Underwater Drone

The Electricool Engineers Featuring Alex | Nathan Czaja Erik Keohane Alex Windschitl
Minnesota State University, Mankato,
Department of Electrical & Computer Engineering & Technology

Background

In recent years, the quality of consumer airborne drones has significantly increased, while their cost has dramatically decreased. The complete opposite conditions exist in the consumer underwater drone space. This segment of the market is heavily divided between small cheaper toy-like drones and higher quality drones that are capable of basic operations but can cost thousands of dollars to procure.

The goal of this project is to create an underwater drone capable of achieving a depth of 50ft, the ability to maintain an accurate depth of around ±1 meter, provide the user with full yaw & forward/backward control, and be manufactured at a cost under $300.

Solution

As seen in *figure 2, t*he Underwater Drone is constructed out of 2 plastic food containers acting as pressure vessels (1). The top pressure vessel contains the Arduino microcontroller (2), thruster controllers (3), stepper motor controllers, main battery (5) and two ballast subassemblies (6).

At the forward end of the drone is the yaw control thruster, which provides control over left/right motion. The rear end of the drone is the forward/reverse thruster. As seen in *figure 3*, These thrusters are provided power and control by a motor controller, which is fed instructions from the Arduino microcontroller.

In the lower pressure vessel, two syringes are connected to stepper motors to provide precise ballast control. As the drone is weighed down enough to be neutrally buoyant (i.e. barely float in the water), the water taken in by the syringes provides enough additional weight for the drone to descend and maintain a certain depth.

To provide user control to the drone, the Arduino microcontroller is controlled by a PC onshore, which is connected by a 50ft USB cable, which is routed through a cable plug (7). A serial terminal such as Tera-Term is can used on the PC to act as an interface with the drone through the USB connection.

A rear adaptor plate (8) provides support for the propulsion thruster assembly and provides a mounting point for a camera and other peripherals (9). The plate also provides a lifting point for handling the drone out of the water.

System Design Figures

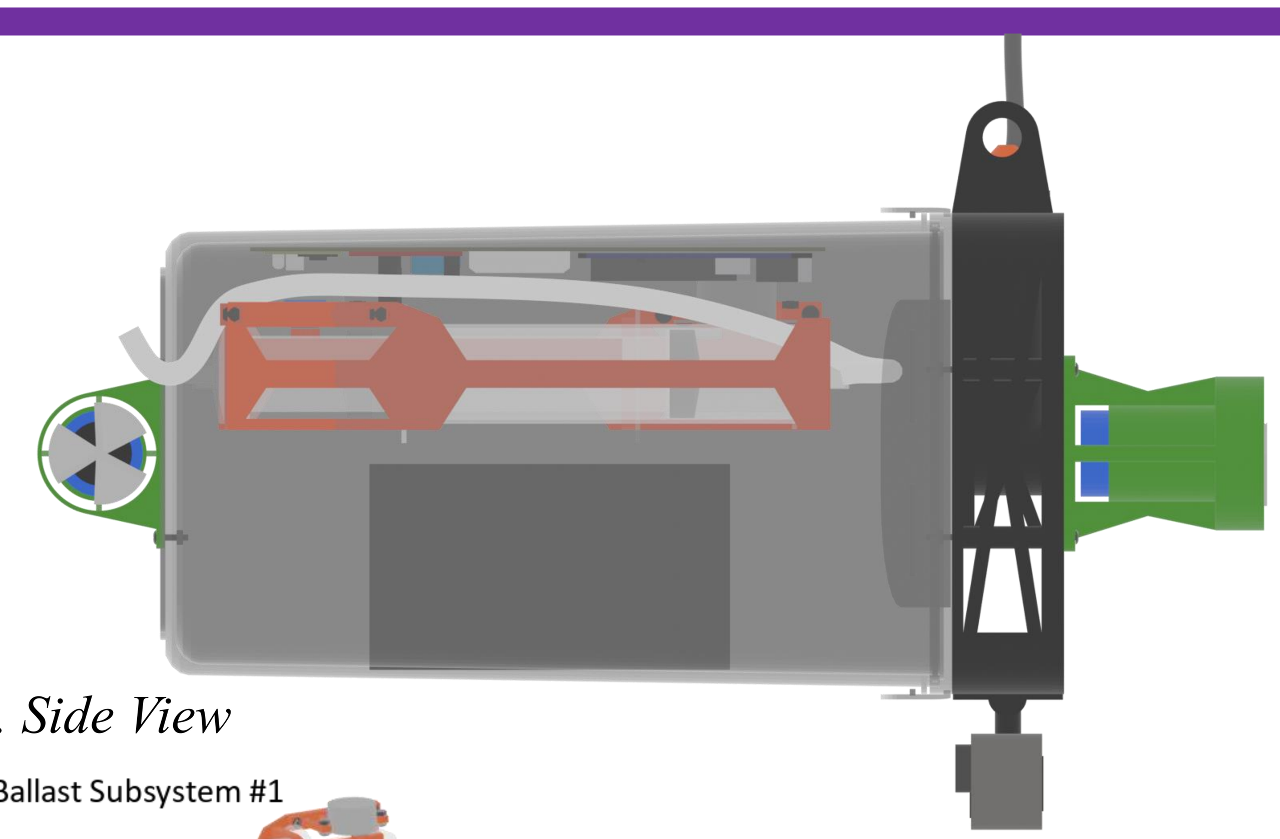

Figure 1. Side View

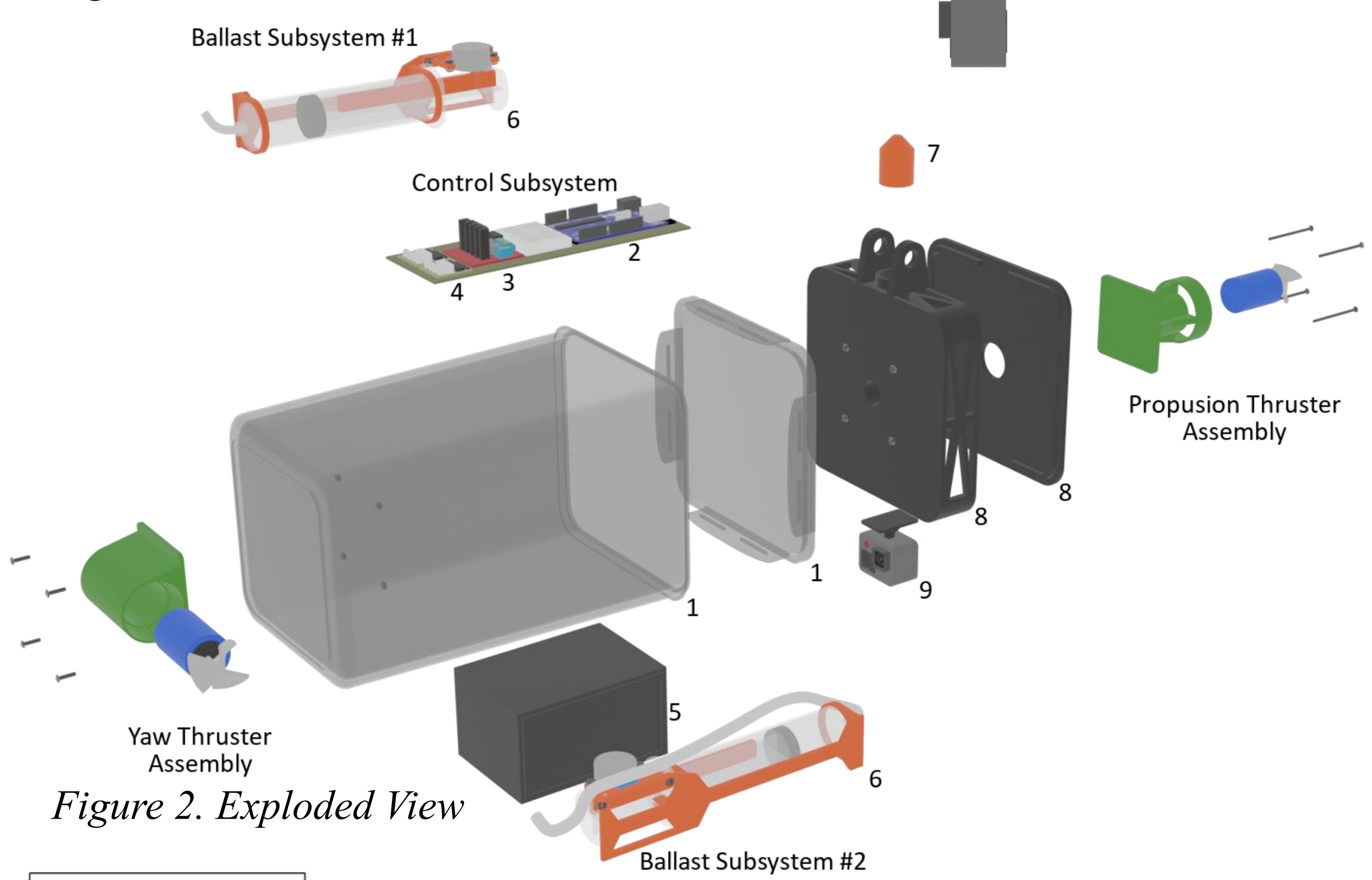

Figure 2. Exploded View

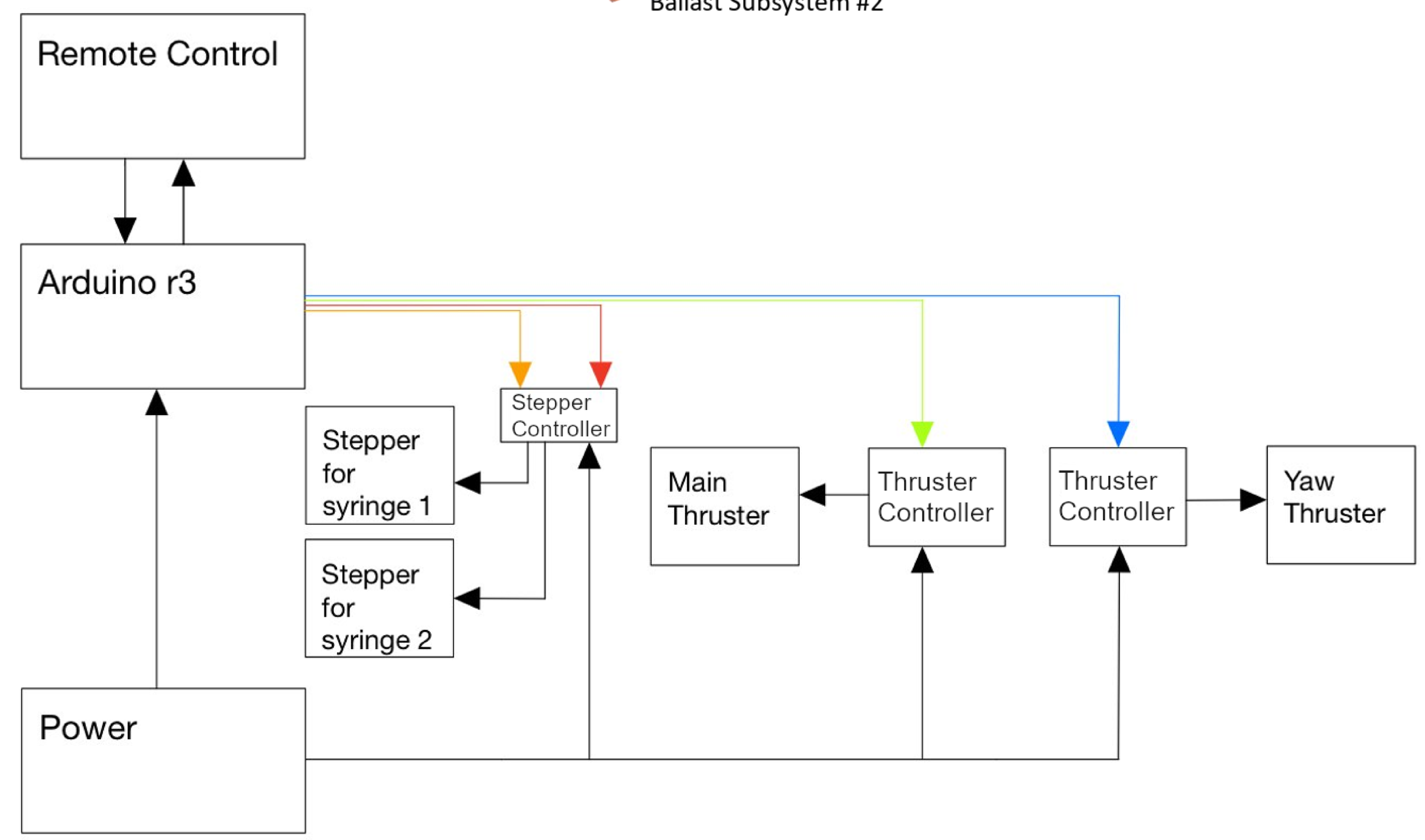

Figure 3. Power and Control System Chart

Budget

By using off-the-shelf components and 3D printed parts, the completed prototype was constructed at cost of around $247. This substantially low-cost leaves room for users to use the underwater drone as a platform for upgrades and modifications to enhance performance and perform specific underwater tasks.

Item	Total Cost
Thrusters x 2	$22.82
Motor Controllers	$12.29
Container	$12.75
3D filament	$20.00
Syringes x 3	$14.00
50 ft USB Cable	$21.41
Sealant	$8.00
Super glue	$3.99
Battery	$20.00
Weights	$35.00
Arduino starter kit	$42.06
Camera	$30.00
Tubing	$5.00
TOTAL	$247.32

Figure 4. Itemized Total Budget

Results

Most of the goals set out for the underwater drone were able to be met with the constructed prototype. The prototype that was constructed could descend and ascend to a desired depth, could move left, right, forward, and backwards directions. This prototype was also able to be constructed at a cost that was far lower than expected, using inexpensive readily available off the shelf components.

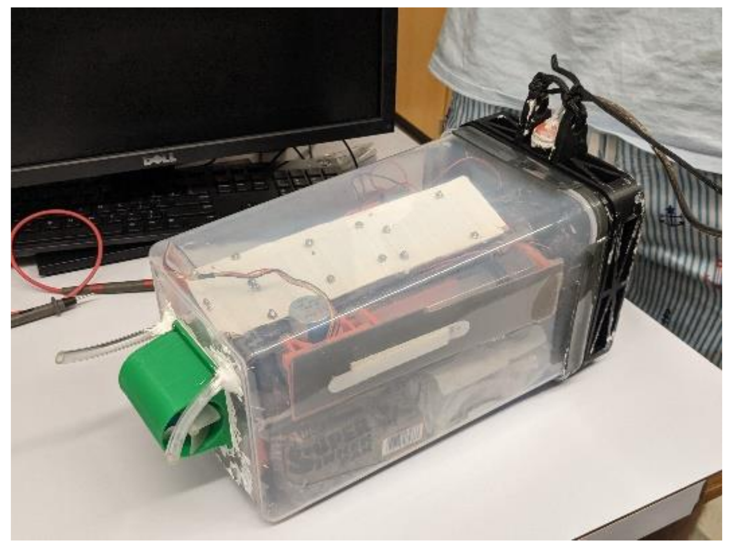

Figure 5. Assembled Prototype

Figure 6. Testing in the Otto Recreation Center Pool