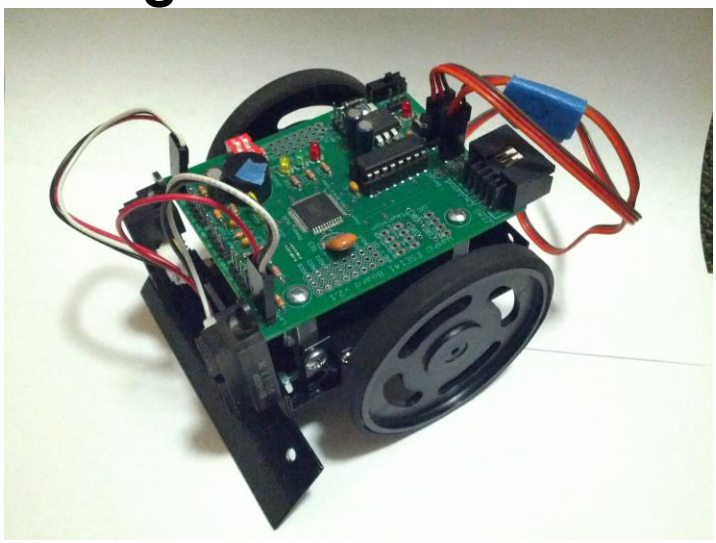
Assembling the ESE 141 Sumo Robot



Prerequisites:

Before you assemble the robot, you must have already:
-Finished and tested the circuit board
-Hacked the motors
-Crimped the floor sensors
-Crimped the distance sensor wires and connected them to the distance sensors
-Soldered and crimped the battery packs together

Materials:

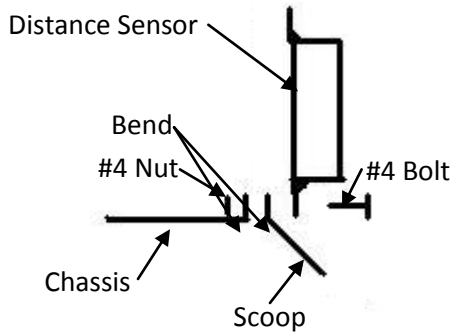
1	ESE141 v2.1 Circuit board
1	Mark III Chassis
1	Mark III Scoop
1	Battery Pack Assembly
2	High-torque Ball-bearing Servo Motors
2	65mm Wheels
2	Rubber Tires
2	Fairchild QRB1134 IR Floor Sensors
2	Sharp GP2D12 Distance Sensors
2	2'' Velcro Hook Strips
2	2'' Velcro Loop Strips
4	1.375'' Standoffs
1	#4 Phillips Head Screwdriver
1	#6 Phillips Head Screwdriver
1	Pair Needle-nose Pliers (optional)
4	6-32 .500" Phillips Head Machine Screws (#6 Bolts)
4	4-40 .375" Phillips Head Machine Screws (#4 Bolts)
2	Small Wheel Screws
8	4-40 .375" Phillips Head Sheet Metal Screws (#4 Screws)
4	6-32 Hex Nuts (#6 Nuts)
4	4-40 Hex Nuts (#4 Nuts)
4	#4 Nylon Washers

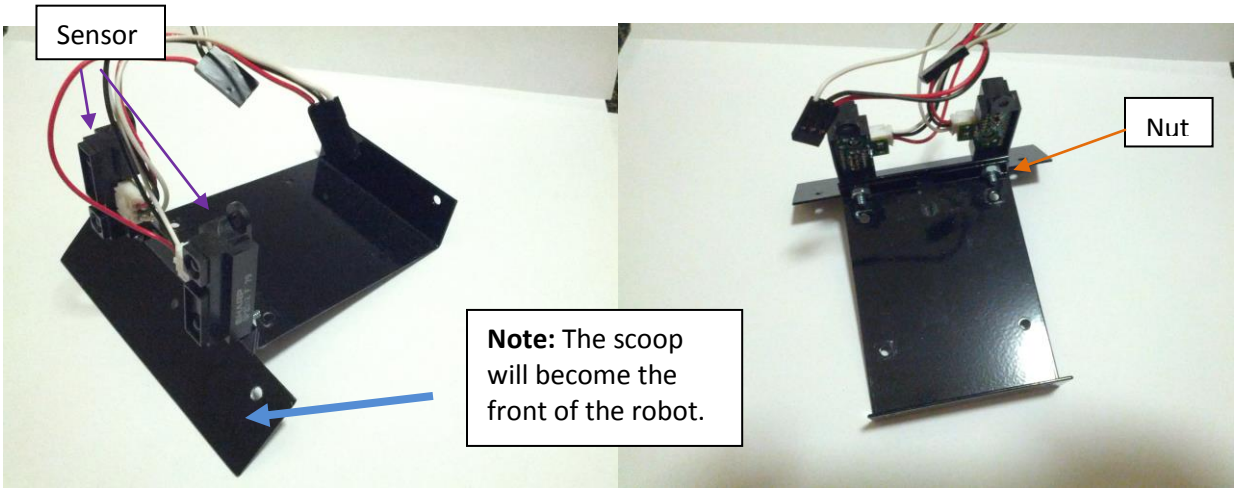
*__Note__: Although they are both correctly called screws, screws with pointed ends will be called screws, while screws with flat ends will be referred to as bolts. A #6 bolt or nut is thicker than a #4 bolt or nut.

Procedures:

1. **Attach the scoop and distance sensors to the chassis**. The scoop is the roughly 1” x 4” piece of metal. The distance sensors are the ones with 2 ‘eyes’ each. Line up the two holes in the bend in the scoop and the small bend in the chassis. Orient the distance sensors such that the cables face toward each other. From this orientation align the bottom hole of each distance sensor with a hole in the scoop bend such that the circuit board on each distance sensor faces inward towards the chassis. Place two #4 bolts (thinner) through the holes and secure them using two #4 nuts.

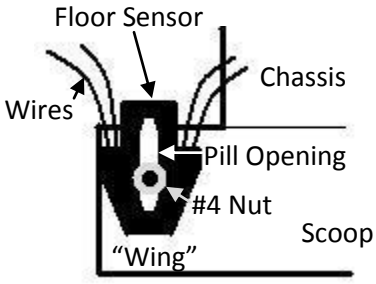
Figure 1. – From right side





2. **Attach the floor sensors to the scoop.** Align the pill-shaped opening of the each floor sensor with a hole on the outer “wing” of either side of the scoop. Orient the floor sensor such that the wires face back towards the chassis and it is on the underside of the scoop (away from the distance sensors). Attach each floor sensor using a #4 bolt and nut.

Figure 2. – Scoop from below



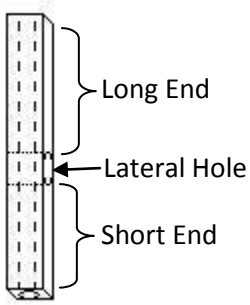
Note: Screws should be just tight enough to make it difficult to rotate the parts they connect. It may help to use needle nose pliers to hold the nut while you tighten the screw with the screwdriver.

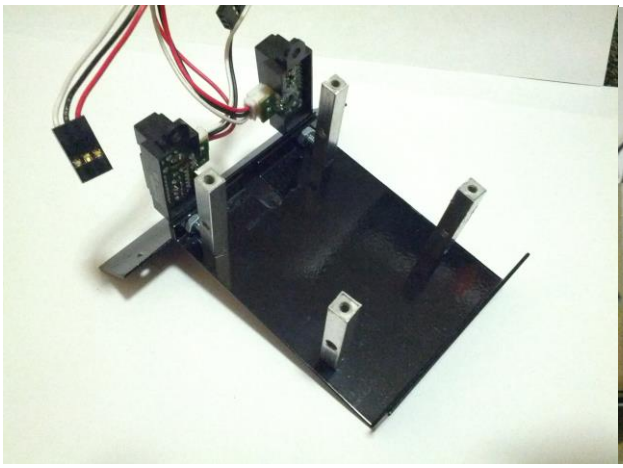
Note: The holes in the scoop and floor sensors are elongated so that they can be adjusted to be level with the ground. Although the process of taking the robot apart, adjusting things, and putting it back together to test it may be tedious, it is very important that your robot is level with the ground so that other robots can't wedge their scoop under yours.

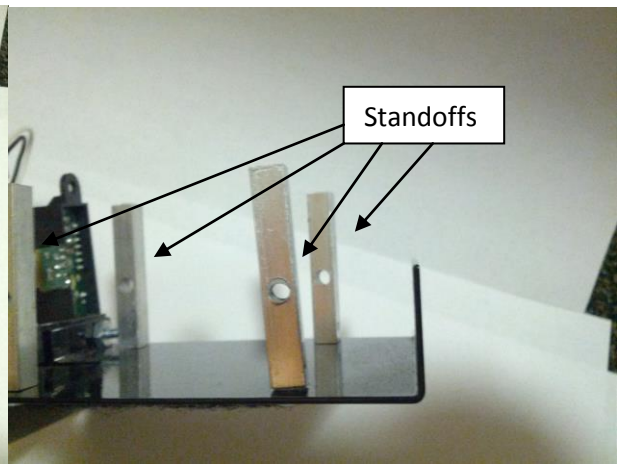
Tap- to cut a screw thread into an opening. The metal standoffs we use are filled with clay. The holes must be threaded by screwing and unscrewing a screw.

3. **<u>Attach the standoffs to the chassis.</u>** Tap a hole into the top and the bottom of the four standoffs using a screw. You are not screwing the standoffs on the chassis yet. *It may be easier to tap the standoff if a screwdriver is inserted through the lateral hole (see diagram) to give extra torque.* Now, screw the short end of each standoff into the four holes on the base of the chassis using the #4 screws. Make sure the lateral holes are visible from the left and right sides, but not the front.

Figure 3. – A standoff



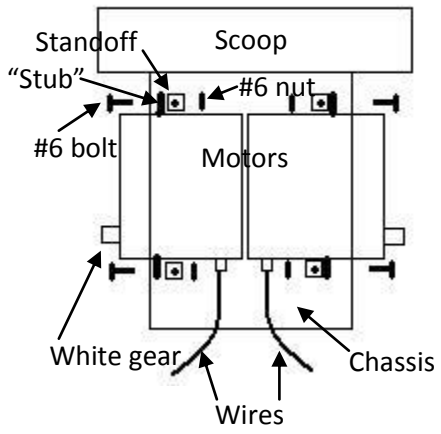


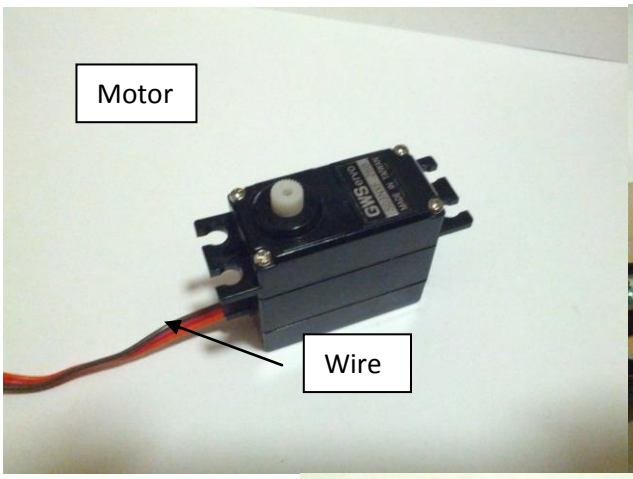


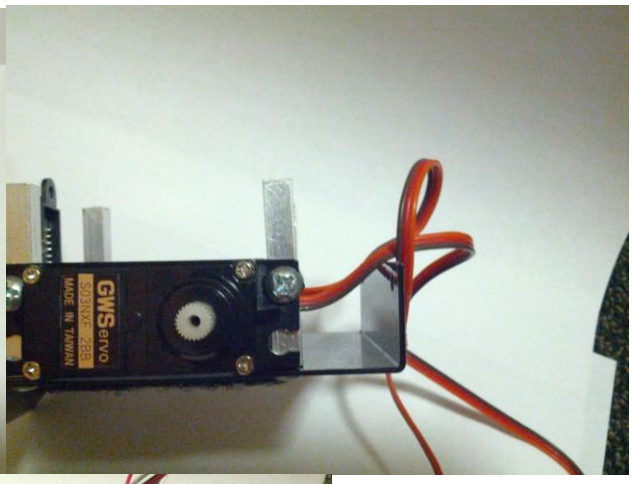
***Note: Important!** Make sure to hack the servos before Step 4! Ask the TAs for help.

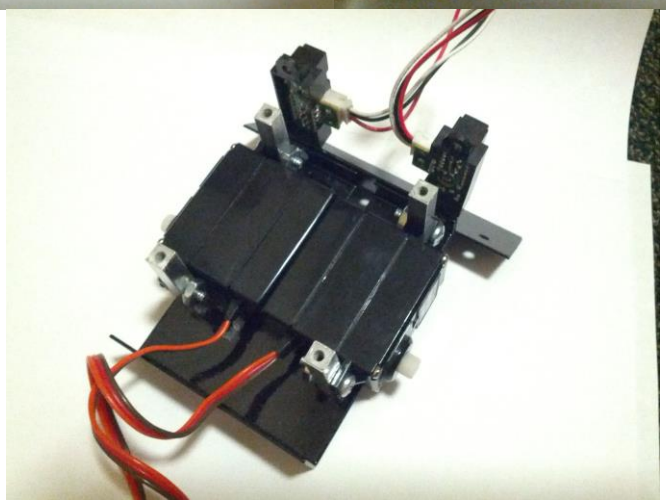
4. <u>Attach the motors to the standoffs.</u> Set each motor on the chassis such that the wires face the back of the robot, the white gear faces outward, and the standoffs touch the "stubs" of the motor. The lateral holes of the standoffs will be aligned with the keyhole-shaped cutouts in the "stubs" of each motor. If they are not, your standoffs are either upside-down or rotated and step 3 must be repeated. Use a #6 bolt and nut to screw the motor to the standoffs.

Figure 4. – From above



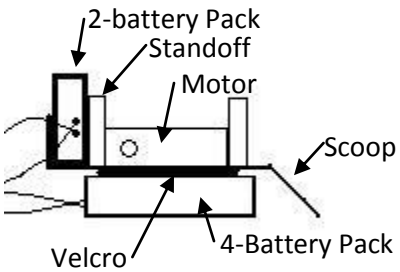




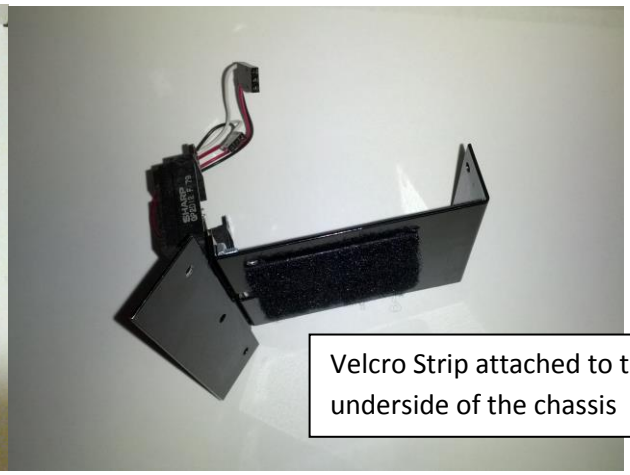


5. <u>Attach the battery pack to the chassis.</u> Stick two strips of Velcro to the center of the back of the larger battery holder. Make sure the strips don't overlap or go off the edge of the battery holder. Stick the other side of the two Velcro strips to the underside of the chassis such that they fit between the heads of the four #4 screws that were used to attach the standoffs. Stick the battery pack securely onto the bottom of the chassis with the battery pack wires face away from the scoop of the robot. Set the smaller battery pack at the back of the chassis between the large bend in the chassis and the standoffs with the batteries facing inward.

Figure 5. – From Right Side



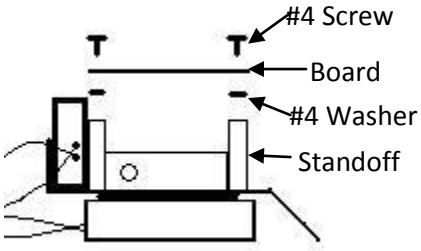
Large and Small Battery Holders



Velcro Strip attached to the underside of the chassis

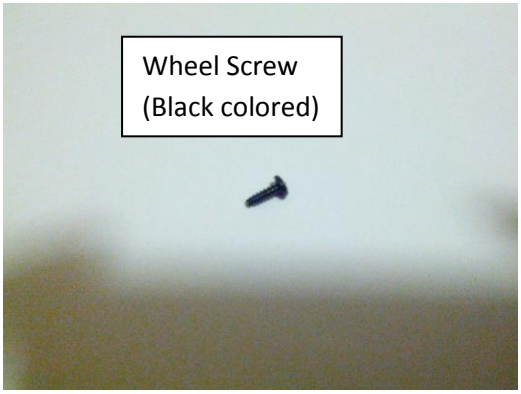
6. <u>Attach the circuit board to the standoffs.</u> Place a #4 nylon washer (the plastic circles) on the top of each standoff. Set the circuit board on the washers with the words "WashU ESE141 Board v2.1" on the left of the bot. Align the holes on the board with the washers and the holes on top of the standoffs. Insert four #4 screws to keep the washers in. Tighten each screw a little at a time and then move to the next screw. This way, the board will stay aligned.

Figure 6. – From Right Side



Note: The nylon washers are **important** because they insulate your board from charge that can build up on your robot.

7. <u>Attach the wheels to the motors.</u> Stretch the rubber bands around the wheel. Press the large hole at the center of one side of a wheel onto the white gear. Screw the small wheel screw through the hole in the center of each wheel.



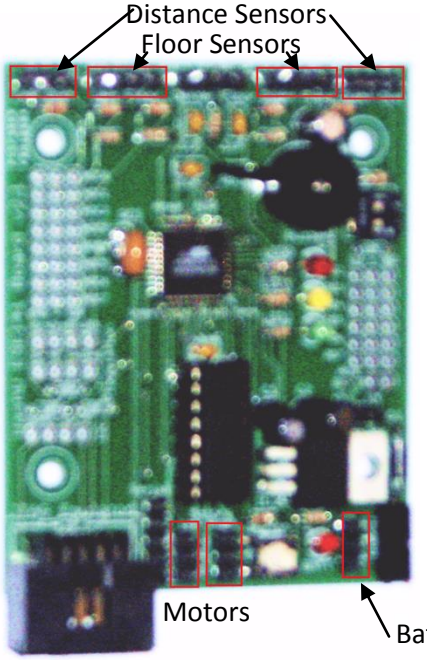
***Note**: Ask TAs about crimping for Step 8!*

8. <u>Attach the crimp housings to the headers on the circuit board.</u> Push the 3-pin distance sensor crimp housing on each side onto the first and fifth headers on the front of the circuit board. The wire colors should be, from left to right when the robot is facing away from you, white, black, then red. Push the 4-pin floor sensor crimp housing on the second and fourth front headers. Wire color order should be: orange, green, blue, white. Push the 3-pin motor crimp housing onto the motor headers in the center back of the robot with the colors: orange, red, brown, from back to front when looking from behind the robot. Finally, push the 3-pin battery crimp housing in place as seen in the diagram. The colors of the wire should be red first, then black in the middle.

Note: As expected, the 3-pin crimp housings should connect to 3-pin headers, while 4-pin housings connect to 4-pin headers

Once you have completed these steps, have a TA check

Figure 8. – From Above



what you've done, and get ready to program.