Teaching potential dividers with the BBC micro:bit

Teaching potential dividers can be tricky. In this activity, a BBC micro:bit has been programmed to give a visual display of the voltages over each component in a potential divider. The hope is that the simplicity of the display will help students understand what is going on.

In the circuits below, the GND (Ground or 0 V) pin of the micro:bit is connected to one end of the chain of five 1 kΩ resistors in series. The 3 V pin is connected to the other end. This means that there is a p.d. of 3 V across the resistor chain. A third lead is connected to pin 1 of the micro:bit. The code running on the micro:bit continually monitors the potential difference between pin 1 and GND. This is the potential difference across the right hand set of resistors (V1 in the circuit diagrams).

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The micro:bit display shows a bar chart representing V2 (left) and V1. One row does not represent one volt. Rather, the three volts have been split into 5 since the display has 5 rows.

Thus, we can see the following:

* The total “voltage” always adds up to 5.
* The voltage across 3 resistors is 3 units, across 4 it is 4 units and so on.

Perhaps we are cheating a bit – we do not actually measure V2, rather we subtract V1 from 5.

We can replace the resistor chain by an LDR and resistor (again, we used 1 kΩ) in series. Here, students can clearly see the voltage across the LDR rise when it is covered, and the corresponding voltage across the resistor fall.

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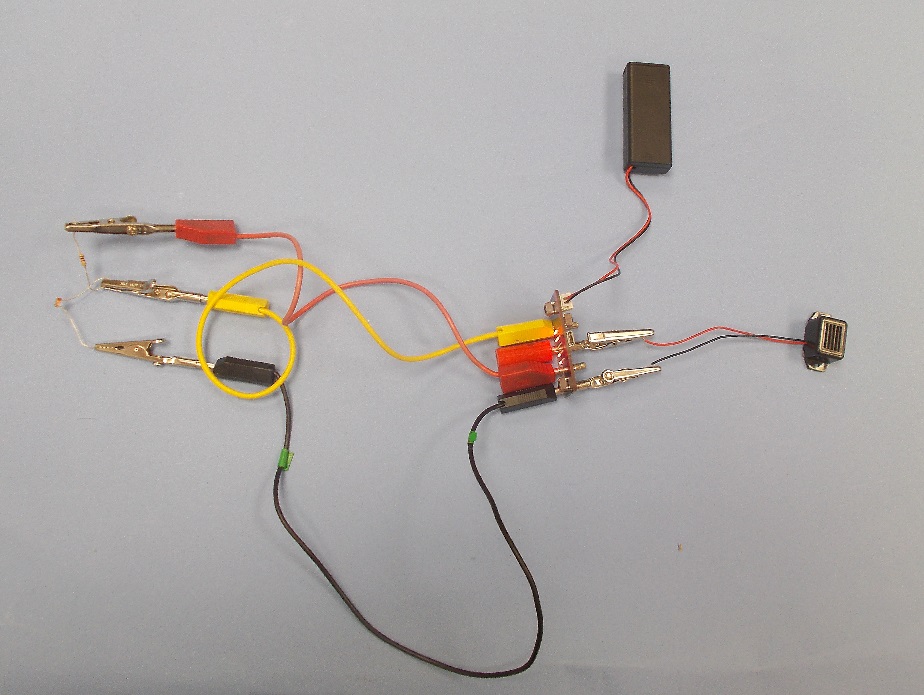
In fact, this program has another string to its bow. If V1, the voltage on the right, exceeds 2.1 V, a suitable device connected between pin 2 and GND will be switched on. Suitable devices include a 3 V buzzer or an LED with the correct series resistor. 2.1 V corresponds to 4 bars on the voltage display, and is, of course, the MOSFET switch-on voltage.

One version of the program displays a dot between the bars at the “switch on” level. Note that in the image below, an attached device would not switch on. It is V1, on the right, that has to be 4 bars or more.

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The circuit below shows a buzzer connected to pins 2 and GND.



The micro:bit continuously monitors the voltage between pin 1 and 0 V (GND).

If you are into programming, you might be interested to know that when the micro:bit reads a voltage, it represents it as a number between 0 and 1023. 0 corresponds to 0 V and 1023 to 3 V. 1.5 V would therefore be 512 and so on.

The program examines the voltage. It displays the appropriate number of bars according to the voltage. If voltage is above a certain level, it “writes” 3 V to pin 2. In other words, there is a potential difference of 3 V between GND and pin 2.

Anything connected across pins 2 and GND will have a potential difference of 3 V across it. We have found this to be large enough to operate a buzzer or LED (with series protective resistor).