NOVA

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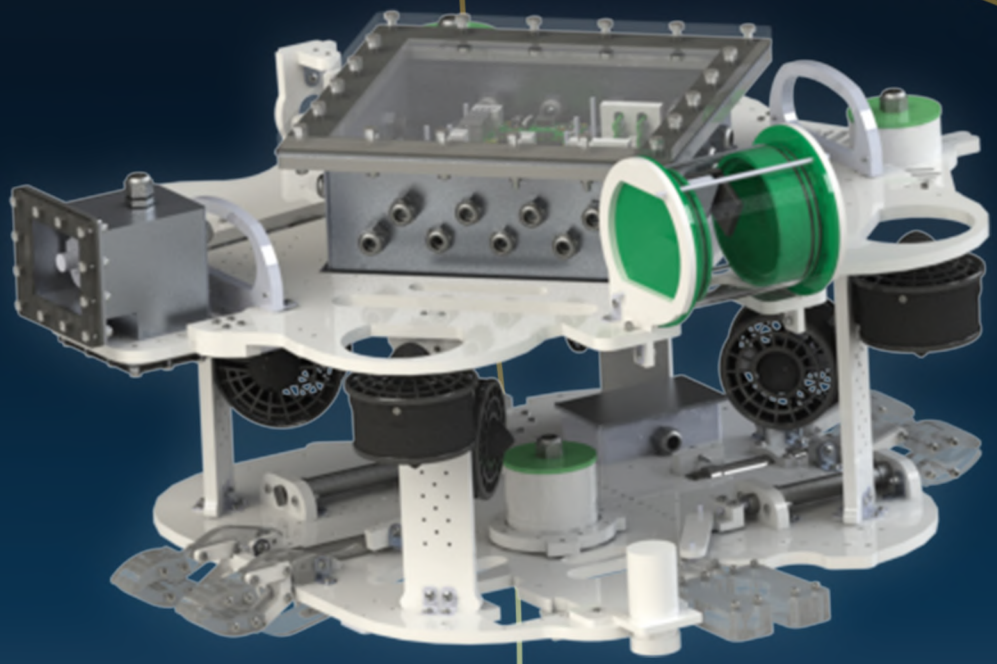
"## Graduation Year

NON-ROV DEVICES DOCUMENT '23



AQUAPHOTON ACADEMY

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1 *Nova*'s Vertical Profiling Float

1.1 Mechanical Design

The float, shown in Figure 1, is operated using five syringes that are connected together with two laser-cut acrylic parts, which allows the 50-RPM DC motor to move them simultaneously. Water is sucked into or pumped out of the syringes depending on the direction of rotation of the motor that is coupled to a lead screw using a flexible coupling. As the syringes get filled with water, the float's weight increases and it starts to overcome the buoyancy force and sink to the bottom of the pool. When the desired depth is reached, the motor's rotation is reversed to release the water from the syringes, allowing the float to rise back to the surface.

The enclosure is sealed by two flanges that are in turn sealed using two radial O-rings. Together, they hold an acrylic cylinder that is 4 inches in diameter and 570 mm in length. The syringes within the canister were sealed with O-rings connected to epoxy-sealed pneumatic cables. The epoxy is added as an extra safety measure to avoid leakage risks. A pair of stainless steel guides are also used to keep it intact. Each flange is connected to two AGRO glands that are responsible for sealing the DC motor cable, antenna and safety valve.

It weighs 4.55 kg and has a volume of 4724.36316 cm^3 and a net buoyancy force of 2.5 N by syringes. A special handle was designed to allow ***Nova***'s crab manipulator to hold the float before deployment.

(a) Assembled View (b) Exploded View

Figure 1: ***Nova***'s Float

1.2 Electrical Design

- **Electrical System**

Our float electrical system, shown in Figure.2 consists of two uniquely designed printed circuit boards: a power unit and a control unit. For protection and safety insurance, a 7A fuse was placed 5cm away from the battery case. They are connected together to allow the limiting switch signal and other control signals to be sent back and forth between the two boards.

(a) Float Power Unit (b) Float Control Unit

Figure 2: Float Electrical System

▶ **Float Power Unit**

The input power, supplied by Varta Zinc Carbon 12V batteries, goes through a latching circuit with reed switches that enables switching float power on and off with ease.

Buck converters are installed, following the limiting switch, to stabilize the voltage supply levels fed to the motor drivers. Moreover, a limiting switch creates a stopping condition signal for the motor driver so the motor doesn't get stuck when the syringes are full. A 3A fuse is added to the board to ensure the protection of onboard components against any damage.

▶ **Float Control Unit**

The main element of the Float Control Unit is the ESP32 microcontroller that controls all functions of the float. A real-time clock chip is used to transmit accurate live time readings to the control station using a wireless module installed on both ends. Data is sent to the wireless module through the UART communication protocol established by the microcontroller.

Linear regulators step down the supply voltage coming from the Float Power Unit to 3.3V and 5V as they are both needed to power different components on the board.

▶ **Float Power Calculations**

Component	Input Voltage	Max Current	Quantity	Consumed Power
ESP32	3.3V	260mA	1	858mW
DC Motor	12V	800mA	1	9.6W
Wireless module	5V	20mA	1	100mW
RTC	5V	1.5mA	1	7.5mW

Table 1: Power Calculations

2 Fry Container

As per the need of preserving and relocating the endangered Northern Redbelly Dace fry, a container, shown in Figure 3, was designed and manufactured.

The fry container has five plates, two of which are 180x70mm and two are 160x70mm while the lower moving plate is 172x162mm. Each of its four legs are 110mm in length.

At first, the container will be held and carried down by ***Nova*** and then de-attached into the safe area. The container will remain closed for 20 seconds before releasing the fry. Then, the lower plate has a piston fixed to it that is attached to a hole in the opposite plate. When the piston opens, the plate slides down to hit the ground where the fry will be transported to safety.

(a) Render (b) Real Life

Figure 3: Fry Container