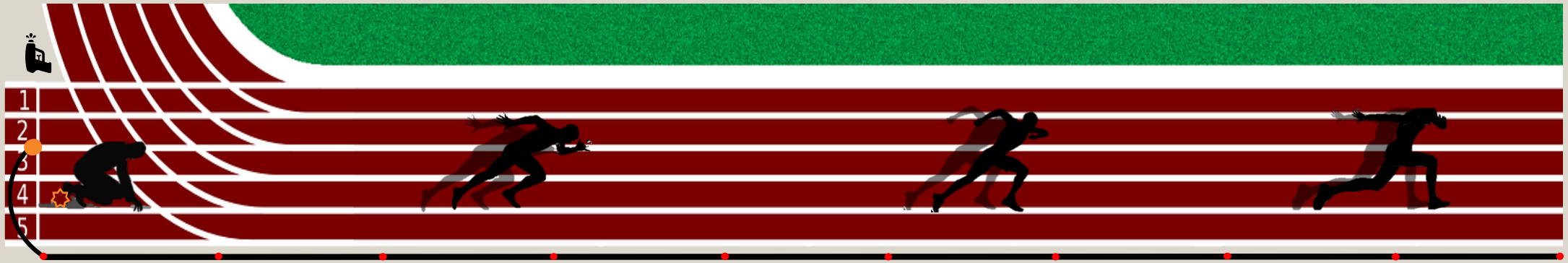
Base Station

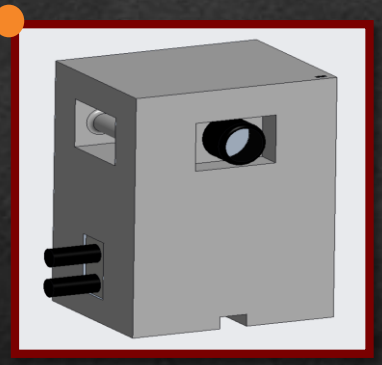
Final Prototype

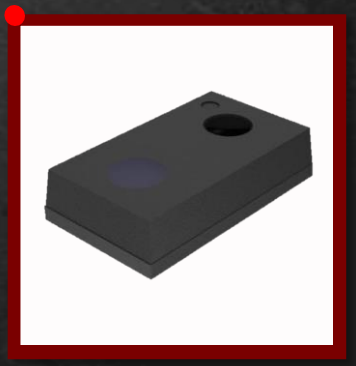
- Houses all components
  - Camera
  - Raspberry Pi
  - Power Supply
  - Wires
- Raspberry Pi still needs to be programmed to accomplish required functions

Dylan Cedeno

Measurements Plan





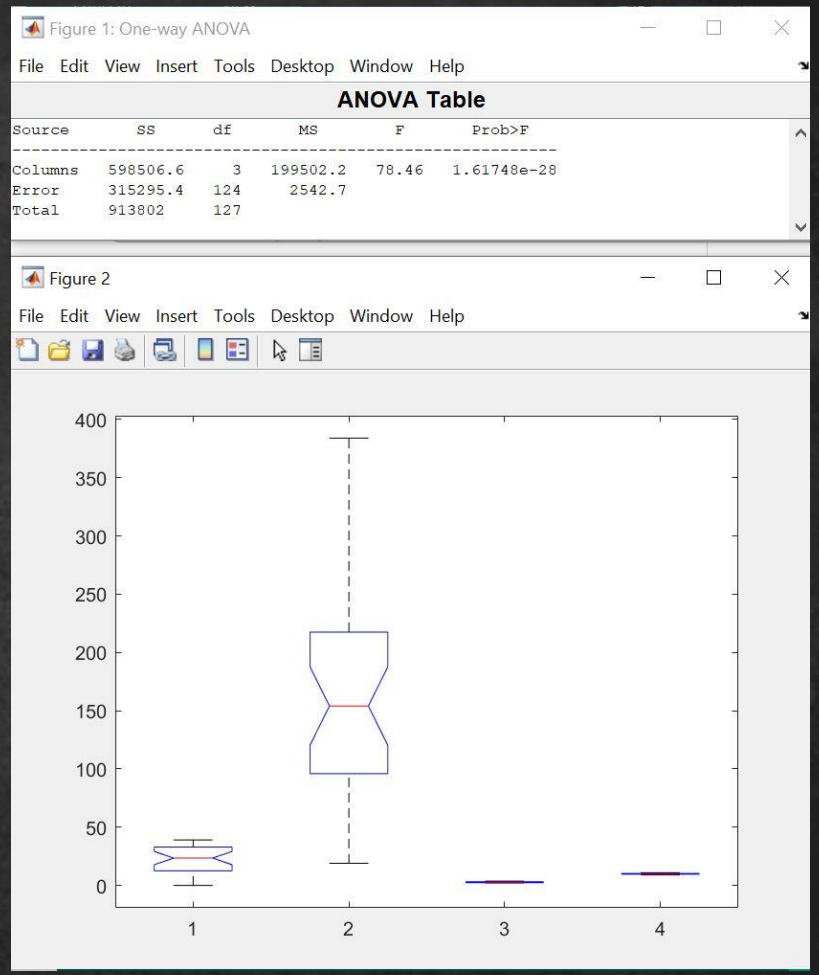


Handy A Pierre

Prediction Model Plan

ANOVA Model

- Will use ANOVA to validate statistical analysis
- Will do 32-36 tests on each sprinter to get accurate results
- Will compare each measurement to time to find correlations

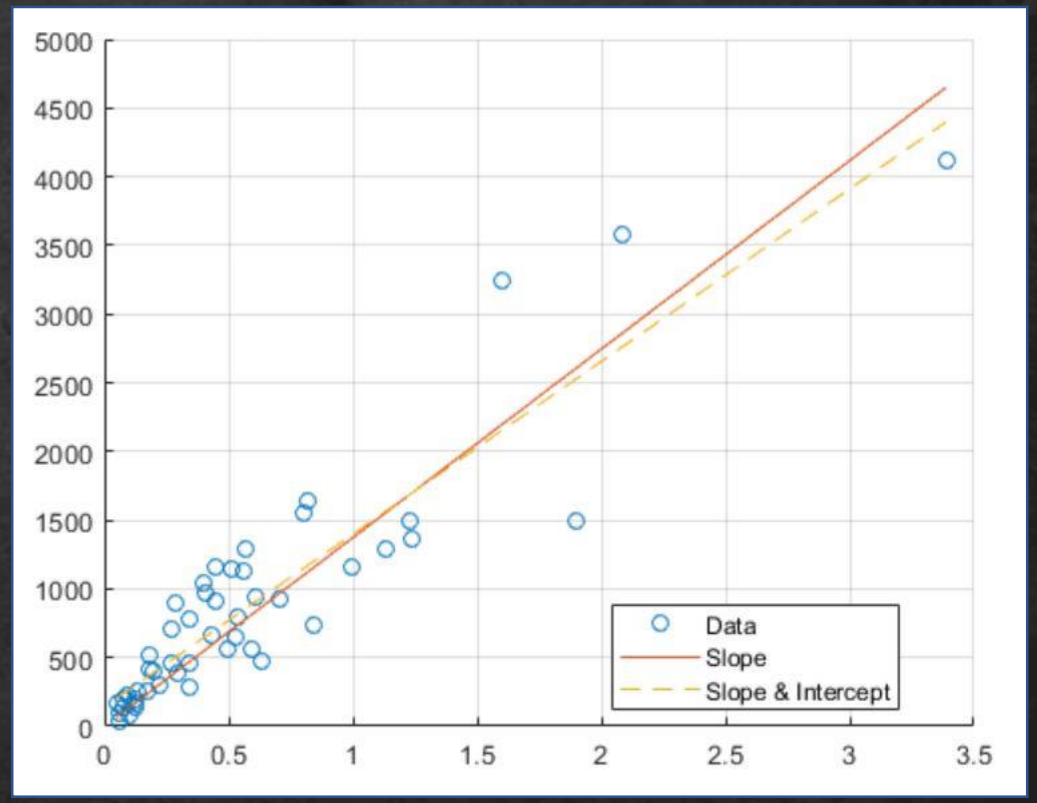


Edwin Ulysse

Prediction Model Plan

Linear Regression Model

- Use correlating independent variables from ANOVA test for linear regression prediction



Edwin Ulysse

Incomplete Work

Dylan Cedeno

Base Station Prototype

- Power Supply and Camera still not in
- May have to use components from previous Senior Design projects to provide proof of concept

Measurements

- Raspberry pi came in much later than planned
  - Lack of expertise in computer programming led to difficulty with implementation
  - Lack of knowledge about Raspberry Pi's led to unpolished system of taking measurements
    - Refinement needed

Prediction Model

- Since we were not able to validate measurements, we could not perform 32-36 actual tests to validate the prediction results
- We could not develop a final model based on real measurements
- We were able to get the ANOVA software working, so once measurements are incorporated they just need to be fed into the software

Lessons Learned

Marc Griffiths

Ordering Parts

- Parts took a lot longer to come than expected
  - Order parts sooner
  - Ask questions about parts sooner to reduce needed assumptions
  - Get more help from professors sooner

Validation

- Start validating sooner
  - Fall semester
  - Create more detailed timeline immediately after concept picked

Processing Board Decision

- Decide on processing system early
  - More time to learn about coding on the system
  - More time to learn the unfamiliar language

Marc Griffiths

Team Communication

- Communication is key
  - Communicate expectations clearly to team
  - Delegate work and split up tasks

Market in Entrepreneurship

- Market plays a key part in entrepreneurship projects
  - Deciding factor as to why we did not advance in the InNOLEvation Challenge

Marc Griffiths

Time Management

- Make more efficient use of time
  - Unproductive, long zoom calls
  - Stick to deadlines

Summary

In Conclusion…

- Started from scratch
  - Only given a project brief for the project, no preceding project to work off
  - Had to conceptualize targets, metrics, markets, etc.
- Designed and began validating a revolutionary product
  - Made it to the Semi-Finals of the InNOLEvation Challenge
- Created a product that we are proud of
  - Learned more than anticipated in the process
- Set up our project to be completed by future groups

Marc Griffiths

Thank You for Listening!

Our mission is to utilize technology to enhance the performance of athletes and help them maximize their full potential.