Portland State
UNIVERSITY

Erebus Labs

STEM SENSORS

BASIC RESISTIVE SENSOR FUNDAMENTALS

Version *1.0*

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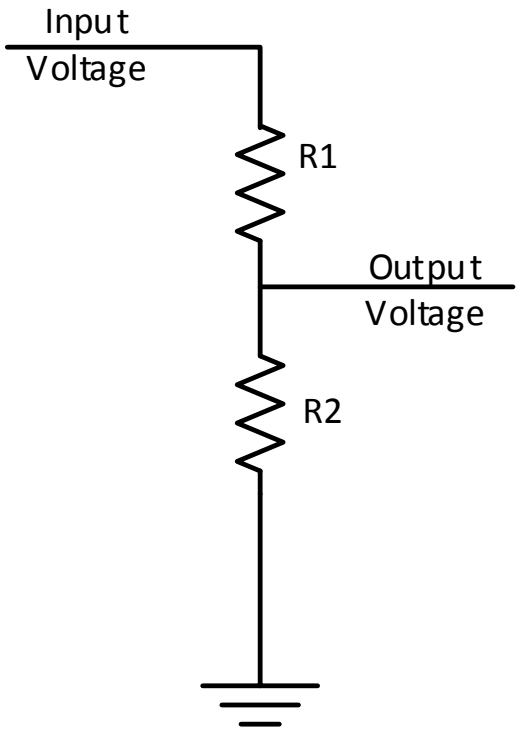
Your Erebus Labs STEM Sensor system includes two sensor modules:

1) Figaro T2600 low oxygen sensor.
2) Photocell ambient light sensor.

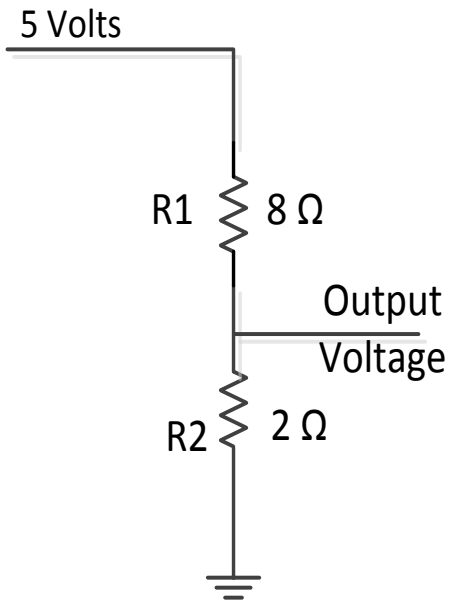
Both sensors are resistive operating in a voltage divider configuration. Below is the general description of a voltage divider topology.



Basic electrical fundamentals tell us that the entire input voltage will be dissipated across the two resistors, with each resistor dissipating some portion of this voltage. With this in mind, the output voltage can be determined from the resistance values of R1 and R2 as follows:

$$Output\ Voltage = Input\ Voltage\ \left(\frac{R2}{R1 + R2}\right)$$

Now examine a simple example of this topology. Imagine an input voltage of 5 Volts and a resistance of 8 ohms for R1 and 2 ohms for R2.



$$Output\ Voltage = 5\left(\frac{2}{8+2}\right)$$

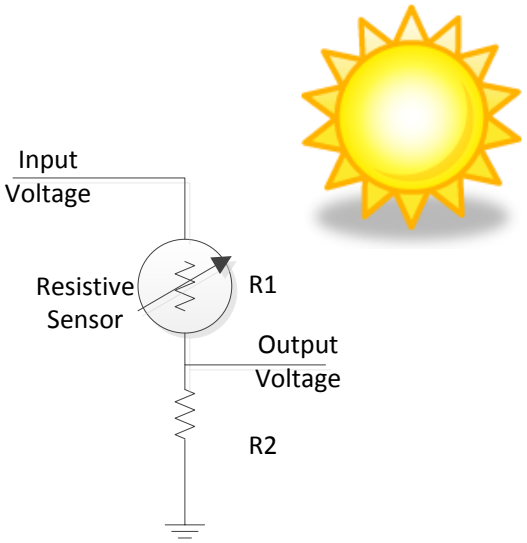
$$= 5\left(\frac{2}{10}\right)$$

$$= 5\left(\frac{1}{5}\right)$$

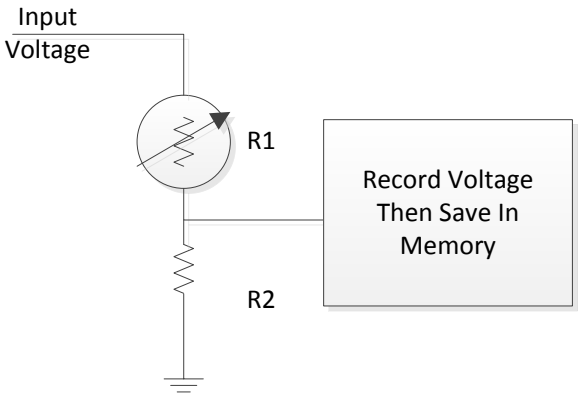
$$= 1\ Volt$$

We see that the outputted voltage will be $\frac{1}{5}$ the original inputted voltage, 1 volt. With these results we can speculate that the higher the resistance, the more voltage will be dissipated across it. In this case R1 dissipated 4 volts of the entire 5 volts!

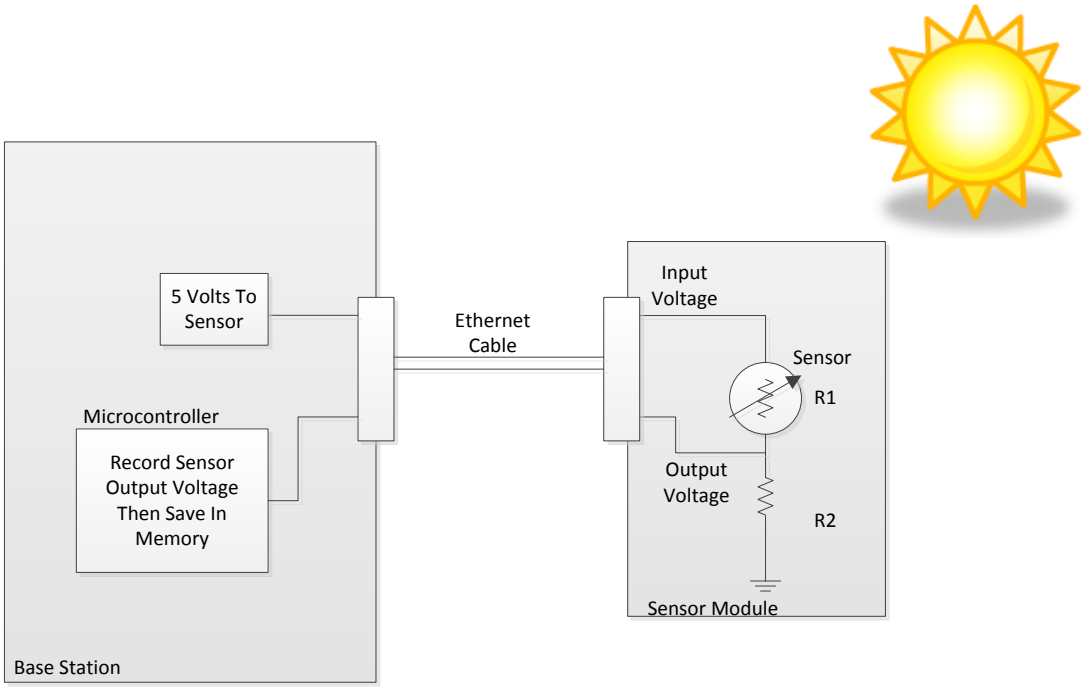
This concept can be used to represent the world around us using sensors and this topology.



Let us replace R1 with a resistive light sensor. The resistance of this component will change with respect to the amount of light seen by the sensor. This change in resistance will cause the output voltage to change as well. The world around is now represented by the amount of voltage seen at the output of this voltage divider! This changing output voltage can be recorded and saved to be analyzed at a later time. Imagine recording the outputted voltages throughout the day, as the sun passes through the sky overhead.



This basic configuration, although basic, is widely used for scientific measurements and is how the Erebus Labs STEM Sensor system collects its data.



The sensor modules are connected via Ethernet where the input voltage of 5 volts is sent from the base station into the sensor module. That 5 Volts is then dissipated across R1 and R2 of the voltage divider circuit. The amount of ambient light on the light sensor will change its resistance, and will create a unique output voltage that will be recorded and stored in the microcontroller back on the base station.

The other sensor module included with Erebus STEM Sensor system is the Figarao gas sensor. Although it is a little more complex than the photocell described above, it operates in the exact same way. Its resistance will change with respect to the amount of oxygen in its vicinity, outputting a unique voltage utilizing our voltage divider technique.

These are just two examples of resistive sensors! Can you think of where you would place these two sensors and what you would be trying to measure?