cpsc 543 Lab 2: Arduino Intro + Actuator Basics

Learning Goals:

- Understand the structure of a basic Arduino program
- Know how to use a solderless breadboard
- Set up and understand a simple electronics circuit
- Make a motor move, using the Arduino board digital outputs
- Know how to convert rotary to linear motion by at least one means.

The Assignment:

- Evolve one variation from Lab 1 with a motor / actuator, controlled by an Arduino.
- Incorporate *both* variability and repeatability, to at least small degree.
- Your solution must involve converting the motor's rotary motion to linear movement at some point.
- Work in pairs or individually.
- As with Lab 1, video/photo document your work and describe on your blog (every individual creates own documentation). Post the blog link onto the course twiki, at: https://www.cs.ubc.ca/wiki/do/view/CS543/Labs

Suggested Steps (requires Arduino Kit w/ Uno R3)

Before / at start of lab:

1) Get to know Arduino. Start here: https://www.arduino.cc/en/Guide/HomePage
   Read the Intro, and at least skim the other linked pages.
2) Review introductory slides for class: linked from course Dashboard.
   Content: anatomy of Arduino board / program (not including shield)
3) Install the Arduino IDE on the laptop you will be using:
   https://www.arduino.cc/en/Main/Software

   I.e. download/load IDE, drivers for the Uno; then load the "blink" program on the Uno
   Current Arduino IDE version: 1.6.7
   Tip: doesn't always do well with hubs; plug USB cable directly to your laptop
4) Familiarize yourself with components in your kit:
   SparkFun Inventor's Kit – v3.2 -- *component list appended below*.
5) If needed, learn or review principles of a solderless breadboard, e.g.:
   http://www.tigoe.net/pcomp/code/circuits/breadboard
6) Bring laptop + full kit to lab anytime you plan to work on the project.
   Note: You can keep your kit in a locker – bring your own lock and claim one.

(continued on next page)

At lab and on your own – referring to the Experimenter's Guide (in kit):

See below for number of circuits in tutorial guide (depends on vendor used).

7) Build and understand ***Blinking LED***. This includes setting up your board and familiarizing yourself with the essential Arduino workflow.

   Tips: Always build while board is unpowered, and check your circuit carefully before powering up. Use a Digital Voltmeter (DVM) to help debug your circuit while under power – there's one in x360.

8) Build and understand ***Spinning motor w/ transistor***, and ***Servo***. Both can be done without a motor shield (low power). These will give you experience with two types of motors. Be sure you understand program structure, the role of the transistor and how the servo motor works differently from the small DC motor.
   Tips: 330 Ohm may work better than 10K Ohm resister. Why?

9) Build and understand ***Potentiometer; analog input***.

10) Explore other programs and circuits as necessary to familiarize yourself with system and the sensors in your kit.

Blinking LED:	*Sparkfun: CIRC-01; Adafruit: CIRC-01*
Spinning motor w/ Transistor:	*Sparkfun: CIRC-03; Adafruit: CIRC-12*
Servo:	*Sparkfun: CIRC-04; Adafruit: CIRC-08*
Potentiometer w/ analog input:	*Sparkfun: CIRC-08; Adafruit: CIRC-09*

11) **FINALLY: do the assignment!** (Refer to the top of page 1, to remember what it is ☺) In addition to the software element, your *mechanical* challenges include: converting rotary to linear motion; and attaching something firmly to your motor shaft. *What are several ways you might accomplish these?*

    Some places to read more (these are "on reserve" in Studio, but please do not remove from room – they are Karon's personal books):

    - David Macaulay, *The Way Things Work*. 1988/1998: Houghton Mifflin.
    - Dustyn Roberts, *Making Things Move DIY Mechanisms for Inventors, Hobbyists, and Artists*. 2010: McGraw-Hill/TAB Electronics.

COMING UP: In the next lab, you will need a motor driver. These are still on order, but will be distributed as soon as we get them.
If you get through Lab 2 quickly, feel free to get started on building and using it (and avoid congestion at our soldering stations!)

Lab 2 Mark Sheet (completed by instructor)

Name: _____

Partner (N/A if none): _____

Term: 2016/18W1 W1

One variation from Lab 1 evolved to use a motor / actuator, controlled by an Arduino.

☐ (25%) Variability incorporated, to at least a small degree

☐ (25%) Repeatability incorporated, to at least a small degree

☐ (30%) Converts rotary to linear motion

☐ (20%) Documentation adequate (visual and words)

☐ Multiplier applied for late hand-ins, as described on course homepage.

OVERALL MARK:

☐	**Great (100%)**	Entirely satisfied and exceptionally well done
☐	**Good (85%)**	Entirely satisfied and well done
☐	**Fair (70%)**	Largely satisfied, few major issues
☐	**Poor (54%)**	Some worthwhile, comprehensible effort, with substantial issues
☐	**Zero (0%)**	Little to no real comprehensible effort; not handed in or otherwise unacceptable

Appendix 1: Linear to Rotary Motion - Ideas

TABLE 8-1 Converting Between Types of Motion

		INPUT			
		ROTARY	OSCILLATING	LINEAR	RECIPROCATING	INTERMITTENT
OUTPUT	CONVERSIONS	ROTARY	Gears, pulleys and belt, sprockets and chain, crank slider	Crank	Rack and pinion, linkage	Piston, bell crank	
		OSCILLATING	Crank, quick return			Linkage	
		LINEAR	Wheels, rack and pinion, scotch yoke	Scotch yoke	Scissor linkage		
		RECIPROCATING	Cam, crank, piston	Crank, cam, bell crank			
		INTERMITTENT	Geneva stop	Ratchet		Ratchet	
		IRREGULAR	Cam	Cam			
	TRANSFORMATIONS	INCREASE/ DECREASE	Gears, pulleys and belt, sprockets and chain	Gears		Lever	Lever, gears
		REFLECT	Gears	Gears	Pulley, lever	Pulley, lever	Pulley, lever
		ROTATE	Bevel gear, worm gear	Bell crank	Bell crank	Bell crank	Bell crank

Appendix 2: Contents of 543 Arduino Kit