Skill Demo 10: Motors

NAME_____ GTID_____

Goals:

Demonstrate mastery of normal DC motors, servos, and stepper motors. Gain familiarity with MOSFETs.

Background:

Read Practical Electronics for Inventors 2000 edition: 409-421 (motors), 206-210 (phototransistors), 138-147 (transistors), 168-177 (MOSFETs)

All videos from Skill Demos 1-9

Tools/supplies:

DC motor
servo
stepper motor
MOSFET transistors and/or h-bridge IC
LEDs, photoresistors/photodiodes, or other sensors
Teensy
laptop
breadboard
USB cable

1) Using your microcontroller and pulse width modulation (PWM), control the speed of a DC motor. Your microcontroller (probably) can not source (or sink) enough current for the motor, and flipping a relay 1000s of times to do PWM would shorten the relay's lifetime considerably. Instead, use a MOSFET transistor in the circuit to control the motor (Figure 13.3 in the book shows an example with a 555 timer instead of a microcontroller). Create a demonstration where the motor starts slow, increases its speed to its maximum, and gradually slows to a minimum level again.

Initials_____ Date_____ Time_____

2) Control your DC motor so that it spins precisely at some multiple of 10 rotations per minute (i.e., 10, 20, 30,..., or 1000 – that way it should be possible to complete this section with whatever motor you find). How? One way is to attach a wheel to the motor with a notch cut out and have an LED on one side and a photoresistor on the other (actually, you may have to use a phototransistor for the sensing to be fast enough). That way your microcontroller can monitor how often it sees the light and modify the PWM signal accordingly. Another option it to attach an arm to it to interrupt the light. Other sensing methods are welcome too! (To get a more technical view of what you are doing, look up PID controller on the web.)

Initials_____ Date_____ Time_____

3) Use your microcontroller and PWM to turn a servo to 0 degrees, pause 2 seconds, turn to 90 degrees, pause 2 seconds, 180 degrees, pause 2 seconds, 90 degrees, pause 2 seconds, and back to 0 degrees. Alternatively, if you find a continuous rotation servo, have it start at 0 rpm, pause, half speed, pause, full speed, pause, half speed, pause, 0 rpm.

Initials_____ Date_____ Time_____

4) Demonstrate that you can control a stepper motor by programming your microcontroller to alternatively start and stop it for 5 seconds at a time for a total of three cycles. You may use an h-bridge IC or construct one yourself using MOSFETS (Figure 4.79 in the book).

Initials_____ Date_____ Time_____

5) 10% Bonus: Reprogram your microcontroller to switch between normal stepping, power stepping, and half stepping and construct a way to demonstrate that it works.

Initials_____ Date_____ Time_____