Multidisciplinary Engineering Design:
Maryland Zoo Animal Enrichment Tracker
Electronics & Software Documentation

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Github Repository

Downloading Code

All code can be found here: https://github.com/j-ma03/md-zoo-enrichment

To download the code to your computer, enter the following command into your terminal:

`git clone https://github.com/j-ma03/md-zoo-enrichment.git`

Alternatively, you can click "Download ZIP".

Important Files

- *Arduino_Uno_Rev_2_with_internal_IMU_timestamp.ino* – collects enrichment data on the Arduino
- imu_data_processing folder – processes raw data into duration-against-time format
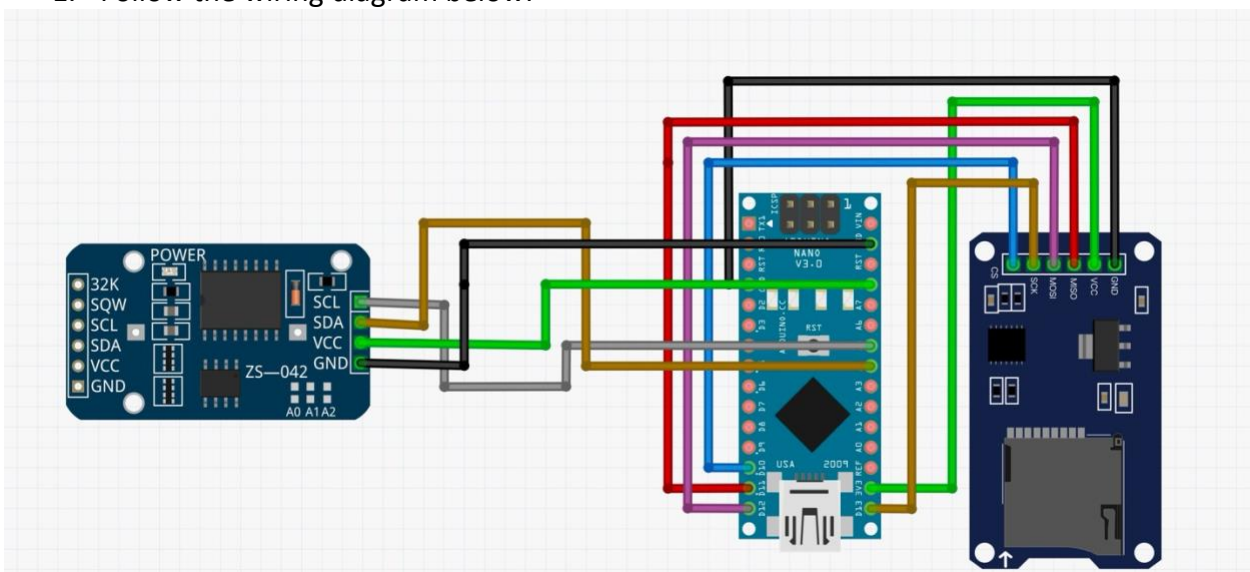
Electronics

Parts Required

- Arduino Nano 33 IoT
- Arduino DS1307 Real-Time Clock Module (RTC)
- CR2032 Battery
- Adafruit MicroSD Card Breakout Board+ (Product ID: 254)
- Jumper Cables
- Power Bank (or any power source that can connect to micro USB)
- RTClib Arduino Library (found in Arduino IDE Library Manager)

How to Set Up

1. Follow the wiring diagram below:

RTC	Arduino
GND	GND
VCC	5V
SDA	A4/D18
SCL	A5/D19

MicroSD Breakout Board	Arduino
GND	GND
VCC/3V	3V3
MISO	MISO/CIPO
MOSI	MOSI/COPI
SCK	D13
CS	D10

2. Insert CR2032 into Real-Time Clock Module.
3. Insert micro SD card into MicroSD Card Breakout Board.

4. Plug in Arduino into your computer and open up Arduino IDE.
5. Upload *ds3231.ino* to set the time on the RTC. Found in File>Examples>RTClib>ds3231
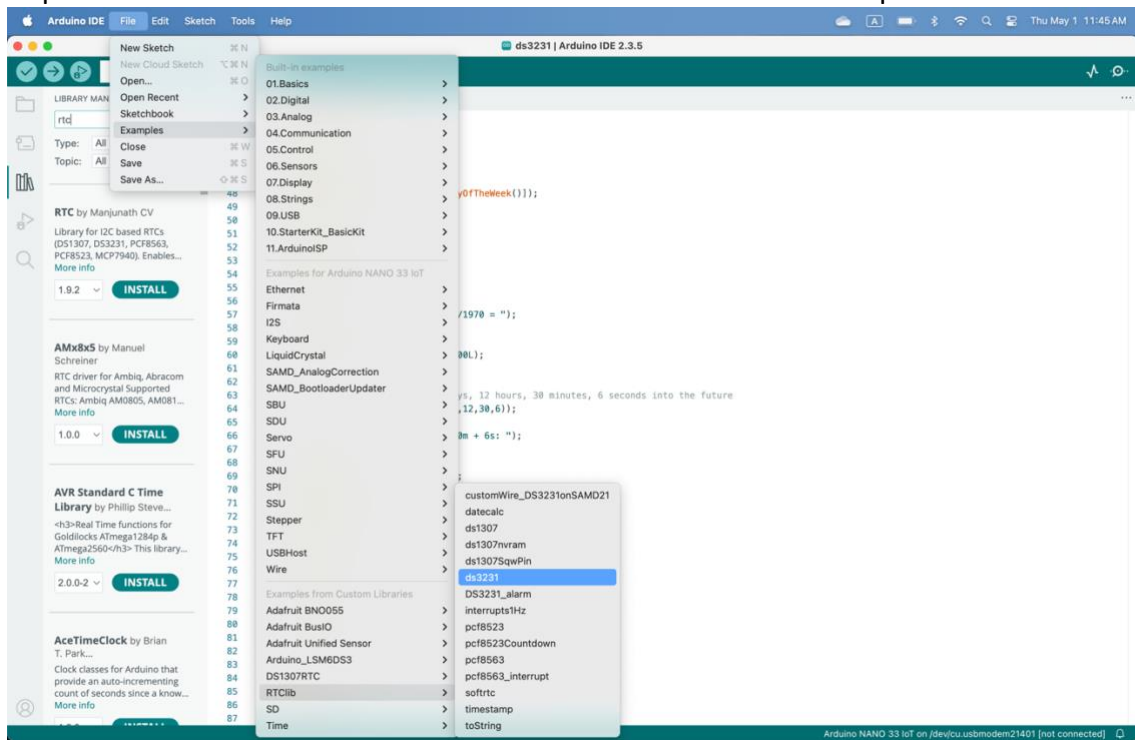
6. Upload *Arduino_Uno_Rev_2_with_internal_IMU_timestamp.ino*.
7. Disconnect Arduino from computer and plug power bank into the Arduino to start collecting data.

Software

Installing Data Processing App

Data Processing App can be found here: https://livejohnshopkins-my.sharepoint.com/:f:/g/personal/jma82_jh_edu/Eo8vz1KqDStAlb3vGnjBlKMBMwYRQJn6hYneybw05m86VQ

1. Go into the folder "enrichment tracker v3.1"
2. For Windows, download *enrichment tracker_v3.1_WINDOWS.exe.* For Mac, download *enrichment tracker.app_v3.1_MACOS.zip.*
3. Your computer's security settings may ask if you want to trust the developer before opening the app. Hit "Run Anyway" to run the app.
4. Alternatively, you can also download the app by running the following commands on your terminal:
   ```
   cd path/to/md-zoo-enrichment/imu_data_processing
   pip install pyinstaller
   pyinstaller --onefile --windowed enrichment\ tracker.py
   ```

How to Use

1. Unplug Arduino from power bank to stop collecting data.
2. Take out micro SD card from Arduino.
3. Download ZOODATA.txt from the micro SD card onto your computer.
4. On the Data Processing App, open the raw data by clicking the "Open Raw Data File" button in the top left corner.
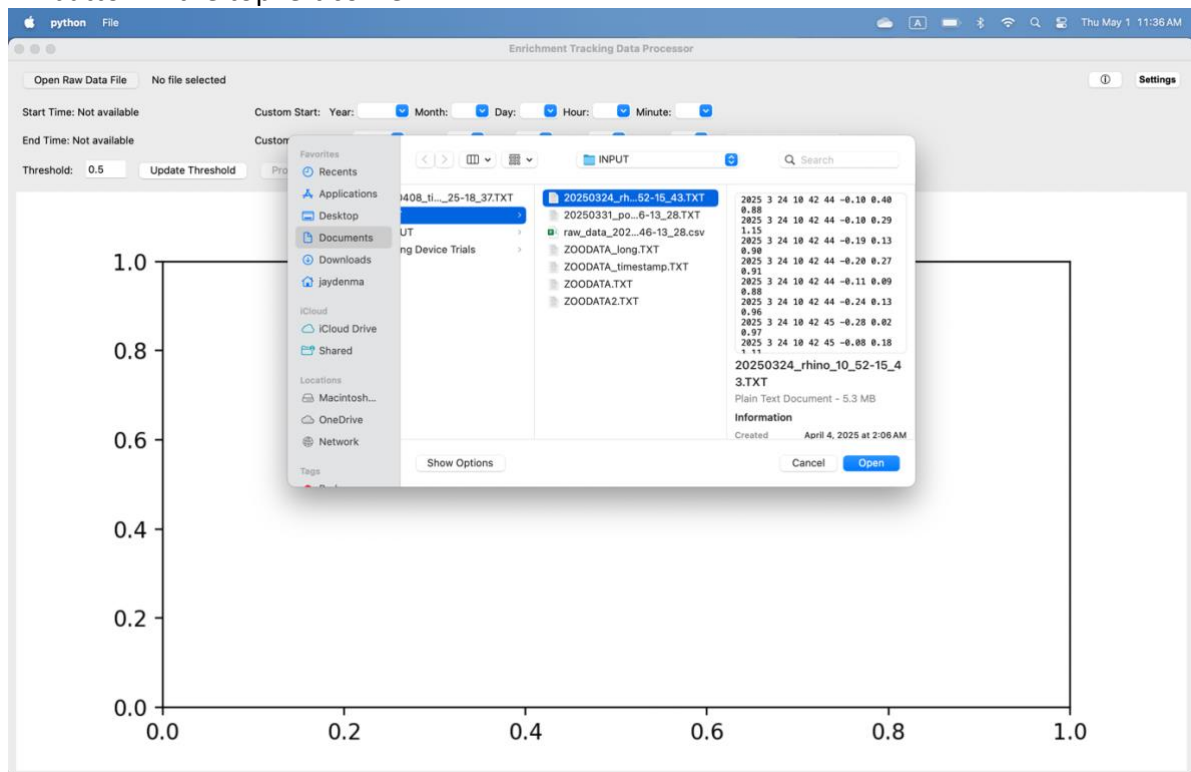
5. Choose the time range that you want to process. Click "Update Time Range" to update the time range.
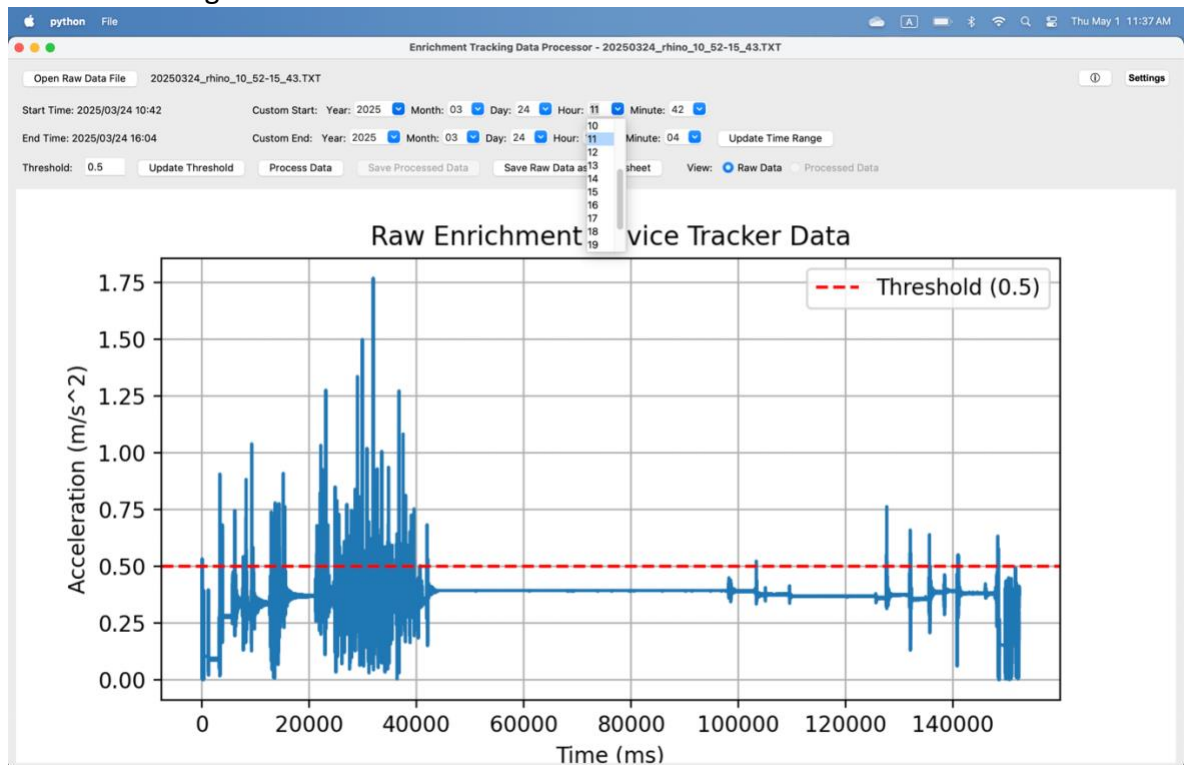
6. Choose the acceleration threshold on the very left. Click "Update Threshold" to update the threshold (see Notes).
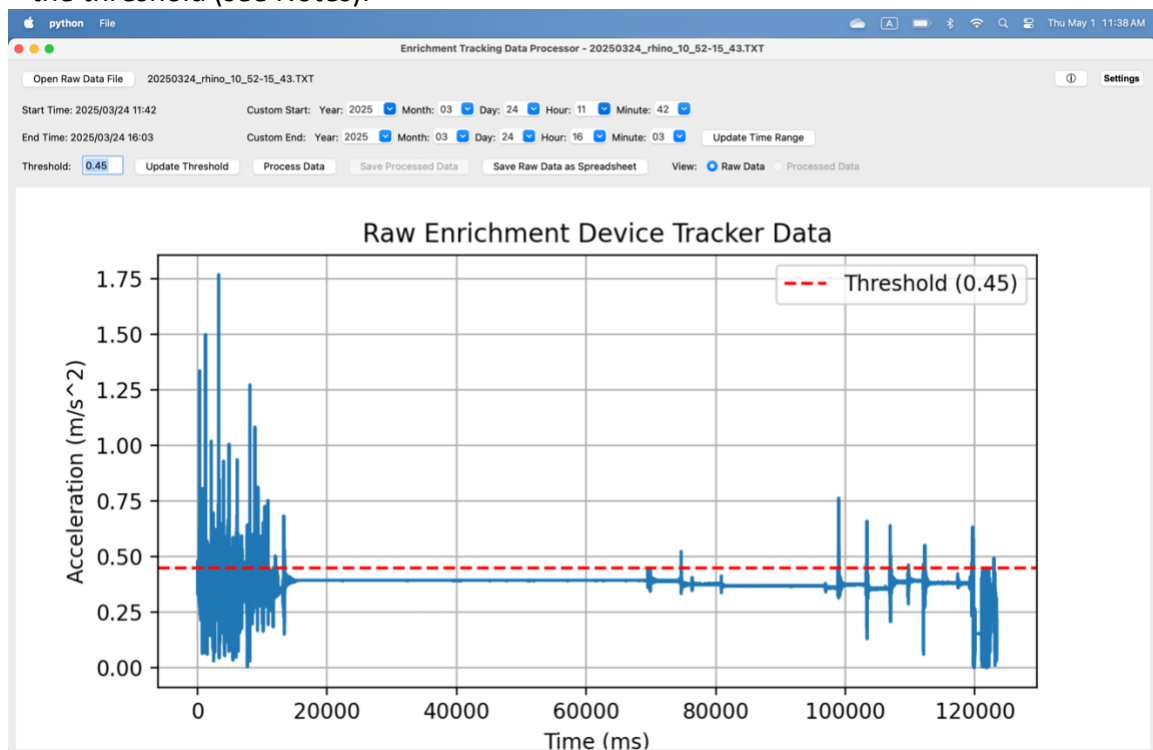

7. Click "Process Data" to process the data.

8. When processing is done, you can save the processed data as a spreadsheet by clicking "Save Processed Data"

Resetting Clock

The clock may drift and become inaccurate over time. You can reset the time by uploading ds3231.ino and then *Arduino_Uno_Rev_2_with_internal_IMU_timestamp.ino* again (See Electronics>How to Set Up>Steps 5 and 6)

Notes

- Choose a threshold that is just above the ambient acceleration. In the example below, the ambient acceleration was 0.4 m/s^2, so a threshold of 0.45m/s^2 (red dotted line) will work best for this particular case.
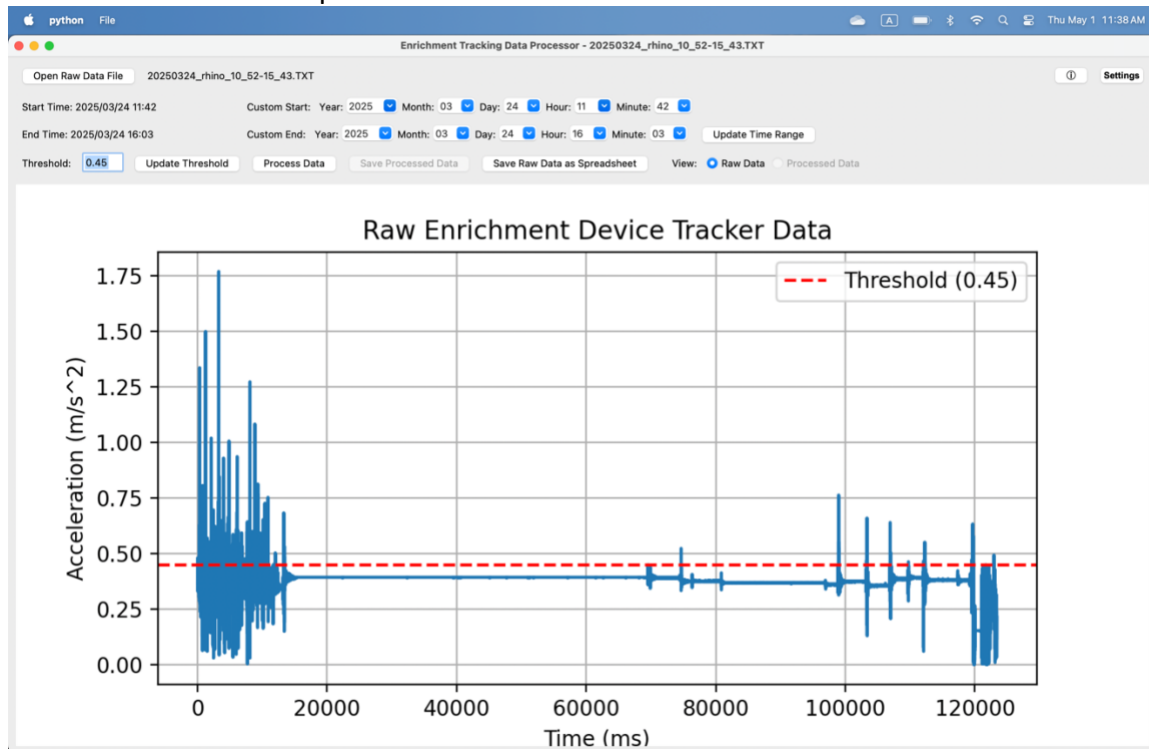
- The Adafruit MicroSD Card Breakout Board+ works best for this setup. Third-party SD card modules may not properly initialize.
- Contact Jayden Ma (jma82@jh.edu) for additional support