P19095 LiveAbility Lab

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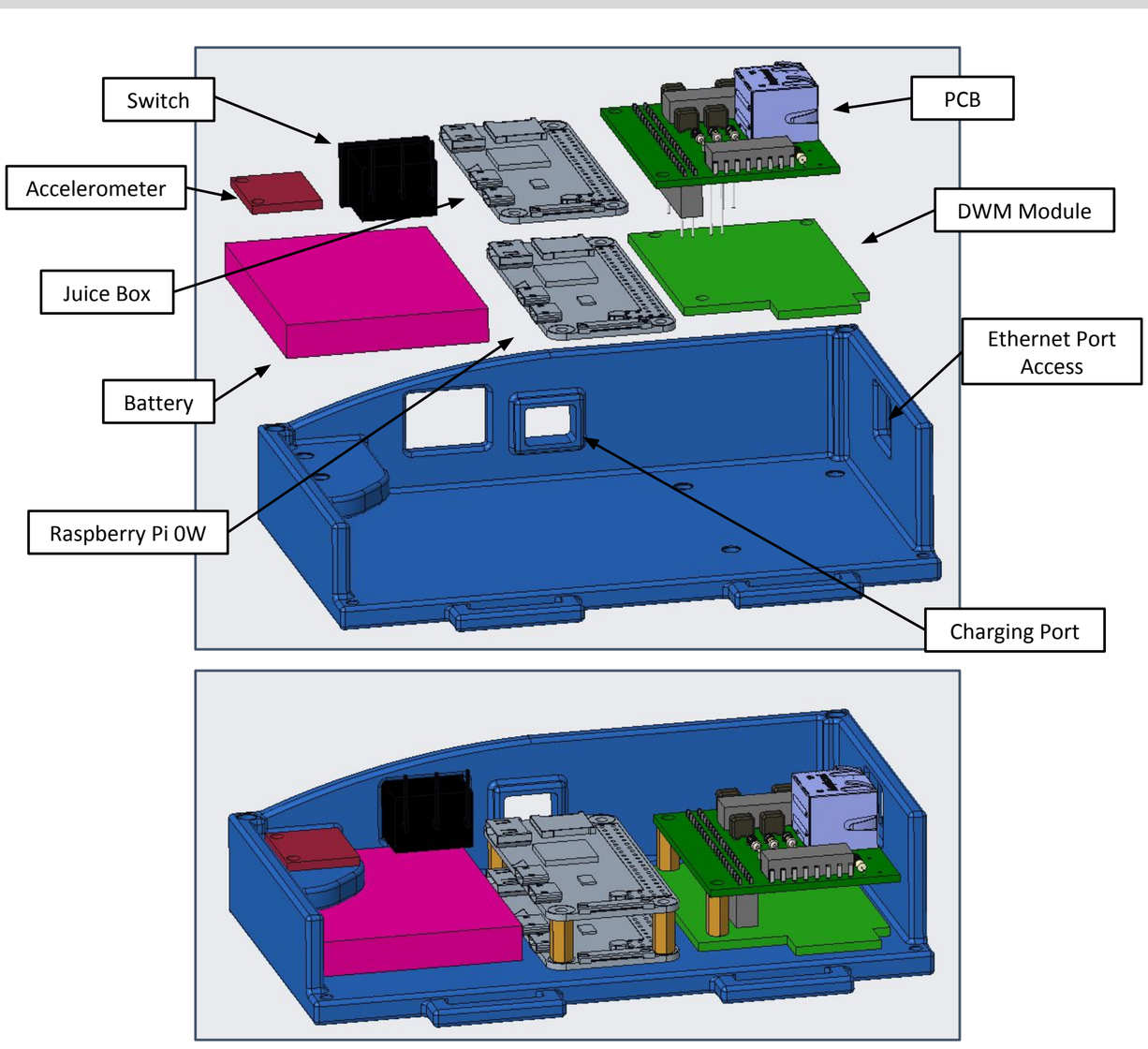
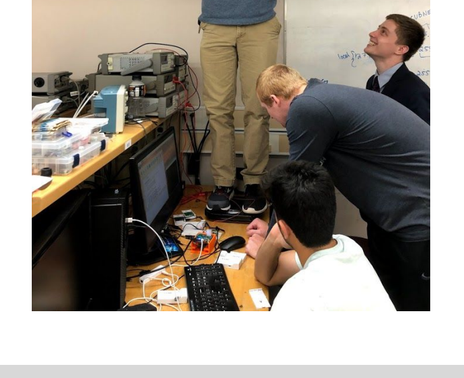
Customer Requirements

Category	CR#	Importance	Description
Safety	S1	1	Safe for daily operation
Functional	F1	1	Use of system will not impact individual's movement
Functional	F2	1	Force and location sensing will be battery powered and communicate wirelessly with the data logging system in real time
Functional	F3	1	Device is secured to individual
Portable	P1	1	Entire system can be used in an individual's home
Comfortable	CM1	1	Tolerable to wear for full day use
Durable	D1	1	Water resistant

Mechanical Design



Force Measurement



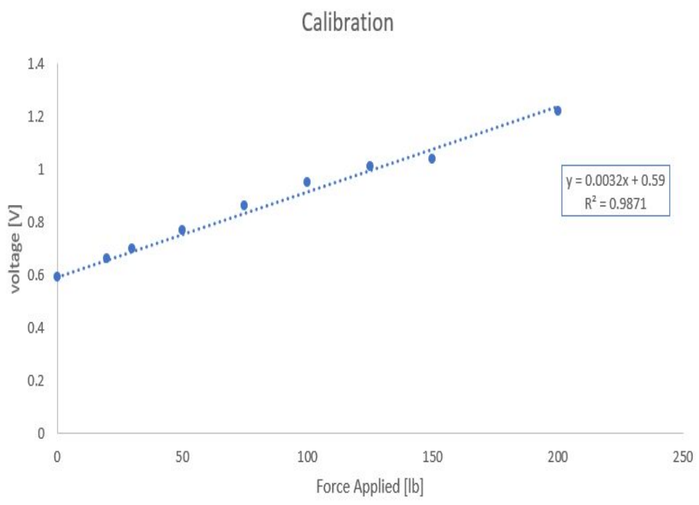
Tekscan A301 Resistive Force Sensor

- Acts as a resistor
- Resistance increases when force is applied
- Change in resistance is seen by an Op-Amp Circuit
- Signal converted to digital
- Raspberry Pi converts Voltage to Force

Testing and Analysis

Pressure Calibration

- Tested by applying a force and reading the value from the scale. The linear change in voltage is used to convert to force.



Background

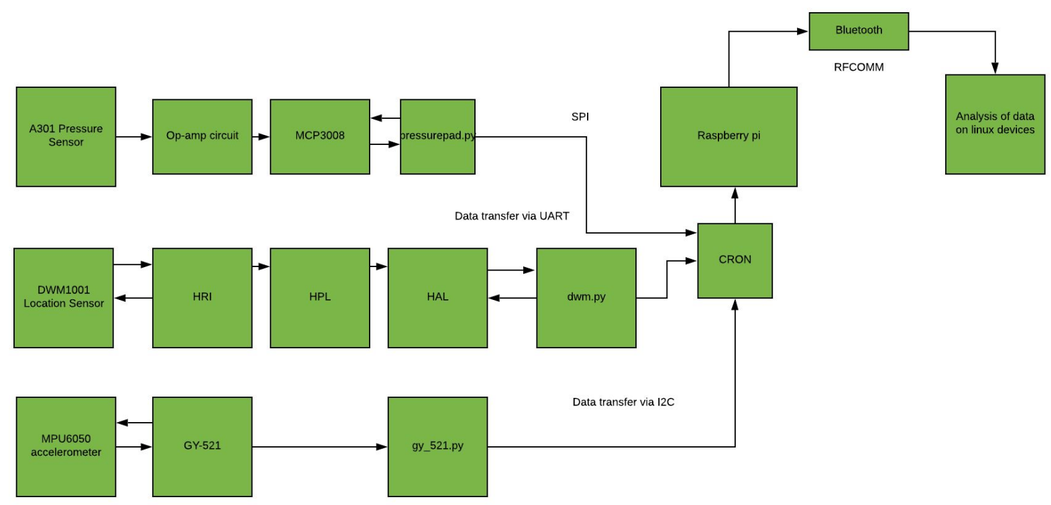
The LivAbility Lab is a research center funded by Al Sigl and Dr. Phillips. The purpose of the facility is to improve the quality of life for individuals with movement impairments. Our device is a tool for researchers at this facility who wish to evaluate assistive devices. The device monitors the location of an individual and the force which they apply on the ground. Since both outputs are influenced by assistive devices, our force and position monitoring system provides valuable data to researchers so they can continue to make improvements to patient's lives on an individual basis.

Engineering Requirements

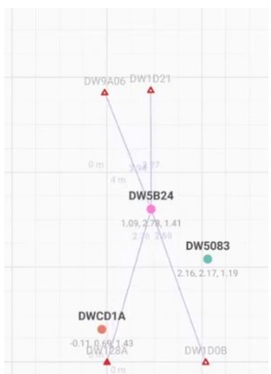
Requirement#	Engineering Requirement	Unit of Measure	Marginal Value	Ideal Value
ER1	2D plane location accuracy	±cm	10	0
ER2	2D plane location resolution	±cm	1	0
ER3	Force accuracy	±%	3	0
ER4	Force resolution	±%	2.5	0
ER5	Location and force sampling rate	samples/s		2x move speed
ER6	Measurements per location	-	5	-
ER7	Data transfer rate	MB/s	10	32
ER8	Range	ft	-	25x25
ER9	Interference	-	-	none
ER10	Duration	hours	-	8
ER11	Maximum weight	ounces	-	10

Software Design

- Wireless communication was established using bluetooth communication.
- Cron script used to create a startup procedure which begins collecting data upon powering up.
- SPI,I2C and UART protocol used to communicate between measurement devices and Raspberry Pi.



Location Measurement



The DWM location module was used to determine the location via triangulation.

- 4 tags were set up around the testing area
- The location of the sensor is determined by its distance from each of the tags

*photo from Decawave

Conclusion and Future Work

- The system serves as a proof of concept for a device which can measure the force and position of a patient with a high level of accuracy.
- Future work may include a model built with an Arduino board (smaller, less power consumption) or improving the method of analysis of data collected.

Acknowledgments

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