

# The Teuthis Miniature Twitchie Assembly Manual v1 April 2011

Welcome to the magical and exciting adventure of Twitchie ownership! Together, you and your Twitchie shall RULE THE WORLD. But before that can happen you have to do a bit of assembly on your new friend. *Don't despair!* It might look like a bag of junk now, but after a little bit of work your new favorite robot will be wiggling into the hearts and minds of all your future subjects. First, we'll assemble and test the circuit board, then we'll build up the mechanical parts. From that point you are free to dress up your happy little Twitchie however you want. Awww! Or alternatively, AAAAGH! It's up to you.

Thank you!

-Dr. Archibald Teuthis, President

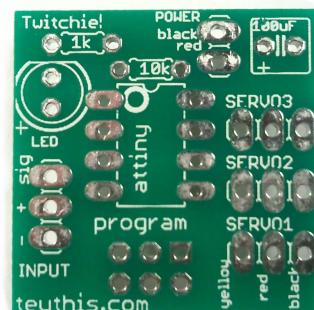
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## Part I: Electronics

### The Mysterious Invisible Force that Drives Robots to Do Our Bidding

Let's get to know the parts, shall we? Good!

To the right is the **printed circuit board**, or **PCB** as seen from the top. This is a piece of epoxy resin with copper traces bonded to each side. The electronic components in the kit will be soldered to the circuit board. Take a moment to get familiar with the board. Don't get the top and bottom mixed up!



This red candy like object is an **LED**, or Light Emitting Diode. Pay close attention to the length of the two leads; one is longer than the other. The longer one is the Anode, and it can be thought of as the “plus” lead. Insert it into the board with the longer lead facing the “+”. If you put it in backward the LED will not light up. However, if you follow your heart (and the instructions) it will glow a marvelous red light!

These two are 1000 ohm and 10,000 ohm resistors, also referred to as 1K and 10K. The colored bands are a numerical code. For our purposes the only band that we need to pay attention to is the third one. On the 1K resistor it's red. On the 10K resistor it's orange. Resistors are not polarized; either end is the same. Bend the leads as shown so that the resistors can be mounted vertically in the board.





Shown here is the mysterious **capacitor**. It consists of a couple of pieces of aluminum foil and a piece of paper rolled up, soaked in magic “electrolyte” and packed in a tiny metal can. The electrolyte does some crazy hoodoo in there and that gives it more capacity but also makes the device sensitive to reverse polarities. Note that the long lead goes to the “+”, just like on the LED. Capacitors are capable of storing small charges of electricity, like a miniature battery. They can charge and discharge very quickly. In our little robot the capacitor serves to smooth out glitches in the power supply.

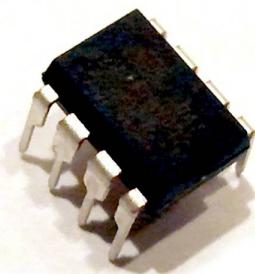
*They can be made to explode with some ingenuity, but I leave that as an exercise to the reader. Good luck!*

This is a robot jawbone, complete with teeth. Handle with care. Some people would prefer to call this a row of **breakaway header pins**. Those people would say that these are nothing more than conveniently shaped pieces of wire that are used to create semi-permanent attachments between electronic devices. Either way, we're going to use them to attach the servos. They can be easily broken to the right length with a set of wire clippers. Move quickly when soldering these because the plastic “gums” are prone to melting. Again, *good luck!*



All robots have a lust for power, just some more than others. Twitchie is totally happy with the power found in just four AAA Ni-MH cells. Alkaline will do too, in a pinch. Shown here is a **battery holder**. The red wire is the “+” wire and the black wire is the “-” wire. Don't insert batteries until you have finished soldering the kit!

Every mad scientist loves brains! Shown here is just that, a robot brain. This particular one is an **AVR microchip** called the **ATtiny85**. It's a teensy computer, complete with storage, RAM memory, a CPU and peripherals. All of the behavior of the Twitchie is controlled from this device. We'll be referring to it as the “**chip**”, short for **microchip**.



**IMPORTANT:** Look at the top of the chip. You should see a small notch or a little circle at one end. That notch and/or circle is there so you can tell which way to put the chip in the PCB. When the time comes to mount the chip in the board, make sure that these are rotated to the same orientation as the corresponding shapes printed in white on the PCB. **If the chip is inserted backwards, it will be destroyed! YOU HAVE BEEN WARNED!**

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## Part II: Mechanics

### Moving Parts and Structural Components

Now let's go over a few of the mechanical parts involved in robot minion making. Nothing too complicated here, and everything is non corrosive and guaranteed inedible.



This blue box is a **servo**. It's a motor, gearbox, feedback loop and mechanical mounting all in one. It has three color-coded wires. The black one is the minus or “ground” wire. The red one is the plus wire. These two are for power. The third one, which is either yellow, white or orange, is the signal wire that the servo monitors for commands. Twitchie's CPU sends commands over this wire to make the servo move to a position. The plastic case has two notches for mounting screws. There's a white cylinder coming out of the top which is the output shaft. That's the part that turns.

Seen here is a **servo horn**. Attach it to the output shaft. There's a little screw that goes through the top to pin it tightly to the servo. Don't over tighten. If the horn is not in the right place when the Twitchie is running, turn it off, remove the screw and make an adjustment.



Servo horn extenders in “unsafety orange”. These give the small movements of the servo more speed and distance, in exchange for a reduction in torque. The lower one has a servo horn glued in place.

To the right is the main frame part of the Twitchie. Its purpose is to hold the motors in place. There are small screw holes, but hot glue works great too.



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## Part III minus one:

### Gather your TOOLS!

You will need: reasonably thin acid-free electronics solder, a soldering iron, diagonal clippers (a nail clipper will do) a small phillips head screw driver, and perseverance. You will also need glue and four AAA batteries.

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## Part III: Electronics Assembly and The Basic Elements of Soldering

Soldering is an art. There are right ways and wrong ways, but there is much about it that is subjective and can only be learned with practice. This is beyond the scope of this manual. If you've never soldered before you should train yourself on some spare bits of wire and parts clippings before you start with this kit. A few hours of tinkering should get you up to speed.

### The Key Elements:

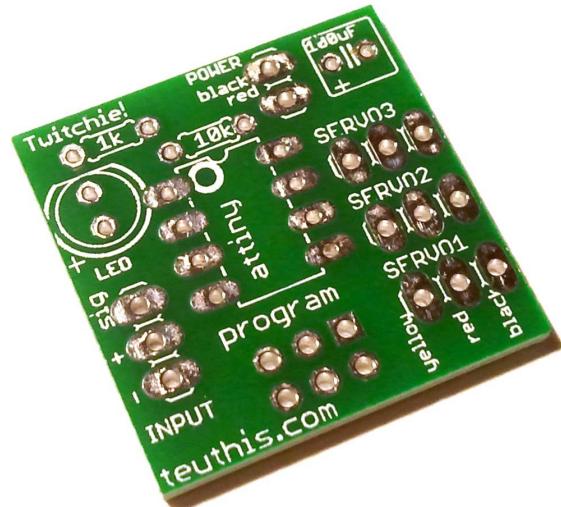
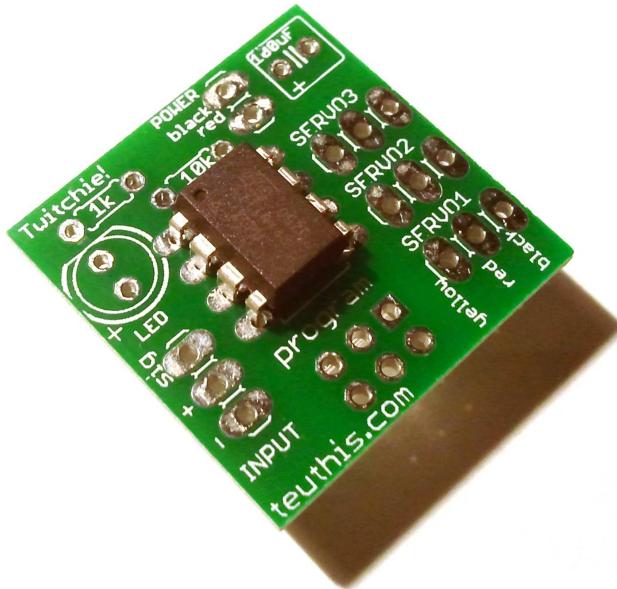
*Heat!* The iron must be hot enough to melt the solder almost instantly. Also, the pads on the board and the pins of the component must all be at or above the melting temperature of the solder by the time you are finished with a connection, or else the solder will not stick. If you don't achieve the required temperature, you will have a "cold joint". If you can afford a nice temperature controlled iron, don't hesitate to buy it. Hakko, Xytronics, and Goot are all excellent.

*Shine!* The tip of the iron should be nice and shiny. If it's dull or turned black then you have an oxide layer that needs to be cleaned off. Use brass wool or damp sponge to clean the iron after every connection. Apply tinning/cleaning compound when the shine gets too dull to be fixed with sponges or brass wool. If even that is ineffective then a gentle sanding with 300 grit followed by a tinning will bring it **back to life**. NOTE: This does *not* count as playing god.  
*Light!* Work in a well lit room. Direct sunlight is the best. At night use a clip lamp or something that you can bring right next to the work.

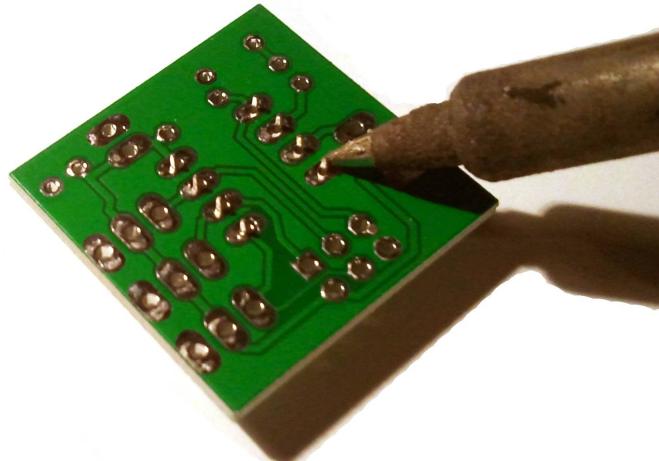
*Air!* Open a window. Fume extractors and fans are helpful, but you need to have a decent amount of fresh air coming in to the room at all times to prevent accumulation of solder smoke. Soldering on the roof of your lair is recommended.

A quick note: The author prefers eutectic lead free alloy for all of his work. If you try this material, be sure to purchase a can of tinning/cleaning compound to counteract the slightly more aggressive flux used in this type of solder. It's better for the environment to use lead free products, so please consider them in *your* work! Kester makes a nice one in .03" that is *very tasty*!

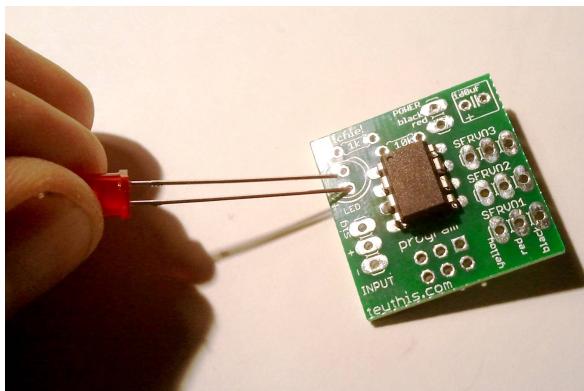
Now let's put the circuit board together! Start with the bare board on the table or in a vise. The word "Twitchie!" should be at the upper left corner and the word "teuthis.com" should be at the lower left. If you don't see any text at all, flip the board over.



Insert the pins of the chip into the holes in the middle of the board. The chip should sit snugly. Make extra sure to have it oriented correctly! The dot and/or notch should be facing away from you.

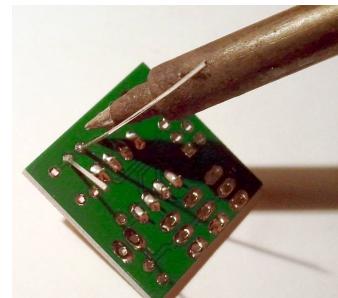


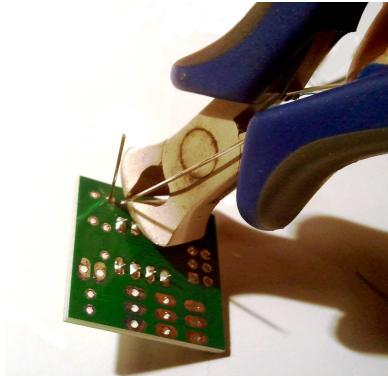
Flip the board over and solder the pins to their pads. Be sure to move swift grace and a steady hand. *Persevere*.



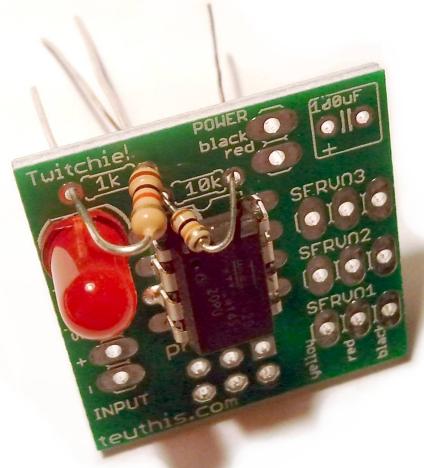
Insert the LED. Pay close attention to the polarity! The long lead should go toward the little "+" sign.

Flip the board and solder in the LED leads.



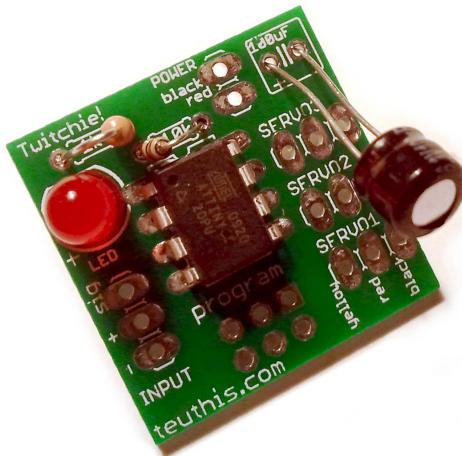


Use clippers to remove the extra length from the leads. (Do this for the LED, resistors, battery wires and the capacitor too.)

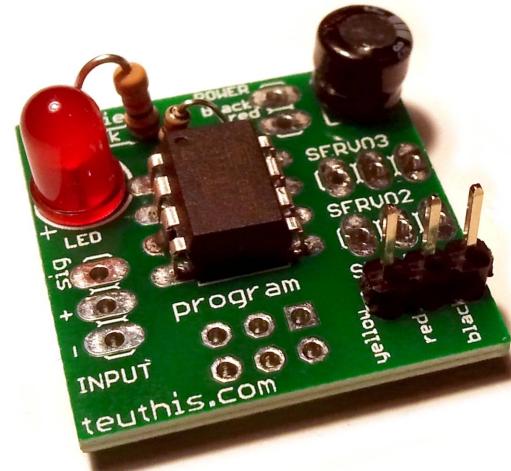


Add the resistors.

The one with the red stripe goes where it says “1K” and the orange-striped one goes in the “10K” position.

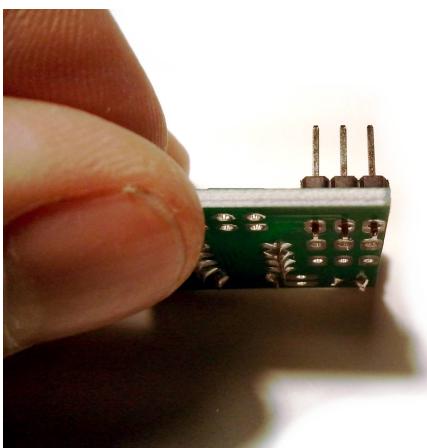


Add the capacitor. Don't forget about polarity!



Add the pin headers. Start by breaking off groups of three pins from the strip. The short ends should go through the board, leaving the long ends sticking up.

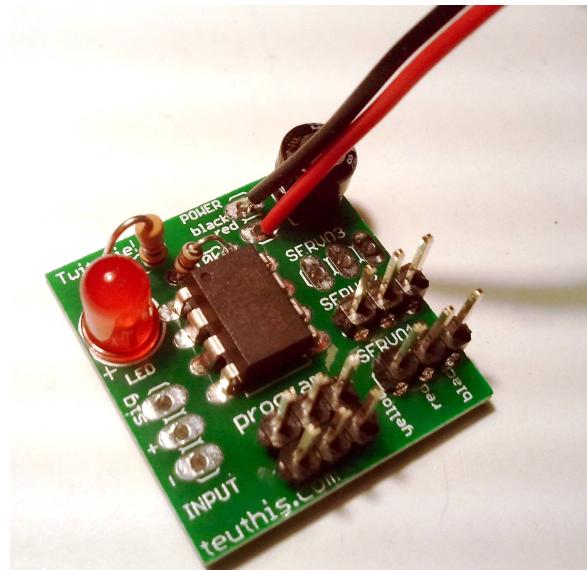
Helping hands are helpful here. Populate the “SERVO1” and “SERVO2” places.



The “INPUT”, “program” and “SERVO3” are optional positions *for the purpose of hacking!*

Finally add the battery pack wires. There are two holes next to the capacitor labeled “red” and “black”. These correspond to the red and black wires on the battery pack. Put the wires in through the top of the board like any other part and solder them in.

That's it! No longer is mere *soldering* getting in the way of *conquest!*



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## Part IV: Mechanical Assembly

### Moving Parts and Structural Components IN ACTION

Now for the somewhat simpler task of assembling the mechanical components into a working robot frame. We start with the servo horn extenders.

With a servo horn standing by, fill the cavity at the thick end of the extender with two liberally sized beads of glue. Be sure not to block the little window.

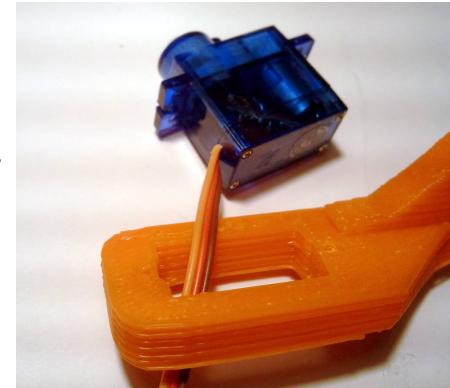
Hot glue is great for this. It's fast and easy. But mainly fast! You have to move quickly with hot glue so that the glue isn't already cooled by the time you press the parts together. So *get to work!*



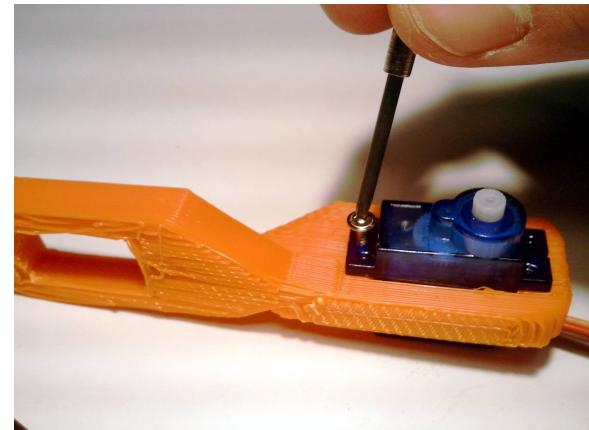


Here's the servo horn glued into the extender. When it's complete, go ahead and add a little more glue on top to lock the horn in place.

Repeat the procedure for the other servo horn and set them aside.

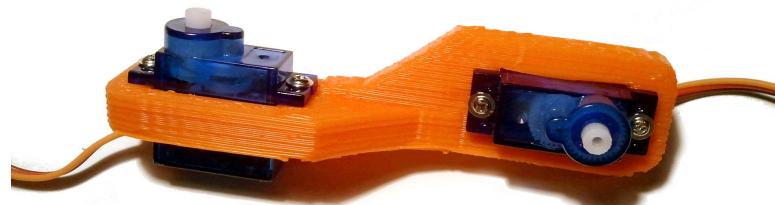


Insert the servos into the rectangular holes of the frame part, preceded by their cables. The end with the cable should go towards the outside, so that the axles of the two servos are further from each other. This makes for better movement.

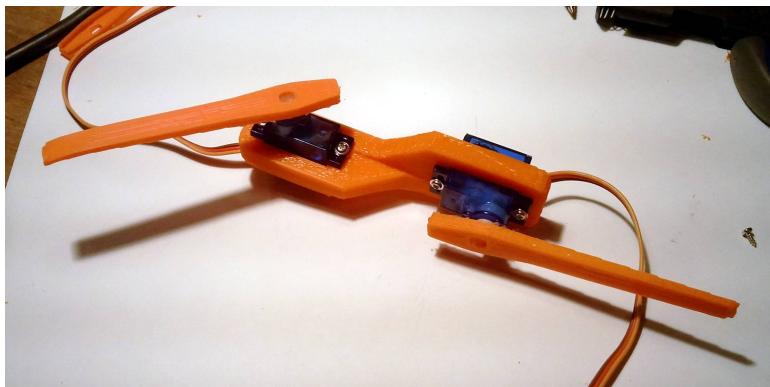
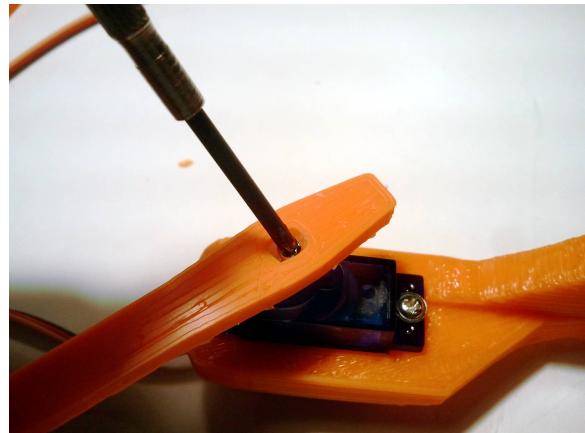


Using the longer screws, tighten the servo into place. Don't over tighten, as the servo case may crack!

Repeat for the remaining servo.



Now, using the small screws, attach the servo horns to the servo drive shafts. (Later on, when running, the servos may go to positions you don't like. Turn off the robot, detach and re-seat the horns as necessary. You have to pull the servo horn off to make an adjustment.)



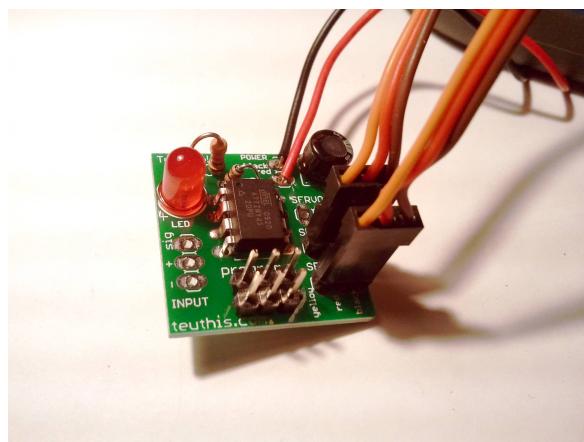
The mechanical assembly is now complete! Hooray!

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#### Part IV: Final Assembly and ACTIVATION

##### Prepare to Cackle Madly

This is it! All that remains is to attach the servos to the circuit board and insert batteries. We're so close!

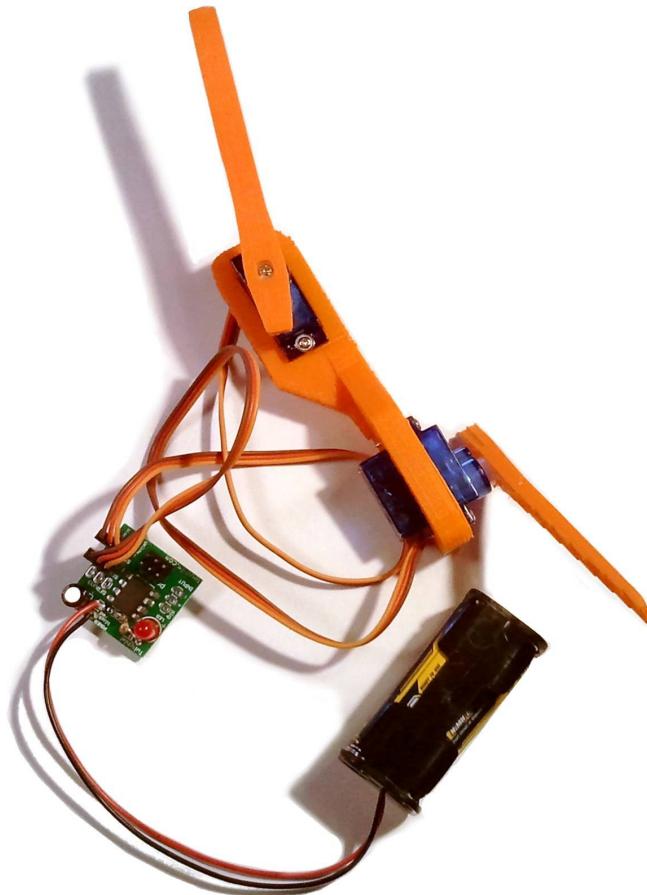


Attach the servo cables to the board by pushing them onto the pin headers. Make sure the color-coded wires are facing the right way. The darkest wire should face the edge of the board, and the lightest one should face the chip. If you put them in backwards it's not going to do any damage, but the servos won't move. It's up to you which servo goes into which port; they are more or less interchangeable.

Now insert four AAA batteries and...

*Life!* You have created LIFE!  
MUAH HA HA HA!!!!!!!

(Good work!)



*A completed Twitchie.*

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## Nakedness and Clothedness: A Personal Decision

Now that you're done, feel free to dress up your robot however you like. Many kinds of glue adhere readily to the ABS plastic that most of the parts are made of. You can also sand the parts, cut them, drill them, bend them with heat, or replace them completely with something you like better. If you do cover the robot with some sort of cloth be sure that it allows for free movement of the motors. Spandex, cotton, neoprene, feathers, fun-fur, leather, wool and many more materials are acceptable if you are careful to tailor them well for the needs of a little tiny robot. Remember: society frowns on nakedness. *Clothe your robot!*

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## Part VI: Reference and Notes

The authors email address is [raphael@teuthis.com](mailto:raphael@teuthis.com).

There is no off switch! Remove a battery to shut Twitchie down.

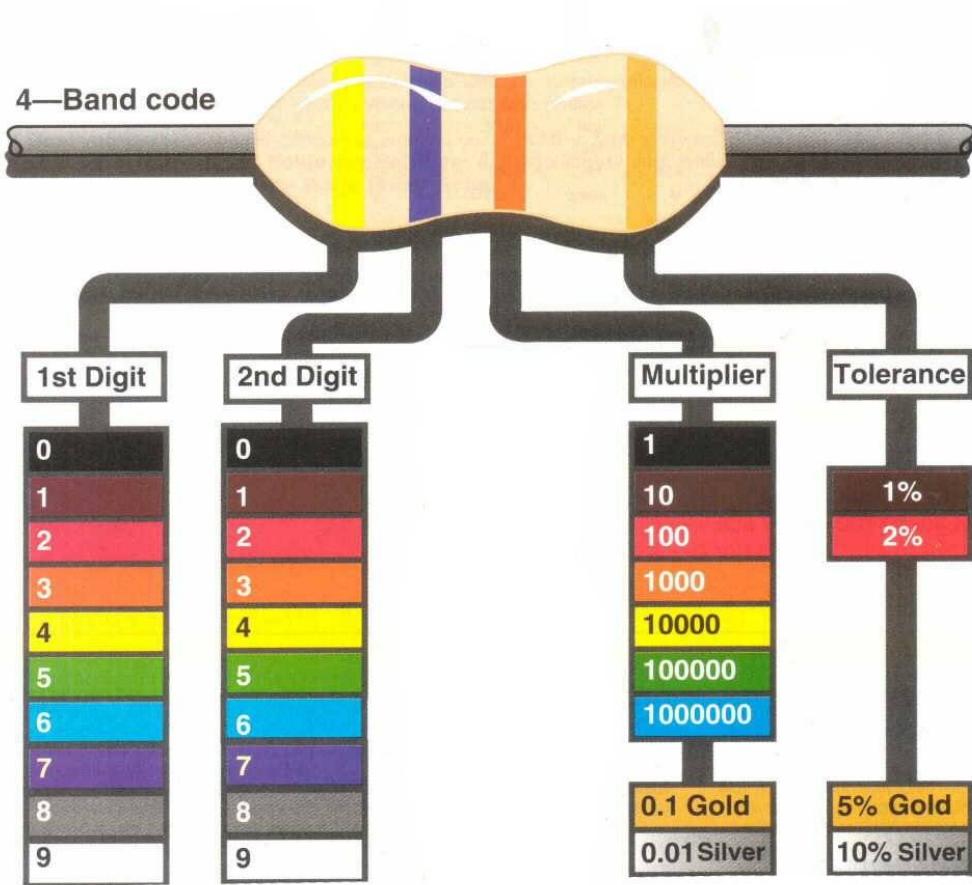
If you're sneaky, you can add two more servos to this kit. There's also room for all kinds of sensors. I leave these as an exercise to the user.

Twitchie works better with rechargeable batteries. Not only are they environmentally sound, they also have higher current capacity. This makes the motors move with more force.

Twitchie uses the free AVR GCC compiler for its program. You can download all the open source files that I have for free at teuthis.com. Please feel free to do with them as you wish, as long as you follow the GPL. Don't know what the GPL is? Look it up! **It's the future!** (The *good* future. Not the bad one that you have to go back in time to stop from happening, thus creating a paradox and destroying the universe as we know it. None of that.) Seriously, go look it up.

Be sure to look for Twitchie videos online at teuthis.com for more ideas! Also, we love to see what *you* create, so please let us know about any fun pictures or videos you may have posted.

## Resistor Color Code:



## Schemaitec:

