Lesson 7: Analog Input

Overview

In this lesson, students explore how the three analog sensors (sound, light, and temperature) can be used to write programs that respond to changes in the environment. The use of these sensors marks a transition in terms of how users interact with a program. By using sensors as an input, the user of an app doesn't have to directly interact with it at all, or may interact without actually realizing they are doing so.

Purpose

This lesson builds on the previous by introducing analog sensors as a new form of input. These sensors all perform analog-to-digital conversion, allowing programs to sense things as represented by a 10 bit number (0-1023).

Assessment Opportunities

1. **Develop programs that respond to analog input**

   Code Studio: See rubric on bubble 11

2. **Scale a range of numbers to meet a specific need**

   Code Studio: See rubric on bubble 11

3. **Represent a sensor value in a variety of ways**

   Code Studio: See rubric on bubble 11

Standards

Full Course Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming
- ▶ **CS** - Computing Systems

Agenda

Warm Up (5 minutes)
Analog and Digital

Activity (35 minutes)
Analog Inputs

Wrap Up (5 minutes)
Sensors All Around

Objectives

Students will be able to:

- Develop programs that respond to analog input
- Represent a sensor value in a variety of ways
- Scale a range of numbers to meet a specific need

Preparation

- Cue up the **Difference between Analog and Digital Signals**
- If your room isn't very bright, it's useful to have some flashlights or other light sources on hand for testing the light sensor

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the teachers

- **Analog Sensors** - Resource
- **CSD Unit 6 - Physical Computing** - Slides
- **Changing Sensor Scale** - Resource
- **Date and Change Events** - Resource

For the students

- **Difference between Analog and Digital Signals** - Video

Vocabulary

- **Analog** - Any continuously changing signal that is not restricted to finite set of values. For example, the wave forms of spoken words are an analog signal.

- **Digital** - Data or signals represented by a finite number of values. Analog signals (which can have infinite values) must be converted to digital in order to be computed with.

Introduced Code

- `lightSensor`
- `soundSensor`
- `soundSensor.setScale(low, high)`
- `soundSensor.value`
- `tempSensor`

Teaching Guide

Warm Up (5 minutes)

Analog and Digital

Think, Pair, Share: How would you quantify each of your five senses (touch, taste, sight, smell, and hearing). Think back to the previous unit and the various ways you came up with to encode data for a computer.

Discussion Goal

The goal here is to get students thinking about how an natural (or analog) value can be converted into a computable format. Encourage students to consider what the upper and lower bounds of each value might be (for example, is there a minimum or maximum amount of sound?).

Video: Today we're going to write programs that have "senses" of their own! Show **Difference between Analog and Digital Signals - Video**

Activity (35 minutes)

Analog Inputs

Distribute: Pass out Circuit Playgrounds.

Transition: Send students to Code Studio. Let them know that today they will be experimenting with some sensors that detect Analog signals and convert them to Digital values that can be used by the computer.

1 **Sensor Experiment**

2-4 **Reading Sensors**

2 3 4

5-8 **Sensor Events**

5 6 7 8

9-11 **Sensors to Colors**

9 10 11

Assessment Opportunity

Level 11 You can use this level as a formative assessment for students. Click inside the level to view a rubric and leave feedback to your students

12 **Extra Challenge**

Wrap Up (5 minutes)

Sensors All Around

Journal: Considering all of the computing devices that you interact with on a regular basis, identify as many potential analog sensors as you can. Where do your computing devices take a continuously changing signal and convert it into digital data?