Smart Cricket Bat

Gavin Dahl, Jiakai Hu, Pablo Barron, Nolapat Pipitvitayakul

EXECUTION PLAN

Execution Plan for the Smart Cricket Bat

Smart Cricket Bat

Gavin Dahl, Jiakai Hu, Pablo Barron, Nolapat Pipitvitayakul

VALIDATION PLAN

Validation Plan for the Smart Cricket Bat

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 data (input for ML Algorithm)	Upload the app to a simulated android phone and test by outputting data to a localized device to test data sending	TESTED: App is able to send real time data to a device via an input stream	Pablo Barron
3.2.1.2	ML Algorithm Precision	The ML algorithm provides precise results of output data within acceptable error range.	Use all data gathered to test the training and testing accuracy.	TESTED: Training accuracy around 98% and Testing accuracy around 23%	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 10ft intervals ranging from 0ft to 100ft, or until bluetooth cuts off.	TESTED: Bluetooth module and mock phone had strong connection until 230 ft, where the connection would cut off.	Gavin Dahl Pablo Barron
3.2.1.2	System Latency	User swing analysis deliver to user via the app in no greater than 10s after the user's bat has struck the ball.	Take 20 practice swings with the bat, timing the time from the ball's impact on the cricket bat till the analyzed swing data is available to the user on app.	FAILED: As of current ML and App integration the process from hit to data available on app takes approximately 10 minutes	Full Team
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 smartphone app.	TESTED: Device Bluetooth connection stayed strong and was able to send data for 5 hours 21 minutes and 6 seconds.	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 the pivoting arm on a protractor, the angle is tracked on both a	TESTED: Sensing unit tracks accurate	Gavin Dahl

			piece of paper and in a text file, and then compared.	degree of turn for all 3 axes	
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.	TESTED: Fully charged 500 mAh lipo battery can run for about 6 hours	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: Hit from anywhere on bat registers movement in 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: IMU sensor leaves no dead zone on bat	Gavin Dahl
3.2.1.8	Detection Sensitivity	Sensors are able to detect degrees of motion within 1 deg 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 real time data output of angle of bat and speed and compare to movements made in real life.	TESTED: IMU can detect the change in angle within 1 degree of sensitivity	Gavin Dahl
3.2.1.9	Ease of Use	System is easily attached to the end of the handle of the cricket bat, is easily connected to the app via bluetooth, and is easy to calibrate during first time startup calibrations. Whole process should take no more than 5 minutes.	Use a stopwatch to measure how long it takes the user to mount the device, pair to phone, and do the calibration setup.	TESTED: Device takes 3 minutes and 28 seconds to set up, 2 minutes of which is calibration time.	Full Team
3.2.2.1	Mass	Mass of the combined control system (MCU and IMU sensors), power system (Li-Po Battery and boost converter), and our housing unit, will weigh no more than 100g.	Use a digital scale to measure the weight of the combined unit.	TESTED: Took average of 10 weigh-ins of sensing unit in its entirety, averaged out to 85.89 ± 0.01 g.	Nolapat Pipitvitayakul Gavin Dahl

3.2.2.2	Volume Envelope	The housing unit for the sensing device should be cylindrical shape, be no more than 70mm in diameter, and have a height of 35mm.	Measure inner and outer diameters and height of the created housing unit for sensors.	TESTED: Outer diameter is 68mm and the height of the device is 36mm	Nolapat Pipitvitayakul Gavin Dahl
3.2.2.3	Mounting	The sensing unit is able to be mounted to the handle of any cricket bat and can lock securely into place.	Use the developed mounting device to mount the sensing unit onto the end of the handle of the bat, and do various shack and shock tests to confirm secure fit.	TESTED: Device does not detach from bat handle via outside forces.	Nolapat Pipitvitayakul Gavin Dahl
3.2.3.1.1	Input Voltage (MCU)	The input voltage for our Beetle BLE board shall be between 5V - 8V.	Use a 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 Li-Po battery as its power supply. These can be charged through a microUSB cable that can supply a maximum 150mA of charge current with a 4.2V charge voltage.	Use a multimeter to validate voltage levels and charge current levels.	TESTED: Charge voltage is 4.2 V and maximum charge current is 150 mA	Nolapat Pipitvitayakul
3.2.3.2.1	App Data Gathering via Bluetooth	The Android device should be able to receive 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 received the data	TESTED: Data is able to send without interruptions or skipping over lines	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 a heating mechanism to raise temperature to 85°C and test systems functionality. Place system in cooling mechanism to lower temperature to 0°C and test systems.	TESTED: Device works in Texas summer of approx. 110°F and in winter at about 32°F.	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	TESTED: IMU and PCB can withstand shocks up to 200 g's (an approx 30 ft fall) and strongest expected hit is about 100 g's	Gavin Dahl

Performance on Execution Plan

The execution plan was executed completely. Some tasks had to be completed out of their original order as there were many complications regarding the consumer application. There were two main problems, integration through bluetooth and integration with the machine learning. The bluetooth integration was a simple fix once the problem was finally discovered, however the machine learning integration took much longer than expected and by the end was only barely integrated and was missing a few of the key components desired by the sponsor, such as the process being fully automatic. Besides that hiccup, however, the rest of the execution plan was completed, the project was mostly completed on time, besides said machine learning and application compromise.

Performance on Validation Plan

The validation plan was completed in full. The validation of all components gave expected results, such as IMU, bluetooth, and power system, however there was one validation requirement set by the sponsor that failed to be completed. The sponsor wanted the time it took to process the hit to be a minute at most, however after all the issues with the machine learning and app integration, that process takes about 9 minutes. The key cause of this is that the database used to house the machine learning to process the data is not automatic and takes about 8 minutes to simply export the data delivered from the phone, and once completed then takes about 1 minutes to process and give the desired data from the data set given.