Automatic Headlights

Design car features that will improve nighttime driving safety.

Learning Objectives

Students will:

Explore the concept of Inputs and the way to control them
Explore the concept of a Wait for function

Vocabulary

Input, output, algorithm, pseudocode, Wait, Color Sensor, debug, ambient light, loop, Boolean logic, parallel programming

Grades

6-8

Subjects

Engineering, STEM, Coding

Duration

45-90 Minutes

Difficulty

Intermediate

Standards

NGSS
MS-ETS1-1. / MS-ETS1-2. / MS-ETS1-3. /MS-ETS1-4.

CSTA
2-A-2-1 / 2-A-7-2 / 2-A-7-3 / 2-A-7-4 / 2-A-5-5 / 2-A-5-6 / 2-A-3-9 / 2-A-6-10 / 2-C-7-11 / 2-C-4-12 / 2-D-5-16 / 2-I-1-20

Materials Needed

LEGO® MINDSTORMS Education EV3 core set.
LEGO MINDSTORMS EV3 Software or Programming app
ROBOTC software (optional).
Direct light source (e.g., flashlight)

Automatic Headlights

CONNECT (5 minutes)

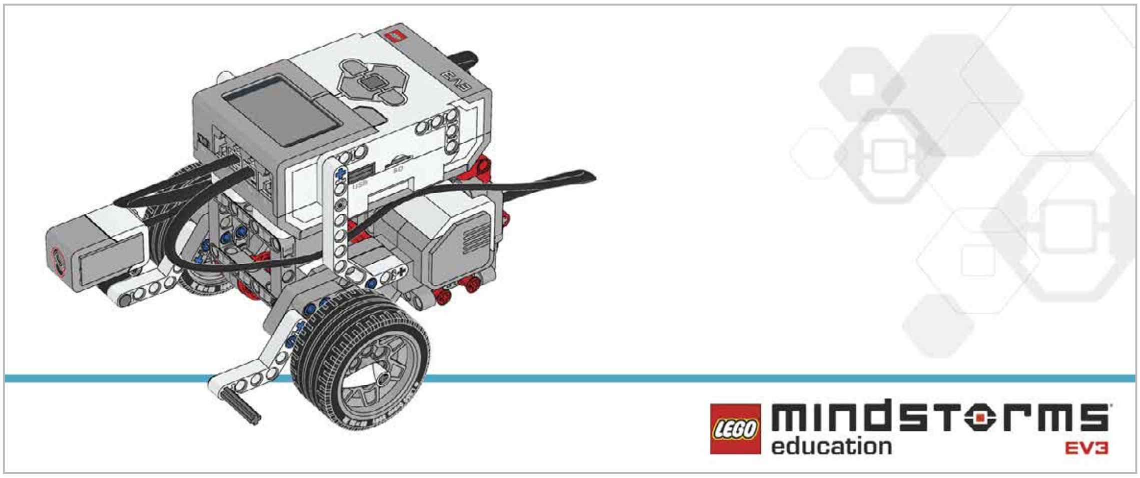
- What are the dangers of driving at night?
- How can we define the concept of ambient light?
- How can drivers be assisted in their nighttime driving?

Tell the students that during this lesson they will be exploring how changes in ambient light can trigger reactions in programs, and that control of a program through a decision is an example of Boolean logic.
Allow the students to select the tool(s) they find most appropriate for capturing and sharing their ideas. Encourage them to document their thoughts using text, videos, images, sketchnotes, or another creative medium.

CONSTRUCT (15 to 30 minutes)

Build

Students will construct the Robot Educator base model, then they will add the Color Sensor pointing forward.



Have the students perform the following building check before they program their robots:

- Are the wires correctly connected from the motors to ports B and C?
- Are the wheels correctly installed?
- Are the wheels rotating freely?
- Are the wires correctly connected from the Color Sensor to 3?

Program

Have the students begin a new project in the EV3 programming environment.
Introduce the Color Sensor and demonstrate to the students that it has three modes:

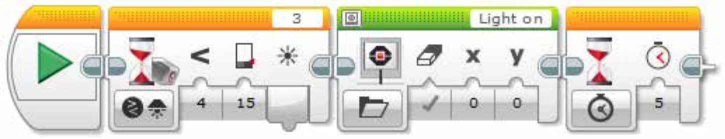
- Color, which detects LEGO® system colors
- Ambient Light Intensity, which detects light levels
- Reflected Light Intensity, which measures the light from the Color Sensor that is reflected off of a nearby surface back to the sensor

Have the students write a program using the Color Sensor in Compare Ambient Light Intensity mode to simulate automatic headlights.
Students can use various methods to simulate the headlights, such as:

- Displaying an image of a light bulb on the EV3 Brick Display
- Using colors of the on the EV3 Brick

Allow the students to select the tool(s) they find most appropriate for capturing and sharing their pseudocode. Encourage them to use text, videos, images, sketchnotes, or another creative medium.

POSSIBLE SOLUTION
FILENAME: CODING-03.EV3 (Tab:1)



AUTONOMOUS AMBIENT LIGHT DETECTION
1. Start the program.
2. Wait for the level of ambient light intensity to drop below 15.
3. Show a light bulb on the EV3 Brick Display.
4. Wait for 5 seconds.

Program solutions for this lesson are available for download at:
http://www.LEGOeducation.com

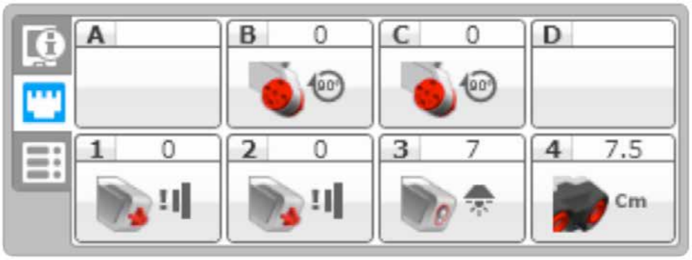
Note

Refer students to the Robot Educator Tutorials for further assistance.

In the EV3 Software :

Robot Educator > Basics > Loop
Robot Educator > Hardware > Color Sensor - Light
Robot Educator > Beyond Basics > Multitasking
Robot Educator > Hardware > Brick Display

Show the students how to use the Port View in the EV3 Software to take readings of ambient light (e.g., Port View showing ambient light intensity, port 3).



Explain that they will be exploring how loops work and how to incorporate these into their programs. Explain the concept of a loop and how it can be used to make programs run indefinitely, until manually stopped.

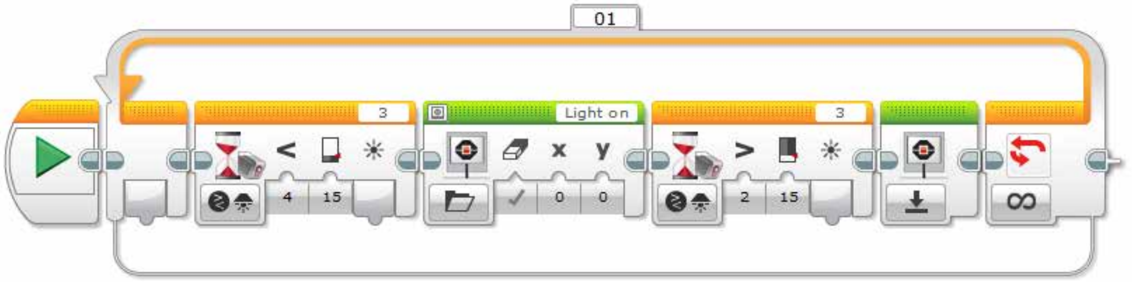
Setup

Have students point a flashlight at the Color Sensor to create a change in ambient light luminosity.

CONTEMPLATE (35 minutes)

Students will create a program that reacts to changes in ambient light intensity, and which simulates automatic headlights more closely. The program will need to turn the lights on when it becomes dark and turn the lights off when it becomes light again.
Highlight that the ambient light intensity settings in their programs will need to be constantly monitored and debugged to ensure that the program is operating correctly.

POSSIBLE SOLUTION
FILENAME: CODING-03.EV3 (Tab:2)



REPEAT OF AUTONOMOUS AMBIENT LIGHT DETECTION
1. Start the program.
2. Wait for the level of ambient light intensity to drop below 15.
3. Show a light bulb on the EV3 Brick Display.
4. Wait for the level of ambient light intensity to rise above 15.
5. Reset the EV3 Brick Display.
6. Repeat steps 2 to 5 forever.

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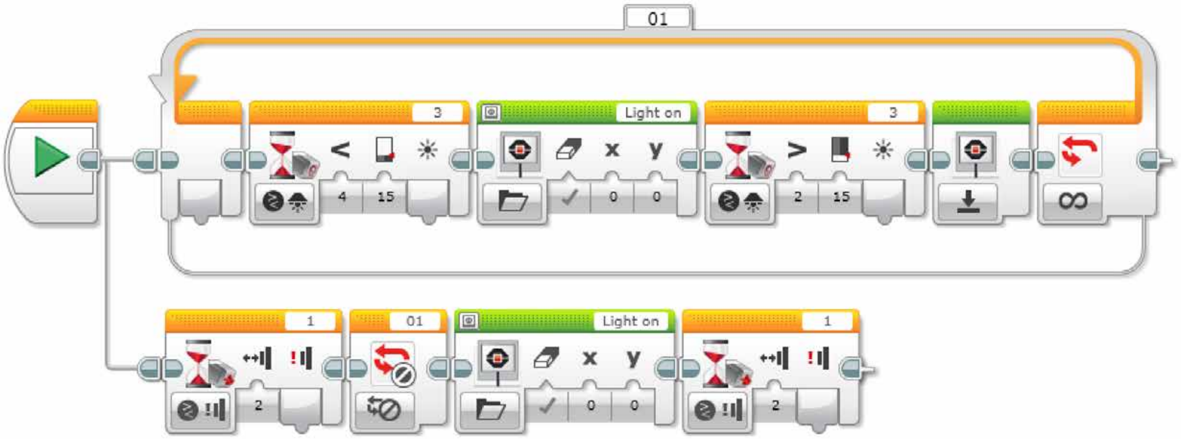
Differentiation Option

Students will use multitasking/parallel programming to simulate automatic and manual light switches.
They can use a Touch Sensor or the Brick Button to simulate the manual switch.
Using the Touch Sensor or the Brick Button as a manual override introduces students to the use of Boolean logic.
Demonstrate to the students how to drag a “wire” from the Start Block in order to create a parallel program (i.e., multitasking).
Show the students the Loop Interrupt Block and explain that we can use this block to stop whatever is happening within the loop in the parallel program.

POSSIBLE SOLUTION
FILENAME: CODING-03.EV3 (Tab:3)



MANUAL CONTROL OVER AUTONOMOUS AMBIANT LIGHT DETECTION
1. Start the program.
TASK 1
2. Wait for the level of ambient light intensity to drop below 15.
3. Show a light bulb on the EV3 Brick Display.
4. Wait for the level of ambient light intensity to rise above 15.
5. Reset the EV3 Brick Display.
6. Repeat steps 2 to 5 of Task 1 forever.
TASK 2
7. Wait for the Touch Sensor (simulating the manual light switch) to be “bumped”.
8. Interrupt the Loop named “01” (override the automatic program).
9. Show a light bulb on the EV3 Brick Display.
10. Wait for the Touch Sensor to be “bumped” again (the light will go off because the program ends).

Program solutions for this lesson are available for download at:
http://www.LEGOeducation.com

Share

Allow the students to select the tool(s) they find most appropriate for capturing and sharing their creations, unique thinking, and learning process. Encourage them to use text, videos, images, sketchnotes, or another creative medium.
Ask one or two groups to demonstrate their programs.
Ask the students to share what they expected to happen vs. what actually happened with their programs.
Ask them whether anything about the results of their programs surprised them.

Assessment Opportunity

Specific rubrics for assessing computational think can be found under 'Assessment'.

CONTINUE (45 minutes)

Using text-based programming

Have the students explore text-based programming solutions so they can compare different programming languages.

IMPORTANT

The following is a possible solution using the text-based programming language ROBOTC. You may choose to use any other LEGO MINDSTORMS Education EV3 compatible text-based programming languages.

LEGO Education has no ownership of the ROBOTC platform and does not provide any support or guarantee of the quality of the user experience and technology used. All required set up information is provided by ROBOTC at http://www.robotc.net/. We recommend always to reinstall the official LEGO MINDSTORMS EV3 Brick firmware when you finish using other programming languages.

POSSIBLE SOLUTION
FILENAME: CODING-03_1.C

```
#pragma config(Sensor, S1, touchSensor, sensorEV3 _ Touch)
#pragma config(Sensor, S4, sonarSensor, sensorEV3 _ Ultrasonic)
#pragma config(Motor, motorB, rightMotor,tmotorEV3 _ Large, PIDControl,
driveRight, encoder)
#pragma config(Motor, motorC, leftMotor, tmotorEV3 _ Large, PIDControl,
driveLeft, encoder)

/*
Create a program that turns on the lights automatically using the Color
Sensor when the ambient light level drops below a certain level.
*/

task main()
{
  //Wait for the level of ambient light intensity to drop below 15.
  while(getColorAmbient(colorSensor) >= 15)
  {
        //Do nothing while we’re waiting.
        sleep(1);
  }
  //Display Image “Light on” on the LCD Screen.
  drawBmpfile(0, 127, “Light on”);
  //Stay on for 5 seconds.
  sleep(5000);
}
```

Program solutions for this lesson are available for download at:
http://www.LEGOeducation.com

WHAT IS NEXT?

Line Detection