Detailed Software Description:

The Hydrogator will have a boat with a microcontroller on it communicating to a PC on shore. Most of the software and processing will be handled by the PC. The microcontroller will interface with the sensors and motors.

The boat will be running an Atmega 324P which will constantly send sensor data wirelessly through the XBee to a computer. The computer will be constantly sending back motor settings to the boat over the XBee and the Atmel will generate PWM to the motors to obtain the correct setting.

A wireless camera will constantly stream video over WIFI to a computer. Since the particular camera used has some codec issues and uses ActiveX, the video can only be streamed in real time using the camera's proprietary embedded player in Internet Explorer. This video will be sampled from the screen in one process and image processing run in another process on the most recent frame.

The processed image will be used to determine the boat's location as well as coordinates of any objects it sees in reference to the boat. The camera will also look for certain markers such as a certain colored bouy and separate this from the rest of the image to determine its coordinates. This will be done by using a threshold for the color of the bouy known a priori and adjusted for brightness to isolate the bouy as a blob.

Combined with the sensor data and information from image processing, a controller in software on the computer will determine the necessary motor speeds for that point in time. The response of the boat is found experimentally. Pathfinding will be done given the boat's current pose and its goal as well as waypoints or obstacles along the way. This could be done using an A-star search algorithm to find the best path. Collisions detection and avoidance will also have to be handled.

The control software for HydroGator is in three parts, initialization, navigation, and complete. First the software will initialize the XBee communication with the PC, GPS, compass, and camera. Once it has its current coordinates, it will then point itself in the proper direction of the end coordinates and wait for the OK from the PC that the camera shows all clear so that it can begin to progress and navigate.

In the navigation stage, as long as the camera says that there are no obstacles, it will try to maintain a direction using the compass that will take it to the end coordinates. Constant adjustments to the motors will change the direction appropriately. If an obstacle is detected by the camera, it will then go into a routine in which it will turn until there is no longer an obstacle, go straight for a period of time, and then try progressing to the end goal again. This back and forth of progressing and avoiding will continue until it reaches the end coordinates and then it will stop and spin for a little while.