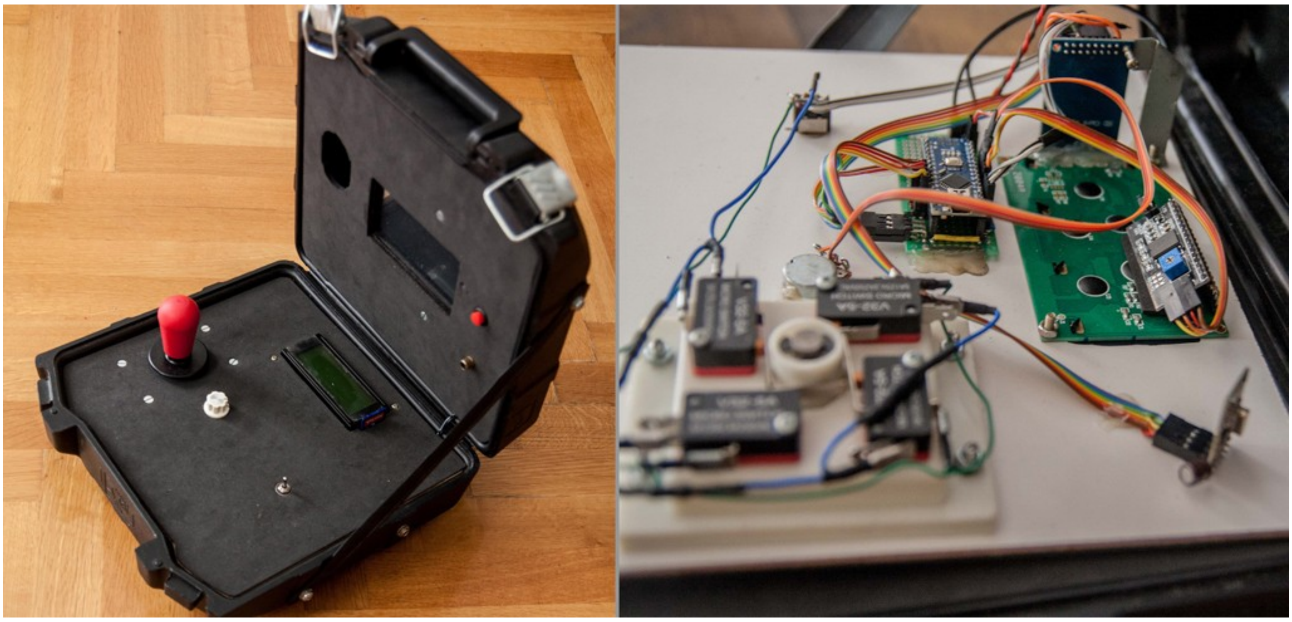
Built process.

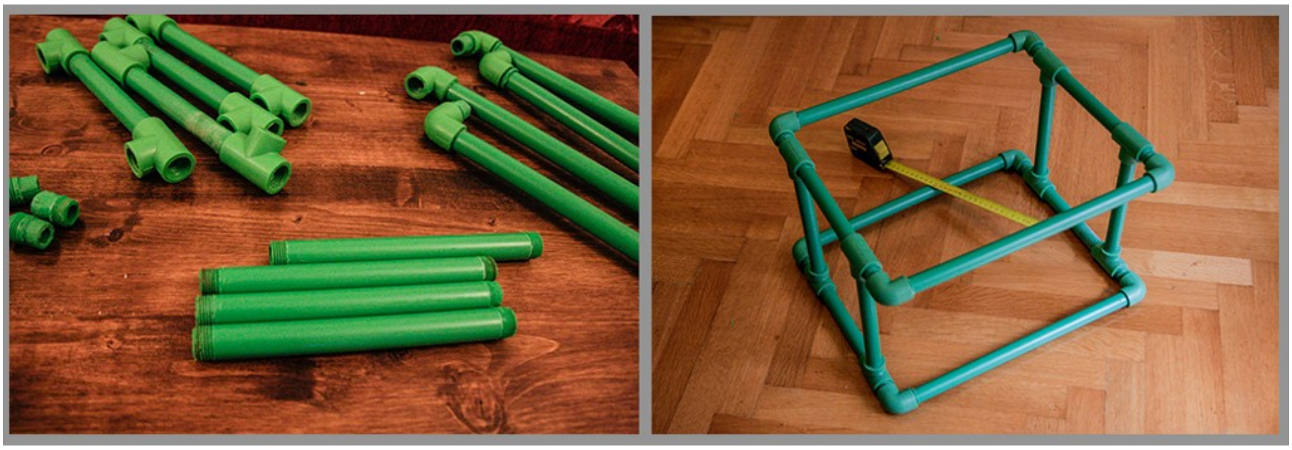
Here we document the built process of the project in stages.
This is not meant to be a step by step built instruction manual, as this is still a work in progress. Consider this a Built-log as this ROV concept is highly customizable and it could be constructed with a wide variety of ways and with a variety of different materials.

The controller / base station is housed inside a rigid case, intended for electrical power-tools. A peli-type case of adequate dimensions can be used for this purpose and that will probably be the most sensible choice. Two face plates were built by routing/cutting a piece of 3mm mdf. We then drilled all the necessary mounting holes and openings needed, to mount the controller's electronics. The faceplates were then dressed with black perforated sheets for protection. The controller can be powered both by a internal battery or by external source. Input voltage can vary from 7.5V to 15V. When both power sources are present it is powered by the external one.



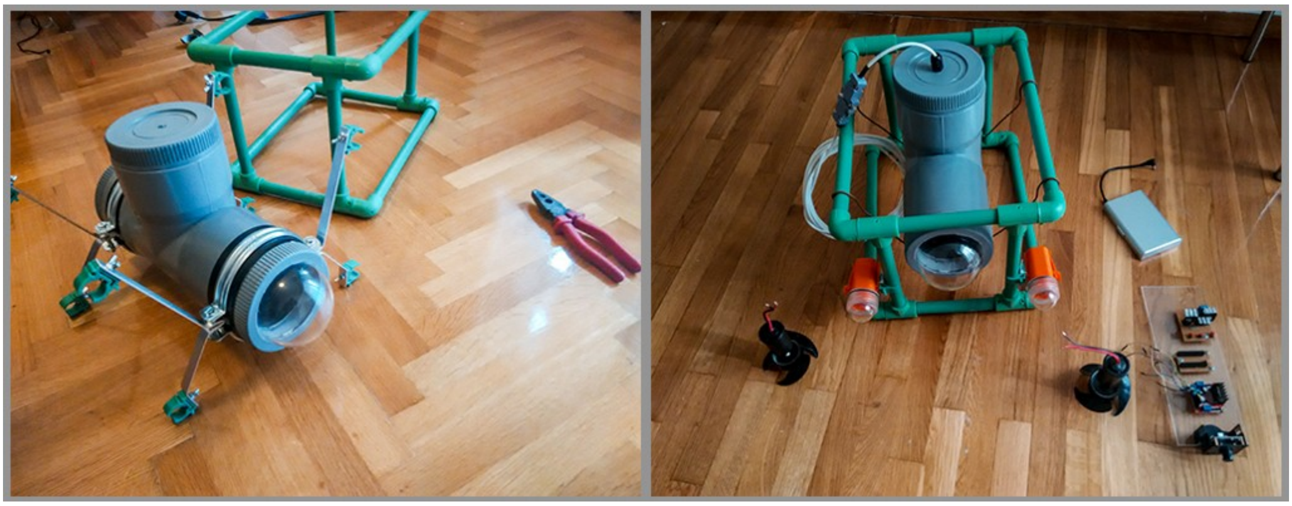
Controller and lower internals test fitting.

The first version of the ROV was built with a “wet type” exoskeleton constructed using polypropylene pipes with a diameter of 25mm. The pipes were heat-welded together forming the external frame of the ROV. It was then drilled in every corner and middle points to allow water into the frame.



Frame costruction with ppr pipes

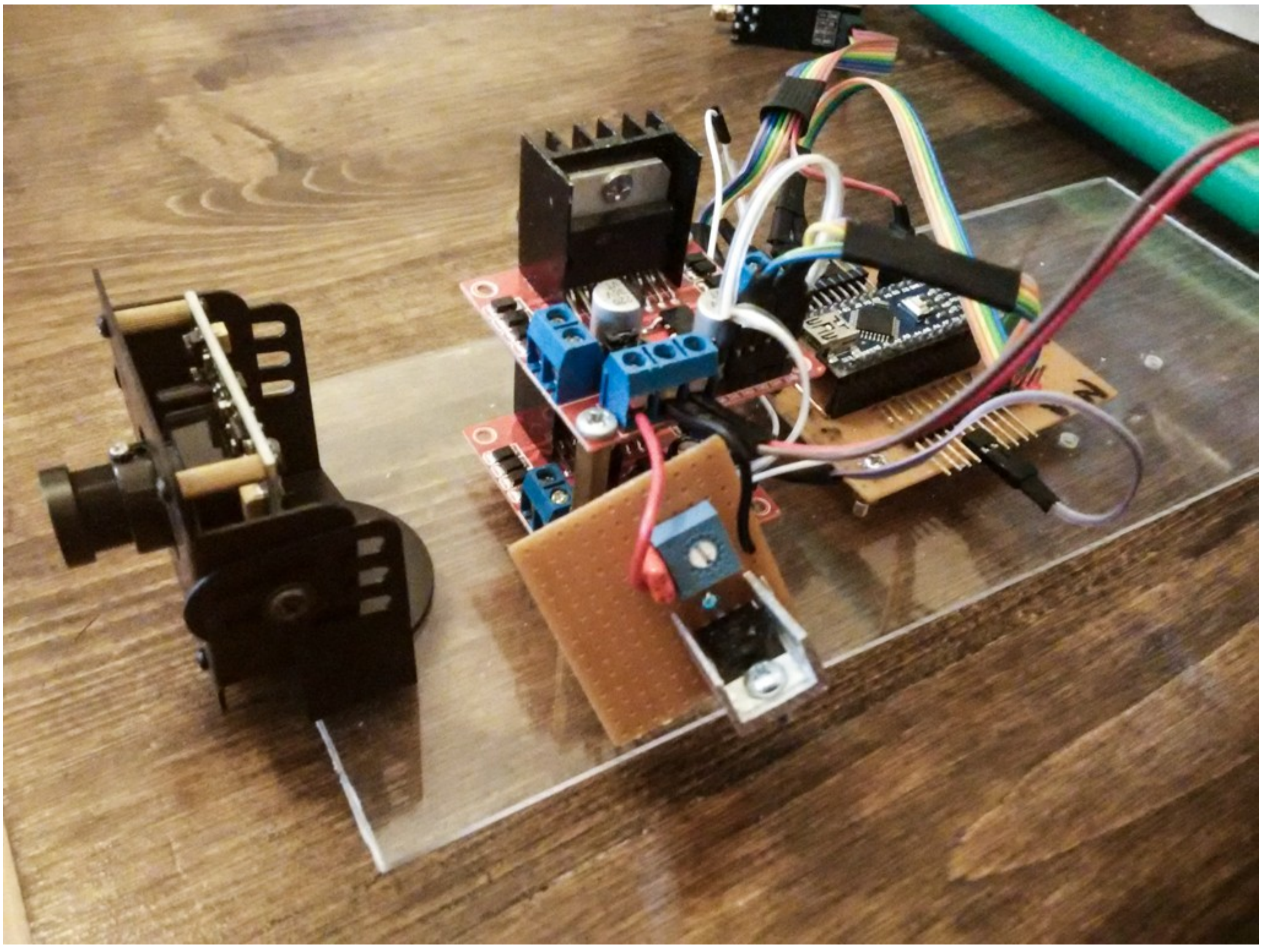
For the main body construction a T type PVC joint was used with a diameter of 125mm. Threaded PVC covers were added to two out of the three T joint openings. A clear acrylic dome was permanently secured to the front using an extremely durable and elastic polyurethane glue.



Mock-up of the ROV.

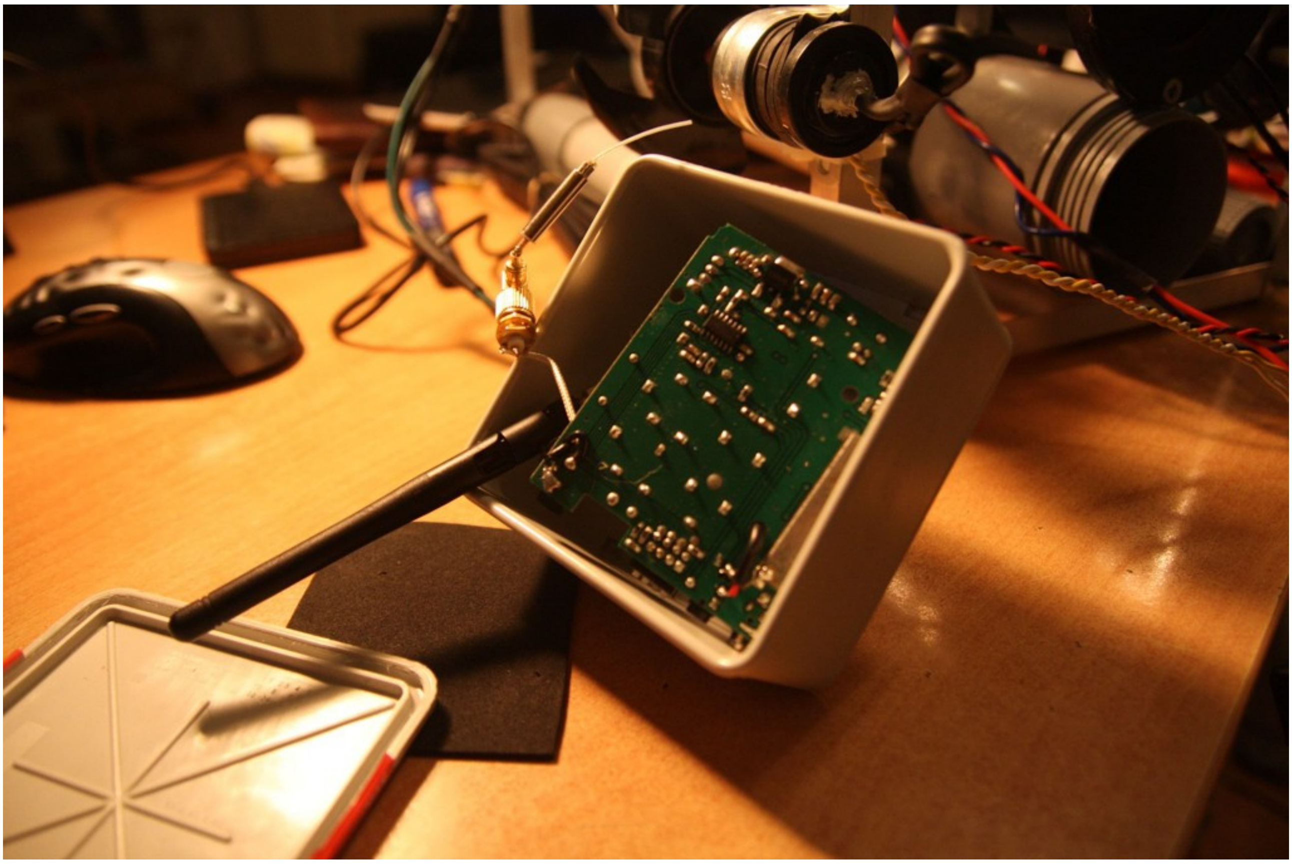
The electronics of the ROV were bolted on an acrylic slate that slides into the main body. The CCTV camera is bolted in the front of the slate so that it sits inside the acrylic dome when the slate is fully inserted.

The top threaded cover was drilled and a cable gland was added so that the wires leading to the motors, sensors and the float could pass through.



Acrylic slate with some of the electronics mounted on it.

The float was built using a box intended for housing electronics at external applications and has an IP67 rating. A cable gland is threaded to it’s underside so that the wires connecting the main body to the float could pass through. The float contains the 5.8GHz video sender and a 2.4Ghz antenna that have to stay above the surface of the water so that communication with the base station is possible. The antenna is ultimately connected with the NRF module inside the main body using a flexible low loss coaxial cable.

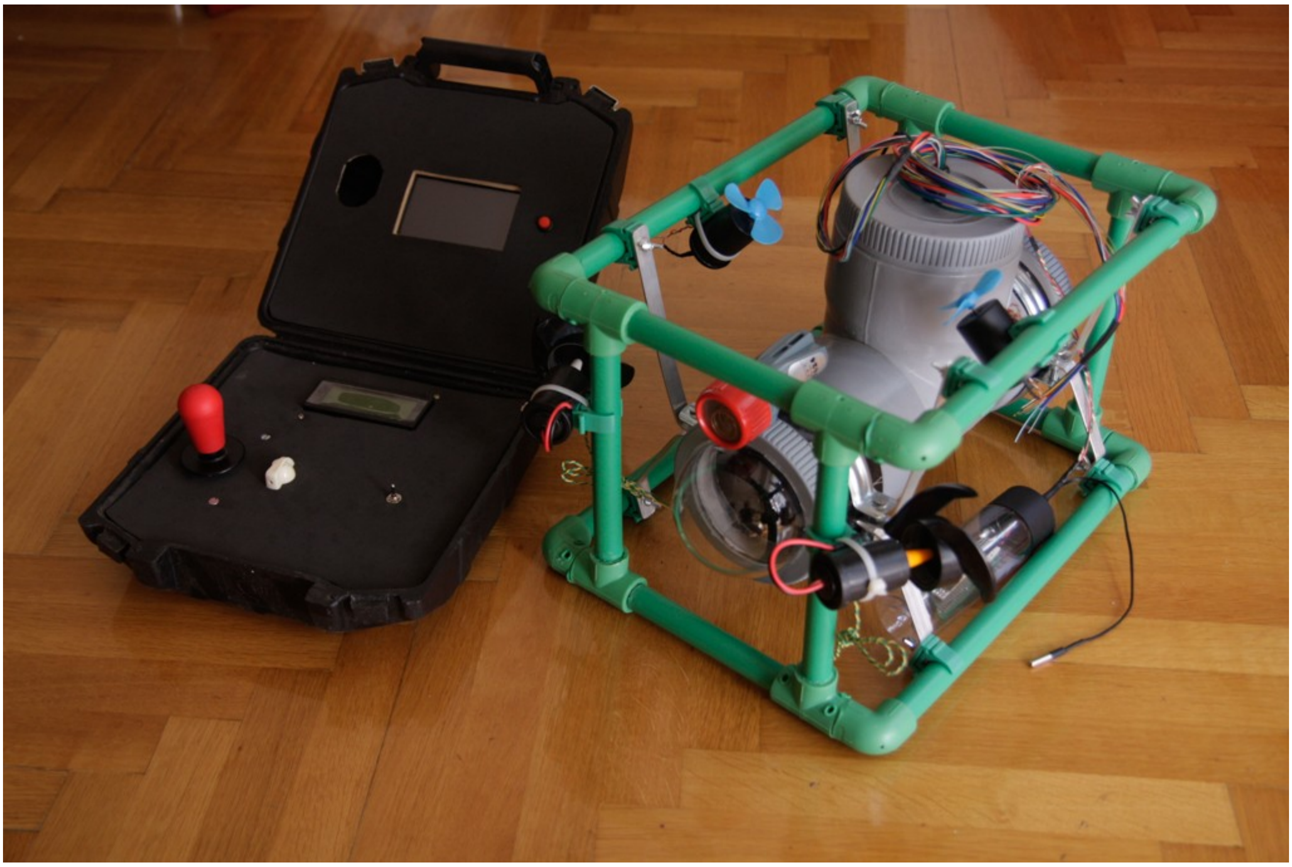


Internals of the float.

The DC motors where bought as a lot and we created two pairs out of the lot. The motors of every pair where closely matched by measuring their RPM in certain voltage intervals. This was done using a temporary rig and an opto-coupler. The motors where sleeved using large diameter heat-shrink tubing. Afterwards they were placed in small cylindrical containers pre-drilled for the output shaft and we filled the empty space of the container with molten paraffin wax.

The motors where then mounted on the frame by using clamps made out of polypropylene. We then press fitted the propellers on the output shafts. X and Y axis propellers have a much larger pitch and are mounted on more powerful motors. Z axis motors have propellers with finer pitch as the buoyancy corrections require finer adjustments in this specific built.

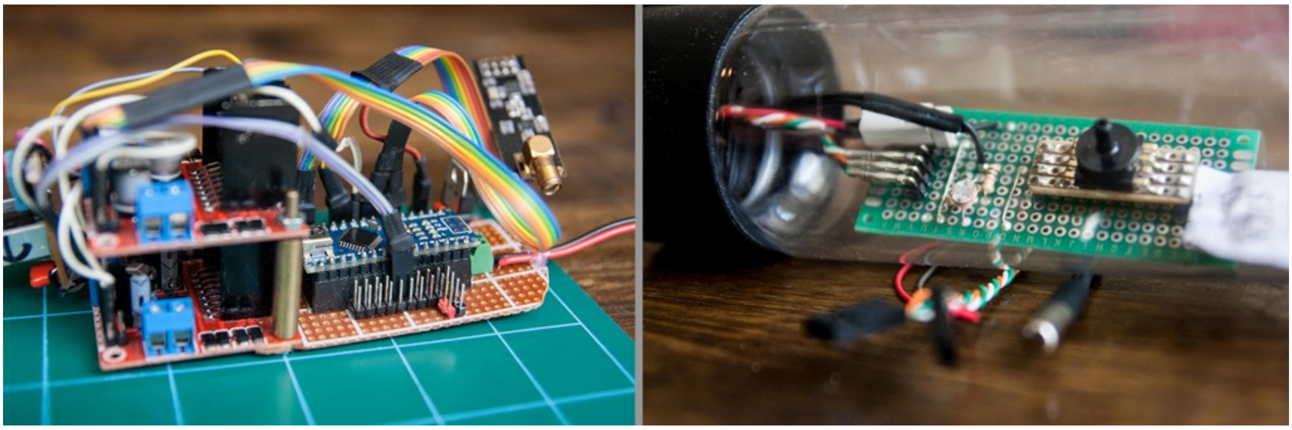
Bellow you can see the prototype version that was ultimately abandoned as a design. The large size of the main body made it difficult to waterproof the construction but the main problem was the large volume of air trapped inside. That and the polypropylene’s low density means that a lot of extra weight has to be added to the ROV in order to achieve neutral density. An extra 4kg to be exact. Making it heavy, sluggish and hard to work with.



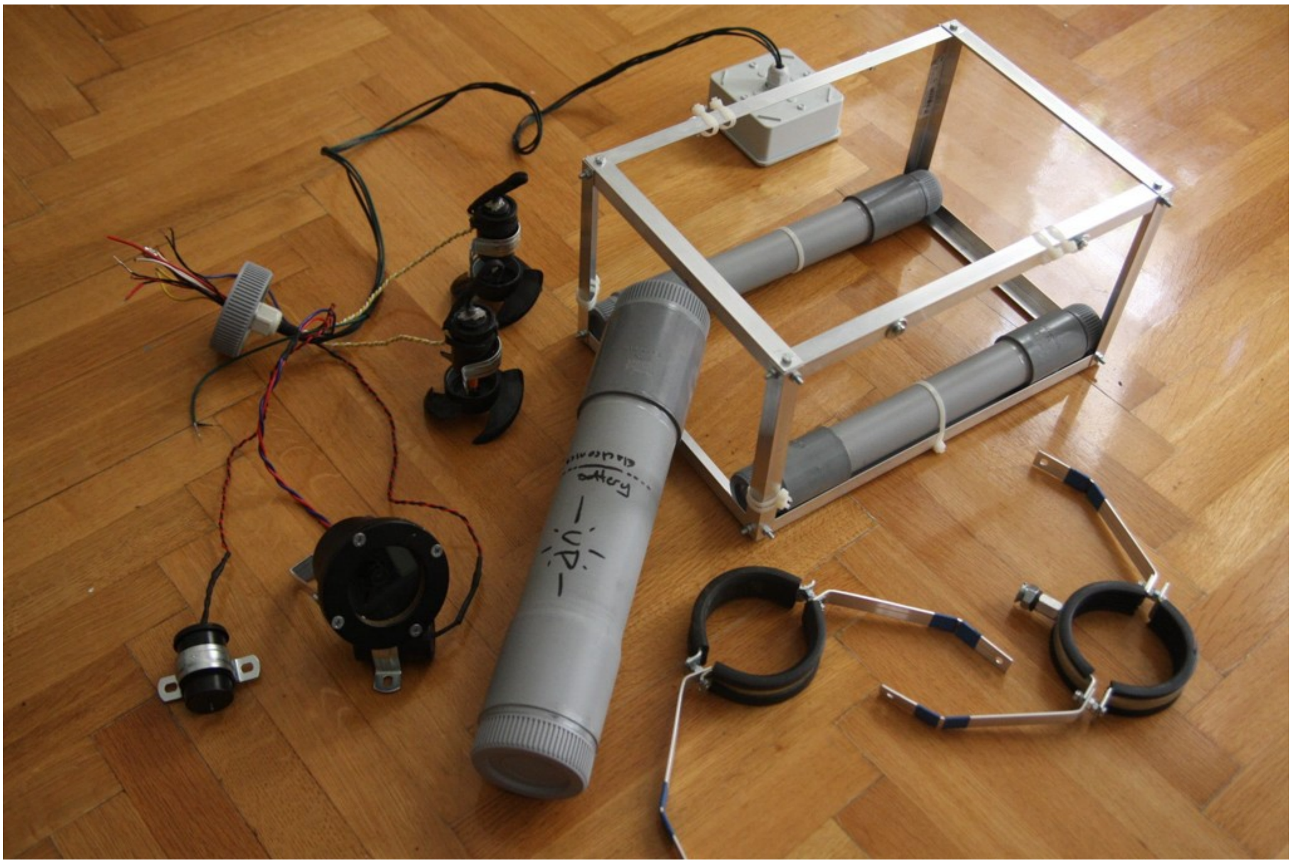
V1 ROV next to the base station.

In the second iteration we approached the ROV with a different perspective. The electronics architecture remained intact, as everything worked as it should. The key new features are described bellow in bullet points.

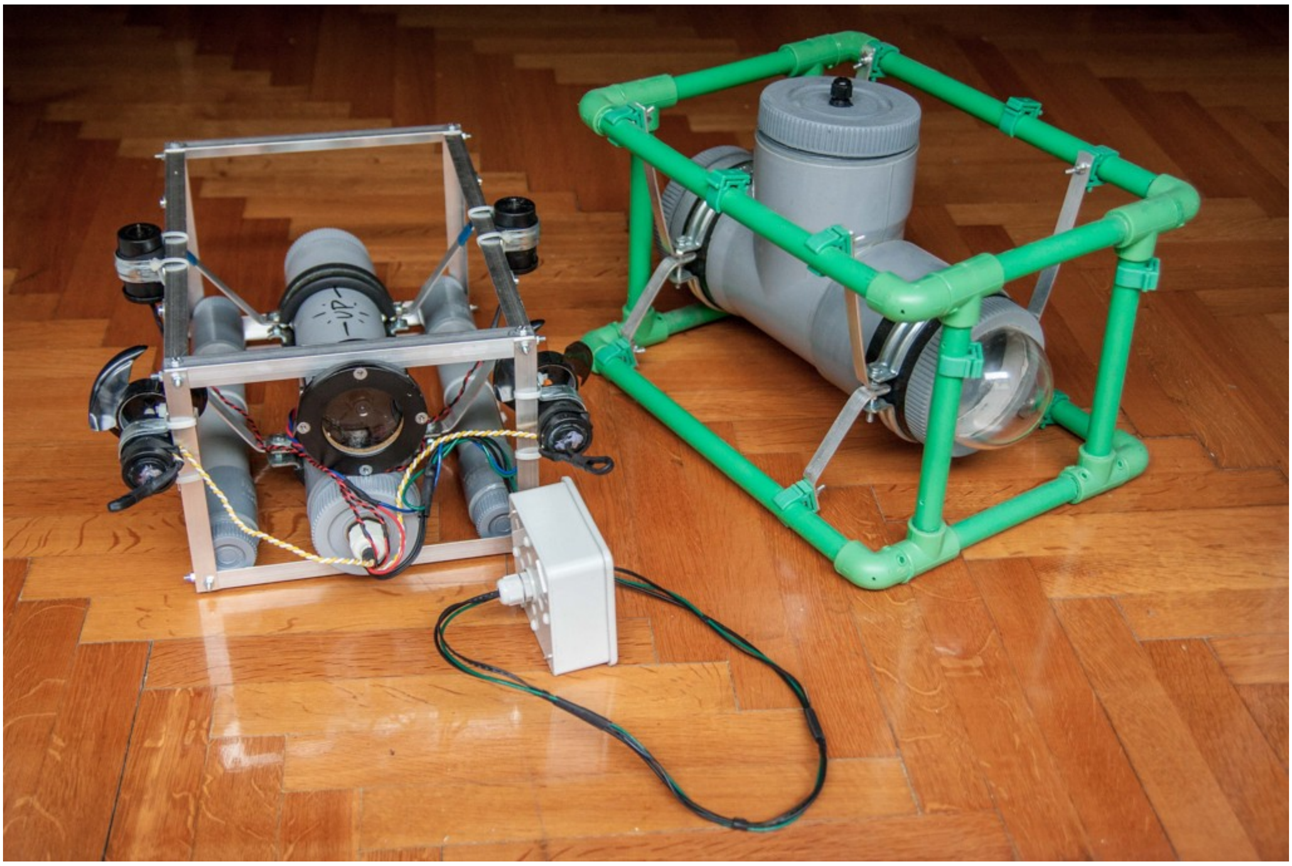
- All metal exoskeleton frame for higher density.
- Smaller and more compact size.
- Minimized unused space inside the main body which in turn minimizes the volume of trapped air inside.
- Easily assembled and disassembled using bolts, clamps etc.
- Straight cylindrical main body PVC.
- Separate aluminum housing with glass front for the CCTV camera.
- Permanent clamps for the motors, that can be slightly adjusted for positioning by sliding (+-1cm).
- Two identical watertight cylindrical containers filled with silicon beads for total weight and buoyancy adjustment.



Stacking the electronic components I order to fit them into v2 body(Left). Sensor board(Right).

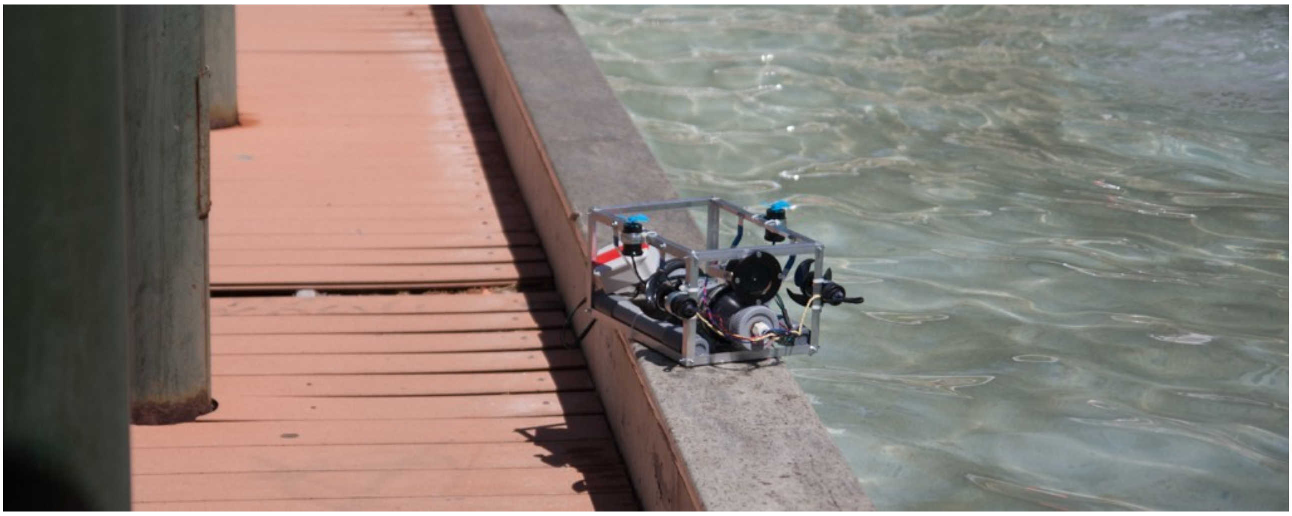


Assembling the V2 ROV parts.



Side by side comparison of the two versions of the ROV.

The second and current version of the ROV works as intended with minimal drawbacks. Namely some drifting due to the dc motors and some slight waterproofing issues.



The whole project has quite a big margin for improvement. Future plans include a more robust main body, upgrades in electronics to ease the accessibility and longevity. Upgraded power source, 3-phase motors, automotive grade micro-controllers, industrial grade sensors and implementation of different wired and wireless communication protocols.

The github repository will be updated with any news/upgrades.