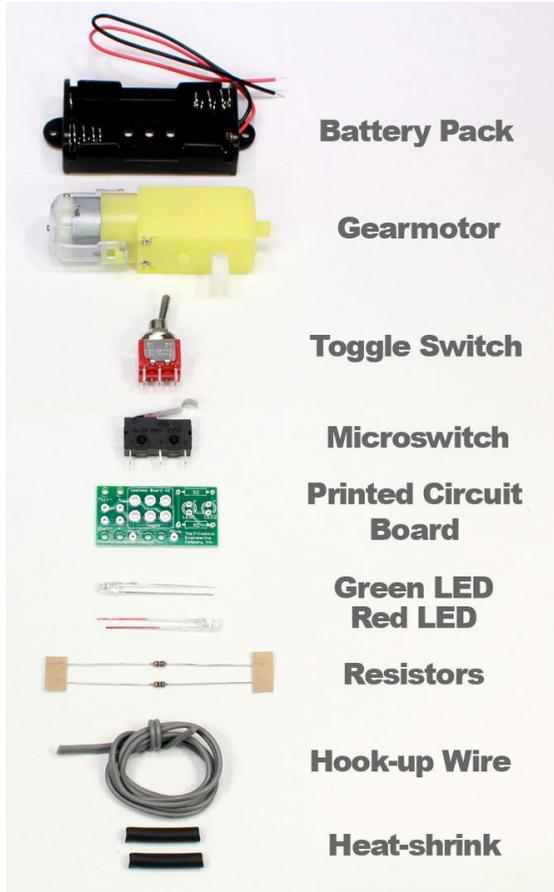# Frivolous Engineering Useless Machine Soldering Instructions

The electronics assembly for the Useless Machine is very easy to solder together. It consists of 11 parts as shown in the photo.

Battery Pack

Gearmotor

Toggle Switch

Microswitch

Printed Circuit Board

Green LED
Red LED

Resistors

Hook-up Wire

Heat-shrink

Required tools & material:

soldering iron

side-cutter

measure tape or ruler

rosin core electronics solder

Option Tools:

wire cutter/stripper

flush-cut side-cutters or "wire nippers"

heat gun

Also helpful is a Panavise, or alligator clip "helping hands. But you can also make do with pliers and a rubber band as shown in the photo.

If you're new to soldering check out **"Soldering is Easy"** by Mitch Altman, Andie Nordgren & Jeff Keyzer.
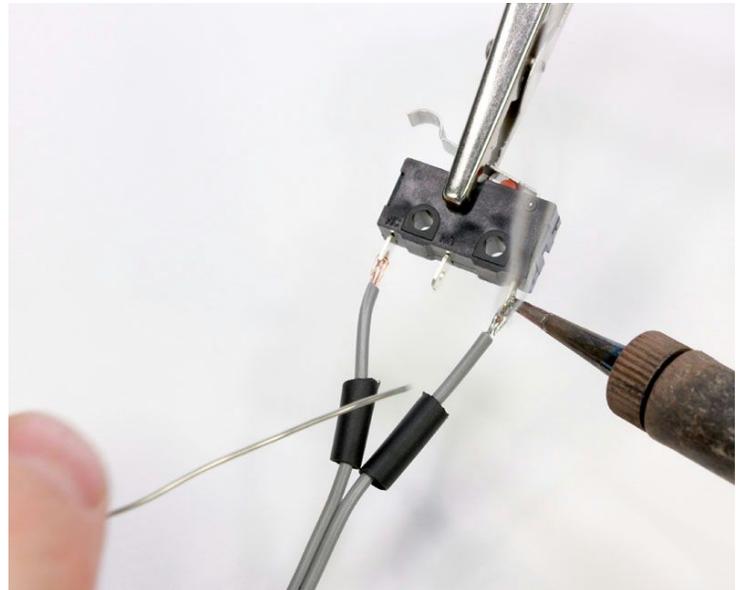
It's a comic book that explains everything you need to know about soldering. In very little time you'll be soldering like a pro!
http://mightyohm.com/files/soldercomic/FullSolderComic_EN.pdf

Micro-Switch Assembly:
First cut the supplied wire into roughly 16 cm (6.5 inch) and 10 cm (4 inch) pairs and strip off the insulation from the ends about 4 mm (3/16 inch).

Tin the wires on one end of the 10cm(4 inch) wire.
Tin the outside pins on the Micro-Switch (the middle pin is not used).

Place the heat-shrink into two pieces then place them over the tinned wires.

Solder the wires to the outside pins off the Micro-Switch.
Move the heat shrink so it covers the pins and using a heat gun or soldering iron, shrink the heat-shrink. Take care not to melt the Micro-switch!

Set the Micro-switch Assembly aside for now.

Split the conductors on the 16cm (6 ½ inch) wire and route it underneath the plastic strap for added strain relief.

Ensure that the copper conductor goes to the correct tab on the motor as shown in the photo.
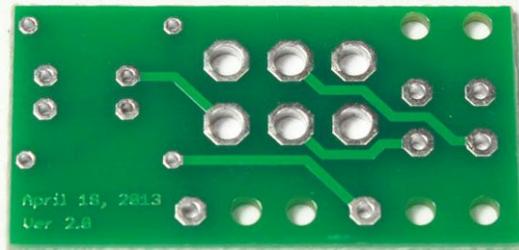 Otherwise the motor will run backwards.

Solder the copper conductor to it's motor tab, and then the silver colored conductor to the other motor tab. Set the Motor Assembly aside for now.
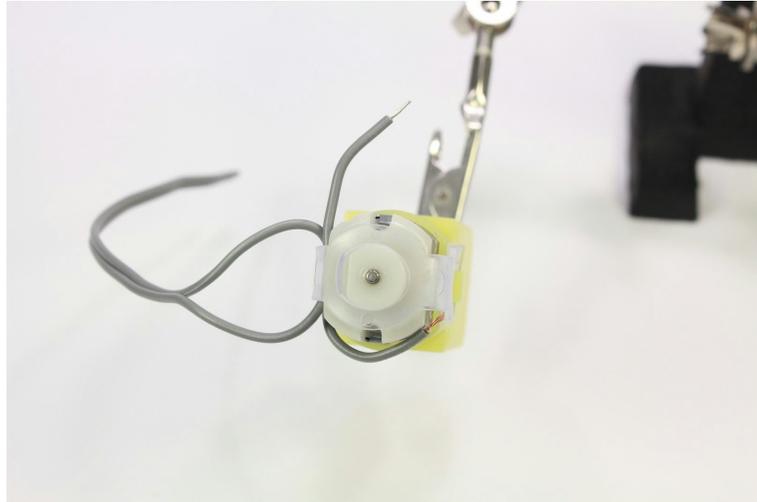
Now it's time to "populate" the printed circuit board. Sounds like fun!
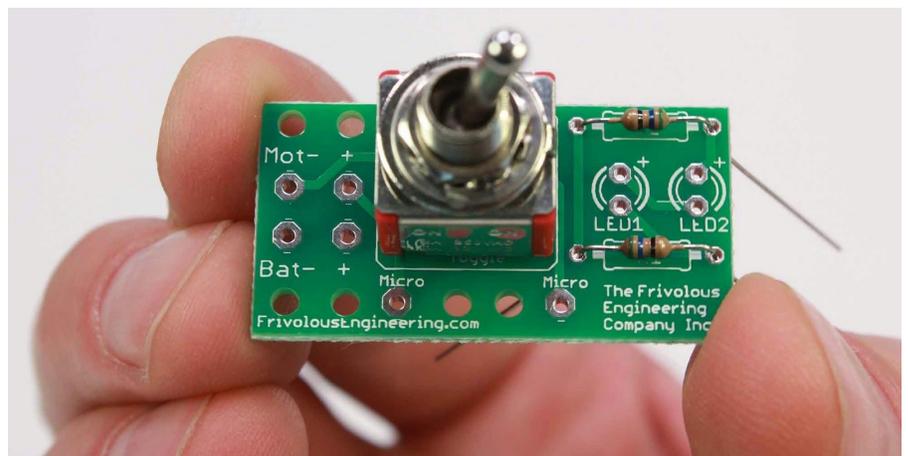
Most of the components & wires are mounted on the top side of the board and soldered on the bottom.

All the components have their positions labeled on the top-side silk screen.

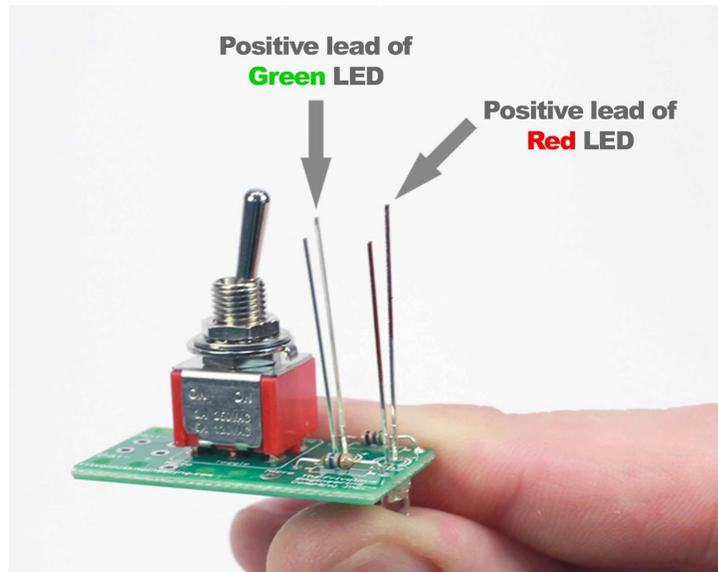Insert the toggle switch & resistors into their respective locations as shown.

Make sure the Toggle Switch is flush with the circuit board.

Solder the Toggle Switch & Resistors in place.

Using side-cutters or nippers, cut the excess leads off of the resistors.

Now on to soldering the LEDs.

Positive lead of
Green LED

Positive lead of
Red LED

Which LED is red & which is green? When they aren't illuminated they look identical.

We've marked the leads of the Red LED with a red marker so you can tell which is which.

You'll notice that one pin on each LED is longer than the other. These are the positive leads and go in the holes marked with a **+** symbol near them.

The green LED goes in the location closest to the Toggle switched, marked **LED1** on the circuit board. Obviously, the red LED goes in **LED2**.

Make sure the LEDs are seated as close to, and as flush to the bottom of the circuit board as possible. Slightly bending the leads apart will help keep them in place when you go to solder them. Soldered the LEDs and snip off the excess leads.

Split the end of the wires on the Micro-switch Assembly about 4cm (1.5 inches).

The circuit board has 2 pads labeled **Micro** & the strain relief holes are between those pads.

Thread the wires of the Micro-switch assembly through the strain relief holes on the circuit board.
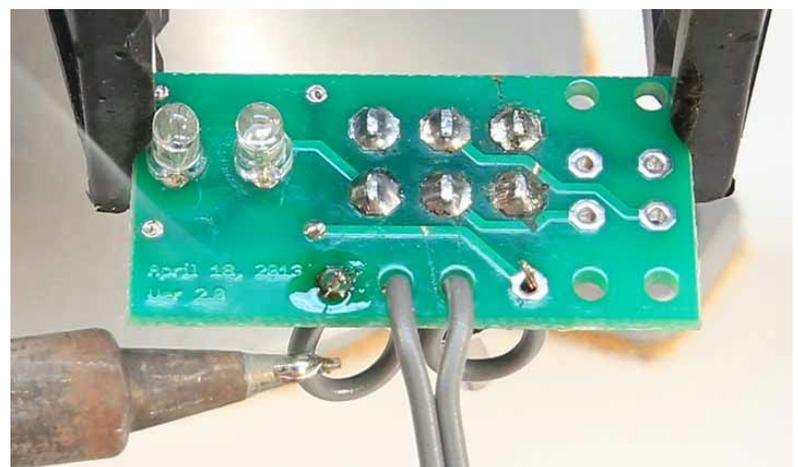
Insert the leads for the Micro-Switch into the through-holes labeled **Micro** and solder them on the bottom of the circuit board as shown.
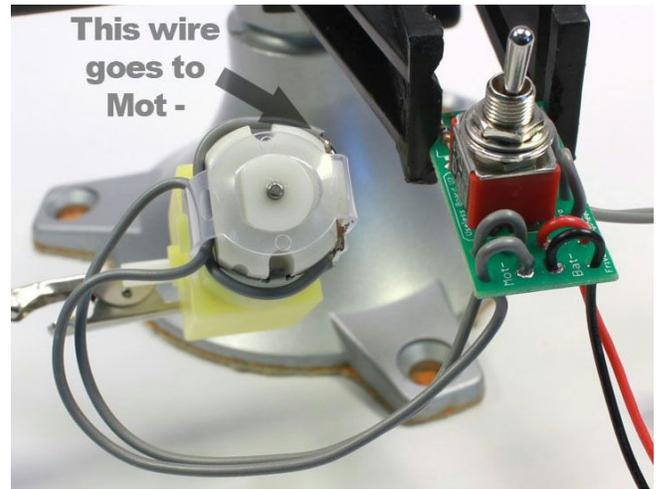
The polarity doesn't matter, so copper or silver conductors can go in either spot.
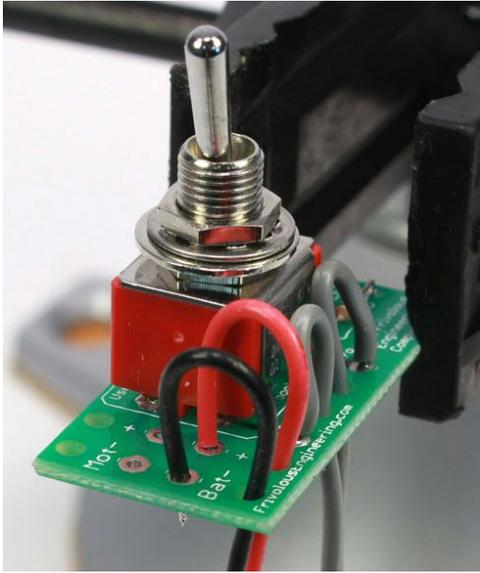
The battery pack comes with it's wire leads stripped and tinned.

Thread the wires through the strain relief holes. The Red wire of the battery pack goes to the hole labelled **+** & the black wire to **Bat -** (minus symbol).

Solder the battery pack wires to the circuit board.

This wire goes to Mot -

Split the conductors on the motor leads about 4cm (1.5 inches) & thread the wires through the strain-relief holes in the circuit board.

The silver colored conductor from the motor goes to **Mot -** on the board. The copper conductor goes to the **+** through-hole. Solder the motor leads to the circuit board.

If you end up soldering the motor wires to the wrong place, the motor will run backwards. If this happens, just unsolder the leads at the motor and switch them around.

You are now done soldering! Time to check the operation of the Useless Machine Electronics assembly. Insert 2 AA batteries into the battery holder.

The motor should begin turning. If the Toggle Switch is "ON" position, the motor turns counter-clockwise & the Red LED is lit. In the "OFF" position the motor turns clock-wise & the Green LED is lit.

Activating the Micro-switch when the toggle is "OFF" will stop the motor and turn off the Green LED. When the toggle is "ON", activating the Micro-switch will have no effect on the motor.

For more info & trouble-shooting, visit our website: **frivolousengineering.com**

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