

ACOUSTIC LARVICIDE WITH AN AUTONOMOUS LARVASONIC BOAT

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Project Summary

The purpose of this study is to create an autonomous boat that can navigate bodies of water and exterminate mosquito larvae using acoustic larvicide. New Mountain InnovationsTM developed a Larvasonic© transducer that kills mosquito larvae by generating sound waves ranging between 18 - 30 kHz, the resonant frequency range for mosquito larvae, that rupture their dorsal tracheal trunks. This results in either instant death, or deformations after hatching. The Larvasonic device is mounted beneath a boat, equipped with two one-directional motors, to create a user-friendly method of controlling the boat and exterminating larvae.

The boat is able to localize itself within the boundaries of a generated map, avoid obstacles, and follow a path using sensors such as Lidar and GPS. The sensor data is processed using ROS (Robotics Operating Software), passed into a ground control software to define a set of GPS waypoints for the boat to follow, and sent to a Pixhawk 2 flight controller to steer the boat. The boat can also be operated via remote control and switched into autonomous mode once the user has approached the intended path.

Problem and Need

Although the Larvasonic© device eliminates mosquitoes, it requires someone to operate it. New Mountain InnovationsTM is working together with Dr. Aaron Becker, the team sponsor, to create an autonomous boat for the Larvasonic© by developing an algorithm to detect boundaries and avoid obstacles. This provides an easy and efficient way to control the mosquito population.

Significance

This project intends to provide an alternative, user-friendly solution for mosquito control. Governments, private entities, and any consumers who are constantly trying to reduce the mosquito population would be able to use the Larvasonic© boat. In this particular case, the Harris County Mosquito Control Department would be able to use this device locally as an alternative to pesticides.

Goal

To create a user-friendly boat that can autonomously navigate a body of water, by using sensors to map its surroundings and localize itself within that map, and exterminate mosquito larvae using the Larvasonic© transducer.

Customer/User Analysis

The Larvasonic© boat can be maintained and operated by anybody who has basic knowledge using a remotely operated vehicle. The user would ideally need background in pesticide control to know where to operate the boat and maximize the effectiveness of acoustic larvicide.

Deliverables

The Larvasonic© Device, powered by its own proprietary battery, emits auditory frequencies between 18-30 [kHz] to eliminate mosquito larvae. The boat's main interpreter between every other device is the Pixhawk 2. It is powered by a separate 12 [V] LiPo battery, and controls the boat by utilizing the built-in gyroscope and various sensors. The Pixhawk 2 then communicates with two ESCs, which regulate the voltages and currents of each motor. The Pixhawk 2 uses a GPS to obtain its current location and set its target location. A Scansense Lidar sensor is also used to detect boundaries and obstacles within 40 meters of the boat. The boat is also equipped with a remote control in case of malfunctions in the autonomous mode. This remote control communicates with the Pixhawk 2 through an X4R telemetry device. Finally, relay switches will be connected to each battery to enable remote powering on/off of the system.

Terminal Objective

To develop a boat that can autonomously follow a user-defined path, detect boundaries, and avoid obstacles by using a Lidar sensor and GPS system.

Overview Diagram

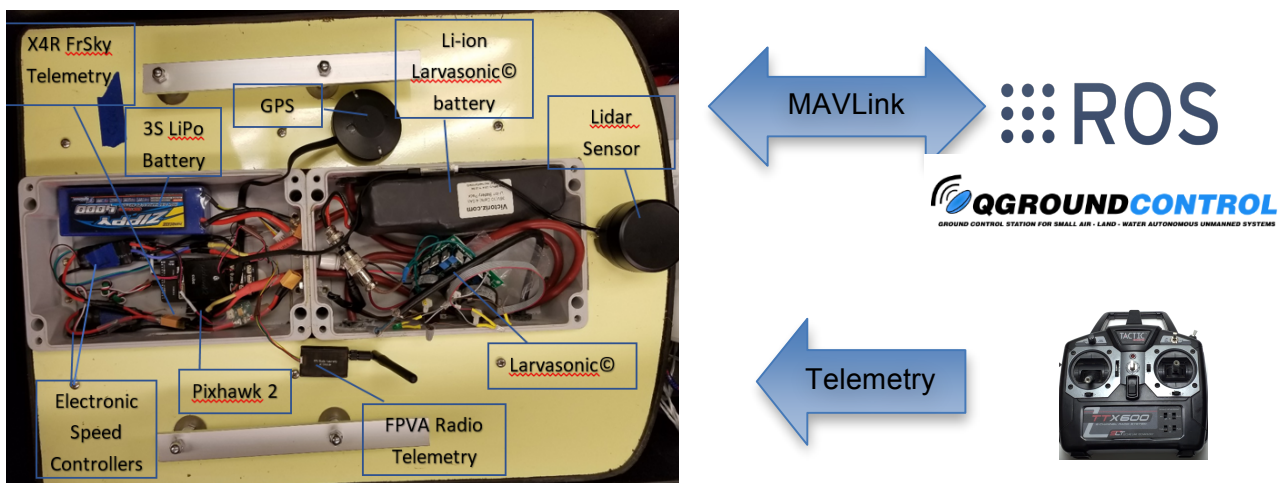


Figure 1. The boat and its components (left) can communicate sensor data to ROS via MAVLink, process the data with a ground control software, and communicate with the Pixhawk 2 to steer the boat. The boat can also be remote controlled via telemetry.

References

- [1] "Larvasonic Products." New Mountain Innovations, www.newmountain.com/acoustic-larvacide/.
- [2] "ROS." ROS · PX4 Developer Guide, dev.px4.io/en/ros/.