Project Echo Mike 1

Post-Release Tracking Device for Small Mammalian Species

ELECOMP Capstone Design Project 2023-2024

Sponsoring Company:

SANCTUARI
Box 559
Warren, RI 02885
https://sanctuari.org/

Company Overview:

SANCTUARI is a 501(c)(3) nonprofit wildlife care organization improving wildlife survival rates by leveraging modern technology. We are privately supported without federal, state, or municipal funds and are unaffiliated with other Rhode Island wildlife organizations.

Technical Directors:

Joe Moreira
Founder and Board Chair
sanctuari.org@gmail.com

Project Motivation:

Reference for further detail and credit (santurari.org) - link

Historically, wildlife rehabilitators accept that contact will be lost when releasing animals back into their natural habitats after providing care throughout the animal's youth or critical recovery period. However, the ability to track and monitor released animals can increase their chances of their survival. Monitoring in aggregate also provides valuable biological and ecological data capable of fundamentally advancing various core conservation efforts. Wildlife tracking technology is evolving, but the most reliable and available systems still involve radio and satellite telemetry. Microchips and PIT (passive integrated transponder) tags can be useful in recognizing a given individual, but they typically provide no location data.

Anticipated Best Outcome:

Successful design, prototyping, and testing of a small, lightweight, wearable, long-service-life tracking architecture (electronics and battery power source) suitable for smaller mammalian species such as fox, raccoon, skunk, opossum, rabbit, and more. A "stretch goal" is to include smaller species should the basic architectural design be suitable.

Project Details:

Overall System Concept and Hardware/Electrical Tasks:

Reference for further detail and credit (sanctuary.org) - link

Many wildlife carers are puzzled by the lack of tracking devices suitable for smaller species, given the ubiquity of cellular phone technology and newer products like AirTags. This project is intended to begin from first principles to create the most elegantly simple battery-powered electronics architecture, even if such includes borrowing from or licensing existing designs.

Engineering students will have wide latitude to adjust and expand the project scope and to specify logical workflows, block diagrams, and system elements, including battery form factor and chemistry, charge regeneration methods, if any (ex.: possibilities for converting kinetic energy to electrical), and communications modes (ex.: Apple/AirTag Bluetooth may be viable for urban/suburban releases but not rural, whereas Amazon's Fire device network, Starlink, 4G/5G cellular networks, and others will also evidence relative advantages and disadvantages).

The final design should be superlative with respect to size, weight, and battery life. Current leading examples to draw from could include various cellular phone subsystems, SwitchBot's (and competitors') temperature and humidity monitoring devices, AirTags, and the like. The design should also have modest onboard data storage capacity for preserving data when unable to communicate remotely.

The design will be user-adjustable, at a minimum in terms of trading signal strength, signaling frequency, and battery life. The optimal design will function properly under wide-ranging temperature and humidity conditions. Prevention of excess heat generation and minimization of risk of battery fire is included in scope, along with means for device recovery alert when it is nearing the end of its service life. The design will be compatible with broader systems enabling users to set alerts based on multiple parameters and conditions (such as signal loss over a given timeframe, lack of motion over a given timeframe, and so forth). Each system will be uniquely

self-identifying and will be capable of reporting location and timestamp data to standard mapping platforms and systems (ex.: Google Maps).

Cost will remain only a secondary consideration relative to ergonomics, particularly overall size, weight, and signaling performance. While any accompanying software/mobile app is outside the scope of this project, students herein can absolutely assist in creating specifications for related apps, software, and firmware.

“Stretch goals” subject to early success of the team include power budgeting for, and optional accommodation of, video and audio monitoring as well as optional thermal, vibration, orientation, and/or similar sensing. These could be especially useful in prevention of abuse and poaching and identification of any abusers.

Aspects to remain outside the scope of this effort include methods for ergonomically securing trackers to animals, IP (ingress protection from the elements), and similar. Prevention of battery structural failure and any chemical leaking will also be handled outside this program in a successive mechanical/industrial engineering effort.

Composition of Team:

2 Electrical Engineers (ELE)

Skills Required:

Electrical Engineering Skills Required:

- Quick learning; high curiosity; comfort with various sensing technologies/schemes.
- Propensity for meticulous analysis and testing, especially with power system design and power budgeting.
- Self-motivation respecting research of existing, relevant solutions; capability to aggregate and compare strengths/weaknesses of "competitors" and useful related tech.
- Accountability and willingness to "own" the system design as a good startup CEO would.
- Desire to be hands-on with testing and drive to optimize and wring out design performance, allowing the hardware system to "tell the designers what it needs next."
- Understanding of various battery technologies and chemistries.
- Understanding of various wireless communication technologies and networks (cellular networks, WiFi, Bluetooth, etc.) and related testing standards and methodologies.
- Understanding of engineering for compliance, especially with respect to radiative emissions and signal integrity.
- While not "electrical engineering skills," students with demonstrable compassion for animals and deep concern for animal welfare are desired.

Anticipated Best Outcome's Impact on Company's Business & Economic Impact:

Successful execution will allow us to rapidly produce and distribute devices to our network of carers, from veterinarians to licensed rehabilitators. This will help us to learn how to release animals of various species most safely in various environments all over the planet.

Broader Implications of the Best Outcome on the Company's Industry:

Saving one animal, or expediting their recuperation, along with proper documentation and communication, can quickly lead to the saving of thousands more. This project will generate data enabling carers to correlate, aggregate, publish, and refine best practices, giving each animal the best possible chance to thrive.