

PROBLEM: ACTION SPORTS PHOTOGRAPHY IS LIMITED TO INFINITE FOCUS.

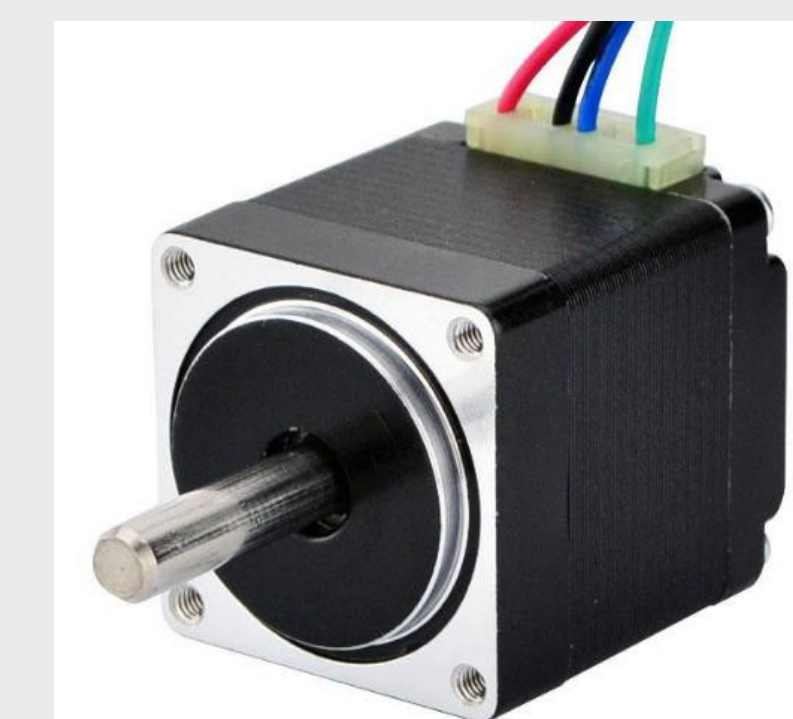
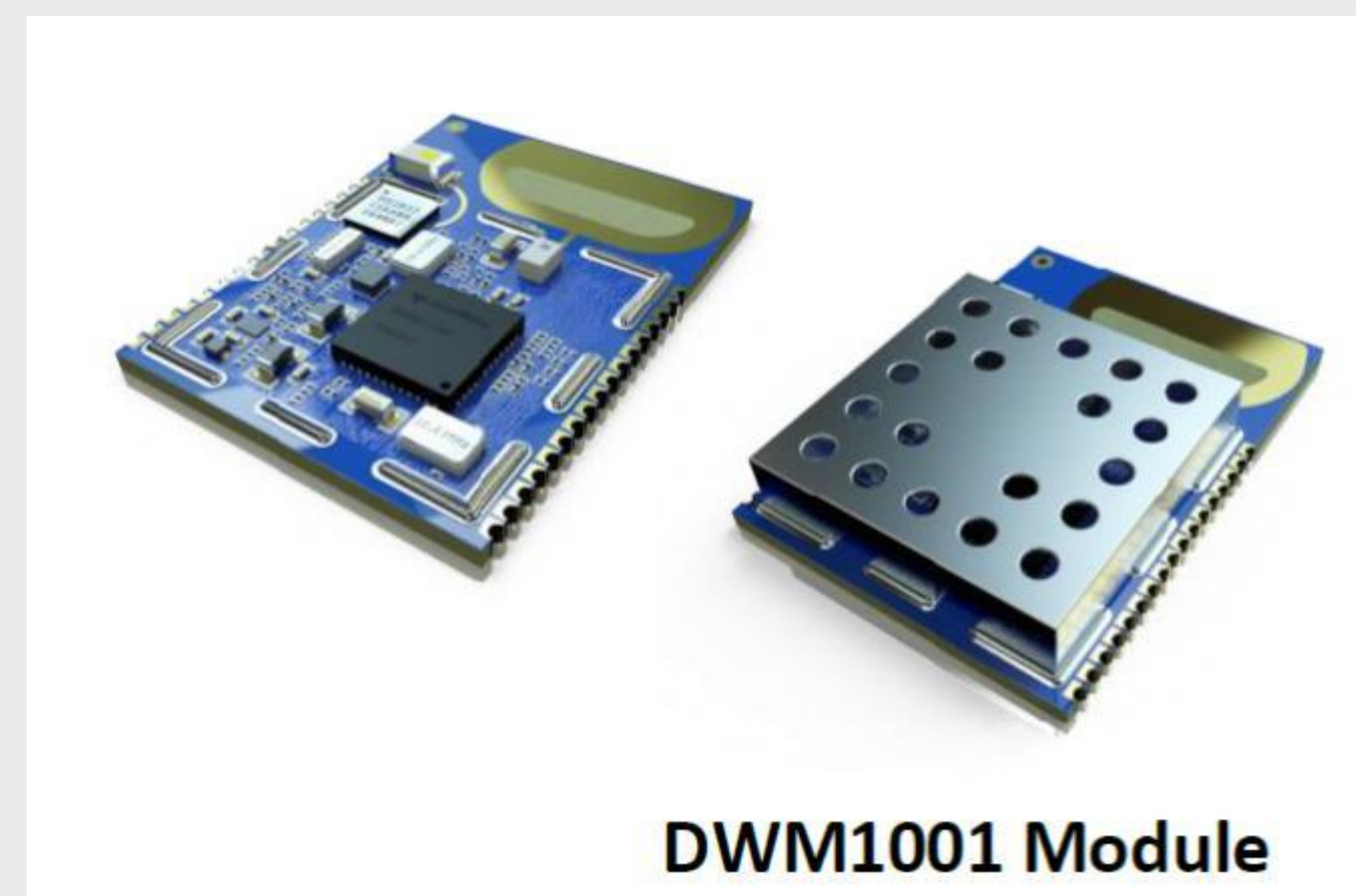
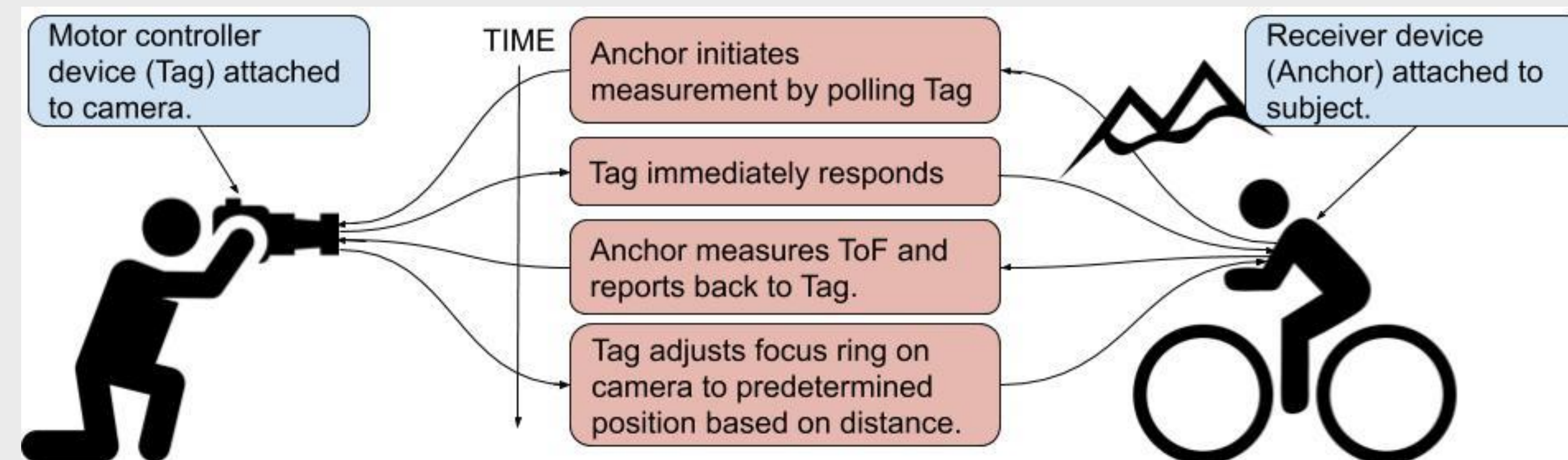
- In photography and videography, there are two basic focus modes. Finite focus, where the subject of the photograph is in focus and all other objects appear blurred. And infinite focus, where everything that it captured by the camera's sensor is in focus.
- When directors film professional action sports subjects, they are often limited to infinite focus due to the high-speed nature of the shots.
- The problem is then compounded, the high-speed nature of the shots restrict the director to infinite focus, *and* infinite focus restricts the director's ability to illustrate how fast the subject is moving since there is no frame of reference.
- This results in many action sports shots falling flat without directors resorting tricks such as fast panning and drone follow shots.
- Remote controlled focus motors exist in the market, but such systems are limited to the reaction time of the operator.

SOLUTION: AUTO-FOCUS CAMERA WITH RF TIME OF FLIGHT

- Our system aims to speed up the feedback loop between distance to subject and camera focus.
- Using state of the art, ultra wide band, fine ranging transceivers we can update subject position and control the focus motor with a feedback rate of 10Hz.

ACTIVE AUTO-FOCUS USING RF TIME OF FLIGHT

Automatically focus professional camera equipment during high speed shots using time of flight measurements between camera and subject.



3.7V

5V-6V



DECAWAVE DWM1001

- The Decawave DWM1001 module is the heart of this project. It employs ultra wide band (UWB) fine ranging technology to achieve a distance resolution of $\pm 10\text{cm}$ for line of sight measurements.
- The DWM1001 has a Nordic Semiconductor nRF52832 ARM Cortex-M4 Bluetooth and 2.4GHz System on Chip (SoC) microcontroller on board to handle existing wireless communications.
- This module uses Decawave's own DW1000 UWB transceiver to manage positioning functions.
- This combination of microcontroller and transceiver allow for computationally intense user applications to run on the ARM μC while the DW1000 handles ToF measurements.

MECHANICAL AND POWER CONSIDERATIONS

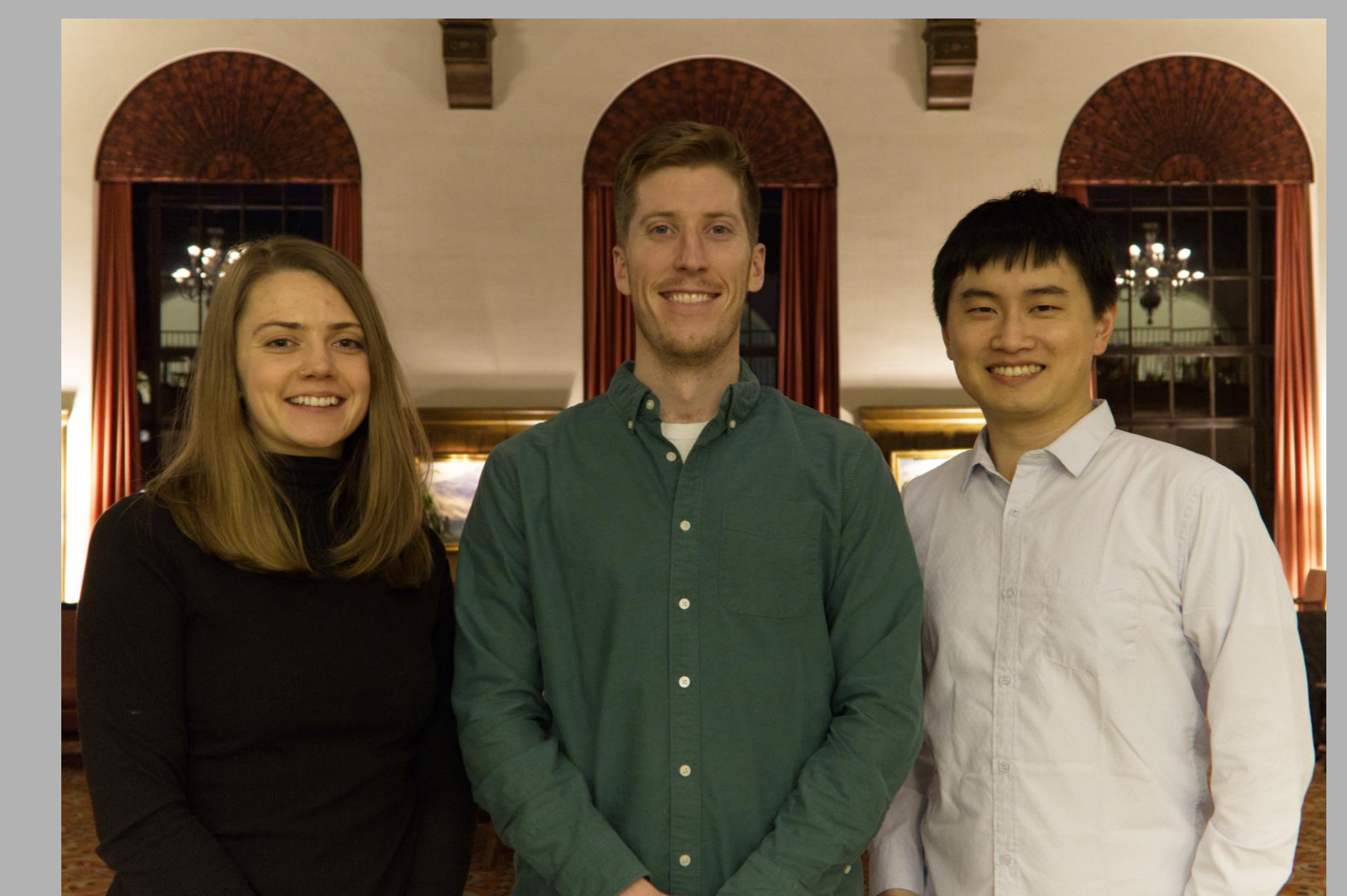
- Most consumer electronics are expected to run on a battery, the most common battery for prototyping is Lithium Polymer (LiPo) batteries due to their low profile and ease of implementation in charging.
- LiPo batteries have an average discharge voltage of 3.7V, but our system's stepper motor requires a minimum of 5V. This challenge was overcome using a boost converter.
- Stepper motors have a set torque limit before they start skipping steps. Our system uses a high, single stage gear reduction to manage the torque required to turn the camera lens.

IS IT MARKETABLE?

- As a stand-alone system, this device is likely too much of a niche product to be highly marketable.
- However, with the wide range of wireless communications capabilities built in to the DWM1001, this system could easily be integrated into a larger, more complete remote follow-focus system that would provide a substantial leg up in the market for these devices.

WHAT WOULD WE DO DIFFERENTLY?

- Stepper motors, while reliable, tend to be loud and vibrate heavily when in use. For a second revision, we would likely use an ultrasonic motor instead of a stepper.
- All professional photographers have a separate power bank attached to their equipment when filming, these banks are specifically designed to be high capacity and deliver power to multiple devices at once. A second revision would see us abandoning a LiPo battery in favor of integrating into this power system.
- Instead of using the entire module provided by Decawave, using just the DW1000 and integrating a higher gain antenna would be preferred.
- Most professional camera equipment uses anodized aluminum enclosures to provide a more finished look. Another iteration would allow more research into manufacturing these.



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