

# Sharkduino Design and Development

Author: William Laney<sup>1</sup>

Advisors: Dr. Deconinck<sup>1</sup> and Dr. Weng<sup>2</sup>

<sup>1</sup>College of William & Mary <sup>2</sup>Virginia Institute of Marine Science

## Background

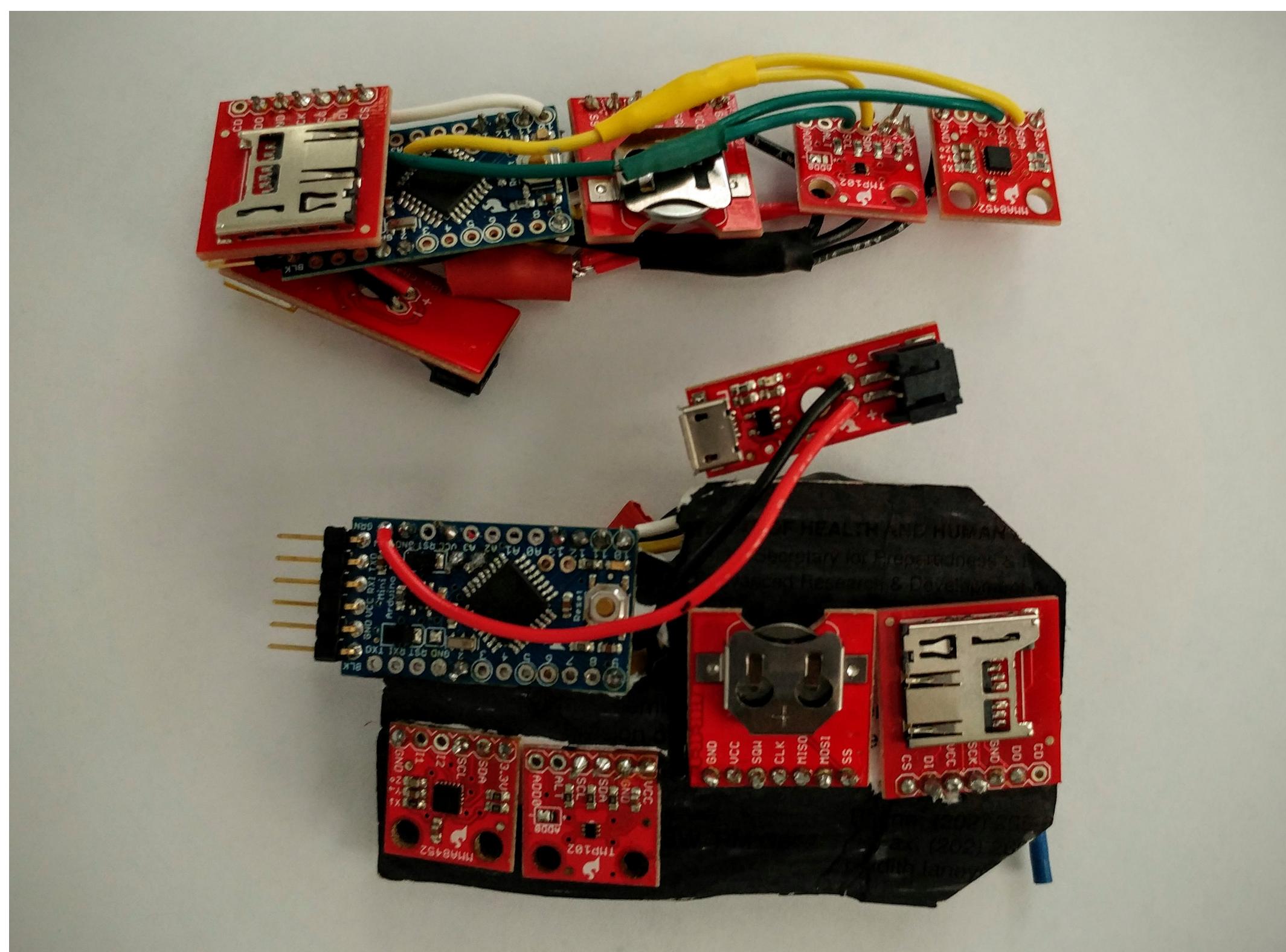
It is difficult to study the behavior of marine animals because direct observation is not easily possible. To overcome this challenge researchers use accelerometer tags to record data about the animals' movement. Signal analysis is then performed on the data to obtain conclusions about the animals' behavior.

## Research Purpose

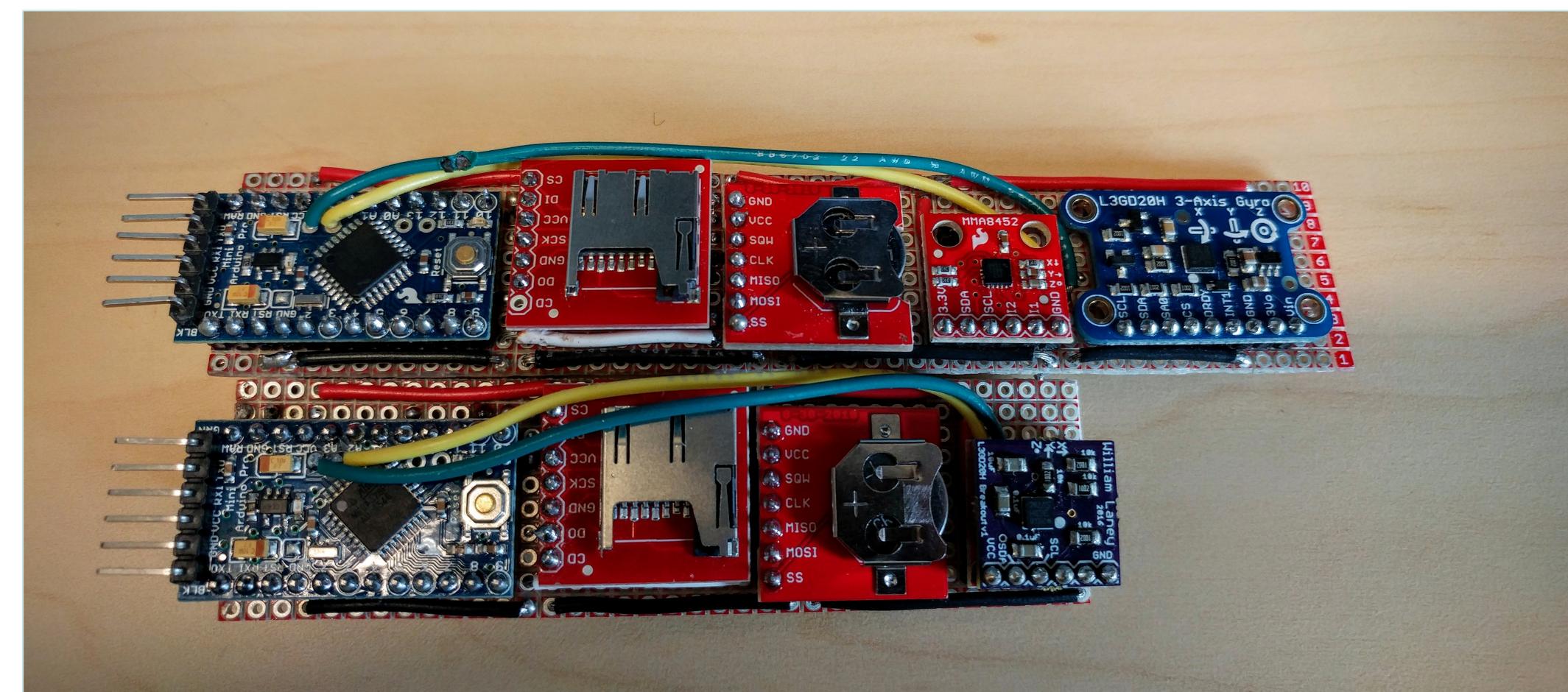
Commercial animal tag systems are often extremely expensive and single-use. The goal of the Sharkduino project is to create a reusable animal tag system at a lower price point than the commercial models. The desired functionality of the tag is to take movement data at 12Hz and write the data to a microSD card with a time stamp. Additionally the tag takes less frequent temperature and pressure data.

## Prototyping

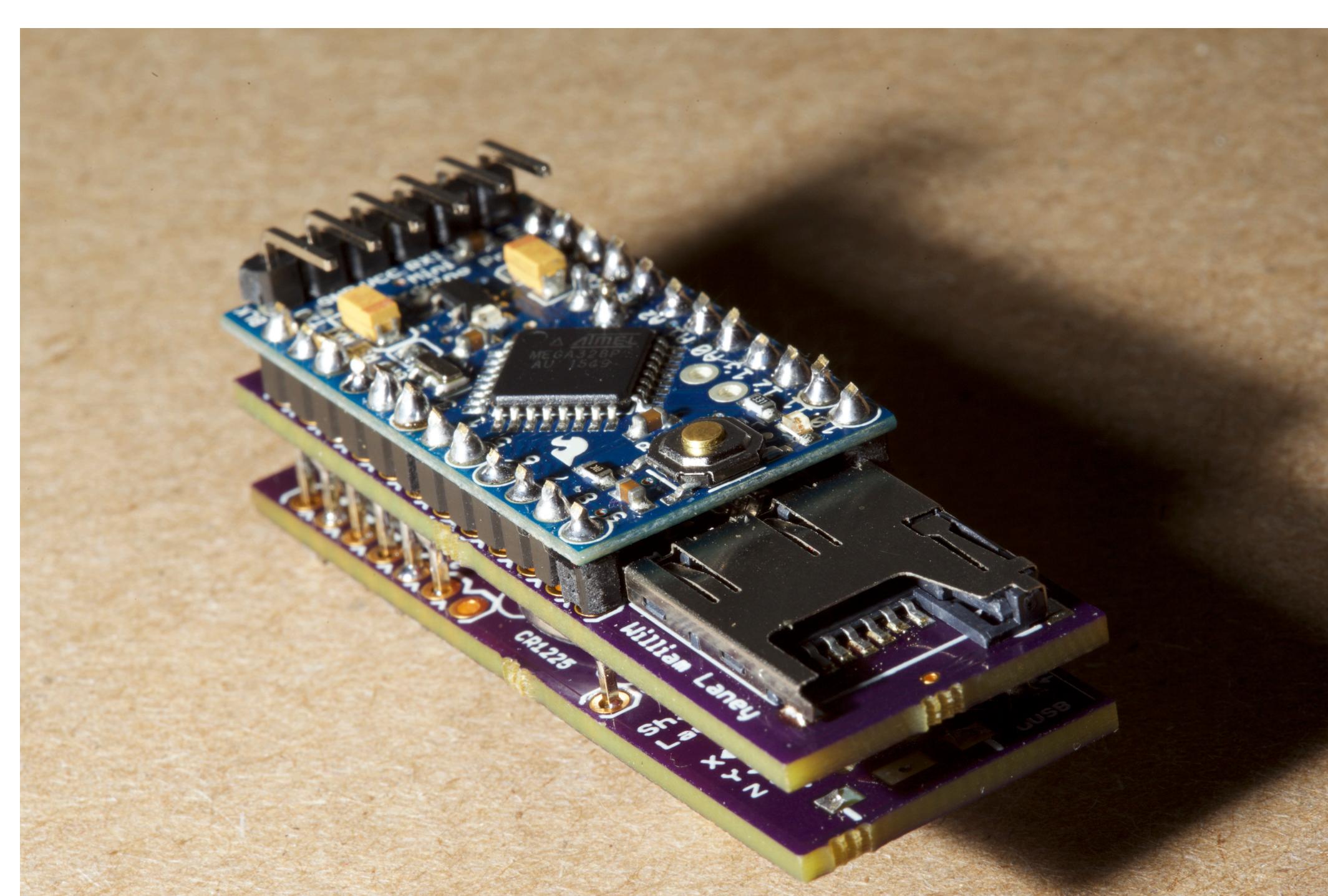
Initial prototypes for the Sharkduino began on a solderless breadboard, so that parts could be easily adjusted. We then progressed to point-to-point soldered versions, and made two prototypes using this method. These prototypes contained an accelerometer, temperature sensor, real time clock, and microSD reader. Later we assembled two tags on solderable breadboards. Prototypes 3 and 4 were created using this method. These prototypes gained a gyroscope and lost the temperature sensor from the previous prototypes. All prototypes used a 3.3V Arduino Pro Mini micro controller. Between prototype 3 and 4 we created a custom gyroscope printed circuit board (PCB) to reduce size. The size of prototype 4 was reduced to 104x25x13mm.



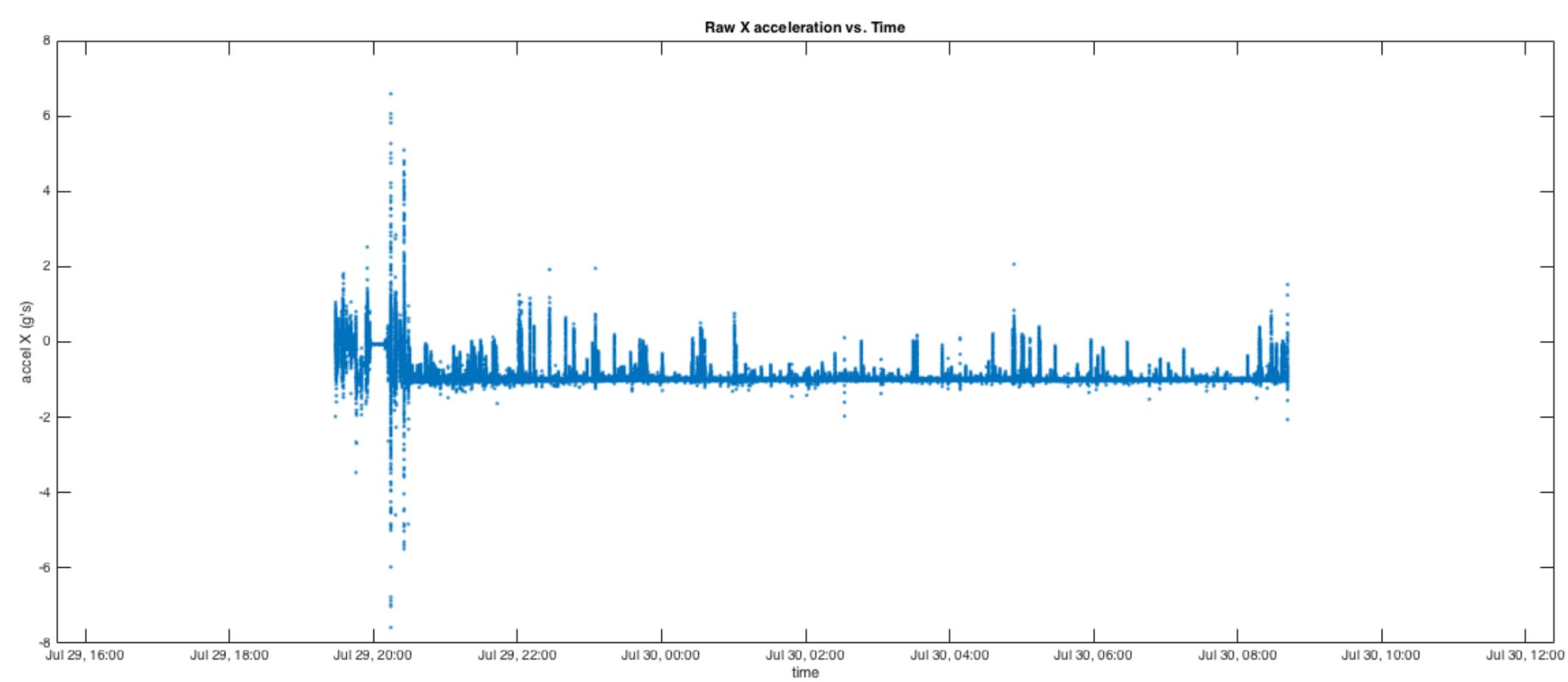
Top: Prototype 2 Bottom: Prototype 1



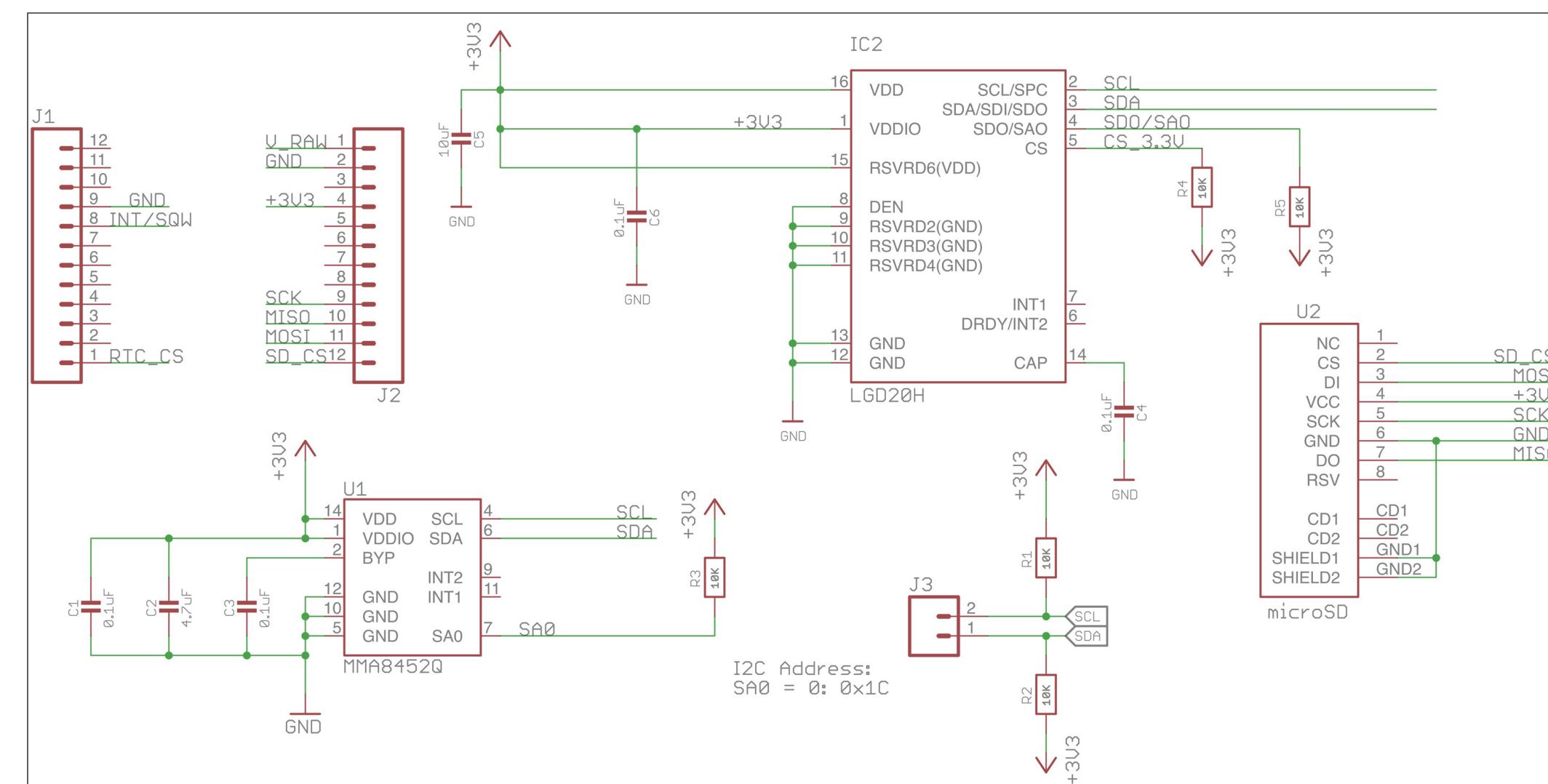
Top: Prototype 3 Bottom: Prototype 4



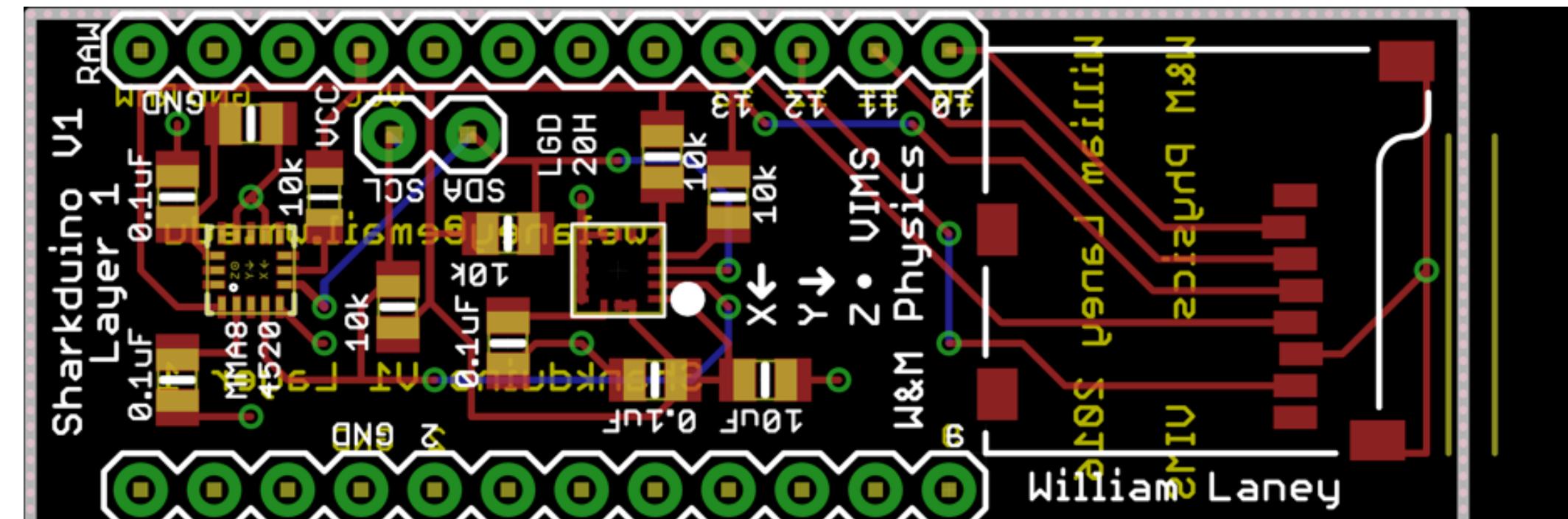
Sharkduino V1



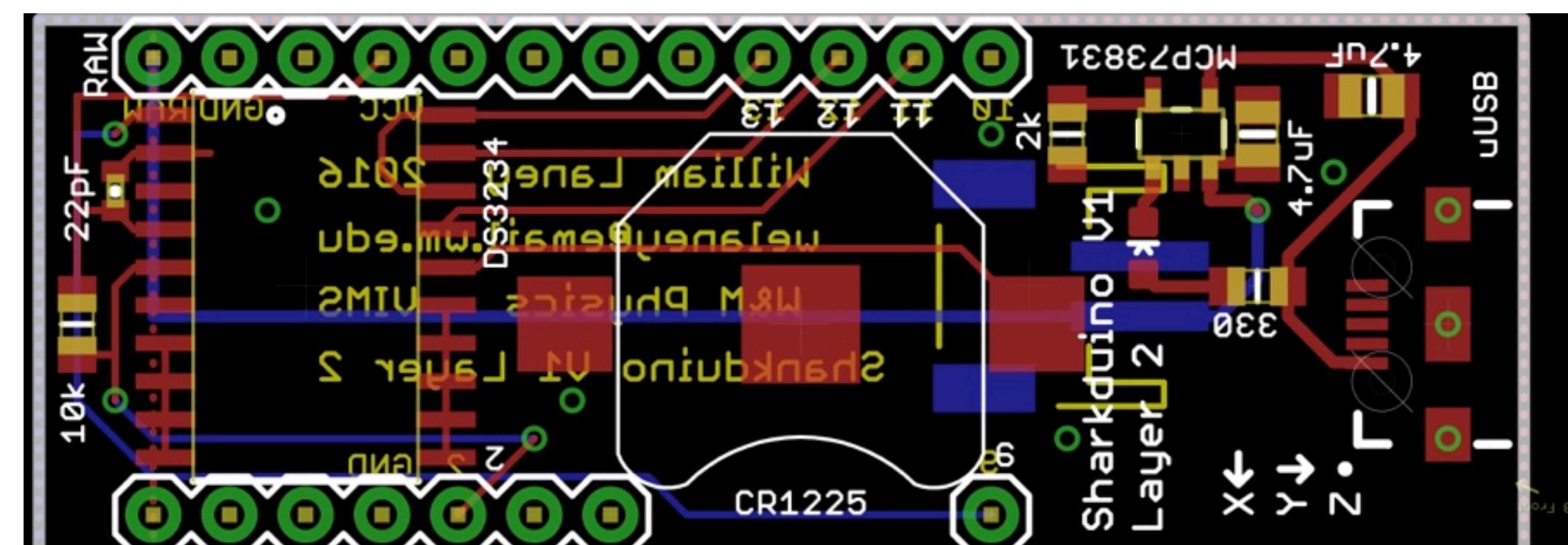
Raw X acceleration from deployment



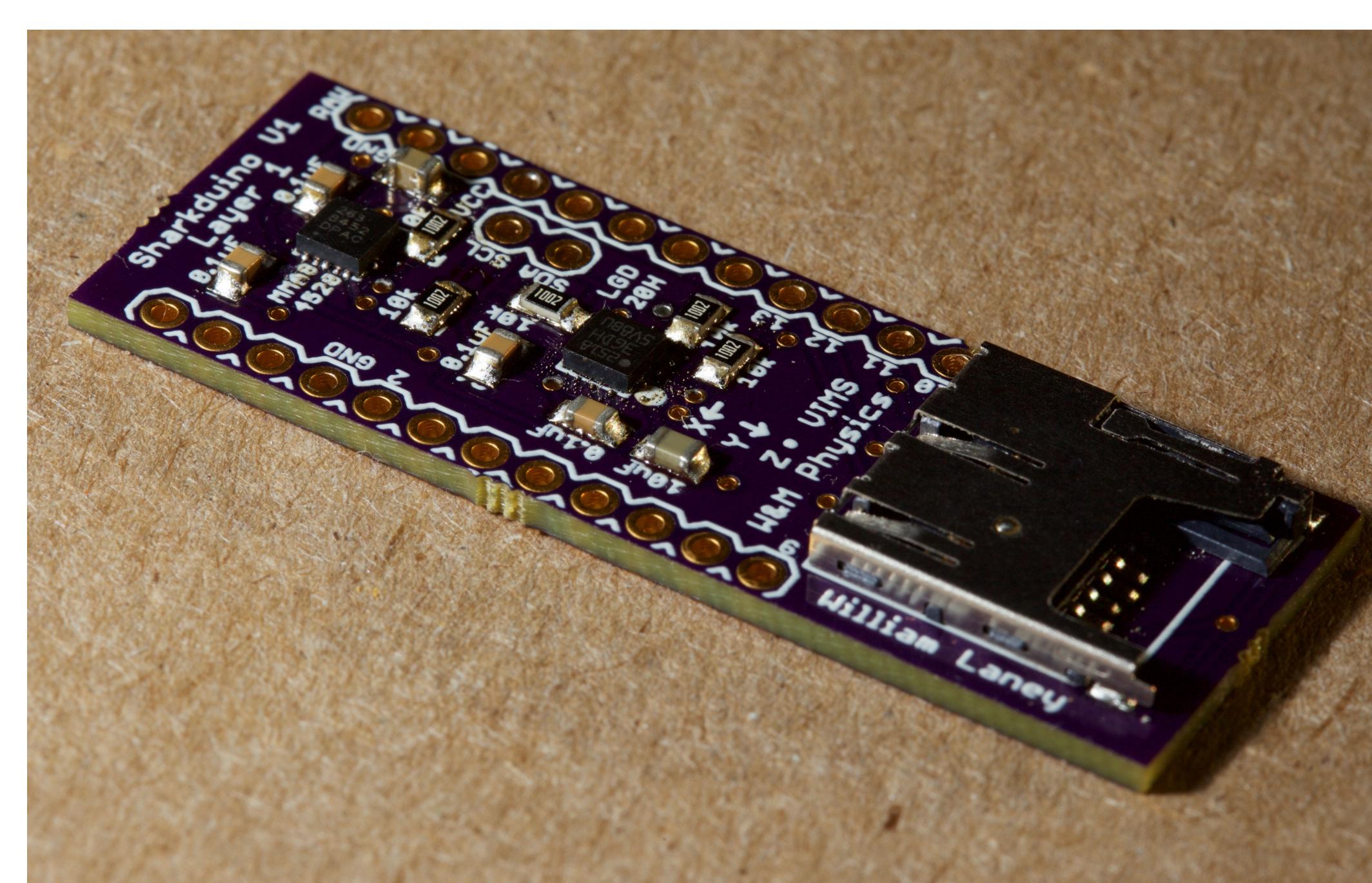
Sharkduino V1 layer 1 schematic



Sharkduino V1 layer 1 PCB design



Sharkduino V1 layer 2 PCB design



Sharkduino V1 layer 1, fully assembled



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 chip set as prototypes 3 and 4 but is consolidated into a much more compact 50x18x22mm package, not including the battery. Battery size is determined by the desired weight and deployment time of the tag. A board was developed that included pressure and temperature sensors, but it was not deployed due to time constraints. The current price of parts is \$75-100 per tag.

## Deployment

The tags were deployed on Sandbar Sharks held in captivity at the VIMS Eastern Shore Lab (ESL). The tag was waterproofed using heat shrink tubing, and attached to the animals using monofilament line through the dorsal fin with a backing plate. Prototypes 3 and 4, along with two Sharkduino V1s were deployed this way. During the course of the deployments prototype 4 was destroyed due to faulty waterproofing. All others tags survived. Not all tags, however, collected usable data.

## Acknowledgments

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