

Background

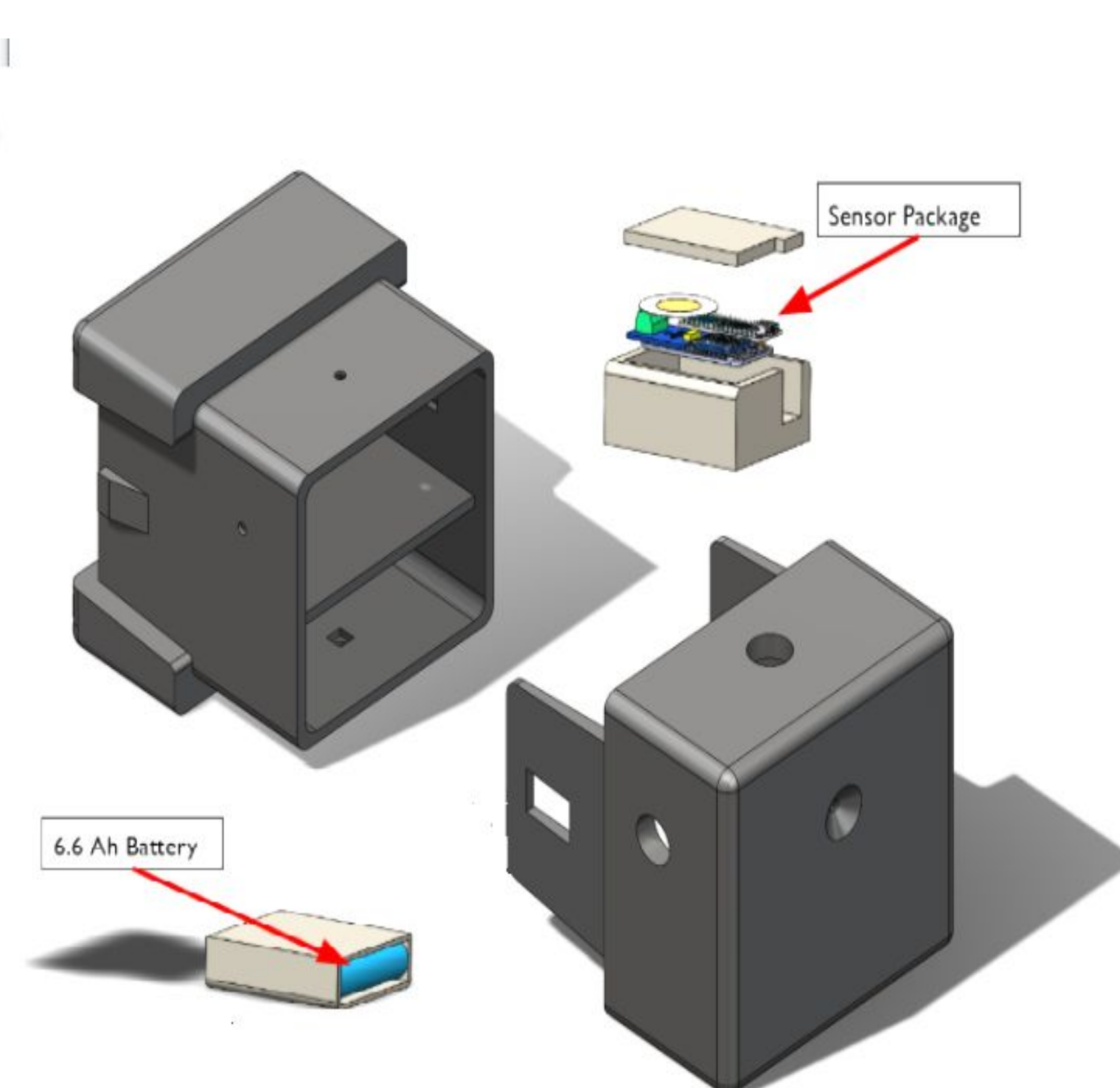
Sandia National Laboratories (SNL) hosted a competition between New Mexico Tech (NMT), the University of New Mexico (UNM), and New Mexico State University (NMSU). The goal was to develop an integrated sensing device (ISD).

An ISD is compact sensing package capable of analyzing environments to meet the requirements listed below.

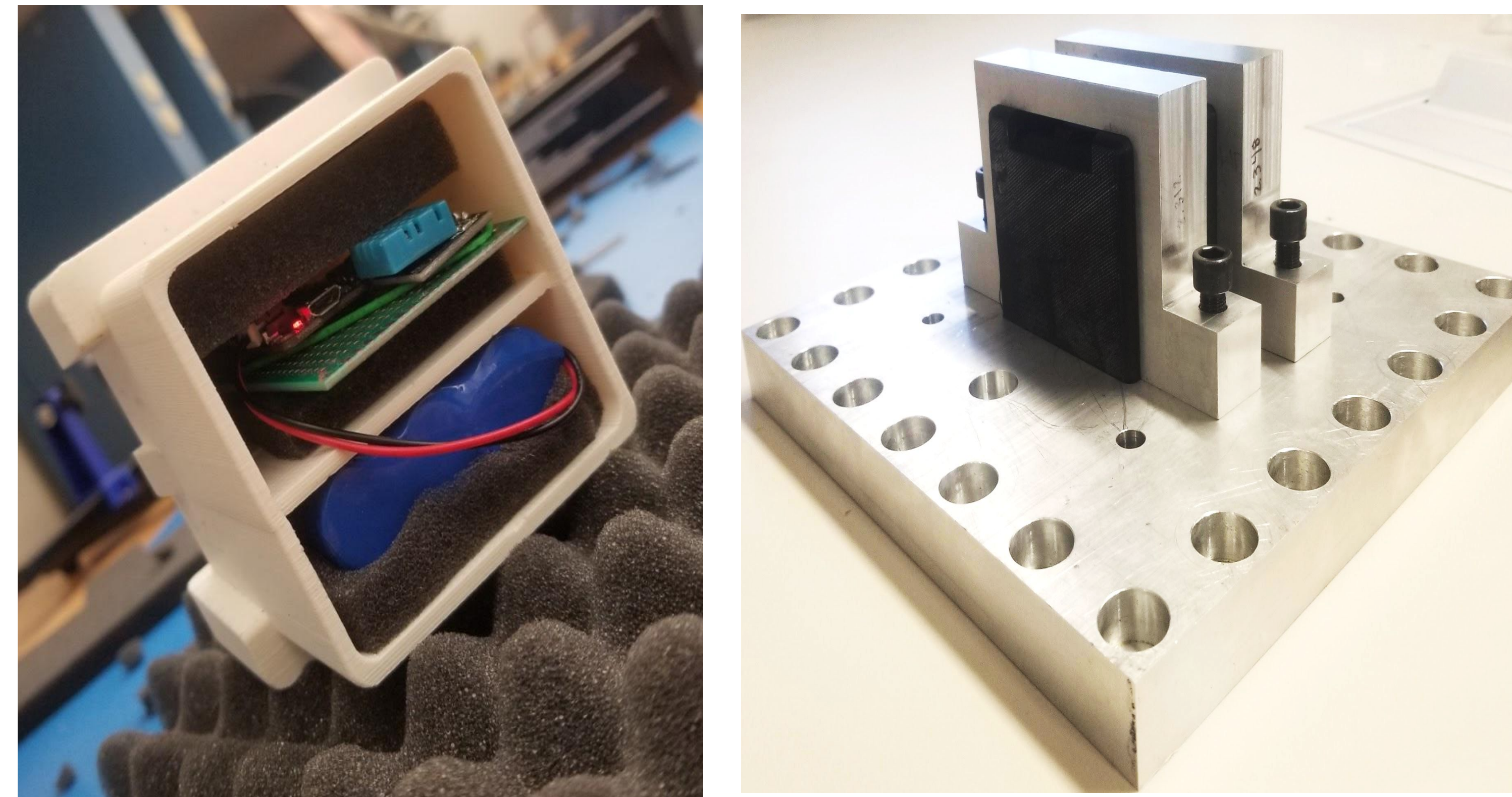
Requirements

Objective	Operating Range
Battery	4 Consecutive Days
Vibration	1 to 500 Hz
Velocity	0 to 100 mph
Linear Acceleration	0 to 1 G
Orientation	Orthogonal Coordinate Frame
Proximity	1 ft ³
Temperature	-20 to 70°C
Volume	Max Volume of 600 cm ³

Initial Concept



Final Design



- **Enclosure** - Fabricated with 3D printed ABS plastic for thermal resistance and impact protection. Cubic design for internal volume optimization. Snap-fit design used for secure yet easy access to sensor package.
- **Mount** - Machined out of 6061-T6 Aluminum. The brackets are easily removable to aide in quick orientation flips for the enclosure. Designed to withstand vibrations of 1500 Hz.
- **Sensor Package - Incorporates the following sensors:**
 - DHT11 temperature and humidity sensor
 - MMA8451 tri-axial accelerometer
 - Adafruit Feather M0 Adalogger microcontroller
- **Planned Sensor Package - Sensors that will be added:**
 - MOD_CH101-03-01 180 degree ultrasonic sensors
 - Botletics SIM7000a LTE GPS tracking board

Testing Results

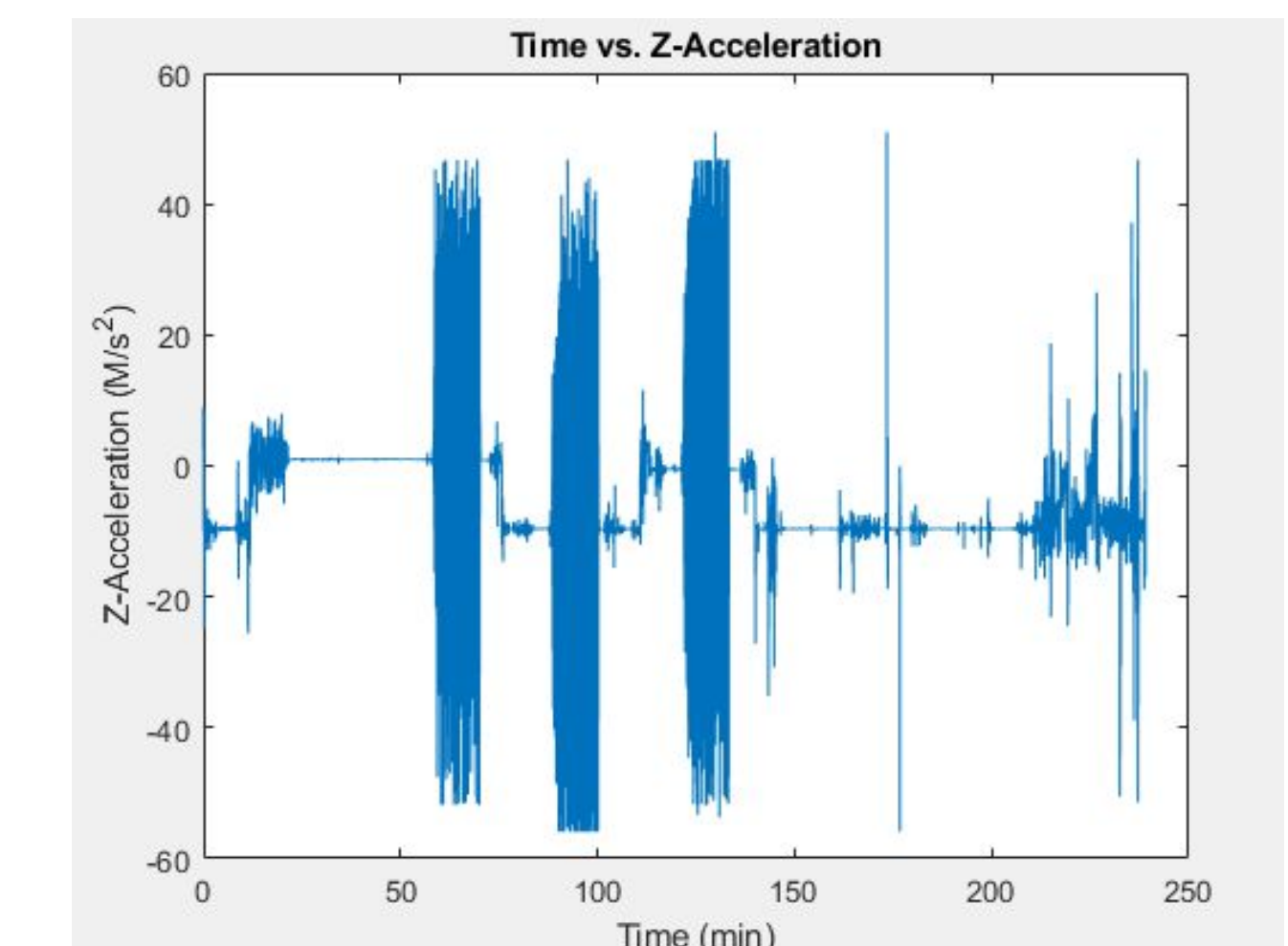
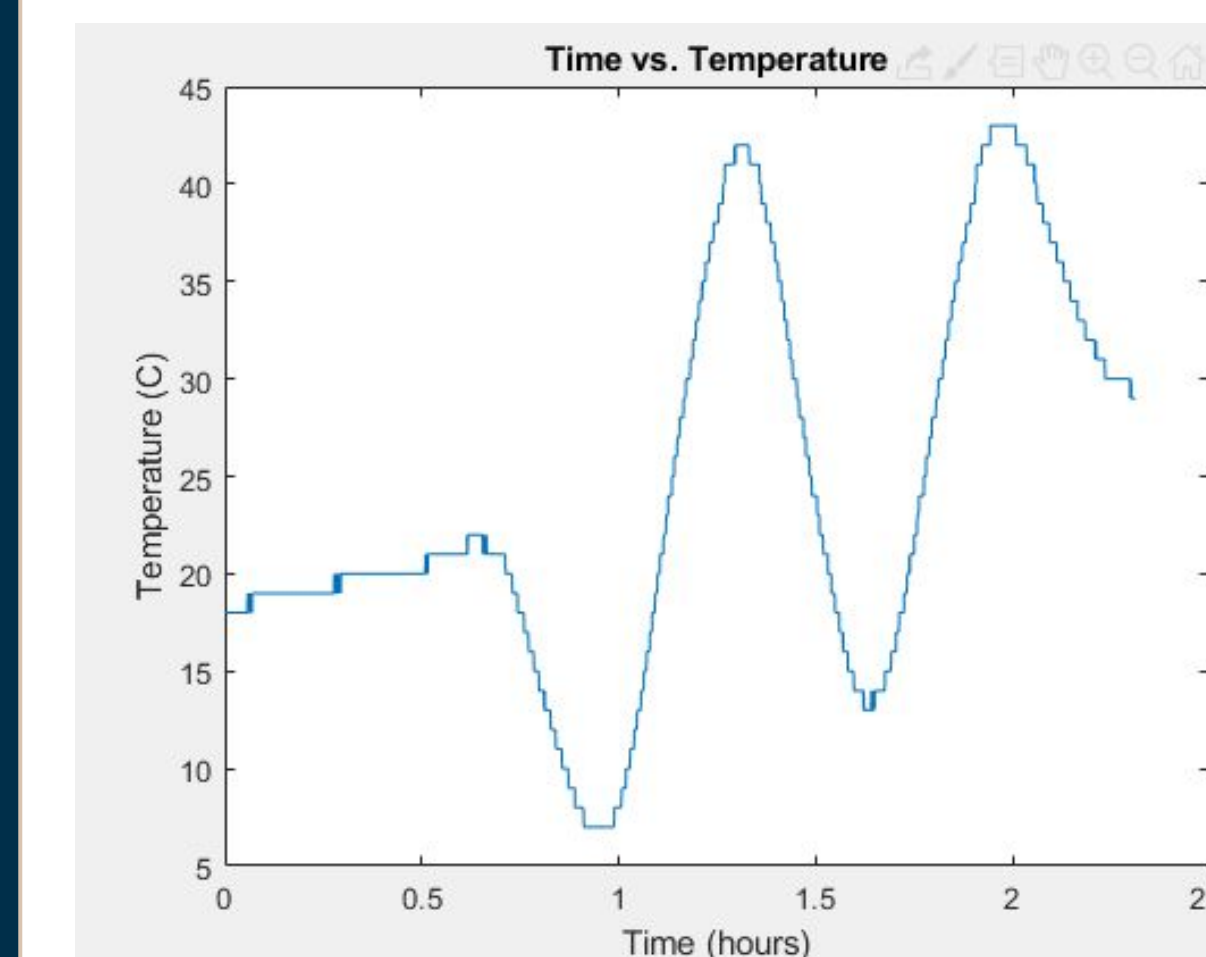


Figure 1. SNL Temperature Test

Figure 2. SNL Z-Axis Vibration Test

Environmental Temperature Testing: The insulation encasing the device kept the internal temperature fluctuations between 5 and 45 degrees Celsius.
Vibration Testing: The on-board tri-axial accelerometer captured the three testing events (high density regions) as well as the drop test conducted by SNL.

Closing Statement

The Sandia Integrated Sensing Device team from New Mexico Tech met all the requirements for the Capstone design challenge by producing conceptual design models despite lacking the resources for a final deliverable fabrication. Through this adversity, the team learned much about working with limited supplies as well as with intense deadlines.

Team Member Photos

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