**Objective**

Construction of an Unmanned Underwater Vehicle (UUV) that is capable of autonomous navigation and garbage collection in a body of water.

**Item List**

Tube Structure

-1/2 inch PVC pipes for the frame

<https://www.homedepot.ca/en/home/p.pvc-12-inches-x-10-ft-schedule-40-plain-end-pipe.1000100828.html>

<https://www.homedepot.ca/en/home/p.12-in-pvc-schedule-40--90-degree-elbow.1000166792.html>

<https://www.homedepot.ca/en/home/p.pvc-tee-34-inch-x-12-inch-sxs.1000166799.html>

Main Module

* <https://www.amazon.ca/Waterproof-Plastic-Enclosure-Junction-265x185x125mm/dp/B00N41E6WU/ref=sr_1_262?ie=UTF8&qid=1496699338&sr=8-262&keywords=waterproof+box>
* <https://www.amazon.ca/265mmx185mmx95mm-Power-Connector-Waterproof-Junction/dp/B00N41E7W4/ref=sr_1_22?ie=UTF8&qid=1496699916&sr=8-22&keywords=waterproof+box+265>
* <https://www.homedepot.ca/en/home/p.thermoplastic-junction-box--6x6x4--in.1000403716.html>
* <https://www.walmart.ca/en/ip/plano-molding-1450-guide-series-waterproof-case/6000077806944>

Two Large Tubes

* 2inch ABS pipes. 22 inch length or 2 ft
* https://www.homedepot.ca/en/home/p.abs-pipe-2-inches-x--3-ft-cell-core.1000109869.html

4 motors and ESCs

* Make sure the ESC has a linear BEC

http://www.ebay.com/itm/2212-920KV-CW-CCW-Motor-for-DJI-Phantom-30A-Simonk-Brushless-ESC-4Pcs-/111842854427?hash=item1a0a5a861b:g:gsIAAOSwOdpXxkg~

<http://www.instructables.com/id/How-to-build-a-thruster-for-a-homemade-submersible/>

Propellers

ht<tps://www.graupnerusa.com/High-quality-nylon-3-blade-electric-boat-propeller-23>08.65L.html

Gyroscope

http://www.robotshop.com/ca/en/mpu-6050-6-dof-gyro-accelerometer-imu.html?gclid=CjwKEAjwpdnJBRC4hcTFtc6fwEkSJABwupNi6eyCkgfcy1w8DG\_f-MMpeFOgpMxDI1w7sN17NzJI\_hoCx2Lw\_wcB

Camera

http://www.robotshop.com/ca/en/arducam-5mp-1080p-ov5647-noir-camera-module-12m-mount-raspberry-pi.html

Flash Light

SONAR/Waterproof Ultrasonic sensor (may not need)

http://www.ebay.com/itm/JSN-SR04T-Ultrasonic-Module-Distance-Measuring-Transducer-Sensor-Waterproof-/201322915390

Transceiver (optional)

Battery

<https://hobbyking.com/en_us/turnigy-nano-tech-3300mah-3s-25-50c-lipo-pack.html?___store=en_us>

Power Distribution Board

<https://hobbyking.com/en_us/hobby-king-quadcopter-power-distribution-board.html?___store=en_us>

Sealing material

http://www.canadiantire.ca/en/pdp/3m-marine-adhesive-sealant-5200-white-3-oz-0790215p.html

**Budget**

|  |  |
| --- | --- |
| **Item** | **Price** |
| Arduino Uno\* | 10.10 |
| Raspberry Pi 3\* | 45 |
| ½ inch PVC pipes (10ft) | 8.38 |
| Main Module | 27.44 |
| 2 inch ABS pipes (3ft) | 7.45 |
| 4 Motors and ESCs | 43.79 |
| MPU-6050 6 DOF Gyro Accelerometer IMU | 10.80 |
| Camera | 41.09 |
| Ultrasonic Sensor | ~10 |
| Water sealant | 16.99 |
| Other expenses (Tax + Shipping + etc) | ~50 |
| Battery | 27.30 |
| Power Distribution Board | 5.53 |
| **Total** | **303.87** |

**Subsystems**

Navigation

* Able to move and turn in the water using its propulsion

Attitude Dynamics and Control

* Stabilizing of the UUV using gyroscope inputs

Obstacle Detection and Avoidance

* Use of SONAR or camera input to go around obstacles

Garbage Detection and Collection

* Detection of garbage, navigation and collection
* Use camera input to detect using OpenCV, navigate using motors, collect using trash grabber

Communication (optional)

**Design**

We need to design the ROV such that it has neutral buoyancy.

Positive buoyancy – an object will float

Negative buoyancy – an object will sink

Neutral buoyancy – an object will tend to stay at the same position when under water

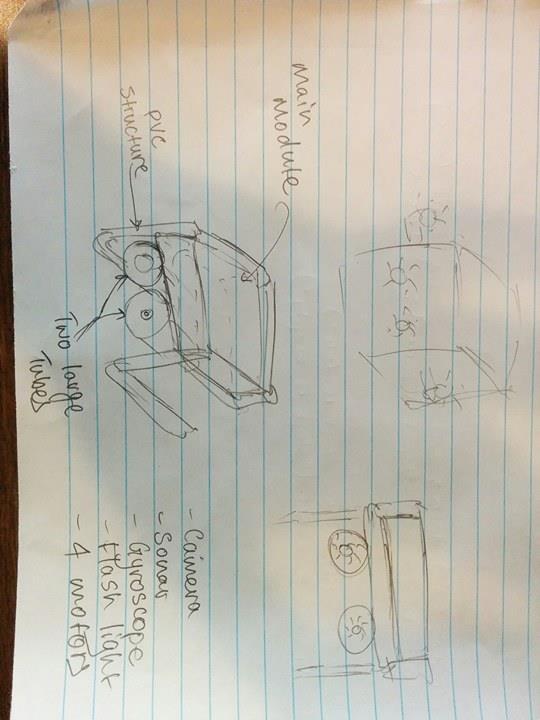
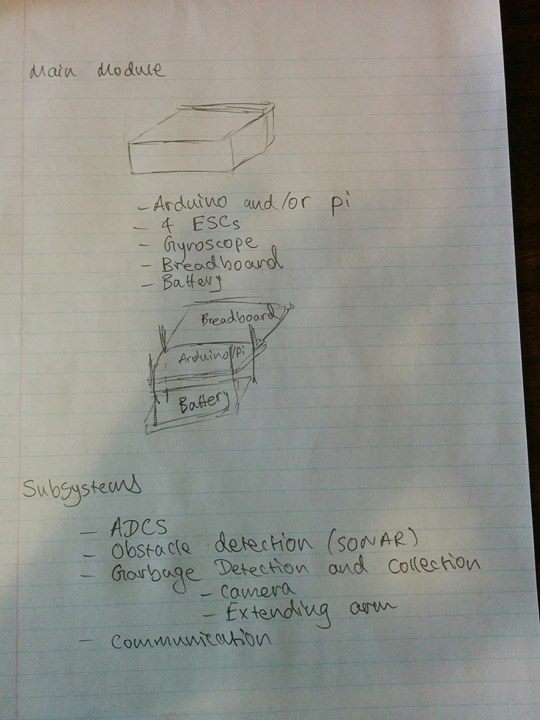
For an object to have a neutral buoyancy, the objects weight must equal the buoyancy force.

Where,

So for neutral buoyancy,

The volume of the ROV can be computed easily through SolidWorks. Which can then be used to compute the weight of the ROV. Weight of the ROV can be adjusted without changing the volume by adding weights inside the tubes. Refer to following link for derivation of buoyancy.

https://www.youtube.com/watch?v=t-0iJ25zbcs



**Battery**

Arduino

- Requires voltage source from 7 – 12 Volts (9V works well)