Beat Parkinson's Disease (PD) PRO

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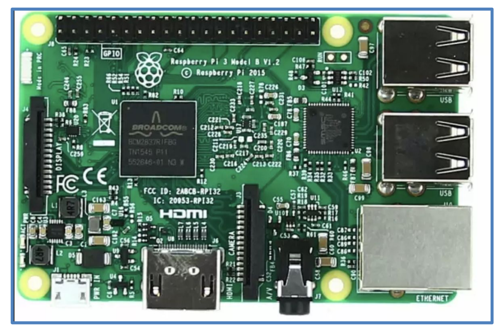
Abstract

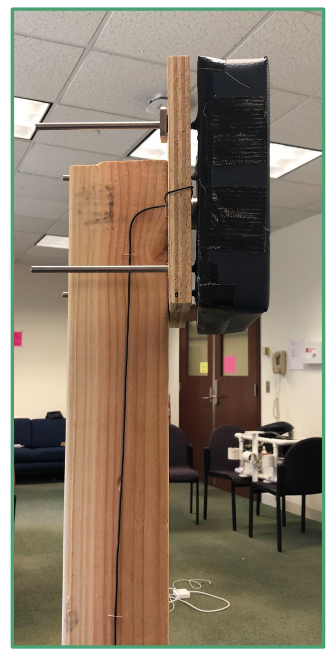
This poster details the research and design of the Beat Parkinson’s Disease (PD) Pro system. Ms. Michelle Hespeler, a Parkinson’s patient owns a boxing rehabilitation program in East Hartford, Beat PD Today, for individuals suffering from the disease. Ms. Hespeler was looking to quantify the progress of her participants in order to disseminate the program and to get it accepted by insurance companies to cover the high cost of class for participants. Because of this, our goal is to develop a system to quantify the progress of PD patients in the Beat PD Today program. The system measures various motor functions in order to show that the program is indeed beneficial to its participants. Data collection is important for Beat PD Today because it will allow this alternative therapy method to have quantitative results to ensure progress.

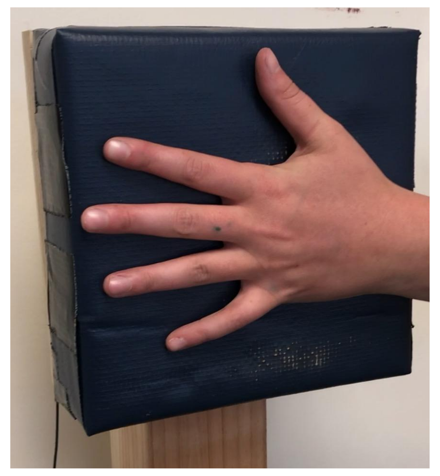
Microprocessors and Software

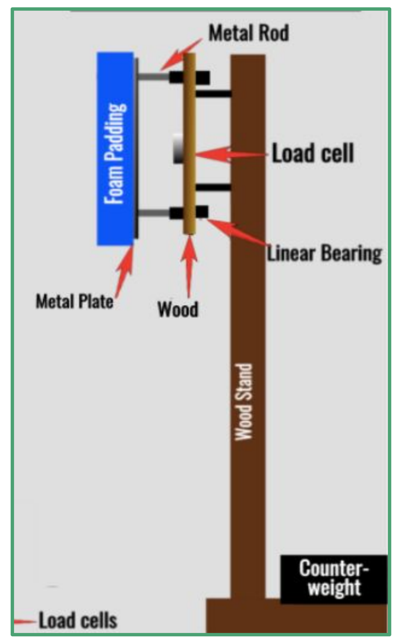
- Two “Raspberry Pi 3 Model B” microprocessors
- Python

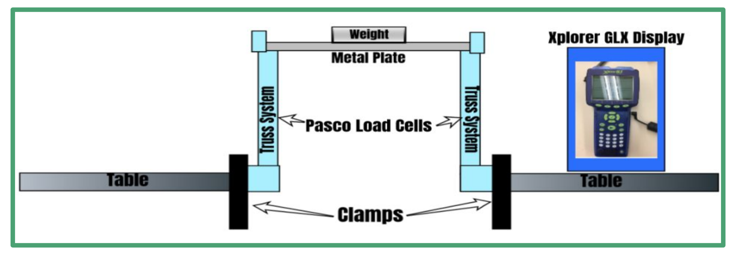


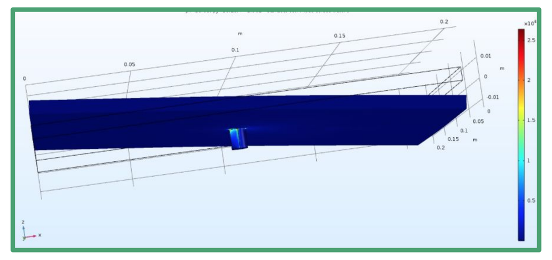
Arm Strength









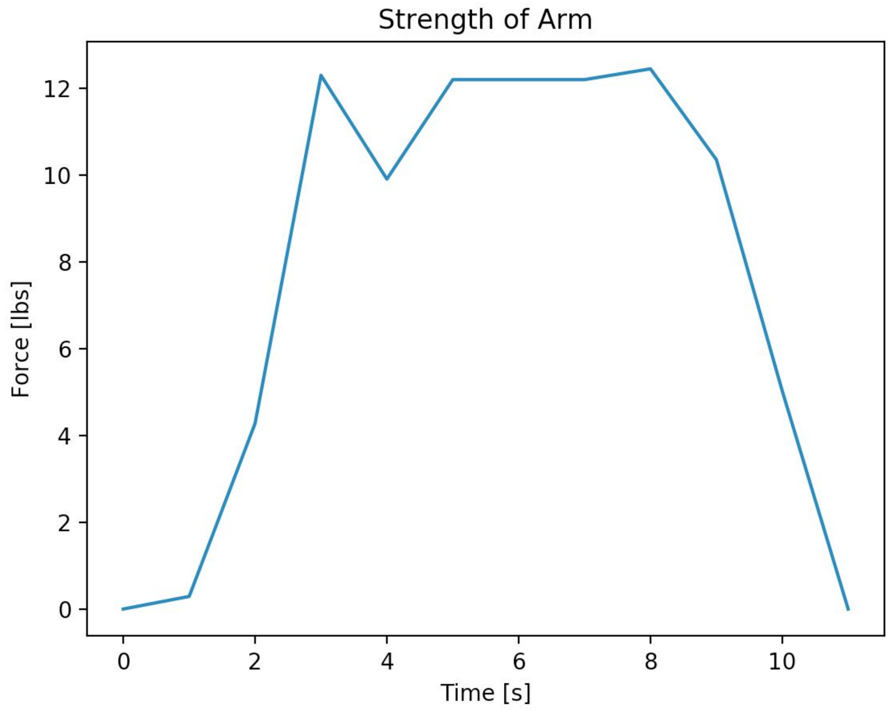


- COMSOL testing shows 1 load cell centrally located is sufficient, using a slightly more expensive and accurate load cell
- Displacement in four corners negligible for 1 load cell design (~10^{-5} m)

Results:

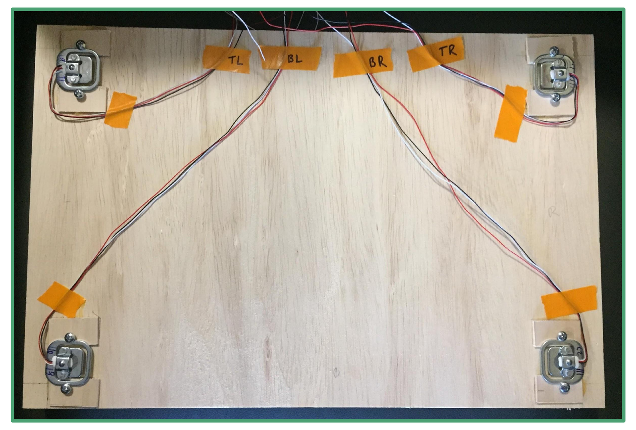
A graph of the force is displayed for the user as well as the values of max force and calculated impulse.

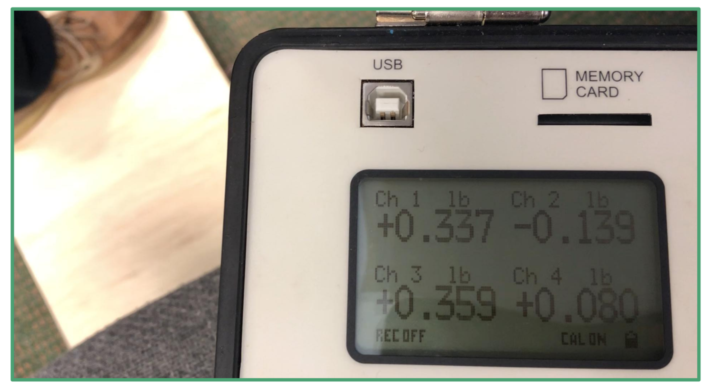
Max force: 12.44 lb
Impulse: 91.17 lb·s



Balance

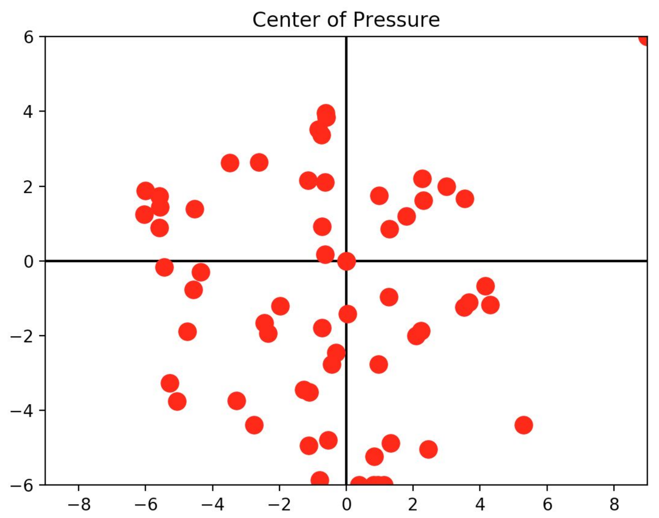
The balance board uses four pressure sensors in each corner of the board to measure the user’s center of mass. The balance board is 18”x12’x3/4” plywood and the load cells, SEN 10245, are located between the two pieces. The board displays the center of pressure in real-time and saves the values for later comparison.

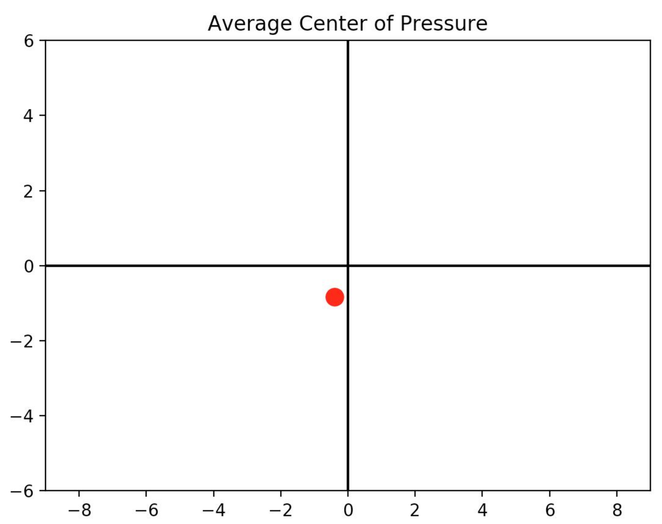




In the image above, the user only has one foot on the board with all of the pressure on the left. From the results above, one can see that the load cells from channel 1 and channel 3 are the highest at 0.337 lb and 0.359 lb respectively.

Results:



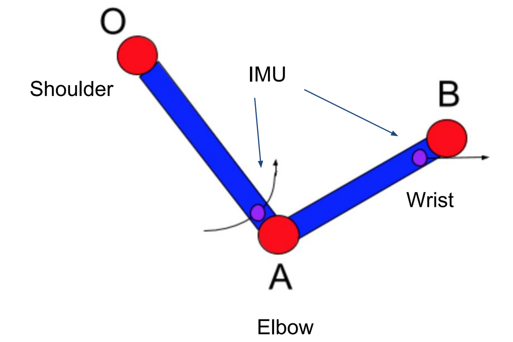


The graph on the left is of all the data points that were collected while the user was on the board for 62 seconds. Usually one point is shown on the board at a time, but here we wanted to show all of the points for the time period. The picture to the right is the average center of pressure for the user in the 62 second time period.

Range of Motion and Pull-Back Speed

- Acceleration is used and angular velocity in all three directions to determine the position of the arm in x, y, z coordinates
- Then finding the range of motion and the pull-back speed

Inertia Measurement Unit (IMU): MPU-6050



- 6 DOF: 3 accelerometers, 3 gyroscopes (angular velocity measurements)
- Accelerometer - Piezoelectric Effect
- Gyroscope – Piezoelectric and Coriolis Effect

In the image above one can see that the user puts the harness on and the attaches each of the forearm straps at each of the wrist and above the elbow. Each arm strap contains an IMU. The two on the wrist extract pullback speed and the two on the elbows track movement in the arm in XY plane to extract range of motion.

Results:

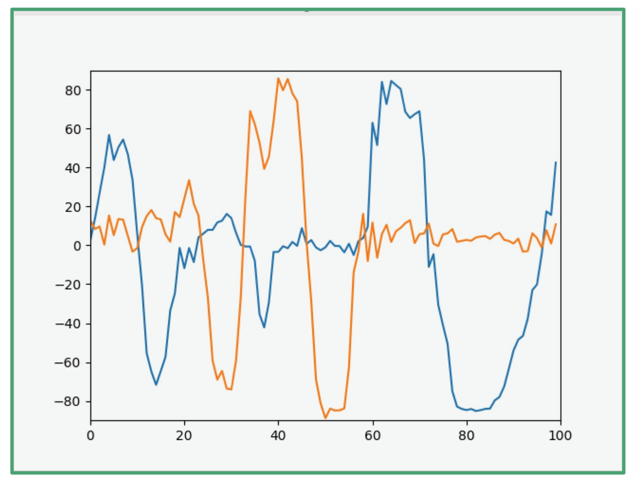


Image above shows the pitch (orange) and roll (blue) of the MPU-6050 for range of motion between -90 and 90 degrees

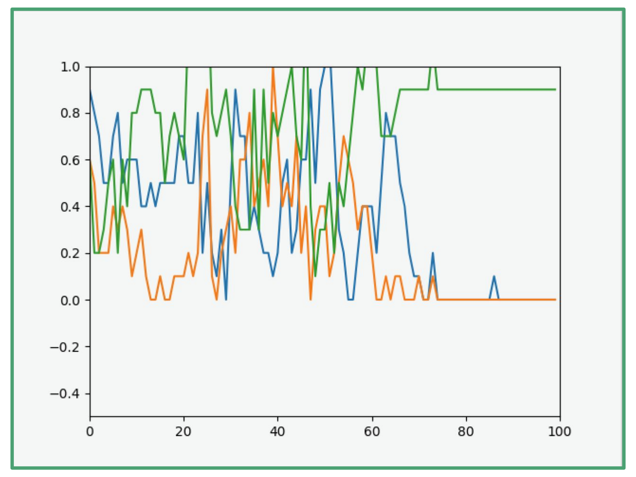


Image above shows acceleration readings in x (orange), y (blue), and z (green) directions

Future Work

- Application or website to provide users their own individual data
- Testing and evaluation with participants at Beat PD Today
- Use of higher resolution sensors and equipment

Acknowledgements

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Works Cited

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