**1-7-2010 Update**

**Solar Ray Conceptual Design - IMDL EEL 5666C - Robert Love**

**Summary**

An underwater robot nicknamed the “Solar Ray” is designed. The solar ray is an autonomous solar powered submarine design. A budget, initial sizing, components layout, and important calculations to ensure feasibility are calculated. The anticipated capabilities of the final product desired are listed below.

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| **Goals:**  |
| 1. Create an autonomous, bio-inspired, marketable, underwater robot that can swim by flapping |
| 2. Follows prescribed path while avoiding obstacles |
| 3. Obtains underwater video and stores on an SD card |
| 4. Automatically recharges with solar energy (surfaces when runs low on power) |
| 5. Dives for up to 1/2 hour, up to 50 ft deep |
| 6. Easy access to sensor locations and all electronics  |
| 7. Built with off the shelf components |

**Initial Sizing and Layout Design**

To ensure that the PVC tubes had large enough diameter to contain all components necessary and get an initial idea for the layout of the design, all components are laid out according to their sizes in their approximate locations in the final robot.

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| --- | --- | --- | --- |
| **Basic Conceptual Budget** |  |  |  |
| **Component** | **Number** | **Price/Item** | **Total Price** |
| **Actuation** |  |  |  |
| Traxxas 2075 Digital High-Torque waterproof servo | 4 | 26.99 | 107.96 |
| **Sensing** |  |  | 0 |
| Sonar/Depth Finder: Avoidance | 1 | 35 | 35 |
| SLC-137C Camera video capture only | 1 | 140 | 140 |
| 3 Axis Accelerometer for orientation | 1 | 40 | 40 |
| Solar Charger | 1 | 55 | 55 |
| Pressure sensor (for depth) | 1 | 25 | 25 |
| **Processing Board** |  |  | 0 |
| Pridgin Vermeer Board | 1 | 128 | 128 |
| Programming USB cable | 1 | 18 | 18 |
| **Batteries** |  |  |  |
| Energizer 2500mAh NiMh packs | 5 | 12 | 60 |
| **Skinning Membrane** |  |  |  |
| Nylon/Lycra Swimsuit material (bulk) | 1 | 35 | 35 |
| **Main Structure** |  |  |  |
| PVC caps 3" (clear) | 2 | 3 | 6 |
| PVC caps 2" (clear) | 4 | 2 | 8 |
| PVC tube, 3" OD, 10' long | 1 | 25 | 25 |
| PVC tube, 2" OD, 10' long | 1 | 10 | 10 |
| Hard Balsa from Lab | 1 | 0 | 0 |
| Carbon Fiber Rods | 5 | 5.29 | 26.45 |
| **Assorted** |  |  | 0 |
| J-style servo connector extensions | 4 | 3 | 12 |
| 8' Portable Pool | 1 | 35 | 35 |
| **Total Price** |   |   | 766.41 |

It should be noted that a SD card recorder which captures RCA video will also be borrowed from the Flight Control Lab to ensure video recording. Initial sources for all components listed have been identified.

**Summary of Essential Calculations**

The Solar Ray needs to be slightly positively buoyant. Therefore a weight estimate and buoyancy estimate were calculated. The vehicle also must be able to produce enough thrust to overcome drag and enough torque to flap the wings. The design will continue to be refined since the power system, battery setup and torque requirements are yet to be calculated.

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| **Quantity** | **Amount** | **Unit (metric)** |
| **Sizing** |   |   |
| Servo Length | 0.055 | m |
| Servo Width | 0.02 | m |
| Servo Height | 0.0423 | m |
| Board Length | 0.0508 | m |
| Board Width | 0.1016 | m |
| Main Cylinder OD | 0.0889 | m  |
| Main Cylinder ID | 0.0762 | m |
| Main Cylinder Length | 0.35 | m  |
| Dual Side Cylinder OD | 0.060325 | m |
| Dual Side Cylinder ID | 0.0508 | m |
| Dual Side Cylinder Lengths | 0.2625 | m |
| Aspect Ratio (span/chord) | 2 | none |
| Wing Span | 0.7 | m |
| Wing Reference Area | 0.031115 | m^2 |
| Body Reference Area | 0.031671 | m^2 |
| Total Reference Area | 0.062786 | m^2 |
| Wing Beat (Max) | 0.5 | Hz |
| Camera Length | 0.0762 | m |
| Camera OD | 0.0381 | m |
| Battery Length | 0.055 | m |
| Battery Width | 0.045 | m |
| Battery Height | 0.03 | m |
| Sonar width | 0.1016 | m |
| Sonar height | 0.0508 | m |
| Pressure width | 0.00953 | m |
| Pressure sensor height | 0.000127 | m |
| Pressure length | 0.203 | m |
| Accel width | 0.01778 | m |
| Accel height | 0.02032 | m |
| **Boyancy Check** |   |   |
| Air Displaced Main Cylinder | 0.003694 | m^3 |
| Air Displaced Dual Cylinder | 0.003283 | m^3 |
| Max Air Displaced | 0.006977 | m^3 |
| Max Boyant Force | 6.968961 | kg |
| % Electronics Main Cylinder | 0.3 |  |
| % Electronics Dual Cylinders (est) | 0.051957 |  |
| % Electronics Dual Cylinders | 0.4 |  |
| Real Air Displaced | 0.004556 | m^3 |
| **Total Boyant Force** | 4.550322 | kg |
| **Weight Check** |   |   |
| **Weights** | **Amt(kg)** |  |
| PVC main tube & caps: est | 0.125 |  |
| PVC dual side tubes & caps: est | 0.166667 |  |
| Servos | 0.36 |  |
| Sonar: est | 0.85 |  |
| Batteries | 1 |  |
| Solar Charger | 0.025506 |  |
| Camera | 0.198 |  |
| Skin: est | 0.2 |  |
| Structures: est | 0.35 |  |
| Board | 0.05668 |  |
| Random Wiring | 0.1 |  |
| **Total Weight of Robot** | 3.431853 |  |