Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Team 22: Smart Cricket Bat

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”

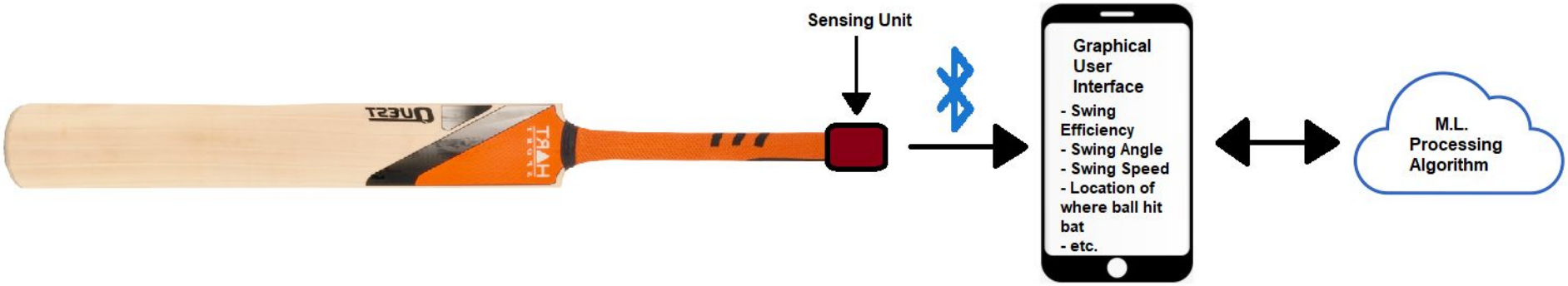
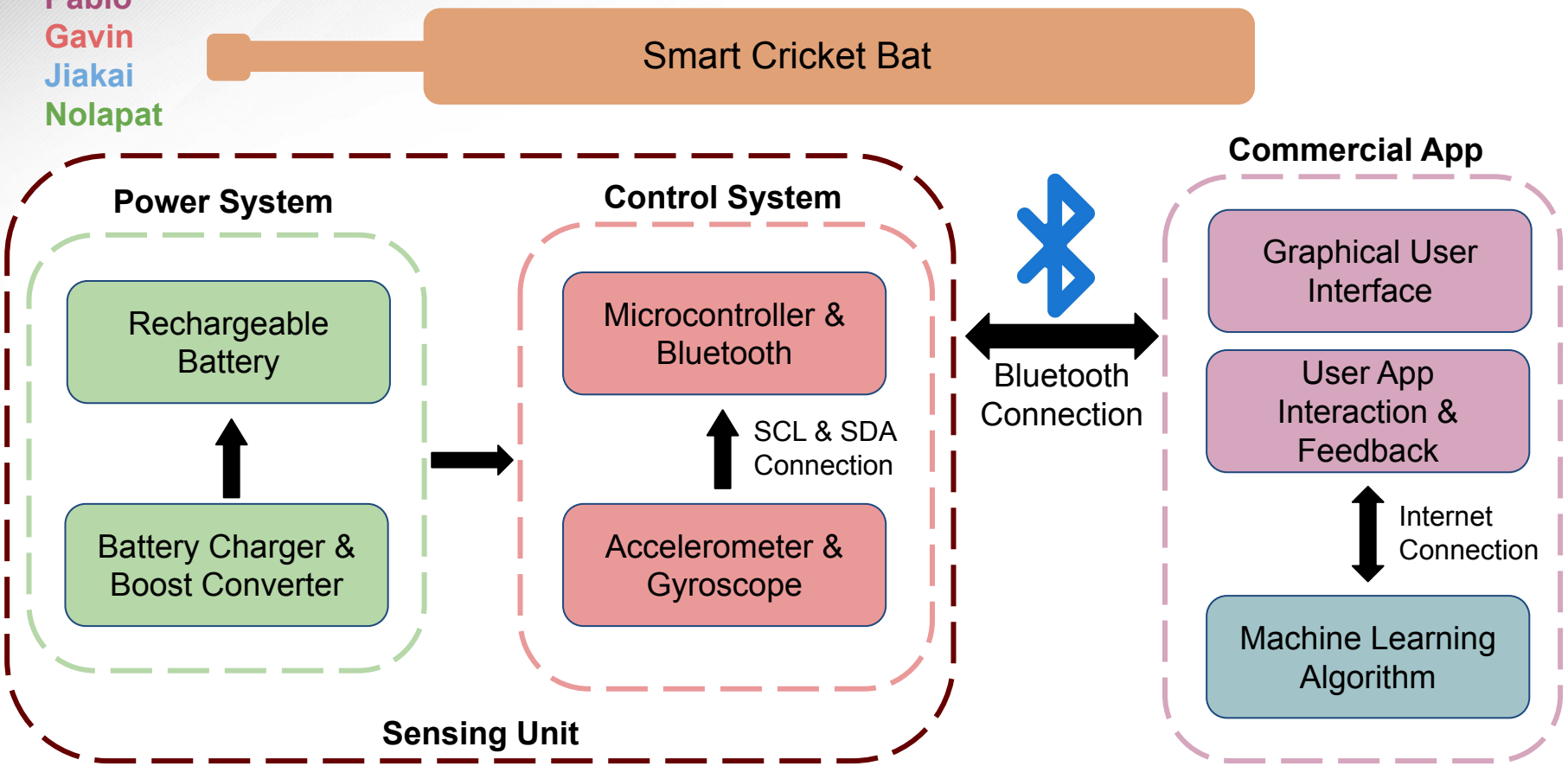


Diagram of subsystems and interface

Pablo
Gavin
Jiakai
Nolapat



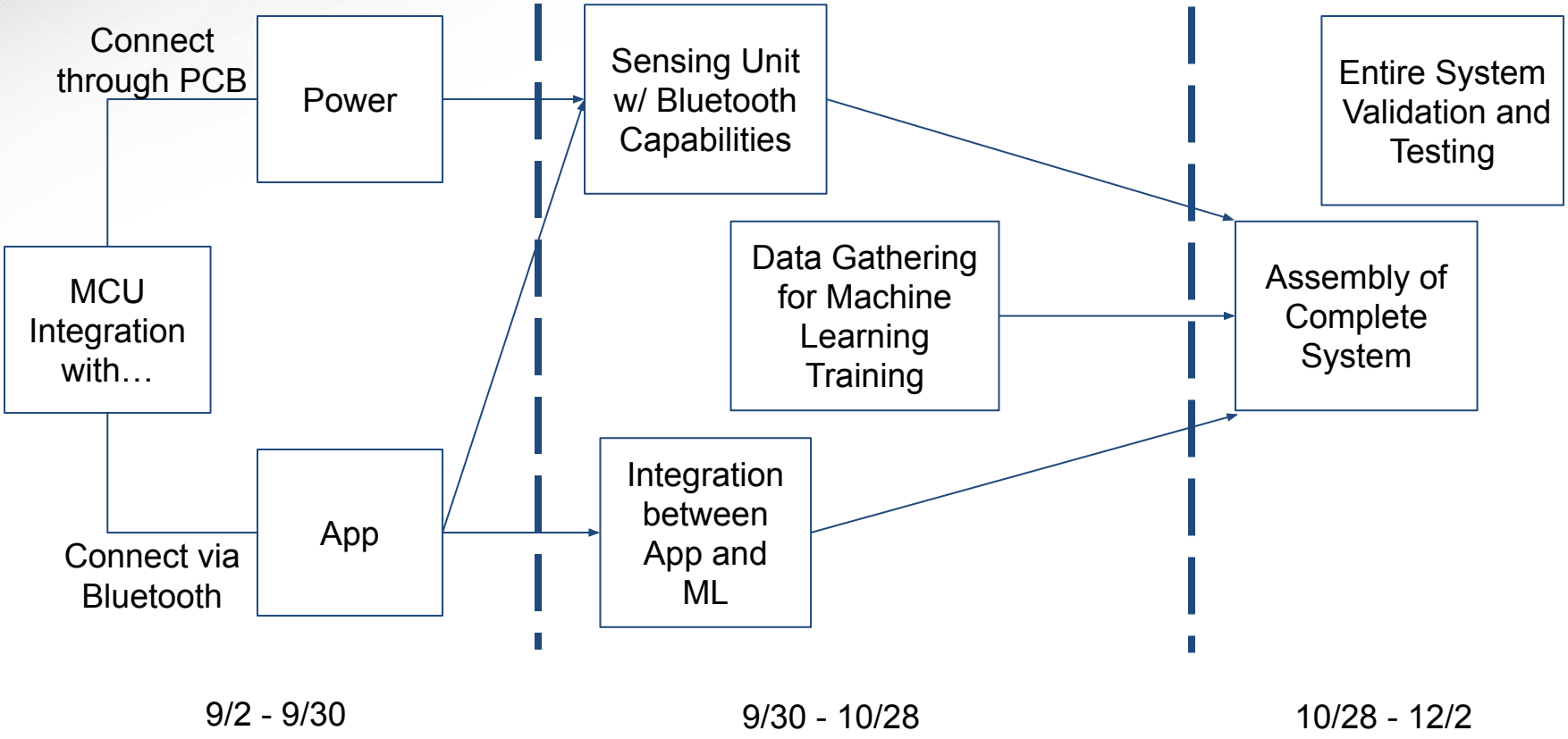
Subsystem Overview

- Android App: Will handle user interaction and communication between the MCU and the ML algorithm. The app receives data from the MCU via a bluetooth connection. The app will then send received data to ML algorithm to be processed
- Power: Contains the boost-converter, on-board lithium battery power supply, and recharging station
- ML Algorithm: Develop the ML algorithm for finding the specific characteristics of users swing
- Control : A sensing unit that will communicate the IMU values from the swing to the user app through an MCU with bluetooth capabilities

Major Changes For 404

- Switching from Low-Energy Bluetooth 4.0 to Standard Bluetooth 3.0
- App language changed from Java to Kotlin due to lack of updated reference/source videos.

Project Timeline



Control System

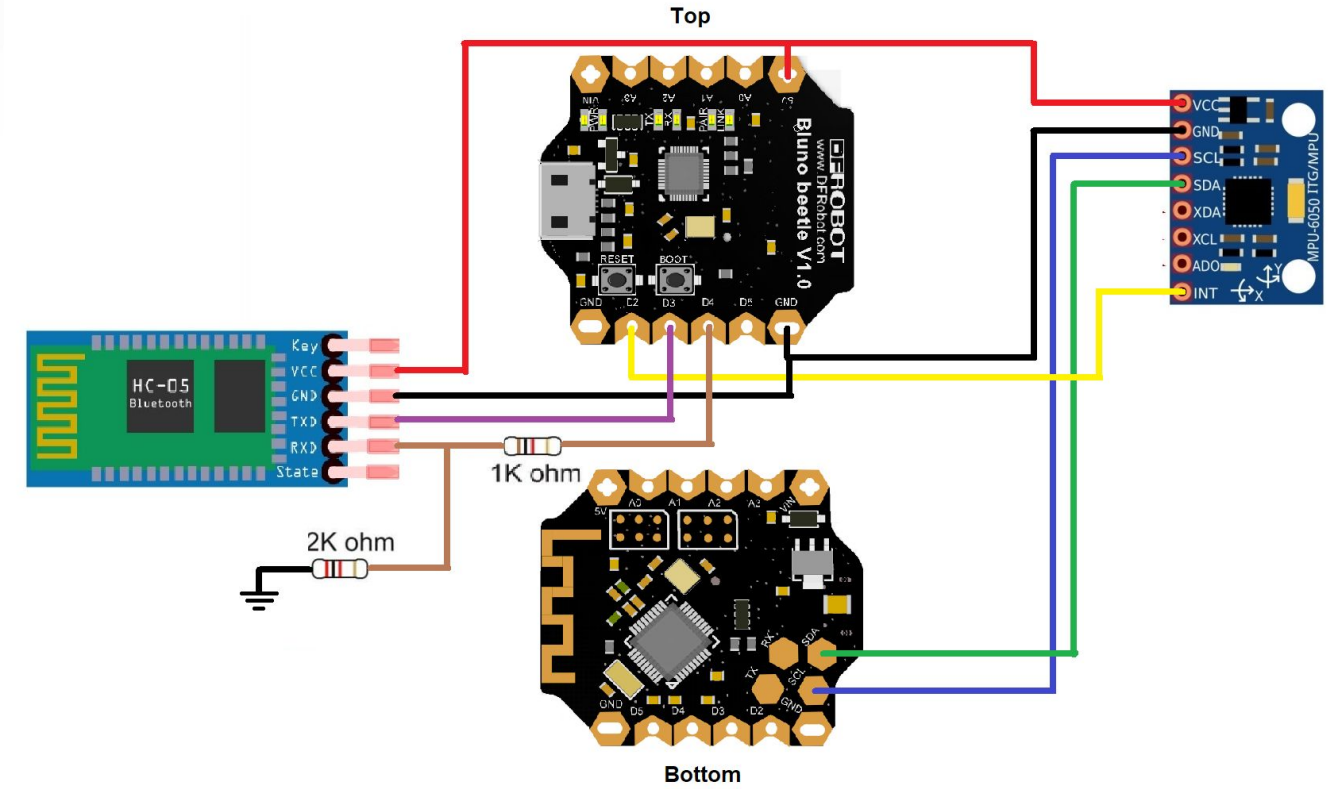
Gavin Dahl

Accomplishments since 403 1 hr of effort	Ongoing progress/problems and plans until the next presentation
• Confirmed MCU and IMU communication is still working as intended	• Integration with power system and finalization of combined PCB design • Integration between MCU and App through new bluetooth module

Control System

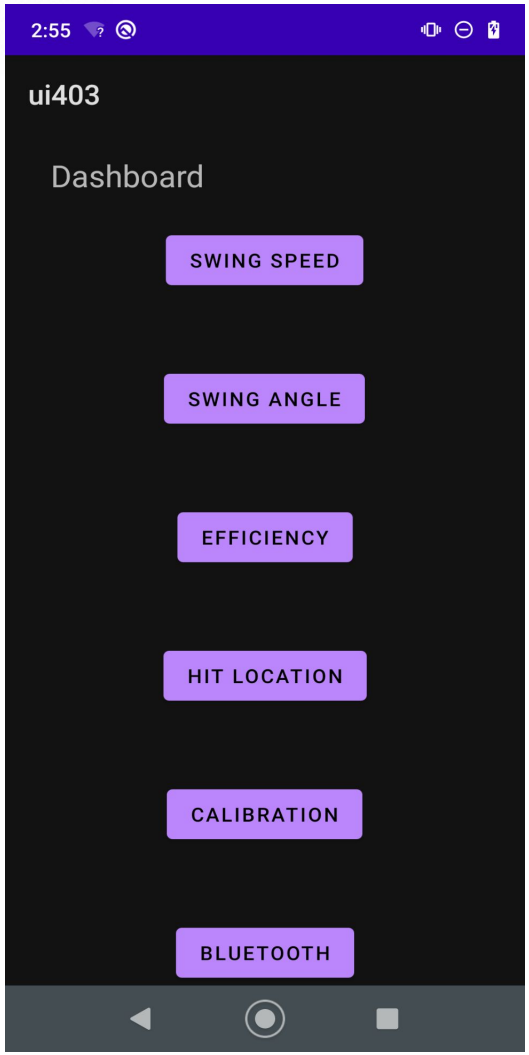
Gavin Dahl

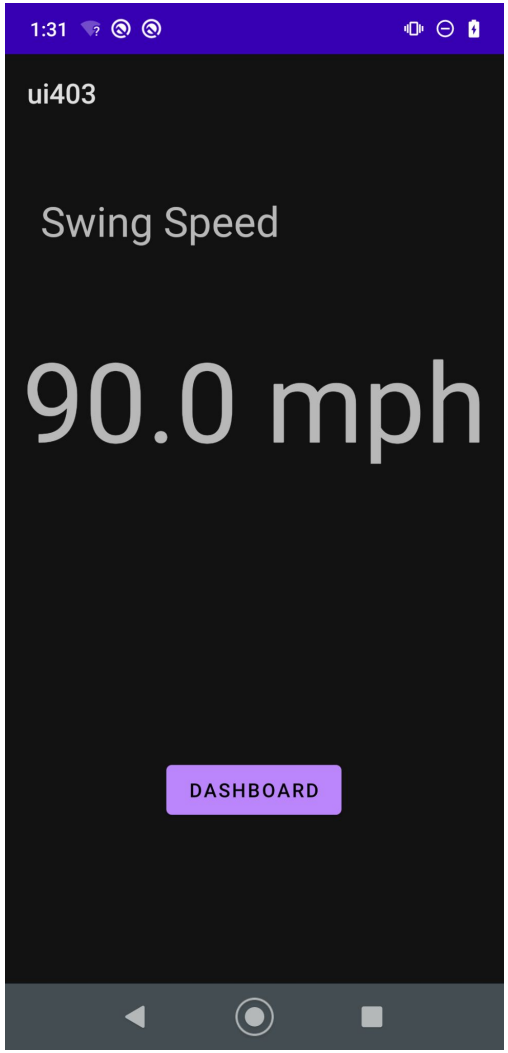
- Microcontroller: ATmega328P
- Bluetooth Module: HC-05
- Inertial Measurement Unit: MPU-6050



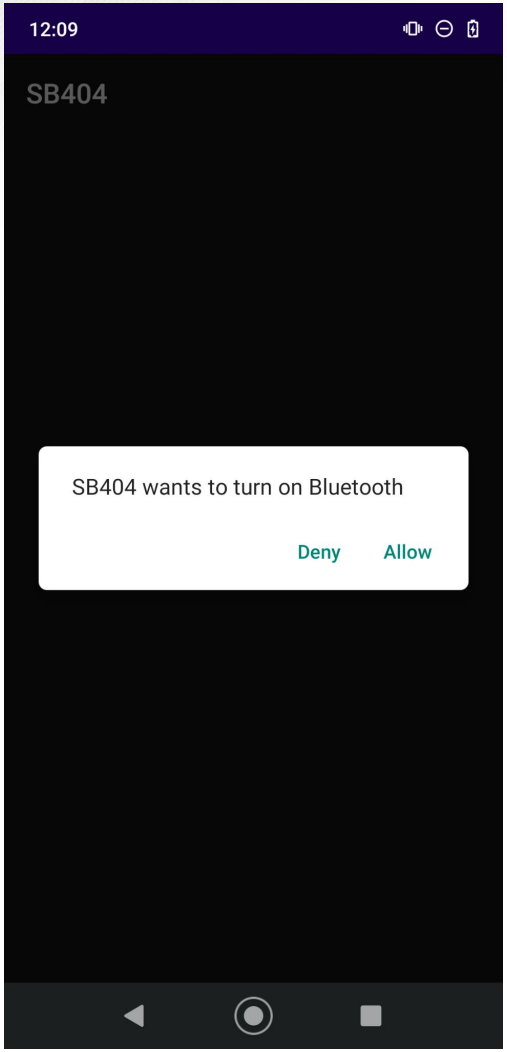
Android App

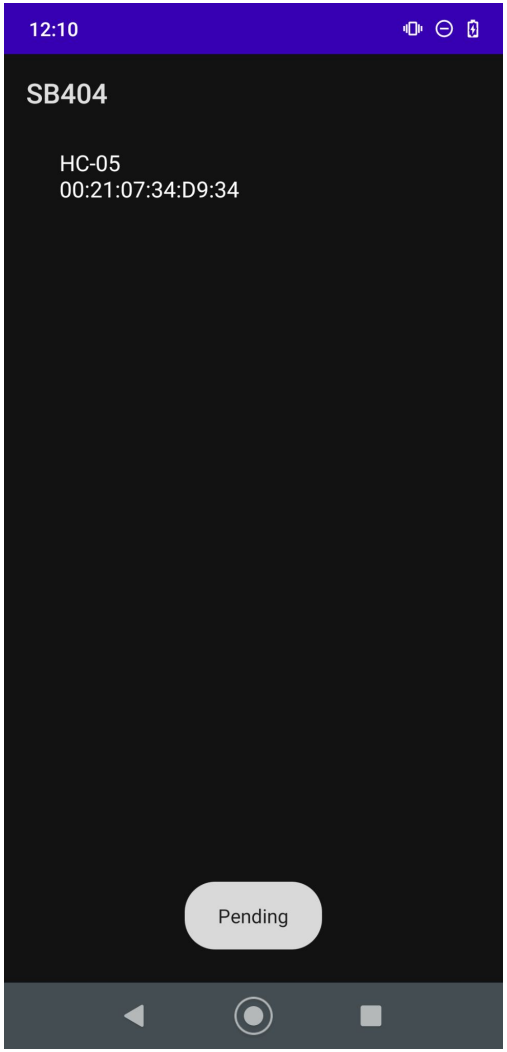
- Accomplishments since 403: 8 Hrs
  - Have established a stable bluetooth connection to received data from MCU
- Ongoing Progress:
  - Fully integrate app with Control Subsystem
  - Make app “prettier”
  - ML and app integration





Android App


12:09
SB404
SB404 wants to turn on Bluetooth
Deny
Allow

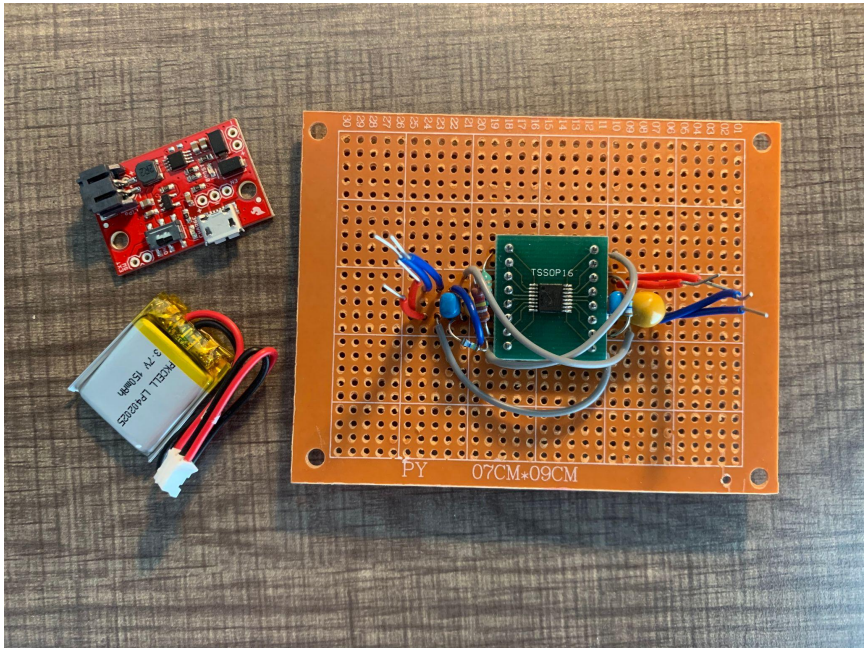

12:10
SB404
HC-05
00:21:07:34:D9:34
Pending

Power System

Accomplishments since 403 1 hr of effort	Ongoing progress/problems and plans until the next presentation
• Confirmed boost converter circuit on perfboard is still working	• Design PCB for boost converter circuit • Integration with control system and finalization of combined PCB design

Power System

- 5V DC-DC Boost Converter Circuit
- 3.7V 150mAh LiPo Battery
- LiPo Battery Charger



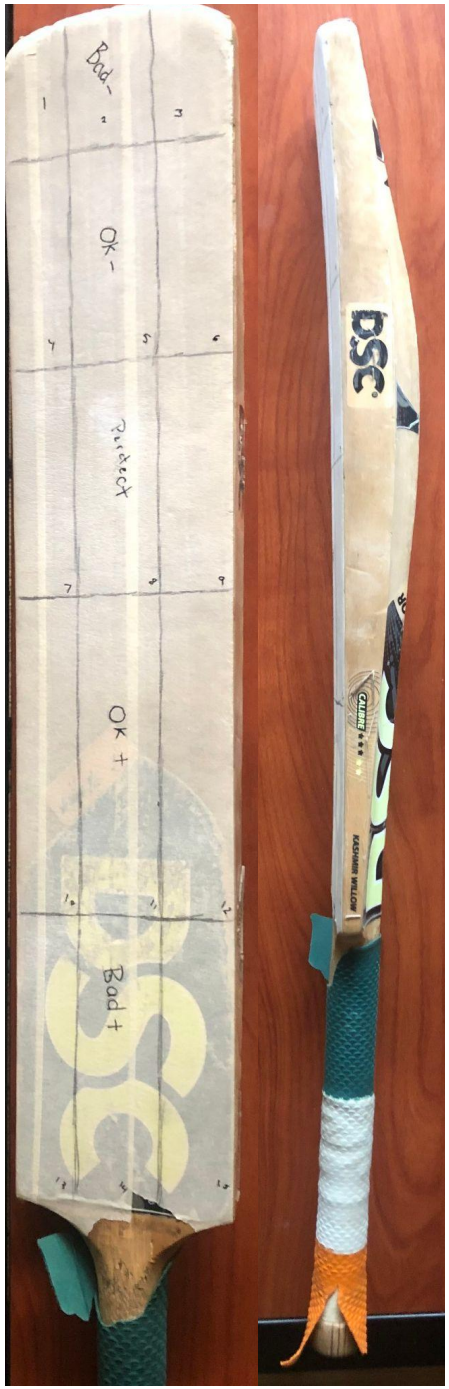
Machine Learning

Achieved in 403:

- Subsystem completed, get around 13% accuracy

Ongoing process:

- Data gathering to increase accuracy
- ML integration with Android App

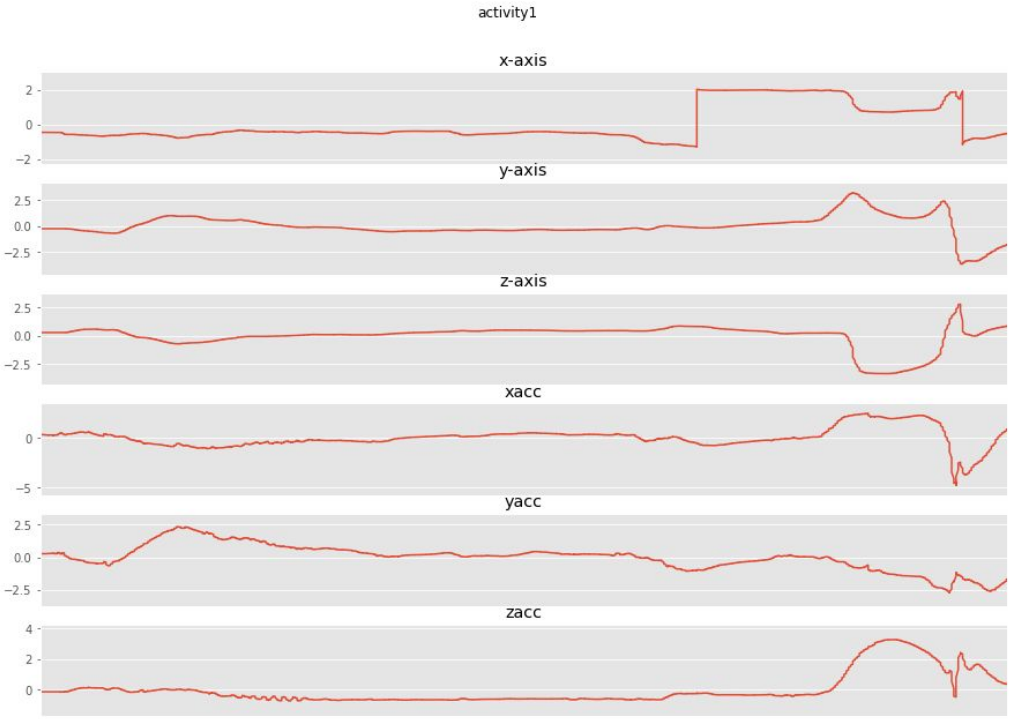


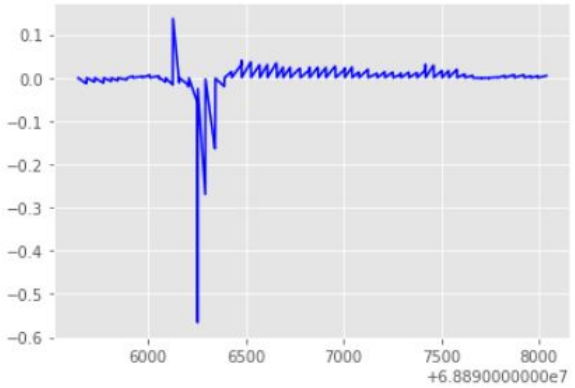
Machine Learning

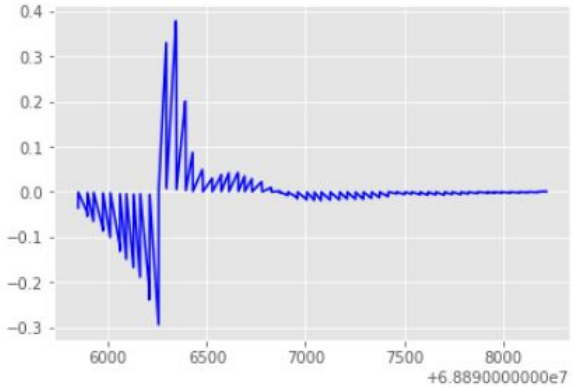
- Chunking over time period
- PSD and FFT and each period
- Take peaks
- Separate data

  70% for training

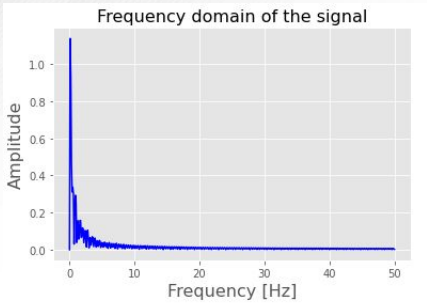
  30% for testing
- recognize each hit to each area

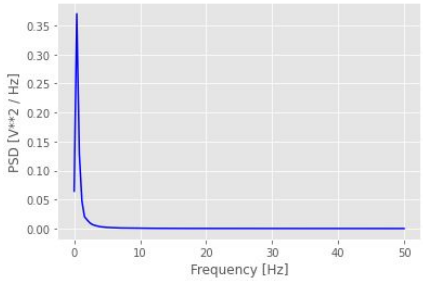


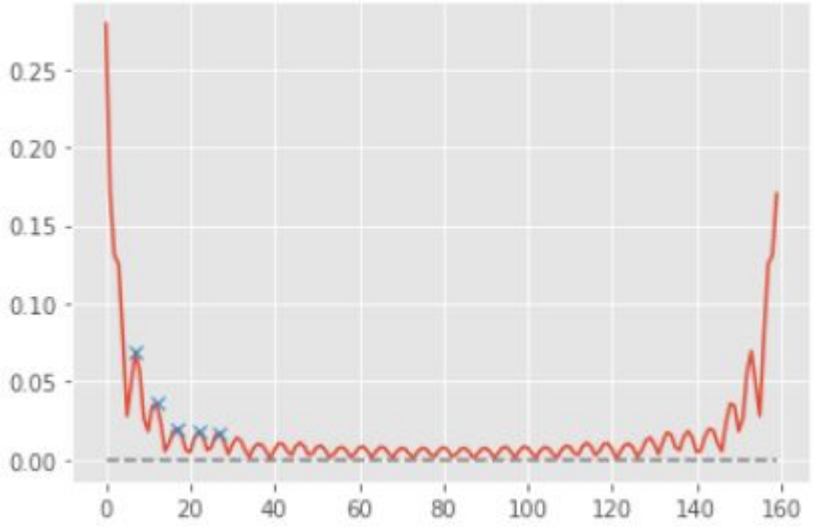


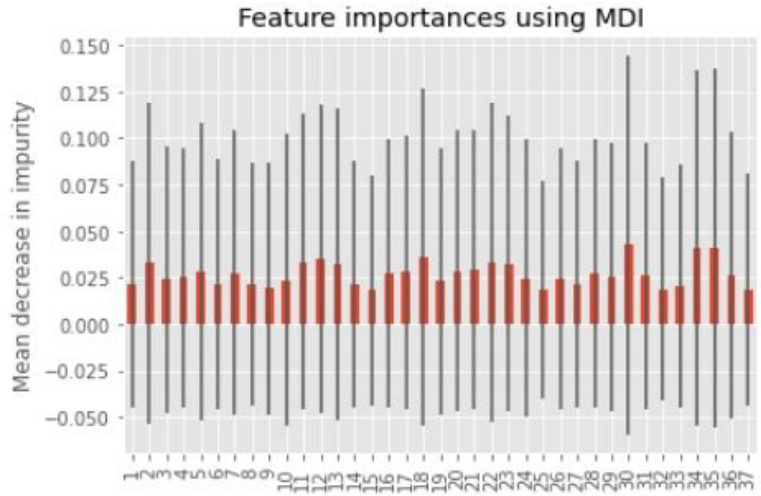


Machine Learning









Execution plan

	9/2/2022	9/9/2022	9/16/2022	9/23/2022	9/30/2022	10/7/2022	10/14/2022	10/21/2022	10/28/2022	11/4/2022	11/11/2022	11/18/2022	11/25/2022	12/2/2022
Status Update 1														
Control System PCB														
Control System and App Communication														
Power System PCB Design														
App/Control System Itegration via Bluetooth														
Status Update 2														
PCB Fabrication and Assembly														
Make App "prettier" by using images														
ML and App Intergration														
ML Data Collection														
Data Training with New Data														
Status Update 3														
PCB Testing and Validation														
Sensing Unit Housing Design														
Status Update 4														
Validate ML with Real Time Swings														
Sensing Unit Housing Manufacturing														
Sensing Unit Handle Mount Manufacturing														
Status Update 5														
Complete System Integration														
System Validation														
Final Design Presentation														
Final Demo														
Final Report														

	Not Started		Jiakai Hu
	In Progress		Nolapat Pipitvitayakul
	Completed		Pablo Barron
	Behind Schedule		Gavin Dahl
			Everyone

Validation plan

Paragraph	Test Name	Success Criteria	Methodology	Status	Responsible Engineer(s)
3.2.1.2	Sending Data via Android device	The app should be able to send and receive data	Upload the app to a simulated android phone and test by outputting data to a localized device to test data sending	UNTESTED	Pablo Barron
3.2.1.2	ML Algorithm Precision	The ML algorithm provides precise result of output data within small error rang	Give a set of test input and see if algorithm returns the hit positions precisely.	UNTESTED	Jiakai Hu
3.2.1.3	Communication Range	Communication between the sensing unit and app stays active for a distance of up to 100ft.	Test normal functionality of the smart cricket bat's operations at 5ft intervals ranging from 0ft to 100ft.	IN PROGRESS	Gavin Dahl Pablo Barron
3.2.1.4	Wireless Connection Stablilty	Connection between sensing unit and smartphone app does not drop.	Sensing unit connected to smartphone app via bluetooth, set to default mode, and left to run for 1 hour. Connection is monitored via smart phone app.	IN PROGRESS	Gavin Dahl Pablo Barron
3.2.1.4	Full Range of Motion	Sensing unit can measure the angle of the bat at a full 360°.	Sensing unit is attached to pivoting arm on a protracter, the angle is tracked on both a piece of paper and in a text file, and then compared.	TESTED: Sensing unit tracks accurate degree of turn for all 3 axes	Gavin Dahl
3.2.1.5	Easy to Use GUI	The app is easily naviagble to allow any person, regardless of technical skills, to use our device	Upload the app to a simulated andriod phone to view the clarity of the app	TESTED: App is able to run on physical device and does not crash	Pablo Barron
3.2.1.5	Operation Time	System operates continously on battery power for a minimum of 2 hours.	Sensing unit is turned on, set to defualt mode, and left to run for 2 hours. Power is monitored via a digital multimeter.	UNTESTED	Nolapat Pipitvitayakul
3.2.1.6	Detection Range	Sensing unit can detect vibrations from at least 38in away when mounted on a bat.	Mount sensing unit on end of the cricket bat handle and hit the top of the bat 10 times to ensure full range.	TESTED: Hits on the end of the bat are noticed by the IMU	Gavin Dahl
3.2.1.7	Detection Accuracy	Sensing unit is able to detect a collison between ball and bat on any area of the cricket bat.	Mount sensing unit on cricket bat, measure data from hits in a variety of areas on the bat (at least 15) until it is confirmed there are no dead areas.	TESTED: Hitting any location (including edge cases) of the bat is noticed by the IMU	Gavin Dahl
3.2.1.8	Detection Sensitivity	Sensors are able to detect degree's of motion within 1deg of change and is able to give changes in speed to 1 decimal places.	Mount sensing unit to cricket bat, connect to PC via microUSB, and watch realtime data output of angle of bat and speed and compare to movements made in real life.	IN PROGRESS	Gavin Dahl
3.2.1.9	Ease of Use	System is easily attached to end of handle of the cricket bat, is easily connected to the app via bluetooth, and is easy to calibrated during first time start up calibrations. Whole process should take no more than 5 minutes.	Use stopwatch to measure how long it takes te user to mount device, pair to phone, and do the calibration setup.	IN PROGRESS	Full Team
3.2.3.1.1	Input Voltage (MCU)	The input voltage for our Beetle BLE board shall be between 5V - 8V.	Use multimeter to validate input voltage level.	TESTED: Boost Converter Output is 5V +- 0.1	Nolapat Pipitvitayakul
3.2.3.1.3	Battery Charging Voltage and Current	The sensing unit has a 3.7V 150mAh Lo-Pi batteries as its power supply. These can be charged through a microUSB cable that can supply 100mA of charge current with a 4.2V charge voltage.	Use multimeter and osciloscope to validate voltage levels and charge current levels.	UNTESTED	Nolapat Pipitvitayakul
3.2.3.2.1	App Data Gathering via Bluetooth	The Android device should be able to recieve data from our MCU via bluetooth	Upload the app to a simulated android phone and input different "dummy" data to see if the android device recieved the data	TESTED: Connection Error with Bluetooth Socket	Pablo Barron
3.2.4.1	Thermal Resistance	The system should be able to operate in environments with tempatures ranging from 0°C to 85°C.	Use heating mechanism to raise tempature to 85°C and test systems functionalitly. Place system in cooling mechanism to lower tempature to 0°C and test systems.	IN PROGRESS	Gavin Dahl
3.2.4.2	Shock Tolerance	The IMU should be able to handle g shocks up to a max of 10,000g.	Test dropping IMU at differing heights and then use systems normal functionality to try to validate that IMU will still function after taking shocks more than 10,000	IN PROGRESS	Gavin Dahl

Parts Ordered

Part Description	Order Status
3 x Bluno Ble Microcontroller	Order Placed
3 x HC-05 Bluetooth Module	Awaiting Order Placement
3 x gy-521 IMU	Awaiting Order Placement

Questions?