Robotic Sunflower Lesson 1:
Measuring Voltage Using a Microcontroller

Student Guide

Record all answers to questions, observations, and notes from the material in your engineering notebook. Proceed through each step per your instructor's prompt.

1. Watch/read the following web site tutorials prior to coming to class.
   a. Resistors (www.robotplatform.com/electronics/resistor/resistor.html)
   b. Photoresistors: www.robotplatform.com/electronics/photoresistor/photoresistor.html
   c. MAKE presents: The Capacitor: http://www.youtube.com/watch?v=ZYH9dGl4gUE
   d. Microcontrollers: http://www.robotplatform.com/electronics/microcontroller/microcontroller.html
   e. Collin's Lab: Schematics: http://www.youtube.com/watch?v=9cps7Q_IrX0
   f. MAKE presents: Ohm's Law: http://www.youtube.com/watch?v=-mHLvtGjum4

2. Obtain a multimeter, resistor, LED, connector wires and battery from your teacher.
   a. Learn how to use a multimeter by watching: http://www.youtube.com/watch?v=BW3Wj7UD-_s
      i. Check the continuity of each connector wire.
      ii. Check the resistance of the resistor. Compare the measured value to the labeled value.
      iii. Check the voltage of the battery. Reverse the contact to see what happens.
      iv. From the positive side of the battery connect the resistor with a connector wire, then from the other side of the resistor, connect the LED (long leg), and lastly connect the short leg of the LED to the negative terminal of the battery. Measure the voltage across each element of the circuit. What do the voltages of the resistor and LED sum to? How does this compare to the battery voltage?
      v. Now disconnect the LED from the negative terminal of the battery. Connect the multimeter negative probe to the negative side of the battery and the positive probe to the LED leg. What current does the LED draw from the battery?

3. Record resistance data for photoresistor and potentiometer.

4. Build Circuit 2. Use one multimeter to measure current and a second to measure the voltage drops across each component (pot and photoresistor). Perform measurements with at least 4 different lighting conditions and with at least 4 different pot settings. This gives a minimum of 16 measurements.

5. Analyze the circuit using Ohm's law. First calculate the values assuming the photoresistor is under full lighting conditions and the pot is turned all the way clockwise. Then calculate values with photoresistor under half lighting conditions and pot unchanged. Then calculate values with photoresistor in dark and pot unchanged. Next do calculations with photoresistor held constant and pot changing. Compare your calculations with the measured values from above. How do they compare? How can you account for any differences?

6. How does each component behave? For example, if you double the intensity of incident light on the photoresistor will the resistance change by a factor of 2 as well? What about the pot? Will turning it ¼ of a turn change the resistance by a factor of ¼? If not, then is there a model that can be used to determine how the resistance changes for a given input change? Design an experiment in which you can answer these questions.

7. What is the function of a capacitor? Why is it that a resistor is usually placed in series with a capacitor? What effect does changing the resistance in an RC circuit have on the circuit?

8. Explain how the RCTIME command works. Address each argument of the command and include a discussion of possible values returned.

9. Explain how you can use an RC circuit incorporating the photoresistor to measure light intensity.