Sharkduino Design and Development

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Background

It is difficult to study the behavior of marine animals because direct observation is not easily possible. To overcome this challenge researchers use accelerometer tags to record data about the animals' movement. Signal analysis is then performed on the data to obtain conclusions about the animals' behavior.

Research Purpose

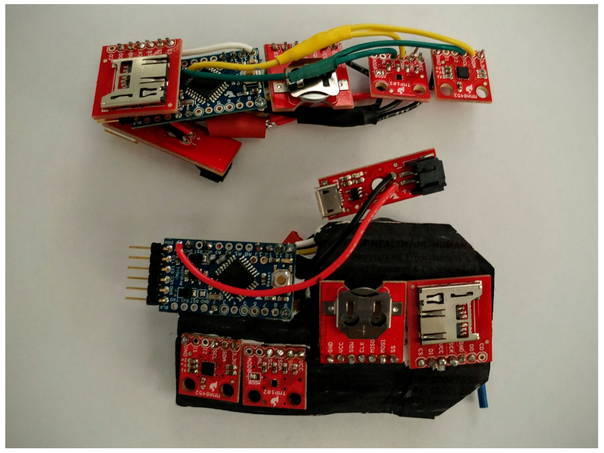
Commercial animal tag systems are often extremely expensive and single-use. The goal of the Sharkduino project is to create a reusable animal tag system at a lower price point than the commercial models. The desired functionality of the tag is to take movement data at 25Hz and write the data to a microSD card with a time stamp. Additionally the tag takes less frequent temperature and pressure data.

Prototyping

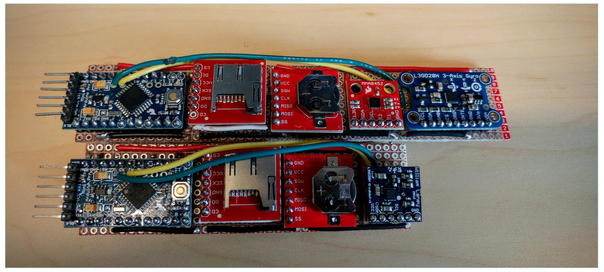
Initial prototypes for the Sharkduino began on a solderless breadboard, so that parts could be easily adjusted. We then progressed to point-to-point soldered versions, and made two prototypes using this method. Later, we assembled three tags on solderable breadboards. All prototypes used a 3.3V Arduino Pro Mini micro controller. Between prototypes 3 and 4, we created a custom gyroscope printed circuit board (PCB) to reduce size.

Deployment

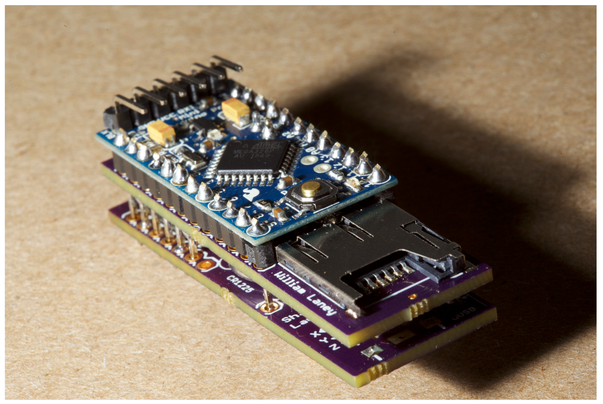
The tags were deployed on Sandbar Sharks held in captivity at the VIMS Eastern Shore Lab (ESL). Each tag was waterproofed using heat shrink tubing, then attached to the animals using monofilament line through the dorsal fin with a backing plate. Two prototypes and two Sharkduino V1s were deployed in this way.



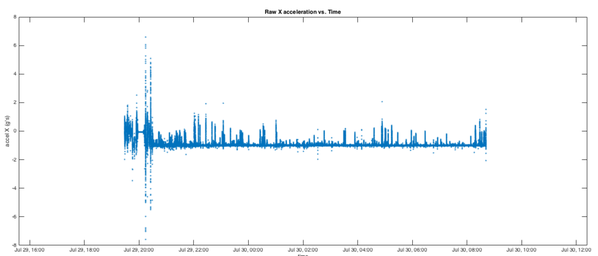
Top: Prototype 2 Bottom: Prototype 1



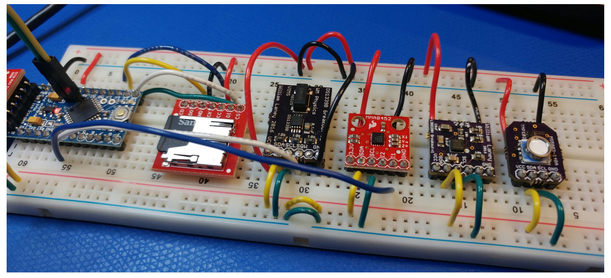
Top: Prototype 3 Bottom: Prototype 4



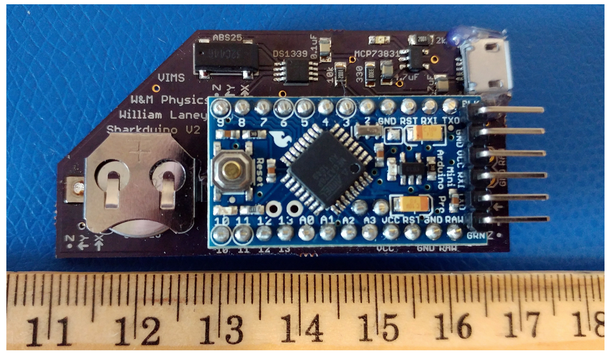
Sharkduino V1



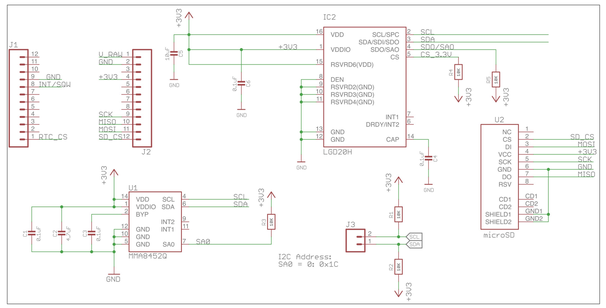
Raw X acceleration from deployment



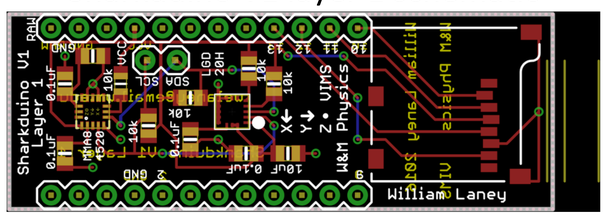
Sharkduino Breadboard



Sharkduino V2



Sharkduino V1 layer 1 schematic



Sharkduino V1 layer 1 PCB design

A Sharkduino V1 attached to an animal

Sharkduino V1

Version 1 of the Sharkduino consists of two PCBs stacked underneath an Arduino. The PCBs were designed in Eagle and printed by OSH Park. The boards were assembled in house using the W&M Makerspace's solder reflow oven. The device uses the same chipset as the prototypes but is consolidated into a much more compact 50x18x22mm (not including battery) package. Battery size is determined by desired weight and deployment time of the tag.

Sharkduino V2

Version 2 of the Sharkduino was designed and assembled using the same techniques as version 1. However, the V2 has a new set of chips, as well as a new form factor. The new form factor is designed to mirror the shape of a shark fin in order to make the tag sleeker and less intrusive to the animals' swimming. At its largest points, the tag measures 57x29x7mm.

The new chips on the tag have the same functionality as the old ones, but are smaller, more power-efficient, and allow for greater flexibility of the system. With these improvements, the device runs for 7 days on an 800mAh battery.

The current price of parts is $50-70 per tag.

Acknowledgments

This work was supported in part by the National Science Foundation under Grant No. PHY-1359364, and by the DeWilde Summer Research Fellowship of the College of William & Mary. Additional supported was provided by the William & Mary Committee on Sustainability. Thank you to my advisors Dr. Deconinck and Dr. Weng , as well as D. Crear, G. Del Raye, R. Brill and both the ESL and W&M Physics Department staffs. Animal research was conducted under IACUC-2016-03-21-11000-kcweng.