# Rugged, High-Frequency Time-Lapse Cameras to Quantify Salmon Migrations

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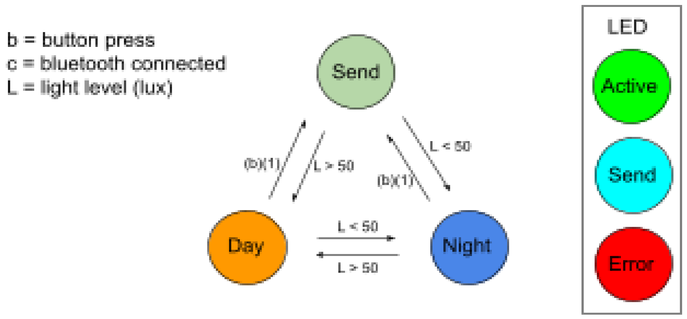
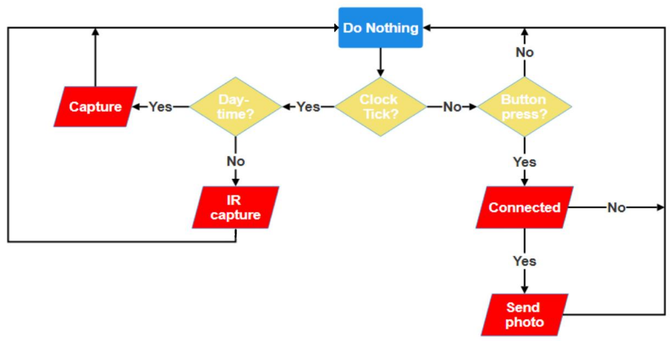
## Overview

- The camera system counts the total number of sockeye salmon swimming upstream through a section of an Alaskan steam filmed by camera over the month-long migration period, to learn more about their behavioral ecology.
- The camera is able to collect information on how salmon may be using social information to make more accurate decisions about when and where to immigrate. The camera has the ability to capture clear frames during night time.
- The camera has minimal environmental impacts because its stealth design and produces no negative effects on local wildlife.

## System Requirements

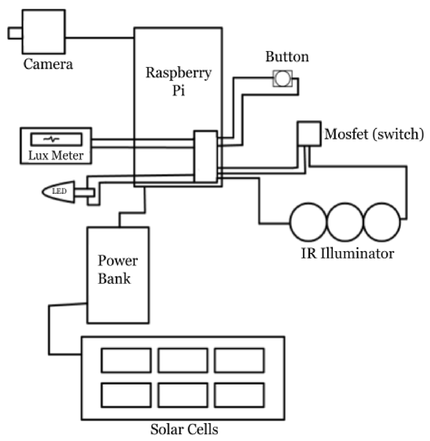
- Ability to capture the movements of salmons in a stream for researchers to analyze the migration patterns and behaviors of sockeye salmons.
- Powered by solar panel, the camera system can last for 2 weeks, without the need to frequently check on the camera.
- Utilized infrared light to enable camera's night vision ability.
- Designed to have minimal impact on environment with eco-friendly design.

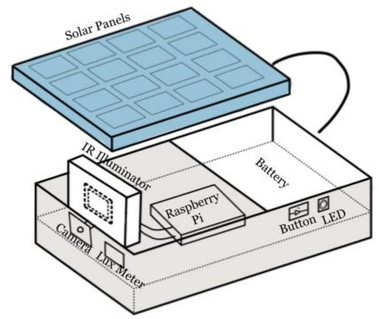


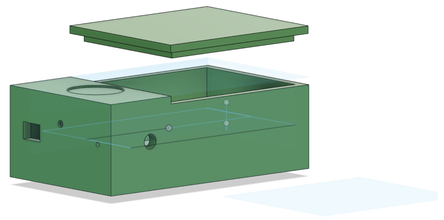




## Model & Development

- The camera system uses light OS system to minimize power consumption.
- The system uses IR illuminator to enhance nighttime image quality.
- A solar panel of 30W is connected to charge the battery.
- A lux sensor detects ambient light level to automatically activate IR illuminator.
- A button is connected to the board to send pictures to a phone.
- 3D printed box can precisely fit all the components and guarantees water resistance.
- The Raspberry Pi runs a script that continuously captures footage 24/7 at a variable rate. The current model is set to 3 frames per second during the day and 1 frame per second at night.



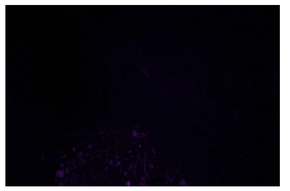



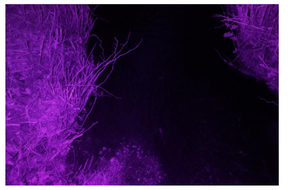
## Results

Complex Ecological Systems Lab, 2023

Stage 1 Development



Stage 2 Development

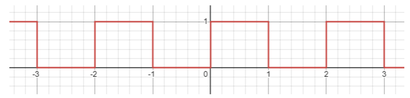


## Power Conservation

Daytime: 0.9 W
Nighttime: 1.8 W
24-Hour avg: **1.2 W**

Duration = Capacity / Power

Duration = 88.8 Wh / 1.2 W = **74 Hours**




IR: Power Vs Time (50% duty cycle)

Solar Power (Direct Sun) = **16 W**

## Environmental Impact

- Salmon are active both day and night. By using infrared light to illuminate the stream for capturing salmon movement at night, we can avoid visible light as it disrupts the animal behaviors in the area.
- The system will be enclosed inside a case that has a self-adhesive hook and loop tape to avoid screws that may damage the trees. By our design, the camera system does not take a large space on ground and blends with the environment.
- Incorporating a heat sink to dissipate heat generated by the constant camera operation. This minimizes the heat accumulation that could attract bugs or insects.

## Conclusion

- Further improvements can be made from the computer vision data that will be collected this summer. The large amount of dataset can be useful for training computer vision model that detects salmon in the future. Those pictures can be made to train an AI model to quantify salmon migration patterns.
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