

Project #1

DIY Magnetic Mixer

To invent, you need a good imagination and a pile of junk.

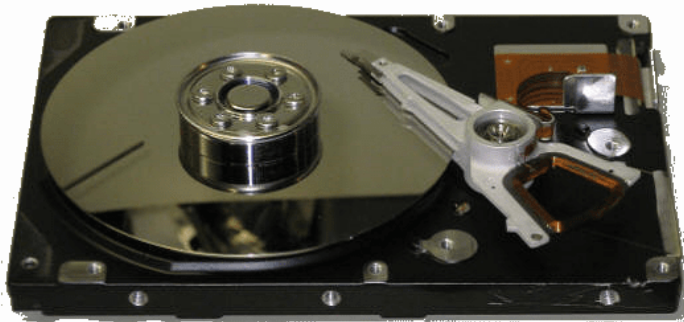
Thomas A. Edison

*To invent, you need **a problem**, a **pile of junk**,
and to **not be afraid** of failure.*

Your imagination will develop on its own.

- Peter Reintjes channelling Ben Franklin

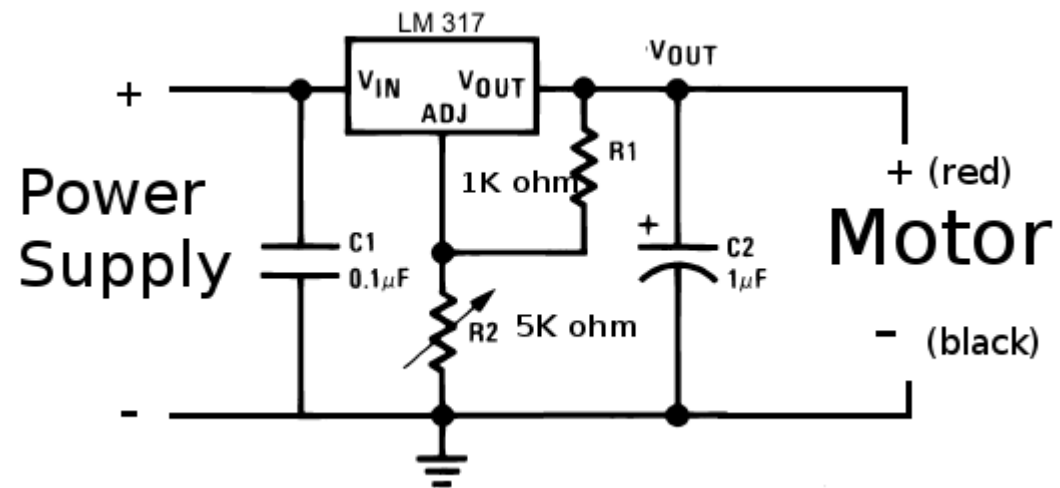
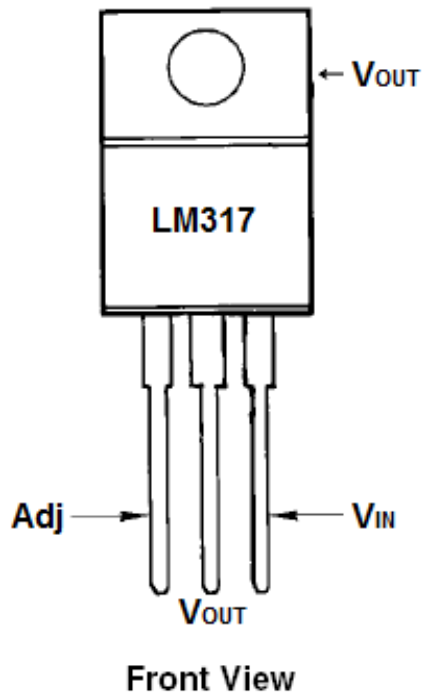
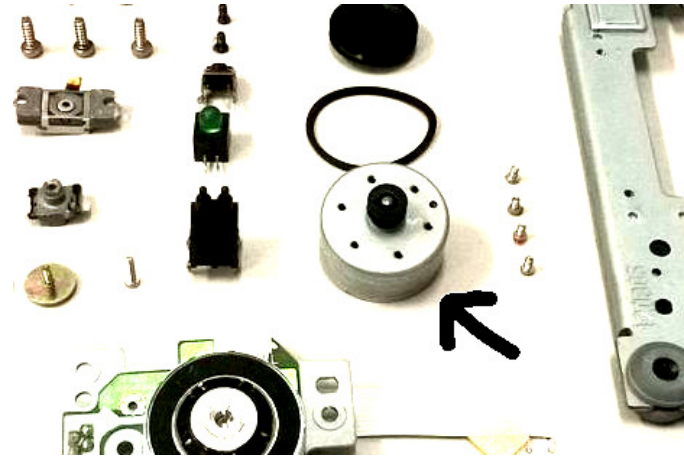
Pile of Junk ca. 2019



Spinning Magnet

Parts from a ten-year-old computer

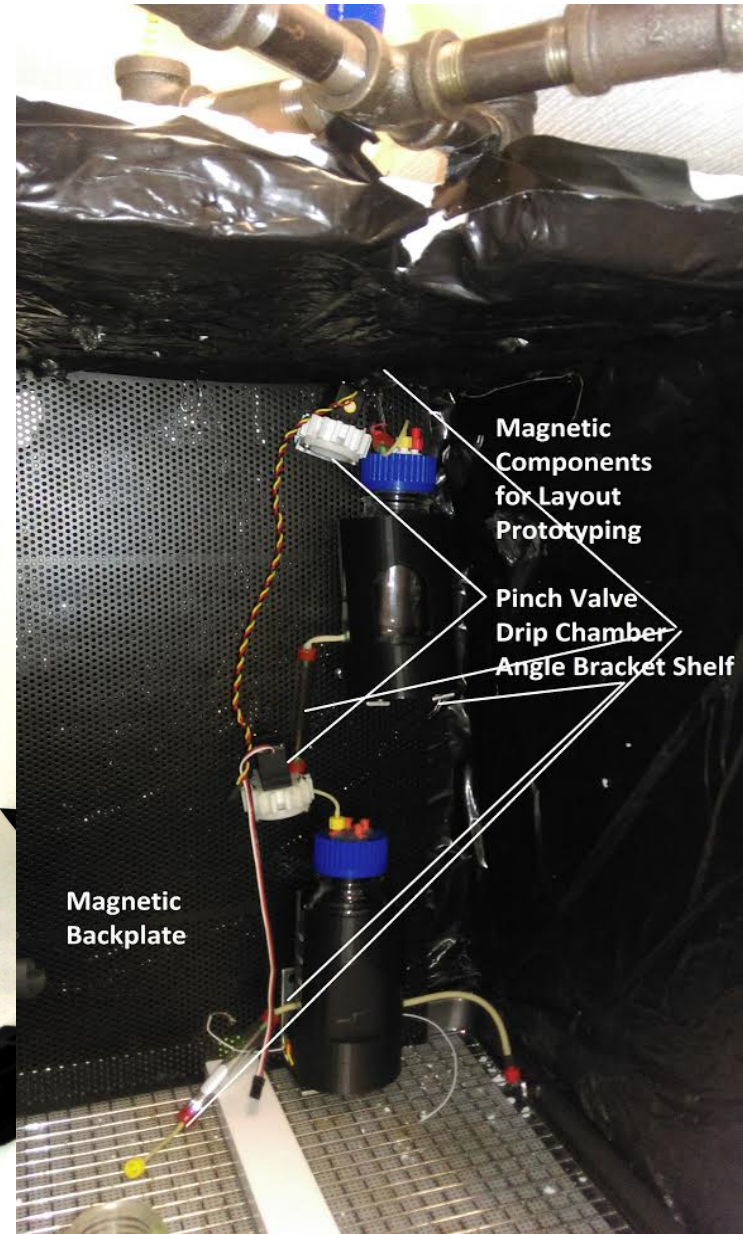
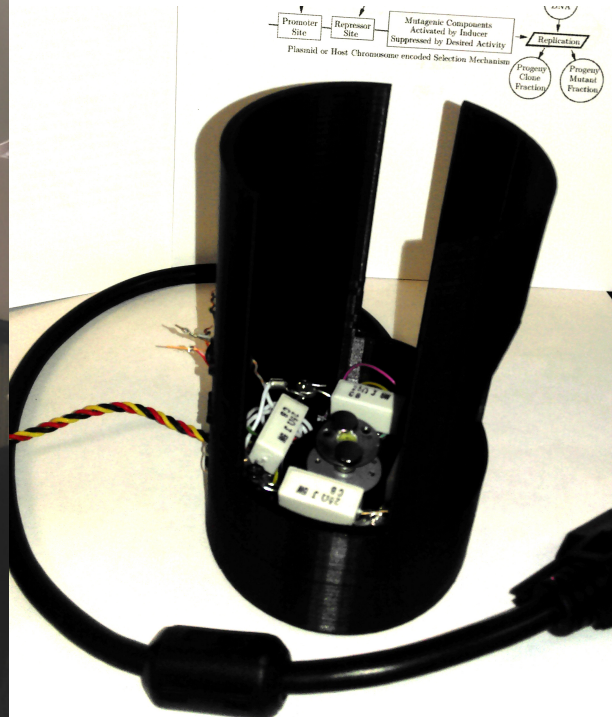
Low current motor adjustable speed control



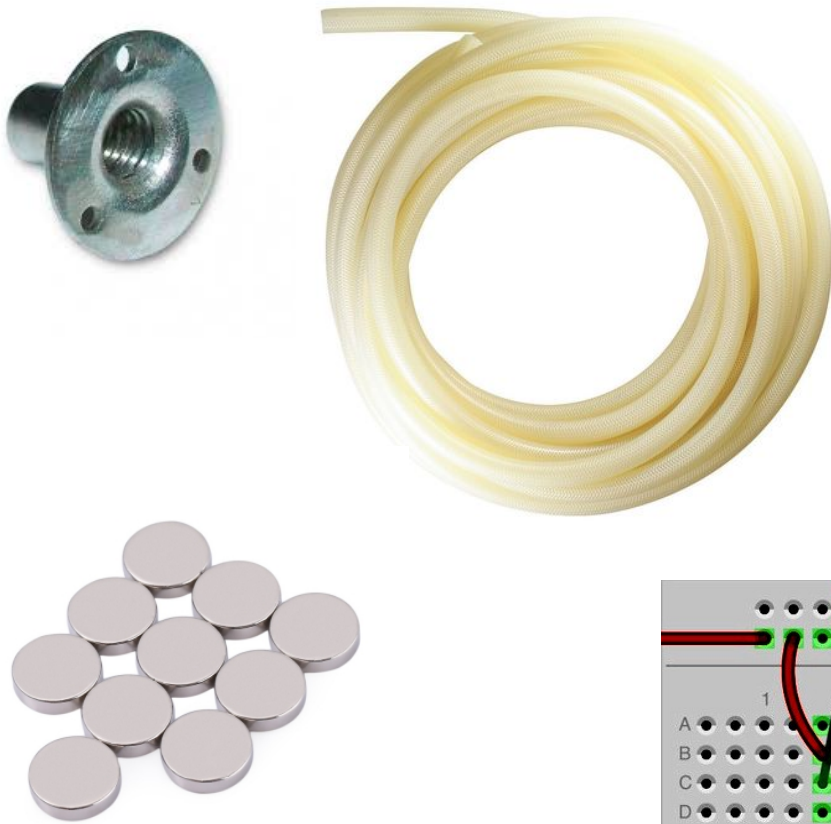
Improvements

- Add speed control: LM317 voltage regulator
- Use better motor: CD/DVD drawer opener
- Use better magnets: Neodymium discs
- Notice excess energy provides heat (resistors?)
- Refine the design:
 - Heater/Mixer with temperature control
 - Design your own Protocols
 - Peltier junction (\$8-12) to add Chiller
- Now you have an excuse to use a 3D printer

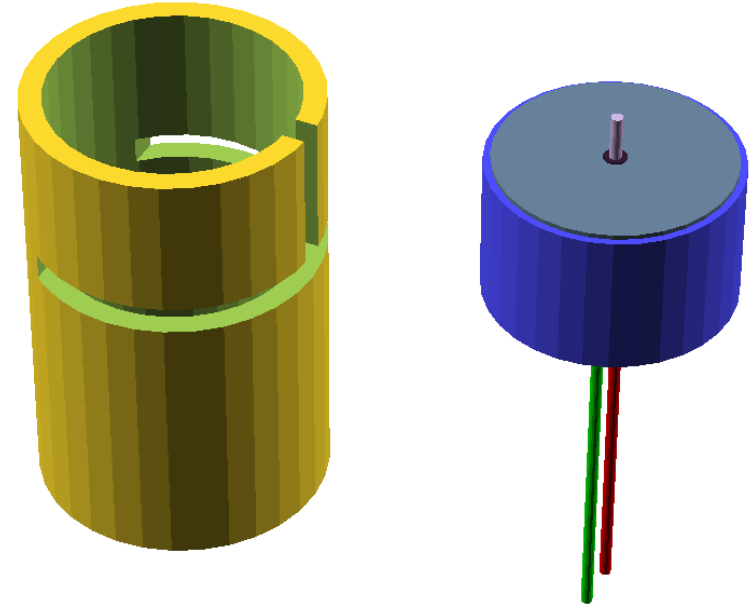
EvoStat Module



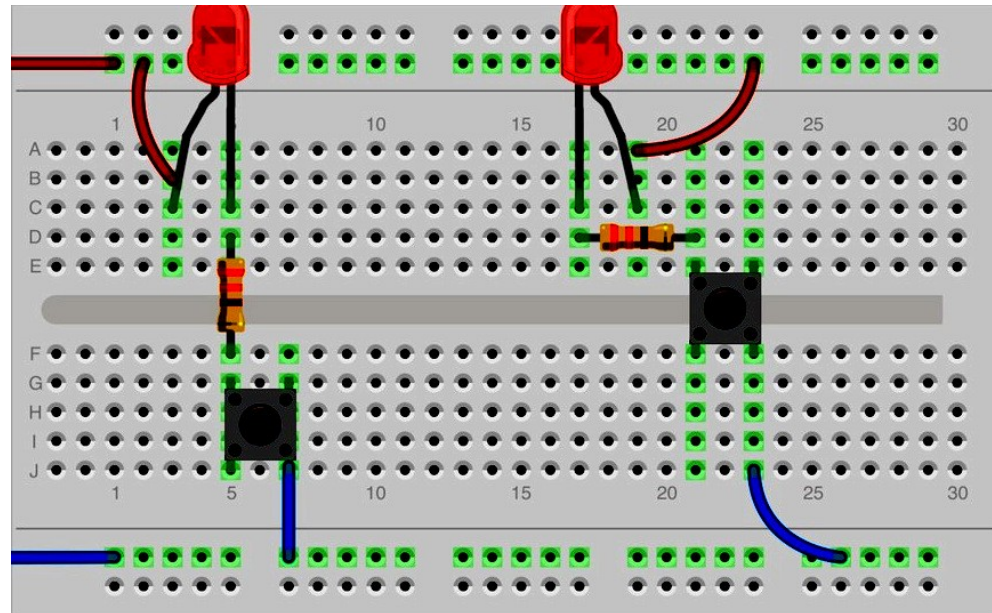
Magnet Rotor



Motor Clamp

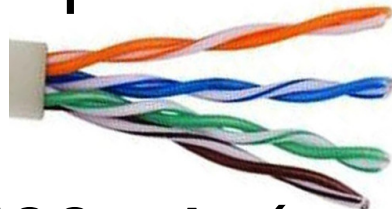
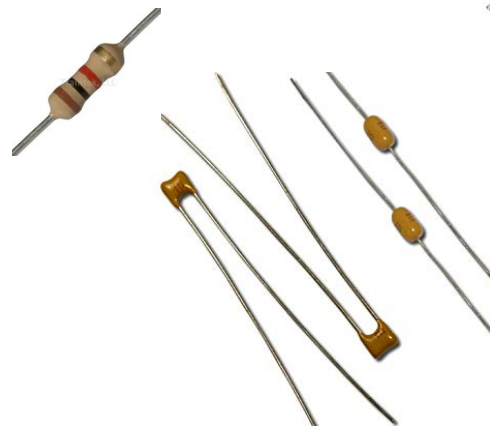
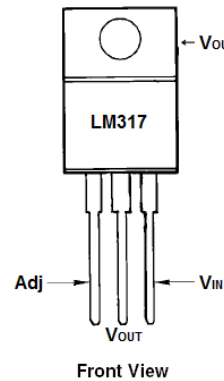


Prototyping Breadboard

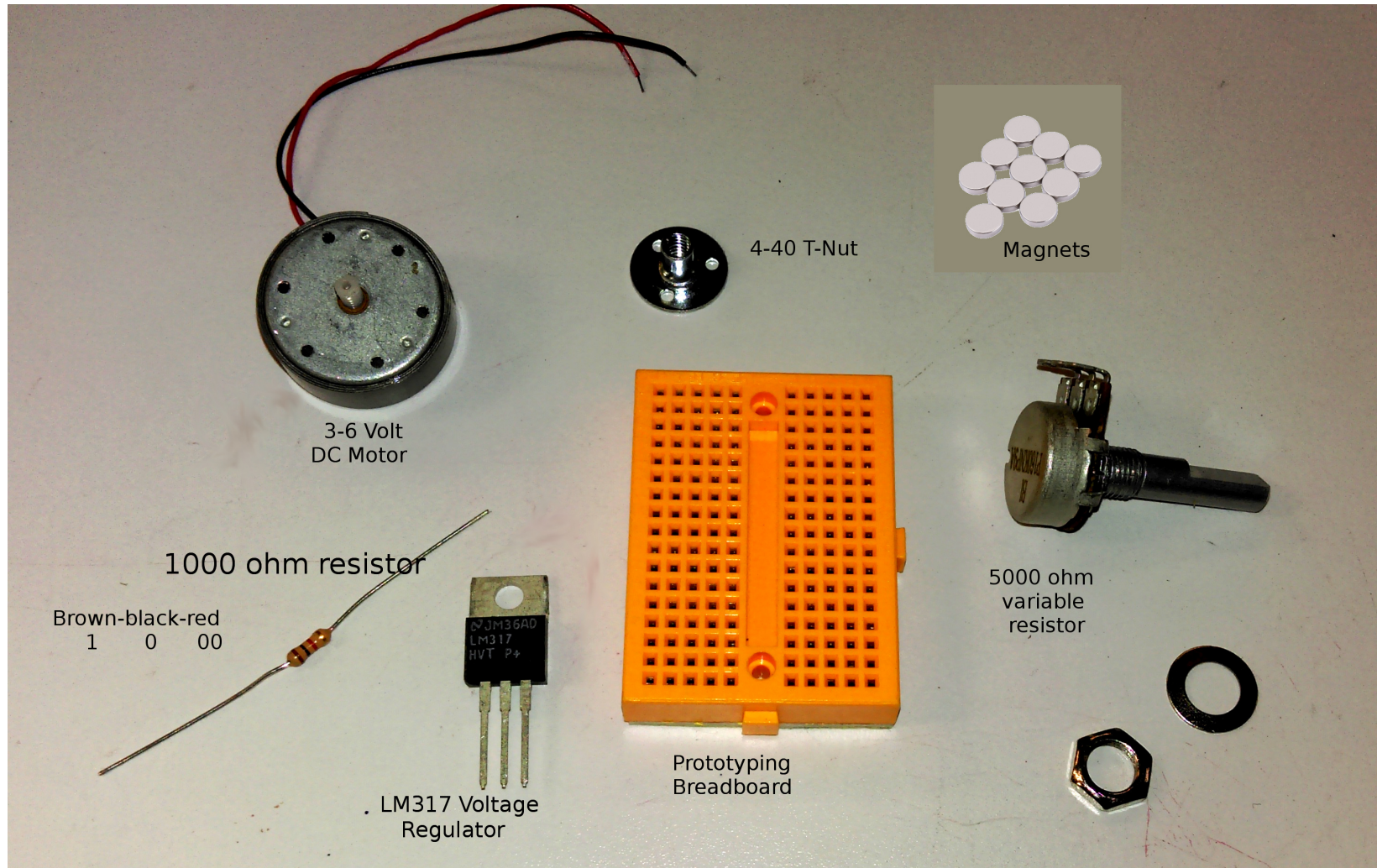


Parts

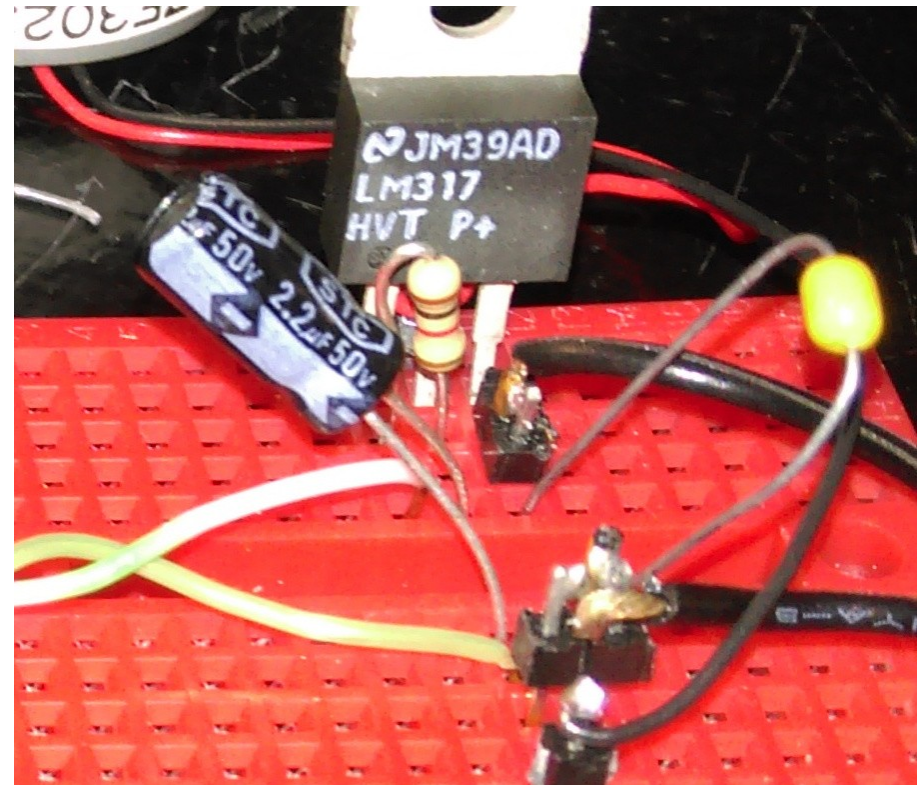
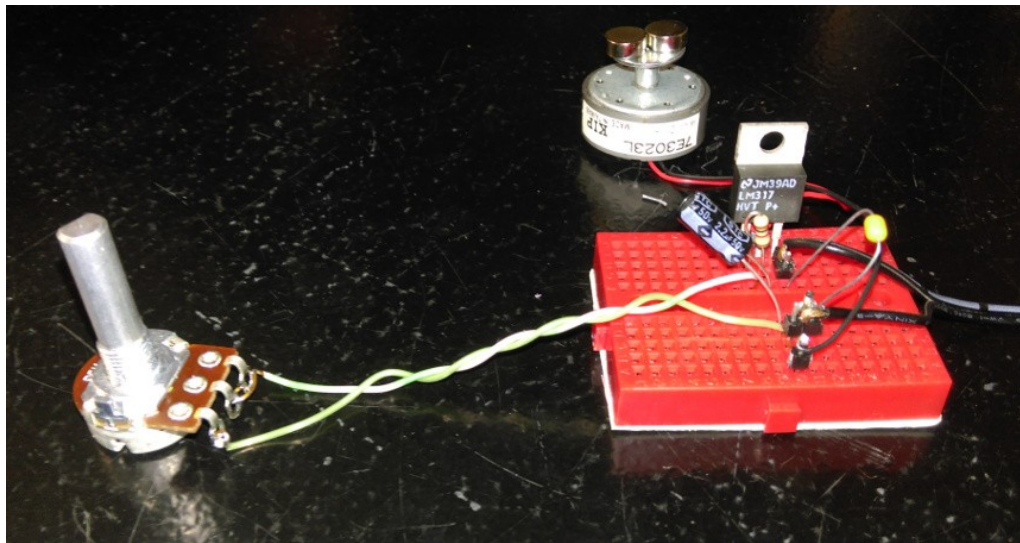
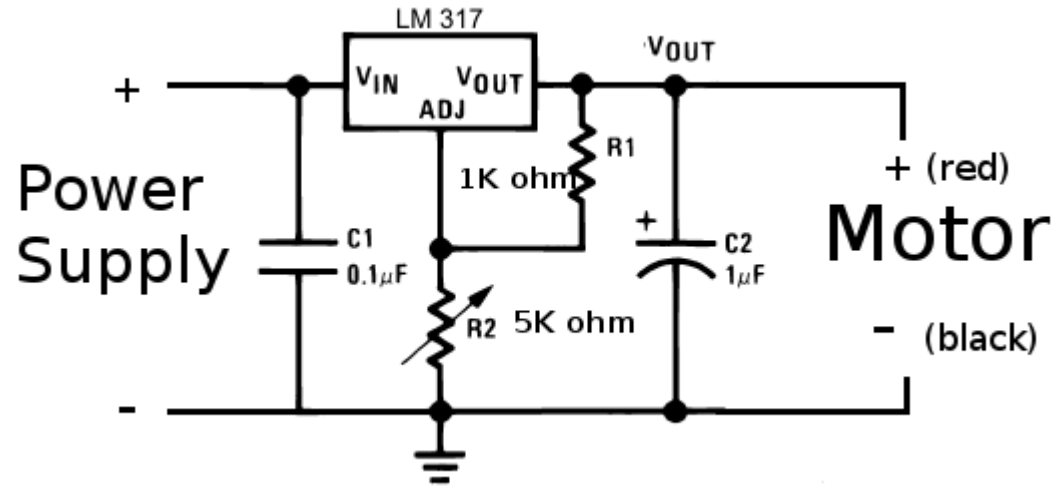
- DC Motor 100mA 3-6v motor
- Rotor (T-Nut)
- Magnets
- LM317 Voltage Regulator
- 5K ohm variable resistor
- 1 K ohm resistor
- 0.1uF capacitors
- Wire
- 5 volt 500mA (or 9 volt 1 amp)



Magnetic Mixer Parts



Schematic vs. Reality



Project #2

\$20 Centrifuge

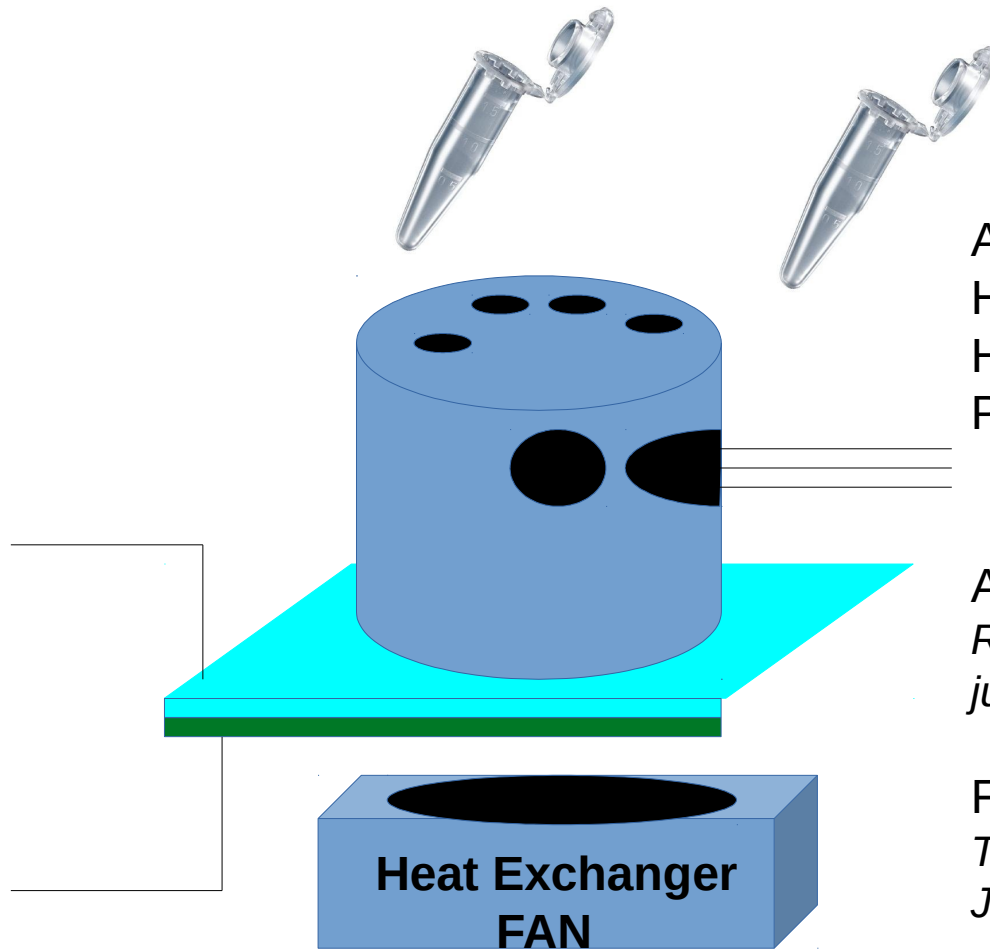
- Motor from a cordless screwdriver
- 3" PVC pipe flange from Lowes
- 2N3055 transistor (\$1)
- Lead/Acid battery from a UPS
- *(or 5-10 Amp 12-15 Volt power supply)*
- Speed control potentiometer (5K ohms)
- High-current diode to suppress motor voltage spike
- 3D printed Rotor
- Plastic box with snap-on lid for safety

Project #3

\$25 PCR Thermocycler

- \$8 Peltier Junction with heat-sink and fan
- LM35 Temperature sensor (~\$1)
- Drill holes in aluminum block
- Power Supply
- 4 MOSFET Transistors (H-Bridge \$4)
- Arduino (\$3)
- USB cable or Bluetooth (\$3)

Thermocycler Heat/Cooling Block

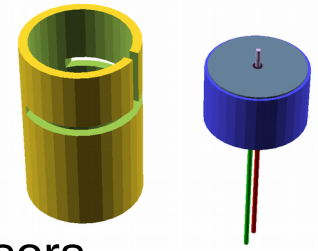


Aluminum block
Holes drilled for Eppendorf tubes
Hole drilled for temperature sensor
Peltier Junction

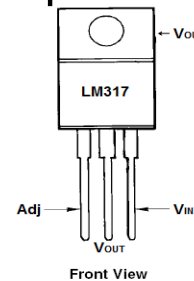
Arduino controller:
Reads temperature sensor and turns Peltier junction on and off to control Temperature

Four transistors (H-bridge circuit)
To provide + or - voltage to Peltier Junction for Heating and Cooling

Assembly Instructions



- Motor Clamp: Cut 2" section of plastic tube and slice with razor or scissors according to the picture
- Glue it to the center inside of the box, with the motor-clamp "C" pointing up.
- Plug the LM317 Voltage Regulator into the prototyping board. When you can read the printing on the voltage regulator and the pins are pointing down, the pins are, from left-to-right:
 - 1) Voltage-adjustment pin
 - 2) Output voltage going to the motor (red wire)
 - 3) Input voltage from the power supply (+5 to +9 volts)
- Connect the 1K resistor between pins 1 and 2 of the LM317, connect the 5K ohm variable resistor between pin 1 and ground, pin 2 to the motor's red wire, Ground (power supply negative – wire, no markings) to the motor's black wire, one capacitor between pin 2 and ground, and one capacitor between pin 3 and ground. Connect +9-volt wire (+ power supply, wire with white lines) to pin 3 of the LM317.
- *[A long-winded way of saying connect the components as shown in schematic]*
- Punch hole in tupperware container for speed control, attach with washer and nut.
- Remove protective paper from breadboard and position inside container.



Assembly Notes

- The voltage regulator provides a controlled low voltage to the motor by maintaining the excess voltage from the power supply across its terminals. The voltage regulator is consuming the energy of this excess voltage and will become warm or even too hot to touch when the difference between the motor voltage and the power supply is large. To improve the situation, we can use a lower voltage power supply (5 volts instead of 9) or a motor that operates at higher voltages.
- The filter capacitors have their negative leads connected to ground, one is the input capacitor and filters the voltage going into the voltage regulator circuit (pin 3), and the other is the output capacitor because it filters the voltage coming out of the voltage regulator (pin 2) to supply power to the motor.
- Fixed resistors are not polarized: it doesn't matter which end is connected to which of the two circuit connections.
- The small yellow ceramic capacitors are not polarized so it doesn't matter which end is which.
- Cylindrical electrolytic capacitors are often polarized, the negative lead is usually marked.
- If the capacitors are polarized, the positive lead (wire) must always be connected to a higher voltage than the negative lead, which is often connected to ground.