

Light Intensity

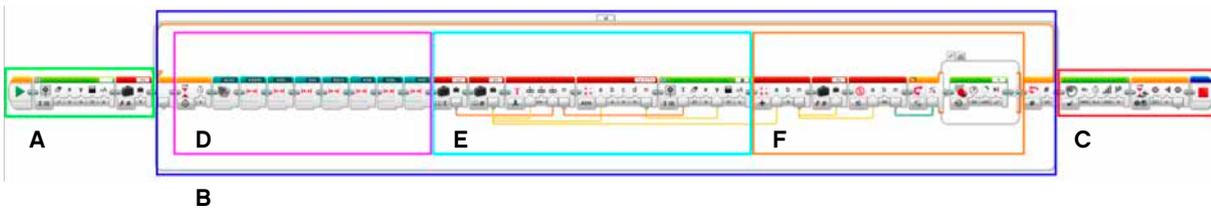
EV3 program description

The program "11" measures the light intensity of a 60W incandescent bulb (other types of bulbs can also be used) at ten points spaced at intervals of 5 cm.

Abbreviations used

- ol Outer Loop – Loop for 10 measurements
- ARI Arithmetic Mean – Loop for adding together multiple measured values to allow subsequent calculation of the arithmetic mean.
- out Output – Output value in W/m^2 that appears on the Brick Display
- in Input – Average value read in by the Color Sensor as a percentage
- dis Distance – Distance from the incandescent bulb in cm
- GCV3 Get Color Value – Performs 500 measurements of the ambient light level (as a percentage), determines the average value and saves the result to variable in
- RG049 Determines whether the measured percentage of ambient light lies within the range $[0; 50[$, in which case it generates output -
- RG5054 Determines whether the measured percentage of ambient light lies within the range $[50; 55[$ and generates a corresponding output in W/m^2
- RG7 Determines whether the measured percentage of ambient light lies within the range $[55; 59[$ and generates a corresponding output in W/m^2
- RG10 Determines whether the measured percentage of ambient light lies within the range $[59; 80[$ and generates a corresponding output in W/m^2
- RG8 Determines whether the measured percentage of ambient light lies within the range $[80; 86[$ and generates a corresponding output in W/m^2
- RG8694 Determines whether the measured percentage of ambient light lies within the range $[86; 95[$ and generates a corresponding output in W/m^2
- RG9 Determines whether the measured percentage of ambient light lies within the range $[95; 100]$, in which case it generates output -

Program summary



Start program

The program starts without any further interaction with the user (program part A). It measures the current light intensity a total of 10 times and outputs it on the Brick Display (program part B). The program uses standard tone A (440 Hz) to signal provisional completion of the experiment (program part C).

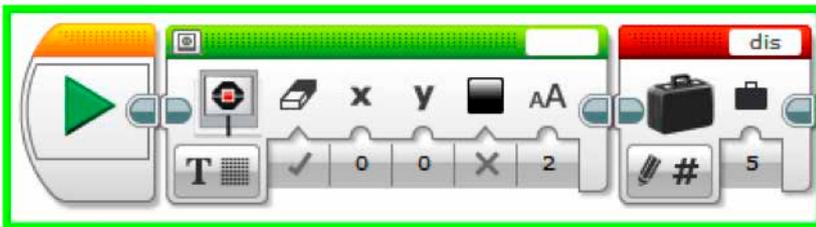
The measurement and output of light intensity (program part B) is broken down into three segments. First, the light intensity is measured. The result of the light measurement, expressed as a percentage, is saved to a variable and converted into W/m^2 (program part D). The measurement (in W/m^2) is shown on the Brick Display along with the distance from the incandescent bulb (in cm) (program part E). As long as a distance of 50 cm from the incandescent bulb has not been exceeded, the model will move on by an additional 5 cm (program part F).

Exit program

The program exits if the EV3 Center Button is pushed after provisional completion of the experiment.

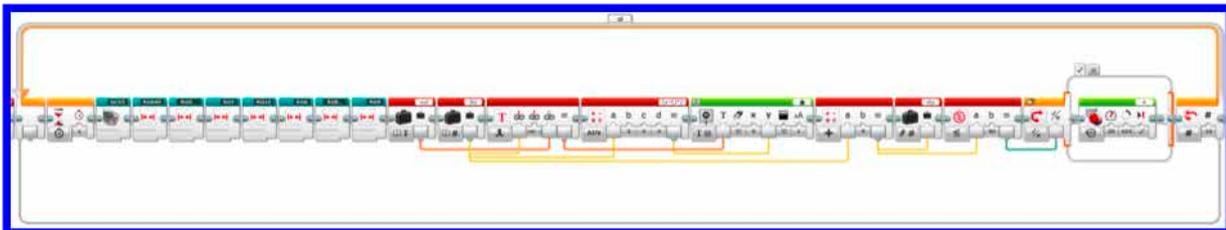
Program parts

Program part A



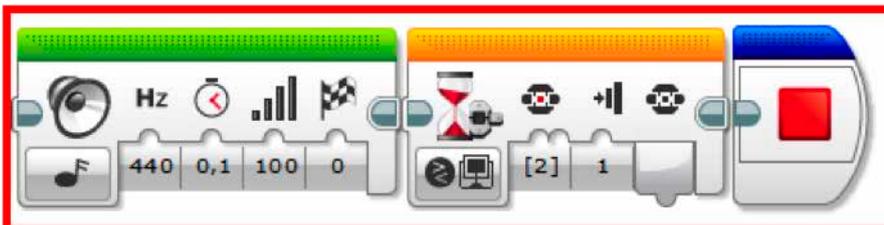
The Brick Display is cleared. The distance from the incandescent bulb is initialized at 5 cm.

Program part B



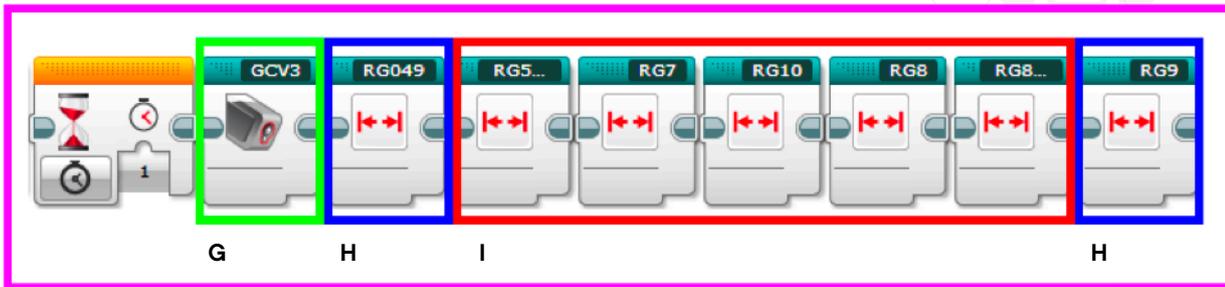
Light intensity is measured a total of 10 times in a loop. The sequences within the loop are described in detail in sections "Program part D" to "Program part F".

Program part C



Preliminary completion of the experiment is signaled by standard tone A (440 Hz). Pressing the EV3 Center Button exits the program.

Program part D



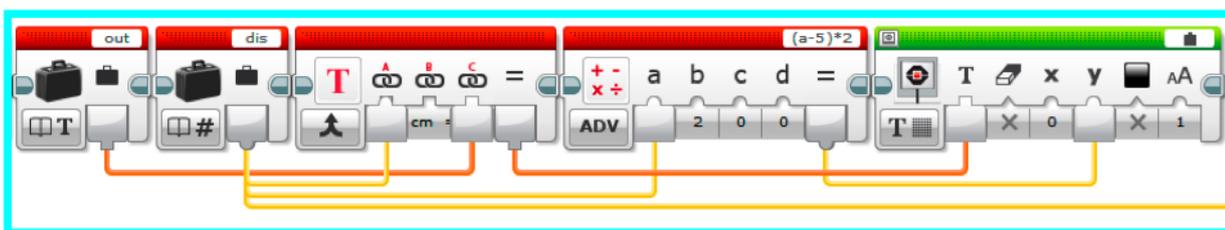
The model remains immobile for one second in order to prevent measurement errors. My Block GCV3 repeatedly measures ambient light as a percentage. The averaged measured value expressed as a percentage is recorded to variable in. Details regarding this can be found under “Program part G”.

My Block RG049 verifies whether the measurement returned a value below the permissible range. In this case, the variable out is set to -. Details regarding this can be found under “Program part H”.

Each of the subsequent My Blocks RG5054, RG7, RG10, RG8 and RG8694 verifies whether the measurement returned a value within a range specified for the respective My Block (see the section titled “Abbreviations used” for information in this regard). In the event of success, the value of variable in, expressed as a percentage, is used to calculate the corresponding light intensity in W/m^2 . This calculated value is saved to the out variable for subsequent output. Details regarding these largely identical My Blocks can be found under “Program part I”.

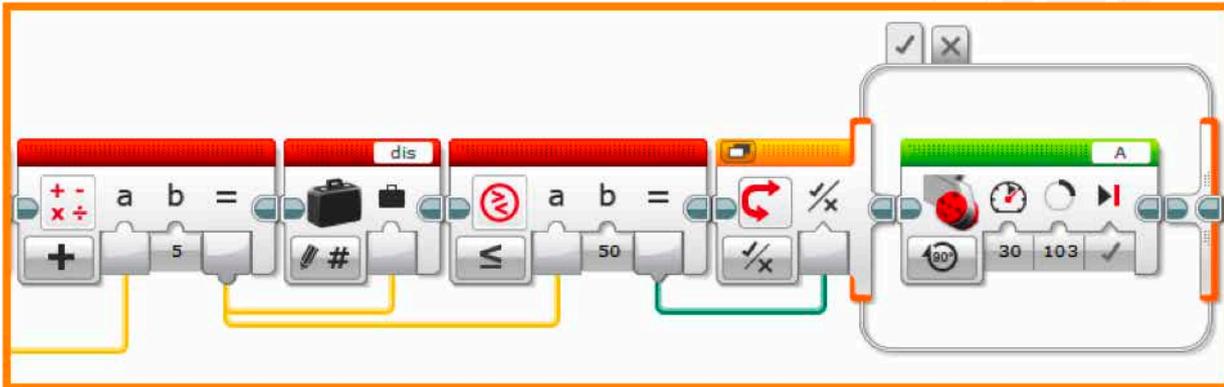
Similar to the first, My Block RG9 runs a check to determine whether the measurement delivered a value beyond the permissible range. In this case, the variable out is set to -. Details regarding this My Block can be found under “Program part G”.

Program part E



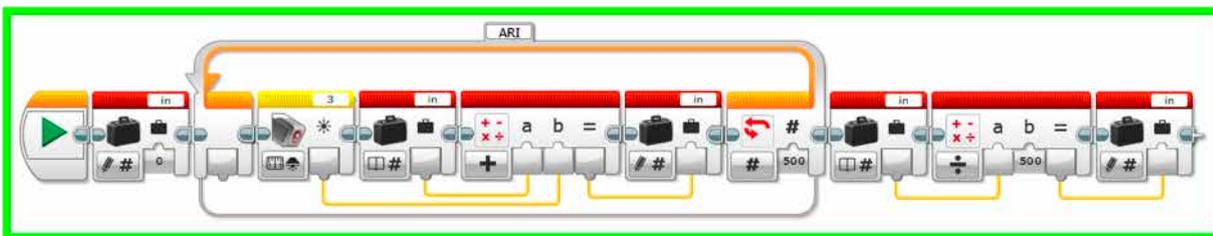
The light intensity determined in program part D is contained in variable out, expressed in W/m^2 . The current distance from the incandescent bulb is contained in variable dis, expressed in cm. Both values should be shown in a separate text line on the EV3 display. Here, the vertical position of the text line is calculated using the formula “ $(dis - 5) * 2$ ”. As the value of variable dis is increased by 5 each time the loop executes, this will result in y-values of 0, 10, 20, 30, etc.

Program part F



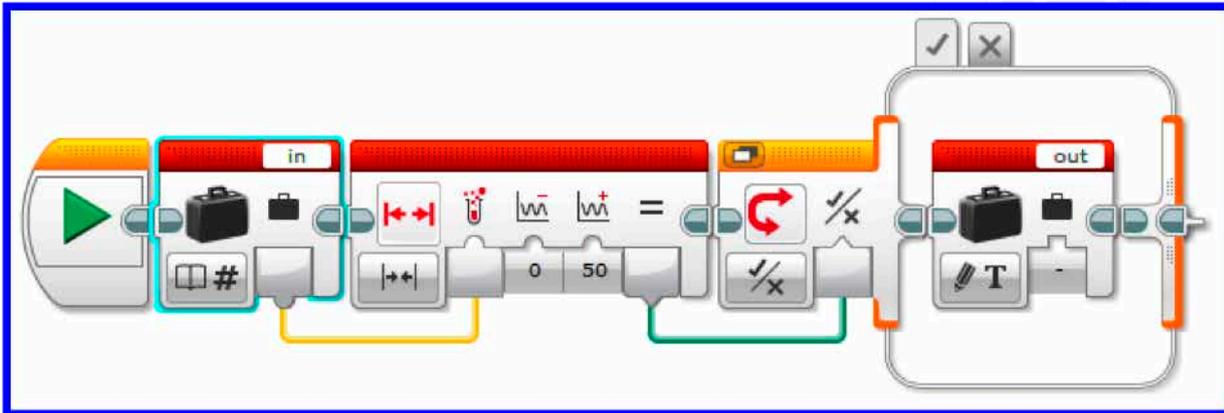
The distance from the incandescent bulb at which the next measurement is taken is increased by a value of 5. Given that a total distance of 50 cm has not yet been reached, the model moves away from the incandescent bulb by an additional 5 cm. At a wheel diameter of 5.6 cm, these 5 cm correspond approximately to a (rounded) motor rotation of 103°. The following holds: $103^\circ \approx 5 \text{ cm} * (360^\circ / 5.6 \text{ cm} / \pi)$.

Program part G



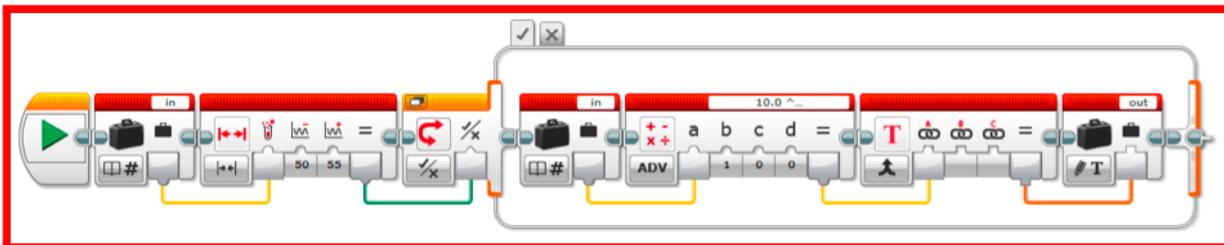
The variable in is initialized at a value of 0. Loop ARI adds together 500 sequential measurements of the ambient light level using the variable in. In order to obtain the arithmetic mean, the total contained in variable in is divided by the number of measurements (500). Thus, for the subsequent program segments, the average light intensity, expressed as a percentage, will be found in variable in.

Program part H



The previously determined measured value of ambient light, expressed as a percentage, is found in variable in. A range verification is performed on the content of this variable. Should the previously measured value actually be below 50% (RG049) or above 95% (RG9), the text “-” will be written in variable out. The content of variable out will be output on the Brick display at a later point (“Program part E”).

Program part I



The previously determined measured value of ambient light, expressed as a percentage, is found in variable in. A range verification is performed on the content of this variable. The program verifies whether the value lies within one of the following intervals:

- [50; 55[(in My Block RG5054)
- [55; 59[(in My Block RG7)
- [59; 80[(in My Block RG10)
- [80; 86[(in My Block RG8)
- [86; 95[(in My Block RG8694)

Should the previously measured value fall within the range tested for, the corresponding light intensity of a 60W incandescent bulb is calculated in W/m^2 and written to variable out. The content of variable out will be output on the Brick Display at a later point (“Program part E”).

The calculation of light intensity is based on a reference measurement using a Haenni Solar 118. As shown in the following diagram, the five permissible ranges are each approximated by a straight line on a logarithmic scale. Therefore, the five My Blocks only differ in terms of the range they cover and the corresponding linear equation.

