

ENGINEERING GATORTRAX MATH EXCELLENCE PROJECT
ENGINEER-FOR-A-DAY LABORATORY MODULES
ELECTRICAL ENGINEERING: ROBOTICS
ELEMENTARY LEVEL

Introduction

Robotics is the science of making robots. Robots are designed to perform a certain task based on a given input. BEAM (Biological, Electronic, Aesthetic, Mechanical) robotics is a subset of robotics that is biologically inspired. BEAMbots use sensory inputs to signal an action. This is known as a nervous network. The example in this lab is light enabling the BEAMbot to roll.

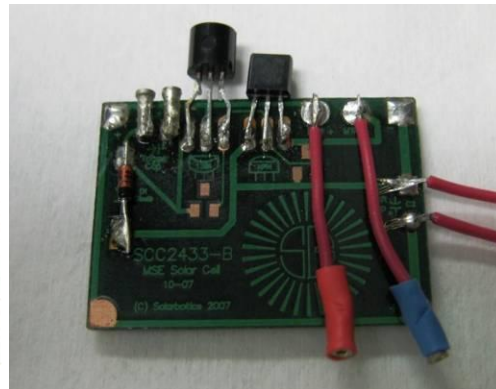
Objective

The objective of this lab is to build a BEAMbot, understand how energy is being transformed to power the bot, and then race them.

Materials for each Team

First, go through the material inside the box and make sure you have the following:

1. Solar cell with circuit on back



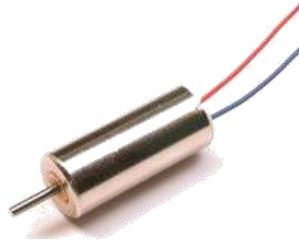
2. Timing capacitor



3. One storage capacitor



4. Motor



5. Three wheels

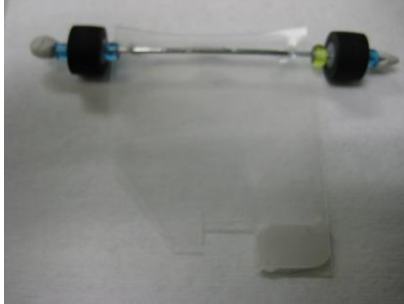


6. Glass beads
7. A small piece of red wire insulation
8. A piece of thick wire
9. Plastic frame
10. White putty
11. Two toothpicks
12. Two labels
13. One flashlight

How to Build the BEAMbot

The following procedures will show you how to assemble a BEAMbot:

- 1) Place the metal wire through the two holes in the clear plastic frame.
- 2) Place beads of your choosing and the two wheels onto the ends of the wire.



- 3) Secure the wheels and beads in place with a small amount of the putty.



- 4) Place a small amount of putty onto the underside of the front end of the plastic frame.



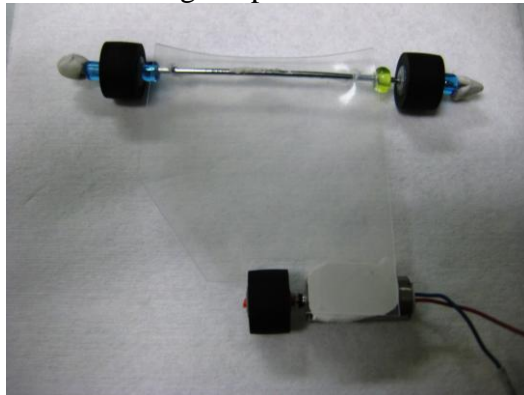
- 5) Find the small piece of red wire insulation and push a small portion of it onto the tip of the motor shaft.



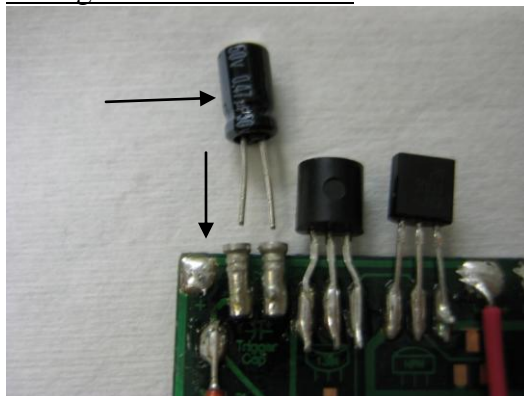
- 6) Then slide one wheel over the insulation and push it onto the motor shaft. Make sure your wheel spins freely afterward.



- 7) Stick the body of the motor to the putty you put on in step 4. Make sure the wheel is not touching the plastic frame and the whole assembly will roll straight.

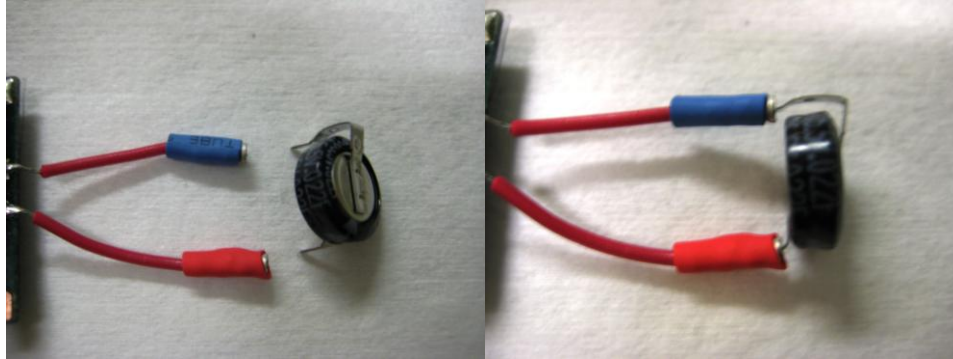


- 8) Now you are ready to finish the circuit. Put the timing capacitor into the sockets on the back of the solar cell. The pin below the gray stripe with a negative sign must go into the left socket.

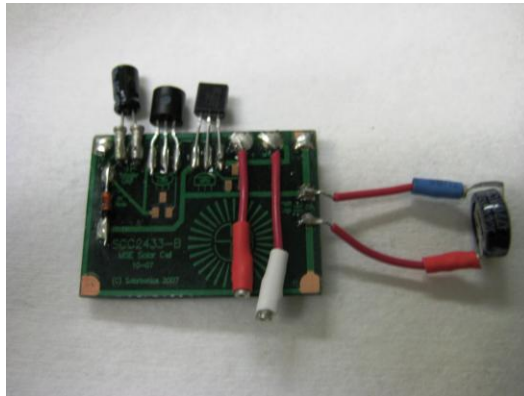


- 9) Place the storage capacitor into the wires coming off the short side of the solar cell. The lead (wire) attached to the top of the capacitor is the negative terminal

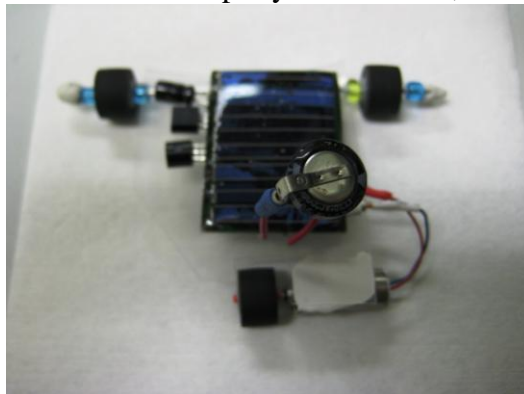
and must be attached to the blue or white wire on the solar cell. The bottom lead must be attached to the red wire.



Your final circuit should look like this.



- 10) Attach the last two wires on the circuit to the motor. Match the color of the wires for now. Secure the solar cell/circuit to the top of the BEAMbot frame with a small amount of putty. Remember, the lighter the solar roller, the better it will roll.



- 11) Create a BEAMbot name, write it onto the white labels and fold it around a toothpick making two flags. You can then stick the flag into the smaller hole in the plastic frame. Leave one side blank so that we can write your race time on it later.

BEAMbot Testing

This testing will see if your Solaroller works.

- 1) Take your flashlight and shine it directly onto the top of the solar cell while holding the front wheel of the BEAMbot off of the table. You may have to wait up to 30 seconds. After some time, the wheel should start spinning.
- 2) If the wheel does not spin, then go back and make sure you have everything connected correctly.
- 3) If you do see the wheel spin, set it down on the table and see if it rolls.
(Remember, the BEAMbot may not roll very far, yet.)

BEAMbot Experiment

You will be getting a better understanding of the engine (circuit) of the BEAMbot with these experiments.

Here you will be quantifying how long the motor is being powered by the energy stored in the capacitor.

- 1) **Case 1:** Hold the BEAMbot off of the table again. Shine the light onto the solar cell and watch the front wheel. Once the wheel starts turning, start counting (one Mississippi, two Mississippi,...). Figure out how many seconds the motor stays on.

Motor On Time (flashlight):_____

- 2) Do the same thing for when the motor is off.

Motor Off Time (flashlight):_____

3) Now graph the on/off times on the plot below.



4) **Case 2:** Go outside and repeat steps 1-3.

Motor On Time (sunlight): _____

Motor On Time (sunlight): _____



Qualitative Assessment:

What did you notice differently with the sunlight?

Quantitative Assessment:

Divide the motor off time of Case 1 by the motor on time of Case 2.

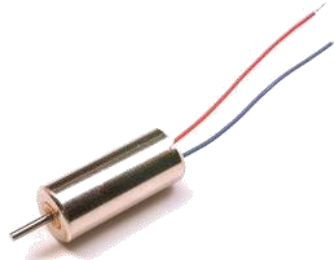
Motor Off Time (flashlight)
Motor Off Time (sunlight) =

Complete this sentence by drawing from your quantitative assessment above:

When being powered by the sun, the solaroller would travel _____ times the distance travelled by the solaroller powered by the flashlight.

Flow of Energy

- 5) Remembering the presentation, draw an arrow showing how energy flows from one component of the BEAMbot to the next.



You lab section is complete!

Now practice racing the solarroller to get ready for the timed race!