HydroGator

Barely Intelligent Design
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Abstract:

Hydrogator is an autonomous surface vehicle (ASV) capable of navigating a course on water while avoiding obstacles. The HydroGator is based on the AUVSI ASV competition and could be used as a testbed for better designs. There is a growing need for ASV’s and their use in oceanography, remote sensing and reconnaissance among other things. The basic top level design can be seen in figure 1.

Features:

The HydroGator would have all the basic functionality needed by most tasks.

- Robust navigation and control
- Obstacle avoidance
- Pre-programmable routes
- GPS
- Wireless communication

Fig. 1 Top Level
Components:

On board processing will be handled by an Atmega128. This controller provides a decent amount of processing power as well as features and is easy to program. Due to our team’s access to a BD Micro board this made it a natural choice.

Wireless communication is not required but is a good feature to allow for external communication. In real nautical applications a longer range wireless module should be used for communicating on shore or with other vessels, but these are much more expensive. Xbee provides sufficient range for our purposes for this project as well as the ASV competition. The Xbee is cheap and easy to use compared to other modules.

A combination of a gyro, compass and accelerometer will be used to determine heading. Due to inaccuracies in these sensors it will be best to use a combination of them. A water speed sensor will also be used to measure the relative speed of the water to the boat. These in conjunction with GPS will be used for localization and control of the vessel.

Sonar will be used to detect objects in front of the vessel. This should allow us to find anything in the path of the boat easily including objects near the surface of the water and pool edges.

We will likely use a camera to aid in navigation and object detection. The CMU cam will be the lowest cost and easiest solution. We already have a CMU cam and will try to use that in order to avoid adding a computer.
The Competition:

For the AUVSI competition, 6 teams competed last year. UCF’s winning team built a catamaran (figure 2) with a camera, GPS, compass and computer. The entire platform weighed about 30 lbs and was made from plastic and aluminum. The boat relied heavily on its camera. To be competitive, the HydroGator needs to be lightweight and fast. We also hope to add some better object detection capabilities with sonar instead of only relying on the camera.

![Image of UCF's Son-of-a-Boatman]

Fig. 2 UCF’s Son-of-a-Boatman

Technical Objectives:

The most challenging aspect of this project will be to develop a good control system for the boat. We will first have to develop a model of how the vessel behaves and then develop a controller for it. Other ASV’s have used the Nomoto model which gives a linear model for steering ships.[1] We may use this as a basis in our project but we will have to do a great deal of testing.

The amount of control over the ship will depend heavily on the accuracy of the sensors. The sensors used will be low cost and not very accurate so they will need to be integrated together to be more accurate. We also want to try to confine everything including sensors to two dimensions instead of three. This is ignoring the effects of pitch and yaw which might affect the craft more than we would like depending on the environment. Since it will be tested in a pool, we will try to work around it using just single axis sensors.
The use of a camera is also a major problem. We would like to finish the design without having to use an onboard computer. This would greatly reduce cost. The CMU cam would allow us to use just a microcontroller but it is unknown whether or not the CMU cam could give us good enough information. We might be able to rely less on the camera using other sensors, but to accomplish tasks like those in the competition we would have to rely heavily on the camera. If we can manage to do navigation without the computer, or a camera at all, would greatly reduce the cost and would fulfill our purposes.

The other problem is power consumption. We would like to minimize power consumption as much as possible, but not limit functionality because of it. Theoretically these kinds of craft should be able to sustain as long periods of time as possible at sea before having to be recharged and refueled. Our project won’t concern ourselves with this too much but will try to make efforts to minimize power consumption.

**Division of Labor:**

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