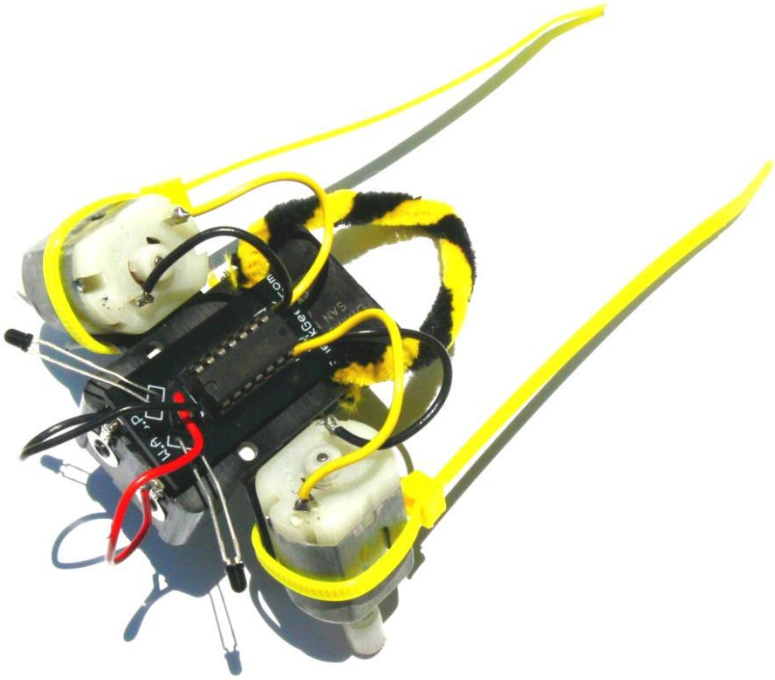
The

W.A.S.P.

Original



SheekGEEK.com

Warning: CHOKING HAZARD -Small Parts. Not for Children Under 9 yrs.

Kit Recommended for Ages 12 and up.

Table of Contents

Welcome to the world of robotics! We hope that this kit sparks your interests and helps you further your knowledge of robots.

Disclaimer of Liability

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Getting Started

Check to make sure you have all of your pieces. Your parts list is as follows.

1 74HCT14 Chip

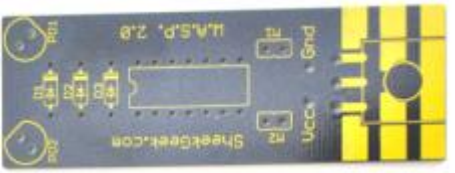
1 14 Pin DIP Socket

2 Phototransistors

1 Power Button
3 Power regulation Diodes
1 Jumbo Paperclip
2 Hobby Motors
1 3” Plastic Mounting Bracket

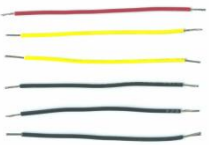
1 9 Volt Battery Pack

1 Printed Circuit Board (PCB)



2 Pieces of 2 sided tape
2 Zip Ties

2 3” Pieces of 24 Gauge Yellow Wire
2 3” Pieces of 24 Gauge Black Wire
1 3” Piece of 24 Gauge Black Wire
1 3” Piece of 24 Gauge Red Wire



2 12” chenille stems (Pipe cleaners)
2 Pieces of Glue Stick “Feet”

Note that the RED wire and one of the BLACK wires are smaller than the others. These wires are only for the power connections on the robot because the larger wire will not fit in the provided holes.

Got it all? I know you do, I packed it myself. However, if you are missing something, please contact us online. Go to the homepage (www.sheekgeek.com) and click "Support." Or contact us at support@sheekgeek.com.

Other things that you may need:
1. Soldering Iron and solder
2. Pliers
3. Lighter
4. Wire strippers

Soldering

(Written by a girl!)

Soldering is an important skill for anyone interested in and/or who may potentially work in electronics. It may look and sound intimidating, but soldering is an easy skill for anyone to master. All it takes is a little practice and correct caution. WARNING! A soldering iron can and will become very hot while in use. Be sure not to touch the iron. Also, do not breathe the fumes while soldering. Most solder contains lead, which is a hazardous material. Make sure you solder in a well-ventilated area. Always wash your hands after handling solder.

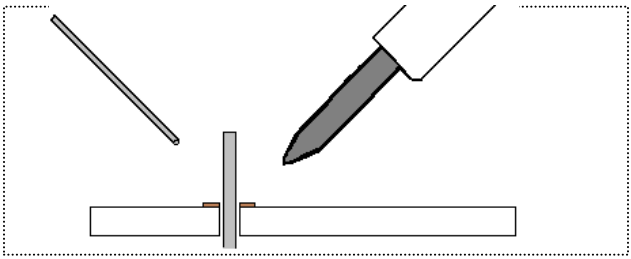
What is Soldering?
Soldering is a method of using a material with a low melting point to fuse materials together. This process requires the application of heat, which is provided by a soldering iron, and the use of solder. For making a robot, a soldering iron that is around 20-30 watts is sufficient. A soldering iron over 35 watts will "fry" your components and will result in a broken robot. Most craft or electronics stores carry soldering irons for 5 dollars or less. You can even find soldering irons at dollar stores; however, you may want to find a soldering iron that comes with extra tips. It is much easier to solder with a *pointed* tip. Keep in mind that the solder you use should be electronics solder, NOT plumber's solder.

How to Solder (The fun stuff!)
If you have never soldered before, or need to brush up on your skills, it is best that you first practice soldering on spare parts. You should not begin on your kit until you have perfected your soldering skills. Now, the correct way to solder is:

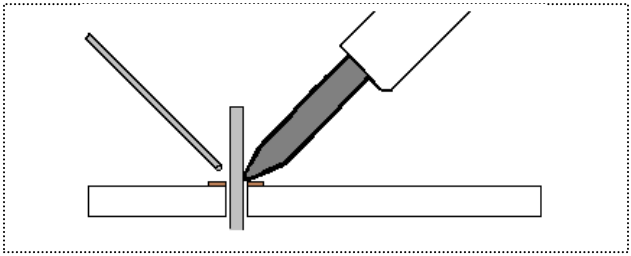
1. Allow your soldering iron to heat up. Generally, after you plug in the soldering iron, it will take about 5 minutes for it to warm up. If this is the first time you are using your soldering iron -or have just put a new tip on- it is important that you "tin" the tip. Tinning is the process of heating up the iron and applying a thin coat of solder to the tip. This helps to achieve maximum heat transfer to the item you are trying to solder.

2. As I mentioned before, if this is your first time soldering; practice, practice, practice! Once the iron is hot, and tinned, you should practice soldering on a scrap board with scrap parts.

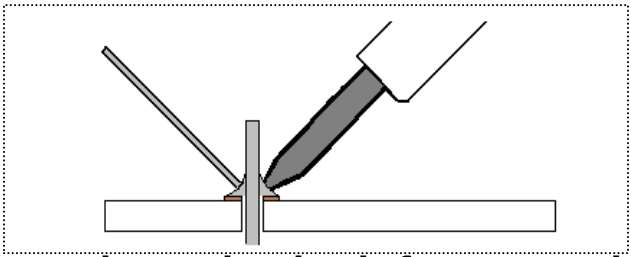
3. Place the leads of the piece you want to solder through the holes in the board where that piece goes.



4. Make sure you place the piece you want to solder so that only the leads stick out on the side of the board with the solder traces and pads.



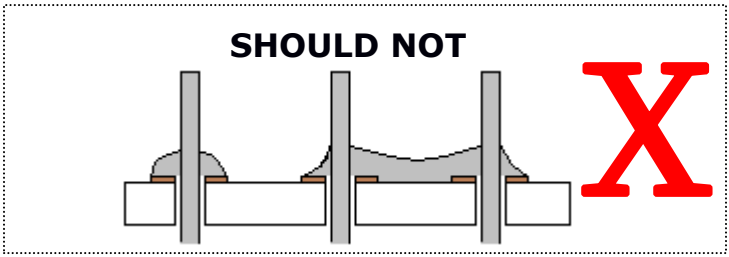
5. Then APPLY THE IRON TO THE LEAD AND PAD you want to solder, and apply solder to that lead where it is closest to the pad on the board.



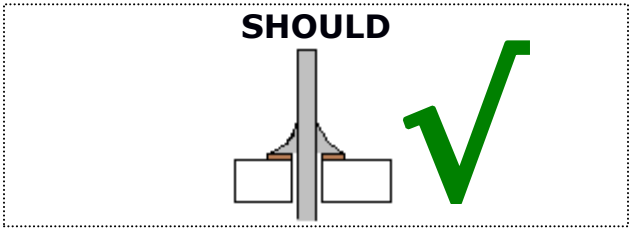
Try not to heat the lead for more than 3 seconds. This will ensure that you do not "fry" any of the pieces.

6. Make sure not to apply too much solder to the iron or connection. Too much solder equals a big mess.

Here are some examples of what the finished connection should and should not look like:



In the picture above the first soldered connection contains too much solder. This is indicated by the semi-circular, rounded appearance. The next two soldered connections are joined together or "bridged" by the solder. This is bad because the bride is connecting parts of the circuit that does not need to be connected. This will result in a non-working robot.



The above picture is how your soldering junctions should look. With a little practice, and the help of this manual, your soldering junctions should look like this in no time.

How The W.A.S.P. Works

Now, time to learn about how your robot works. It's not much, just a little introduction to what you are building and how it works. Do not build anything yet, if you do, it won't work, (and that's not just a trick, it really won't work.) I am going to go through and explain how this robot works for you, piece by piece.

This symbol 

stands for the positive side of the battery. It is also known as "logic high," "Vcc," and "1."

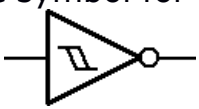
This symbol 

stands for the negative side of the battery. It is also known as "logic low," "ground," and "0."

This is the schematic symbol for a phototransistor.

These will be the eyes of our robot. They work like switches that only turn on when light hits them. They will see which side of the robot more light is coming from, and tell the other brains of the robot where to go.

This is the schematic symbol for an inverter.

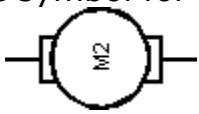


These are found in our chip. An inverter does just what the name says; it inverts the input. The input is on the base of the triangle in the symbol, and the output is just after the little circle shape on the other side. This works with logic inputs. Logic inputs are

"high" (which means the positive side of the battery, which is shown as "1",) and "low" (which means the negative side of the battery, shown as "0.") If the input to an inverter is a logic high (1) then the output is a logic low (0.) If the input is a logic low (0) then the output is a logic high (1.) These values are easier to see in a truth table.

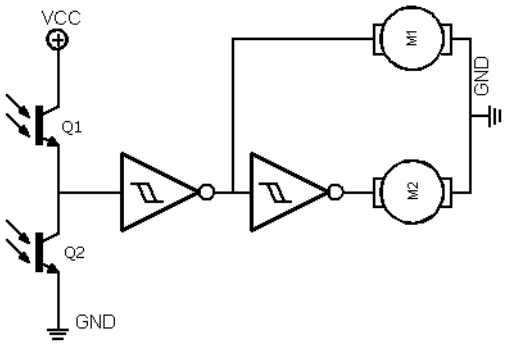
Input	Output
0	1
1	0

This is the schematic symbol for a motor.



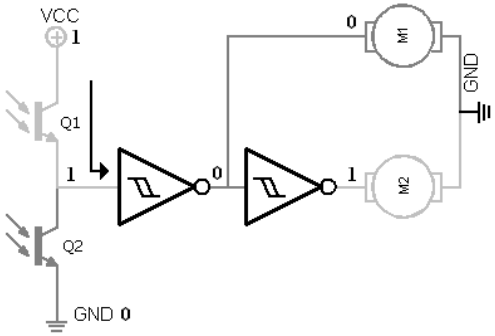
Most people know how a motor works on a basic level; a motor spins. A more scientific way of saying that is "a motor turns electrical energy into kinetic energy." Inside a motor, there is a coil (a long wire wrapped up) and some permanent magnets. When electrical current flows through a wire, it creates an electromagnetic field. The electromagnetic field of the wire pushes and pulls against the magnetic field of the magnets inside the motor, making the coil spin, creating kinetic energy from the original electrical energy. But enough of that; all you need to know about a motor for this project is that when you put the positive (+) on one lead and the negative (–) on the other, it spins.

This is the basic schematic of what you are building:



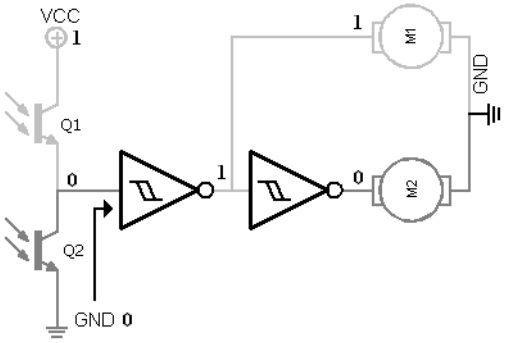
We connect the phototransistors (parts labeled “Q1” and “Q2”) together in such a way that is creates a voltage divider, or “photobridge.” A photobridge varies the output (the point in the center of the two phototransistors) depending on which photosensor gets the most light. If more light is on Q1, then the output of the photobridge will be logic High, and if Q2 gets more light, then the output of the photobridge will be logic Low. The output of the photobridge is connected to the input of the first inverter, which ultimately controls which motor does what.

Let’s take a closer look at this:



In the picture on the bottom of the left page, the **LIGHT GREY** shows where there is a logic high, and the **DARK GREY** shows where there is a logic low. Remember, that to make the motor spin, you need a logic high on one side, and logic low on the other, so in this robot, only one motor will be on at a time. The arrow shows which phototransistor is currently getting more light. Q1 is getting more light than Q2; therefore, the input to the first inverter will be a logic high, or “1.” This means that when Q1 is on, M2 is on. Technically this robot is not following light; it is running away from the dark because the motor on the side with the LEAST light on it turns on, rolling the robot away from the dark.

Now let's look at what happens when the opposite side gets more light.



A closer look here shows that when Q2 is on, M1 is on. This produces a robot that will follow light or, in other words, run away from the dark. It turns out that IF you actually want your robot to hide from light, you can switch which side either Q1 and Q2 or M1 and M2 are on. This will make the motor on the side with more light on it turn on, making the robot try to find a nice dark spot to hide in.

Okay, enough with the hard stuff, my brain hurts. Let's get to the fun part already, the build!

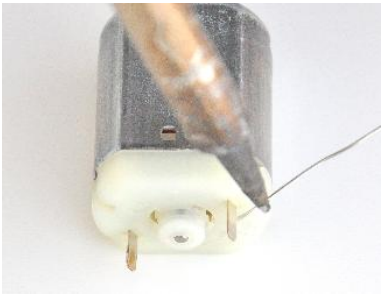
The Build

It is easier if you have all the parts and equipment ready. Gather it together now.

1. Strip about 1/4th of an inch (about 1 cm) of insulation off each end of two black wires and the two yellow wires.

2. Now we will "tin" **one end of each** of these wires. Simply apply heat with the soldering iron to the wire, ad melt a bit of solder onto the wire.

We will also "tin" each one of the motor leads.



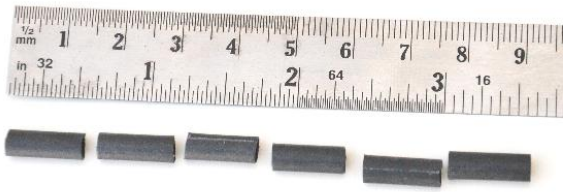
Before

After

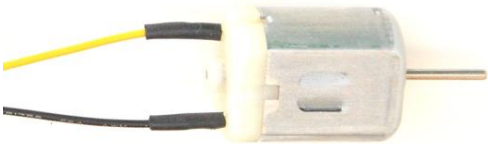
Place the motor so the vents are facing down on the workspace and the shaft is pointed away from you.

3. Connect the wire to the motors. On the right lead of that motor, touch the yellow wire to the tinned lead as shown and apply heat with the soldering iron to create a secure connection. Make sure it looks like the one below. Do the other motor exactly the same way.

Cut the 3” heatshrink tube into 1/2 inch sections (this should give you 6 pieces of equal size.)



Place one 1/2 inch piece over the wire on the motor wires, and cover the connection between the wires and the motor. Carefully use a heat gun or candle to shrink the heatshrink around the motor connections as shown below:



Perform the exact same steps with the other motor.

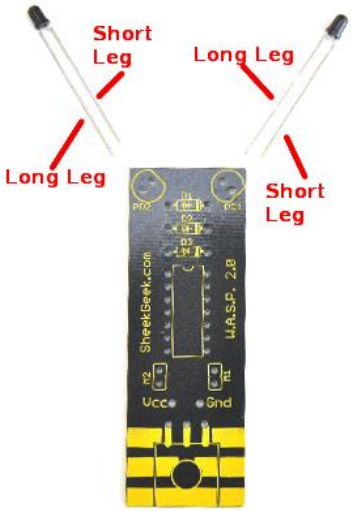
4. Next, we will put the wheels on the robot. To do this, first unwind the paperclip.

Carefully heat one end of the paperclip above a candle for about 15 seconds or so.

Then stick it one of the flat ends of one of the glue stick wheels. Move it around to make a hole that is about 3/32” (0.5cm deep) and with a diameter that can accept the motor shaft.

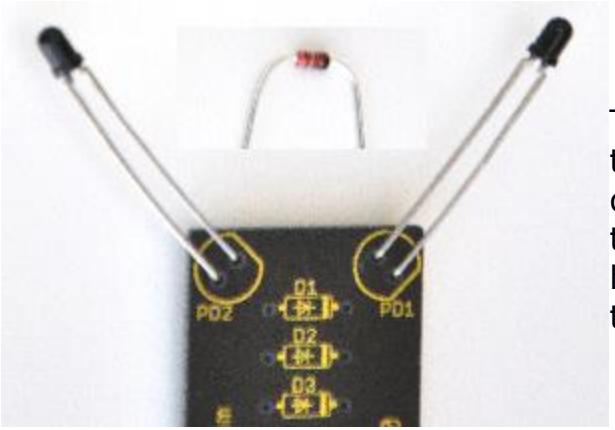
While the glue is still hot, shove the motor shaft into the. Try to get this aligned as closely as possible with the center of the glue stick. Hold until dry. Perform the same action on the other motor wheel.

5. Set aside the motors for now and find the two phototransistors and the WASP circuit board. Place the phototransistors into the PCB as shown. Note that the **short leg of the phototransistor goes in the hole next to the flat spot on the symbol.**



6. Once the phototransistors are soldered in correctly, bend the forward. These are the "eyes" of the robot and we want the robot to look forward, not up in the air.

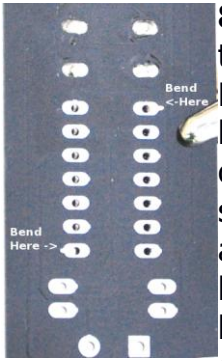
7. Next, we need to solder in the power regulation diodes. Diodes are a "polar" component. This means that they need to be place in the circuit board in the correct direction, otherwise they won't work. If you look at the circuit board, you can see that one side of the diode symbol has a thicker line than the other side. Looking at the diode, you should see a black line on one side of the diode. Be sure to match up the



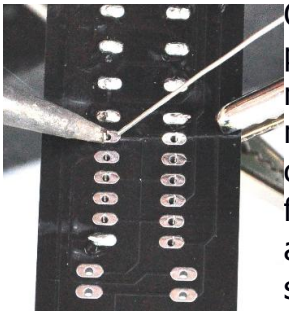
The simplest way to insert the diodes is to bend their leads slightly before inserting them one by one.

Solder the diode into place and then snip the excess leads.

Solder the other 2 diodes in the same fashion, making sure that the diodes are inserted correctly.

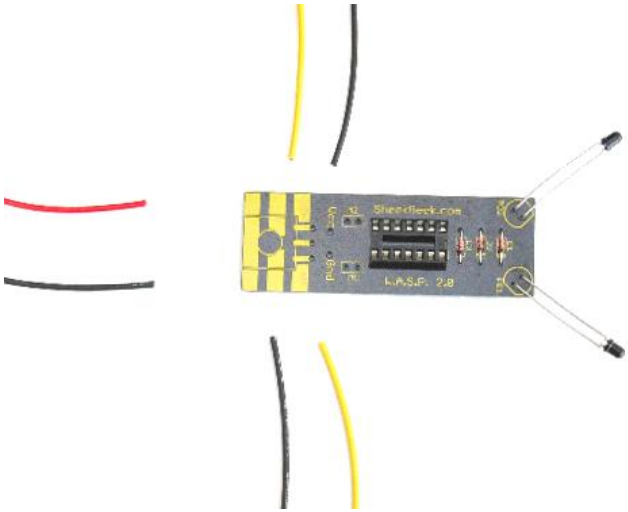


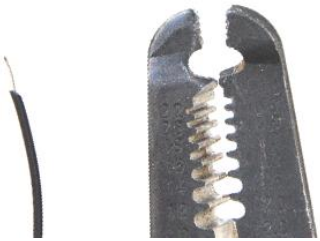
8. Place the socket onto the board so that the leads go through the holes. Be sure that the notch on the socket lines up with the notch shape drawn on the board. Bend the first lead of the socket on the other side of the board at the top right corner, and the last lead on the bottom left corner. This will hold the socket in place while you solder.



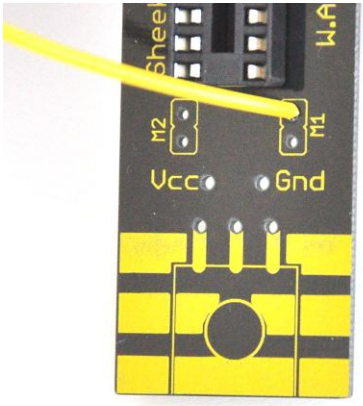
Once you have bent the leads in place, double check to make sure the notch in the socket lines up with the notch on the graphic symbol on the circuit board. Solder each bent pin first, then solder the other pins one at a time until the entire socked is soldered into place.

9. Now we will solder the wires onto the circuit board. Arrange the wires as shown. The two motors have the black and yellow wires. The red and black wires are power wires and haven't been soldered yet.

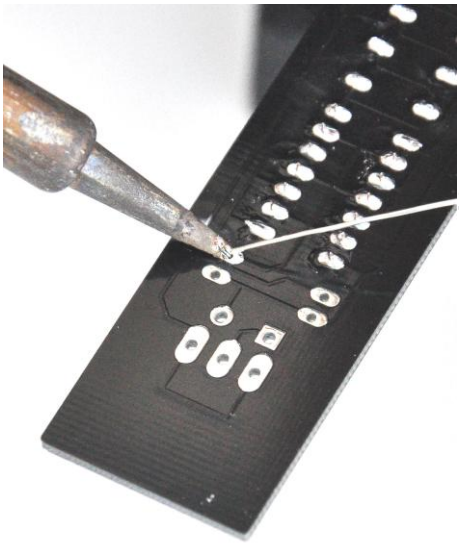




Strip the remaining ends of all of the wires to about 1/8th of an inch (3-5mm) using the wire strippers.

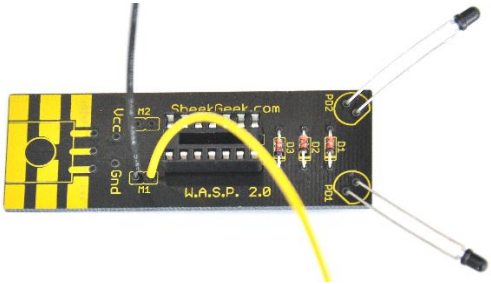


10. Insert the yellow wire in the top hole in the "M1" motor symbol on the circuit board.



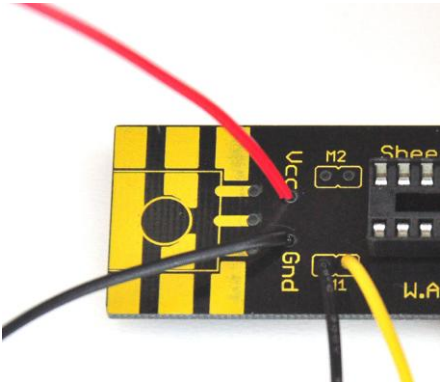
Solder this wire on the bottom of the board

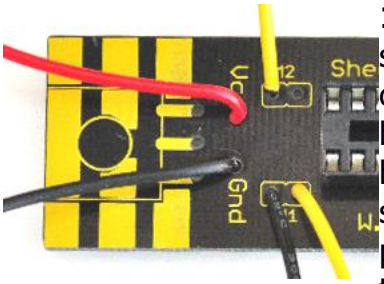
11. Next insert the black wire from Motor 1 into the remaining hole in the "M1" symbol on the circuit board.



Solder this wire into place as well.

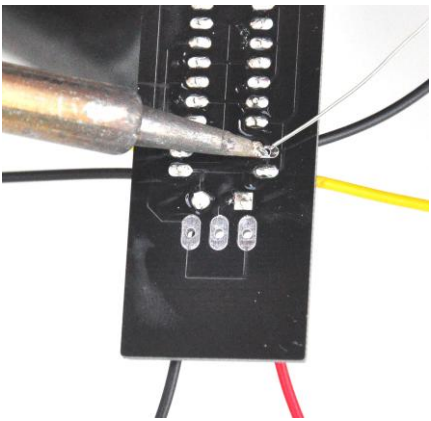
12. Next, strip both ends of the red and black power wires. The **black wire goes into the hole labeled "Gnd"** and the **red wire goes into the hole labeled "Vcc"** as shown.

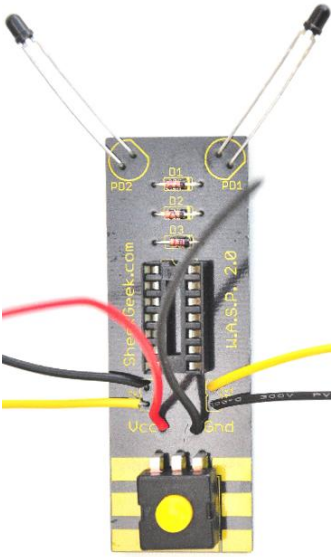




13. Insert the yellow wire of the second motor into the hole in M2 closest to the back of the circuit board. Notice that this is backwards from the way we soldered Motor 1. This is purposeful. Solder the yellow wire to the board.

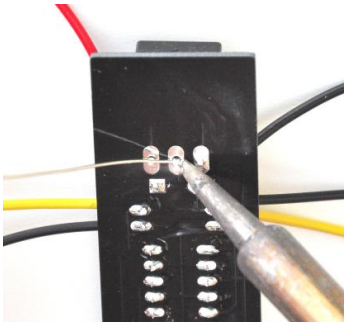
14. Finally, insert the black wire form the second motor into the other hole in the "M2" symbol on the circuit board, and solder it into place.



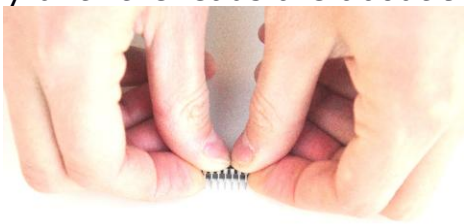


15. Now we will solder the button into place.

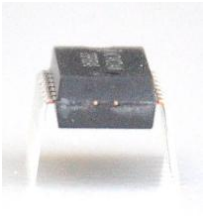
Insert the button as shown. It is easiest to solder the button in without helping hands. Simply flip the circuit over on your work surface and solder it into place.



16. The next step is to insert the chip. To do this, we need to bend the leads of the chip to have an angle of about 90. to do this, Simple hold the chip sideways and press it against your work surface, bending slowly until the leads are about 90 degrees.



(Seating the chip)

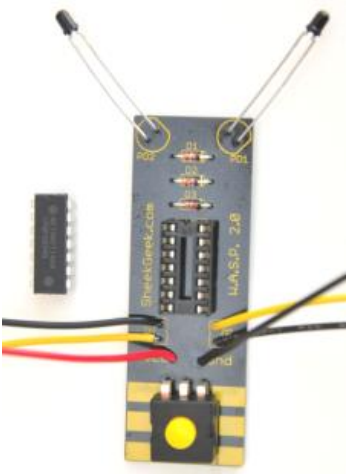


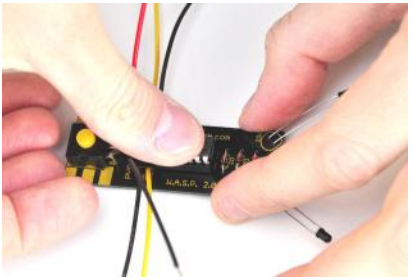
Before

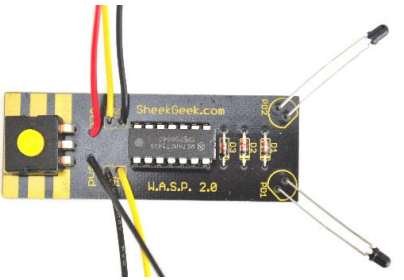
After

Now align the chip notch with the notch in the chip socket on the board (the notch should be on the end towards the phototransistors) and insert the chip into the socket. Make sure all of the pins line up correctly and apply a little force to seat the chip.

(The notch is on this end.)

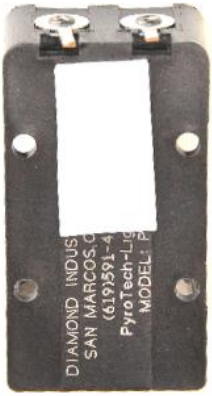




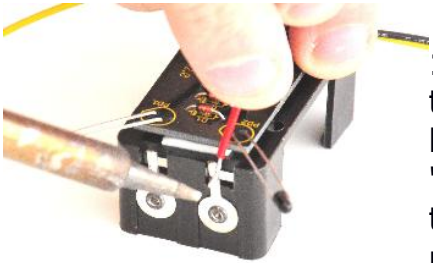


(Inserting the chip into the socket)

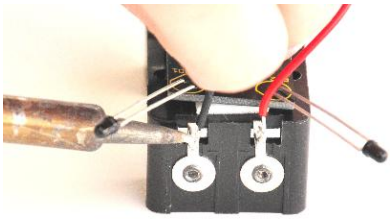
17. Place one end of the two-sided tape on the top of the battery pack. And tape bottom of the circuit board to the battery pack as shown.



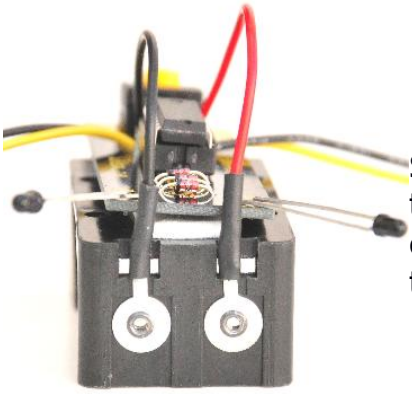
As shown above, place the last two pieces of heatshrink on the power wires. One goes on the red wire and one goes on the black wire.



18. Solder the red wire to the positive side of the battery pack. The '+' and '–' symbols are printing on the inside of the battery pack.

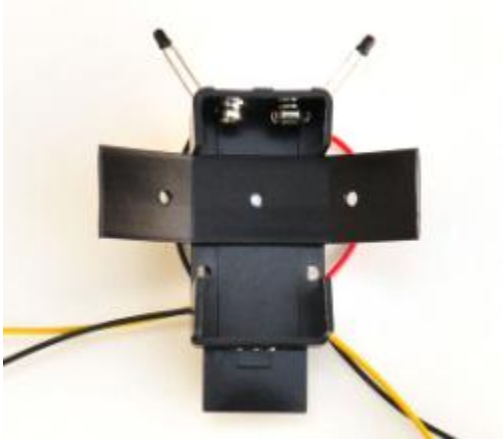


Solder the negative wire to the negative lead of the battery pack.



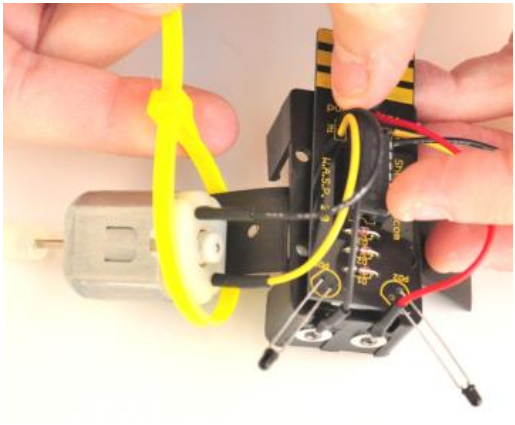
Slide the heatshrink over the newly soldered connection, and shrink them with a heat gun.

19. The final steps involve attaching the motors. First, apply the remaining piece of the two-sided tape to the center of the top of the motor mount. Mount this on the bottom side of the battery pack closest to the front where the "eyes" of the WASP are located.



Notice that the "wings" of the motor mount are pointing up in this picture.

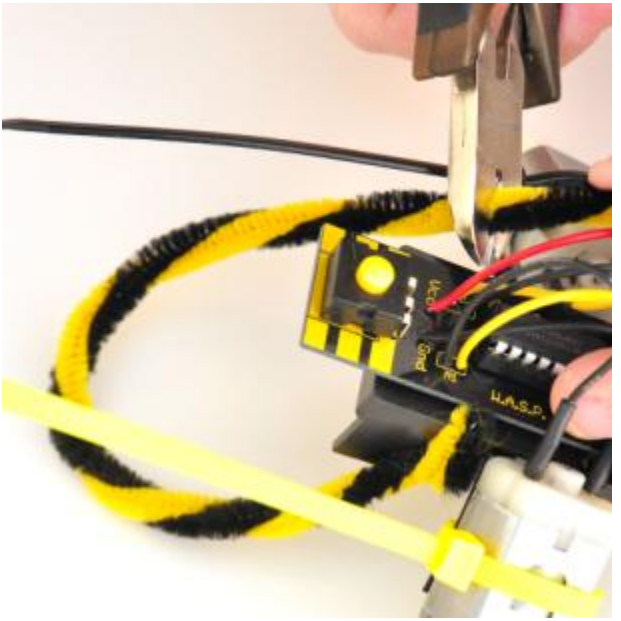
20. Strap the motors to the "wings" of the motor mount using the zip ties in a manner as shown below.



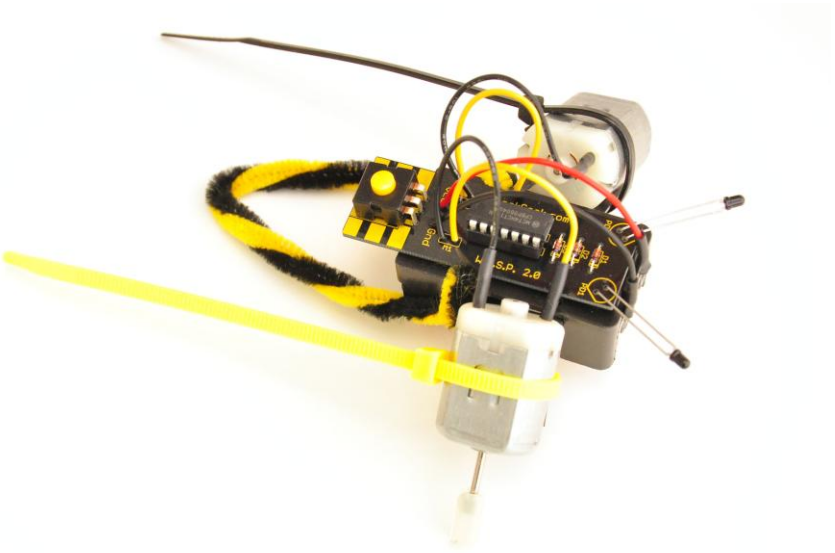
21. Once both motors are mounted, twist the two chenille stems together as shown.

Place the end of the chenille stems into one of the holes on the side of the battery pack, then bend the top portion over to keep it in place.

Measure about 1/3 from the other end of the chenille stems, and cut them off.



Insert the newly cut end of the 2/3 length piece into the hole on the other side of the battery pack and bend the top portion down to keep it in place.



22. Plug the battery all the way in. As soon as you connect the battery, only one of the motors should come on at a time. As you will find out, your robot works best in darker rooms and on a hard, flat surface. Grab a flashlight and play with your new creation for a while.

Congratulations, you have built a working robot! You should be very proud of yourself; we are! Show off your final product and spread the word about the exciting and challenging world of robotics.

Troubleshooting

If the motors do not come on, or if you have trouble, please read this section. If you are still having trouble, contact us online at support@sheekgeek.com.

Question: My robot doesn't respond to light; it just spins in a circle all the time.

Answer: This means that one of your phototransistors isn't connected all the way. Check the solder connections at the phototransistors and if they are bad. A little reheating of them with the soldering iron will usually fix the problem. If that did not help, one of your motor connections may be bad. Reheat them as well.

Question: Both of my motors are always on, and the robot only goes straight.

Answer: This means that both of your phototransistors are not connected. Go back and check to see if you soldered them in. If they are soldered in, please check to see if they have good connections. Again, reheating the solder joints may remedy the situation.

Question: My robot does not work after I finished building it.

Answer: Is your battery dead? If not, make sure you did every step in the manual. Check all solder connections; look for solder bridges and bad connections. Check the battery connections to the PCB, and that the battery is inserted the right way and plugged in all the way.

Another common problem would be that your chip isn't inserted correctly. This can be fixed by taking the chip out of the socket and turning it so the

notch on the chip lines up with the notch on the socket.

Make sure you soldered all the diodes and the phototransistors in correctly.

Notes