

Week 5 - Overview

This week we will cover different ways of controlling the robot based on sensor feedback. The simplest way to control the robot is called a two-level controller. Based on the values of the sensors, there are only two states the robot can be in - usually stopped or moving. This method can lead to errors due to the robot inconsistently overshooting its target. We will also look at a 3-level controller which corrects for overshooting. We will use a proportional controller to allow the robot to slow down before it gets to its target. The first step is to look at the error between where the robot is, and your target. The power is proportional to this error. We will use this with both the ultrasonic distance sensor and the gyro sensor.

Computer Science Skills

- Two-level controller
- Proportional controller
- Set-point
- Gain function
- Error functions
- Boolean statements
- Tuning a controller
- Overpowered and underpowered controllers
- Using indices

STEM Skills

- Proportional or linear equations
- Using data tables
- Converting fractions into decimals
- Graphing linear functions
- Slope and y-intercept of a linear graph

CoderZ Techniques

- Using floating point variables
- Using nested math blocks
- Using variables
- Using IF Switches

Implementation Thoughts

During the first lesson, allow the students to explore the inaccuracies in the programs with the two-level controller. Guide the student as to how slowing the robot down may help with accuracy, but the slower speed may be inefficient. This will set the stage for the later solutions. When introducing the proportional controller, have the students think about examples in real life where the power is proportional to the error. Driving a car is a great example. Landing an airplane or rocket ship is another good example. You have the option of integrating a lot of math and linear functions into this week's lesson. When you cover tuning the controllers, the behavior of an overpowered controller may seem erratic. The robot will constantly overcorrect for its errors.

Lesson 1: Two-level Controller

- Using the touch sensor
- Using the ultrasonic sensor to stop
- Using the gyro to stop
- Define a Boolean condition
- Exploring speed vs accuracy

Lesson 2: Slow Down

- Coding the robot to slow down
- Using math blocks to control the robot
- Using dynamic sensor feedback
- Introduce gain and setpoint functions

Lesson 3: Gain and Setpoint

- Combining gain and setpoint in the same code
 - Tuning the controller
 - Using variables for gain and setpoint
 - Optimizing the code
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Lesson 4: Spinning

- Using the proportional controller with the gyro
- Using a 3-level controller
- Integrating a gyro and ultrasonic controller

Lesson 5: Amazing Part 2

- Navigating the maze using our new tools
- Using proportional gyro controllers
- Using switches and IF-ELSE statements
- Making decisions
- Using indices