small · e

Stereovideographic & Macromolecular Acquisition of Low-Light Emitters

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Abstract

The UCSB Oakley Evolution Lab aims to investigate the evolutionary history of the **bioluminescent courtship signaling patterns** of tiny crustaceans known as **ostracods**. The primary goal of small · e is to capture footage and other data of these mating calls and reconstruct them as **4D models** through a process of stereo-rectification. We have designed small · e to be more **compact** than its predecessor and support additional features such as overnight video capture, precise light intensity measurements, and eDNA collection.

Ostracod Bioluminescence

Key Components

Nvidia Jetson Nano

- Handles encoding/decoding of captures
- Synchronizes camera footage automatically
- Controls eDNA collection

Watec Super Low Light Camera

- Captures low light 1080p video at 30 FPS
- Powered by and transfers data through Ethernet

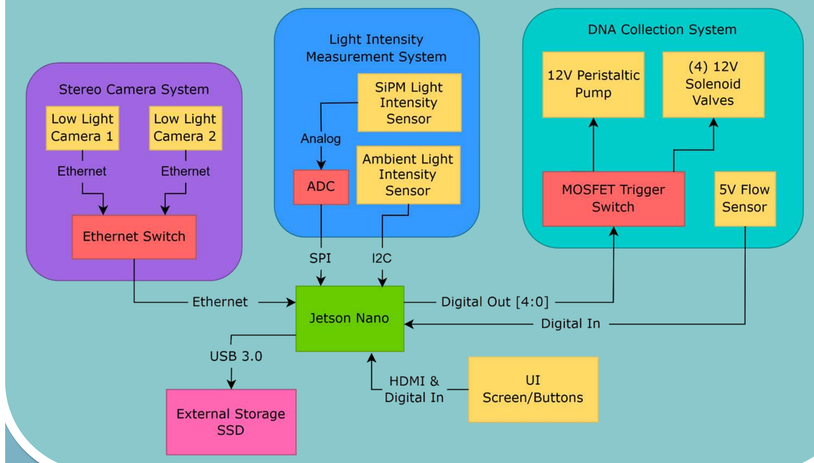
Sterivex Sampling Filters

- Filter membrane retains particles from water
- eDNA acquired when given enough concentration of water

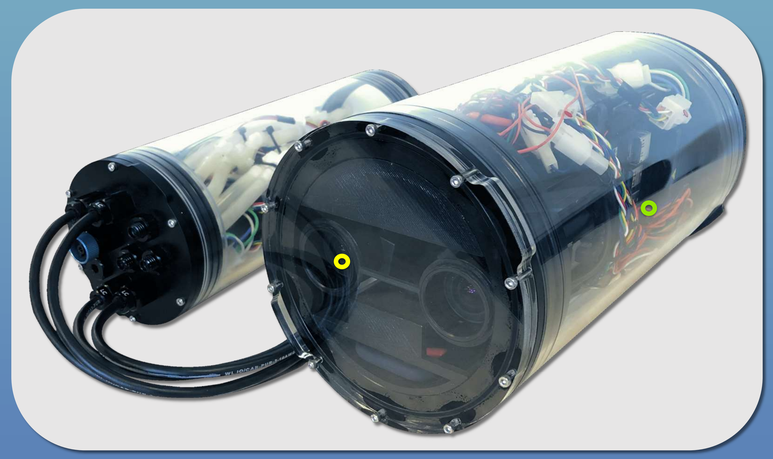
Hamamatsu Light Intensity Module

- Silicon Photomultiplier (SiPM)
- Captures precise light intensity measurements at 200 Hz

Block Diagram



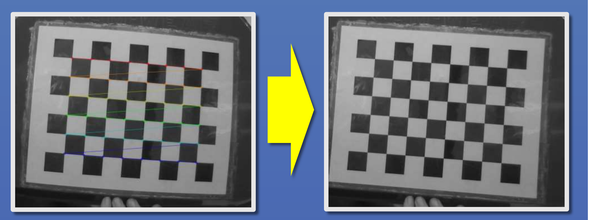
Stereovideography System



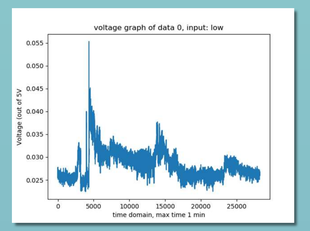
Watec WAT 933IP · Nvidia Jetson Nano · Hamamatsu Module

Camera Sync

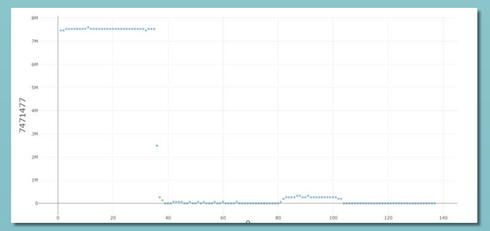
Camera Disparities Correction



Light Sensor Testing

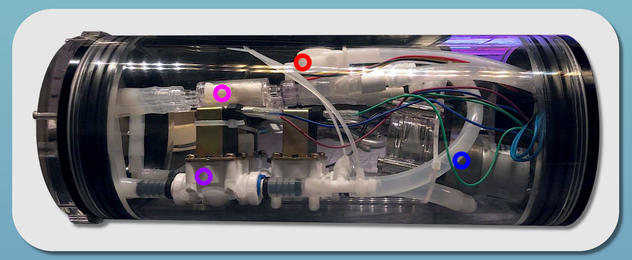


ADC Noise



Ambient Light Data

eDNA Collection System



Peristaltic pump is triggered to push water through Sterivex filters. Valve solenoids are also triggered to select a single filter to sample 2L of water. A flow sensor determines how much has been sampled.

Challenges

Camera Synchronization

No low-light sensitive, hardware-synced cameras were available. Open-source software (gstreamer) was used to synchronize the IP cameras.

Light Sensor Stability

An ambient light sensor activates the SiPM when it reaches a certain threshold, preventing malfunctions.

Establish Water Flow Pathway

Lacking suitable parts to extract water via the end caps. Improvised solution using a vacuum plug and marine sealant to provide a tubing interface for eDNA collections.

Overheating

Heat generated from small · e is dissipated via forced convection with two 40mm fans. Compromised power to ensure functionality of electronics inside enclosed space.

OAKLEY EVOLUTION LABORATORY UC SANTA BARBARA

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