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Robot Name: Arduino

Project Railway Crossing

ACTIVITY: Servo Motors

Grade Level	7-8	**Difficulty**	Beginner
Subject	Practical and Applied Arts Science Mathematics		
Description	Each project is broken up into several circuits, the last circuit being a culmination of the technologies that came before. The purpose of these projects is to help students learn about new technologies and concepts. This first project is titled “Railway Crossing” and is divided up into several activities. By completing these activities, students will be given the knowledge and skills to design, build, and program their own a railway crossing using a distance sensor that will trigger the lights, sounds, and the railway arm. In this Activity, students will learn about learn how to control a servo motor using a rotary knob (potentiometer). They will then learn how to automate the servo by timing it to move in a specific sequence		
Outcome(s)	Supports: **PAA** - **Electronics Modules** - ELEC02A, ELEC04A; **Robotics Modules** - Module 6: Troubleshooting A, Module 9: Debugging Circuits, Module 11A: Basic Electricity A, Module 12A: Solderless Breadboards A, Module 14A: Drawing Circuits A, Module 20: Hardware / Software Interface; Module 22A: Output A, Module 26A: Block-Based Coding A; **Science** - CE9.1, CE9.2, PW1 **Math** P7.3, SS7.1, SS7.3, SS7.4, P8.1, N8.3, SS9.1		
Required Prior Learning	Getting Started: Activity One - Downloading Programs for Arduino		
Time Frame	One hour		
Materials	Computer, Arduino Uno Board, USB cable, Breadboard, Potentiometer, Servo, Six jumper wires, Scissors		
Assessment	Review lesson ending questions with students for understanding and future application.		

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Activity: Servo Motors

Procedure

Review the organization of the kit and how groups need to be careful with all the components, how they are used, and how they need to be kept organized and put back into their place when done.
Divide your class into groups of two (Paired Programming). Paired programming is highly recommended when working with coding and robotics so that students can piggyback off each others ideas and strengths.

Students will learn how to control a servo. In simple terms it is a simple motor which tracks the angle. It is very useful in robotics to control steering or direction. Servos can rotate from 0 Degrees to 180 Degrees.

Extension: Students can complete the extension challenges once they have done the first program

Student Handouts

Activity - Servo Motors

Assessment Guide

Circulate the room observing and assisting with students so that they can complete the project. Correct the assignment sheet as a class ensuring that students share their errors and successes while reinforcing the importance of persistence and patience in programming.

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Activity: Servo Motors

Purpose: In this activity, you will learn how to wire a servo and control it with code. Servo motors can be told to move to a specific position and stay there. Low-cost servo motors were originally used to steer RC airplanes and cars, but they have become popular for any project where precise movement is needed.

Materials:
Computer, Arduino Uno Board, USB cable, Breadboard, Potentiometer, Servo, Six jumper wires, Scissors

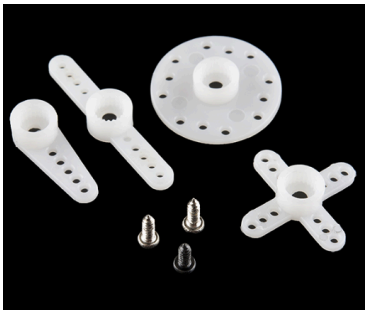
New Components:

Servo Motor: Servo motors have three wires: one for power, one for ground and one for signal. When you send the right signal through the signal wire, the servo will move to a specific angle and stay there. Common servos rotate over a range of about 0° to 180°.

BROWN is GROUND
RED is POSITIVE
ORANGE is DATA (assigned to a pin on the Arduino)

Note: Its best to avoid driving the servo all the way to 0 or 180 degrees. It can cause the motor to jitter, which is bad for the servo. So typically a range of 20-170 works best.

Servo Motor Components: Included with your servo motor you will find a variety of motor mounts that connect to the shaft of your servo. You may choose to attach any mount you wish for this circuit.



Potentiometer (pot): A potentiometer is a 3 pin variable resistor. The middle pin outputs a voltage between 0 and 5 volts depending on the position of the knob. The more volts that the pot allows to travel through the circuit, the greater the volume, speed, or intensity of the function will be. We need to hook up the pot to one of the analog pins which are labelled A0 to A5. The inside post of the “pot” needs to be hooked to an analog pin.

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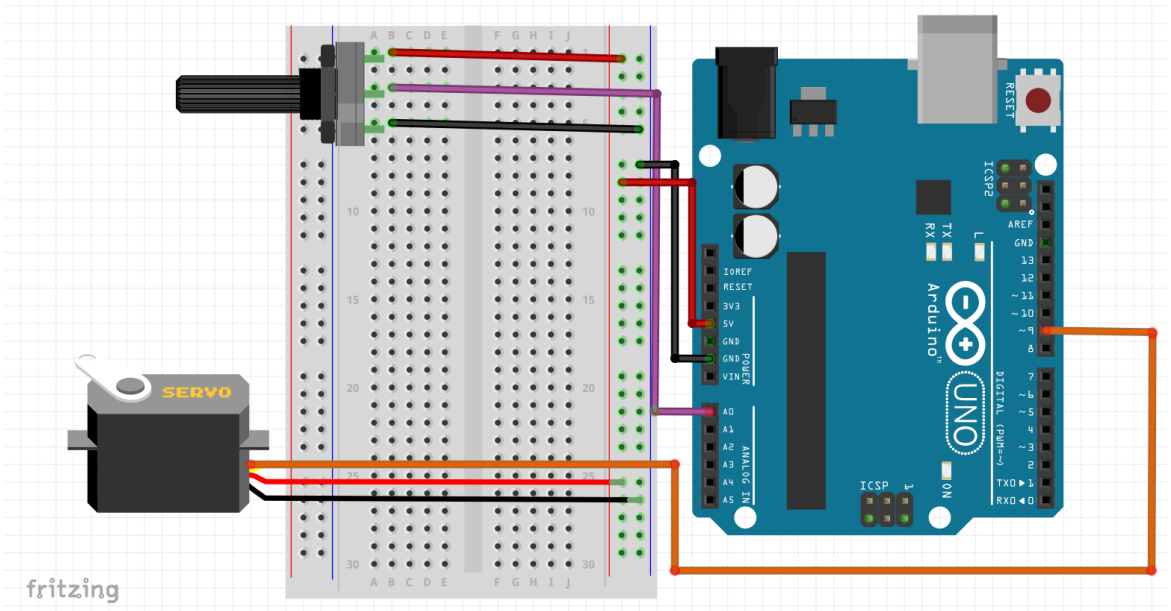
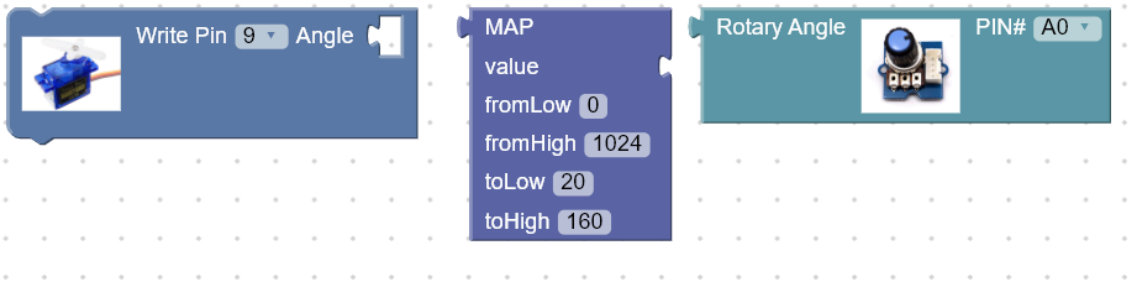
Procedure:

1. Wire the project using the following schematic.



Code

You can create your code in the BlocklyDuino then paste it to the Arduino IDE. Click BlocklyDuino Reference for a link to all the blockly codes. Here are the blocks you will need.



1. Select the servo from the blocks menu and assign it to pin 9. Servo has its own set of blocks and they are found under “SERVO” on the left hand side of the menu. We are then going to assign a map function to the angle in the next step.

2. The code below uses the “MAP” function. The MAP function converts the resistance of the potentiometer (0-1024) to an angle (0-180). You will find the map block in “MATH.” Drag the block into the blockly editor and attach it to the angle of the servo. Therefore, the angle of the servo will depend on a value that the potentiometer gives. We will add the “pot’ with the next step. 7

3. The potentiometer (rotary angle) controls the resistance. Select “rotary angle” from the GROVE menu under “INPUTS” and assign it to pin A0

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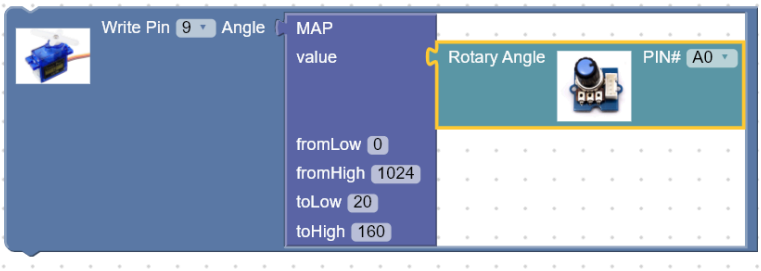
4. If the servo motor is jittery when you moving it, switch your angles in your code from (0-180) to (20-160). Your code should look like this:



5. Once your blockly code is finished, click on the arduino to transfer the information in the blocks to Arduino.

*****SAVE your sketch to your BlocklyDuino Folder that you created*****

You can now copy the Arduino code by using “ctrl A” then “ctrl C”. Then paste this into the Arduino IDE. Click the arrow to upload the following sketch onto your board.

6. What happens when you turn the potentiometer?
7. We are now going to automate the servo. Servos can be controlled using code to move at different degrees without the use of a potentiometer. Copy and paste the following code to operate a servo without a pot.
    a. Remove the potentiometer from your wiring. You will now code your arduino to operate a servo using code (automation).

    b. Now program your arduino using the following blocks.

    a. What did your servo do?

8. Experiment. Get your servo to move to different angles at different times. Get a second servo and see if you can get them at the same time or at different times.

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Assignment: SERVO

Attach a servo mount to the arm so that you can observe the motion of the servo motor to answer the following questions:

1. What did the servo do when you turn the potentiometer clockwise? Counter clockwise?

2. How would you get the servo to rotate at a different angle?

3. What are some real life applications would incorporate a servo and a potentiometer?

CHALLENGE

4. Servos can be controlled using code to move at different degrees without the use of a potentiometer. Copy and paste the following code to operate a servo without a pot.
    - Remove the potentiometer from your wiring. You will now code your arduino to operate a servo using code (automation).

    - Now program your arduino using the following blocks.

b. What did your servo do?

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c. Change your code to make your servo rotate 170 degrees, wait for ½ a second and rotate to 90 degrees, wait for 2 seconds and rotate back to 10 degrees.

5. Code and wire two servos to work in succession. Have one servo turn to 90 degrees. Input a wait time so that another servo can turn to 120 degrees and then back to 0 degrees. Then have the first servo return back to 0 degrees. (“Dancing Servos:)”

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