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SEDC 73600

Lesson Plan 12-13: Windmill Project

Unit: Arduino Motors Unit

Previous lesson: Stepper Motors
Next lesson: Shark Tank! Final Project Introduction (this is the first lesson in the Final Project unit)

Main objectives: Students will be able to choose an appropriate type of motor, attach it securely to a model windmill so that the blades can spin freely, and program it to spin continuously. SWBAT incorporate one or more inputs (button switch, toggle switch, potentiometer, or remote control) that allow the user to turn the windmill on/off and control the speed.

Standards:

- 9-12.IC.7 Career Paths: Investigate the use of computer science in multiple fields.
- 9-12.CT.4 Abstraction and Decomposition: Implement a program using a combination of student-defined and third-party functions to organize the computation.
- 9-12.CT.8 Abstraction and Decomposition: Develop a program that effectively uses control structures in order to create a computer program for practical intent, personal expression, or to address a societal issue.
- 9-12.DL.2 Digital Use: Communicate and work collaboratively with others using digital tools to support individual learning and contribute to the learning of others.

Skills assessed:

- Justifying motor choice (which demonstrates an understanding of the advantages/limitations of the 3 motor types)
- Wiring motors correctly using an external power supply
- Wiring switches correctly
- Incorporating a library into code
- Using custom functions and library functions
- Using control flow in code to respond to user input
- Writing complex code to address a real-world application
- Working in a team with classmates and younger students

Timing: This is a 2-period assessment completed in pairs.

In-class exercises: The students will complete the assignment below.

Notes: The teacher will need to coordinate with the Freshmen engineering classes on timing—the freshmen need to finish building the model windmills and share them with the Electrical Engineering students before they can begin this assessment.

Resources: Stepper motor tutorial: https://www.youtube.com/watch?v=CEz1EeDlpbs

Materials: Windmill projects from Freshman engineering class, Elegoo uno circuits kits (including Arduino Uno, breadboard, stepper motor, stepper motor driver board, power supply module, battery wire, jumper wires, USB cable), 9V battery, student handouts, computers

Assignments: The class assignment for students is below.

Summative assessment: This assignment is a summative assessment for the unit.

Lesson:
5 min: Intro

- The 9th grade Freshmen Engineering students have designed and build miniature windmills, but they need your help to make them move! You will need to use your experience with motors to attach a motor to the mini-windmill and program it to rotate.
- Go over project specifications
    - Windmill spins freely (10%)
    - Motor is securely attached (10%)
    - Motor is correctly wired to the Arduino (10%)
    - Arduino is programmed to spin the motor at an appropriate speed for a display windmill (10%)
    - One or more switches are correctly wired to the Arduino (10%)
    - Arduino is programmed so that the user can turn the windmill on/off (15%)
    - Arduino is programmed so that the user can control the speed of the windmill (15%)
    - Code uses self-defined functions and functions from the appropriate library in order to create a clear, concise, and understandable program (10%)
    - Worksheet below is completed (10%)

40 min: Work time

- Students work with partner on the assessment

Day 2:
5 min: Intro

- Address any common questions or issues that came up yesterday

40 min: Work time

- Students work with partner on the assessment

The Bronx High School of Science
Ms. Thomas

Physical Science Department
Electrical Engineering

EE Student Names: ____ Period: ____________

Freshmen Engineering Collaborators: ____

Windmill Assessment

The 9th grade Freshmen Engineering students have designed and build miniature windmills, but they need your help to make them move! You will need to use your experience with motors to attach a motor to the mini-windmill and program it to rotate.

In class, we discussed how different motors work and experimented with DC motors, servo motors, and stepper motors. You will need to choose an appropriate type of motor, attach it securely to the windmill so that the blades can spin freely, and program it to spin continuously. You should also incorporate one or more inputs (button switch, toggle switch, potentiometer, or remote control) that allow the user to turn the windmill on/off and control the speed.

This assignment counts 40 points in the Assessment category of your grade.

Technical specifications/grading criteria:

- Windmill spins freely (10%)
- Motor is securely attached (10%)
- Motor is correctly wired to the Arduino (10%)
- Arduino is programmed to spin the motor at an appropriate speed for a display windmill (10%)
- One or more switches are correctly wired to the Arduino (10%)
- Arduino is programmed so that the user can turn the windmill on/off (15%)
- Arduino is programmed so that the user can control the speed of the windmill (15%)
- Code uses self-defined functions and functions from the appropriate library in order to create a clear, concise, and understandable program (10%)
- Worksheet below is completed (10%)

Optional extensions:

- Add an LED at the top of the windmill that blinks every time it completes one revolution
- Save the birds! Add an ultrasonic sensor that causes the windmill to stop rotating if an object (or animal) gets too close
- Add an LCD screen and display a count of the number of revolutions and power that would be generated by a real windmill (this will require some research)

Video of functioning windmill. Make sure to include your names in the video. Make sure the video displays all the functionality of the windmill (i.e. show how to turn the windmill on/off and change the speed).

Paste your completed code here:

Explain why you chose the motor type that you selected. What are the benefits, and what drawbacks will you need to overcome?

There are many different ways to program the button(s) so that the user can turn the windmill on/off and control the speed. Explain how the buttons work in your project and why you chose to make them work this way.

Identify one bug that you encountered while coding (OTHER than mistyping a word or forgetting a semicolon). What was your original code and why didn't it work? What did you change it to and why did that work? *(If you didn't encounter any bugs while programming, then you haven't challenged yourself enough—make your program more complex or add some of the extensions until you encounter a bug)*