Aquapod: A Tumbling Amphibious Robot for Environmental Monitoring

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Introduction

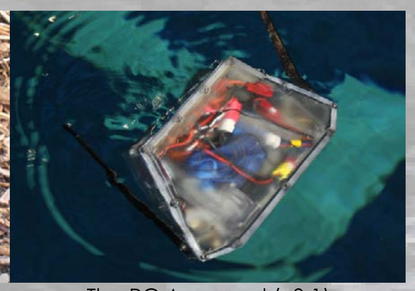
Maintaining high mobility in small robots is a difficult challenge. Tumbling is an unexplored method of locomotion that has the potential to offer a high mobility-to-size ratio. By actively involving the body of the robot it can scale larger obstacles and traverse more dynamic terrain in comparison to a similar sized wheeled robot.

This iteration of the Aquapod was built to explore the marshlands of the Gulf Coast after the Deepwater Horizon oil disaster. A specifically designed sensor suite and water sampler pack will allow the robot to look for oil contaminates in areas that are difficult or dangerous to get to in person.

Tumbling

The Aquapod has been modeled after another tumbling robot from the Center for Distributed Robotics, the Adelopod. The Adelopod was created to investigate the viability of tumbling as a form of locomotion. The hardware simplicity of the design offers many advantages over a bi-ped robot while having increased mobility over wheels. However, the advantages come at the cost of non-intuitive and difficult to predict path planning algorithms.

The Adelopod

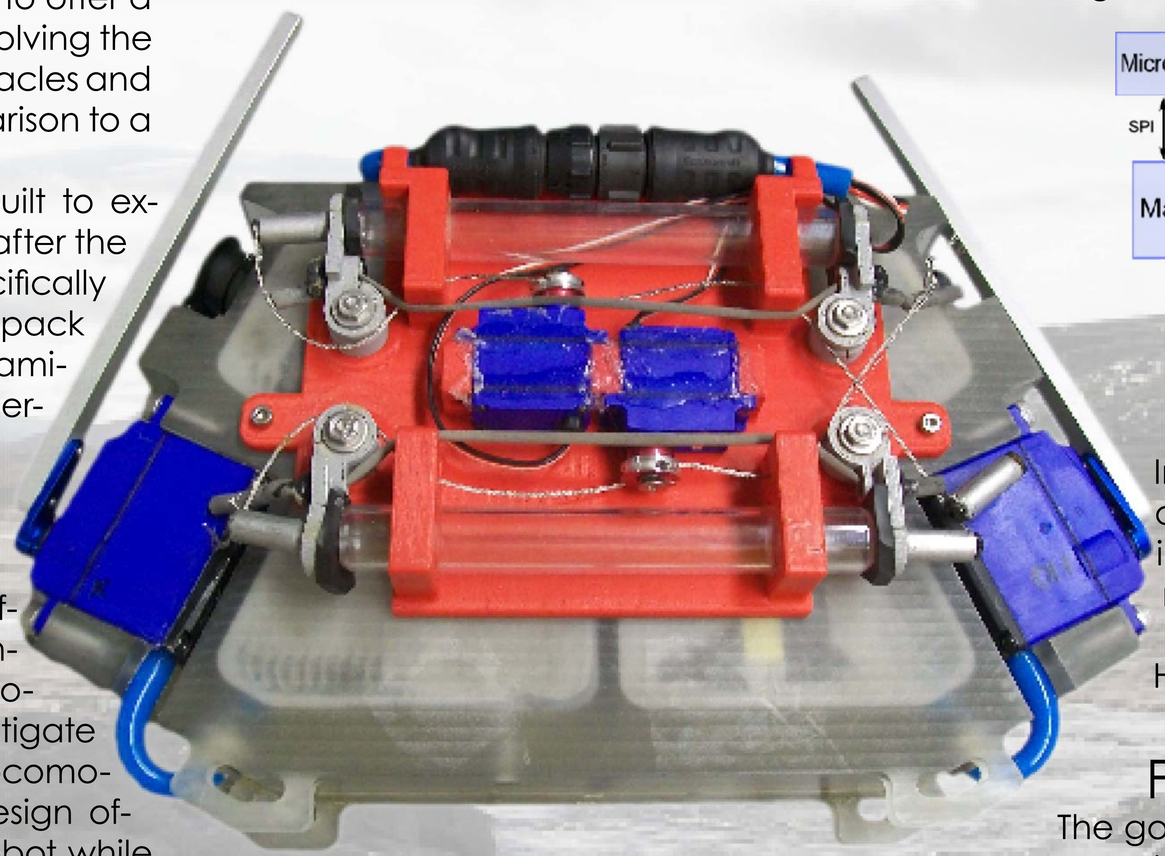


The RC Aquapod (v0.1)

The Aquapod System

Sealing

All the components on the outside of the Aquapod were carefully designed or modified from stock products to withstand a hydrostatic pressure of 10m of water. This will allow the Aquapod to dive and collect samples near the bottom of most small lakes and streams.



Buoyancy Control Unit

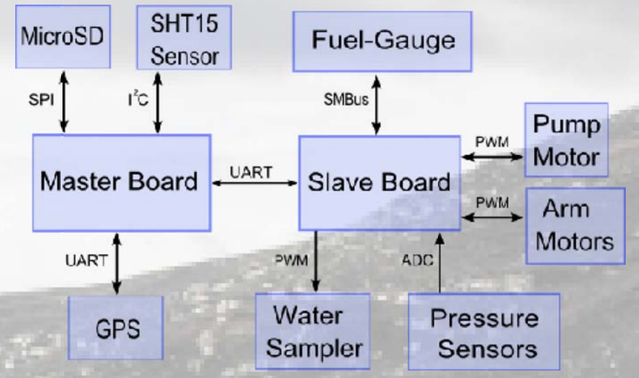
The Aquapod is equipped with an internal buoyancy control unit that allows it to sink or float in water. A peristaltic pump brings in water from the environment, increasing the overall density to the point of sinking.

Water Sampler

One of the modular backpacks that was designed for the Aquapod is the water sampler. Modeled after Van Dorn bottles, the two servo tubes can collect small samples of water at a specified depth for further analysis later on.

Embedded Systems

Inside the Aquapod there are three main PCBs that control the robot. A master/slave combination and fuel gauge board. This modular system provides the opportunity to replace components to change the specialized function of the design.

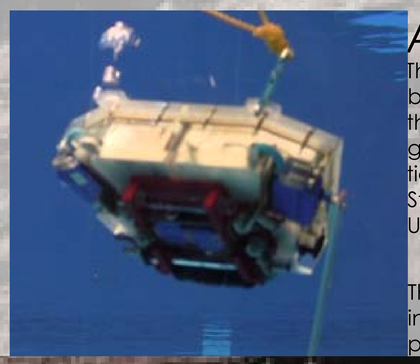


Sensor Package

In addition to the water sampler there are a number of other sensors included in the robot. These are internal and external pressure sensors, a temperature sensor, GPS, and an optional independent HOBO sensor (not pictured).

Future Work/Conclusion

The goal of the Aquapod is to be used for environmental monitoring as a team of robots working together with different sensor suites. The current iteration was designed to be tested in the Gulf Coast marshlands. Knowledge gained from these tests, in addition to the on-going research in path planning with eventually allow these tumbling robots to be used autonomously in the field for long-term monitoring.



The Aquapod collecting a water sample in a pool at a depth of 5m.

Acknowledgements

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