

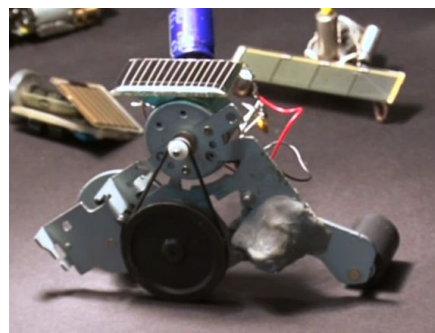
The low-tech, hacker-friendly world of BEAM robotics has produced a bestiary of bots, including Rollers, Walkers, Jumpers, Climbers, Swimmers, Flyers, and Crawlers. This project includes two bots: a clever, non-electronic, obstacle-aware robot called a Beetlebot, and a solar powered rolling robot called, logically enough, a Solar-Roller.



Robot Project 1: The Solar Roller

The Solar roller drives straight ahead in fits and starts. This light-sensitive critter will look cool and très geeky on your desk, as long as you can keep it from wandering off the edge.

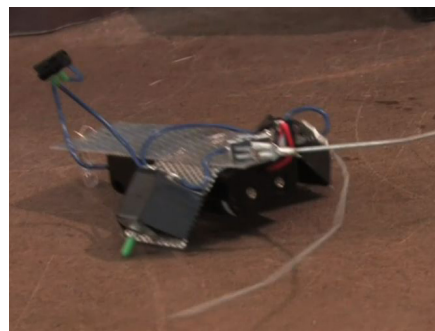
Solar Rollers can be built using all sorts of materials, from Lego bricks to soldered paper clips to computer mouse cases. Our approach relies on parts from an old cassette player and a VCR. Your results will depend on the parts that you use for the body and drivetrain.



Robot Project 2: BeetleBot

The BeetleBot is a simple robot that avoids obstacles without using any “intelligent” electronics... in fact, it’s brainless.

Two motors propel the bot forward, and when one of its feelers hits an obstacle, the bot reverses one wheel to steer around the obstacle. The project requires only 2 switches, 2 motors, and 1 battery holder, and is based on the article written by Jerome Demers in MAKE Magazine, Volume 12.



Estimated cost for each project: \$20

Before you begin:

You may find it necessary to modify these instructions, depending on what materials and tools you have at hand, and any improvements you might want to make in the design. Go ahead and customize the project and make it your own!

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Robot Project 1: The Solar Roller

Tools

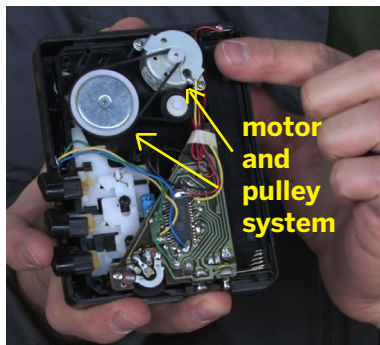
Soldering iron, stand, solder
 Optional - de-soldering tool
 Rotary tool with grinding wheel, cut-off wheel, and router bits
 "Third hand" tool with alligator clips
 Vise
 Needlenose pliers
 Wire cutters
 Hobby knife
 Medium-grade sandpaper or metal file
 Ruler
 Epoxy
 Safety glasses

Materials

Motor/cassette mechanism
 PN2222 transistor
 1381 voltage detector
 Diode
 C2 Power Storage Capacitor (4700 μ F electrolytic, looks like a small can with two leads)
 C1 Timer Capacitor (0.47 μ F)
 24x33mm Solar Cell (rectangular solar-cell with circuit panel on backside)
 Hook up wire
Parts are available at Solarbotics (www.solarbotics.com)

Step 1. Harvest the robot parts

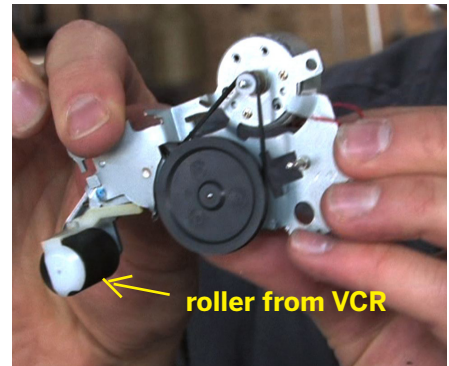
Detach the cover of an old cassette player and then remove the motor, belt, and pulley system. The pulley will form the drive wheel of the Solar Roller. Cut away any excess parts. This assembly will be used as the chassis for the Solar Roller.



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Step 2. Add a front wheel

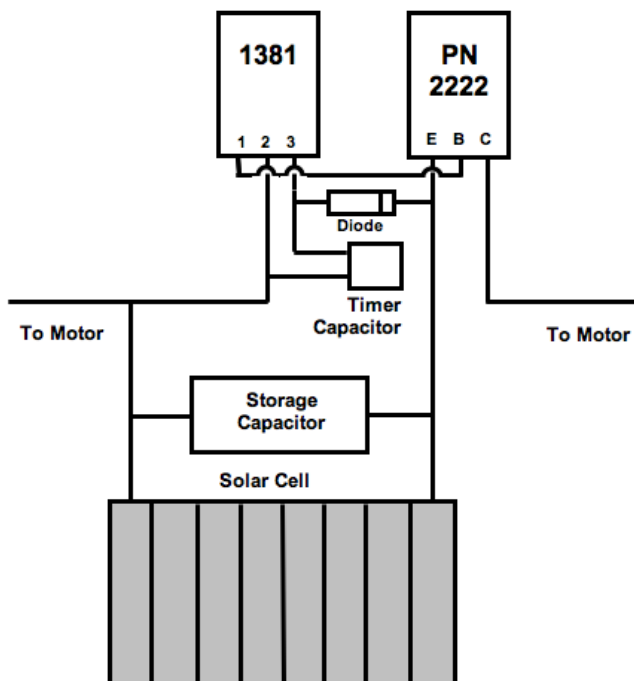
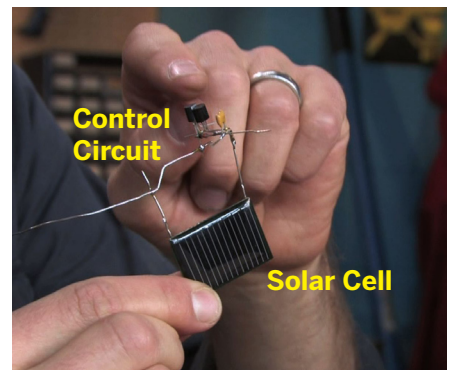
The solar roller needs a front wheel for stability. Many parts can work, but we used an idler pulley from a scrapped VCR. Attach the front wheel to the chassis with epoxy or a small machine screw.



Step 3. Build the power supply

Solder together the control circuit and solar cell. For each of the circuits, touch intersecting wires from the parts with the tip of the soldering iron to heat the wires. Then apply a small amount of solder to the contact point.

You can use a breadboard for the circuit, but it's simple enough that you can assemble it by soldering the leads from the individual parts directly, as indicated in the schematic below. (For a more detailed description, see the Resources at the end of these instructions.)



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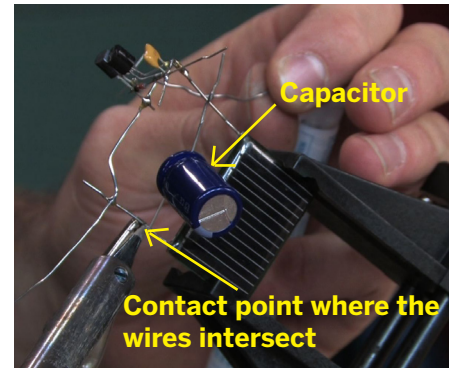


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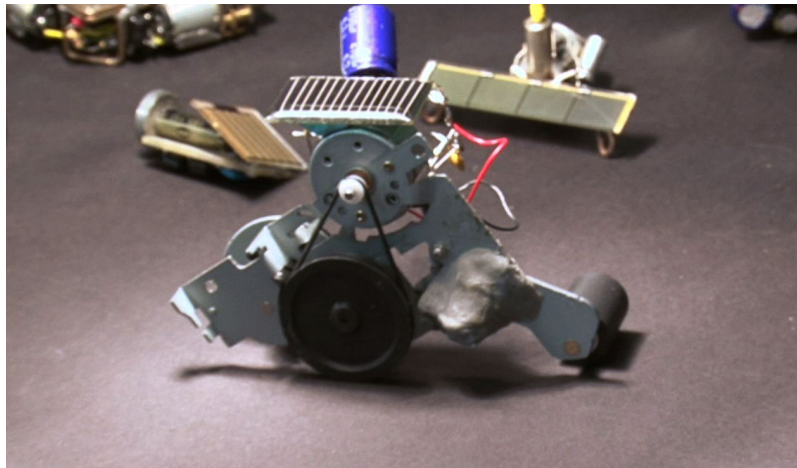
Next, solder the storage capacitor to the circuit. The capacitor stores the energy from the solar cell until it discharges and turns the drive wheel. A vice and “third hand” tool can help hold all of the parts so you can use your hands to solder.

Finally, attach the circuit to the motor assembly. Use a bit of putty or epoxy to hold the solar cell to the bot.



Step 4. Shine a light on your bot

Once the whole assemblage is soldered into the motor wires, place the completed bot on a flat surface under the sun or a bright light. After a little while, the circuit will trigger, the capacitor will dump, and your solar roller will take off for a short run. Shine, wait, and repeat.



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Robot Project 2: BeetleBot

Tools

Soldering equipment: Iron, stand, solder, and de-soldering tool
 “Third hand” tool with alligator clips
 Vise
 Needle-nose pliers
 Wire cutters
 Safety glasses

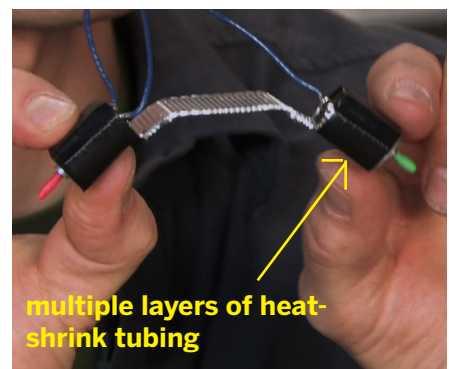
Materials

1.5V motors (2)
 You can often scavenge these from toys, dollar store fans, etc.
 SPDT (single pole double throw) momentary switches with metal tabs (2)
 You can scrounge these from an old VCR or mouse, or buy new ones for a few dollars
 Electrical wire, 22 gauge
 AA batteries (2)
 AA battery holder
 LED (to function as a rear “wheel”)
 Heat-shrink tubing
 Electrical tape
 Terminal connectors, spade type, small (2)
 Perforated scrap metal sheet:
 1 ½” x 3 ½” (1)
 1” x 3 ½” (1)
 Paper clips
 Cyanoacrylate glue or epoxy
 On/Off toggle switch (4)

Step 1. Build the crossbar

Bend the 1” x 3 ½” metal strip on both ends in 45° angles, as shown in the photo. Attach the motors to the bent ends of the metal strip with electrical tape. The motors will act as the BeetleBot’s “wheels.”

Heat-shrink tubing makes for an ideal tire. To build tires for the wheels, cut pieces of heat-shrink tubing and use a high-heat source (heat gun, soldering iron, hair drier, etc) to shrink the tubing onto the motor shafts. Trim the tubing evenly, while allowing a small portion to run past the ends of the shafts. Use multiple layers of tubing to build a thicker tire, which will help improve traction.



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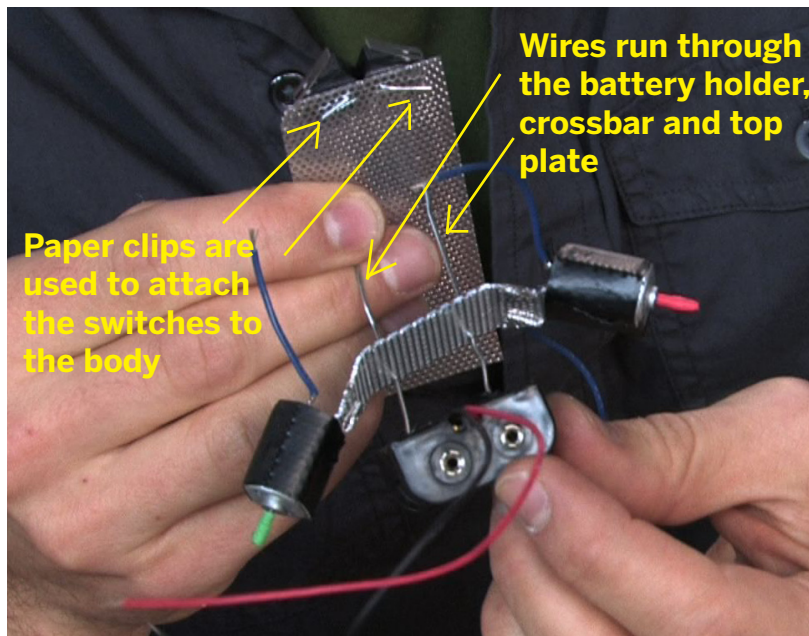
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Step 2. Attach switches and battery to the body

Attach the SPDT switches to the remaining metal plate with glue, or by inserting a thin wire through the switch holes and twisting tightly.

Attach the battery holder to the motor plate with glue or twisted wires. Then connect the switch-holding plate to the motor-holding plate by gluing or twisting it on with wire.



How the BeetleBot works

The wiring diagrams on the next page show how the switches control the bot's motion. The photos that follow show how to wire the parts together.

For the BeetleBot to work, the two batteries must be wired so they work separately. Battery holders usually connect cells in series and combine their voltages, but with the BeetleBot, a wire soldered between the two batteries puts them into separate subcircuits.

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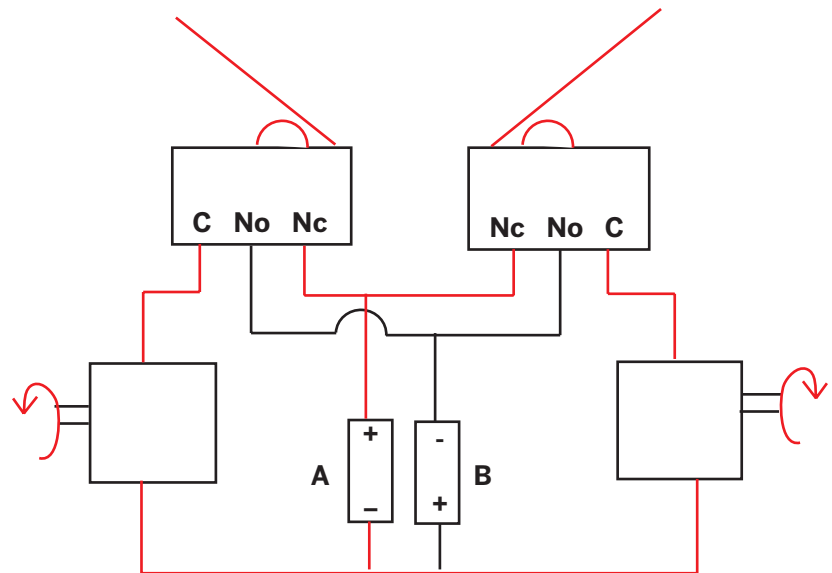


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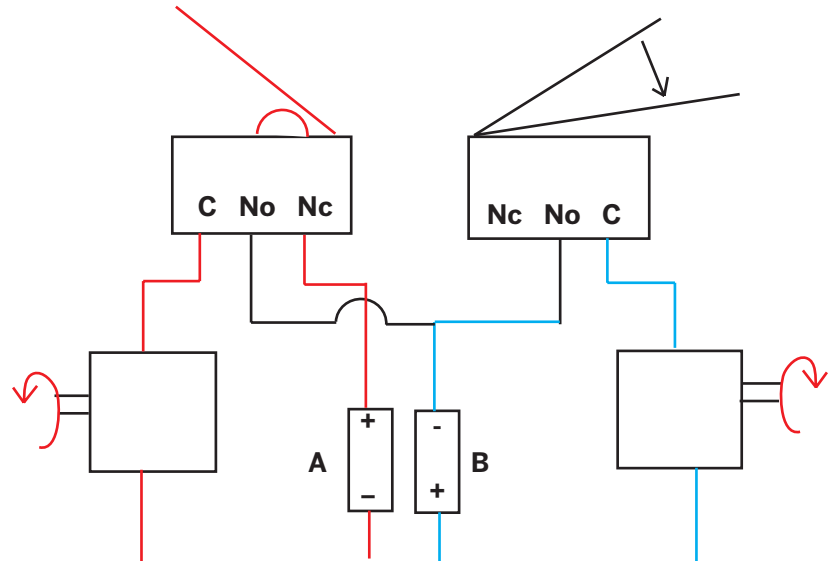
The motors draw from only one battery at a time. Each switch's common connection runs to a motor. The switches' normally open (NO) terminals are both connected to one battery's negative terminal. The switches' normally closed (NC) terminals are both connected to the other battery's positive terminal.

When the bot goes forward, voltage from the positive-side battery splits and is directed through both motors via the NC terminals, and the negative-side battery is not used at all.



But when the bot hits an obstacle, the switch closes the circuit with the negative-side battery, through the NO terminal. This reverses the motor on that side while the other side continues running forward. The bot turns away from the obstacle.

When both switches are activated, both motors momentarily run backward, and the robot backs up.



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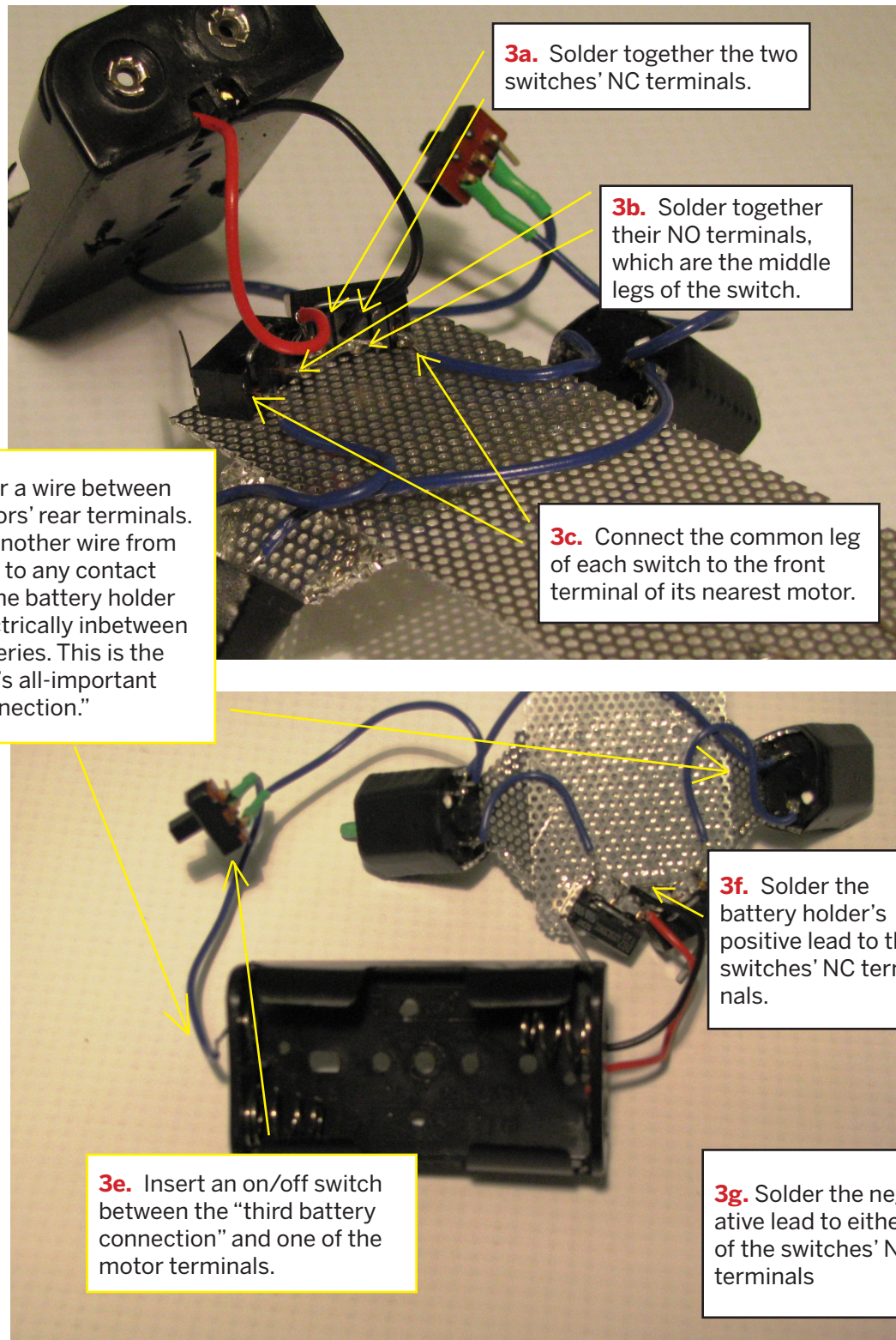


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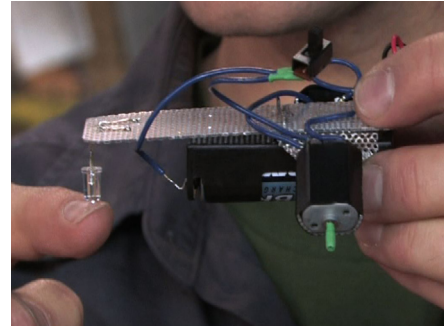


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Step 4. Attach a back “wheel”

Attach an LED to support the back of the robot and to prevent the BeetleBot from dragging.



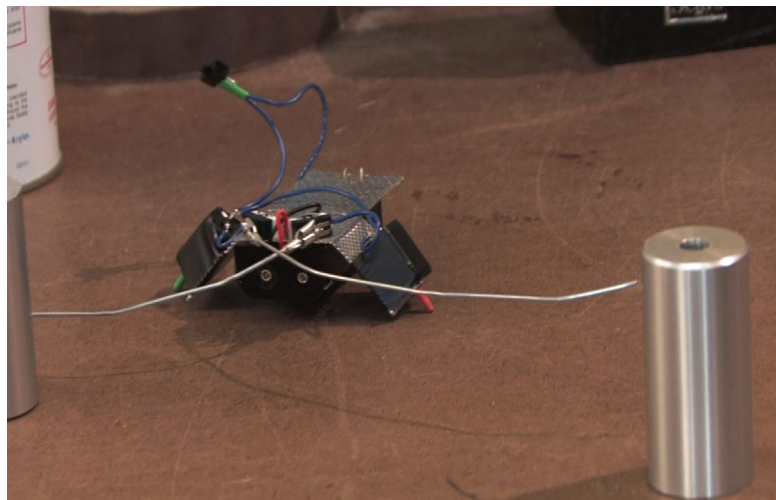
Step 5. Build the antennas

The BeetleBot's antennas are made from two spade connectors and two paper clips. First, straighten the paper clips. Then, slip the connectors over the paper clips, squeeze them tightly with pliers and solder them in place. (To attach the spade connectors, you may have to remove the insulation.) Clip the spade connectors onto the BeetleBot switch levers.



Step 6. Set the BeetleBot free!

Your robot is finished. Add two AA batteries, and it should come to life. If it spins in a tight circle or runs backward, you need to reverse one or both of the motor connections. To change the bot's speed or to make it move in a straight line, bend the metal plate to adjust the angles of the motors.



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Building small bots is lots of fun. It's not unusual to have to spend some time troubleshooting, disassembling, reassembling, and seeking guidance from other robot builders online and at local robotics clubs. Stick with it and your robots will come to life!

Resources:

For more information on the Solar Roller, see Solarbotics's detailed pdf instructions:

http://www.solarbotics.com/assets/documentation/k_mse_manual_-_may_3_2007.pdf

For more information on the BEAM robotics, visit:

http://www.beam-wiki.org/wiki/Main_Page

For BEAM robot kits and parts, visit:

<http://www.solarbotics.com/>

TELL US HOW YOUR MINI ROBOT WORKS!

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