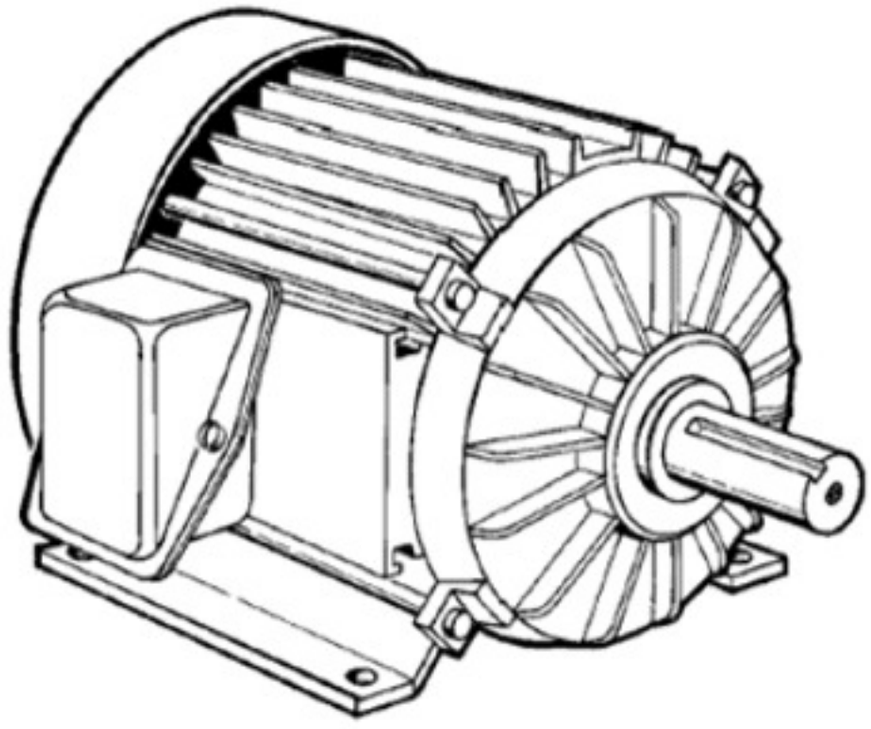
Arduino 4

Making it move



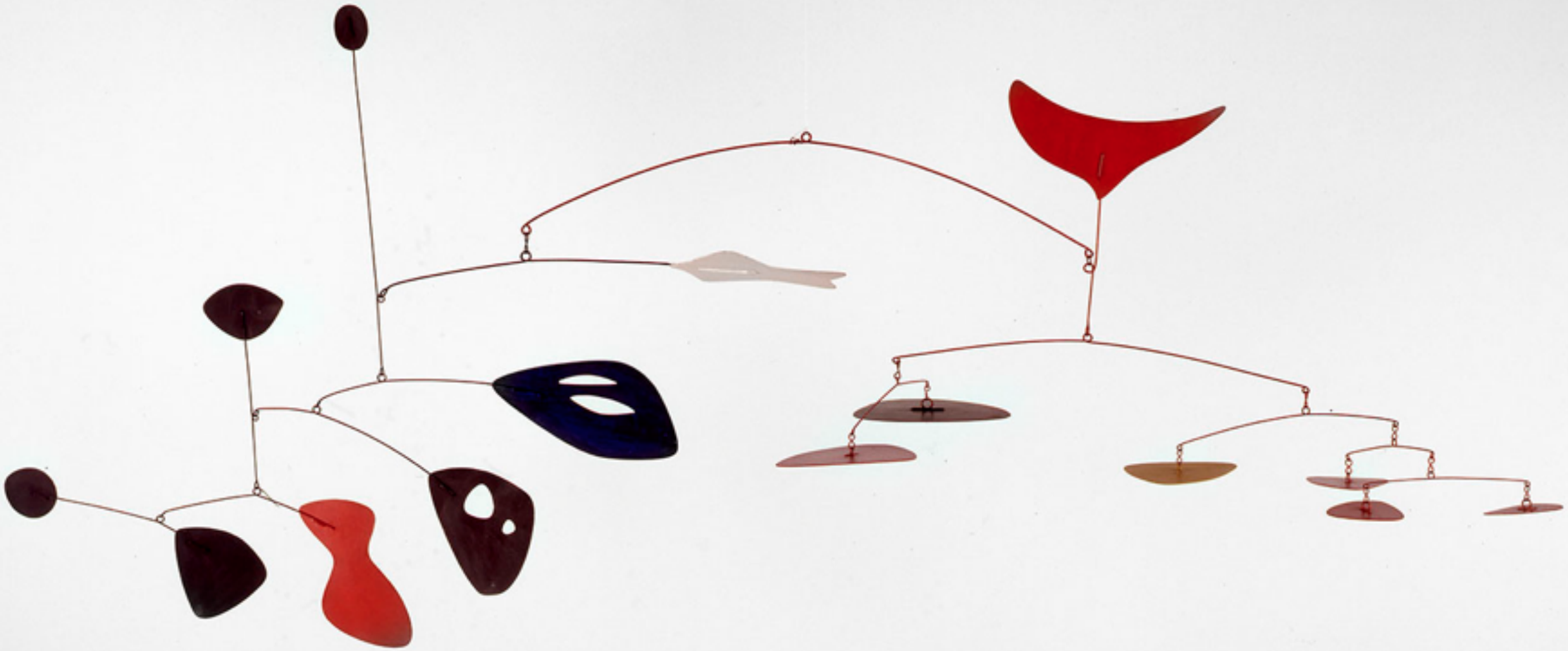
Owen Mundy | Spring 2012

Overview

- History of kinetic art
- DC motors
- Types of DC motors
- Example circuits

History of kinetic art

- Kinetic art, that which involves motion, automated or viewer-controlled, has its roots in Dada and Constructivist movements.
- Through movement, kinetic works create new relationships to the viewer.

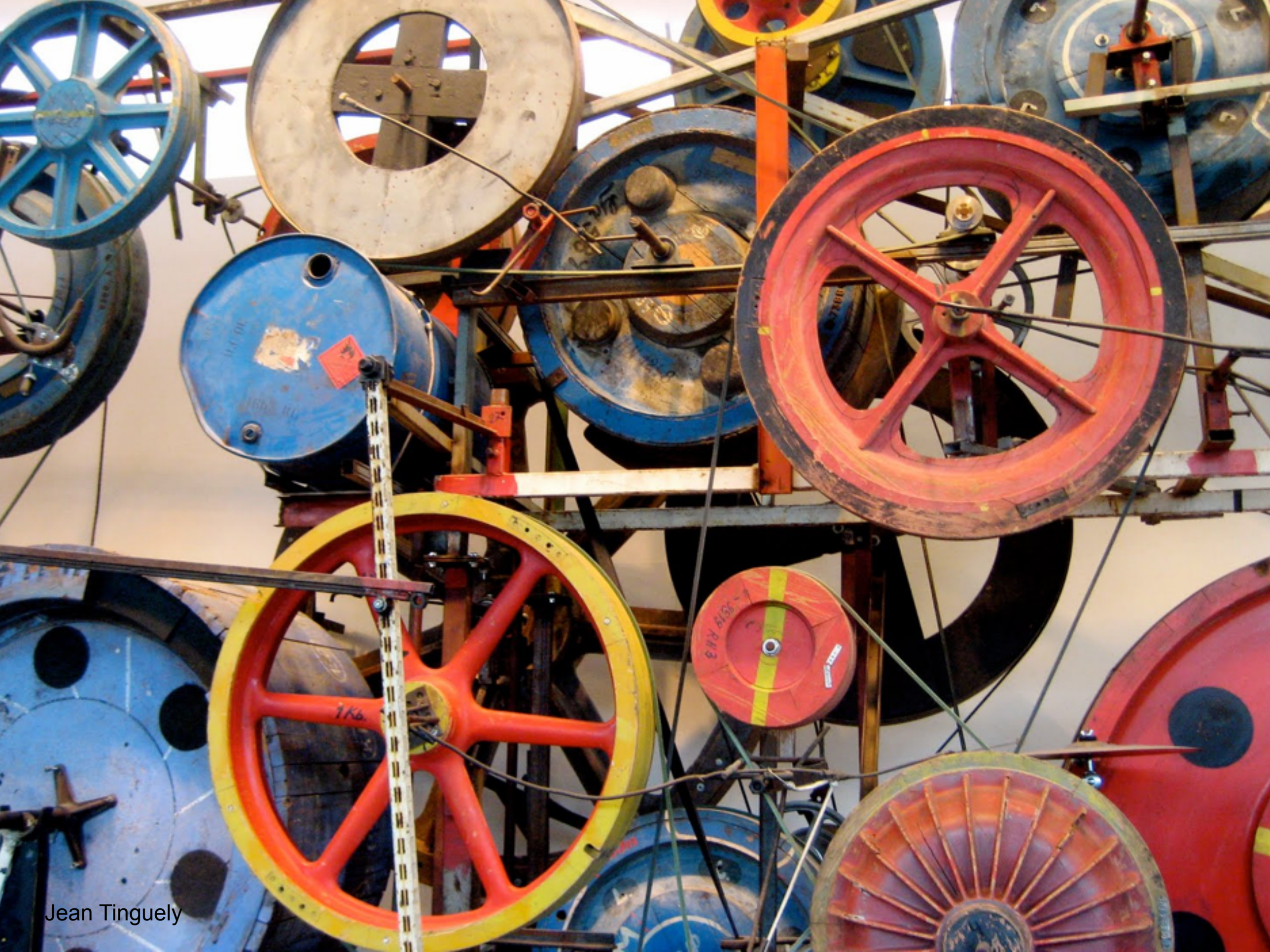


Alexander Calder, Hanging Mobile, 1951

History of kinetic art

- Early kinetic artists were inspired by the Dada movement's use of found objects and anarchic response to industrialized society.

Jean Tinguely

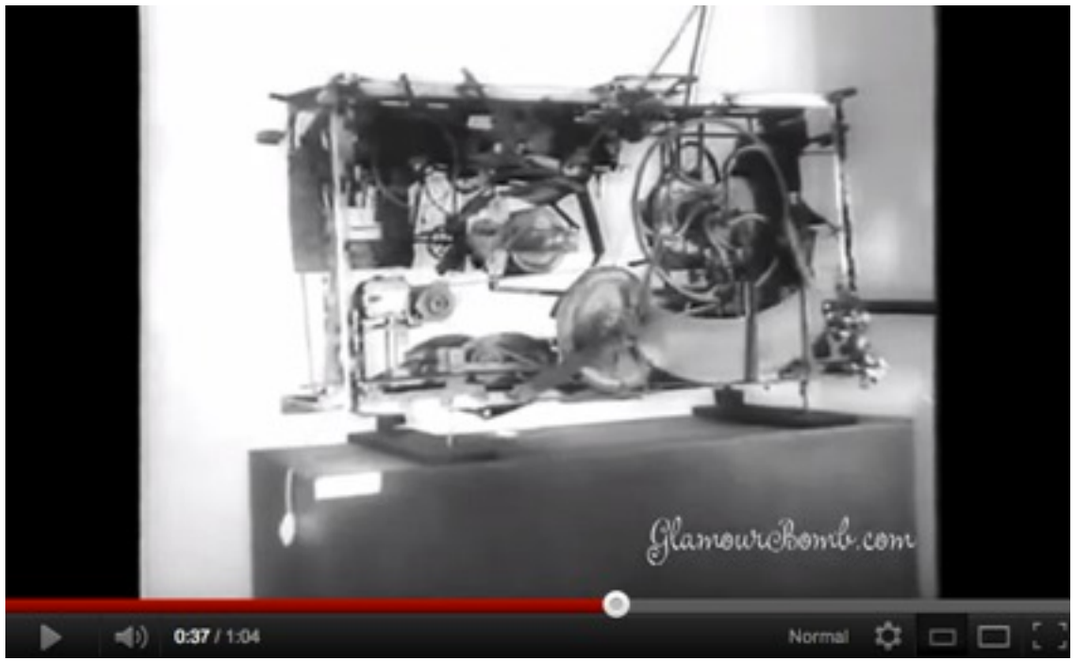


Jean Tinguely

History of kinetic art

Jean Tinguely

Art Machines Machine Art at Museum Tinguely part 2



Jean Tinguely

Art Machines Machine Art at Museum Tinguely part 1

History of kinetic art

- In the late 20th century artists developed analogies between machines and the human body. They augmented performance-based works with devices, drawing on Dada and Fluxus movements to comment on the disfunctionality of the irrational human “machine.”

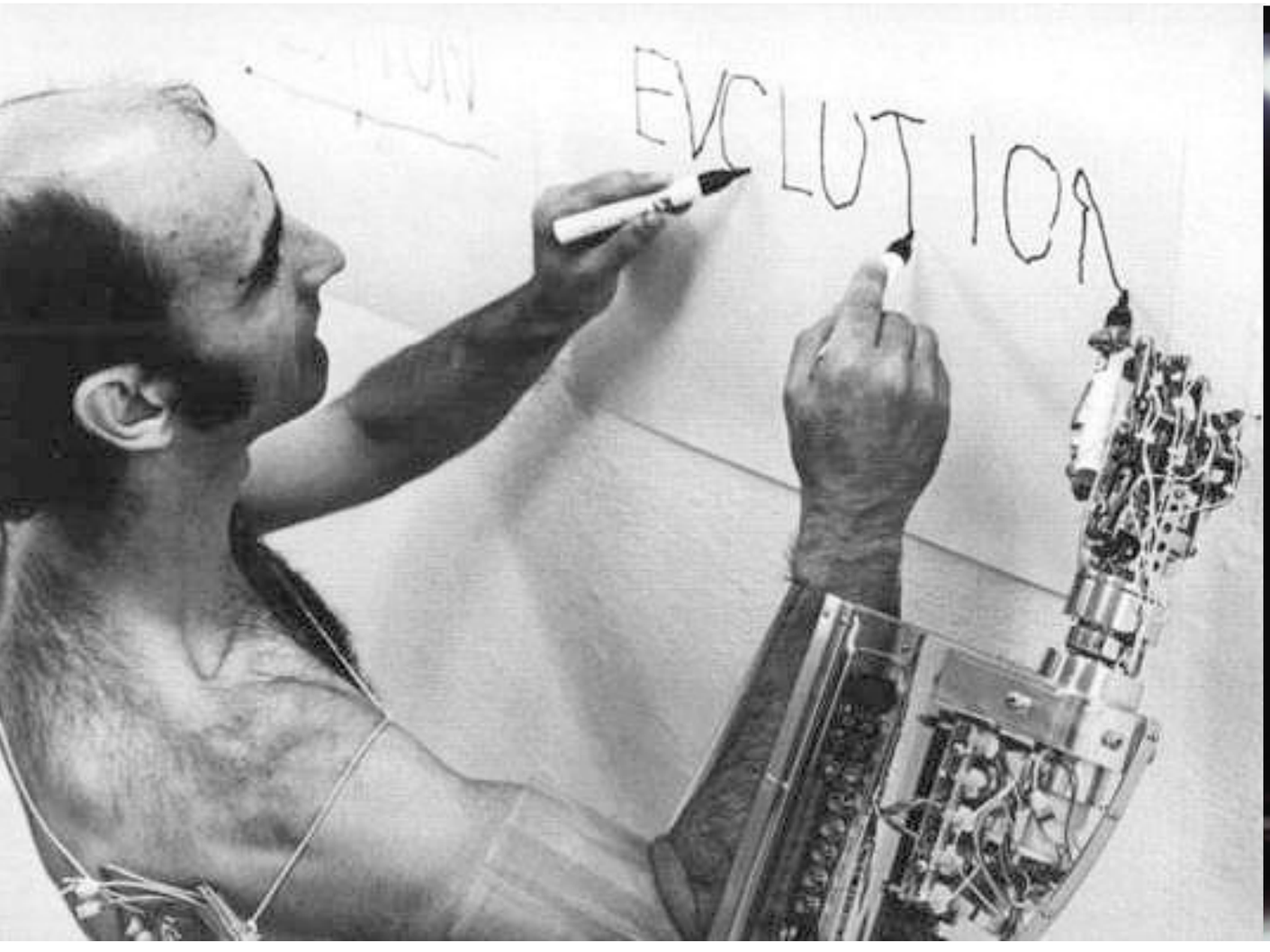
Rebecca Horn

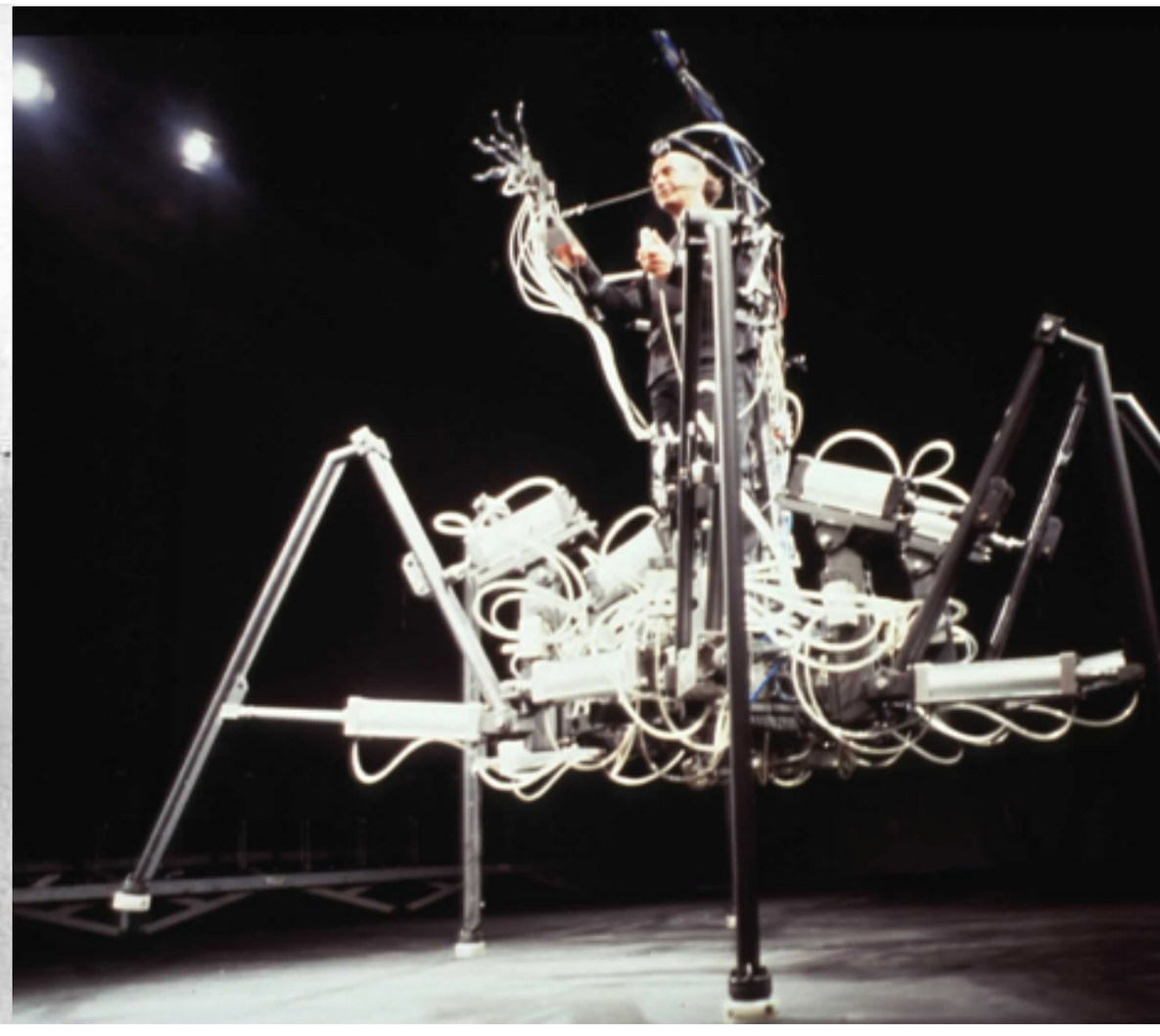
History of kinetic art

Rebecca Horn, Concert for Anarchy, 1990 and Les Amants, 1991

History of kinetic art

- As the information age began artists like Stelarc continued to comment on automation in society and mechatronic extensions of the body through his machine-augmented works.

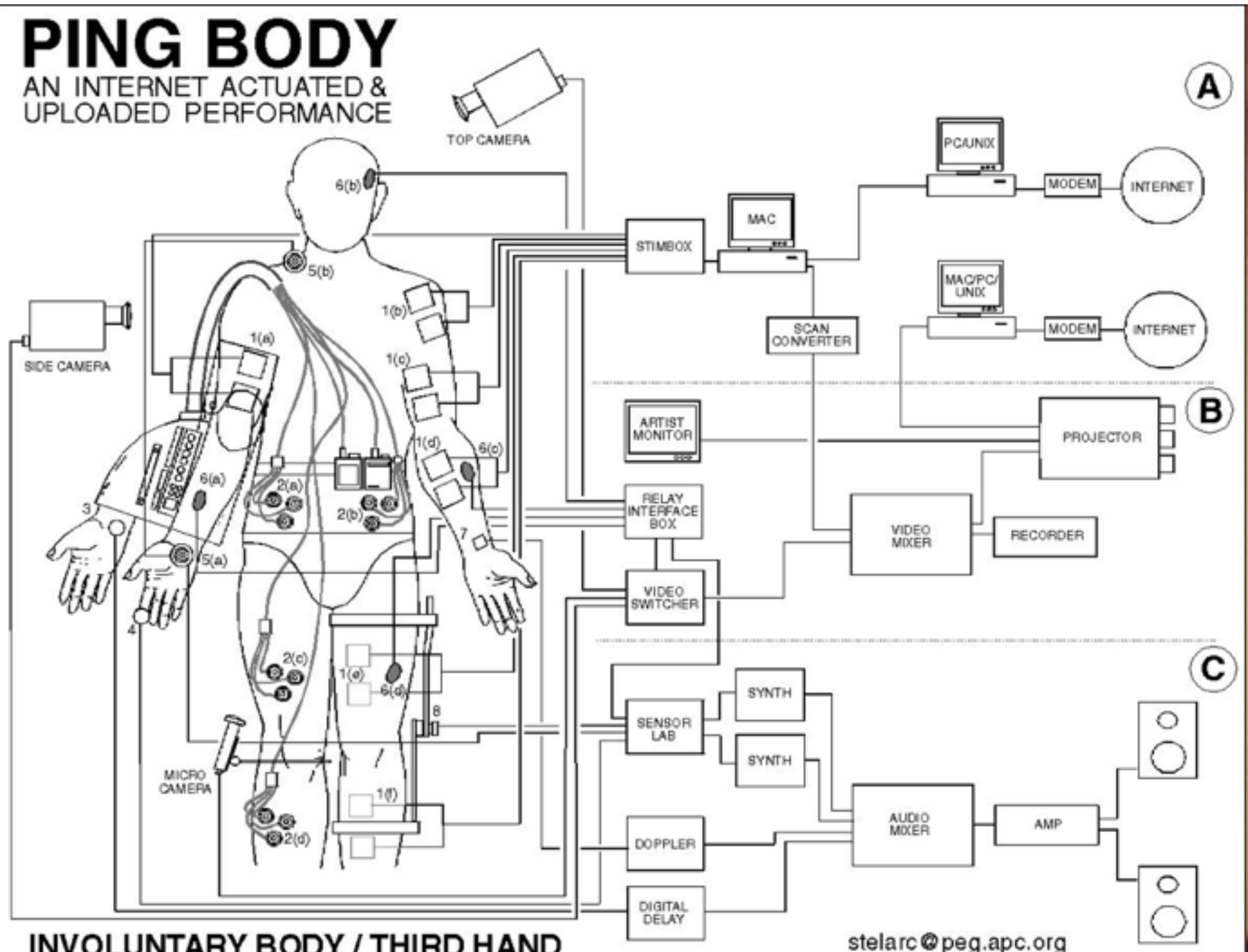


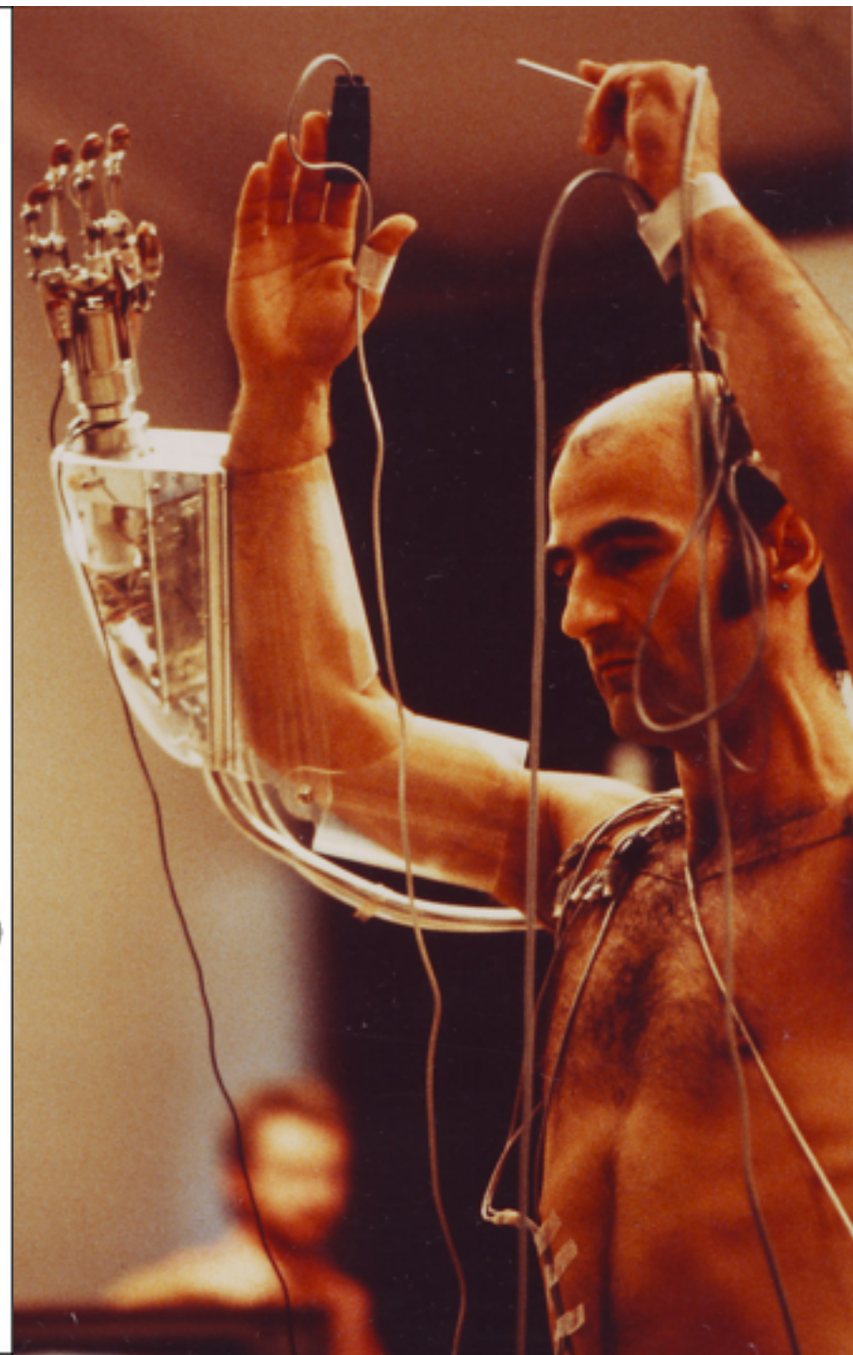


Stelarc

History of kinetic art

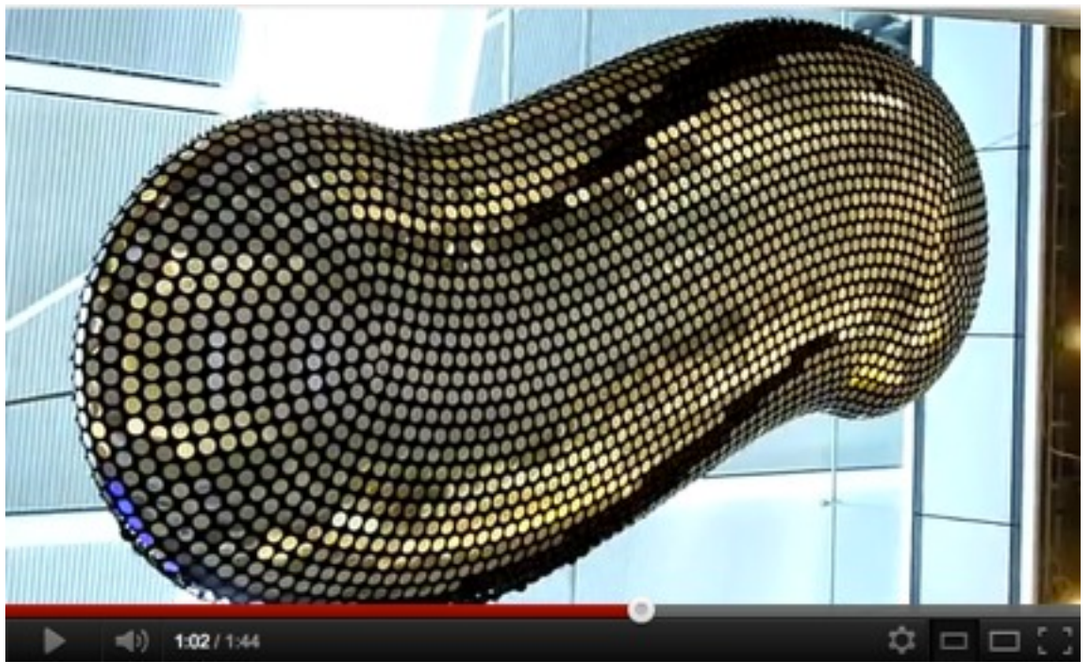
- Works like his, *Ping Body*, not only use automation to extend his body, but push the limits of human-machine connectivity to reveal what he feels are technological excesses.





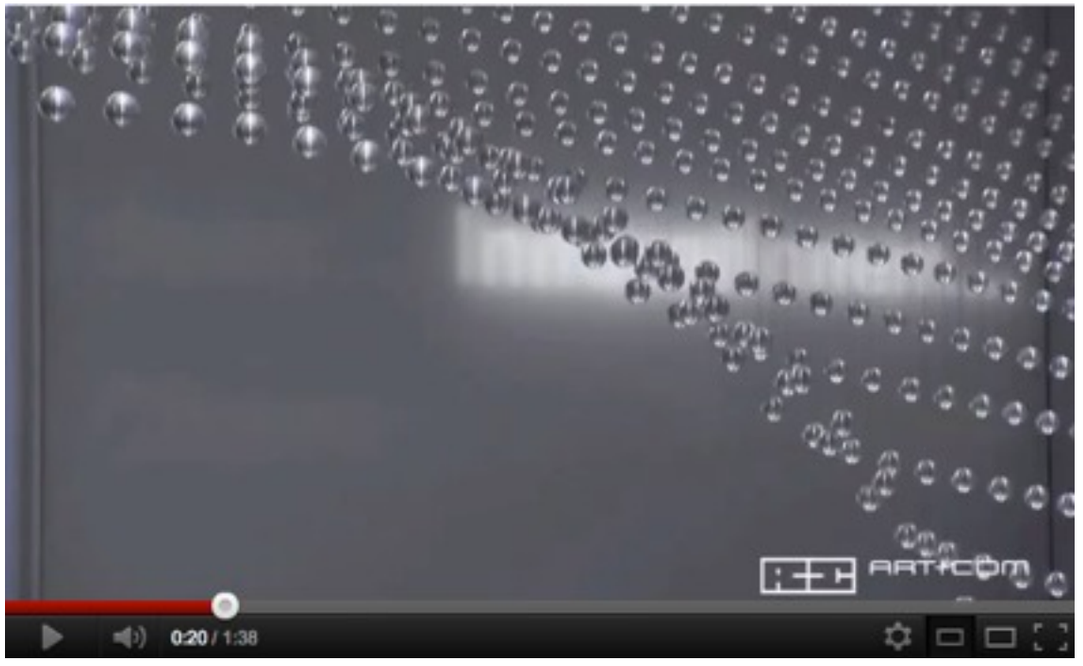
Complexity continues to increase

Wooden Mirror by Daniel Rozin



Cloud by Troika

Theo Jansen



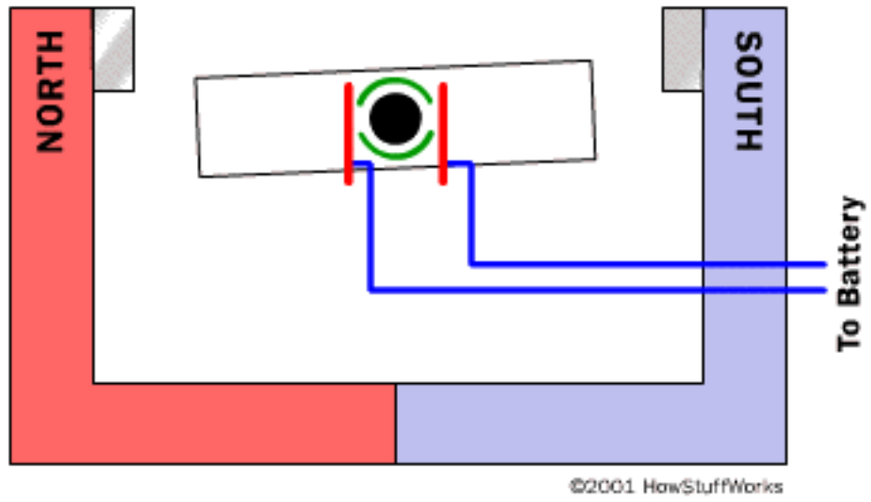
BMW museum by ART+COM

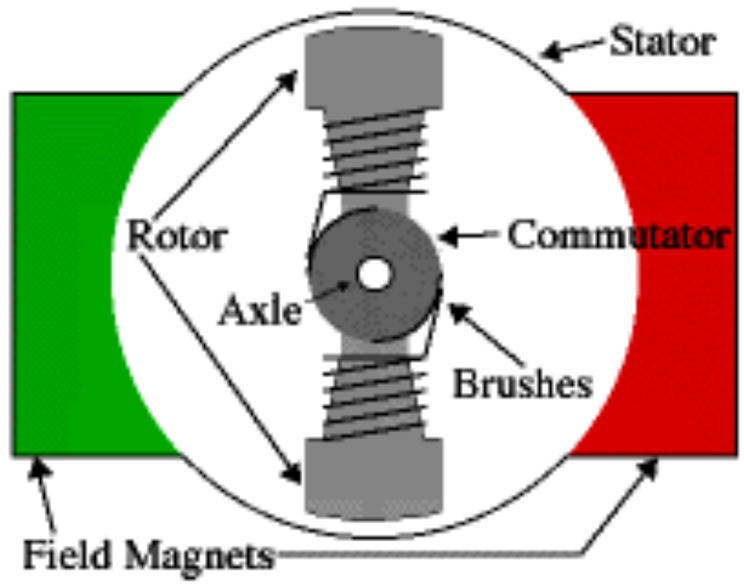
DC motors

- So how do we do this?

DC motors

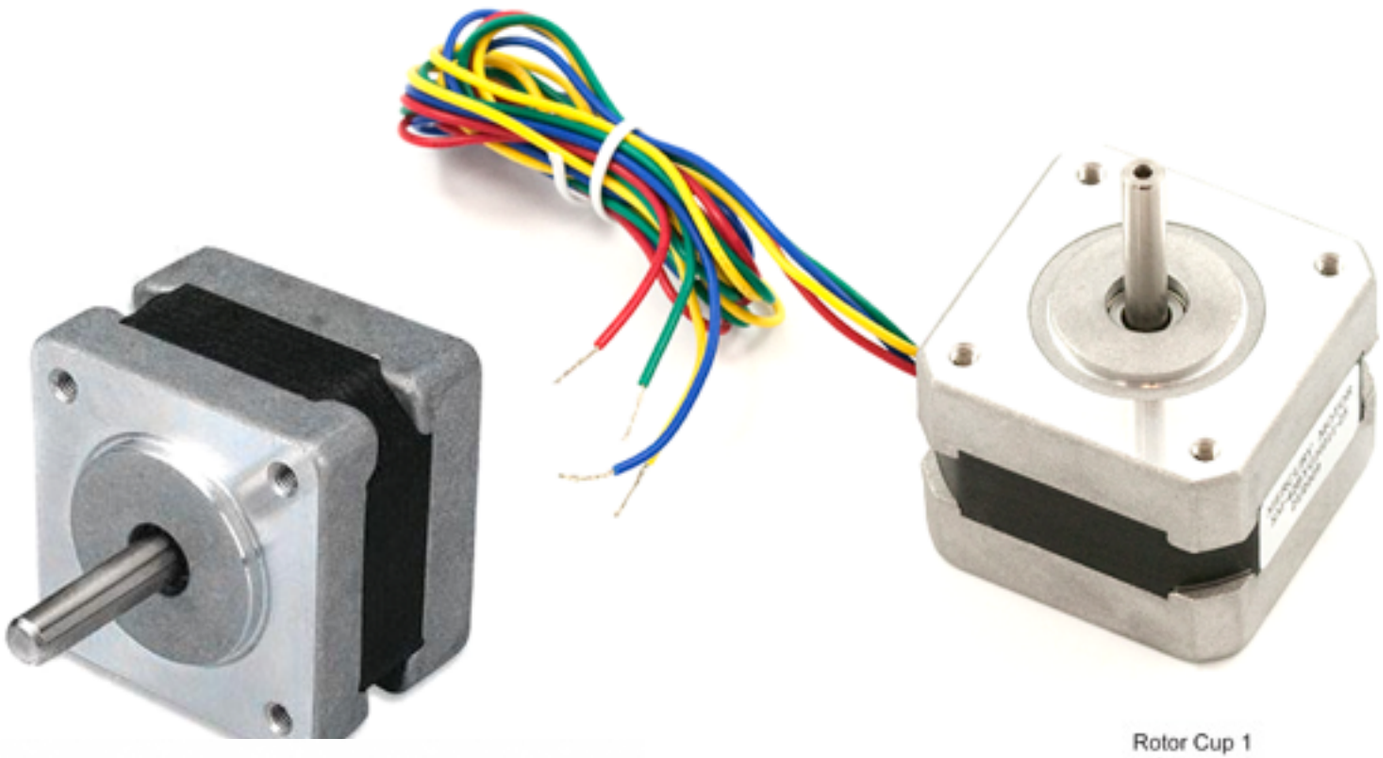
- Good for many applications. Can be driven forward or backwards by reversing the polarity. Speed is based on +V but can be varied by using an H-bridge and PWM.

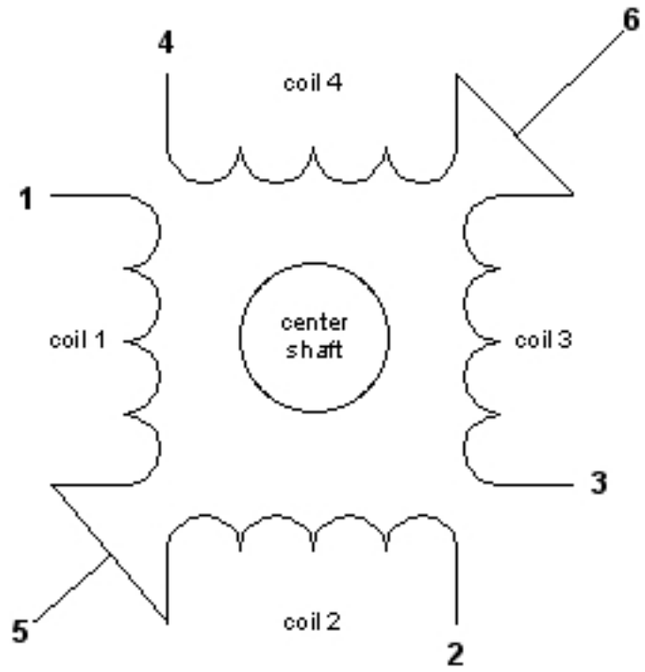


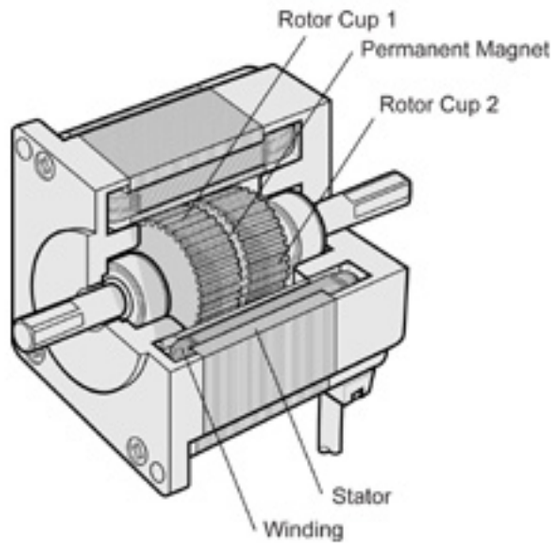


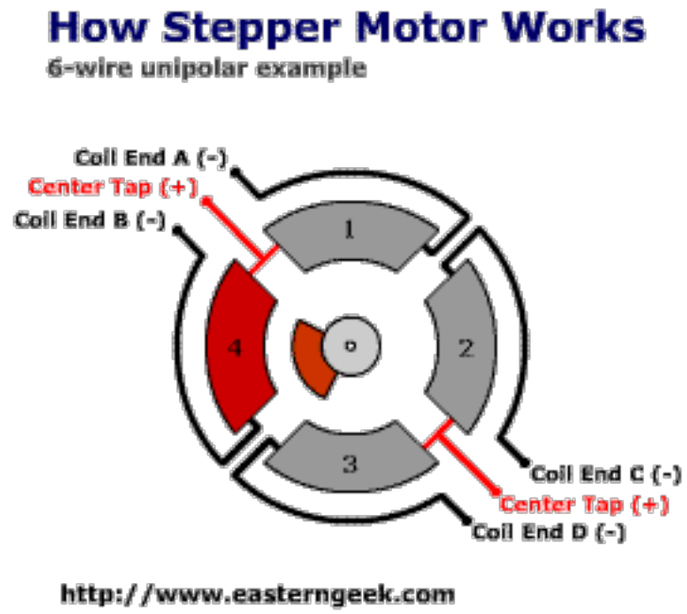
Stepper motors

- Good for semi-precision control because they can take micro “steps.” Require PWM to operate. Can be found in 4, 5, and 6-wire, as well as unipolar and bipolar varieties.



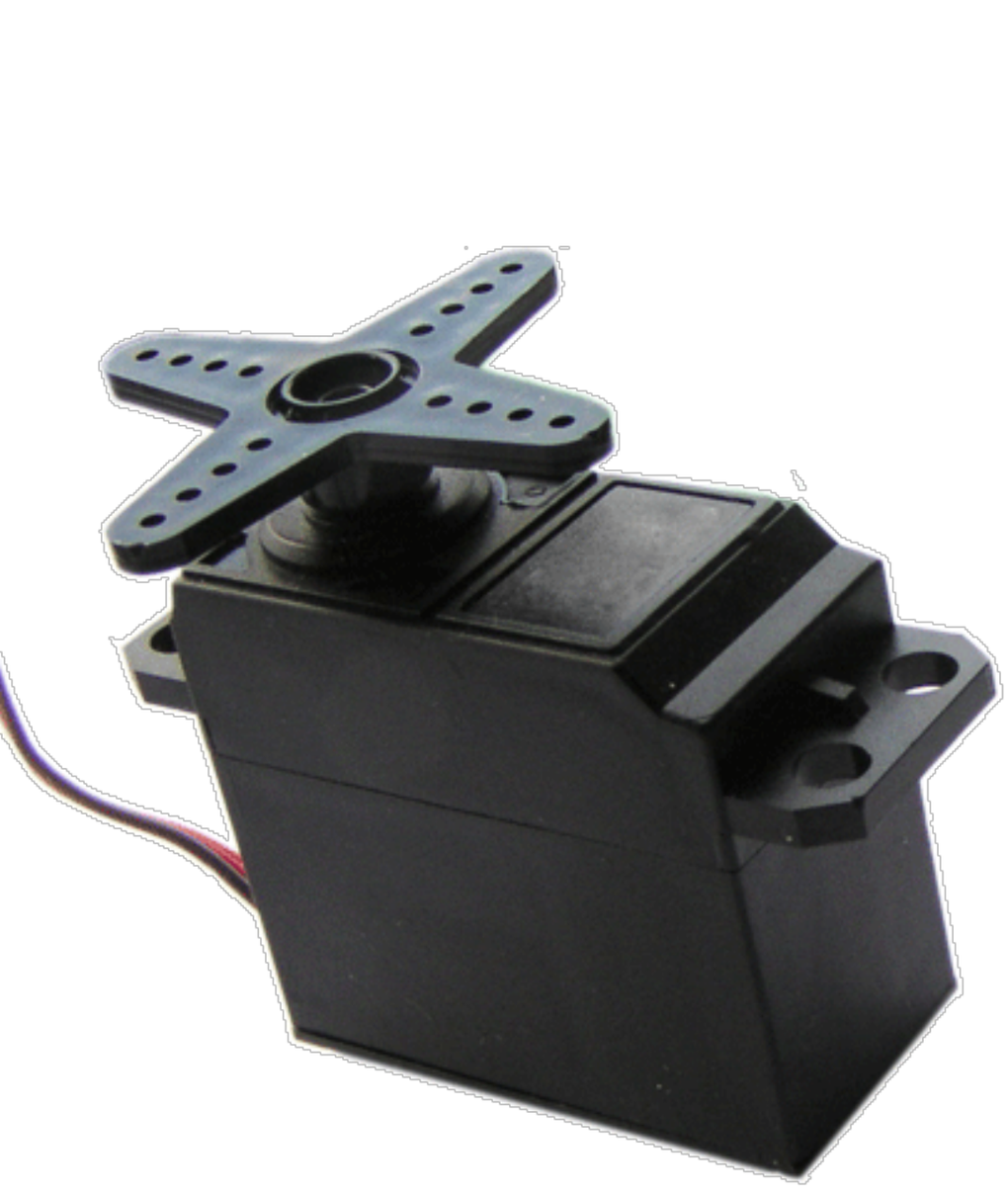






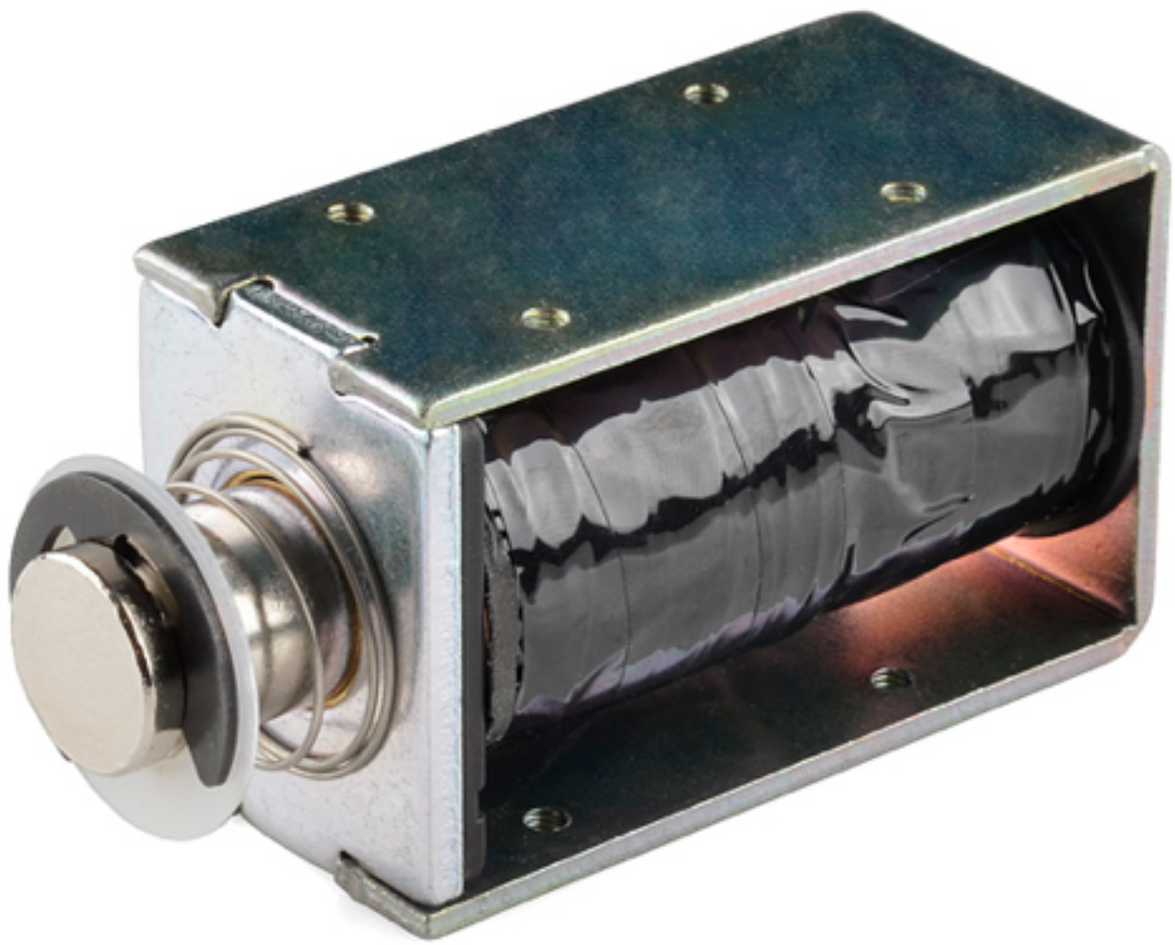
Servo motors

- Often used in robotics. The box contains the motor, gears, and control circuitry.
- Usually contain three wires: +V, ground, and control.



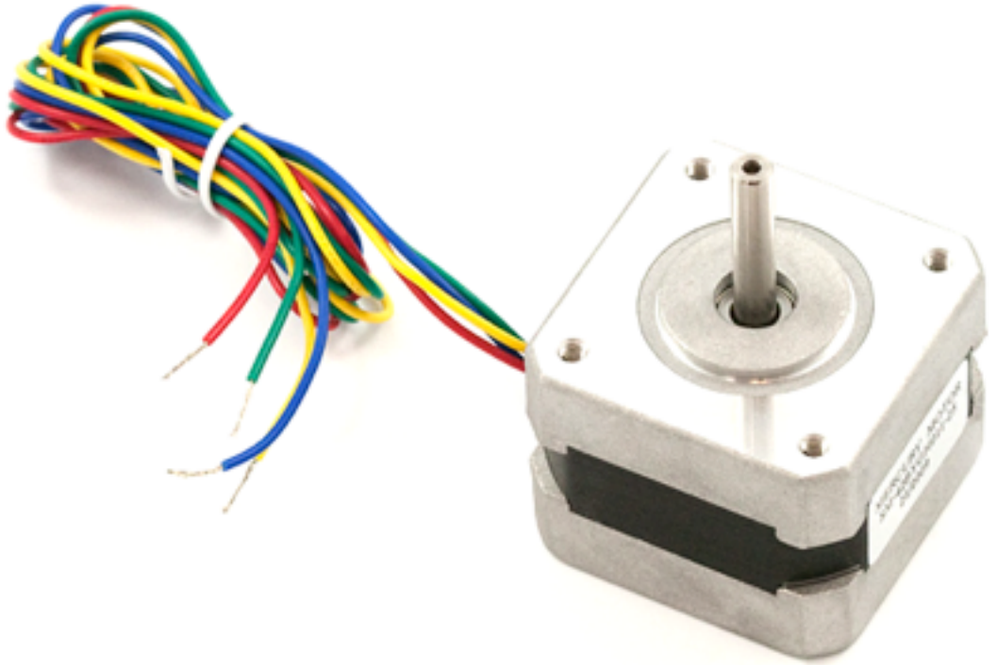
Solenoids

- Solenoids are not technically motors by the regular sense (they don’t rotate), but they do provide movement through the use of electromagnets.
- Sparkfun video on large solenoid
- Sparkfun video on small solenoids



Powering motors

- Motors need a lot of energy. The cheaper the motor the less efficient it is.
- To use a motor first determine what voltage you need. Typical values are 5–25V.
- The larger the motor and/or more torque or speed required will draw more current. You won’t be able to power a motor with a battery very long.



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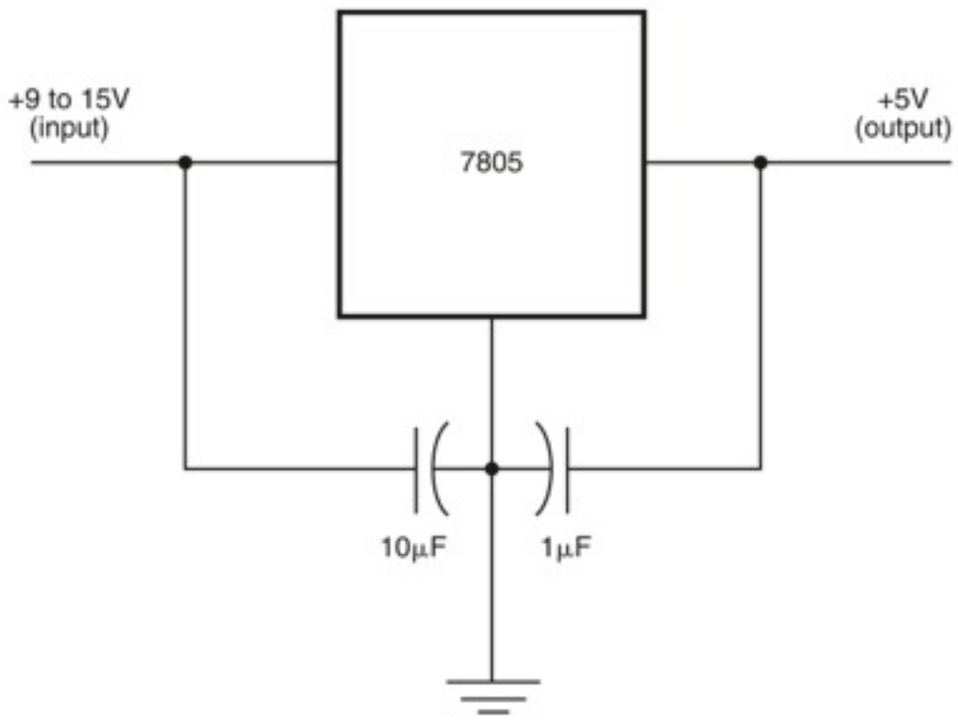
Powering motors

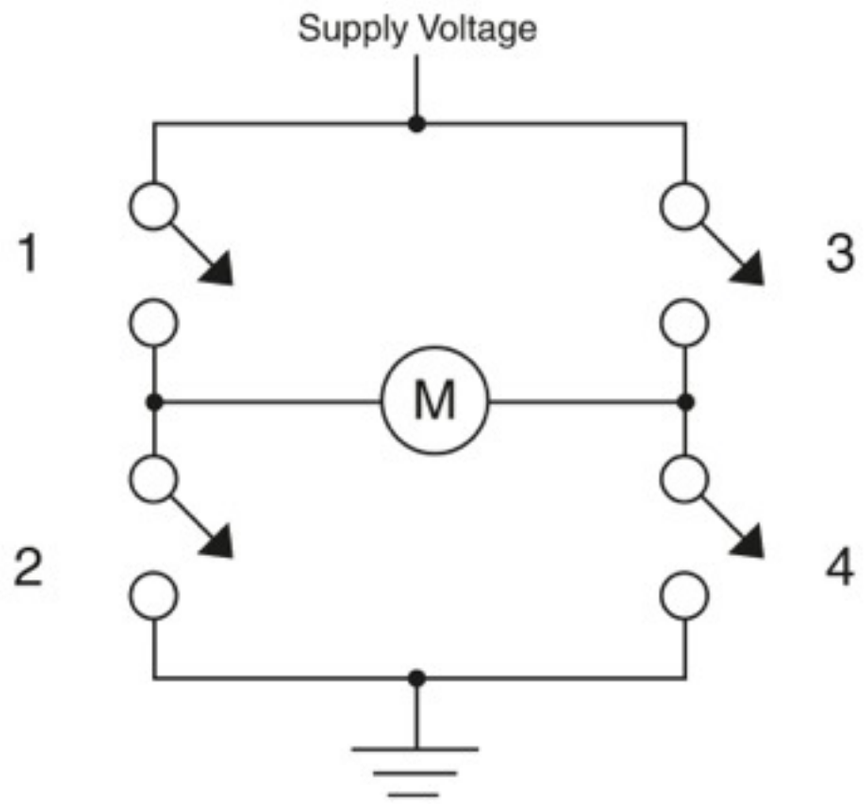
- One of the main issues in powering motors is the possibility of *blowback* or *back voltage*, which can damage your microcontroller. You can protect your Arduino by using a diode, which allows current to travel in one direction only.
- Another issue is that with the high voltage/current required, if you are powering the micro with the same power source, their is a large current drop when the motor(s) turn on and off. This can be avoided using capacitors, which smooth out the spikes in current, with a voltage regulator, which brings the +V to a workable value for the Arduino.

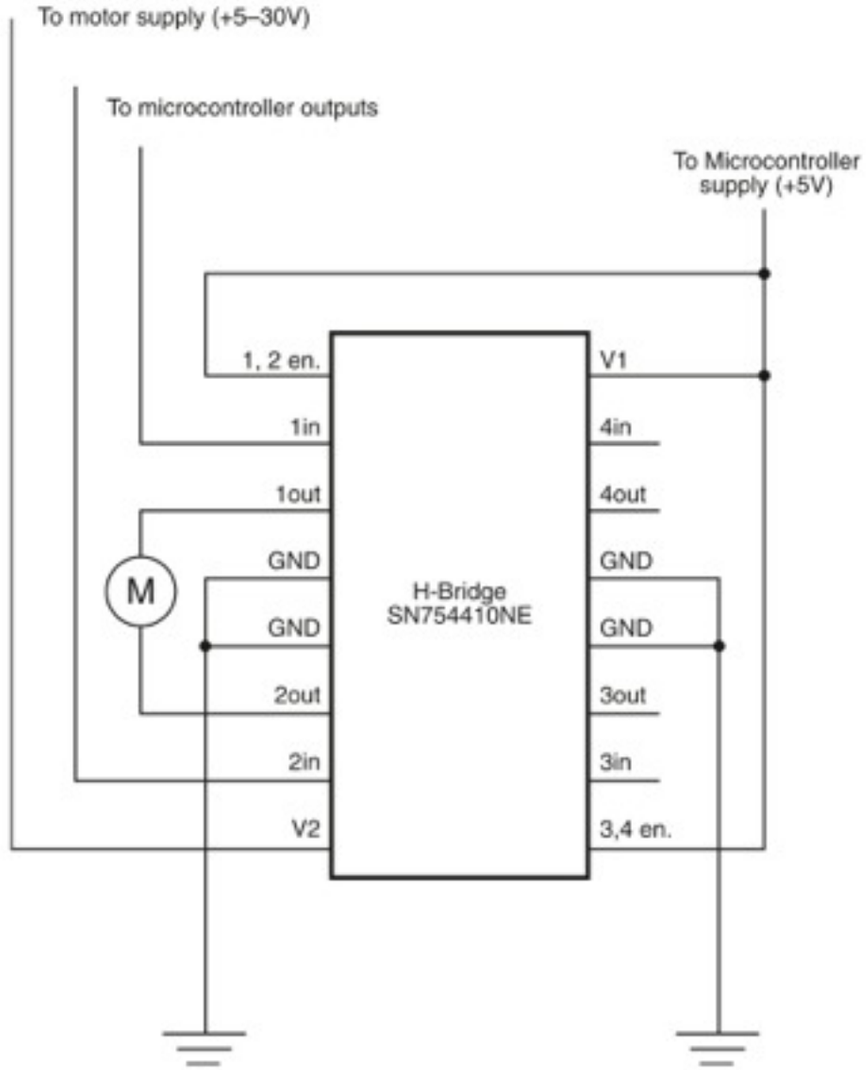


For more information see p.255 of Physical Computing by Tom Igoe

Controlling motors

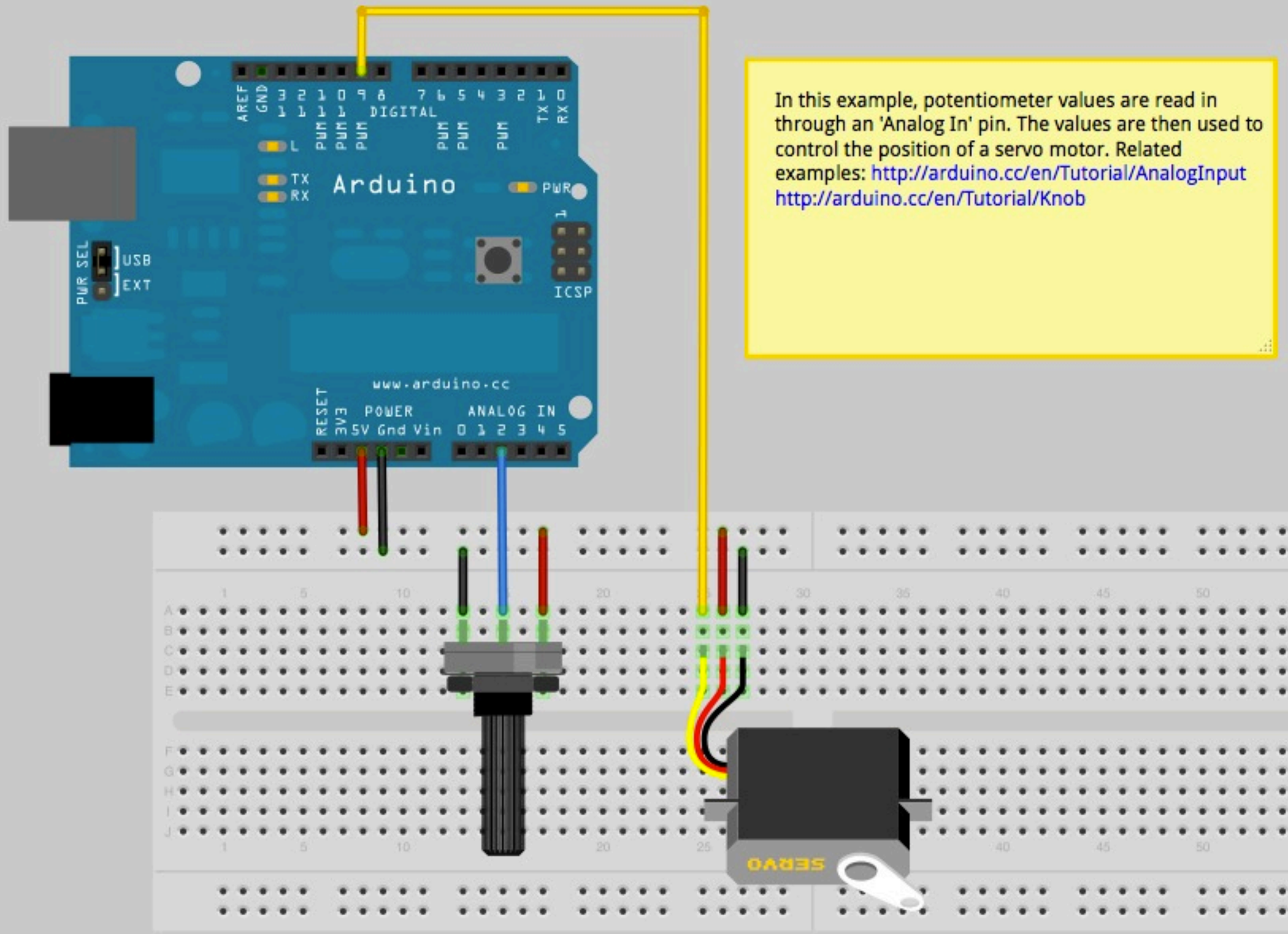
- The other challenge with motors is that their internal components require precise timing. So you need to use a switching arrangement called an “H-bridge.”
- An H-bridge alternates voltage flow from the left lead of the motor to the right, in order to control polarity and thus the magnetic field inside the motor.
- While you can make your own, it’s generally cheaper (and easier!) to buy one. They cost ~ $3 and can be found easily.





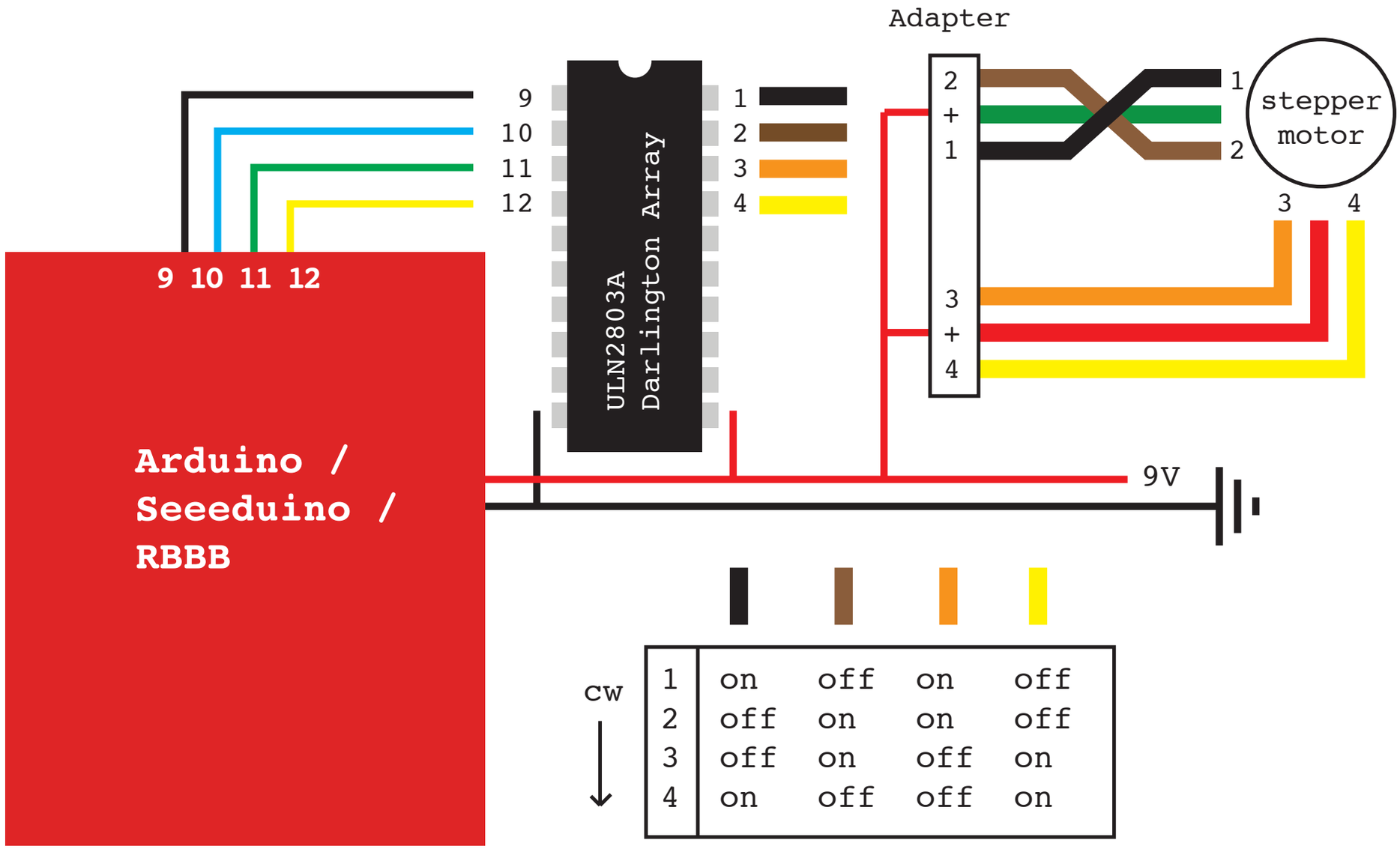
For more information see p.256 of Physical Computing by Tom Igoe

Example circuits: Servo



In this example, potentiometer values are read in through an 'Analog In' pin. The values are then used to control the position of a servo motor. Related examples: http://arduino.cc/en/Tutorial/AnalogInput http://arduino.cc/en/Tutorial/Knob

Example circuits: Stepper



1	on	off	on	off
2	off	on	on	off
3	off	on	off	on
4	on	off	off	on

Running a 6-wire stepper motor with a Darlington Array

6-wire Unipolar Stepper motor (48 step Nippon Electric Pulse Motor)
http://www.allelectronics.com/make-a-store/item/SMT-108/STEPPER-MOTOR-6-WIRE/1.html

For more details see p.262 of *Physical Computing* by Tom Igoe

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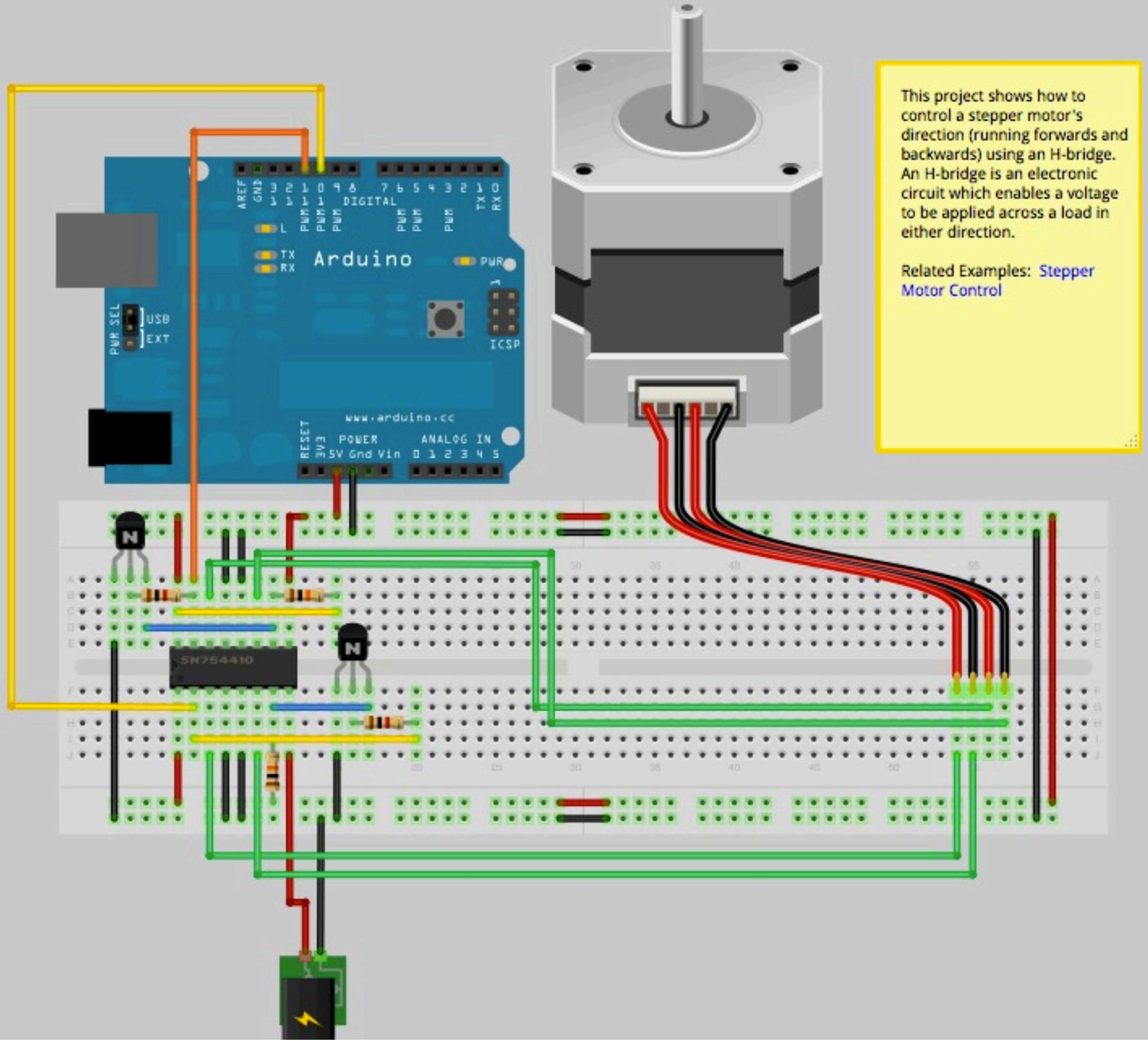
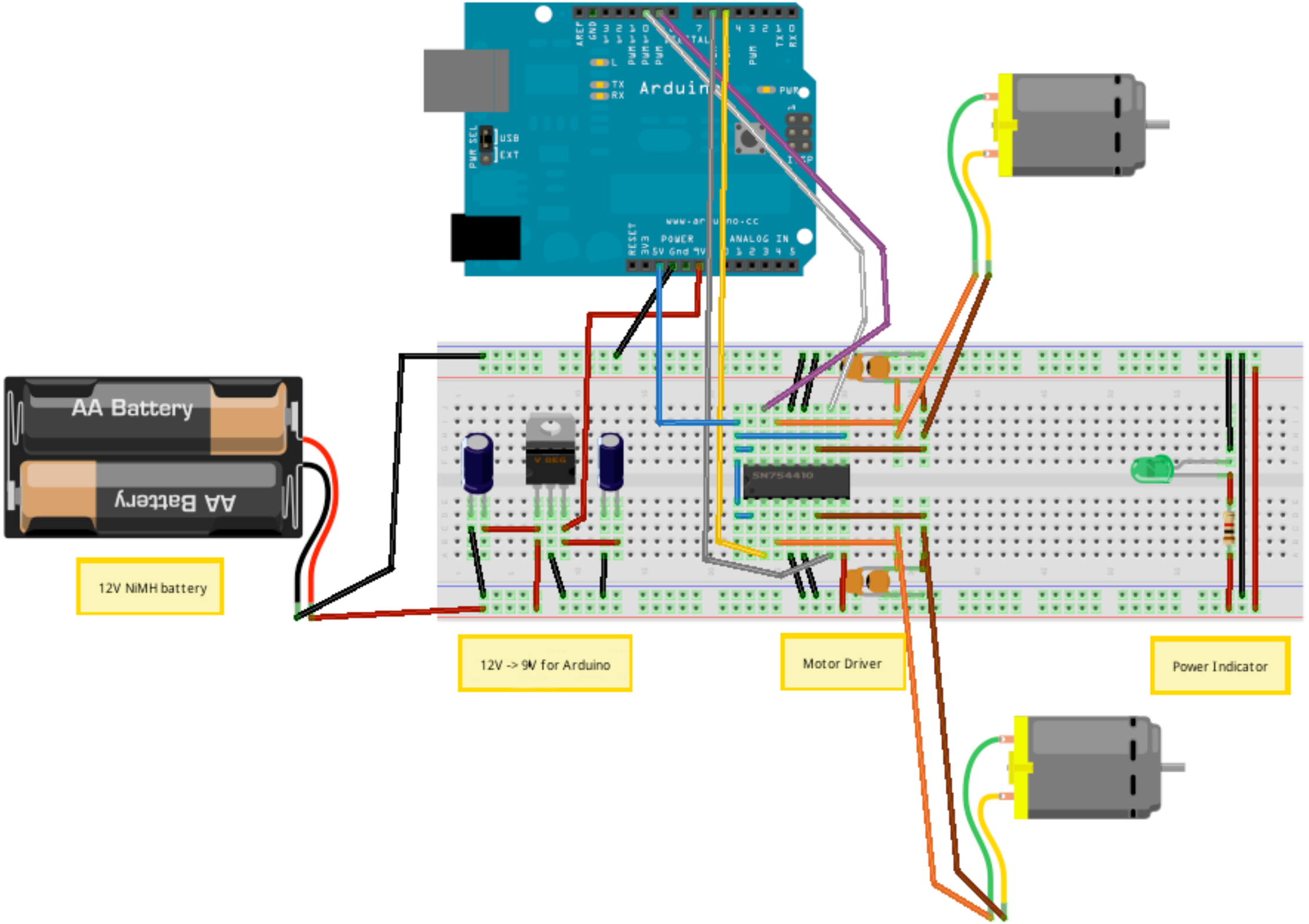
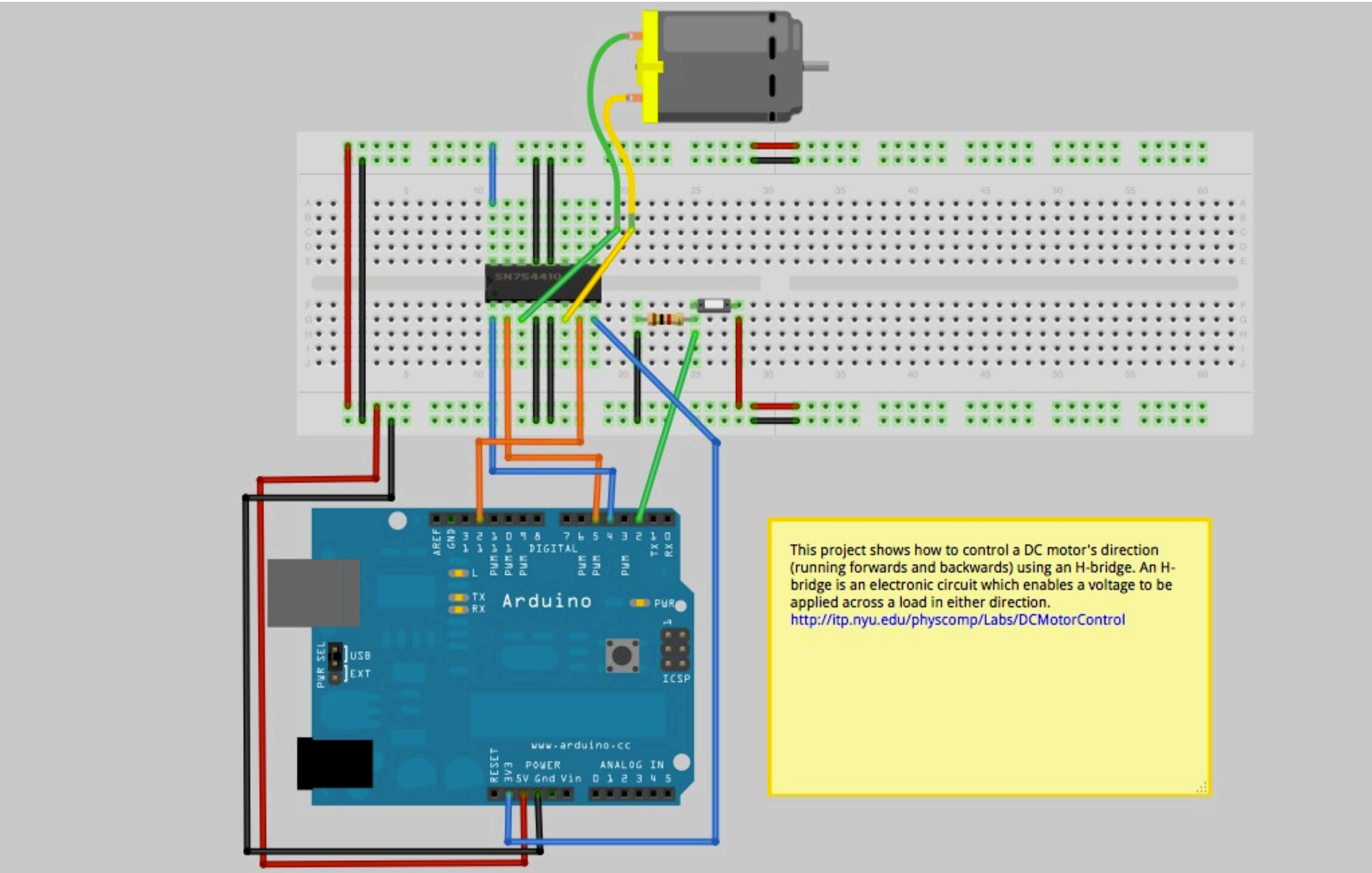
Example circuits: Stepper



Example circuits: Stepper



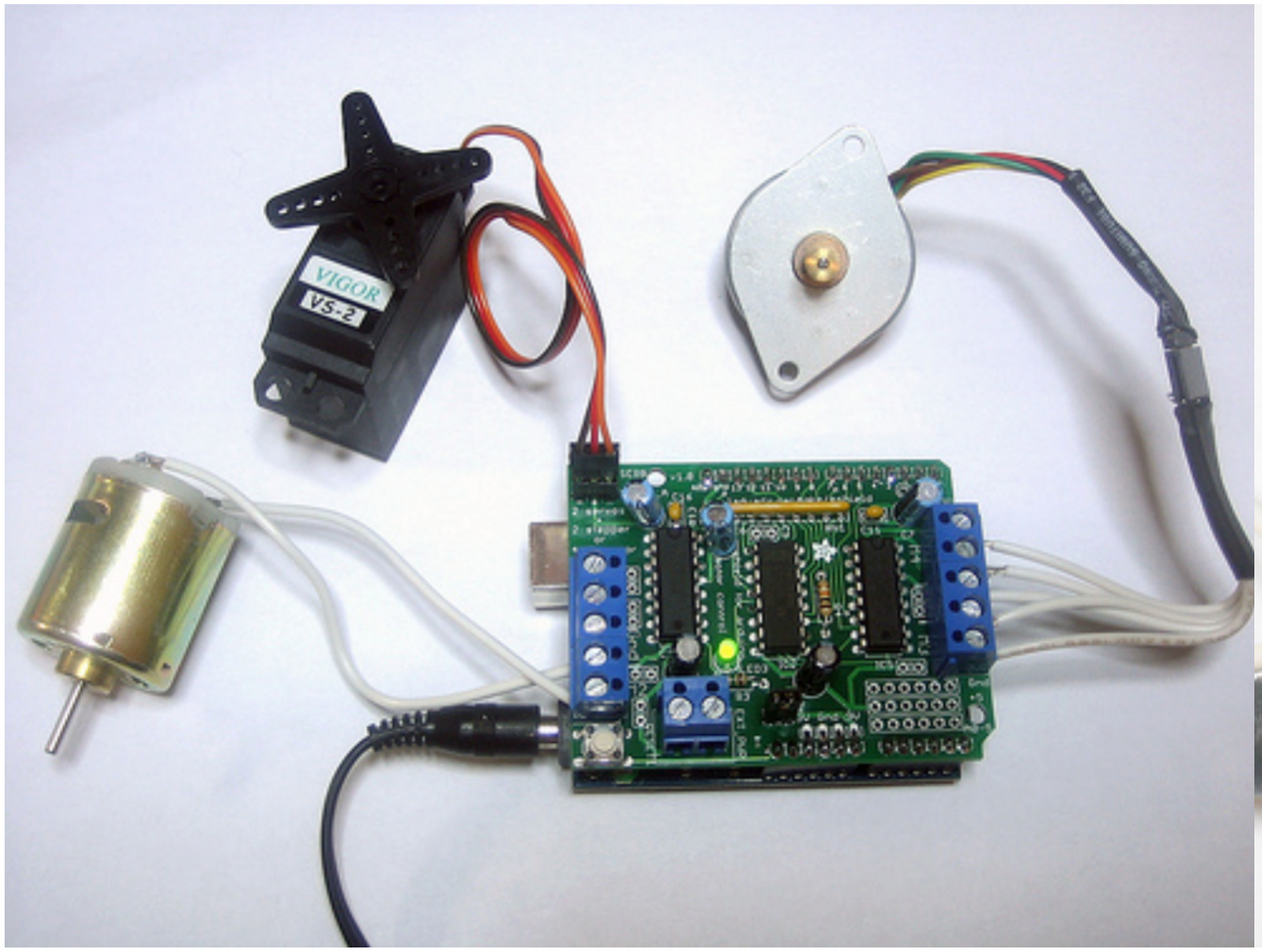
Example circuits: DC motor

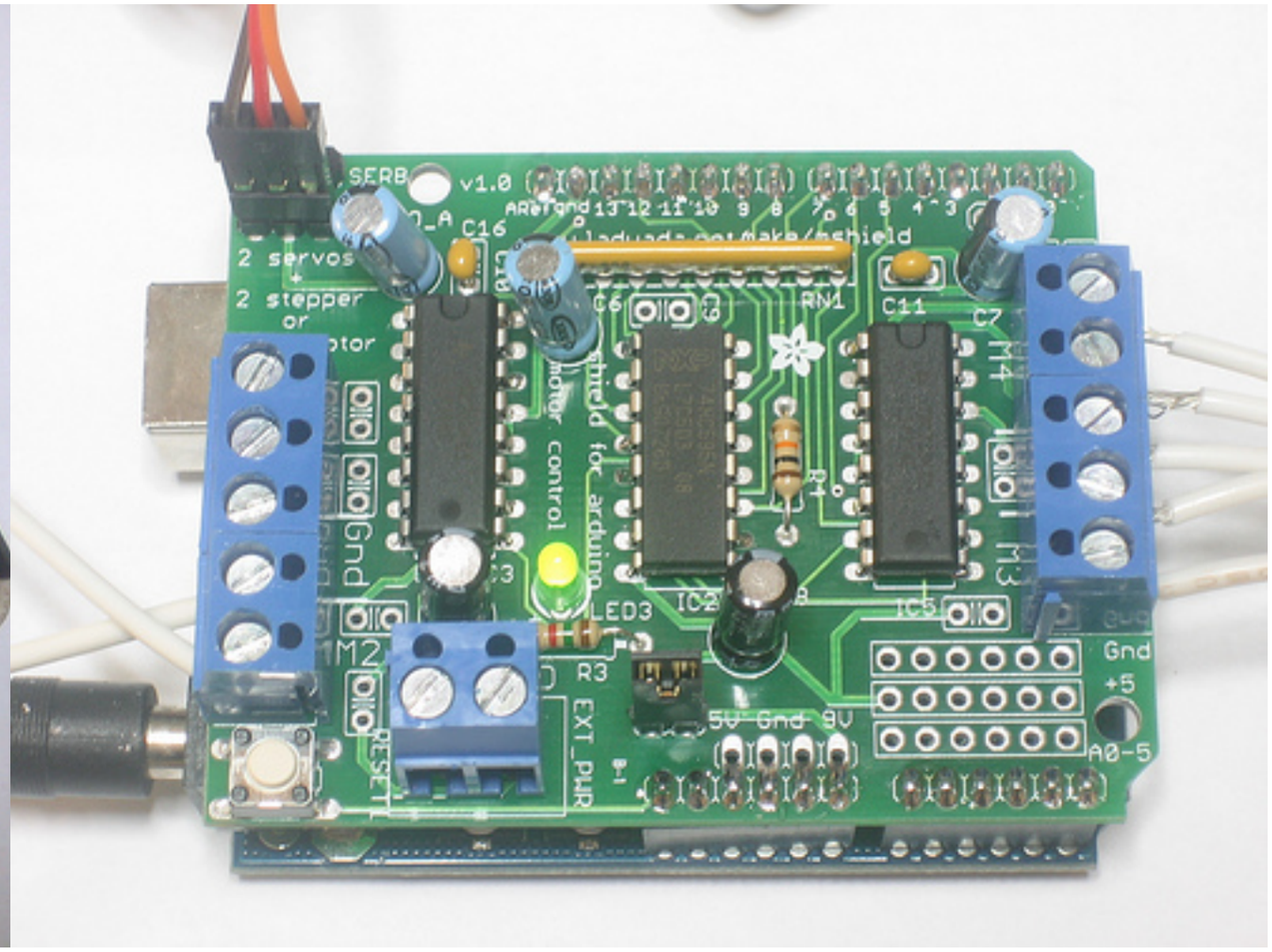


This project shows how to control a DC motor's direction (running forwards and backwards) using an H-bridge. An H-bridge is an electronic circuit which enables a voltage to be applied across a load in either direction.
http://itp.nyu.edu/physcomp/Labs/DCMotorControl

Controlling motors

- Lady Ada makes a Motor Shield shield that can make wiring/controlling motors much easier. Simply plug the shield onto your Arduino, supply the board with plenty of voltage, and connect your motors.





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