# Red Newt Racing Tracker Team


*Kobe Phillips*
*Andrew D'Onofrio*
*Joey Nadol*
*Jamison Taylor Jr*

***Community Partner:***
*Ian Goldsing*
*Jackie Augustine*

***Project Advisor:***
*Dr. Max Zhang*

# Our Team

***Kobe Phillips***
*Design Technology '26*

***Andrew D'Onofrio***
*Mechanical Engineering '26*

***Joey Nadol***
*Mechanical Engineering '26*

***Jamison Taylor Jr***
*Mechanical Engineering '26*


RNR
FINGER LAKES RUNNING & TRIATHLON Co.
Trails COLLECTIVE
FINGERLAKESRUNNING.COM
FINGER LAKES RUNNING
SYRACUSE & ITHACA
Baja Jail

# Social Context

## *The Race:*

*Seneca 7 is a **77.7**-mile relay race around Seneca Lake organized by Newt Racing and race director Ian Golding in Ithaca, NY.*

*The race starts and finishes in Geneva, NY at the New York Welcome Center.*

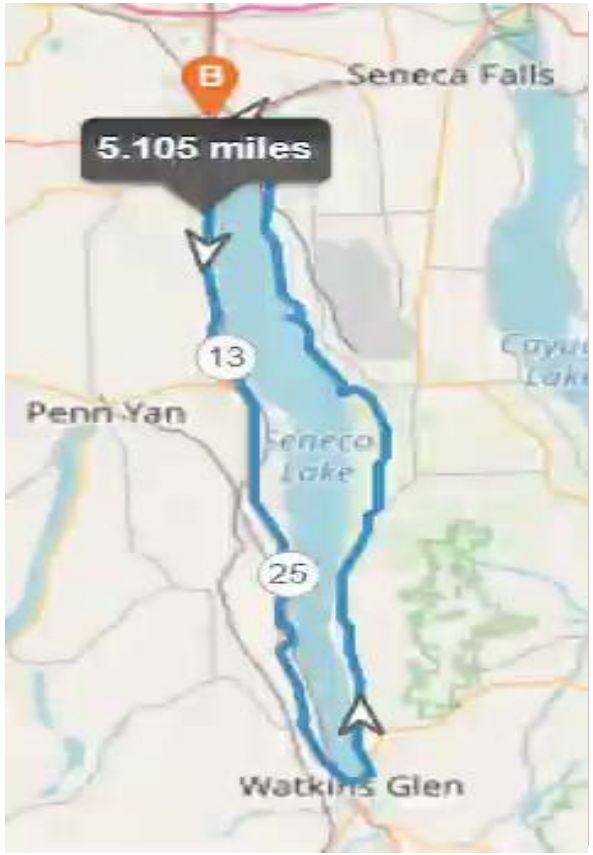
*Each year the event brings 300+ teams of seven runners, totaling over 2,000 participants from across the United States.*

## *Race Challenges:*

*The race currently uses a simple slap bracelet as the baton.*

*This setup provides no real-time runner location, no individual performance data, and no automatic baton exchange detection.*

*Because of this, race monitoring is more difficult for volunteers, and runners do not receive detailed performance statistics.*




## Tracking for Racers:

- *Personal Performance and Track Improvements*
- *Speed Data and Team Locations (Position in Race/ Passing)*

## Tracking for Organizers:

- *Location Tracking for Safety and Emergency Response*
- *Improves Overall Race Experience*
- *Attract New Runners and Encourage returning participants*

*Reusability + Cost Efficiency + Higher Charity Opportunities*

# AIM:

*We aim to design a GPS-enabled smart baton that brings real-time tracking and performance analytics using* ***LoRaWAN*** *to the Seneca 7 relay race. With 300 teams, 2,000+ runners, and 20 exchange points spread across four counties, our system gives race officials complete course visibility and delivers per-runner performance data to every participant for the first time.*


START
RED NEWT RACING
Cayuga
State Farm
ITHACA BEER CO.
Garden Inn

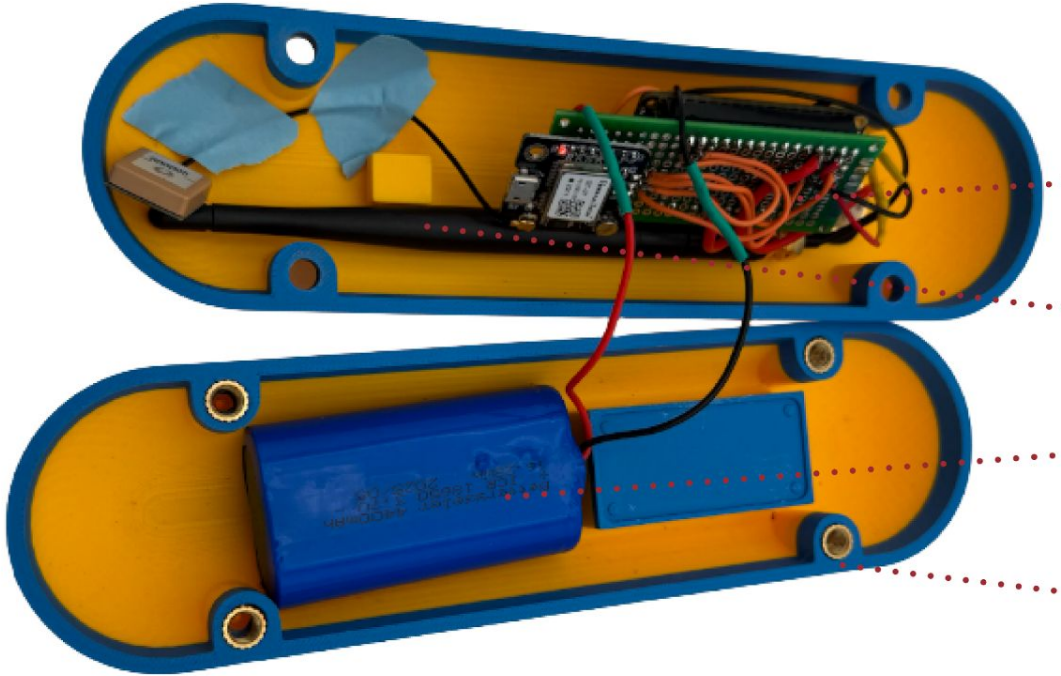
# Device Design

# DESIGN


***Version 1.***

# DESIGN

***Version 2.***
***"The Minion"***



*LoRaWAN Feather M0 Board | Protoboard*

*868 MHz Antenna*

*Battery Pack | 3.7 V*

*Heat-set Inserts*

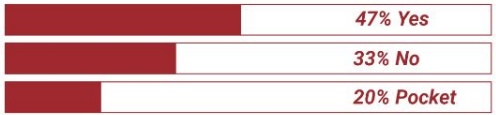
**Too Large - Handling Improvements Needed*
**No Ergonomic holding or options for attachment.*

# User Studies

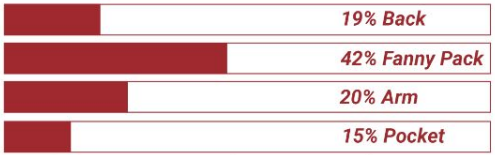
***Sample Size: n = 45  Female = 25 | Male = 20***

***Q1. For Long Distance Running, do you carry items in your pocket?***


***Q2. For Long Distance Running, do you hold your phone?***




***Q3. For Running, how would you strap items to your body?***




# User Studies

***Sample Size: n = 45  Female = 25 | Male = 20***

***Q1. For Long Distance Running, do you carry items in your pocket?***

- 35% Yes
- 65% No

***Q2. For Long Distance Running, do you hold your phone?***

- 47% Yes
- 33% No
- 20% Pocket

***Q3. For Running, how would you strap items to your body?***

- 19% Back
- 42% Fanny Pack
- 20% Arm
- 15% Pocket

# Newt Racing — Seneca 7 Live Baton Tracker

## Latest Baton Status

## GPS Track & Button Press Locations

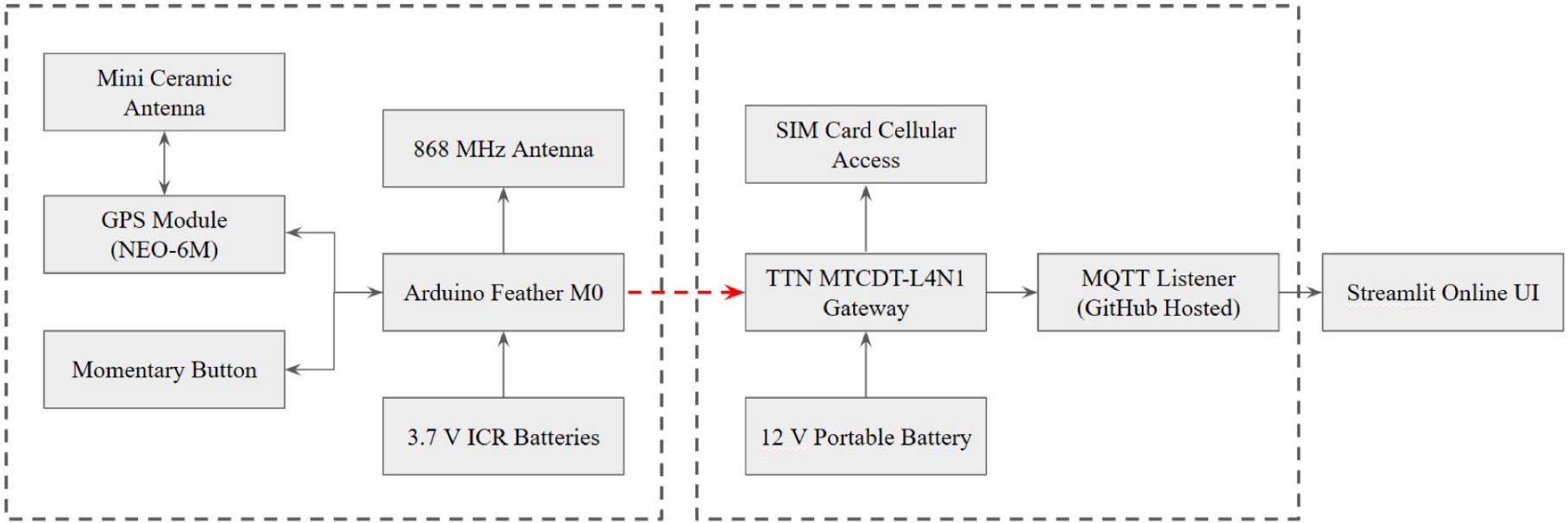
# DESIGN

***Version 4.***
***"Grips"***

# Tracker Methodology

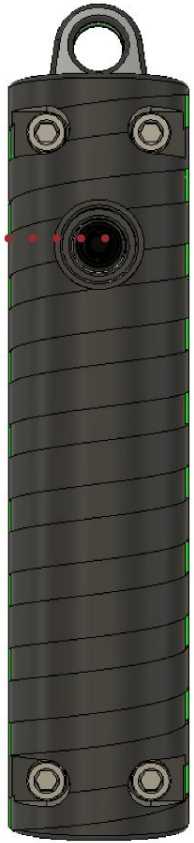
## Physical Baton Device

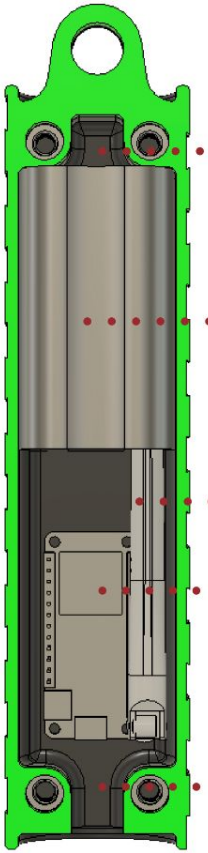
## TTN Gateway



Button

PLA
Matte
3D-Printed
Baton





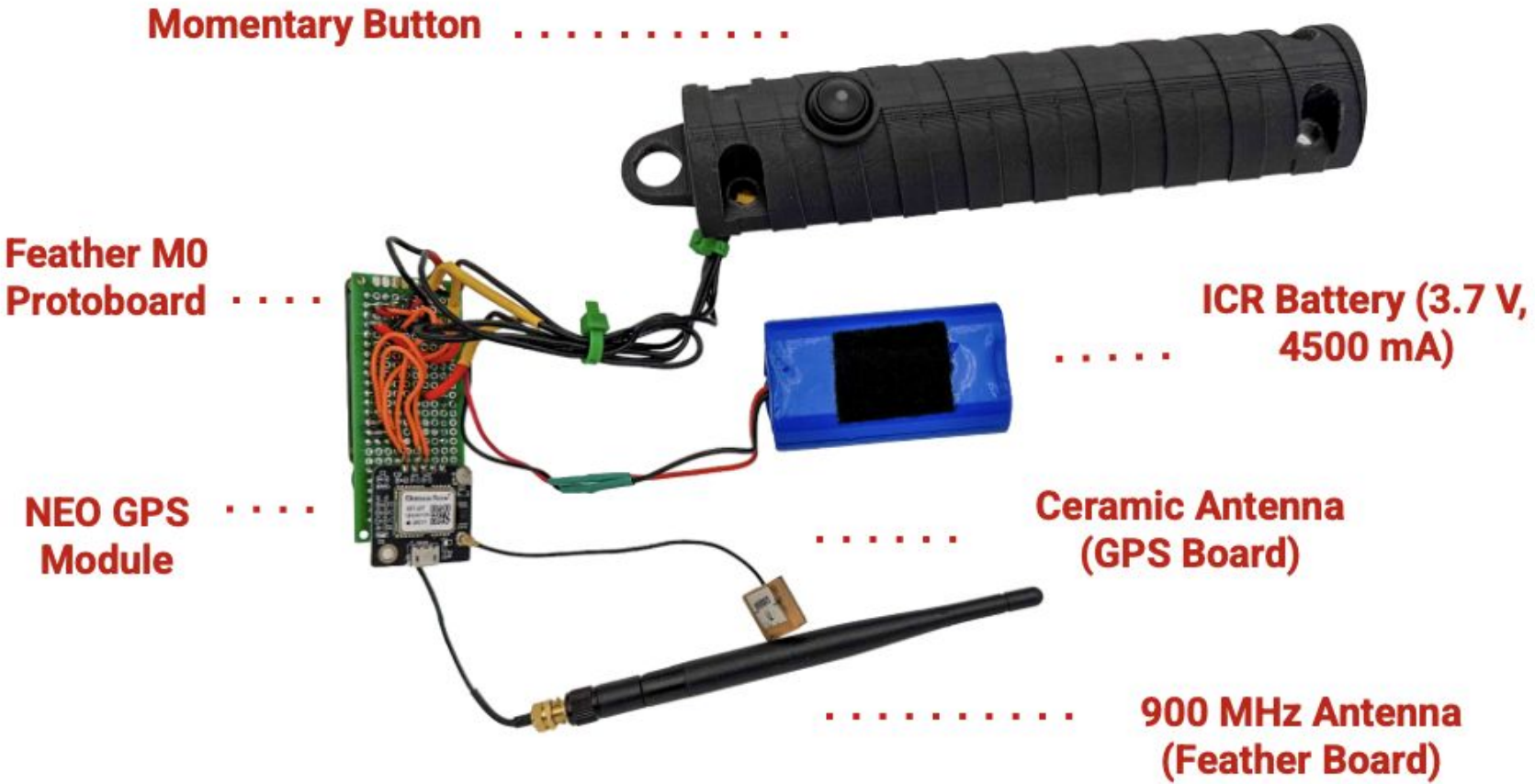
GPS Module

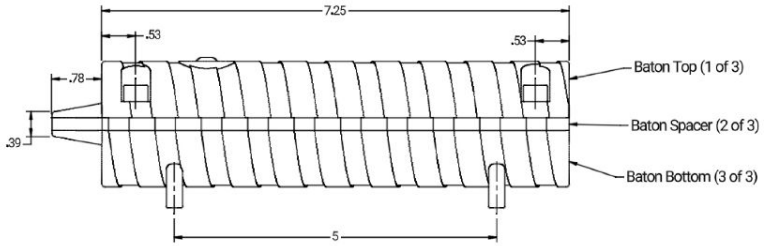
Lithium Ion Battery
3.7V

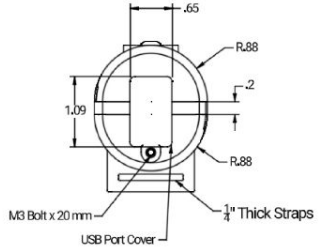
900 Mhz Antenna

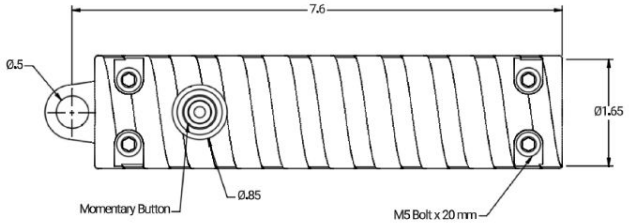
LoRaWAN Feather
M0 Board

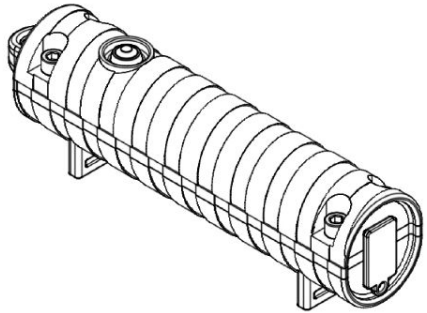
USB Port


Momentary Button
Feather M0
Protoboard
ICR Battery (3.7 V,
4500 mA)
NEO GPS
Module
Ceramic Antenna
(GPS Board)
900 MHz Antenna
(Feather Board)



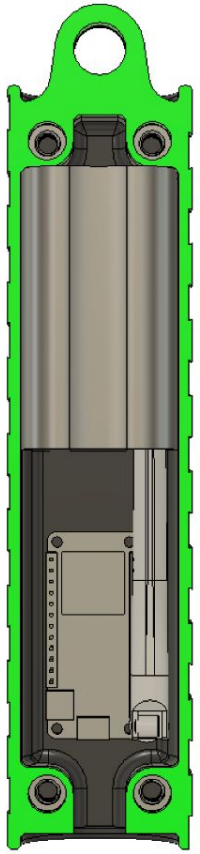



**NOTES:**

Diagram Provided in Standard (In)
Wall Thickness: 1/8 "
Included Components:

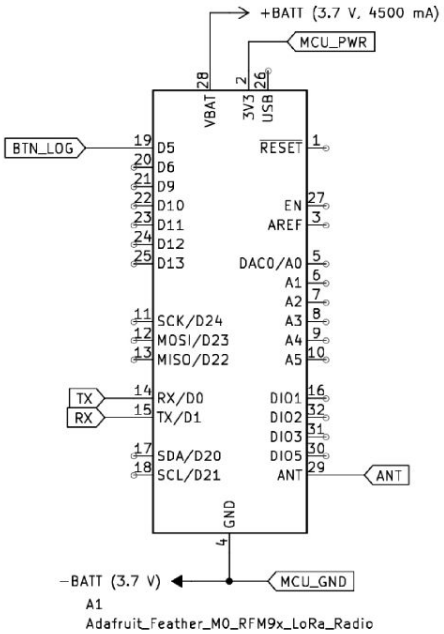
1. M5 Heat Set Inserts (4)
2. M3 Heat Set Inserts (1)
3. M5 Hex-Head Bolts (4)
4. M3 Hex-Head Bolts (1)



Tracker Team - Red Newt Racing

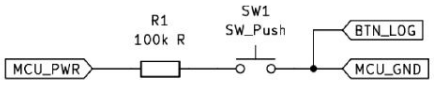
Feather Board Connection Points

## Feather M0 Board

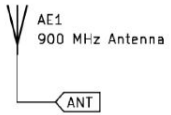



Feather Board Peripheral Connection Points

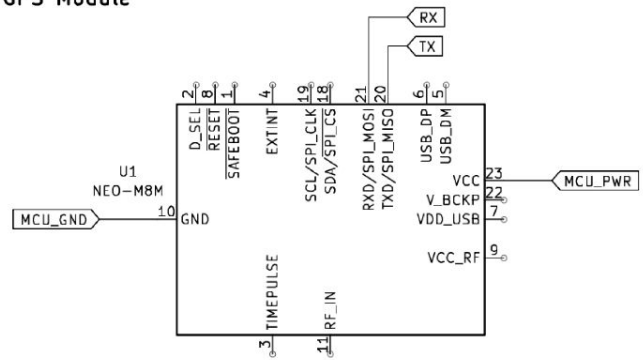
## Push Button




## Antenna




## GPS Module




Baton Tracker Project
MAE 4220: Internet of Things
May 10th, 2026

# Data Packaging & Sending

Runner + Baton


Race Organizers and Staff

**Initialization**

1. Find/ Locate Gateway
2. Wait for GPS to connect/ provsion.
3. + Button Presses

Every 30 seconds

**Package to TTN**

1. Baton ID
2. Latitude and Longitude Values (GPS)
3. Timestamp
4. Button Presses (# of within time X)

| | | | | |
|---|---|---|---|---|
| 42.483524322509800 | -76.49275207519530 | 2026-05-01 17:34:51.805144589+00:00 | 1 | baton-prototype-1 |

*In TTN:*
*Python decodes bytes and locates position.*

**Streamlit UI**

Streamlit post processes and reconfigures the data into understandable visuals.

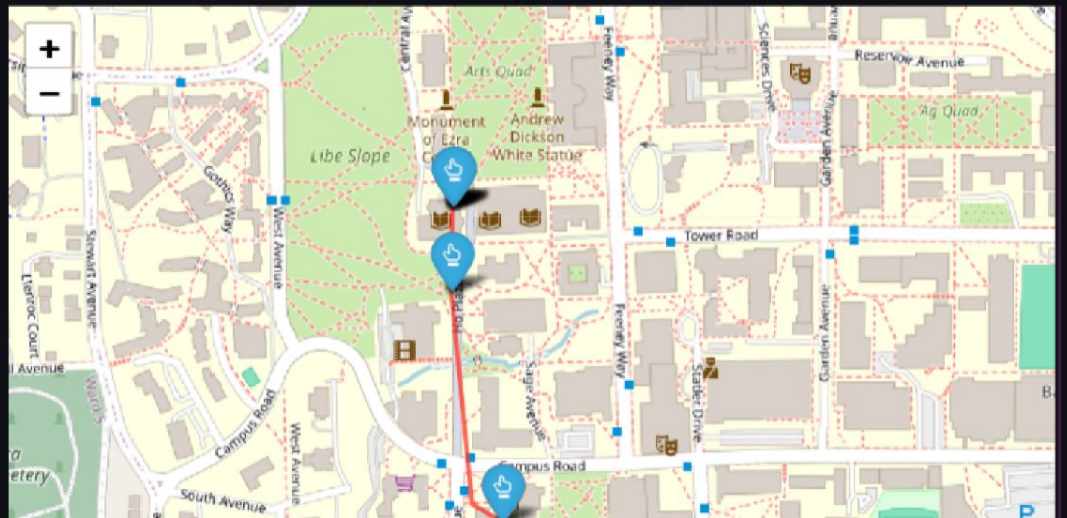
# 🏃 Newt Racing — Seneca 7 Live Baton Tracker

🟢 MQTT: connected | Packets received: 8 | Button events: 12

## Latest Baton Status

| | baton_id | buttonPressed | lat | lon | rssi | time |
|---|---|---|---|---|---|---|
| 0 | 1 | 12 | 0 | 0 | -26 | 2026-04-17 03:20:46+00:00 |

## GPS Track & Button Press Locations

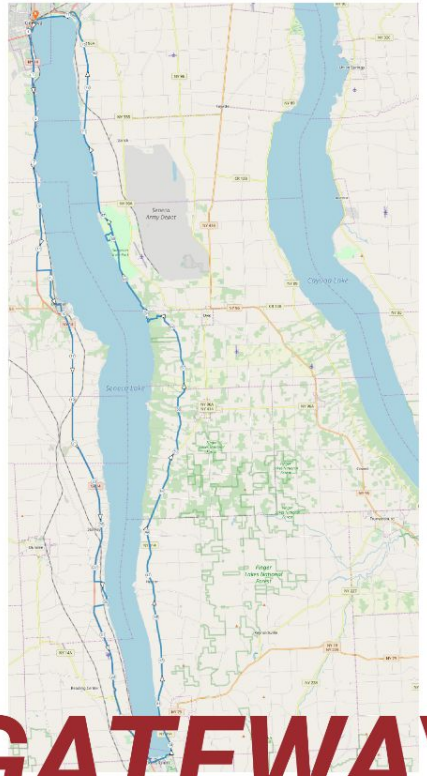



## *UI Design:*

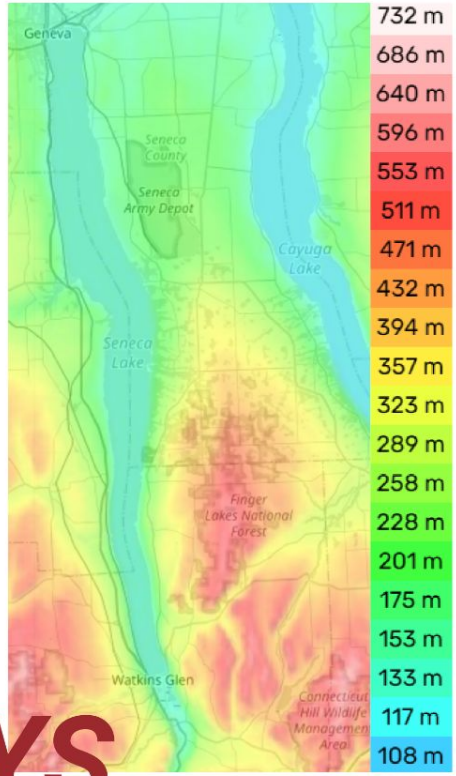
*A Python-based system hosted on GitLab and deployed via Streamlit integrates an MQTT listener to process baton data packets containing ID, button events, and GPS coordinates. The interface displays recent acquisition points on a satellite map, supporting post-processing at a 30–60 second sampling rate (0.0333–0.0167 Hz).*

*GPS Tracking 1 minute updates on high signal*

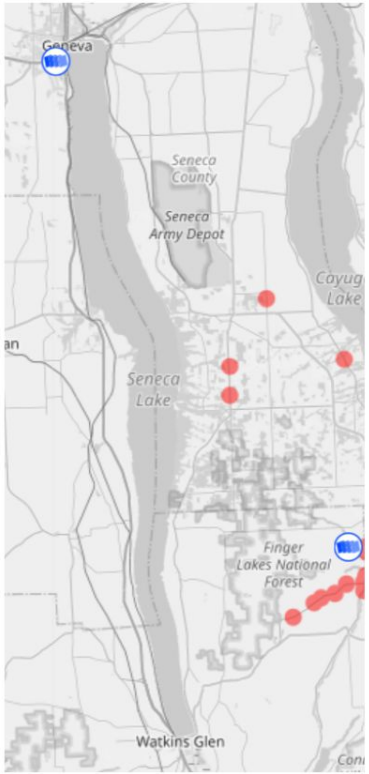
### Seneca7 Race Map



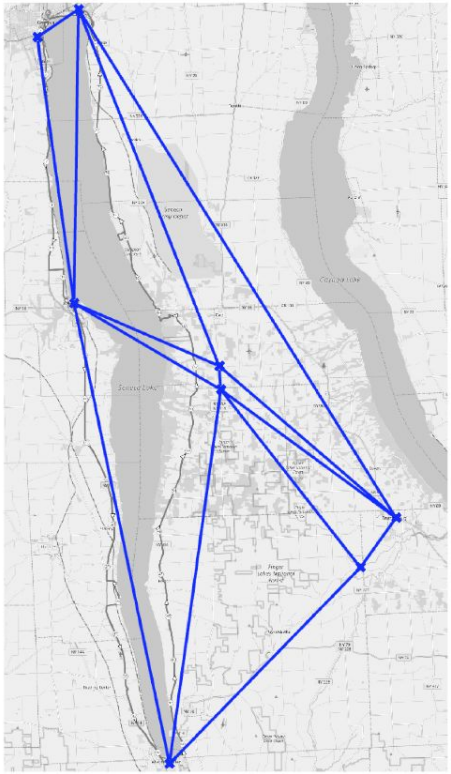
### Topography Map




### TTN Coverage Map




### Calculated Coverage Map



# GATEWAYS

Tracker Team - Red Newt Racing

# MOBILE GATEWAYS

***Hand-held, Controlled Battery (9V, 9000 mAhr) | 11-14 Hours of Battery***

***Portable for Running Gateway | Functional Prototype***



RF
MULTITECH
Conduit

# Testing Methods

# Technical Testing

***Seneca 7***

***Goal:*** *Explore form factor and race integration with the existing infanstructure.*

***Initial Beta Test:***
***How Does it Work?***


***Ithaca Mall***

***Goal:*** *Collect packages, data, with new mobile gateway system under turbulent conditions.*

***Initial Verification Test:***
***Is it doing something?***

***Belle Sherman 5k***

***Goal:*** *Full-Stack Outputs, Mapping, and RSSI Testing with MATLAB Heatmaps.*

***Initial Validation Test:***
***Does it Work?***


Seneca 7 Race
Giddyup


SALOMON


KING

# *Race Discussion:*

***Form Factor:***

***Easy to Handle***

***Multiple Methods of Carry***

***Lightweight***

***Slightly Large Diameter***

***Code Errors & Gateway Struggles.***

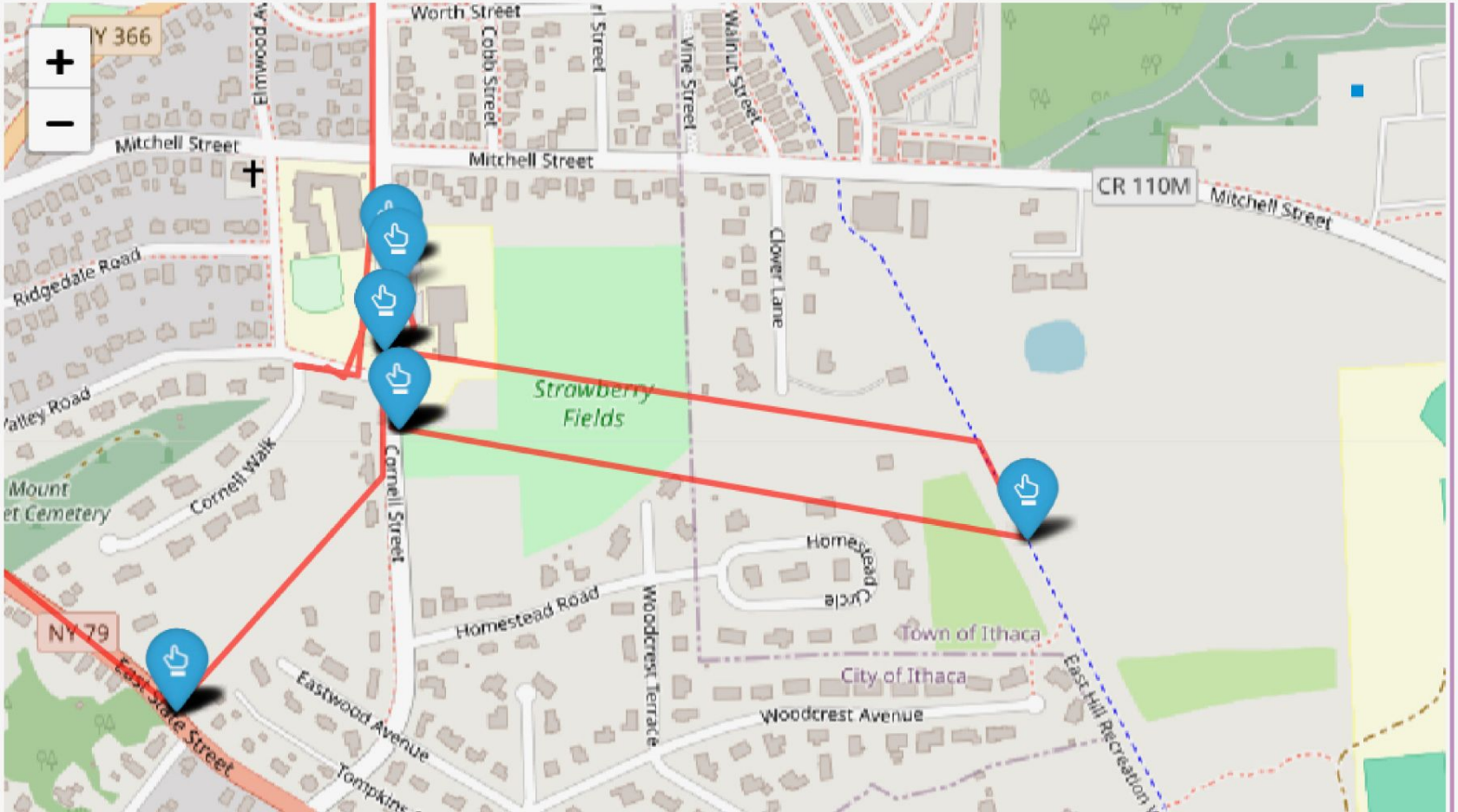
# GPS Track & Button Press Locations


| time | device_id | baton_id | buttonPressed | lat | lon | rssi | snr |
|---|---|---|---|---|---|---|---|
| 2026-05-01 17:21:50.866963118+00:00 | baton-prototype-1 | 1 | 0 | 42.484474182128900 | -76.49288940429690 | -15 | 10.25 |
| 2026-05-01 17:22:20.872900766+00:00 | baton-prototype-1 | 1 | 1 | 42.484481811523 40 | -76.49288177490230 | -19 | 10.0 |
| 2026-05-01 17:22:50.926792191+00:00 | baton-prototype-1 | 1 | 1 | 42.484344482421900 | -76.49252319335940 | -2 | 8.75 |
| 2026-05-01 17:23:21.196206649+00:00 | baton-prototype-1 | 1 | 1 | 42.483837127685 60 | -76.49320983886720 | -5 | 10.25 |
| 2026-05-01 17:24:51.019422883+00:00 | baton-prototype-1 | 1 | 2 | 42.482414245605 50 | -76.49211120605470 | -9 | 9.5 |
| 2026-05-01 17:25:21.229402176+00:00 | baton-prototype-1 | 1 | 2 | 42.481391906738 30 | -76.49156870117190 | -8 | 9.25 |
| 2026-05-01 17:25:51.052274329+00:00 | baton-prototype-1 | 1 | 2 | 42.481151580810 60 | -76.49019622802730 | -17 | 11.0 |
| 2026-05-01 17:26:21.050518414+00:00 | baton-prototype-1 | 1 | 2 | 42.481433868408 2 | -76.48871612548830 | -8 | 9.0 |
| 2026-05-01 17:26:51.435035585+00:00 | baton-prototype-1 | 1 | 3 | 42.482162475585 90 | -76.48861694335940 | -6 | 10.25 |

*Every 30 seconds*

# Belle Sherman 5K

# GPS Track & Button Press Locations




Signal Strength
Signal Points
5K Route
Gateway Test
42°26'30"N
42°26'20"N
42°26'10"N
42°26'N
42°25'50"N
Latitude
76°28'45"W
76°28'30"W
76°28'15"W
76°28'W
76°27'45"W
76°27'30"W
Longitude
100 m
500 ft
New York State, Vantor
-65
-70
-75
-80
-85
-90
-95
-100
RSSI (dBm)


# Race Discussion:

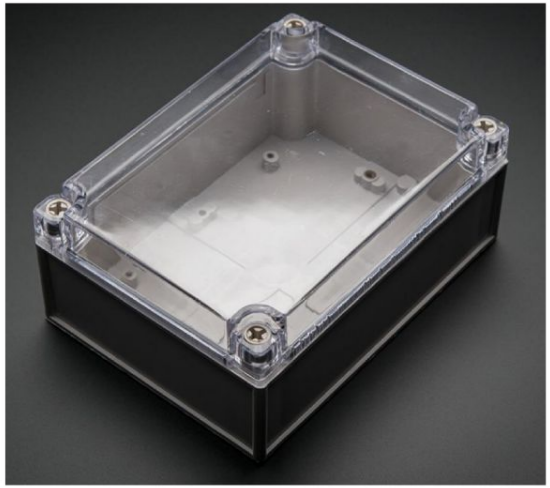
*Gateway Performance*
*~ 600ft*

*Mechanical Chamber too condensed for the Antenna connection.*

# Takeaways & Future Directions

# Gateway Next Steps:

*Future improvements should focus on increasing signal performance by mounting the gateway externally on the vehicle to reduce signal obstruction from the car body. This would require a weather-resistant enclosure made from thin plastic or glass materials that protect the electronics while minimizing radio interference. Similar enclosure strategies could also be explored for the baton antenna system, including integrating a cylindrical antenna design such as the ANT-5GW-SPS1-1 Puck Antenna to improve protection, durability, and signal transmission.*



# *Mechanical Next Steps:*

*Our next steps focus on improving usability and deployment readiness. Strap-based carrying alternatives will be developed alongside improved Antenna accessibility. Focusing on designs for connection to the gateway and improving strength. Additionally, adding an ON/OFF switch will be useful for long term charging and reusability.*

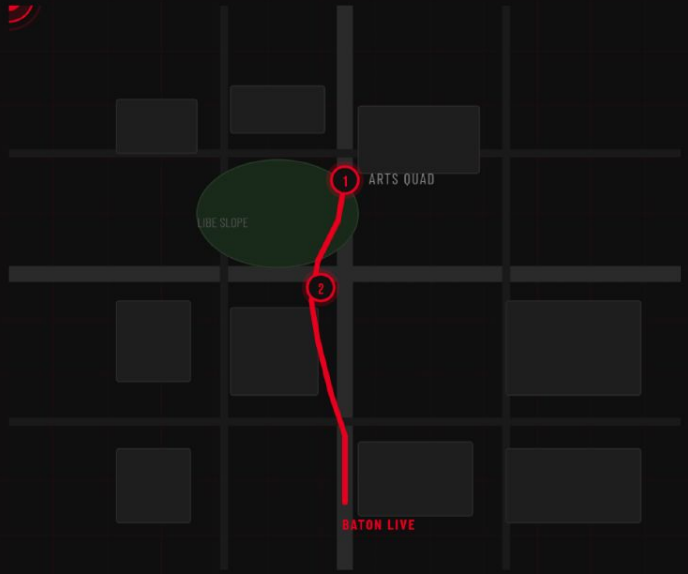
LIVE BATON TRACKER

RNR

# NEWT RACING
# SENECA 7

MQTT CONNECTED

8 PACKETS | 12 EVENTS




CURRENT BATON
BUTTON PRESS
ROUTE TRACK

| BATON ID | BUTTON EVENTS |
|---|---|
| 01 | 12 |
| **LATITUDE** | **LONGITUDE** |
| — | — |
| **SIGNAL (RSSI)** | **PACKETS RX** |
| -26 | 08 |

03:20:46 UTC · APR 17

LIVE

TEAM PHOTO

RACING TEAM

## BELLA'S SQUAD

RECENT EVENTS

| | | |
|---|---|---|
| Baton Press Detected | 03:20:46 — Campus Road | 12 |
| Location Ping | 03:18:31 — Libe Slope | 8 |
| Signal Acquired | 03:15:02 — Arts Quad | 1 |


Thank you.