S.W.I.M.M.E.R.

Surface Water Ingestor of Miscellaneous Material and Experimental Robot

By: Steven Palmieri **December 19, 2006**

This is my very first BS2 project. SWIMMER is an autonomous robot that moves along the surface of a swimming pool and skims floating debris into an onboard net bag. The robot utilizes one BS2, two homebuilt H-bridges to control the direction of the motors and three sensors to identify it's proximity to the wall of the pool and 8-12V batteries to power the motors.

The motors I used were leftovers from two pool toys my kids had. Once the pool toys broke I knew those motors would be used in a project, I didn't what at the time, so I put them in my garage.

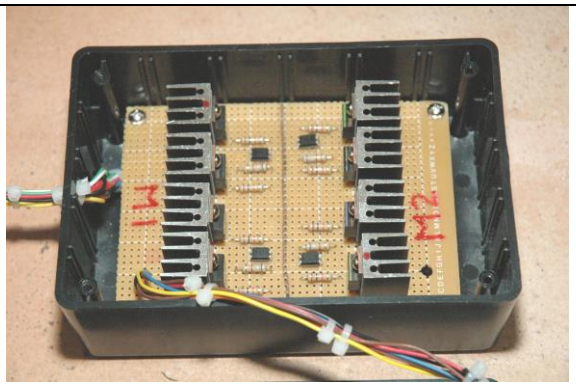
For the "hull" I needed something that met the following criteria. It needed to be buoyant enough to float the batteries, sensors and motors. It needed to have a water tight section to keep the electronics. After trying many different designs I ended up with the perfect solution. The hull is the armrest from a floating pool lounge chair. I cut to holes in the top and installed two water tight access hatches that are used on boats. These make a perfect watertight seal and give ample access to the inside of the hull. The other modification to the hull was to glue 1x2 pieces of wood with Velcro on them laterally inside the hull. By doing this I can mount my electronics boxes and batteries securely but also be able to move them around to keep the robot floating straight in the water.

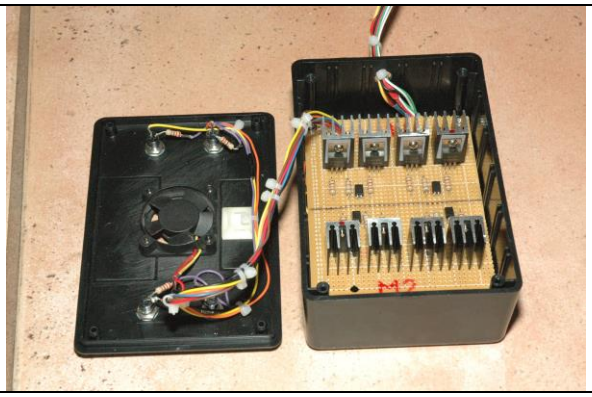
The first step was to fit the motors to the hull. This was done using PVC and utilizing the molded-in nuts from when this was a lounge chair. Nylon nuts are used to keep the motors in place. They will be used to "trim" the motors.

The next step was to build the “sensor pack”, this is the PVC framework where the “whisker switches” and infrared detector will be mounted. Once again, the original molded-in nuts in the hull were utilized

Now I needed a circuit to control the two motors. After doing some research on the internet, I determined a simple H-bridge is the best way to control the direction of the motors. I used, but simplified a schematic I found on;
http://www.mcmanis.com/chuck/Robotics/tutorial/h-bridge/bjt-circuit.html

To control the speed I choose to “pulse” the motors programmatically with the BS2.



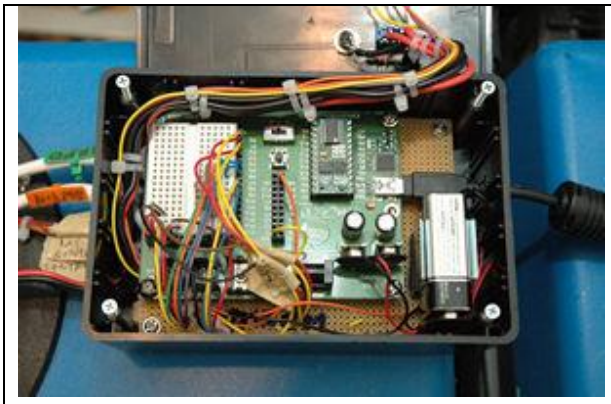


The first, and primary, sensor is an infrared sensor made by 'Lynxmotion' mounted on the front. This has a range of 15" to 30" depending a sunlight conditions and can determine if an obstacle is on the right-side, left-side or in the center. The IR detector is mounted in a modified 3" PVC end-cap. One of my challenges was to waterproof the enclosure but still provide access to the circuit because there is an adjustment POT on the board to adjust the sensitivity. After experimenting with many different methods, I stumbled across a child's swim mask at the 'Dollar Store'. As soon as I saw the swim mask I knew it was the correct size and by attaching it with a hose-clamp the seal was made.

The second set of sensors are "whiskers" which are made by attaching a bent piece of wire from the hobby store between two momentary lever switches. Each set of switches are wired together to create one big switch. A whisker is mounted on each side to provide feedback if the SWIMMER touches the pool wall.

For the debris intake, I used an attachment from a shop-vac that is connected to a 3” piece of PVC and ultimately empties into a net bag that is mounted in the rear. There is no vacuum, the forward motion is enough to guide the debris into the intake and therefore into the net bag.

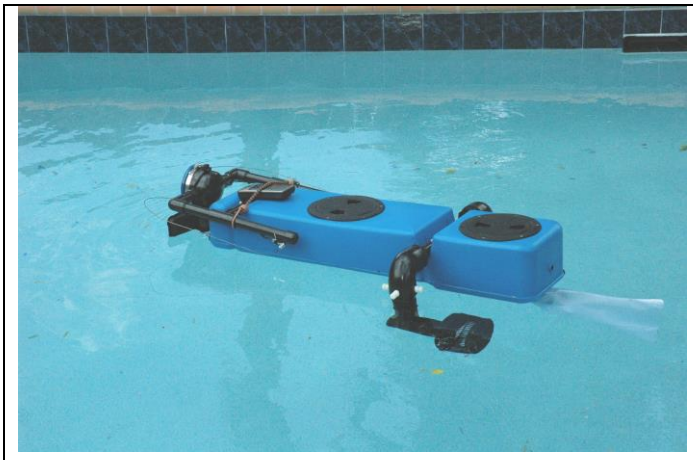
I choose to use the BS2 on the ‘Board of Education’ because this is an experimental robot and I plan to continue to use the integrated breadboard. The BOE is mounted to another circuit board on stand-offs. A USB cable is siliconed into the project box so I can download programs to it without the need to open the box every time. The two switches on the box are used to power-on the BS2 and to power-on the motor controller. There are also LED lights on the box to indicate when each unit is tuned on

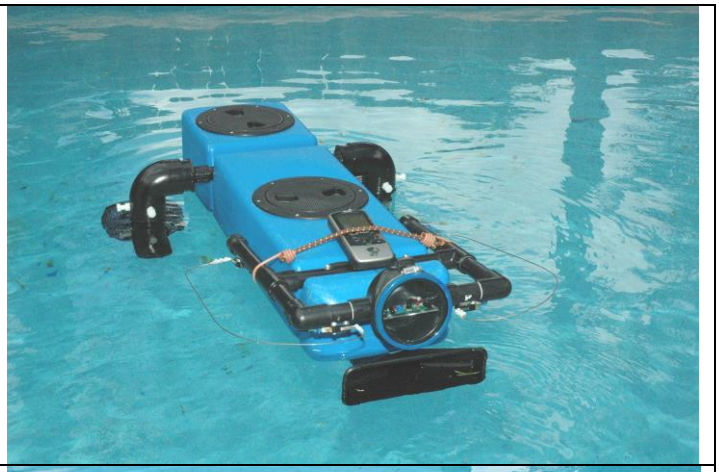


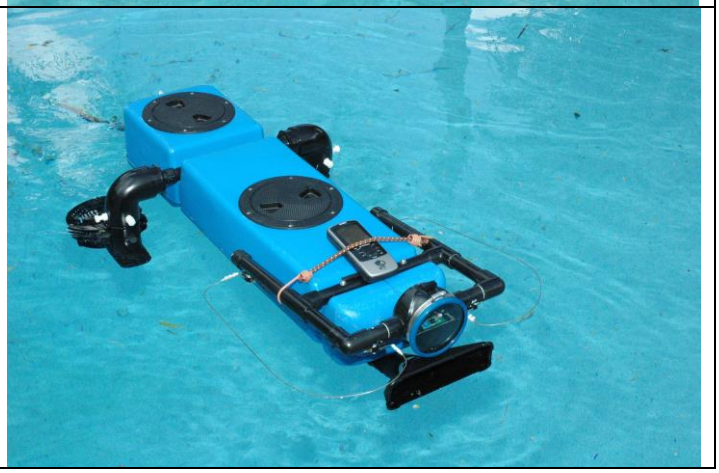
Here are pictures with the access hatches removed. The picture on the left is where the BS2 is mounted. The picture on the right is where the motor controllers are mounted, note, I also added LED's on the motor controller box to indicate each motor's direction.

Here are a couple more detail photos. The front IR detector and a close-up of one of the motors.

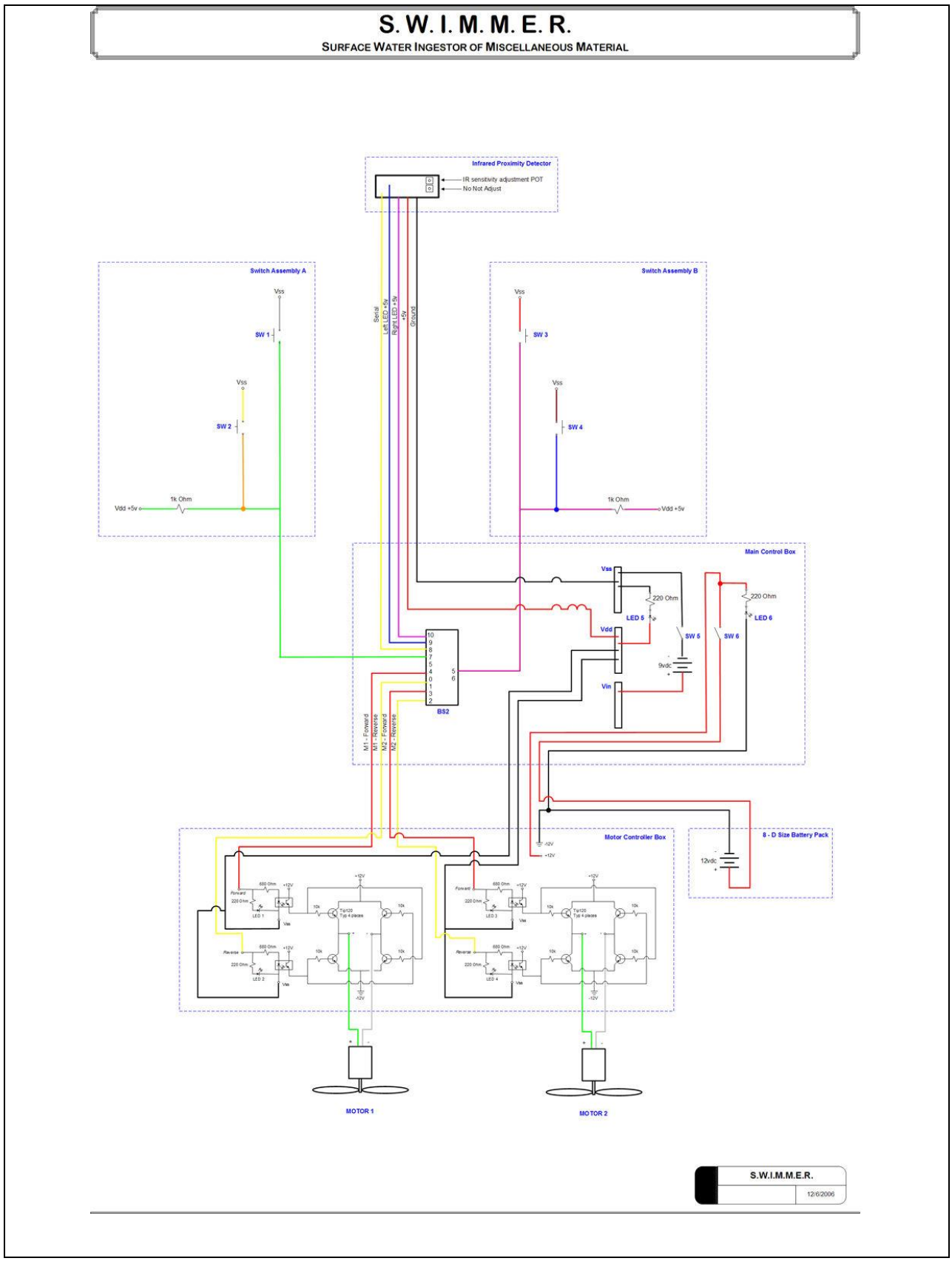
Here are some photos of SWIMMER in action. Note, the handheld GPS is strapped on in these pictures because, at the time, I was trying to get an idea, by saving the GPS track, how long it took to cover the entire surface. Although this is to finite of a measurement for commercial GPS it did give me some idea of the coverage. The findings are, it take SWIMMER approximately 50 to 60 minutes to cover the entire pool.







SWIMMER Schematic



Future Plans for SWIMMER

I intend to outfit SWIMMER with a water temperature sensor, a battery voltage sensor and a radio transmitter.

I am experimenting with the TIVO developer's kit. I intend to transmit the water temperature, battery condition and current SWIMMER activity (forward, reverse, turn-about, etc) to a computer and be able to access the information from a menu item on my TIVO.