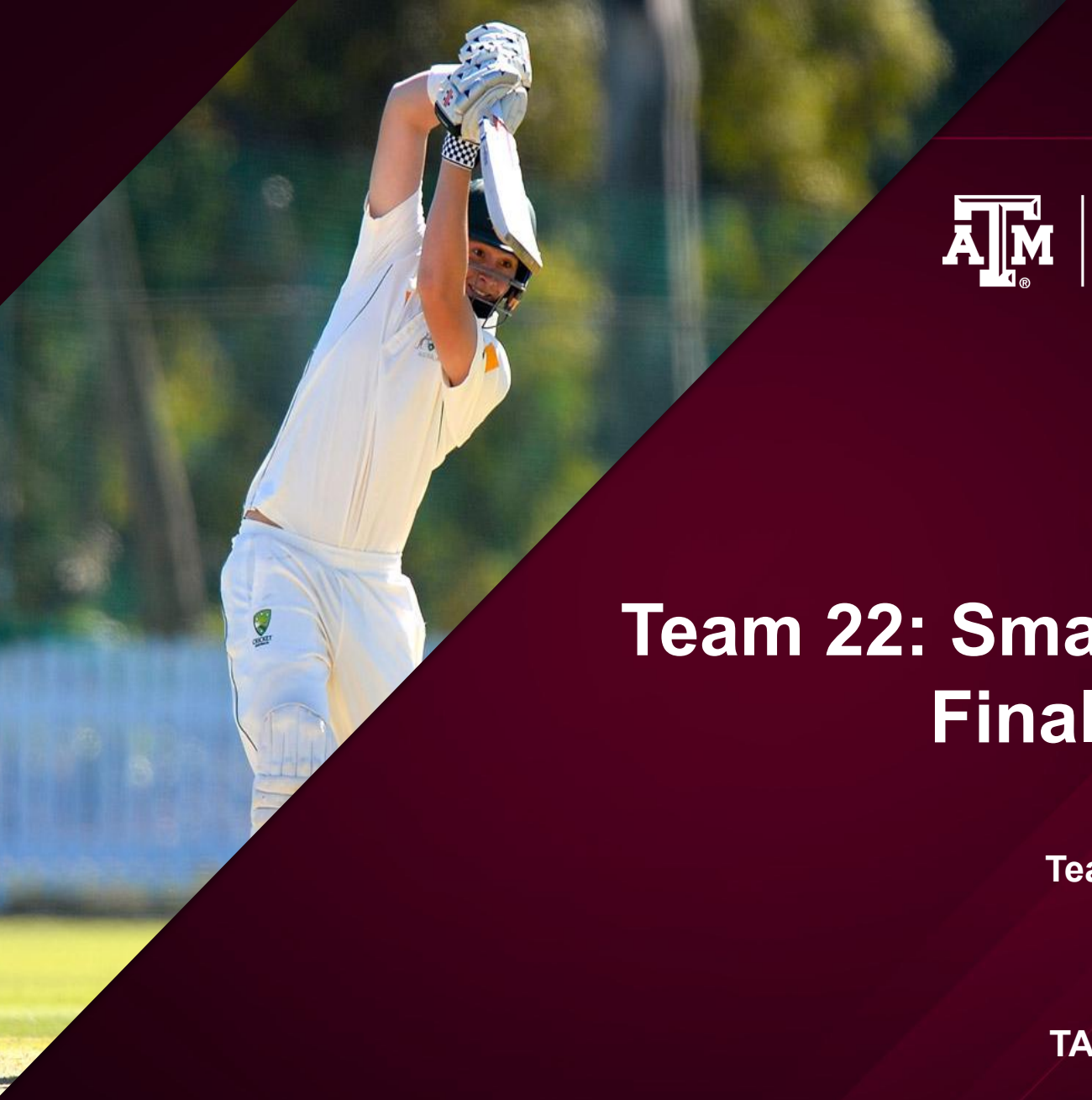

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Team 22: Smart Cricket Bat
Final Presentation

Team members: Pablo Barron
Gavin Dahl
Jiakai Hu
Nolapat Pipitvitayakul
TA: Fardeen Hasib Mozumder
Sponsor: Pranav Dhulipala

Project description

- Problem: “Cricket practice equipment lacks effectiveness without the assistance and guidance of a coach”
- Solution proposal: “Create a device that will mount on the cricket bat and, through a user friendly app, gives real time feedback on the user’s cricket swing i.e. efficiency and swing angle. Must be easy to use and set up”

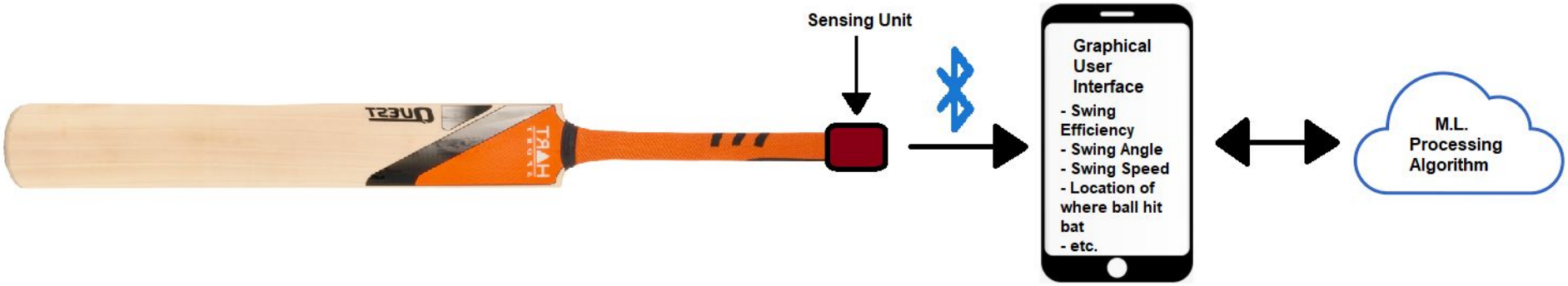
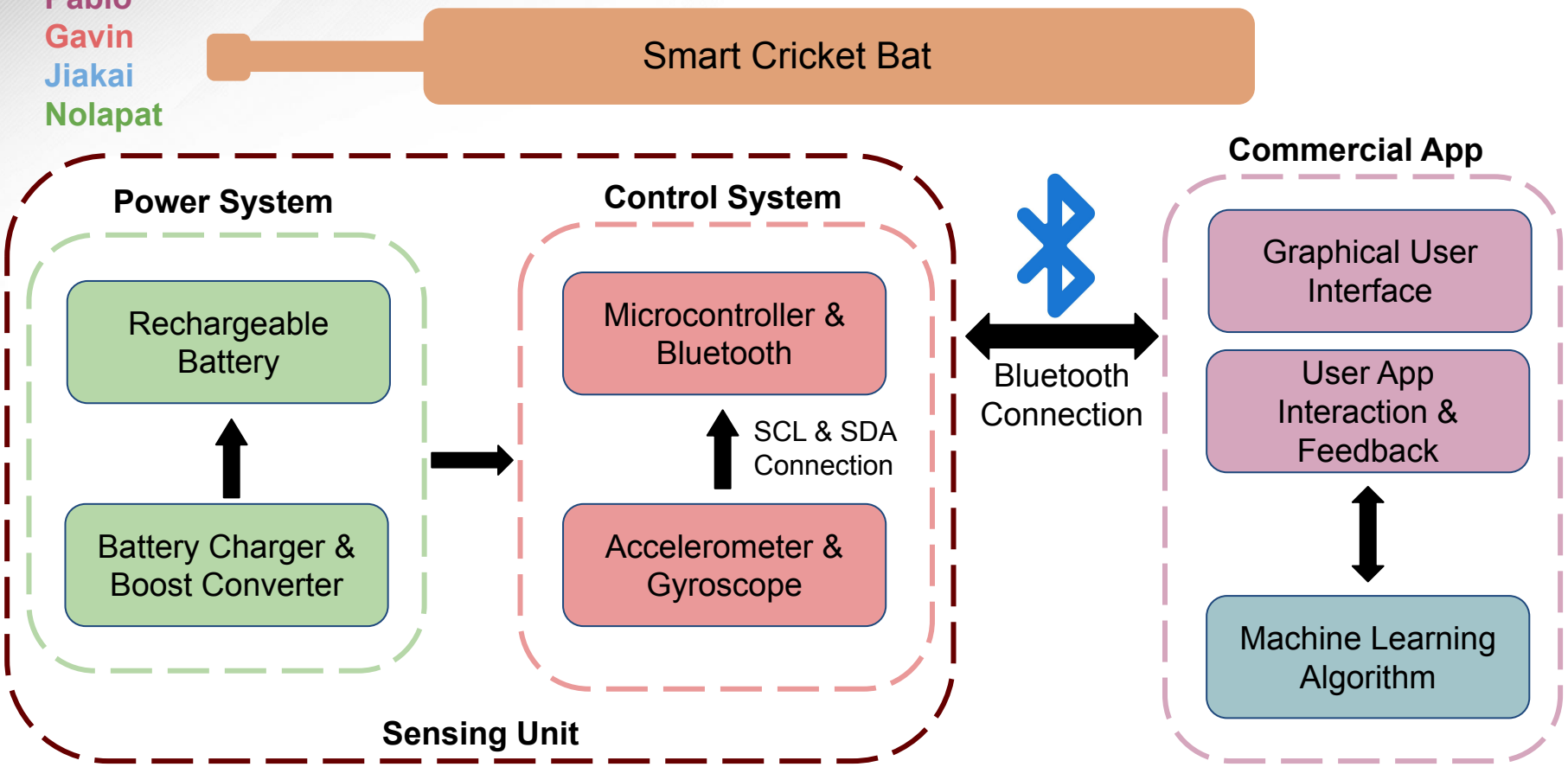


Diagram of Subsystems and Interface

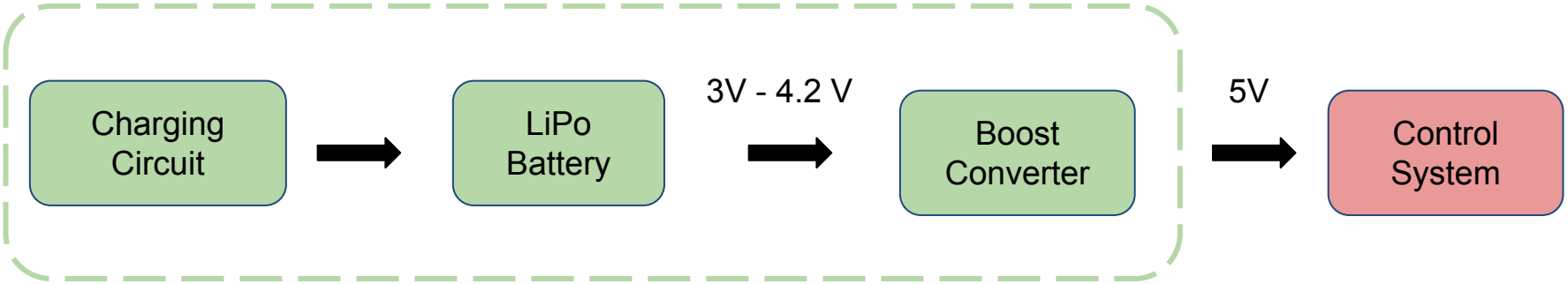
Pablo
Gavin
Jiakai
Nolapat



Picture of System

Power System

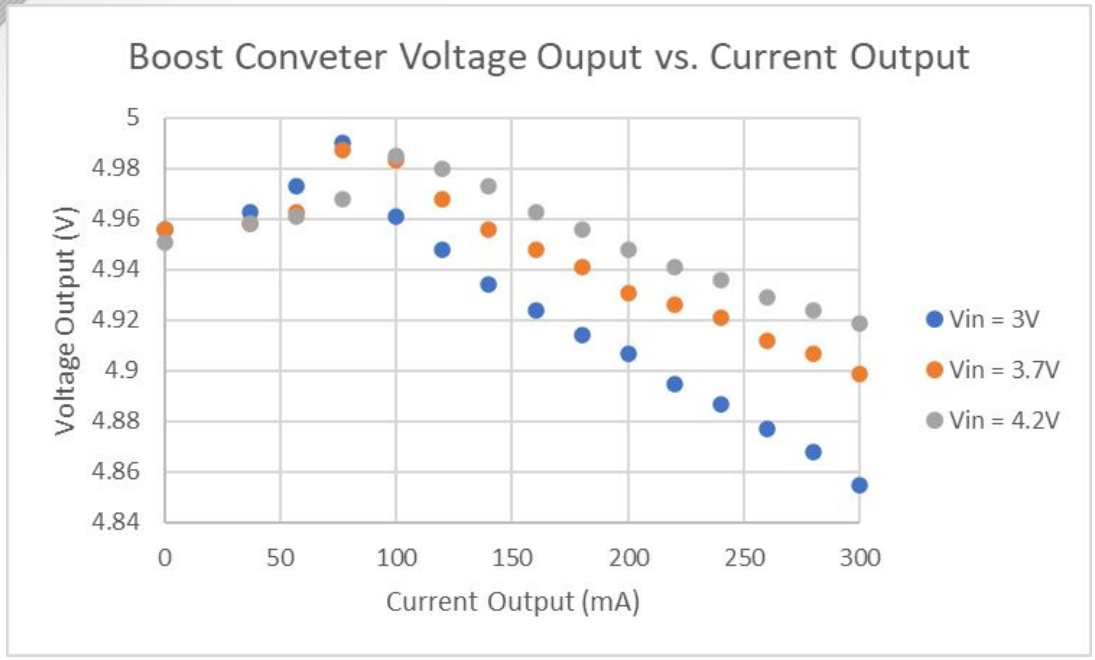
- Distribute proper power requirements to MCU, IMU, and bluetooth
- LiPo battery as a power source
- Boost battery voltage with boost converter
- Charging circuit to charge the battery



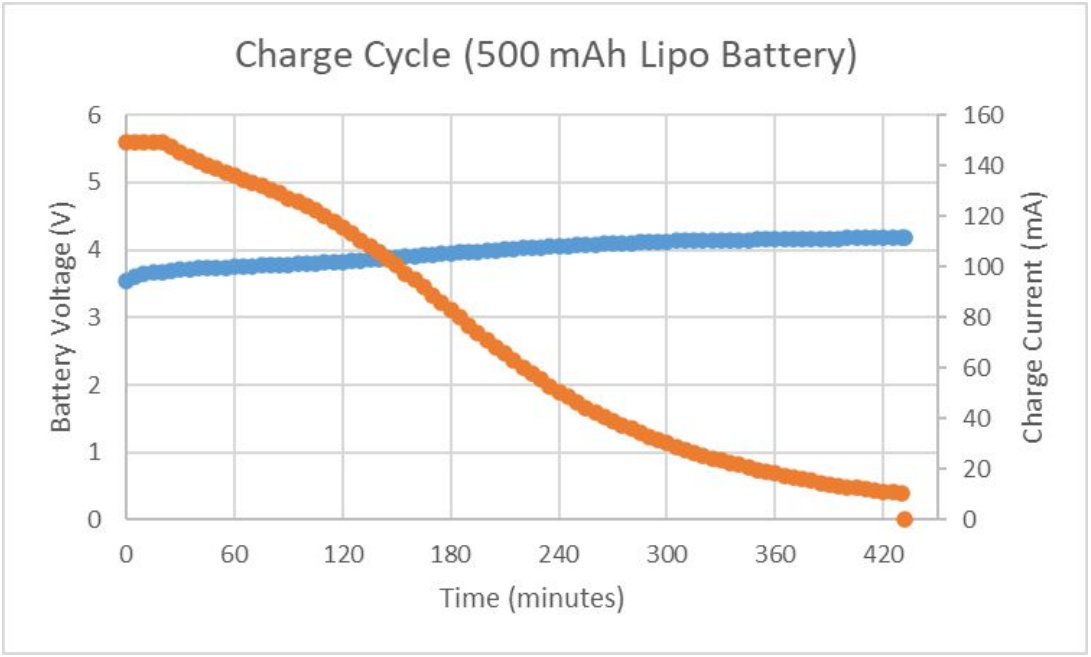
Power System

Power System

- Boost the LiPo battery voltage with 5V dc-dc boost converter
- Battery charging circuit with 4.2V charging voltage and 150mA charging current



	Min	Nominal	Max
Battery Voltage (V)	3	3.7	4.2
Current Draw (mA)	101	123	158
Voltage Output (V)	4.975	4.976	4.988



Control System

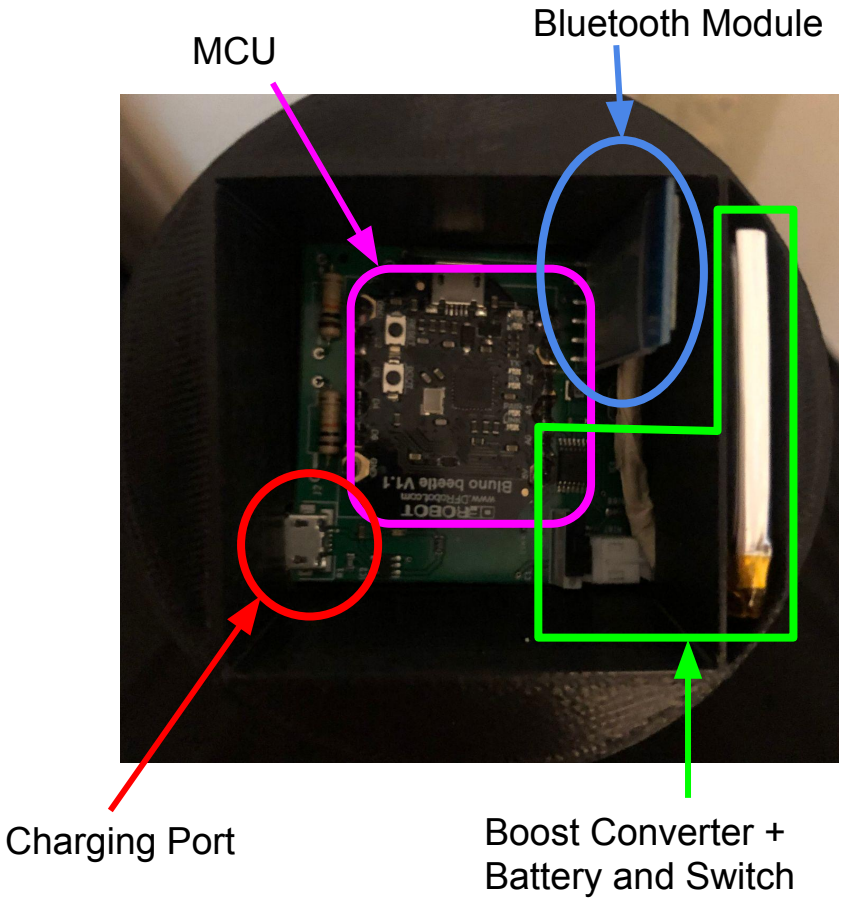
Gavin Dahl

Overview

- Microcontroller: ATmega328P
- Bluetooth Module: HC-05
- IMU: MPU-6050

PCB Specs

- Mass:
  - 21.47 ± 0.01 g
- Dimensions:
  - 47.5 mm x 47.5 mm



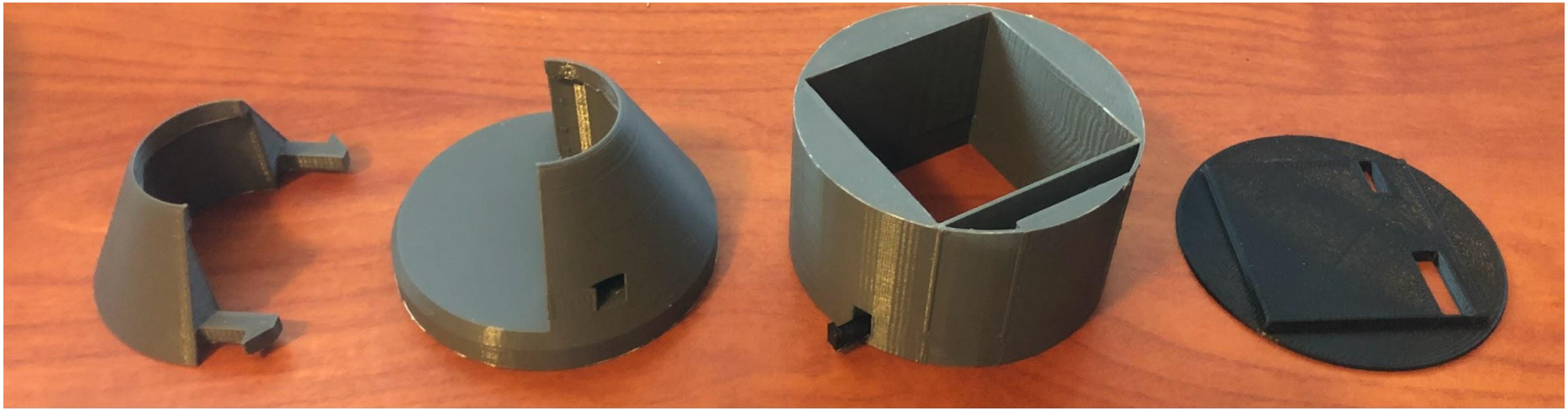
*IMU on bottom layer/side of PCB

Control System

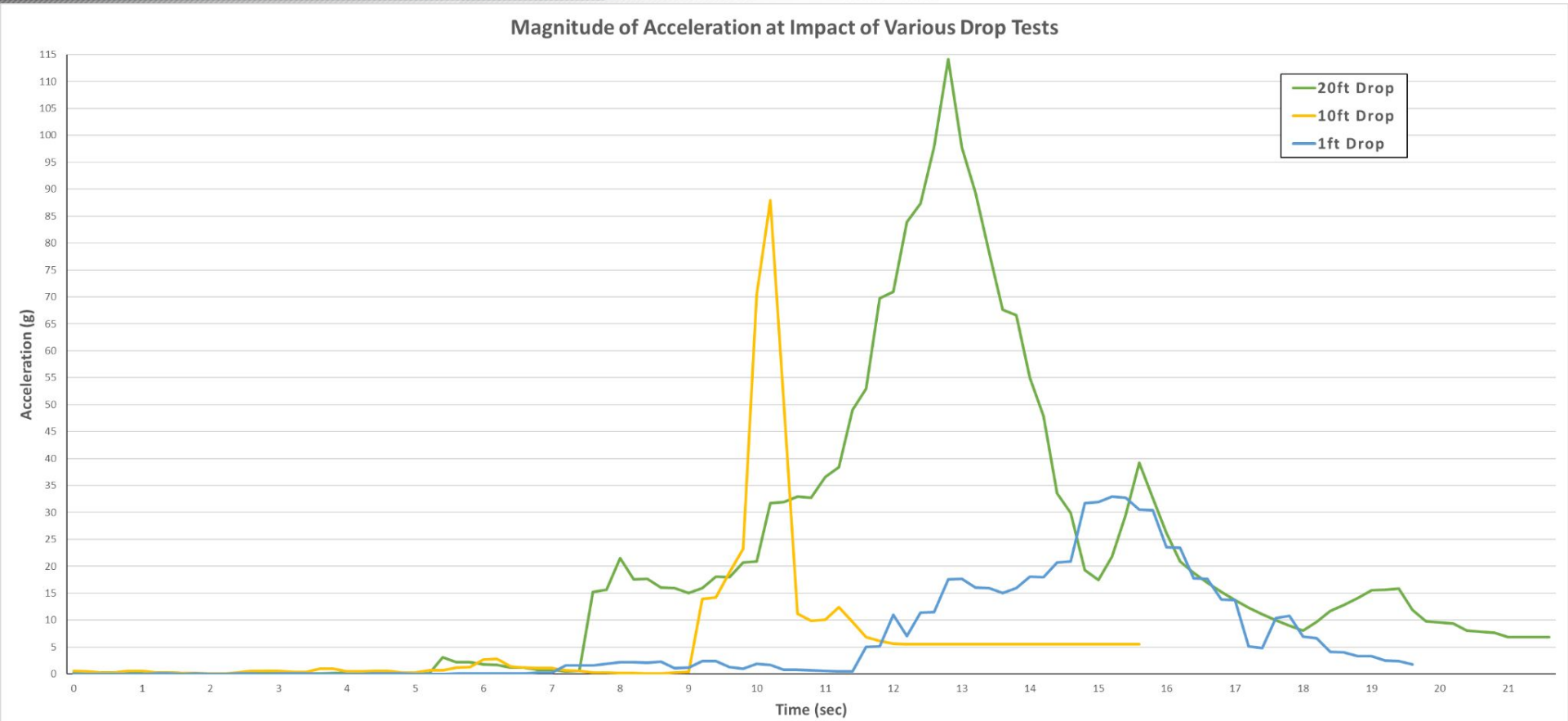
Gavin Dahl

Housing Unit Specifications

	Actual	Sponsor Specifications
Dimensions (d x h)	69mm x 38mm	60mm x 35mm
Mass	55.74 ± 0.01 g	less than 100g

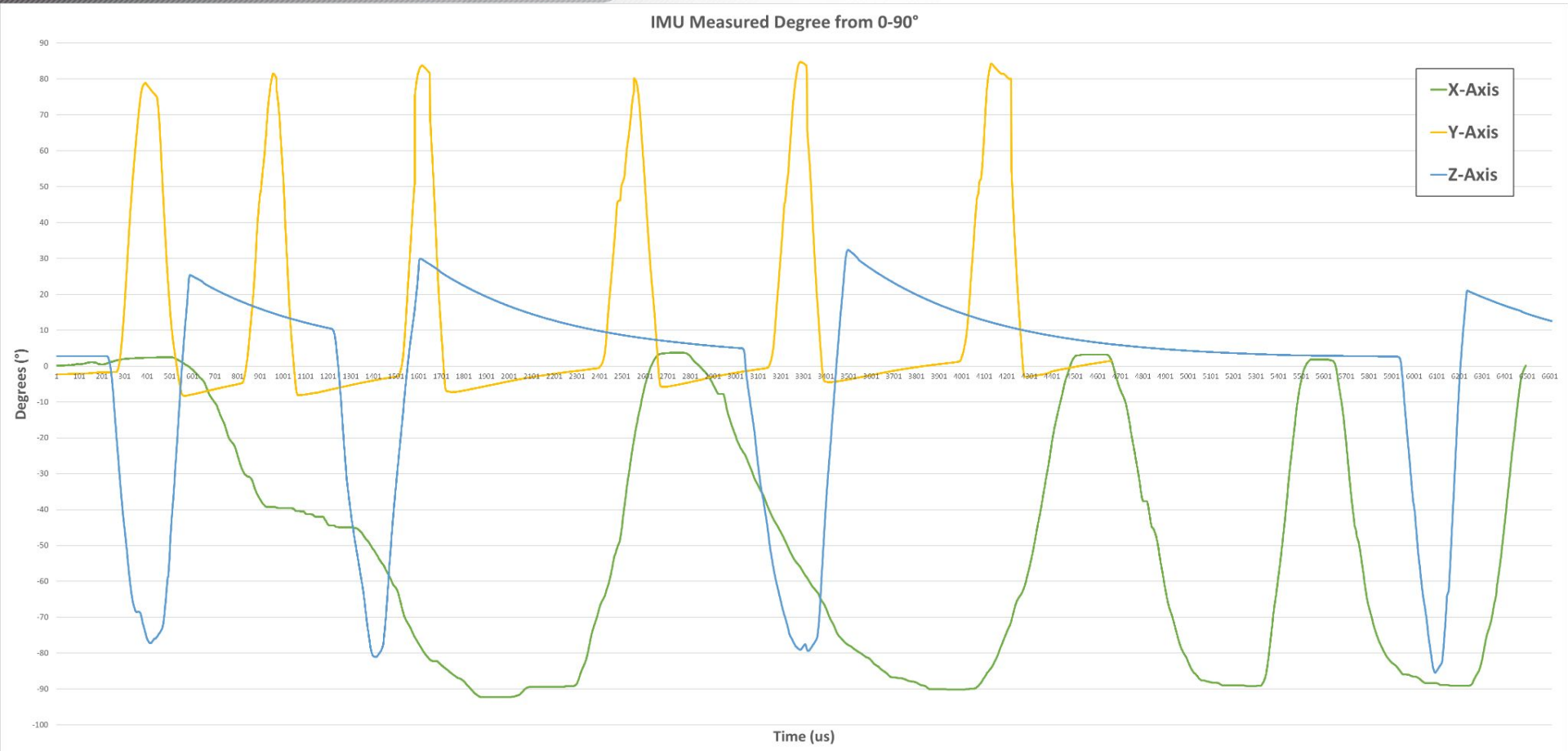


Control System



Height of Drop	Calculated Impact (g)	Actual Impact (g)
1ft	31.16	32.883
10ft	98.534	87.95
20ft	139.4	114.188

Control System



Axis	Measured Range of Degree	Average Peak-to-Peak Variation
X	5° to -92°	~0.1°
Y	-5° to 83°	~1.67°
Z	5° to -81°	~14.32°

Control System

Gavin Dahl

COM6

```
14:45:28.211 -> BT connection at: 10 ft
14:45:59.332 -> BT connection at: 20 ft
14:46:32.348 -> BT connection at: 30 ft
14:48:49.184 -> BT connect ft
14:49:28.085 -> Btion at: 50 ft
14:50:18.726 -> BT connection at: 60 ft
14:52:31.356 -> BT connection at: 70 ft
14:53:30.461 -> BT connection at: 80 ft
14:54:43.617 -> BT connection at: 90 ft
14:56:12.299 -> Bion at: 100 ft
14:58:25.228 -> BT connection at: 110 ft
14:59:28.717 -> BT connection at: 120 ft
15:01:02.842 -> BT connection at: 130 ft
15:02:11.232 -> BT connection at: 140 ft
15:03:25.615 -> BT connection at: 150 ft
15:05:20.859 -> BT connection at: 160 ft
15:07:03.971 -> BT connection at: 170 ft
15:08:31.987 -> BT connection at: 180 ft
15:10:15.585 -> B90 ft
15:12:56.856 -> BT connection at: 200 ft
15:14:36.078 -> BT connection at: 210 ft
15:15:46.228 -> BT connection at: 220 f
```

(a) Bluetooth Distance Validation

Bluetooth Validation

- Wrote sketch for MCU to send current distance, incremented by 10ft, when prompted by bluetooth-connected device
- Connection stable and able to send data until 220 to 240 ft (~67 to 73m)
- Sponsor Specification - 165 ft (~50m)

Sensing Unit Mass Verification

- Took average mass from 10 weigh-ins:
  88.27 ± 0.01 grams

(b) Housing Unit + PCB + Battery Total Mass

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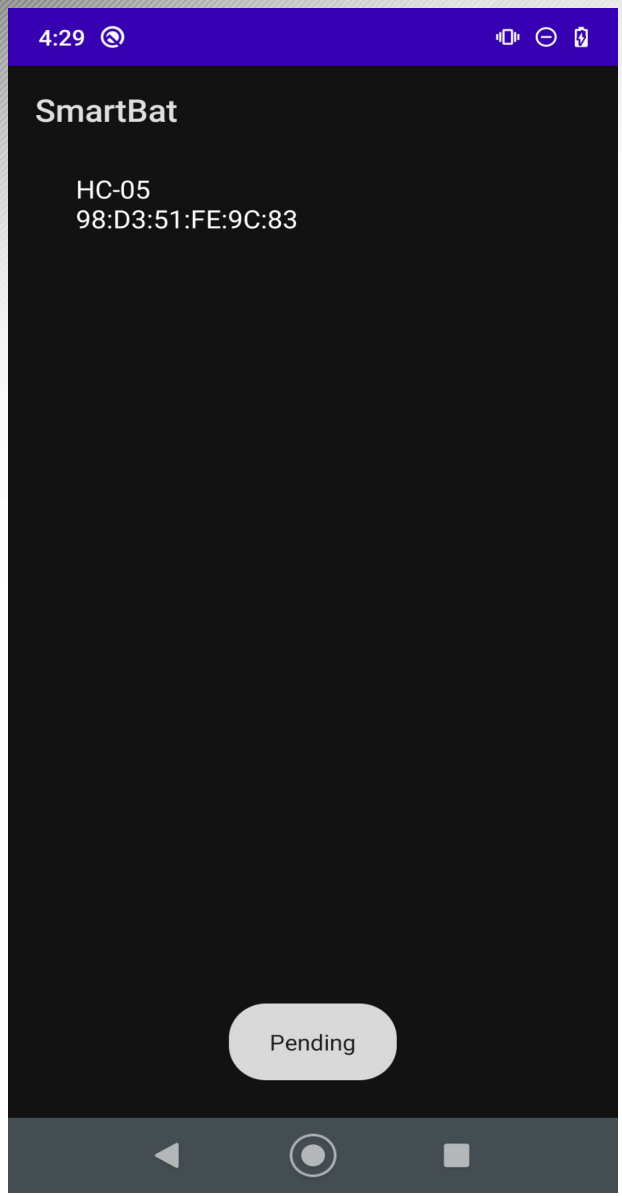
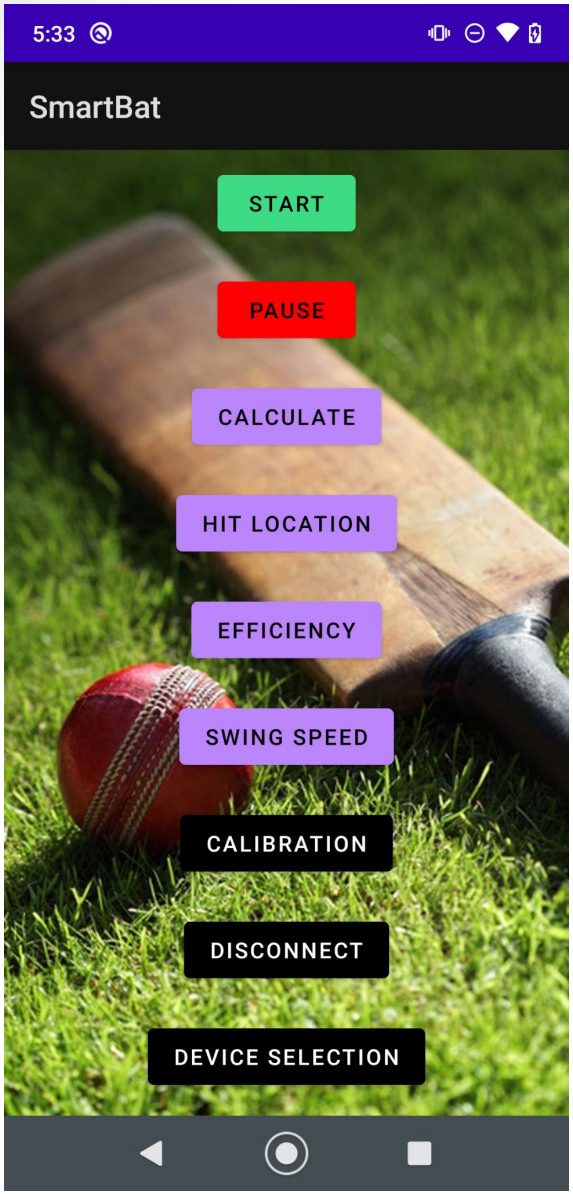
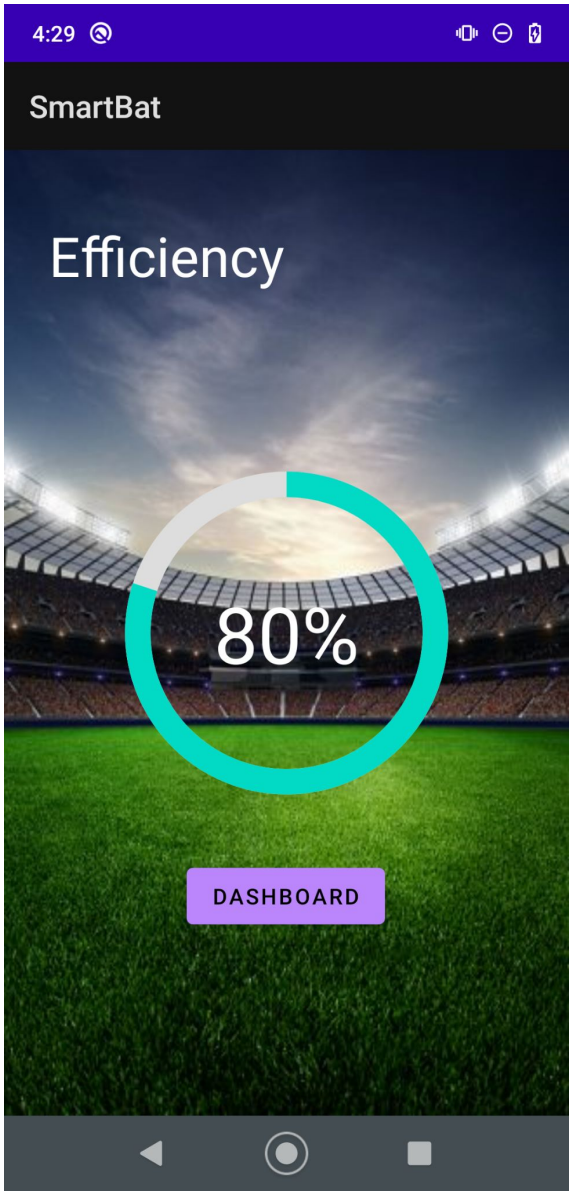
Android App

Pablo Barron







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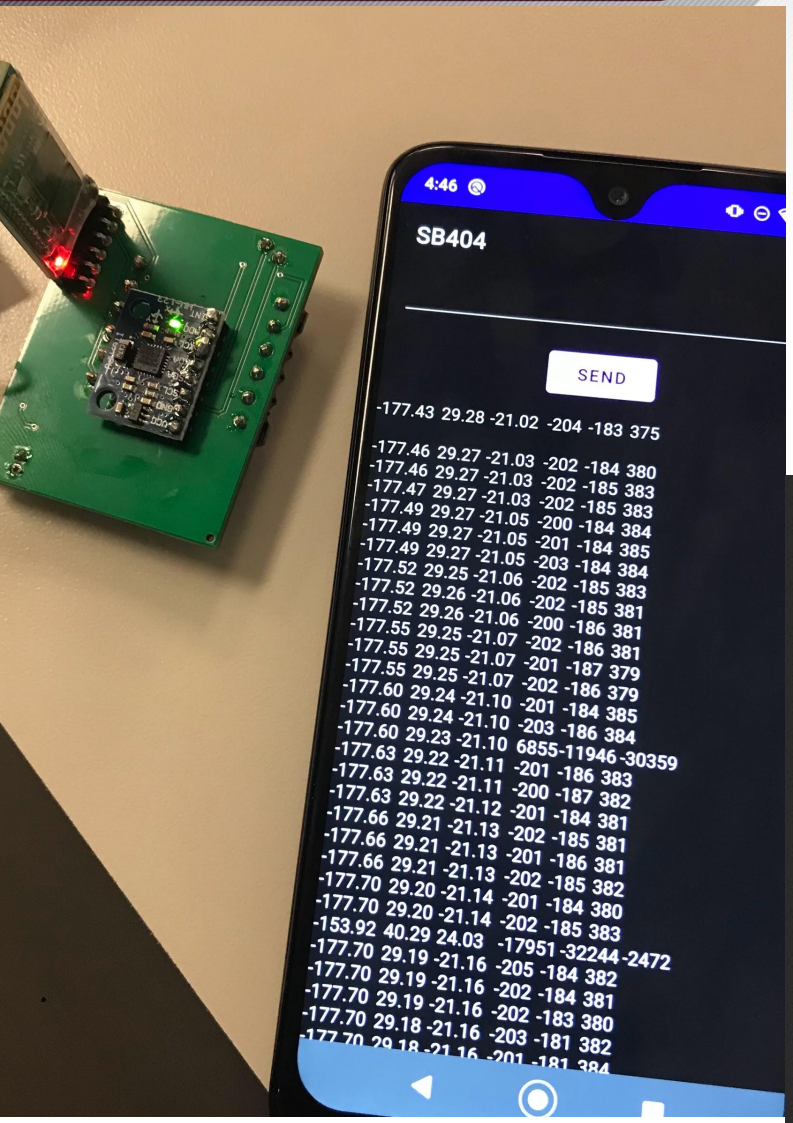
Bluetooth Data Sending and Range Validation



Bluetooth Range: 220ft - 240ft

	Time	Gyro: XYZ			Acce: XYZ		
I/System.out	100414	0.00	-0.24	-0.20	1135	-2052	-5713
I/System.out	100414	0.00	-0.24	-0.20	1135	-2052	-5713
I/System.out	100770	-0.88	-9.51	12.95	2307	-4828	819
I/System.out	100414	0.00	-0.24	-0.20	1135	-2052	-5713
I/System.out	100770	-0.88	-9.51	12.95	2307	-4828	819
I/System.out	100924	-0.91	-9.69	13.21	2282	-4792	830
I/System.out	100414	0.00	-0.24	-0.20	1135	-2052	-5713
I/System.out	100770	-0.88	-9.51	12.95	2307	-4828	819
I/System.out	100924	-0.91	-9.69	13.21	2282	-4792	830
I/System.out	101178	-2.09	-15.34	21.53	1530	-3710	1341
I/System.out	100414	0.00	-0.24	-0.20	1135	-2052	-5713
I/System.out	100770	-0.88	-9.51	12.95	2307	-4828	819
I/System.out	100924	-0.91	-9.69	13.21	2282	-4792	830
I/System.out	101178	-2.09	-15.34	21.53	1530	-3710	1341
I/System.out	101434	-2.70	-18.05	25.50	1203	-3226	1660
I/System.out	100414	0.00	-0.24	-0.20	1135	-2052	-5713
I/System.out	100770	-0.88	-9.51	12.95	2307	-4828	819
I/System.out	100924	-0.91	-9.69	13.21	2282	-4792	830
I/System.out	101178	-2.09	-15.34	21.53	1530	-3710	1341
I/System.out	101434	-2.70	-18.05	25.50	1203	-3226	1660
I/System.out	101691	-3.09	-20.16	28.49	969	-2872	1932

Android App and ML Sending

Pablo Barron

```
√ Initialized provider successfully.
  Initialized your environment successfully.

Your project has been successfully initialized and connected to the cloud!
```

```
W/xample.smartba: Accessing hidden method Lan
I/SmartBatApp: Initialized Amplify
I/AdrenoGLES: QUALCOMM build
```

Problems Faced:

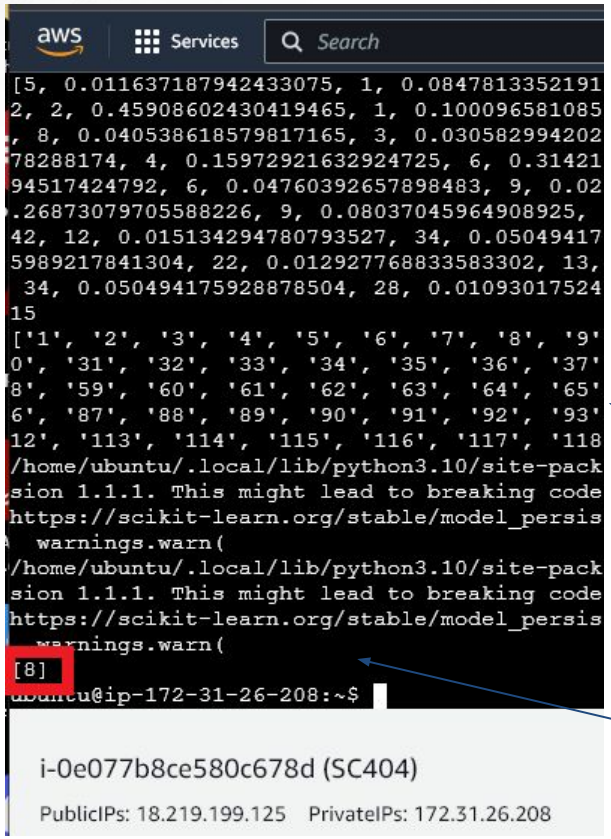
- **Switched from running locally to having to run ML Code on a cloud server**
- **Firebase did not accept our ML model, constant conversion errors when converting to TensorFlow**
- **Currently working with AWS ec2 and s3 with AWS Amplify**

ML integration

Transferring model to aws server

```
C:\Users\hjk0811>scp -i D:/111/SC404NK.pem D:/111/sv.py ubuntu@ec2-18-219-199-125.us-east-2.compute.amazonaws.com:/home/
ubuntu/
sv.py                                         100%   20KB 236.4KB/s   00:00
```

Results on aws server are the same with google colab




```
    list_of_features.append(zapsdFiveY[i])

print(list_of_features)
print(list_of_labels)
```

```
[5, 0.011637187942433075, 1, 0.0847813352191105, 1, 0.03752700460896405, 1, 0.04536442340566216,
15
```

```
[18] array2d=[[0]]
     array2d[0]=list_of_features
```

```
[19] columnNames=['1','2','3']
     for i in range(4,121):
       columnNames.append(str(i))

     print(columnNames)
     df = pd.DataFrame(array2d, columns = columnNames)
```

```
['1', '2', '3', '4', '5', '6', '7', '8', '9', '10', '11', '12', '13', '14', '15', '16', '17', '
```

```
[20] df2 = df[['22', '31', '77', '118', '55', '102', '53', '108', '93', '46']]
```

```
from joblib import Parallel, delayed
import joblib

# Load the model from the file
clf_from_joblib = joblib.load('/content/drive/MyDrive/filename.pkl')

# Use the loaded model to make predictions
print(clf_from_joblib.predict(df2))
```

```
[8]
```

Results

Random Forest

```
Accuracy on training set is : 0.725
Accuracy on test set is : 0.3793103448275862
              precision    recall  f1-score   support

           1       0.46      0.38      0.41        32
           2       0.39      0.41      0.40        32
           3       0.29      0.35      0.31        23

    accuracy                           0.38        87
   macro avg       0.38      0.38      0.38        87
weighted avg       0.39      0.38      0.38        87
```

KNN

```
[[17 12  3]
 [ 9 17  6]
 [11  7  5]]
48
              precision    recall  f1-score   support

           1       0.46      0.53      0.49        32
           2       0.47      0.53      0.50        32
           3       0.36      0.22      0.27        23

    accuracy                           0.45        87
   macro avg       0.43      0.43      0.42        87
weighted avg       0.44      0.45      0.44        87
```

Decision Tree

```
Confusion Matrix:
[[14  7 11]
 [10 12 10]
 [ 5  9  9]]
Accuracy:  0.40229
f1 Score:  0.39954
Precision:  0.4037
```

Logistic Regression

```
[[ 7 17  8]
 [11 12  9]
 [ 9  8  6]]
62
              precision    recall  f1-score   support

           1       0.26      0.22      0.24        32
           2       0.32      0.38      0.35        32
           3       0.26      0.26      0.26        23

    accuracy                           0.29        87
   macro avg       0.28      0.28      0.28        87
weighted avg       0.28      0.29      0.28        87
```

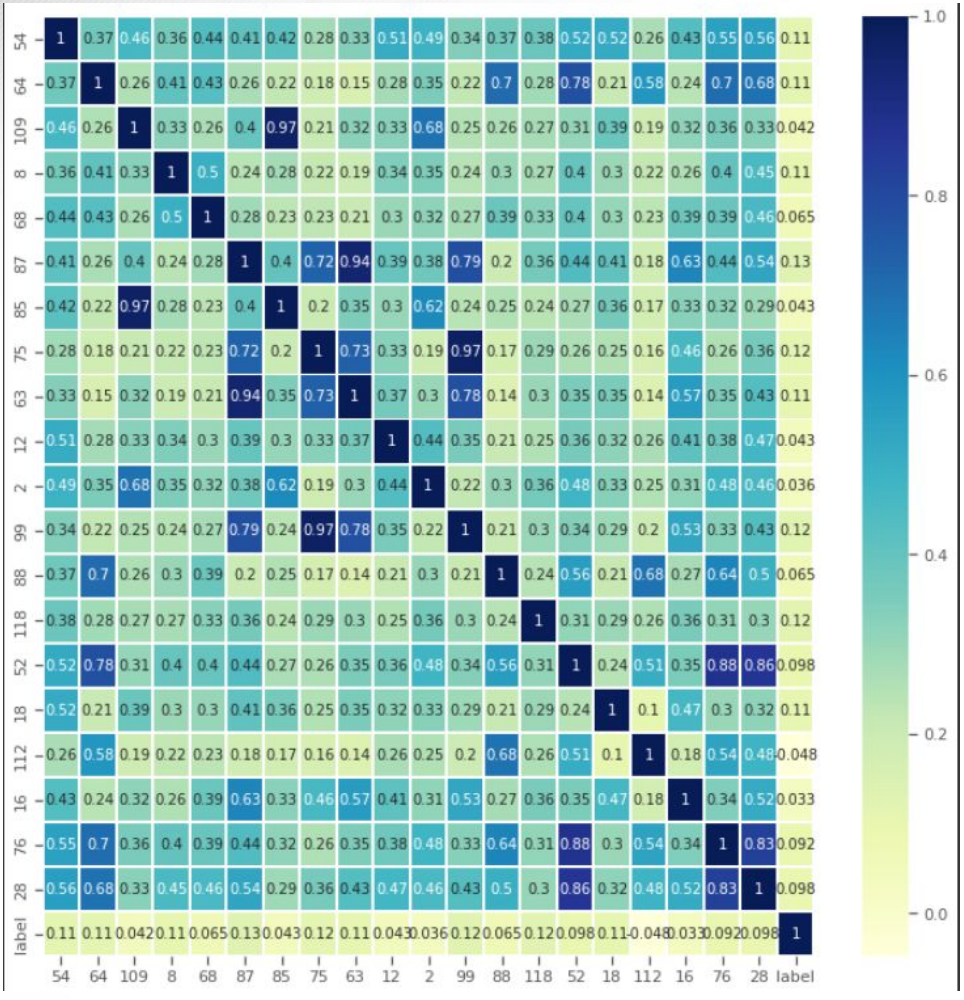
SVM

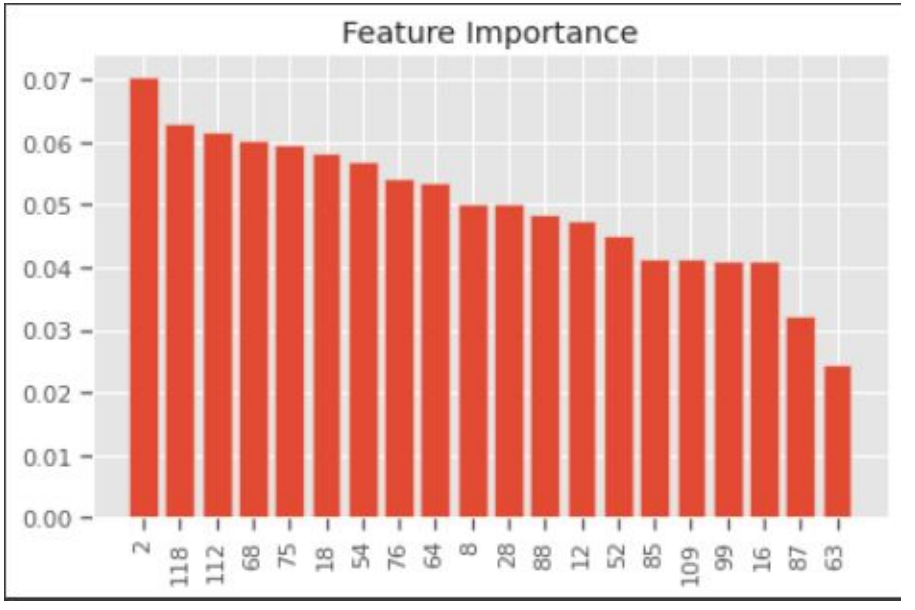
```
[[15 10  7]
 [13  9 10]
 [10  6  7]]
56
              precision    recall  f1-score   support

           1       0.39      0.47      0.43        32
           2       0.36      0.28      0.32        32
           3       0.29      0.30      0.30        23

    accuracy                           0.36        87
   macro avg       0.35      0.35      0.35        87
weighted avg       0.35      0.36      0.35        87
```

Heatmap and feature importance





Conclusion

Changes from 403 Documents

- ML will run on a cloud server instead of running locally on device
- Bluetooth changed from BLE to Classic Bluetooth

Tasks to Complete Before Demo

- Finish ML and App integration ~ 1 week
- Collect more data to increases ML accuracy
- Validate ML and App Communication and test completed system

Questions?