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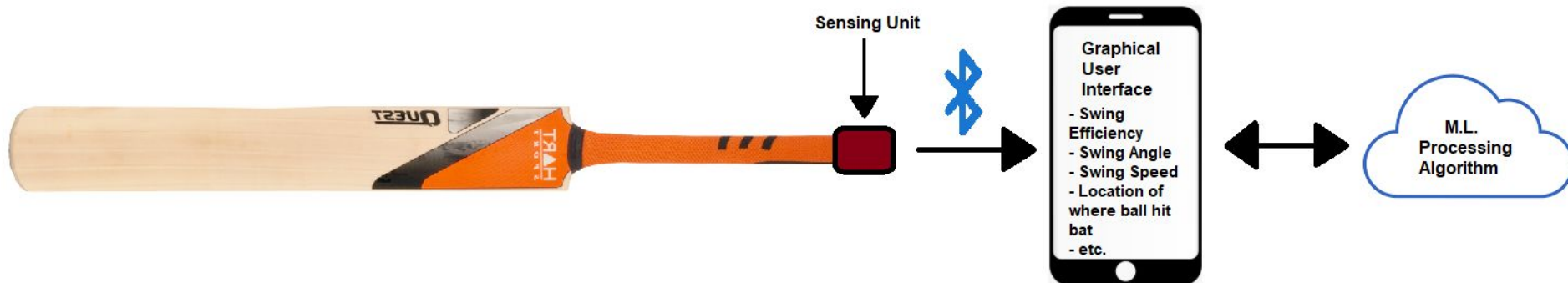
**ENGINEERING**  
TEXAS A&M UNIVERSITY

# Team 22: Smart Cricket Bat Bi-Weekly Update 2

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

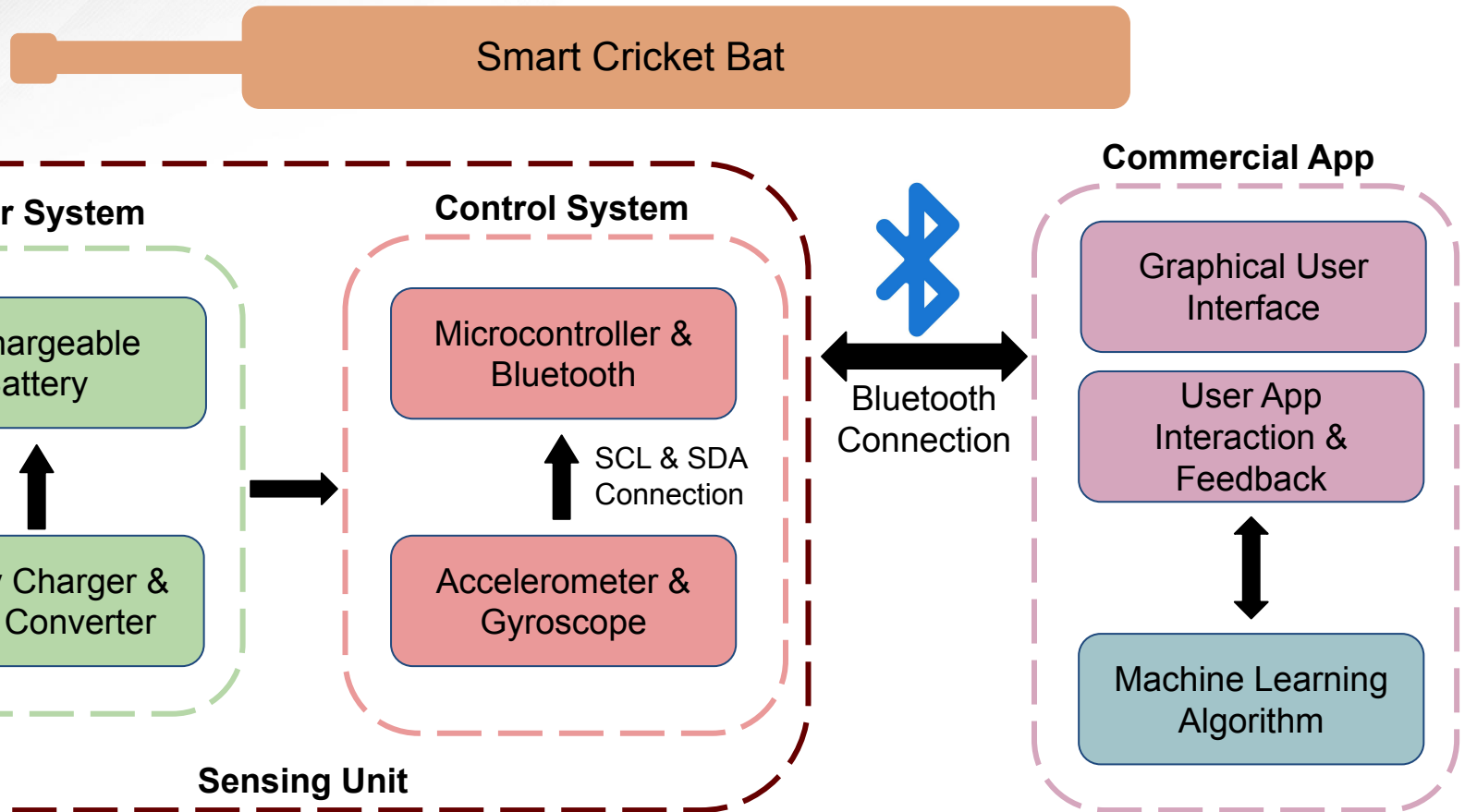
# Project description

- 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

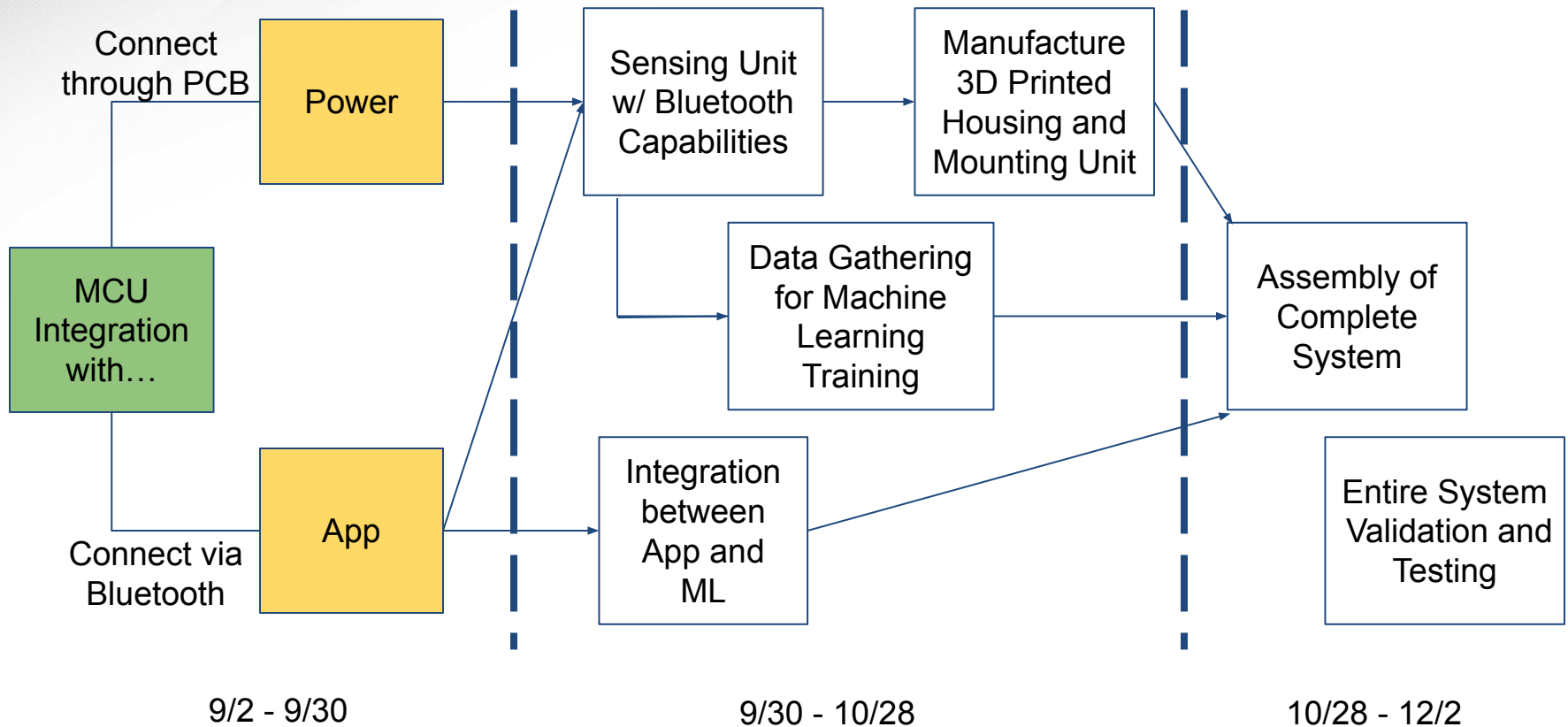
Pablo  
Gavin  
Jiakai  
Nolapat



# 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

# Project Timeline

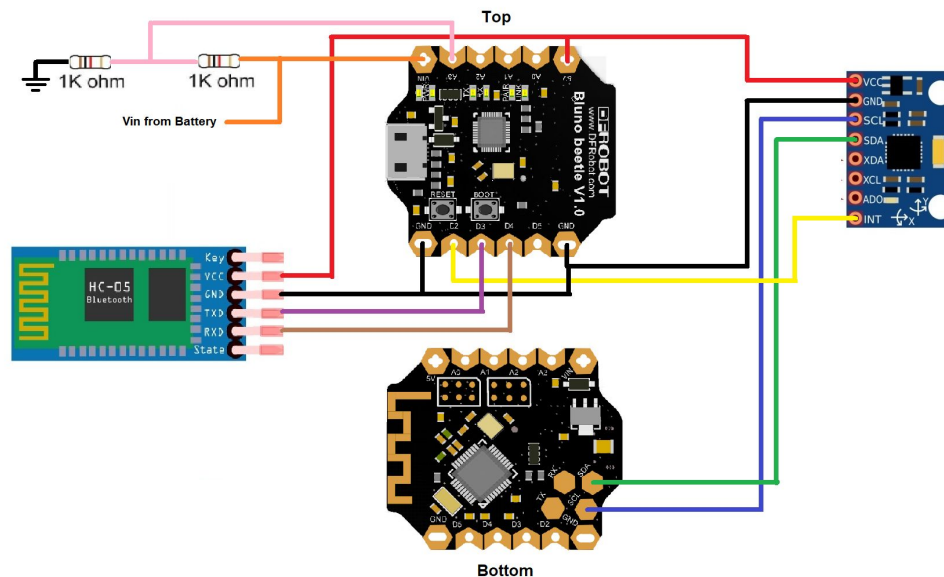




# Control System

Gavin Dahl

Accomplishments since 403 28 hr of effort	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"> <li>Power and Control PCB designed and ordered.</li> </ul>	<ul style="list-style-type: none"> <li>Assemble PCB</li> <li>Continue work on MCU and App integration through bluetooth</li> <li>Optimize MCU code</li> </ul>





# Control System

Gavin Dahl

- MCU can currently send and receive data to/from a laptop via the Bluetooth module, but data can be out of sync

```
COM4
12:01:55.783 -> FINISHED CALIBRATING BAT SENSOR!
12:01:55.823 ->
12:01:55.823 -> Sensor readings with offsets: 6 6 16376 -1 -1 0
12:01:55.863 -> Your offsets: -1445 -4019 6358 172 47 29
12:01:55.903 ->
12:01:55.903 -> Data is printed as: accelX accelY accelZ gyroX gyroY gyroZ
12:01:55.983 -> FIFO Reset!
12:01:56.023 -> euler -41.74 -0.01 -0.04 aworld 1 -1 -2
12:01:56.183 -> euler -41.74 -0.01 -0.04 aworld 1 -2 -2
12:01:56.303 -> euler -41.74 -0.01 -0.04 aworld 1 0 -4
12:01:56.463 -> FIFO Reset!
12:01:56.543 -> euler -41.74 -0.01 -0.04 aworld 0 0 -4
12:01:56.703 -> euler -41.74 -0.01 -0.04 aworld 0 -1 -3
12:01:56.823 -> euler -41.74 -0.01 -0.04 aworld 0 -2 -6
12:01:56.983 -> FIFO Reset!
12:01:57.063 -> euler -41.74 -0.00 -0.03 aworld 0 0 -3
12:01:57.183 -> euler -41.74 -0.00 -0.03 aworld 0 1 -2
12:01:57.343 -> euler -41.74 -0.01 -0.04 aworld 0 0 -4
12:01:57.463 -> FIFO Reset!
12:01:57.583 -> euler -41.74 -0.01 -0.04 aworld 1 -1 -5
12:01:57.703 -> euler -41.74 -0.01 -0.04 aworld 1 -1 -4
12:01:57.863 -> euler -41.74 -0.01 -0.04 aworld 0 0 -4
12:01:57.983 -> FIFO Reset!
12:01:58.103 -> euler -41.74 -0.01 -0.04 aworld 0 0 -4
12:01:58.223 -> euler -41.74 -0.01 -0.04 aworld 0 0 -4
12:01:58.343 -> euler -41.74 -0.01 -0.04 aworld 0 0 -3
12:01:58.503 -> FIFO Reset!
12:01:58.583 -> euler -41.74 -0.00 -0.03 aworld 0 -2 -4
12:01:58.743 -> euler -41.74 -0.00 -0.03 aworld 0 -1 -4
12:01:58.863 -> euler -41.74 -0.00 -0.03 aworld 0 0 -3
12:01:59.023 -> FIFO Reset!
12:01:59.103 -> euler -41.74 -0.00 -0.03 aworld 0 0 -4
12:01:59.263 -> euler -41.74 -0.00 -0.03 aworld 0 0 -2
12:01:59.383 -> euler -41.74 -0.00 -0.03 aworld 0 0 -3
12:01:59.503 -> FIFO Reset!
12:01:59.623 -> euler -41.75 -0.00 -0.03 aworld 0 0 -2
12:01:59.743 -> euler -41.75 -0.00 -0.03 aworld 0 0 -3
12:01:59.903 -> euler -41.75 -0.00 -0.03 aworld 0 0 -2
12:02:00.023 -> FIFO Reset!
12:02:00.143 -> euler -41.75 -0.00 -0.03 aworld 0 0 0
12:02:00.263 -> euler -41.75 -0.00 -0.03 aworld 0 0 -1
12:02:00.423 -> euler -41.75 -0.00 -0.03 aworld 0 0 -3
12:02:00.548 -> FIFO Reset!
12:02:00.623 -> euler -41.75 0.00 -0.03 aworld 0 0 -4
12:02:00.783 -> euler -41.75 0.00 -0.03 aworld 0 0 -2
12:02:00.903 -> euler -41.75 -0.00 -0.03 aworld 0 0 -3
12:02:01.063 -> FIFO Reset!

COM6
12:01:08.579 -> 1 -10 20 1022
12:01:58.312 -> Calibration Complete-01 -0.04 -01 -0.04 -01 -0.04 -01 -0.04 -01 -0.04 -01 -0.04 -01 -0.04
12:02:03.148 -> -41.74 -0.01 -0.04 1 -1 -4
12:02:03.148 -> -41.74 -0.01 -0.04 0 0 -4
12:02:03.148 -> -41.74 -0.01 -0.04 0 0 -4
12:02:03.148 -> -41.74 -0.01 -0.04 0 0 -4
12:02:03.148 -> -41.74 -0.01 -0.04 0 0 -3
12:02:03.148 -> -41.74 -0.00 -0.03 0 -2 -4
12:02:03.148 -> -41.74 -0.00 -0.03 0 -1 -4
12:02:03.148 -> -41.74 -0.00 -0.03 0 0 -3
12:02:03.148 -> -41.74 -0.00 -0.03 0 0 -4
12:02:03.148 -> -41.74 -0.00 -0.03 0 0 -2
12:02:03.148 -> -41.74 -0.00 -0.03 0 0 -3
12:02:03.148 -> -41.75 -0.00 -0.03 0 0 -2
12:02:03.148 -> -41.75 -0.00 -0.03 0 0 -3
12:02:03.148 -> -41.75 -0.00 -0.03 0 0 -2
12:02:03.148 -> -41.75 -0.00 -0.03 0 0 0
12:02:03.148 -> -41.75 -0.00 -0.03 0 0 -1
12:02:03.148 -> 0 -0.03 0 0 -2
12:02:03.265 -> -41.75 -0.00 -0.03 -0 -0.04 -01 -0.04 -00 -0.03 -0 0 0 -3
12:02:04.129 -> -41.76 -0. -0.04 -0 -0.04 -41.76 0.00 -0.04 0 0 -2
12:02:04.250 -> -01 -0.04 -0 -0.04 -0 0 -3
12:02:07.950 -> -41.76 -0.00 -0.03 0 0 -3
12:02:07.950 -> -41.76 -0.00 -0.03 0 0 -3
12:02:07.950 -> -41.76 -0.00 -0.03 0 0 -2
12:02:07.950 -> -41.75 -0.00 -0.03 0 0 -1
12:02:07.950 -> -41.75 -0.00 -0.03 0 0 -2
12:02:07.950 -> -41.75 -0.00 -0.03 0 0 -2
12:02:07.950 -> -41.75 -0.00 -0.03 2 0 -2
12:02:07.950 -> -41.75 -0.00 -0.03 0 0 -1
12:02:07.950 -> -41.75 -0.00 -0.03 1 0 -3
12:02:07.950 -> -41.75 -0.00 -0.03 2 1 -3
12:02:07.950 -> -41.75 -0.00 -0.03 1 0 -4
12:02:07.950 -> -41.75 -0.00 -0.03 0 0 -5
12:02:07.950 -> -41.75 -0.00 -0.03 0 0 -4
12:02:07.950 -> -41.75 -0.00 -0.03 0 0 -3
12:02:08.026 -> -1 -0.03 -01 -0.03 -01 -0.03 -01 -0.03 -01 -0.03 -00
12:02:12.779 -> -41.75 -0.01 -0.03 2 0 -6
12:02:12.779 -> -41.75 -0.01 -0.03 3 1 -5
12:02:12.779 -> -41.75 -0.00 -0.03 0 -1 -3
```

MCU Side

"App" Side



# Android App

Pablo Barron

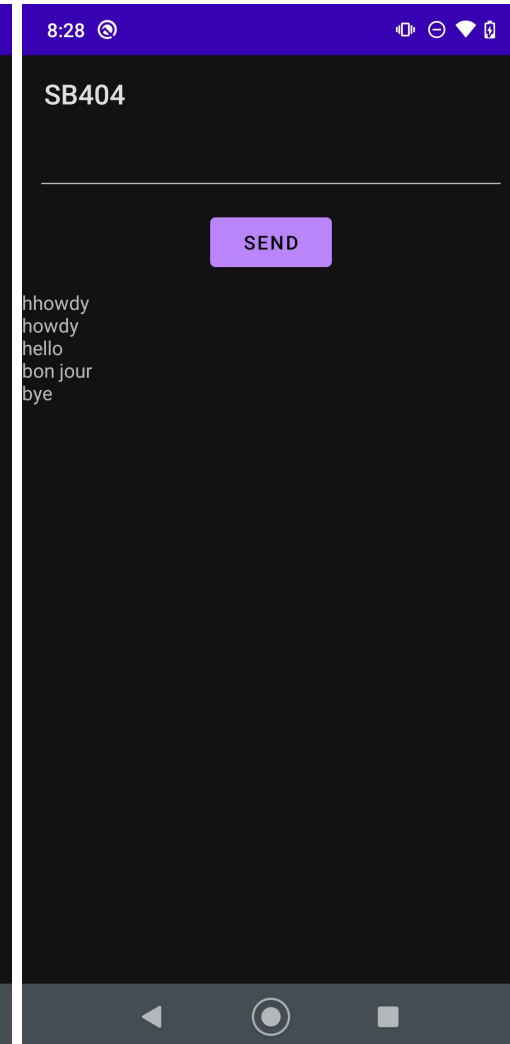
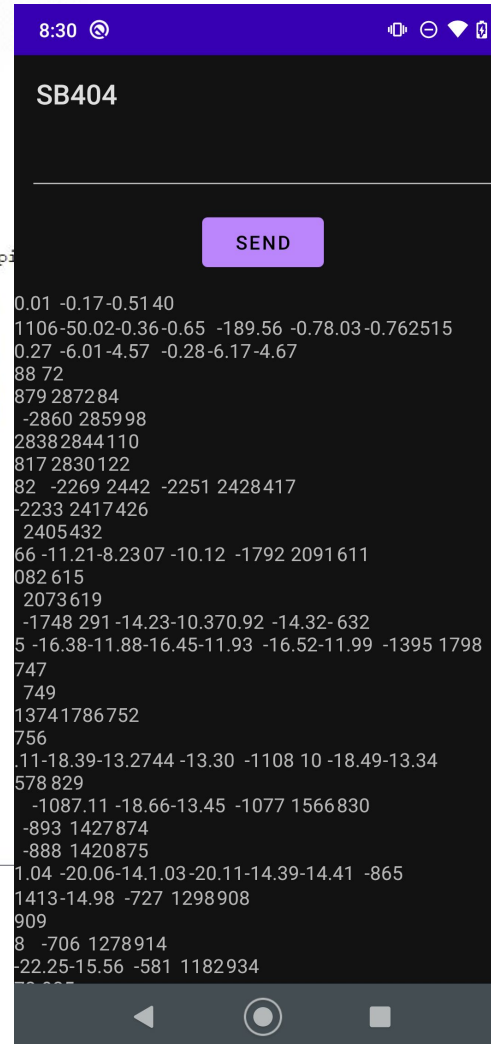
Accomplishments since last presentation: 4 Hrs	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"><li>Nothing has been completed since I have started integration with the MCU</li></ul>	<ul style="list-style-type: none"><li>Currently integrating with Control Subsystem and encountering some minor data sending issue</li><li>App and Control subsystem should be fully integrated by the end of september</li></ul>





# Android App

```
20:29:51.326 -> Enabling DMP...
20:29:51.366 -> Enabling interrupt detection (MCU external interrupt digital pin 2)
20:29:51.446 -> DMP ready! Waiting for first interrupt...
20:29:51.486 -> euler 0.01 -0.17 -0.51 aworld -1240 1106 -5645 0.01 -0.17-0.5140
20:29:51.526 -> euler 0.02 -0.36 -0.65 aworld -1892 1725 -4281 1106-50.02-0.36-0.65 -189.56 -0.78.03-0.762515
20:29:51.566 -> euler 0.02 -0.56 -0.78 aworld -2363 2175 -3267 0.27 -6.01-4.57 -0.28-6.17-4.67
20:29:51.646 -> euler 0.03 -0.76 -0.92 aworld -2701 2499 -2515 88 72
20:29:51.686 -> euler 0.04 -0.95 -1.06 aworld -2941 2731 -1954 879 287284
20:29:51.726 -> FIFO Reset! -2860 285998
20:29:51.726 -> euler 0.27 -6.01 -4.57 aworld -2943 2918 45 28382844110
20:29:51.806 -> euler 0.28 -6.17 -4.67 aworld -2922 2902 59 817 2830122
20:29:51.846 -> euler 0.29 -6.32 -4.79 aworld -2901 2888 72 82 -2269 2442 -2251 2428417
20:29:51.886 -> euler 0.30 -6.47 -4.89 aworld -2879 2872 84 -2233 2417426
20:29:51.926 -> euler 0.31 -6.62 -4.99 aworld -2860 2859 98 2405432
20:29:51.966 -> euler 0.32 -6.77 -5.10 aworld -2838 2844 110 66 -11.21-8.2307 -10.12 -1792 2091611
20:29:52.006 -> euler 0.33 -6.92 -5.21 aworld -2817 2830 122 082 615
20:29:52.086 -> FIFO Reset! 2073619
20:29:52.086 -> euler 0.61 -10.64 -7.82 aworld -2269 2442 409 -1748 291 -14.23-10.370.92 -14.32-632
20:29:52.126 -> euler 0.63 -10.75 -7.91 aworld -2251 2428 417 5 -16.38-11.88-16.45-11.93 -16.52-11.99 -1395 1798
20:29:52.166 -> euler 0.63 -10.87 -7.98 aworld -2233 2417 426 747
20:29:52.246 -> euler 0.64 -10.98 -8.07 aworld -2218 2405 432 749
20:29:52.286 -> euler 0.65 -11.10 -8.15 aworld -2201 2392 438 13741786752
20:29:52.325 -> euler 0.66 -11.21 -8.23 aworld -2185 2380 445 756
20:29:52.365 -> FIFO Reset! 11-18.39-13.2744 -13.30 -1108 10 -18.49-13.34
20:29:52.406 -> euler 0.88 -13.87 -10.12 aworld -1792 2091 611 578 829
-1087.11 -18.66-13.45 -1077 1566830
-893 1427874
-888 1420875
1.04 -20.06-14.1.03-20.11-14.39-14.41 -865
1413-14.98 -727 1298908
909
8 -706 1278914
-22.25-15.56 -581 1182934
10-205
```

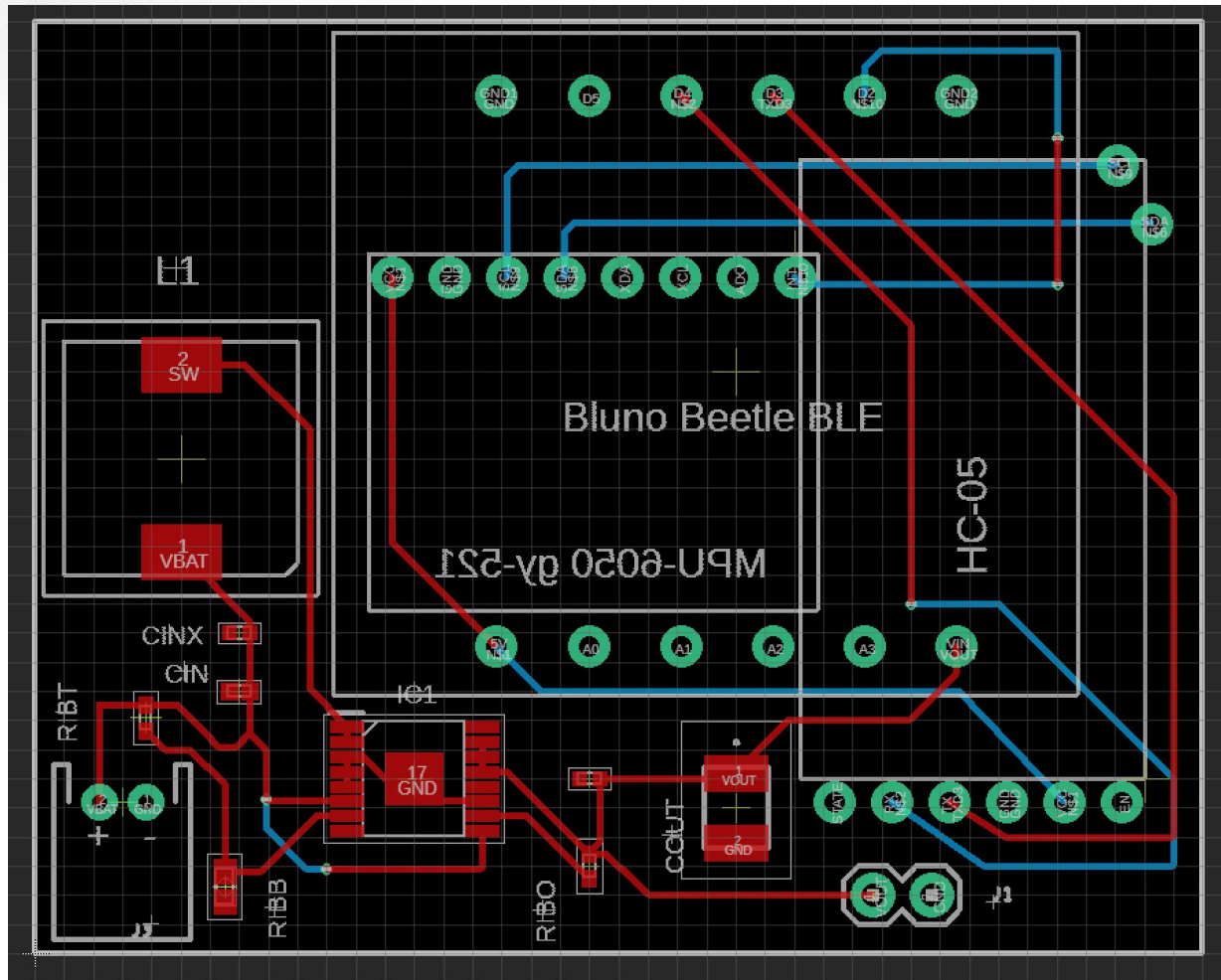




# Power System

Accomplishments since 403 12 hr of effort	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"><li>• Power and Control PCB designed and ordered.</li></ul>	<ul style="list-style-type: none"><li>• Solder components onto a PCB</li></ul>

# Power System



50.8x40.6 mm



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# Machine Learning

Plans until next presentation:

- More data gathering to increase accuracy
- ML integration with Android App





# Execution plan

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 Iteration 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														
Final PCB Manufacturing														
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 range	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 Stability	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 protractor, 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 navigable to allow any person, regardless of technical skills, to use our device	Upload the app to a simulated android 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 continuously on battery power for a minimum of 2 hours.	Sensing unit is turned on, set to default 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 collision 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 oscilloscope 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 temperatures ranging from 0°C to 85°C.	Use heating mechanism to raise tempature to 85°C and test systems functionality. 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	Part Received
2 x HC-05 Bluetooth Module	Part Received
3 x gy-521 IMU	Part Received
1 x LiPo Battery 3.7V 150mah	Part Received
12 x Capacitor	Part Received
8 x Resistor	Part Received
3 x Inductor	Part Received
1 x Switching Voltage Regulators	Part Received
1 x JST Right-Angle Connector TH 2-Pin	Part Received



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# Questions?