Sensebridge
making the invisible visible

Step 2

Building North Paw V2.0

Step 2: The Display

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During this step we're building the North Paw's haptic "display". This display consists of eight vibrating pager motors attached one by one to a length of ribbon cable and mounted on a Veltex foam backing. You'll need:

Supplies (incl. in kit)

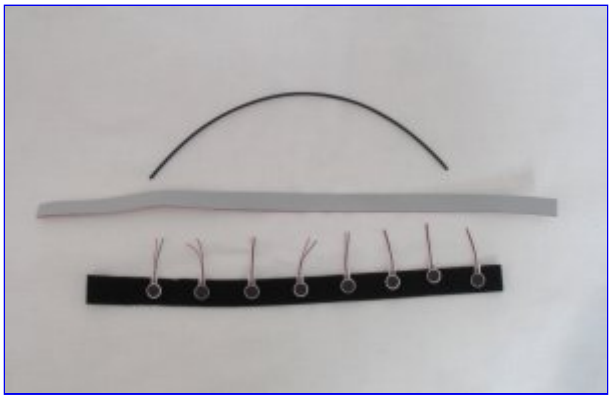
- **8 pager motors**
- **11 inch strip of Veltex foam (inside the armature)**
- **12 inches of ribbon cable**
- **Shrink tubing**
- **8 velcro "dots"**

Tools (not incl.)

- **Soldering iron**
- **Clear packing or scotch tape**
- **Wire cutters**
- **Wire strippers (recommended, but wire cutters can work if you're careful)**
- **Heat gun (recommended for shrinking the shrink tubing, but soldering iron can work too)**

This is the most difficult part of the kit! It is quite conceivable that you could snip the wrong wire at various points in the procedure, so please take your time and be careful.

Note: these instructions were originally written and photographed for V1.5 kits. V2.0 kits are similar, although the velcro dots have changed their appearance slightly. The new dots are stamped out of a strip of velcro, they are slightly better sized (a little smaller, reducing overlap over the edges of the motors) and the new dots are much less likely to have shifted off their backing during transport. You'll also see that the circuit board has changed a little – the old compass was mounted differently. But for the purposes of this step, the differences in the circuit board do not matter.

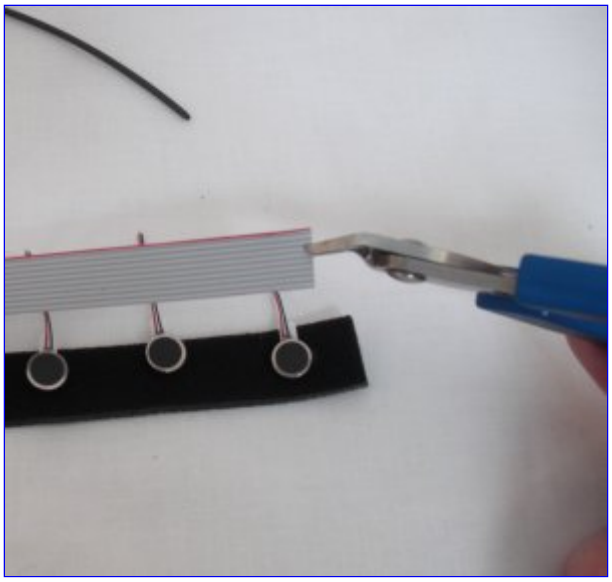


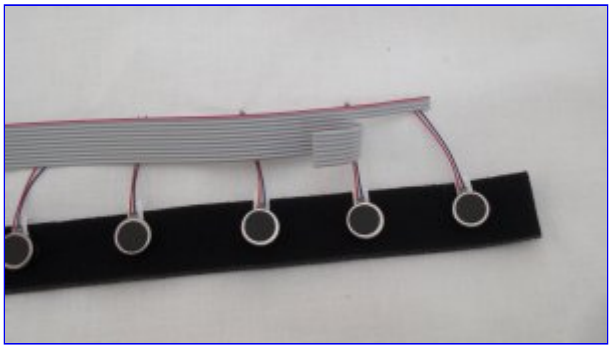
To get things started, place the strip of veltex (take it out from inside the armature) flat on the table. On top of that, space the eight motors out evenly. The motors won't be affixed to the veltex until the end of this process, but having them spaced out on it will be a handy length reference as you cut the ribbon cable.

Now you need to start separating the different strands of the ribbon cable. The easiest way to do this is to get your wire cutters in between two strands and gently snip the insulation. You only need to snip a milimeter or two, after that you can peel the strands apart by hand.

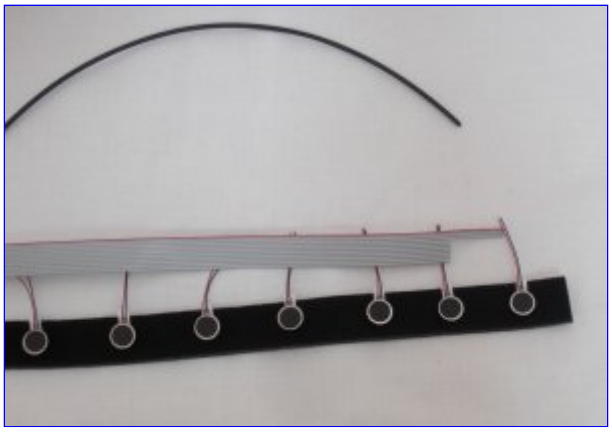
With the red wire on top snip below the third strand.

A brief explanation: The first (red) strand will be the common power line for all the motors. The third strand is the sink for the first motor which will be turned on or off by the controller. Leave the first three strands together for now.

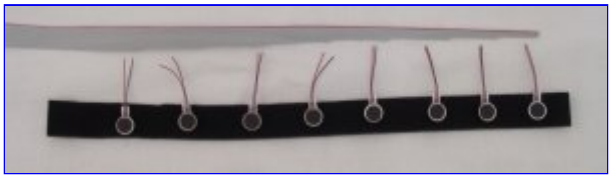




Next peel back the lower seven strands until just to the right (2-3mm – it doesn't need to be super exact) of the next motor.

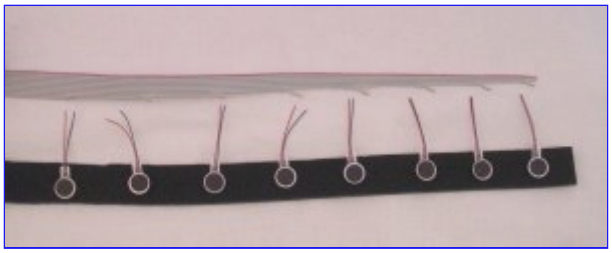


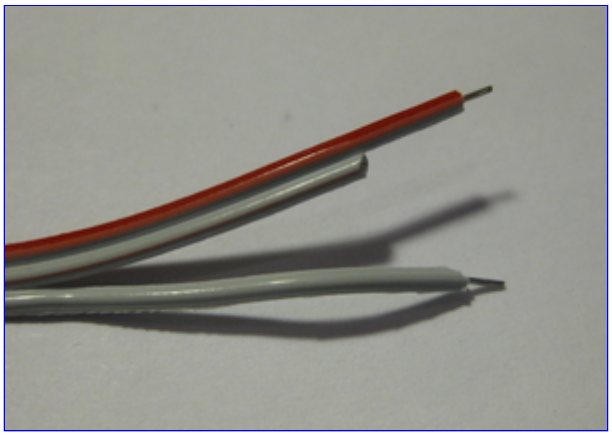
Cut those seven strands there.



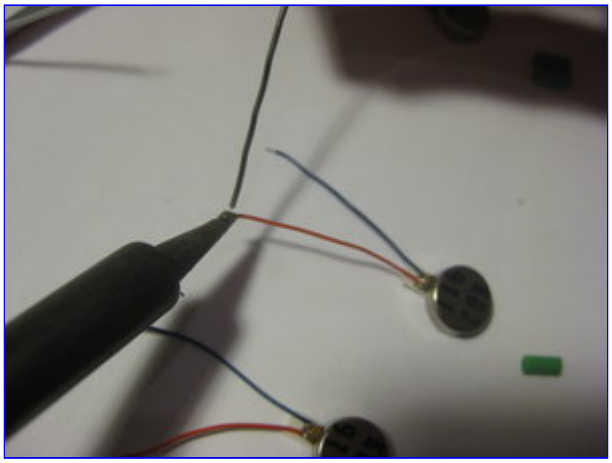
Now separate the fourth strand from the next six strands. Peel back until just to the right of the next motor and cut again. Continue in this fashion to the left, peeling and cutting each strand in turn. When you're done, each strand will terminate just to the right of each motor.

Peel each strand away from the rest of the ribbon cable so that there is about 0.5 inches of wire

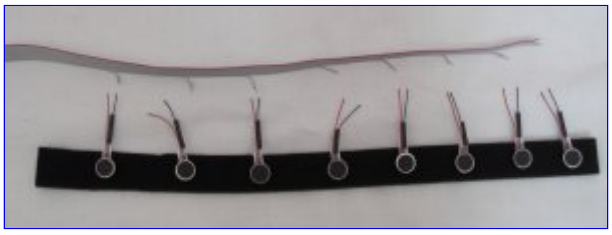




Strip the insulation off of all of these wires. For the end two, it might be helpful to cut the second (no connection) strand to keep it out of the way.

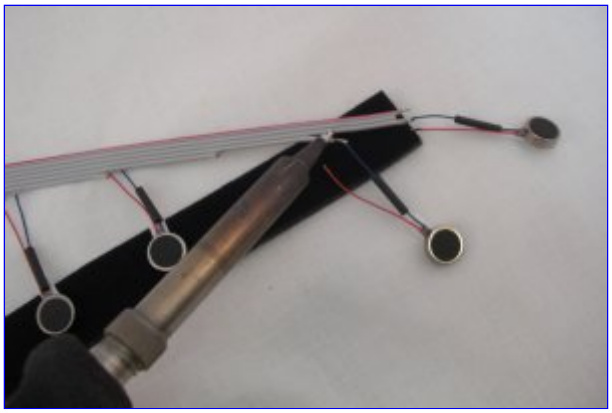


Tin everything in sight. To tin, all you need to do is heat up the exposed bit of metal wire and melt a little solder over it. Don't worry if it seems that the pager motors' little tiny wires aren't picking up too much solder.



You're almost ready to start actually soldering things together! But, you've got to get the shrink tubing on *before* soldering, of course. Now's the time to cut a bunch of 1/3 inch pieces of shrink tubing. You should need 9 pieces of shrink wrap in total.

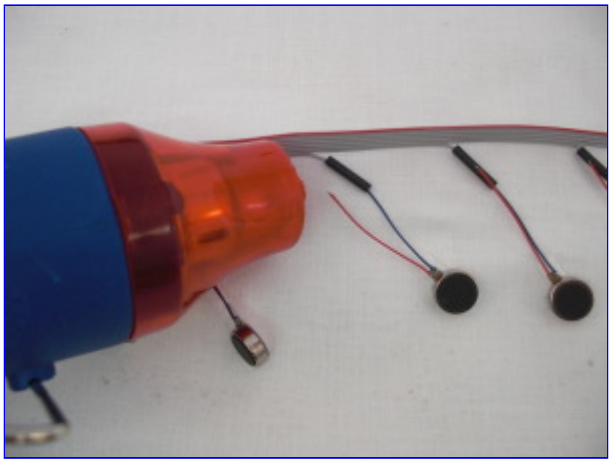
Making sure to put the shrink tubing on first, solder up one lead of each motor to each exposed strand of the ribbon cable. If you tinned everything properly, this will be as simple as holding the exposed ends of the two wires together and heating them up with the tip of the soldering iron. As soon as the solder on the to wires melts together, slowly remove the iron. Wait



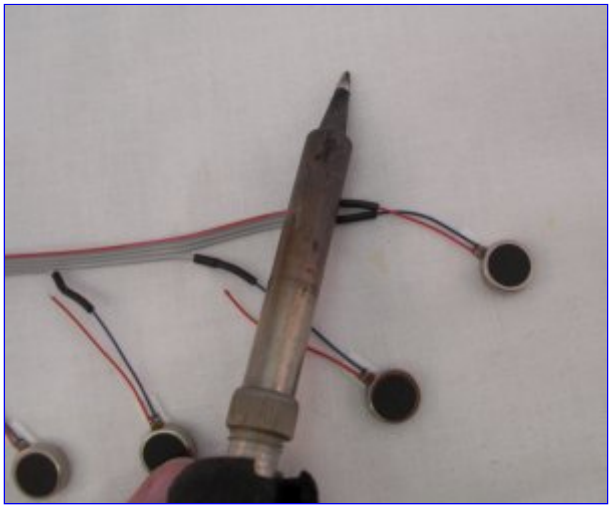
a second or two before letting go of the wires – if you let go too soon, the solder will not yet be solidified, and the wires won't be stuck together yet.

These DC motors are non-polarized, meaning it doesn't matter which lead of the motor you solder up now. That being said, if you solder the red lead, the little bit of adhesive on the motors will be facing a more convenient direction later. It's a small point, so don't worry about it too much.

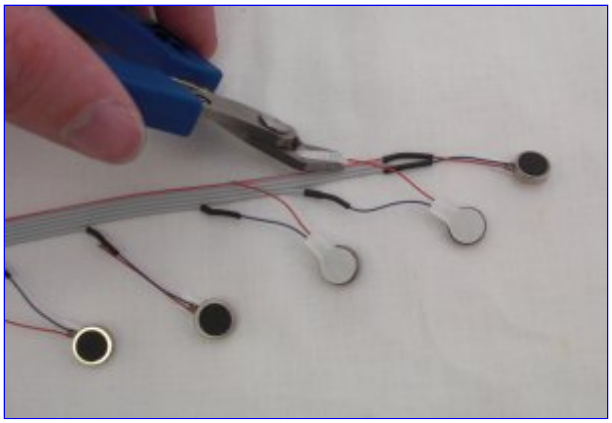
On the very last motor, go ahead and solder the second lead to the red (power) line, making sure you have some shrink wrap of course.



If you are lucky enough to have a heat gun, go crazy shrinking up all that tubing over the solder joints.

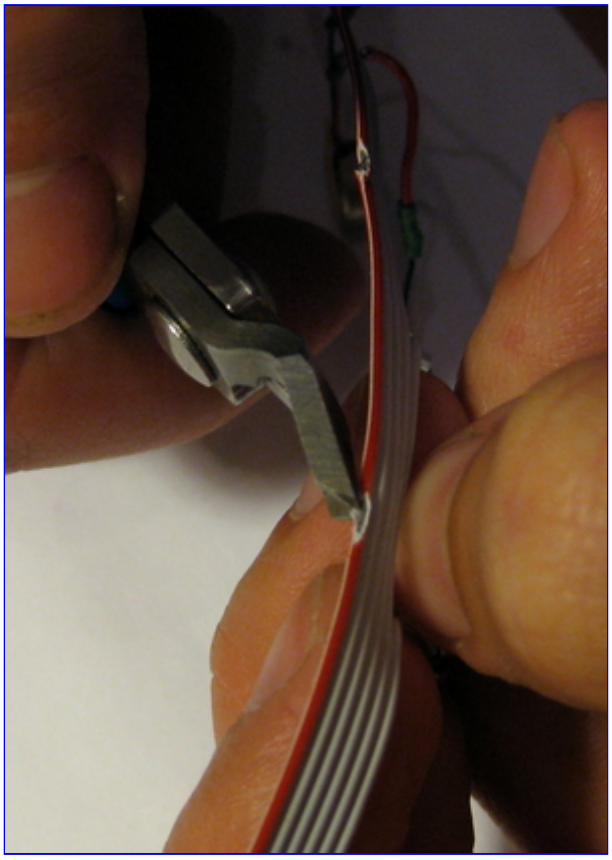


If you don't have a heat gun, you can shrink the tubing with the soldering iron. But, don't go crazy! Gently slide *the barrel* of the iron across the shrink tubing. DO NOT use the tip of the iron, as this can have the unfortunate side-effect of melting the solder under the shrink tubing, ruining a solder joint which you now can't see because it's under the shrink tubing. Fixing that is always a pain.



Don't despair, you're almost done! There just one tricky bit left.

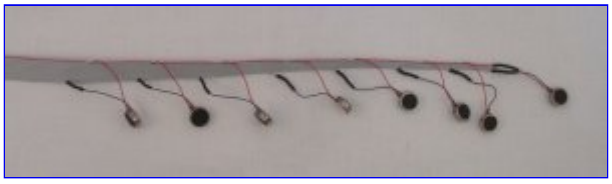
Take each motor and line up each free lead against the red power line. Where the end of that lead meets the power line, you need to trim off the insulation without cutting the whole wire. That's it, that's the last tricky bit.



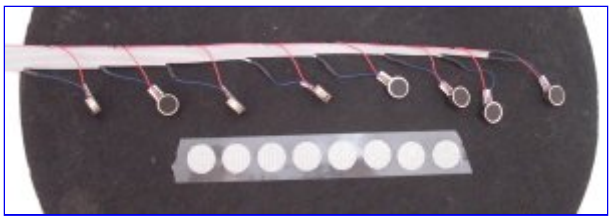
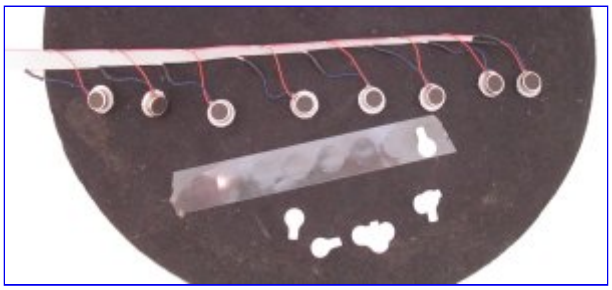
The best way to do this is to take a number of small, gentle cuts at the insulation with your wire cutters. Once a tiny bit of the metal wire is exposed, stop cutting away and instead use the sharp edge of the cutters to scrape a bit more insulation away. After that it can also be helpful to pull at the side of the opening to widen it slightly. If you do accidentally cut the whole wire, don't worry! Just solder it back together.

Another slightly different method (which you might find easier) is to separate the top wire from the rest of the wires in little chunks where to need to solder to it. Once the wire is not so close to the others it's much easier to strip, and also to resolder if you happen to cut the whole wire. In fact, one way to accomplish this is to deliberately cut the top red ribbon wire, peel it back a little both ways, strip the two ends, then solder it back together along with the motor wire. A little electrical tape when you are done will prevent it having a spot which might catch when you put it in the armature.

You should now have seven exposed sections of the first strand of the ribbon cable. Tin them all.



Solder the other lead of each motor to these exposed sections. Congratulations, the hard part is over! You're really, really good at soldering by now, for what it's worth.

	**The motors now need Velcro backing so they can be adjustably affixed to the Veltex strip. This step has been simplified hugely compared to the V1.0 kits, so enjoy the new simplicity!**
	**Take the little bits of paper off of the motors to reveal their own adhesive side. Keep that side *up*. Take a velcro dot off the plastic. Place it carefully unto the motor, trying to center the dot on the motor. It might be easier to place the motor unto the dot, try both and see what works for you.**
	**Now just do it 7 more times, easy!**
	**Stick the motors onto the Veltex strip (the Velcro will only stick to the soft side of it). Use the armature as a reference for length – you want the motors to completely fill up the space inside it, the veltex strip itself is likely a little long. Space the motors out evenly over the proper length, then fold the ribbon cable *behind* the veltex strip.**
	**If it looks like this, you're done! And don't worry, final assembly is about one fifth as many steps as this was, and there's absolutely no soldering.**

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North Paw V2.0, for help contact eric@sensebridge.net

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