

A photograph of a baseball in mid-air, slightly out of focus, with a blurred pitcher in the background on a baseball field. The sky is blue with some clouds.

Instrumented Baseball

David Adams | Mathew Brown | Riley Ferrer | Yanni Giannareas | Charles Whitaker

Meet Team 516



David Adams

*Design
Engineer*



Mathew Brown

*Mechatronics
Engineer*



Riley Ferrer

*Manufacturing
Engineer*



Yanni Giannareas

*Systems
Engineer*



Charles Whitaker

Test Engineer

David Adams

Sponsor and Advisor



Dr. William Oates, P.E.

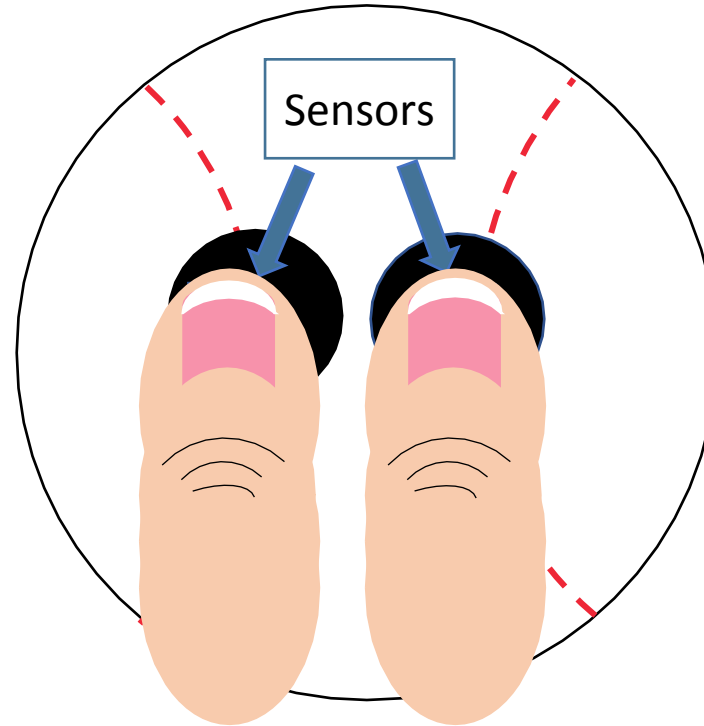
*FAMU-FSU
College of Engineering*

David Adams

Project Objective



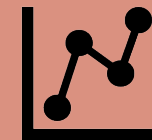
Develop technology to measure dynamic fingertip forces on a baseball



Develop accurate method of measurement



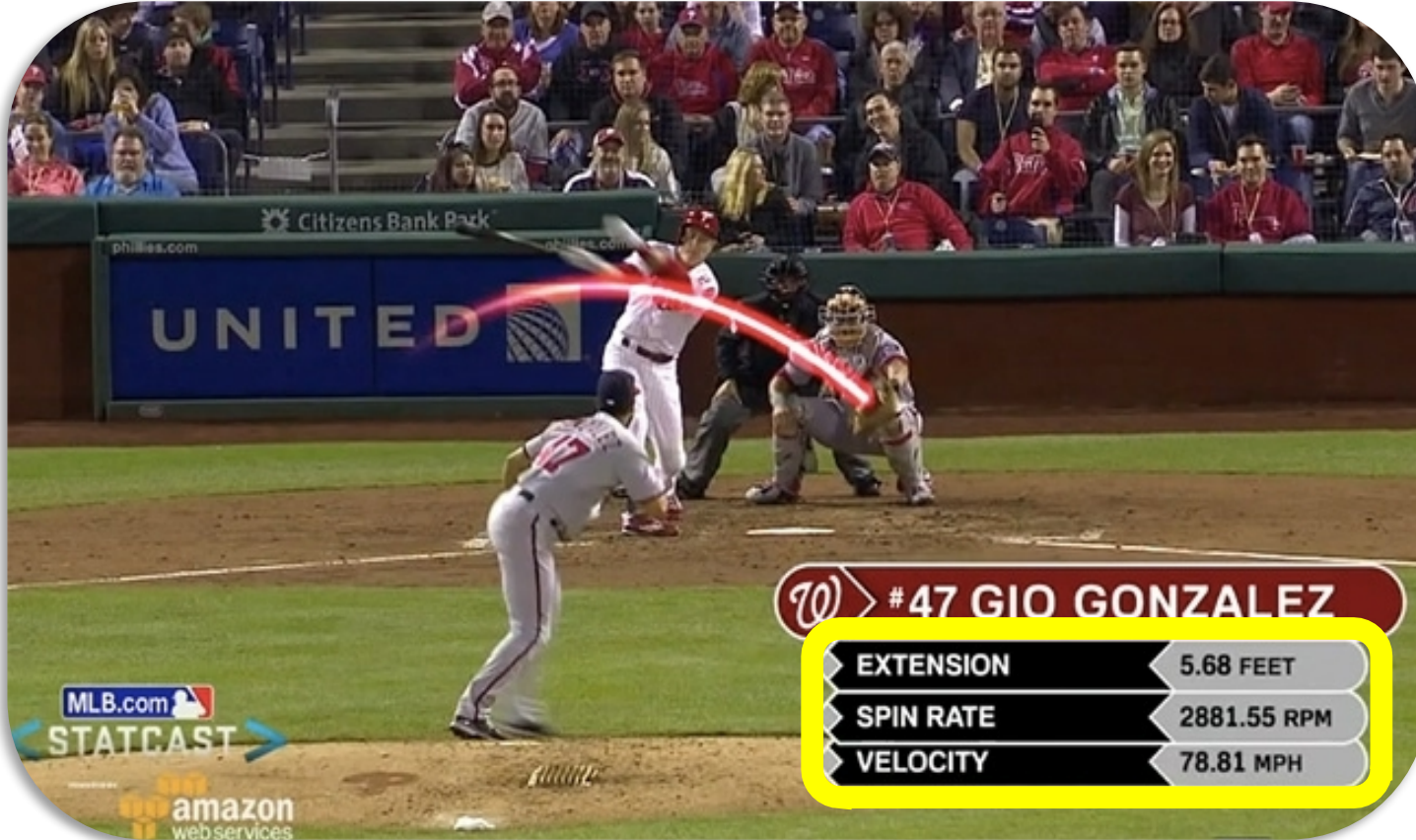
Maintain the original characteristics of a ball



Facilitate access to the gathered data

David Adams

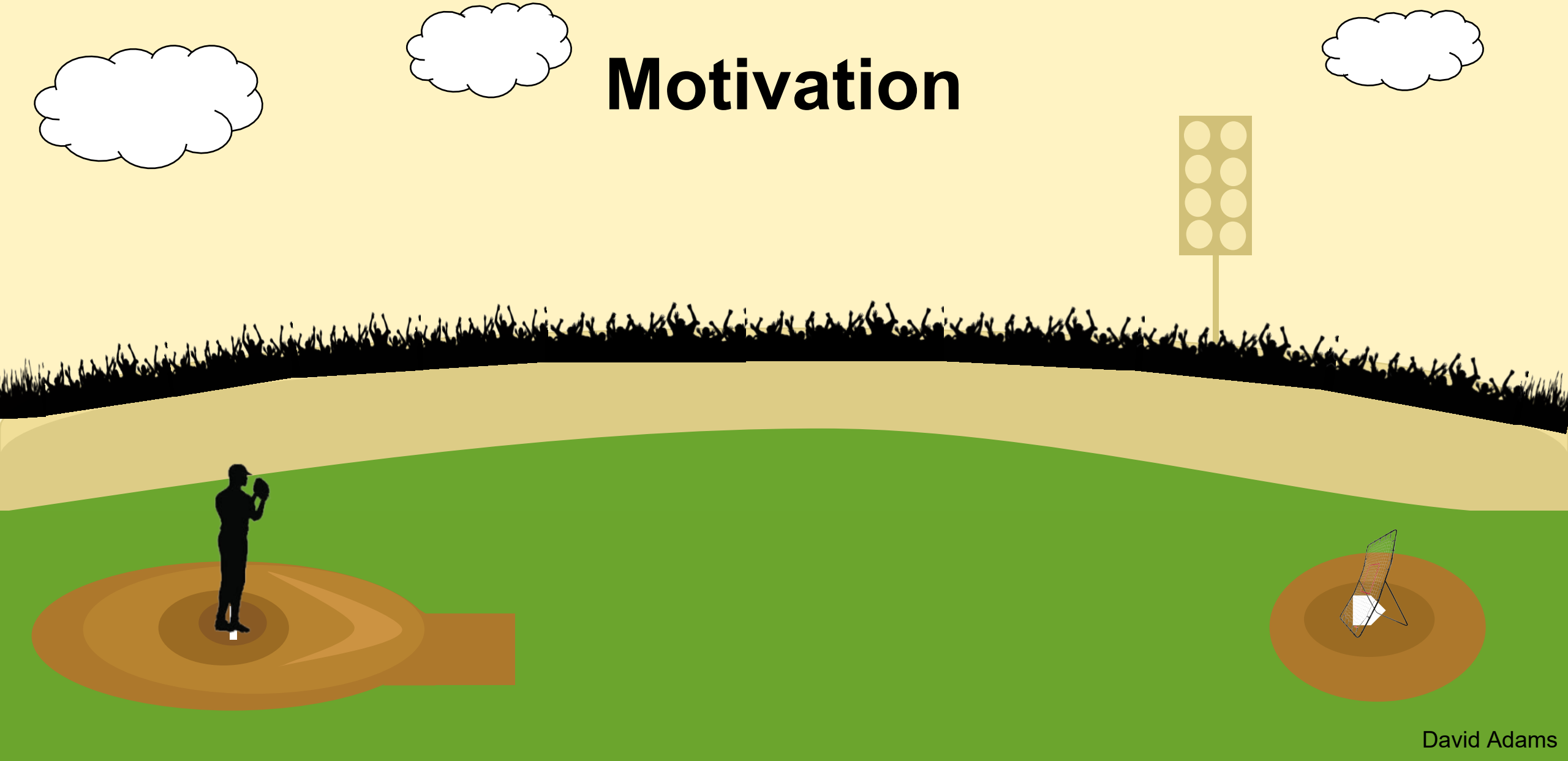
Background



Your goal shouldn't be to buy players. Your goal should be to buy wins. In order to buy wins, you need to buy runs.
- Michael Lewis, *Moneyball*

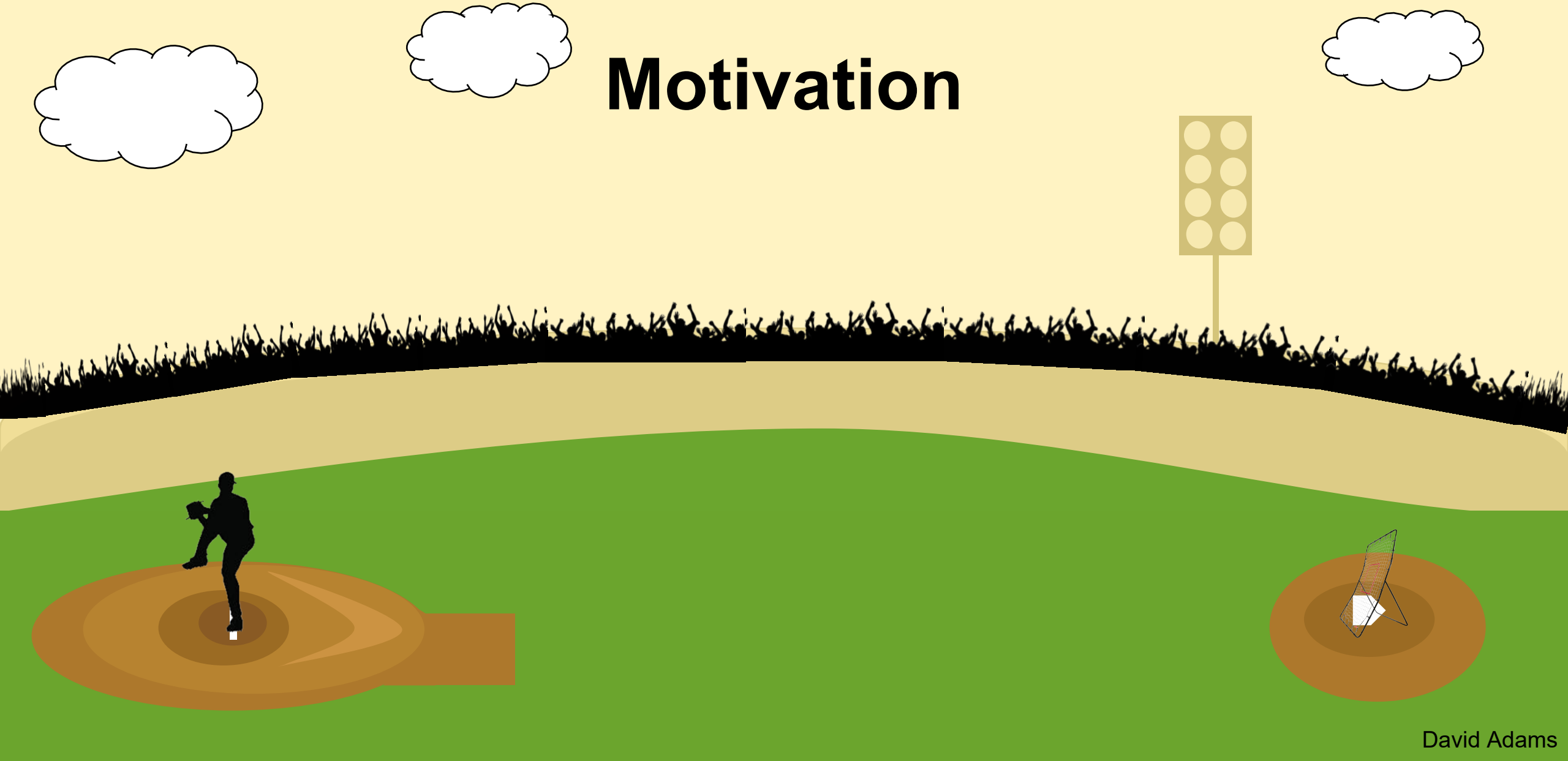
David Adams

Motivation



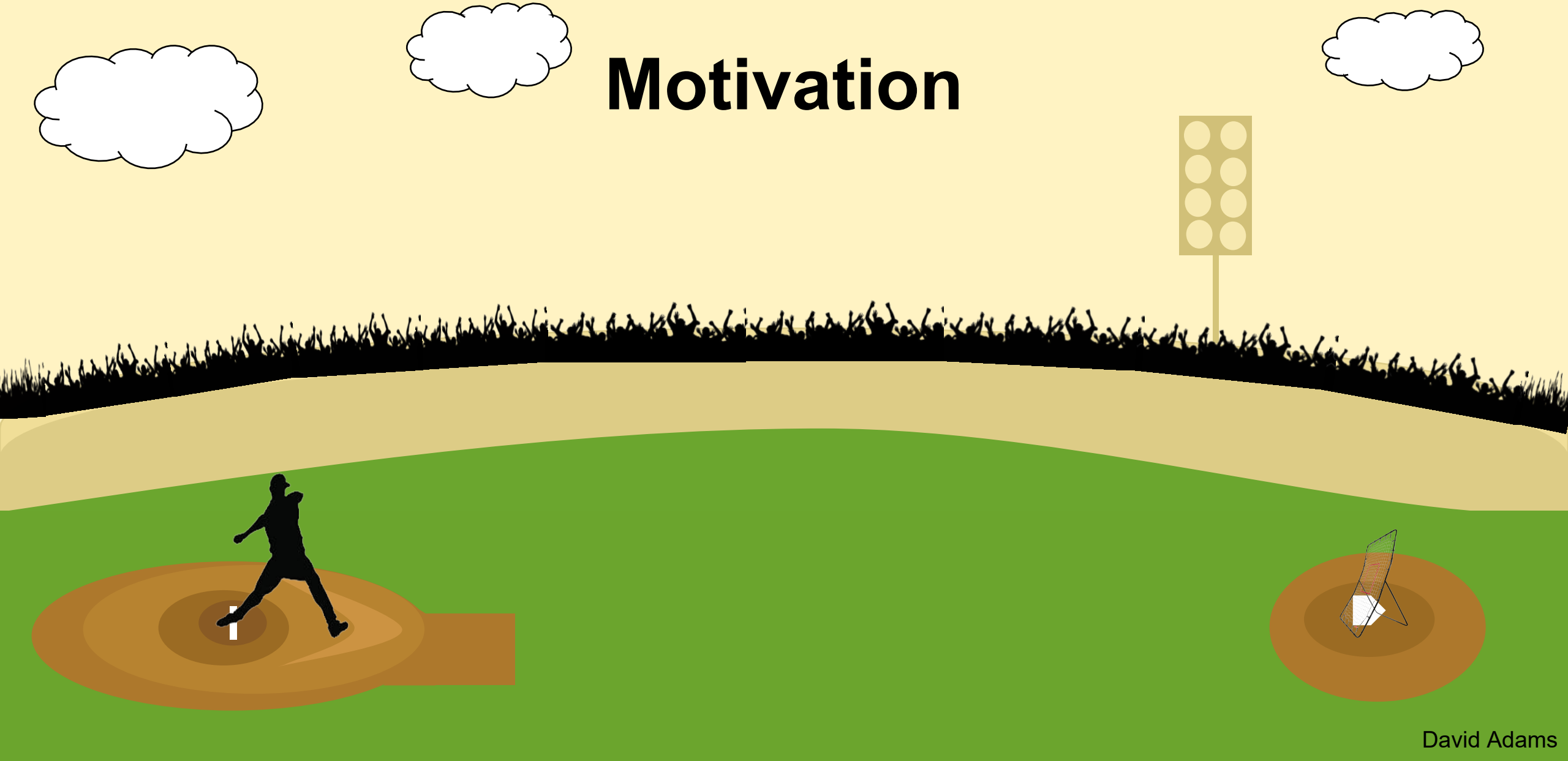
David Adams

Motivation



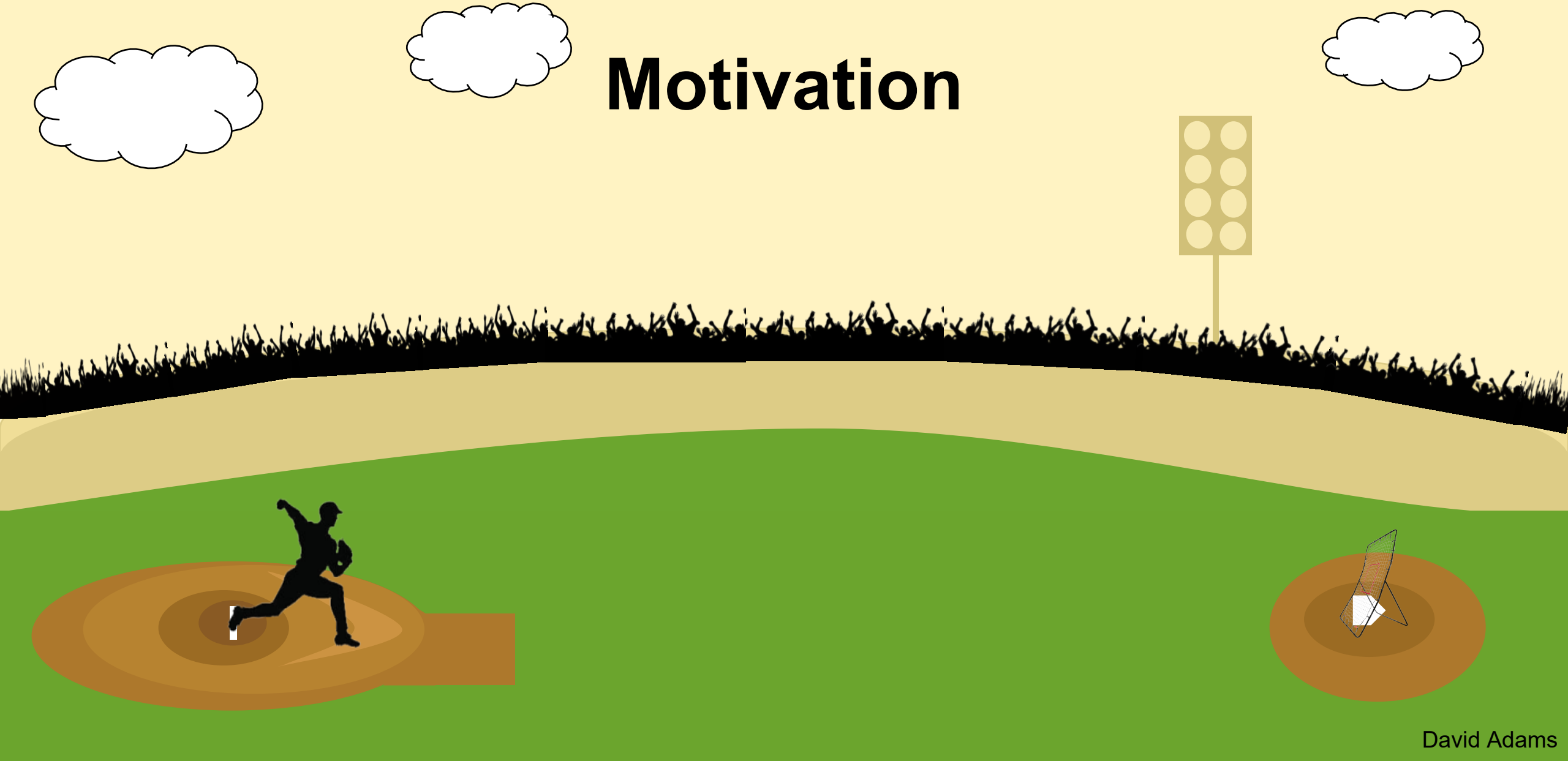
David Adams

Motivation



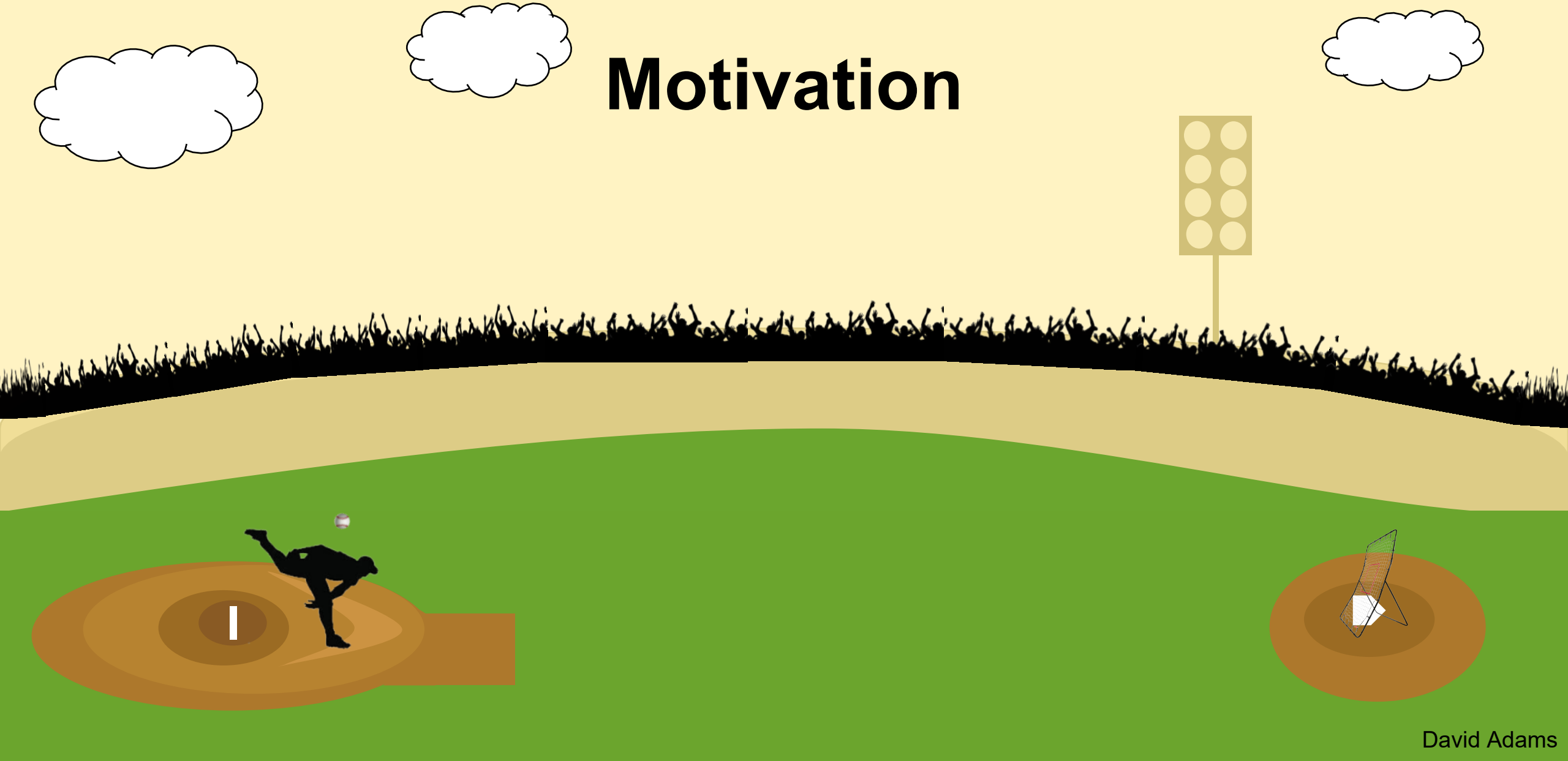
David Adams

Motivation



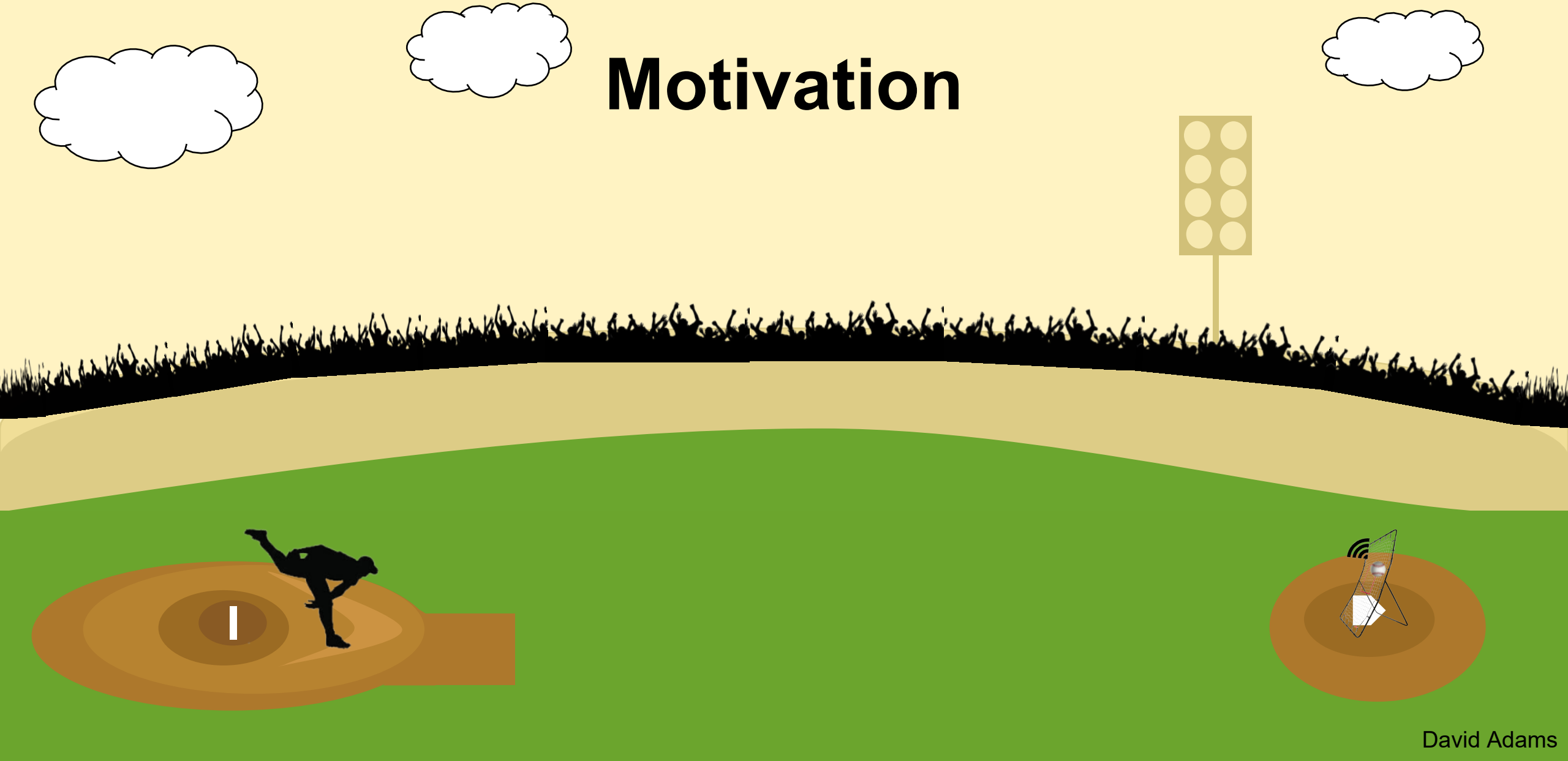
David Adams

Motivation



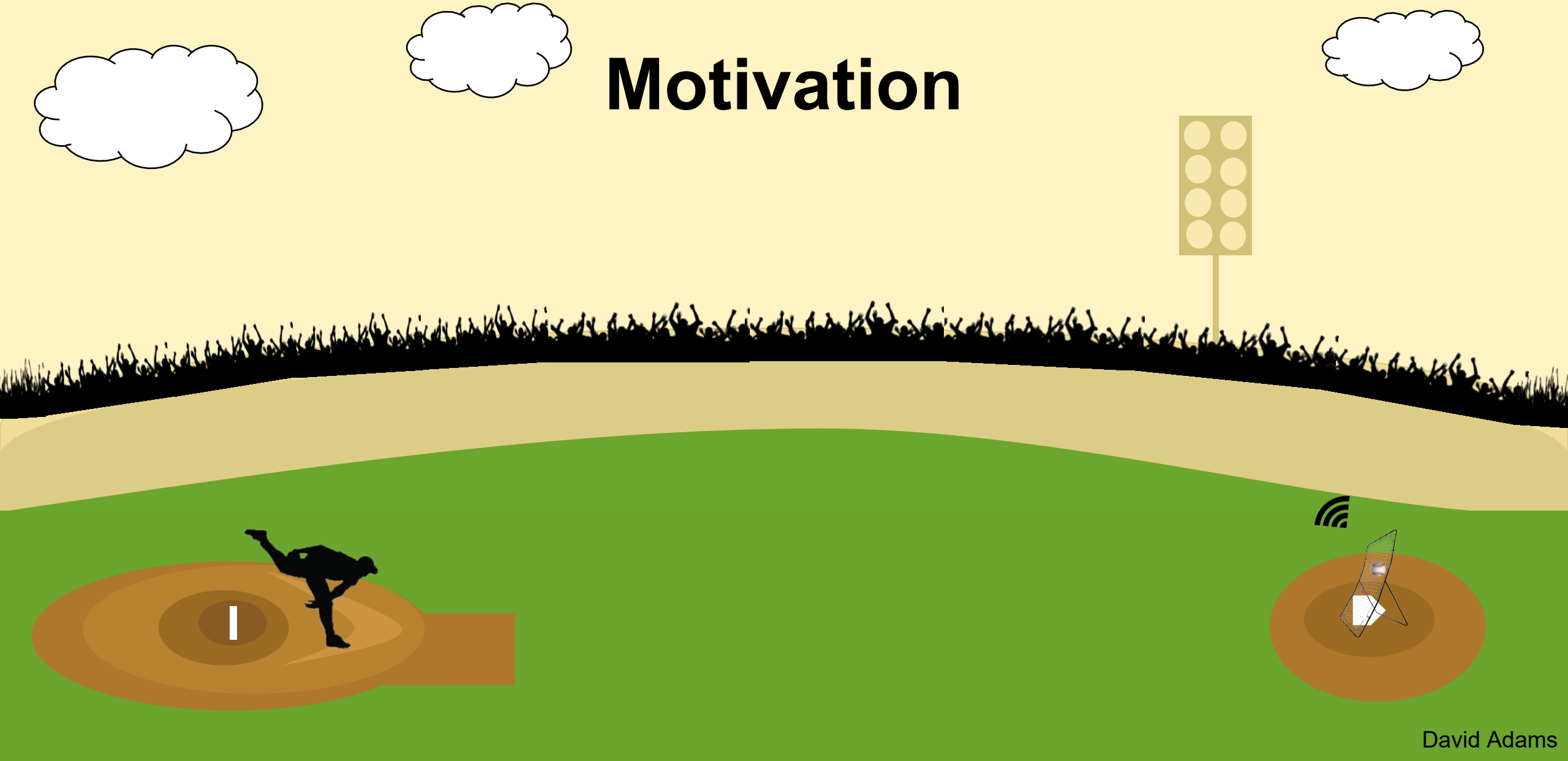
David Adams

Motivation



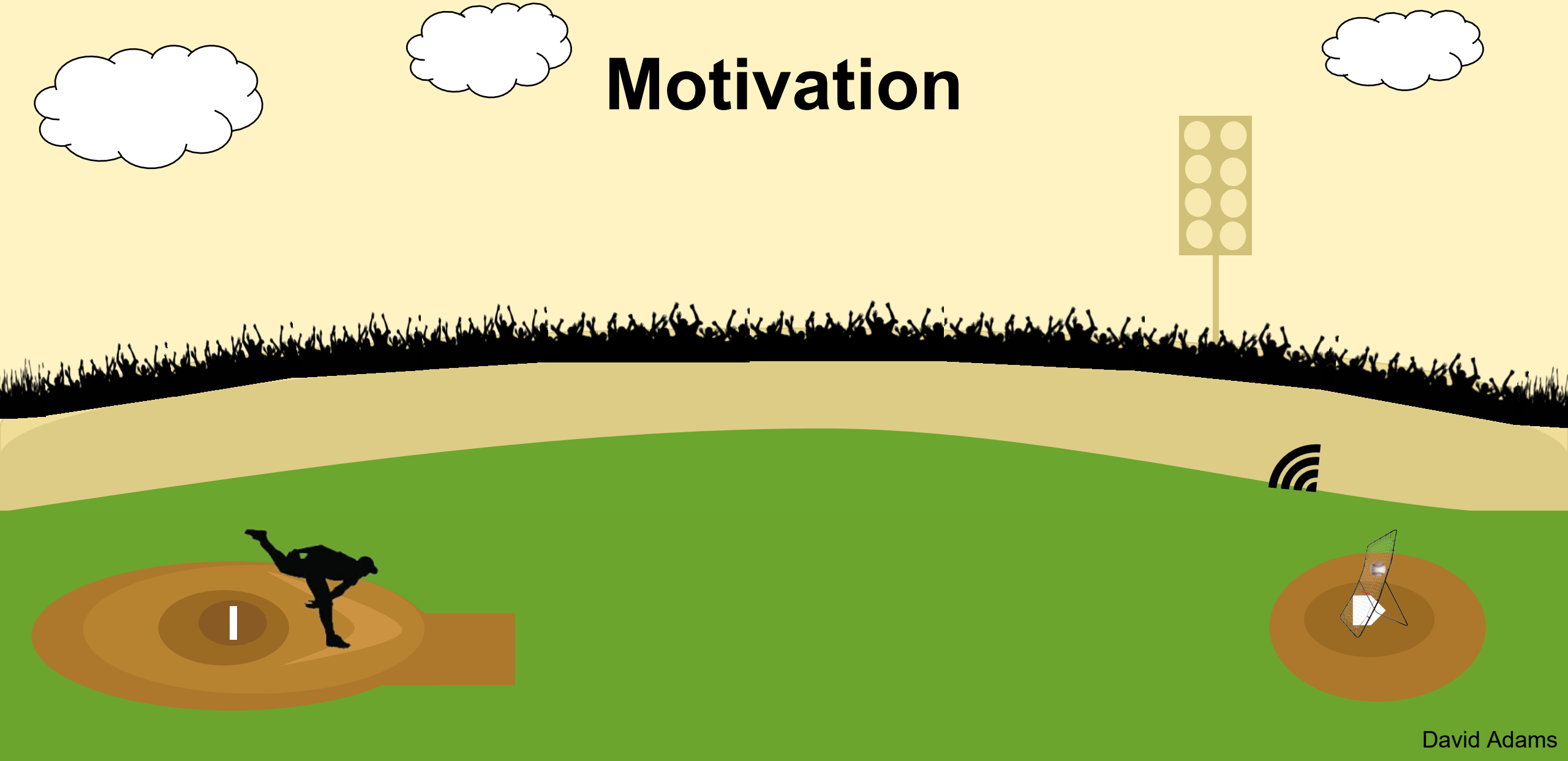
David Adams

Motivation



David Adams

Motivation



David Adams

Motivation



David Adams

Motivation



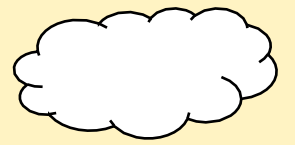
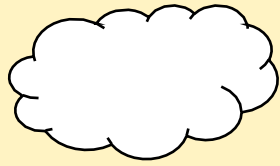
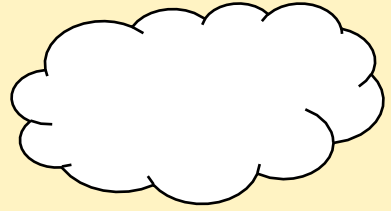
David Adams

Motivation



David Adams

Motivation



User T516
Fingertip
Forces

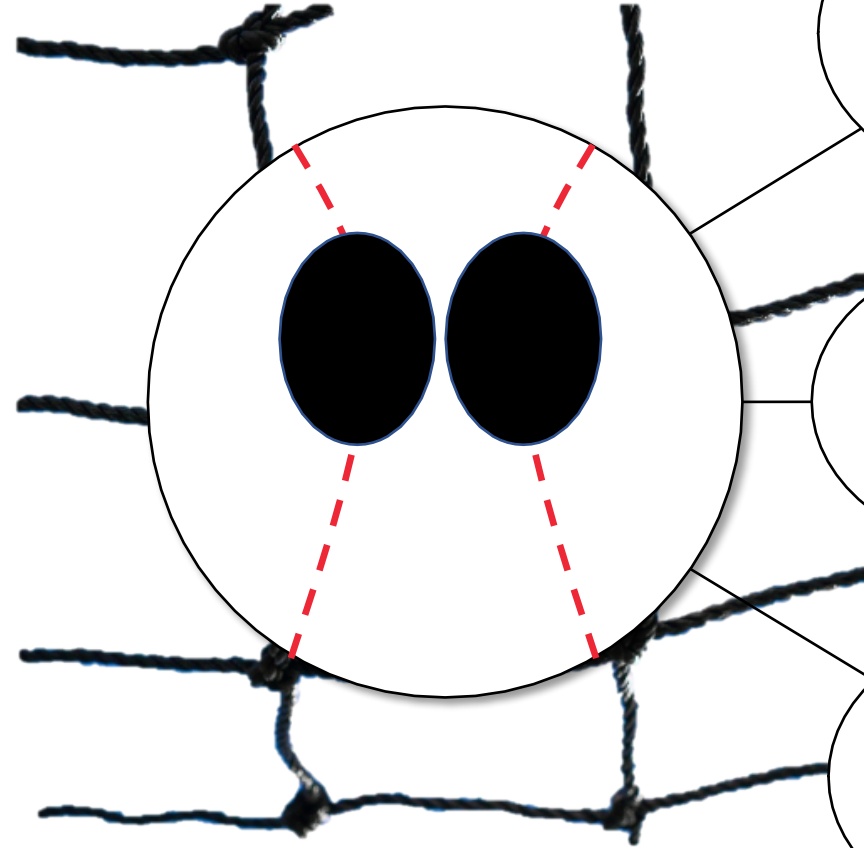
Middle
Finger = 117
N

Index Finger
= 115 N



David Adams

Assumptions



Ball is safely caught after the throw by a net.

Ball is thrown in a specific position.

Device can be used to read the data.

David Adams

Customer Needs

The device can be charged repeatedly.

The device doesn't interfere with the pitcher.

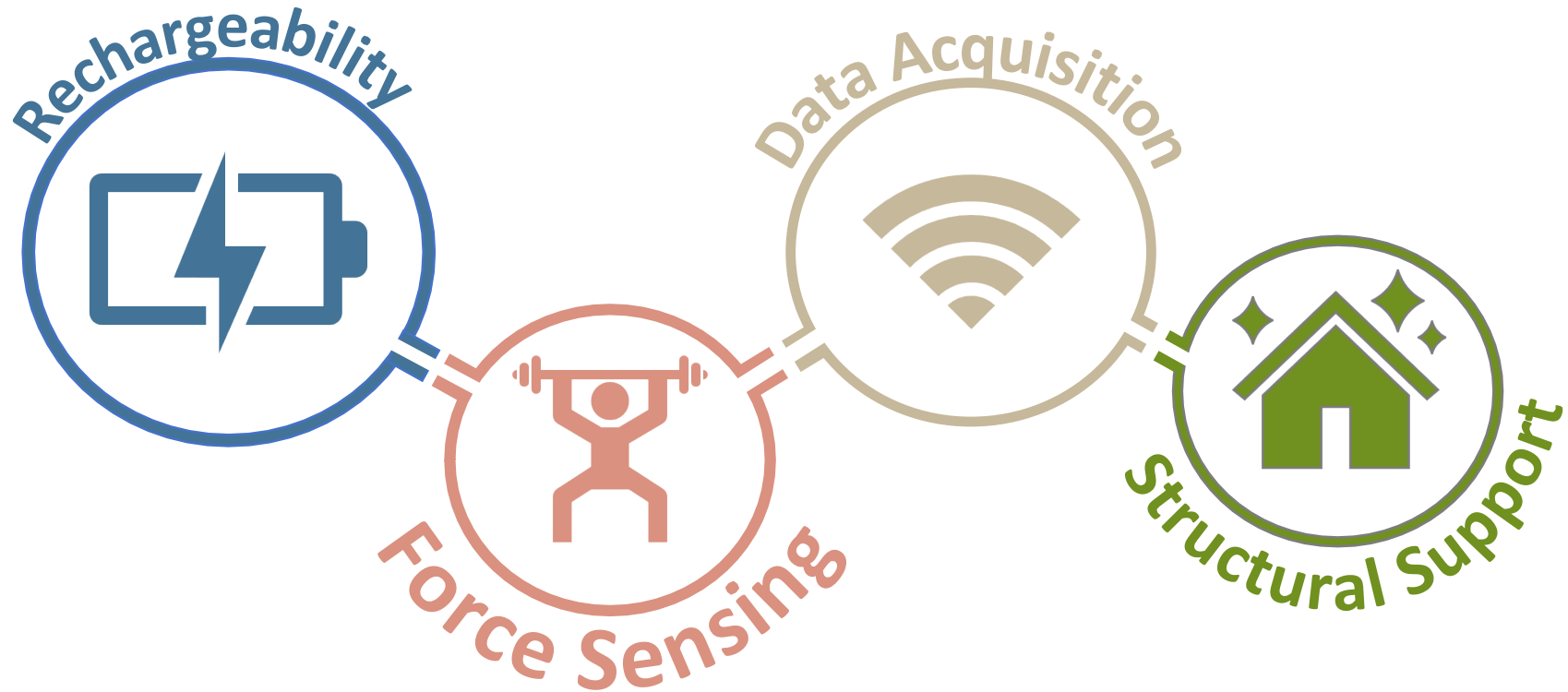
Device is tailored to detect forces on the index and middle fingers.

The device captures pressure and shear forces.

Device is tailored to a 4-seam style.

David Adams

Functional Decomposition



David Adams

Functional Decomposition



Contains
supplied
voltage



Transforms
signals from
analog to
digital

Plot time-
dependent
data



Senses
applied load

Isolates
region for
fingertip
application



Match
moment of
inertia close
to standard

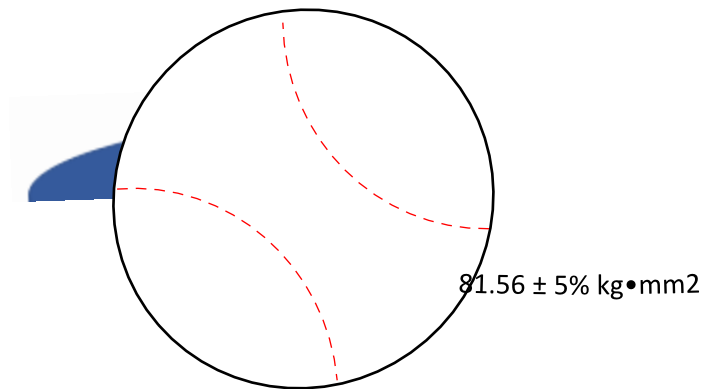
Lock
components
in place

Supports
weight of
components

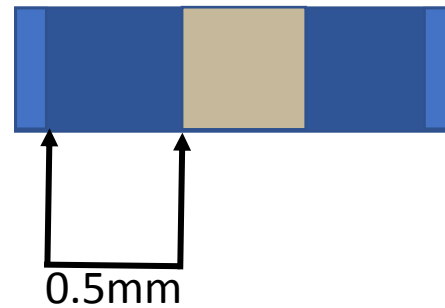
David Adams

Targets And Metrics

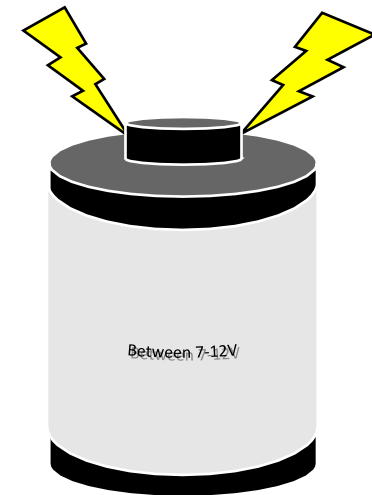
Standard Moment of Inertia



Component Movement



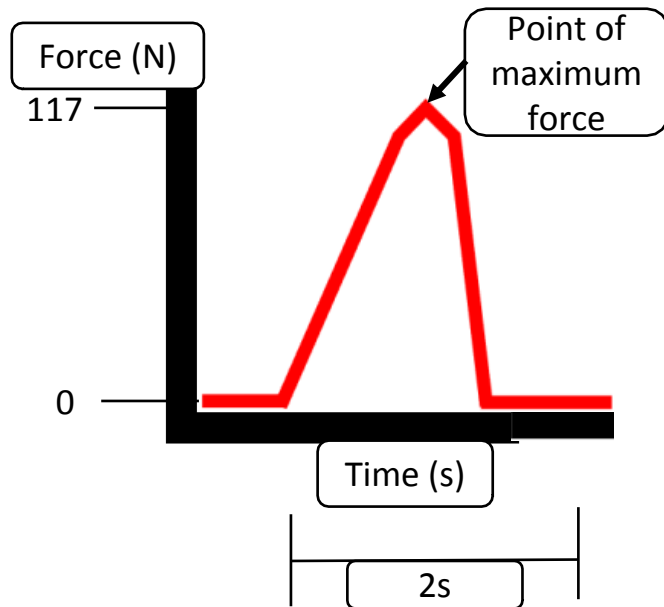
Supplied Voltage



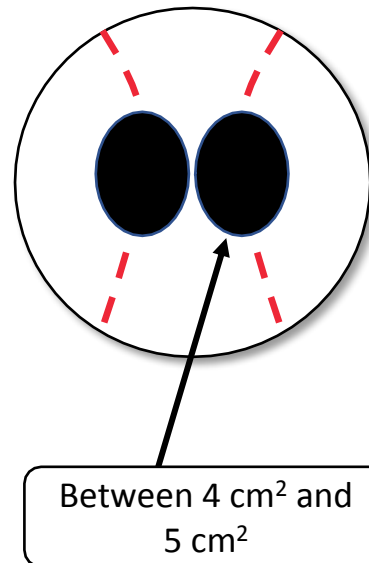
Mathew Brown

Targets And Metrics

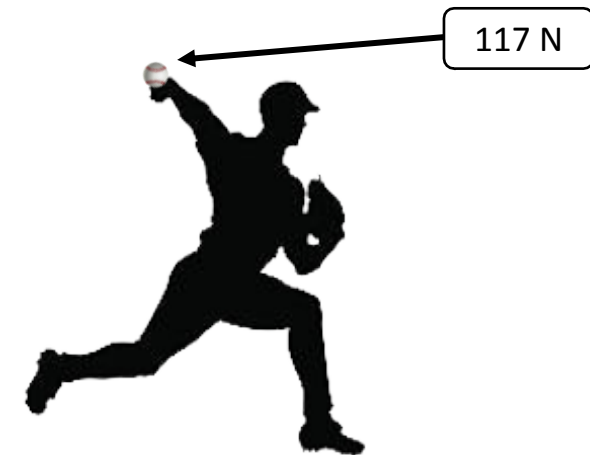
Plot time-dependent data



Region for index and middle finger application

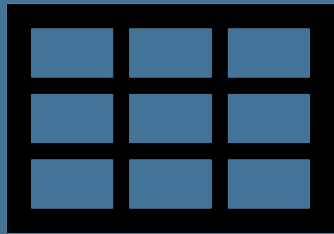


Senses applied load



Mathew Brown

Concept Generation



Morphological chart

1



Biomimicry

2



Concept Generation

3

Mathew Brown

Sphere
RP Pi

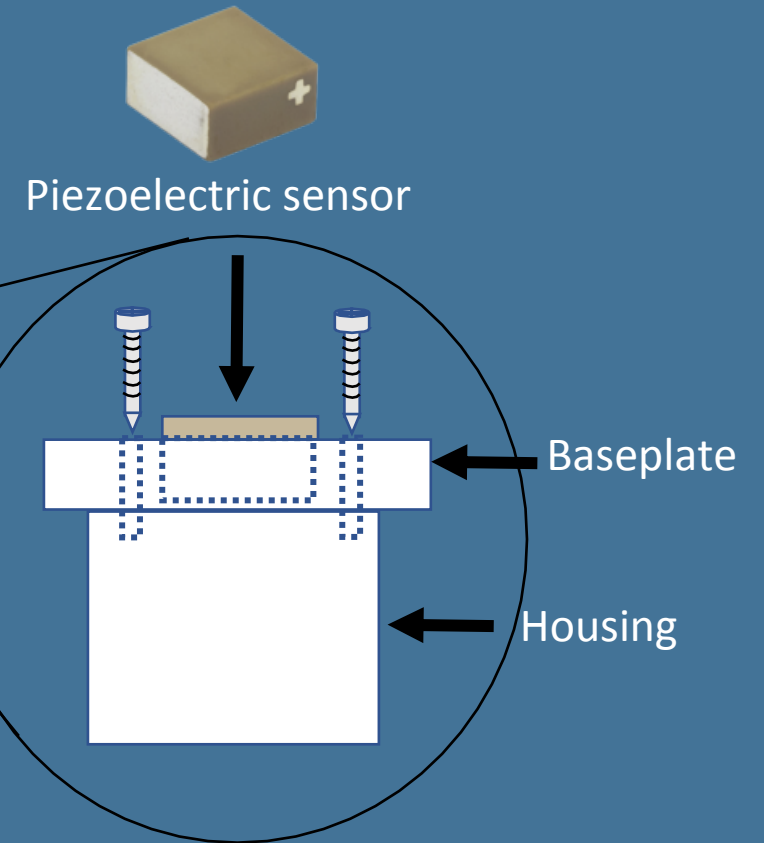
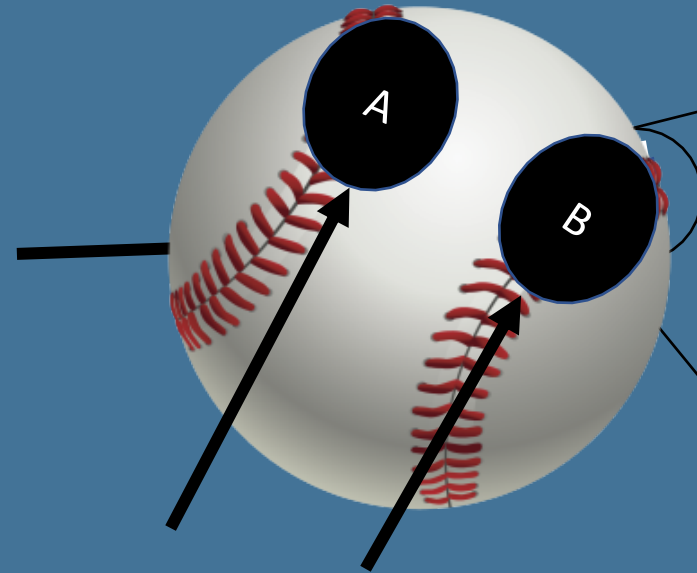
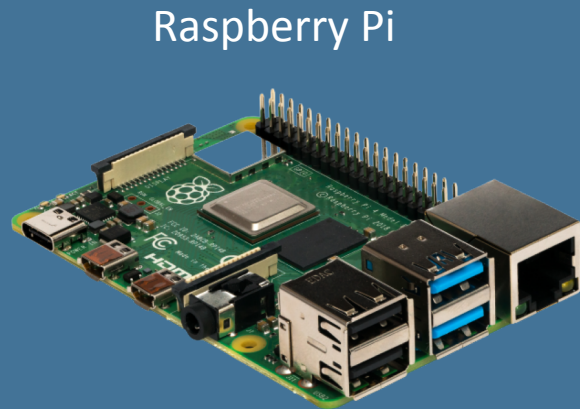
Medium Fidelity

Sphere
AR Pi

3D RP
Pt

Multi-
house
AR Pi

Multi-
house
MAT Pi



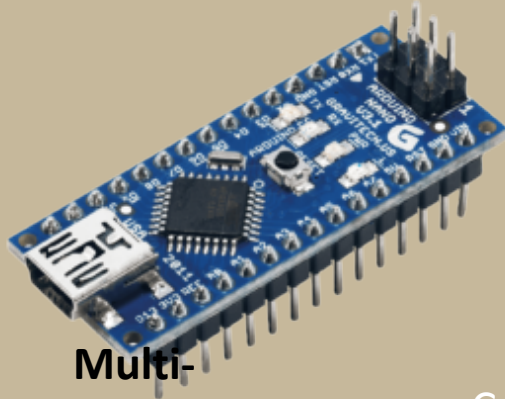
Mathew Brown

Sphere
RP Pi

Sphere
AR Pi

Sphere
AR Pi

Blue Nano Arduino

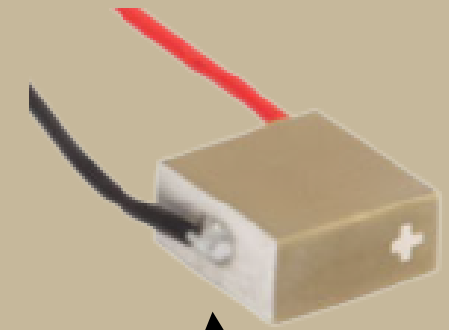
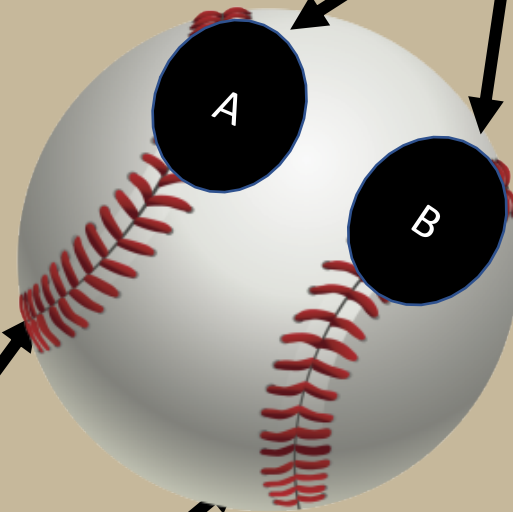


Multi-
house
MAT Pi

Counterweights

Medium Fidelity

Stickers for indication



Soldered connection on
piezoelectric sensor

3D RP
Pt

Multi-
house
AR Pi

Multi-
house
MAT Pi

Mathew Brown

Sphere
RP Pi

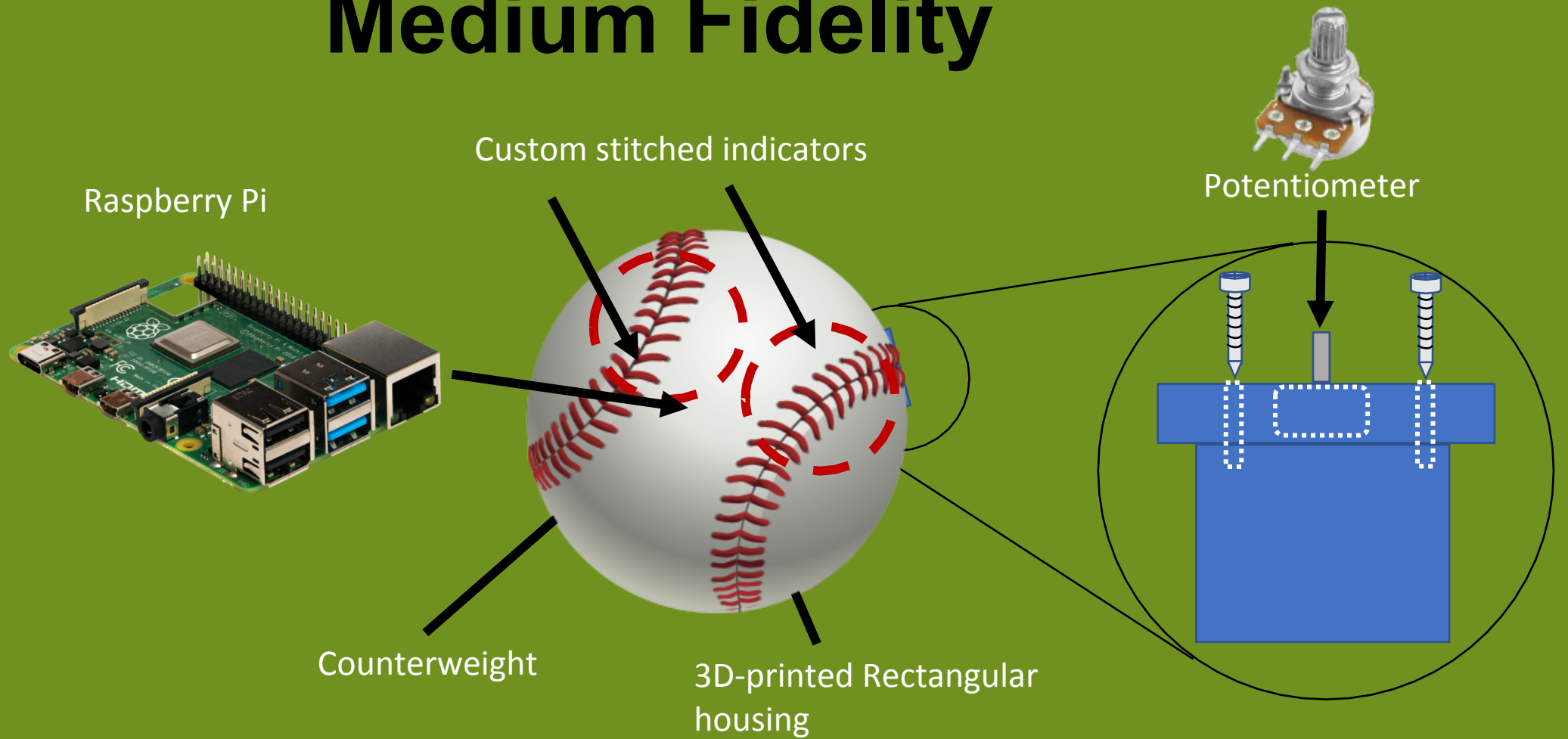
Sphere
AR Pi

3D RP
Pt

Multi-
house
AR Pi

Multi-
house
MAT Pi

Medium Fidelity



Mathew Brown

Medium Fidelity

Sphere
RP Pi

Sphere
AR Pi

3D RP
Pt

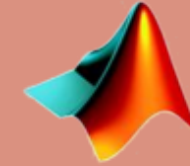
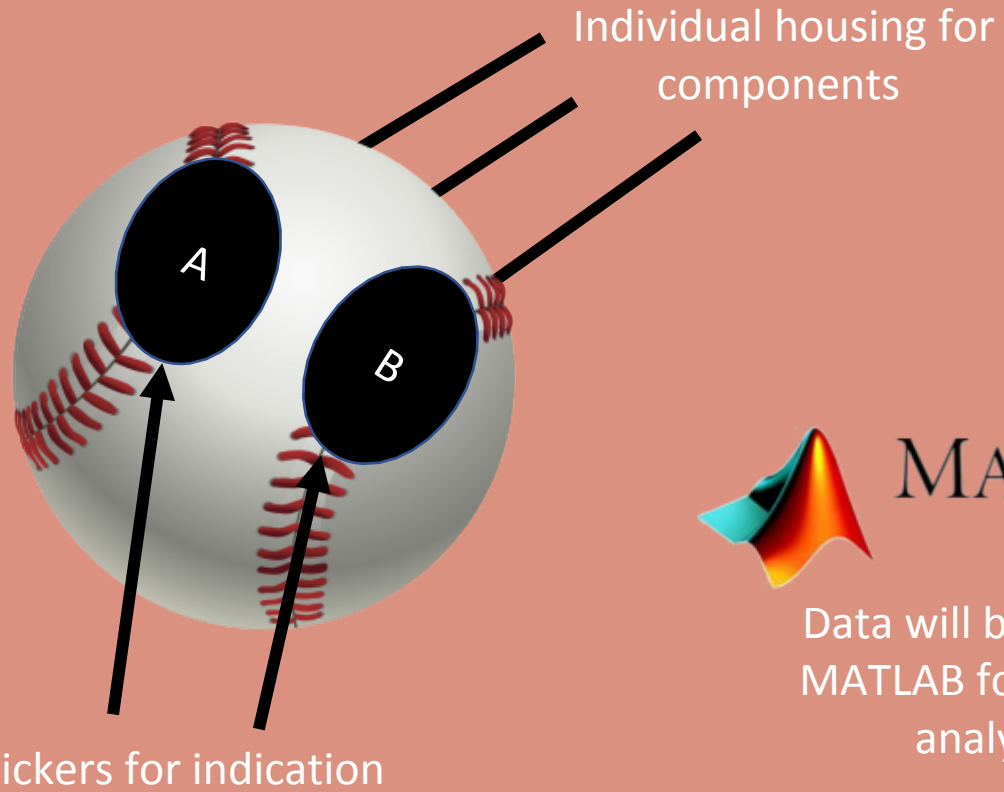
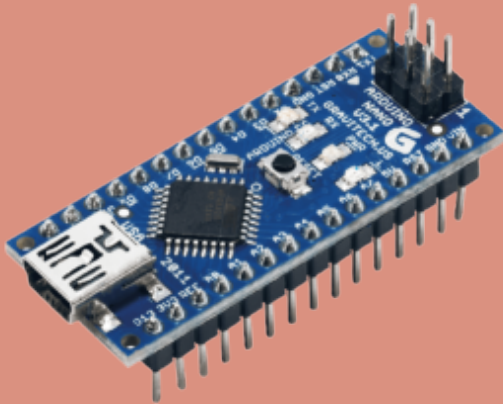
Multi-
house
AR Pi

Multi-
house
MAT Pi

Piezoelectric sensors



Blue Nano Arduino



MATLAB

Data will be sent to
MATLAB for further
analysis

Mathew Brown

Medium Fidelity

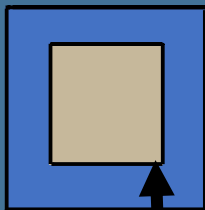
Sphere
RP Pi

Sphere
AR Pi

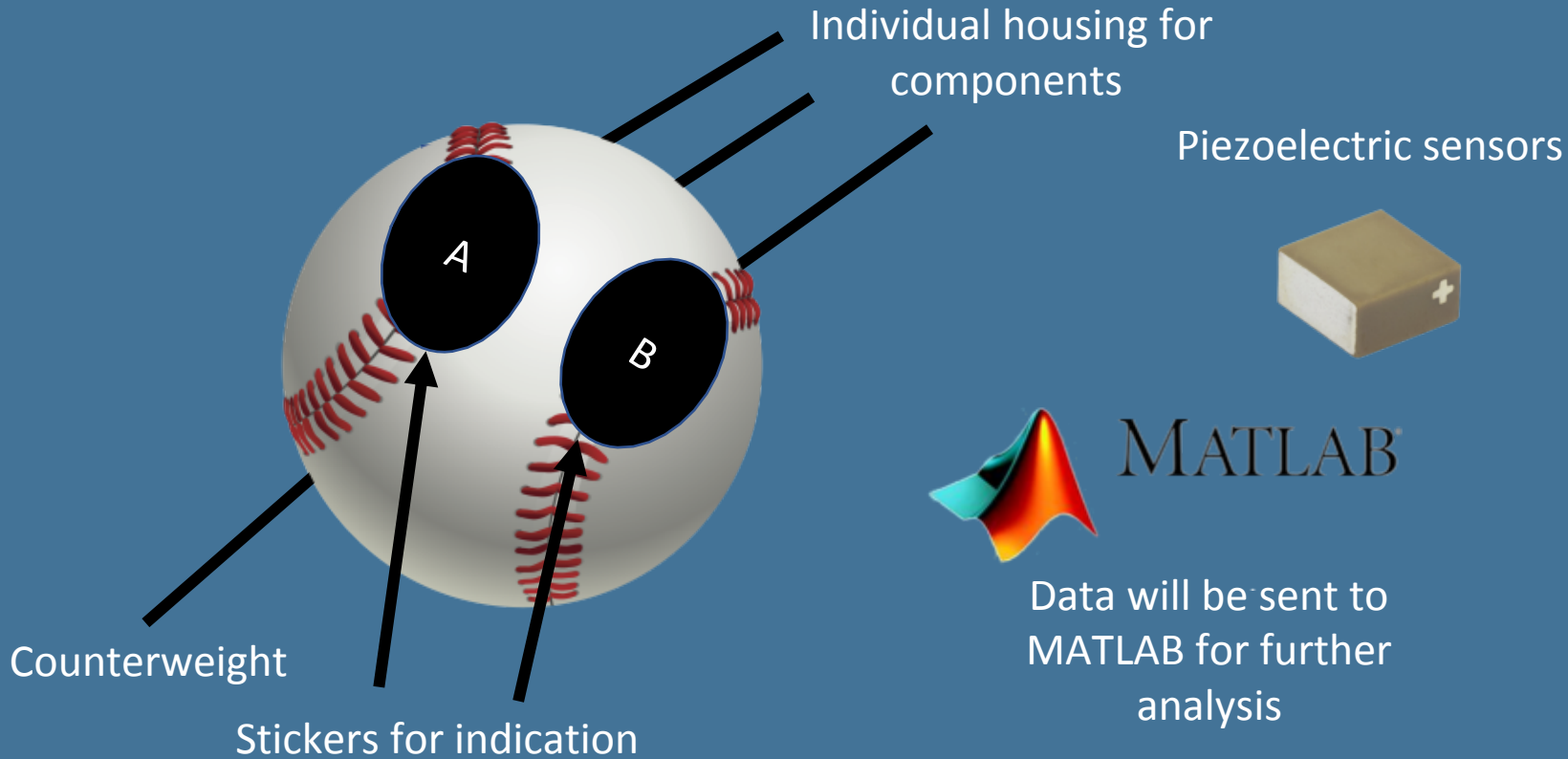
3D RP
Pt

Multi-
house
AR Pi

Multi-
house
MAT Pi



Force fitted components

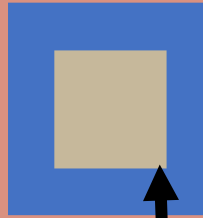


Mathew Brown

Plastic
AR Pi

High Fidelity

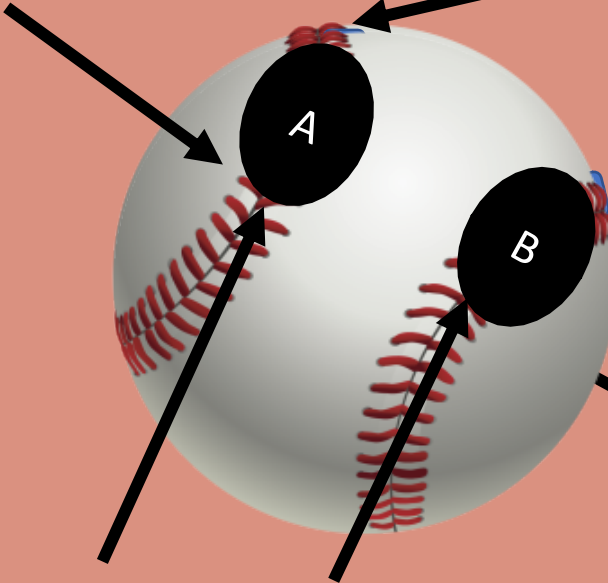
3D AR
Pi



Force fitted
components

3D AR
Pr

Plastic housing



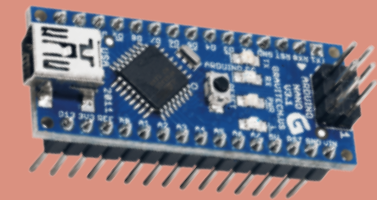
Indicating stickers



Piezoelectric sensors



Blue Nano Arduino



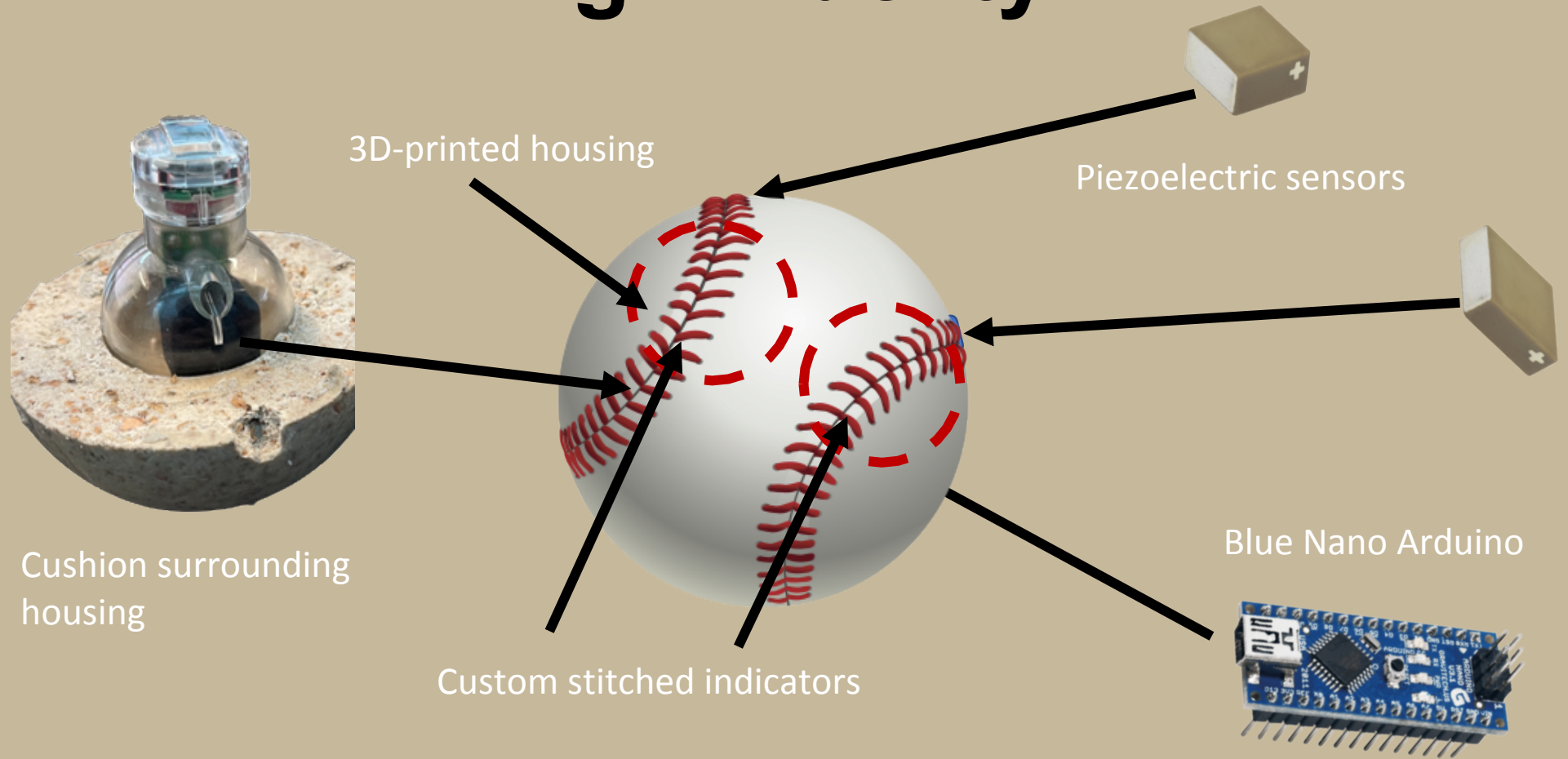
Mathew Brown

Plastic
AR Pi

3D AR
Pi

3D AR
Pr

High Fidelity



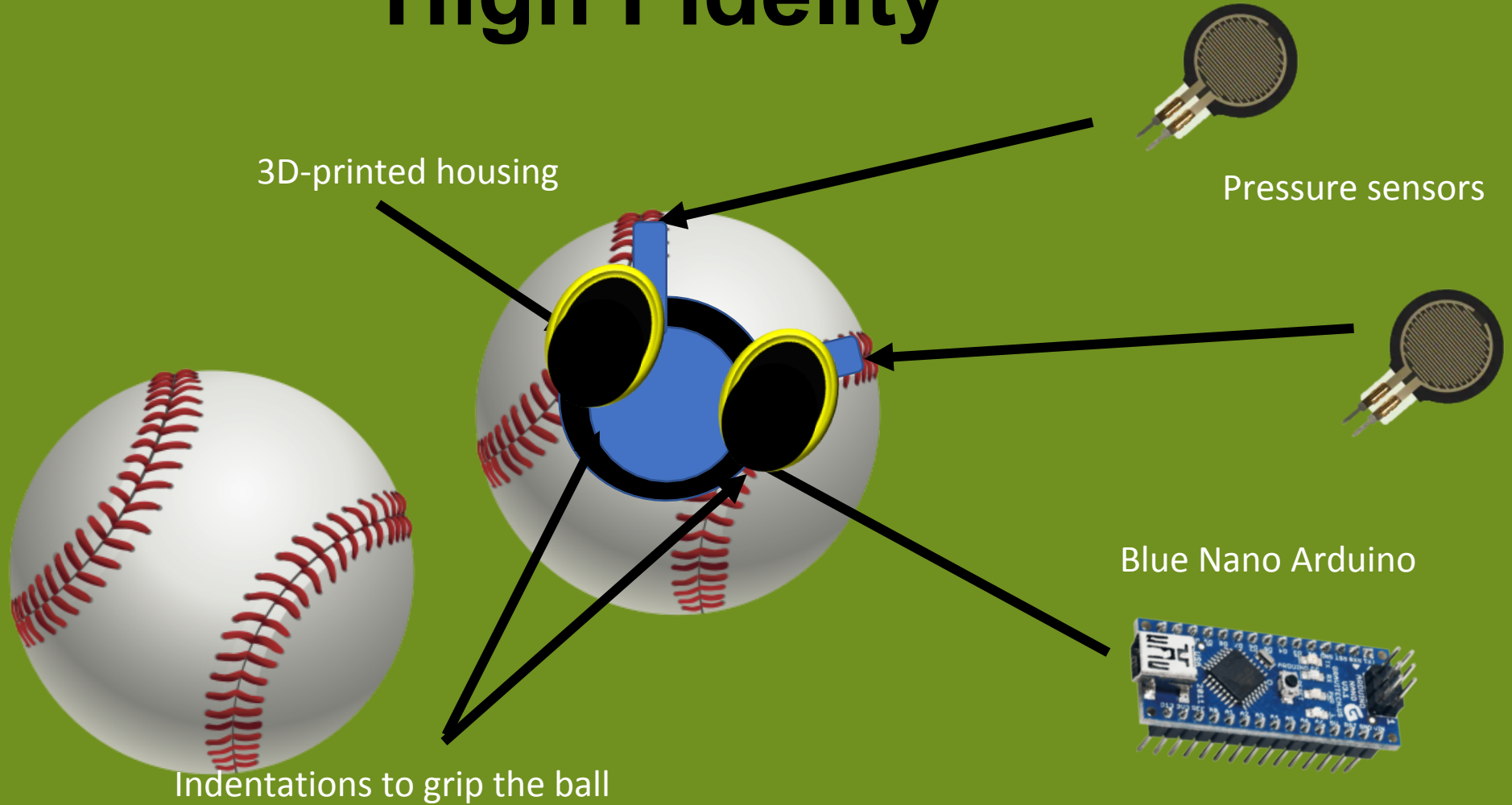
Mathew Brown

Plastic
AR Pi

High Fidelity

3D AR
Pi

3D AR
Pr



Mathew Brown

Concept Selection



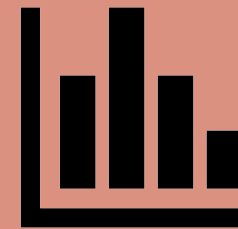
House of Quality

1



Pugh Charts

2



AHP

3

Yanni Giannareas

Concept Selection

Most important needs



Most important variables

Sensors tailored for index and middle finger

Captures pressure and shear forces

Measure forces for a 4-seam style of pitching



Applied load sensed (N)

Area for fingertip application (cm²)

Data-gathering frequency (Hz)

Yanni Giannareas

Concept Selection



Difficult to maintain standard MOI

Larger component area required

Heavier components

~~Plastic AR Pi~~

3D AR Pi

3D AR Pr

~~Sphere RP Pi~~

Sphere AR Pi

~~3D Concept~~

~~Multi-house MAT Pi~~

~~Multi-house AR Pi~~

Yanni Giannareas

Concept Selection



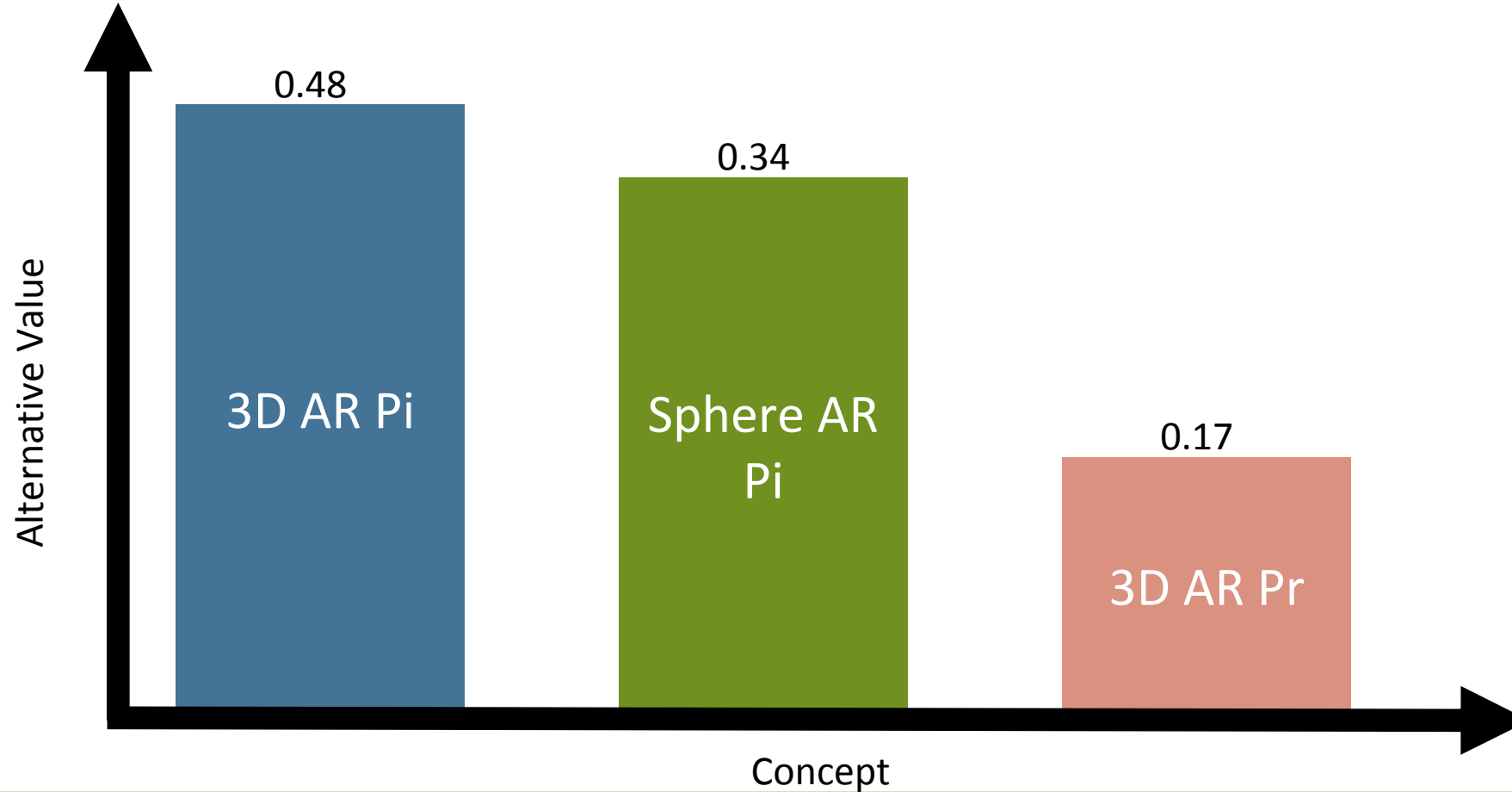
3D AR Pi

3D AR Pr

Sphere AR Pi

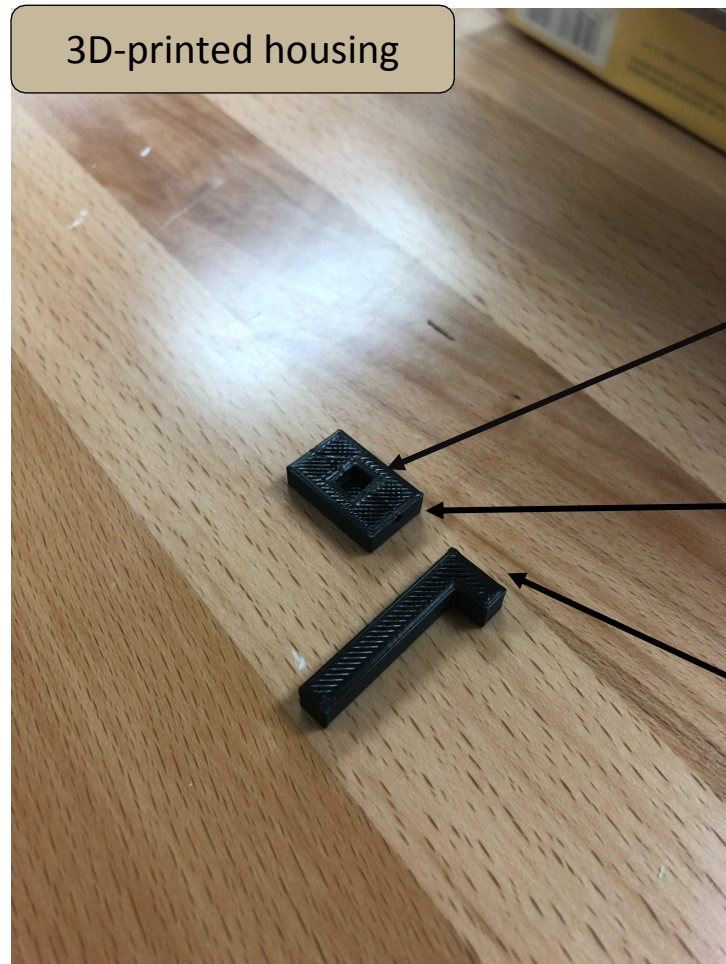
Yanni Giannareas

Concept Selection



Yanni Giannareas

Prototyping: 1st Iteration



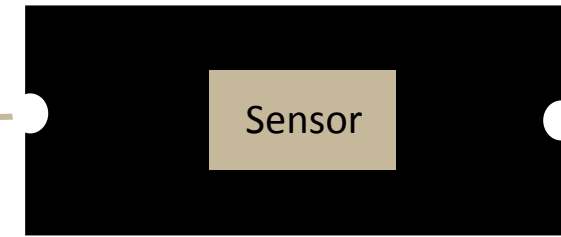
3D-printed housing

Gap for sensor

Opening for cable connection

Bracket for force application

Top view



Side view

Force applied



Yanni Giannareas

Prototyping: 1st Iteration

What worked

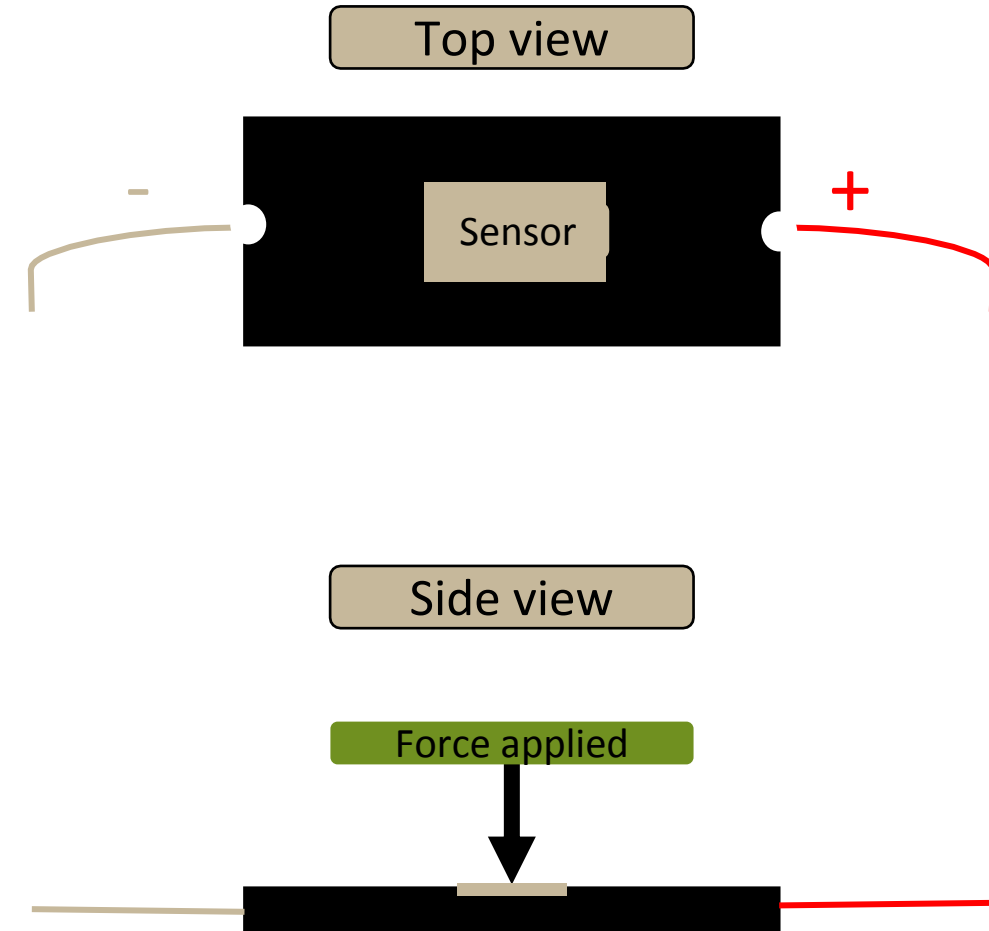
Cable openings worked well

Housing stiffness was sufficient

What didn't work

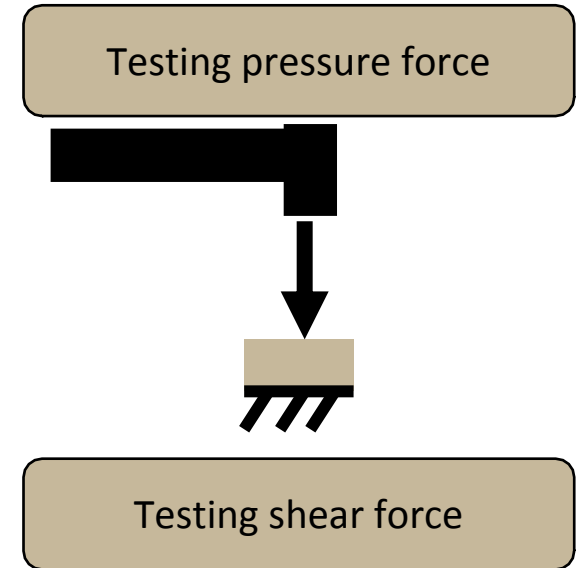
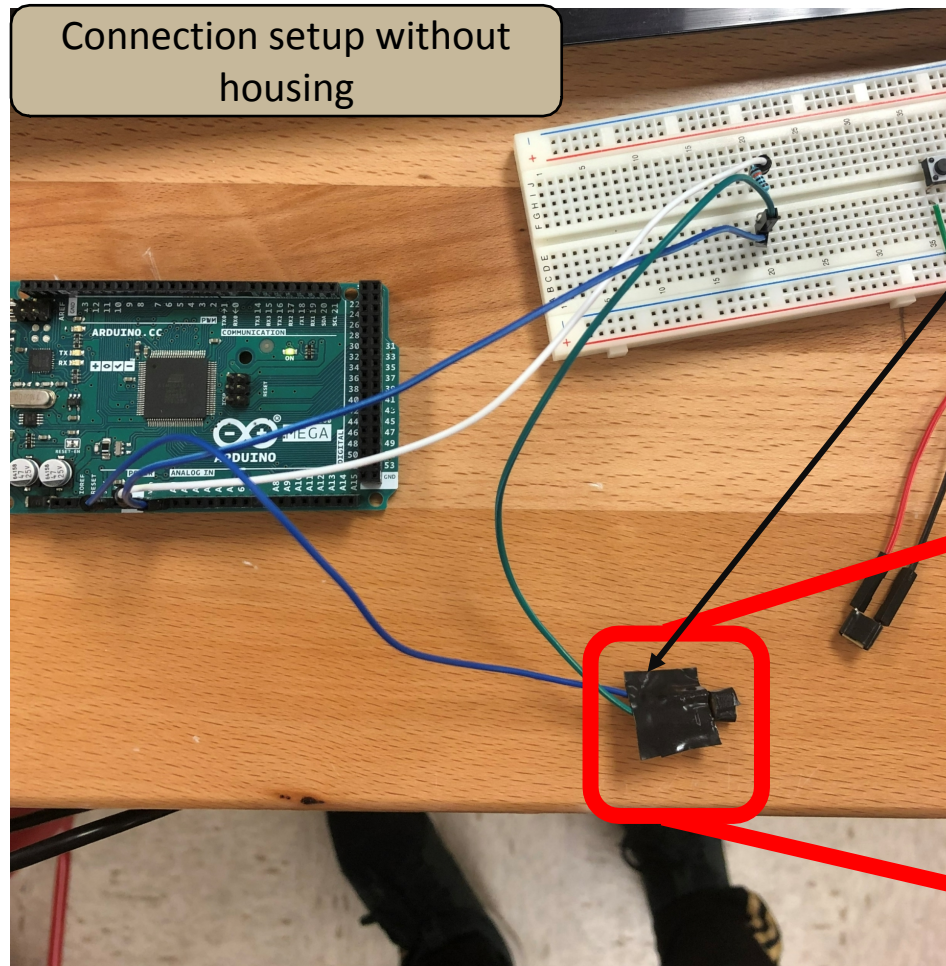
Sensor didn't fit

Connection between sensor and cables



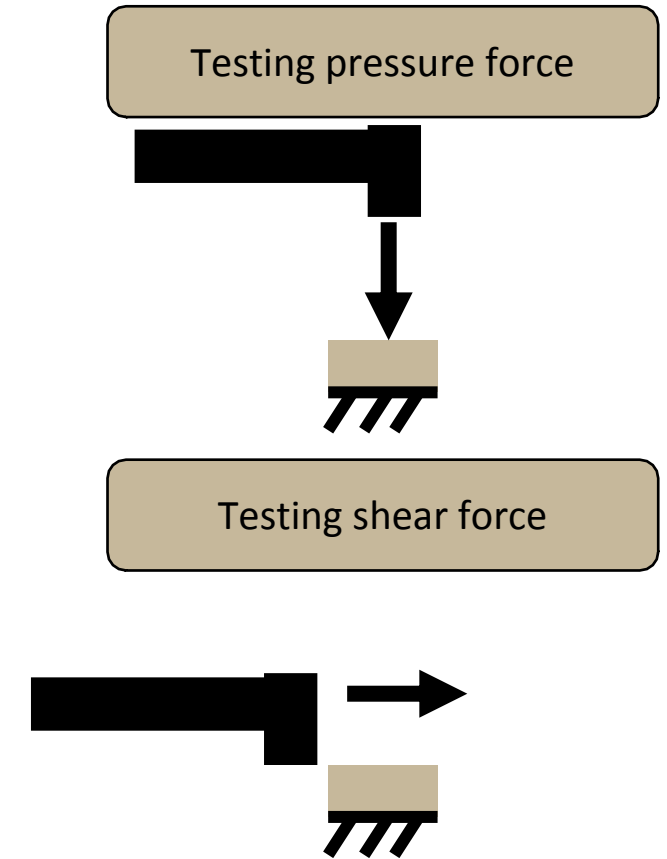
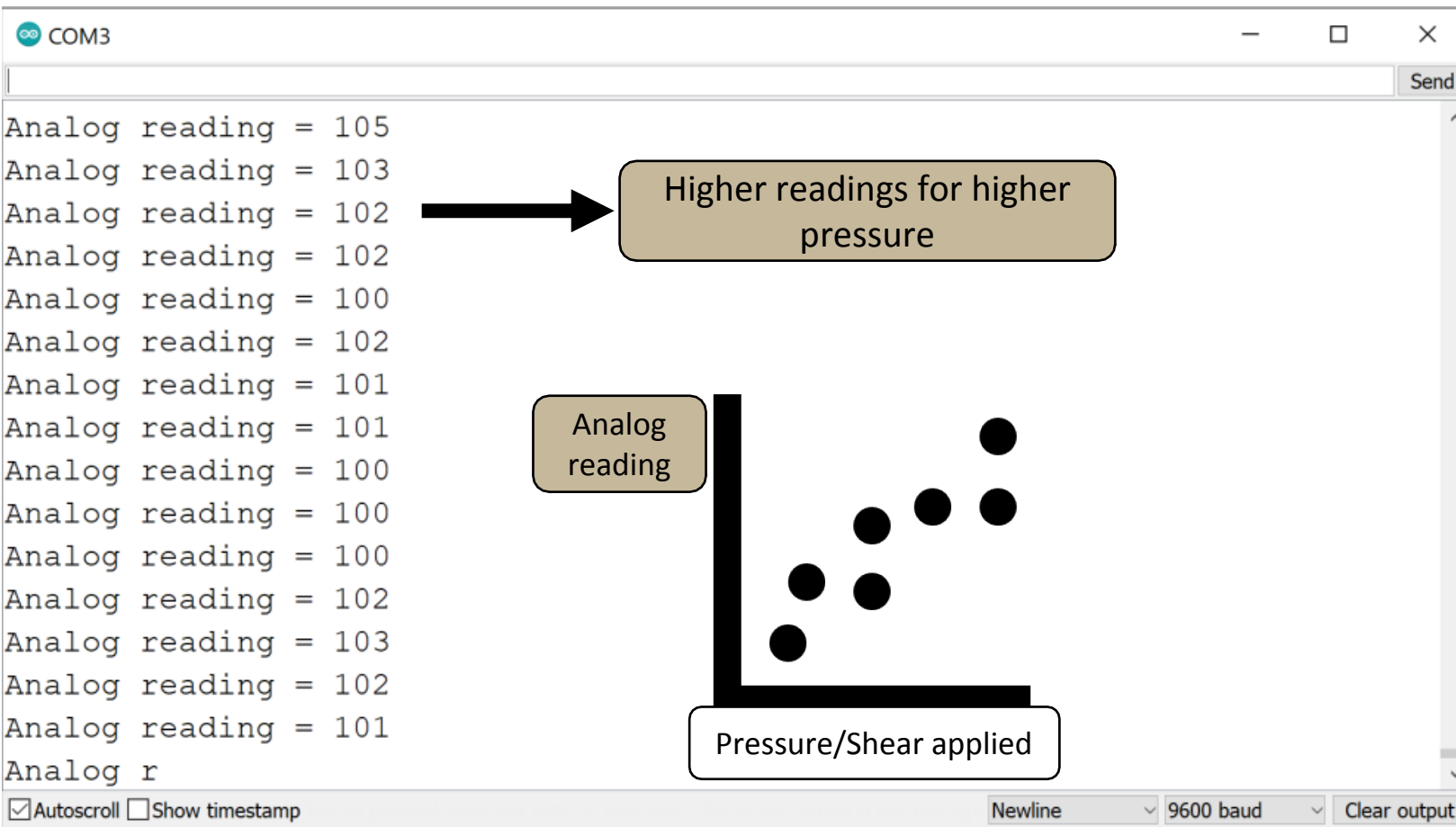
Yanni Giannareas

Prototyping: 2nd Iteration



Yanni Giannareas

Prototyping: 2nd Iteration



Yanni Giannareas

Prototyping: 2nd Iteration

What worked

Cable connections

Analog response from sensor

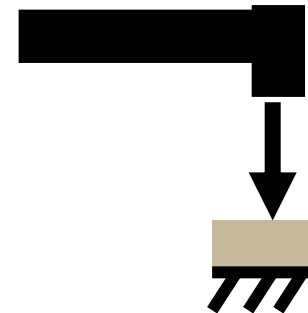
Both loading methods

What didn't work

Insulating tape for fixed surface

Ability to get consistent readings

Testing pressure force



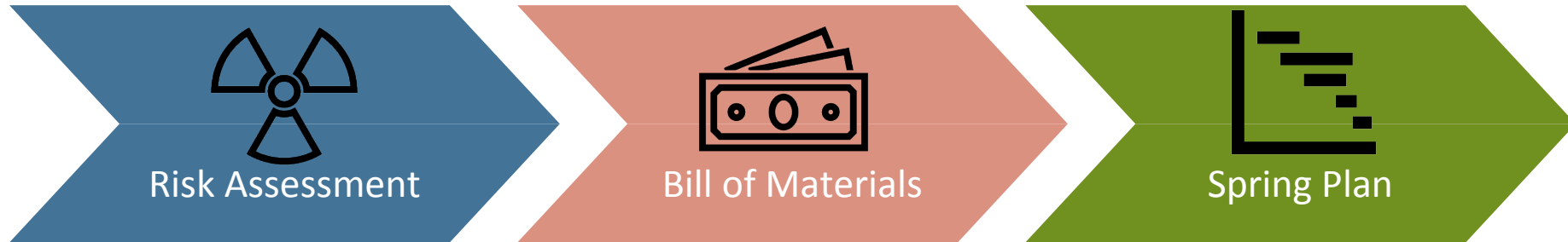
Testing shear force



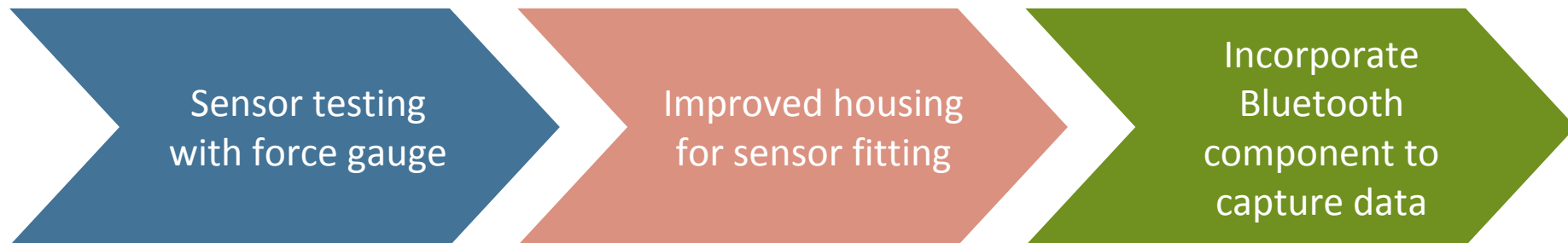
Yanni Giannareas

Future Work

Deliverables



Prototyping



Yanni Giannareas



Instrumented Baseball

David Adams | Mathew Brown | Riley Ferrer | Yanni Giannareas | Charles Whitaker