Program Your Robot to Perform a Task

Description
In this activity, students gain hands-on experience with programming a robot to perform tasks.

This activity includes seven task challenges. Students will work in teams with a time boundary to perform as many task challenges as possible. Be sure to consult the “Materials” section before beginning the activity to ensure you have all that you need to complete the challenges.

Challenge 4 requires a ramp with balls inserted into holes along the ramp’s perimeter. See Figure 1 in the Procedure section for an example.

Students will be required to work with inputs and outputs under various conditions within the computer program.

Lesson Outcomes
Students will be able to:
- Use programming software to create a set of instructions for the robot to perform a task
- Upload the program to the robot
- Troubleshoot errors in the computer program code
- Adapt programming code to solve a challenge more efficiently
- Effectively communicate and work in a team
- Use appropriate terminology to describe the components in their electronic circuit

Assumptions
Students will have:
- Some experience with computer programming and sensors
- Some experience with computer interfaces, saving and opening files

Key Terminology
Rolling platform robot: a basic robot that can move from one location to another.

Estimated Time
3+ hours

Recommended Number of Students
2–3 students per robot team
Facilities
Any classroom with tables
Robot testing area: table that is 120 × 240 cm, 120 × 120 cm, etc. (4' × 8', 4' × 4', etc.)

Tools
Computers and programming software
Tools are platform-specific based on the robotics platform selected
A basic tool kit that includes pliers, wrenches, nail files (to round off sharp corners)

Materials
Robot kits (e.g., VEX EDR, VEX IQ, LEGO Mindstorms)
A ramp with small balls (see Figure 1)
Objects of various sizes that the robot will pick up

Resources
VEX Robotics
http://www.vexrobotics.com/

LEGO
http://www.lego.com/en-us/mindstorms

Computer programming examples:
Program your LEGO NXT Robot
https://vsbrobotics.wordpress.com/program-your-lego-nxt-robot/

Program your VEX IQ Robot
https://vsbrobotics.wordpress.com/program-your-vex-iq-robot/

Program your VEX EDR Robot
https://vsbrobotics.wordpress.com/program-your-vex-robot/

Website forums for team-to-team or peer-to-peer online discussions:
VEX IQ Forum
http://www.vexiqforum.com/

VEX EDR Forum
http://www.vexforum.com/

FIRST Forums
http://forums.usfirst.org/
Procedure

First, teams will build a rolling platform robot on wheels that has components to pick up objects and release them.

Next, have various objects available for the robot to pick up and drop off. Students may make additional attachments such as a small arm or claw to help to help to complete the challenge.

Also, have a ramp built with balls inserted into holes along the ramp’s perimeter (Figure 1).

Figure 1—Ramp with balls inserted into holes

The following challenges are not intended as classroom competitions but rather as in-class exercises that will give a better understanding of how to use computer programs to enable robots to perform various tasks. Each activity should be demonstrated in front of the teacher and/or the entire class. The criteria for each activity can be decided based on available materials, space and student ability.

Challenge 1
Write a computer program to move the rolling platform robot forward for a few seconds and stop. Install the program into the robot and test your program; revise as necessary.

A video example of Challenge 1
http://youtu.be/5Wk3hXGI-N-I

Challenge 2
Write a computer program to move the rolling platform robot forward for a few seconds, turn around and return to the starting position. Install the program into the robot and test your program; revise as necessary.

A video example of Challenge 2
http://youtu.be/D-Byf8K--2Q
Challenge 3
Write a computer program to move the rolling platform robot forward for a few seconds, turn left or right, move forward for a few more seconds, then return to the starting position. Install the program into the robot and test your program; revise as necessary.

Challenge 4
Write a computer program to move the rolling platform robot forward and up a ramp (Figure 1) and knock the balls off, then return to the starting position. Install the program into the robot and test your program; revise as necessary. Each ball knocked off counts as a point toward this challenge.

Challenge 5
Write a computer program to move the rolling platform robot to pick up an object and return the robot to its starting spot. Install the program into the robot and test your program; revise as necessary.

Challenge 6
Write a computer program to move the rolling platform robot to pick up an object, deliver it to a specific location and return the robot to the starting spot. Install the program into the robot and test your program; revise as necessary.

A video example of Challenge 6:
http://youtu.be/xBZRK1NunFQ

Challenge 7
Write a computer program to move the rolling platform robot to pick up an object and deliver it to a specific location. Install the program into the robot and test your program; revise as necessary.

Next, have the robot pick up a second object, stack it on top of the first object, then return the robot to its starting spot.

Extension Activities
Additional activities that can be added as an extension of this activity can be found under “Classroom Challenges” at:
Jr. Robotics: a place for teachers, students and parents
https://vhsbrobotics.wordpress.com/
Assessment

The evaluation of this lesson is based on the learning outcomes outlined above.

Prior to teachers using the evaluation grid it is recommended that students perform some form of peer-assessment and self-assessment.

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<thead>
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<th>Outcome To Be Assessed</th>
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<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
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<tbody>
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<td><strong>Outcome 1</strong></td>
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<td>Using programming software</td>
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<td>1.1 Successfully writes programs to perform robot tasks.</td>
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<td>1.2 Robot responds as expected.</td>
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<td>1.3 Attempted a variety of task challenges.</td>
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<td>Troubleshooting errors</td>
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<td>2.1 Effectively responds to errors and course-corrects.</td>
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<td><strong>Outcome 3</strong></td>
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<td>3.1 Division of work.</td>
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<td>3.2 Effort of each team member.</td>
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<td><strong>Outcome 4</strong></td>
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<td>Understanding Key Terminology</td>
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<td>4.1 Demonstrates the use of Key Terminology.</td>
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<td>4.2 Applies terminology appropriately.</td>
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Total Points:

- 6 Completed successfully at the exceptional level
- 5 Completed successfully at higher than the expected level
- 4 Completed successfully to the expected level
- 3 Attempted successfully to the minimum level
- 2 Attempted - Unsuccessful - Close to Successful
- 1 Attempted - Unsuccessful
- 0 Not Attempted

Comments: