Logging Data on a Hockey Puck

Adapted from our Preliminary Design Review

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Contents

- Overview
- Parts:
  - Microcontroller
  - Storage
  - Battery
- Model
- Testing Physical Properties
- Simulations
- Applying Results
- Software:
  - Puck
  - GUI
  - Data Files

Overview

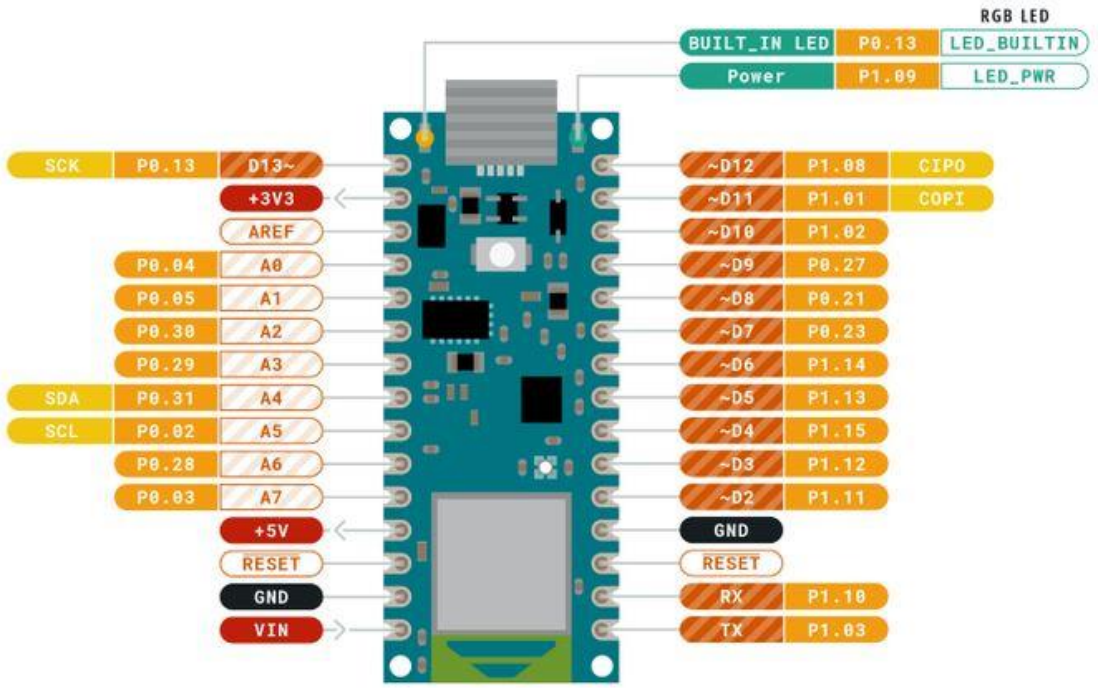
Design a hockey puck-sized data logging module:

- Capable of data logging for accelerometer, gyroscope, and magnetometer
  - Storage on board
  - Power on board
  - Able to extract data
- Resistant to impact
- Applicable to any object of roughly the same size
- With a GUI that runs on the user's computer to convert the data to a usable format

Microcontroller

Specifications:

- 14 Digital I/O pins
- 8 Analog pins
- 5 PWM pins
- Onboard BLE
- 9-axis IMU
- 3.3 V circuit operation voltage
- 64 MHz clock speed



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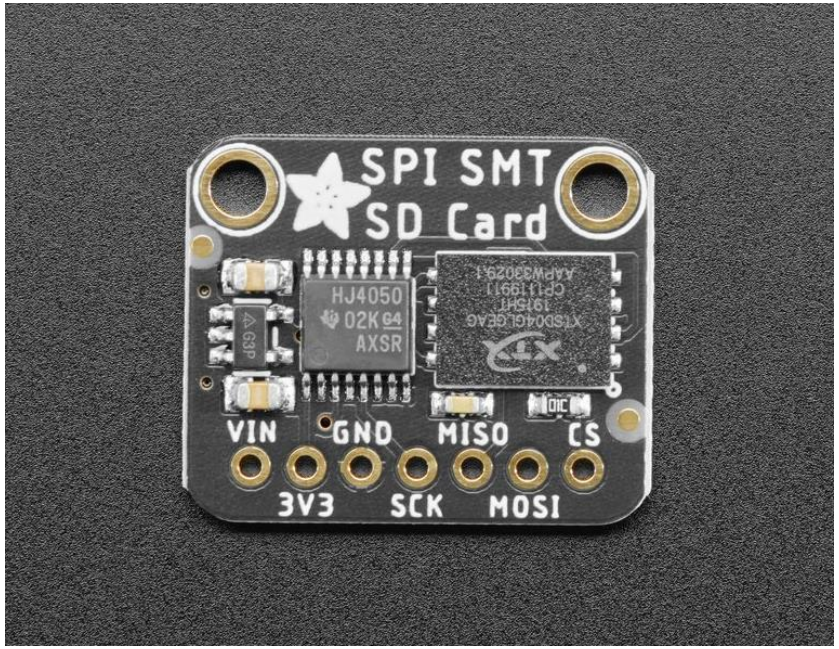
Storage

Memory storage:

SMT SD Card:

- 512 Mbyte storage
- 3V or 5V
- 50 MHz clock



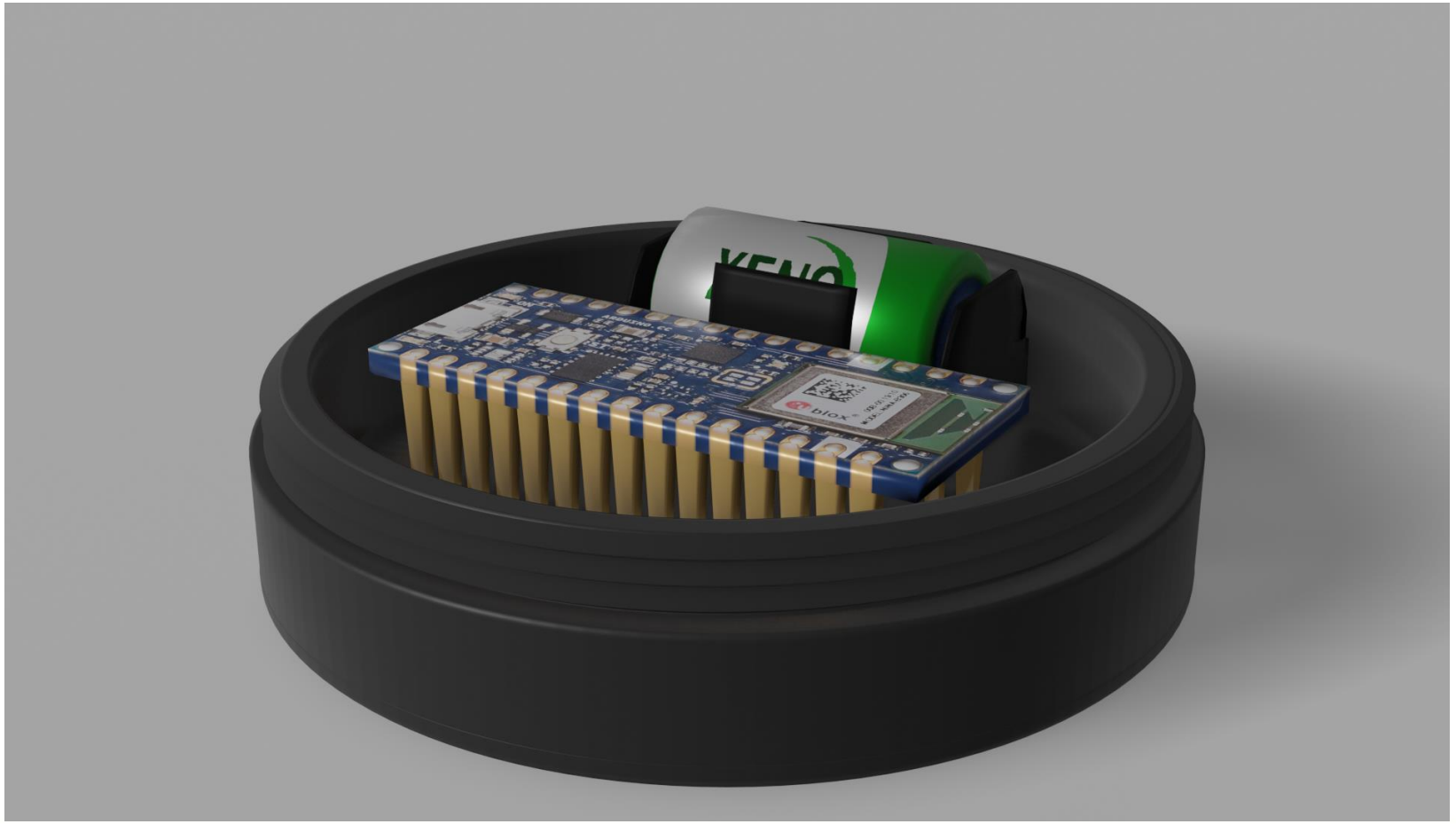
Battery

Power Supply:

Xeno XLP-050F 1/2AA Lithium Thionyl Chloride battery

- 1200mAh
- 3.6V

Model



Testing Puck's Physical Properties

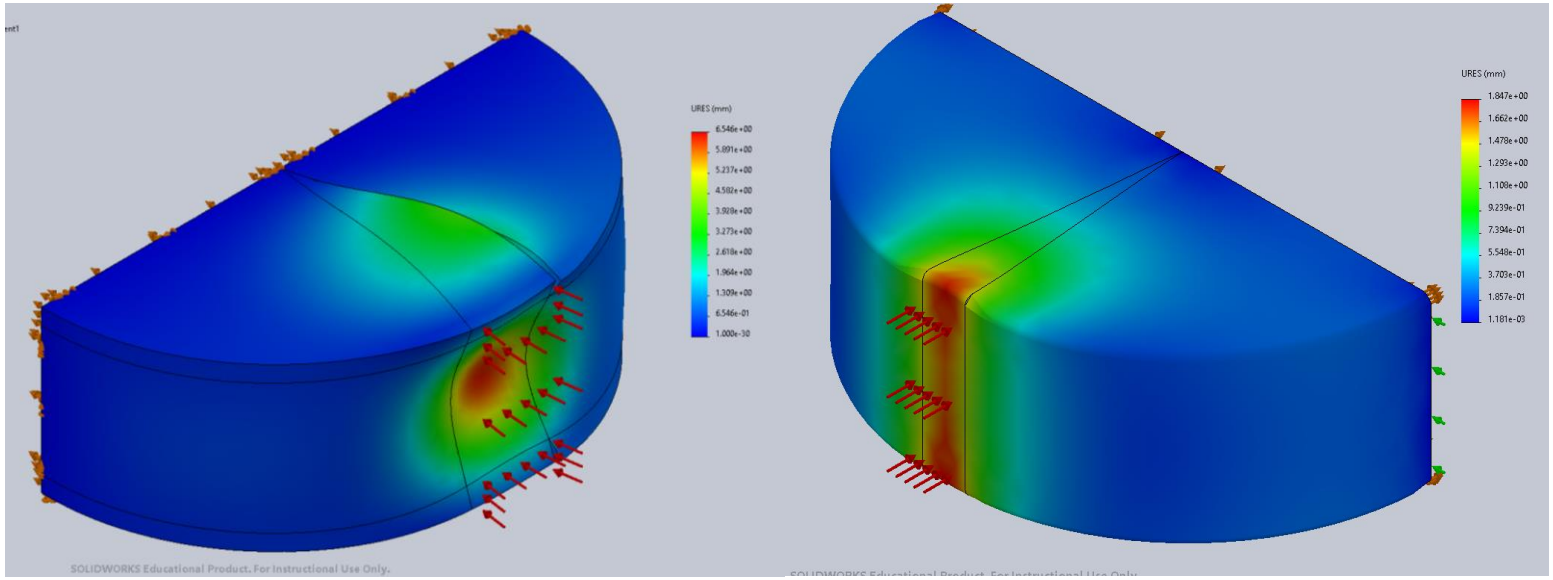
Tests Conducted

- Stiffness test
  - Measured puck deformation relative to a steady force
  - Achieves a stiffness constant for puck

Possible Future tests

- Coefficient of restitution
  - Compares initial drop height to rebound height
- Physical impact study
  - Use a system to measure velocities before and after impact.

Simulations of the Puck



Hollow Puck No Structure

Solid Puck

Applying Results

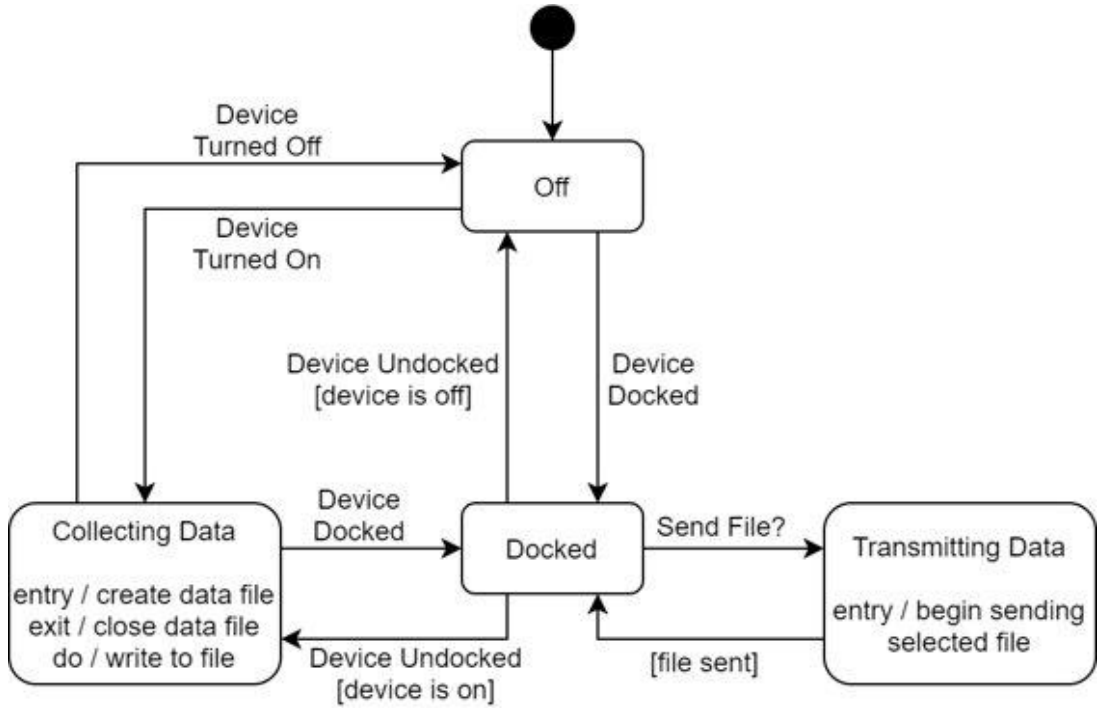
- **Determine what stresses puck undergoes**
  - External deformation and if forces exist through center of the puck
- **Use results to determine potential weak points in design**
  - Puck's structure being severely altered will give little support to high forces
- **Determine feasibility as an accurate puck tracker**
  - What speeds become too much for accelerometer?

Software Overview

- The data logging software on the puck must be capable of both storing data locally on the puck and transmitting data to the user's computer.
- The software on the user's computer will request data from the puck and convert it into CSV.
- The system architecture takes the form of server and client.

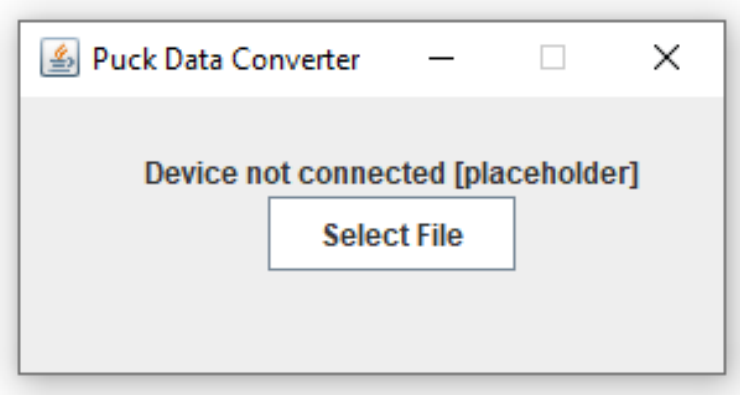
Puck Software

- The data logging software does the following:
  - Stores data logging sessions as separate files.
  - Stores data from the sensors and system time in the onboard storage.
  - Automatically stops logging when power is low, storage is full, or the puck is docked.
  - Sends data files requested by the user software.



GUI Software

- The GUI does the following:
  - Connects to the puck using serial
  - Requests data files
  - Converts data files to CSV
  - Clears puck data files



Data Files

- **Format of a data point:**
  - Time since session start: 4 bytes
    - Unit: milliseconds
    - Value range: 0 to 4.3 billion
  - Accelerometer: 2 bytes per axis
    - Unit: G's
    - Axis range: +/- 16
  - Gyroscope: 2 bytes per axis
    - Unit: degrees per second
    - Axis range: +/- 2048
  - Magnetometer: 2 bytes per axis
    - Unit: gauss
    - Axis range: +/- 4

```
00 00 00 00 0F 01 01 00 00 00 FF FF 00 00 80 00 00 00 00 01 01 00 00 00 00 01 0E 01 00 00 00 00 FF FF 00 00 80 00 FF FF 00 02 02 00
00 00 00 02 0F 02 03 00 08 00 FF FF 00 00 80 00 00 00 00 04 04 00 00 00 00 03 0E 02 02 00 10 00 FF FF 00 00 80 00 FF FF 00 08 08 00
00 00 00 04 0F 03 05 00 18 00 FF FF 00 00 80 00 00 00 00 10 10 00 00 00 00 05 0E 03 04 00 20 00 FF FF 00 00 80 00 FF FF 00 20 20 00
00 00 00 06 0F 04 07 00 28 00 FF FF 00 00 80 00 00 00 00 40 40 00 00 00 00 07 0E 04 06 00 30 00 FF FF 00 00 80 00 FF FF 00 80 80 00
```

	A	B	C	D	E	F	G	H	I	J
1	time (ms)	acc (x)	acc (y)	acc (z)	gyro (x)	gyro (y)	gyro (z)	mag (x)	mag (y)	mag (z)
2	0	1.875488	0.125	0	-0.0625	0	-2048	0	0.000122	0.03125
3	1	1.750488	0	0	-0.0625	0	-2048	-0.00012	0.000244	0.0625
4	2	1.875977	0.375	1	-0.0625	0	-2048	0	0.000488	0.125
5	3	1.750977	0.25	2	-0.0625	0	-2048	-0.00012	0.000977	0.25
6	4	1.876465	0.625	3	-0.0625	0	-2048	0	0.001953	0.5
7	5	1.751465	0.5	4	-0.0625	0	-2048	-0.00012	0.003906	1
8	6	1.876953	0.875	5	-0.0625	0	-2048	0	0.007813	2
9	7	1.751953	0.75	6	-0.0625	0	-2048	-0.00012	0.015625	-4

Questions?