



# Twinkling Wrist Cuff Tutorial

Using the LilyTwinkle and Sewable LEDs

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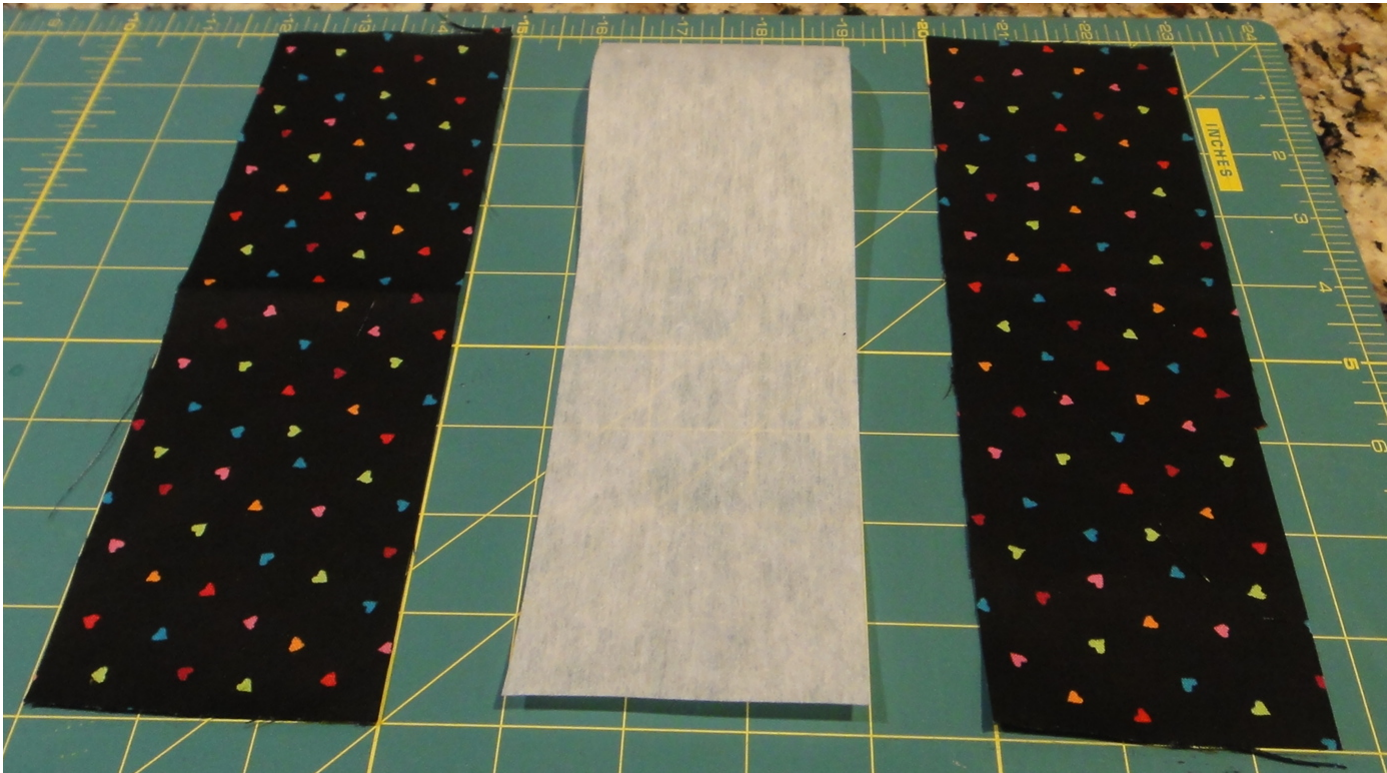


- This project is a great chance to use up some scrap fabric!
- All electronics supplies can be ordered from <http://sparkfun.com>
- Strategies for making these for large groups are included at the end.

#### Supplies:

- ¼ yard lightweight cotton fabric
- ¼ yard interfacing
- 2 buttons
- Matching thread
- Thin elastic cord
- Fabric glue (optional)
- LilyTwinkle
  - DEV 11364
- LilyPad coin cell battery holder – switched 20mm
  - DEV 11285
- Coin cell battery 20 mm CR2032
  - PRT-00338
- 4 LilyPad LEDs in a matching color
  - Various #s
- Conductive thread
  - DEV 10867
- Needle for hand sewing

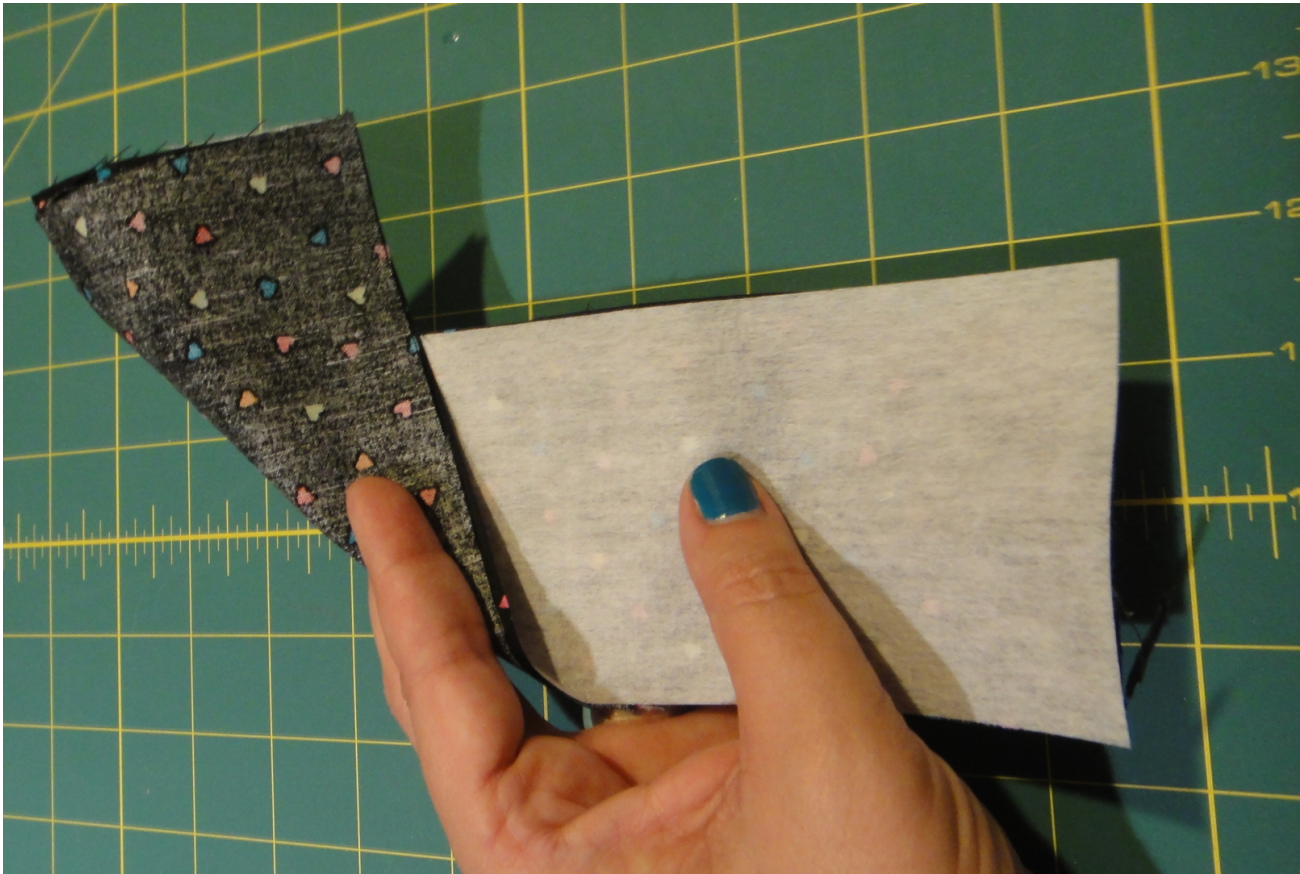
You need two fabric strips and one strip of interfacing. I made mine 3" x 9", planning for a  $\frac{1}{4}$ " seam allowance. This will make the cuff 2  $\frac{1}{2}$ " side by 8  $\frac{1}{2}$ " long. You can adjust for desired width and your wrist size. You want to make sure you make it long enough that it overlaps by at least 1" on your wrist.



If you are making a lot of these, consider borrowing a self-healing cutting mat and a cutting wheel



Layer the two pieces of printed fabric with the wrong sides facing out. Add the interfacing on top. Sew through all three layers down one long side.





What I did: Cut two 2" loops of the elastic cord. Shape each piece into a teardrop shaped loop. Open your stack of fabric along the seam you just sewed. Pin the elastic between the right side of the fabric layers, on one of the short ends of the cuff. Position so that the loops points in towards the length of the cuff and the ends of the elastic are on the other side of the seam allowance.



What I would try next time:  
I think I would cut longer elastic loops and tie a knot in each one. Then I would pin with the loops facing in and the knots on the other side of the seam allowance. This would make it harder for the elastic to slip out once sewn.

Re-fold the stack of fabric so that the right sides are facing in. Sew down the short side of the cuff multiple times, securing the elastic in place as you sew. At this point, two of the sides of the cuff are sewn, one long and one short. Here you can press the seams. I didn't because I was creating a project to use in a classroom and didn't want to hassle with an iron in that setting. Turn right side out and your elastic loops should look like this:



# We interrupt this tutorial...

This is normally the place where we would start working with the code in the arduino IDE and doing some prototyping with alligator clips. However, one of the reasons the LilyTwinkle board is so small and inexpensive is that there is no USB or FTDI connection so there are fewer components on the board. It comes pre-programmed to make your LEDS twinkle.

If you would like to see what that code looks like, it can be viewed here:

[https://github.com/sparkfun/LilyTiny\\_LilyTwinkle/blob/master/Firmware/LilyTwinkle/LilyTwinkle.ino](https://github.com/sparkfun/LilyTiny_LilyTwinkle/blob/master/Firmware/LilyTwinkle/LilyTwinkle.ino)

It is possible to re-program the LilyTwinkle and there are tutorials out there on how to do it. They seem to require, at a minimum, intermediate skills.

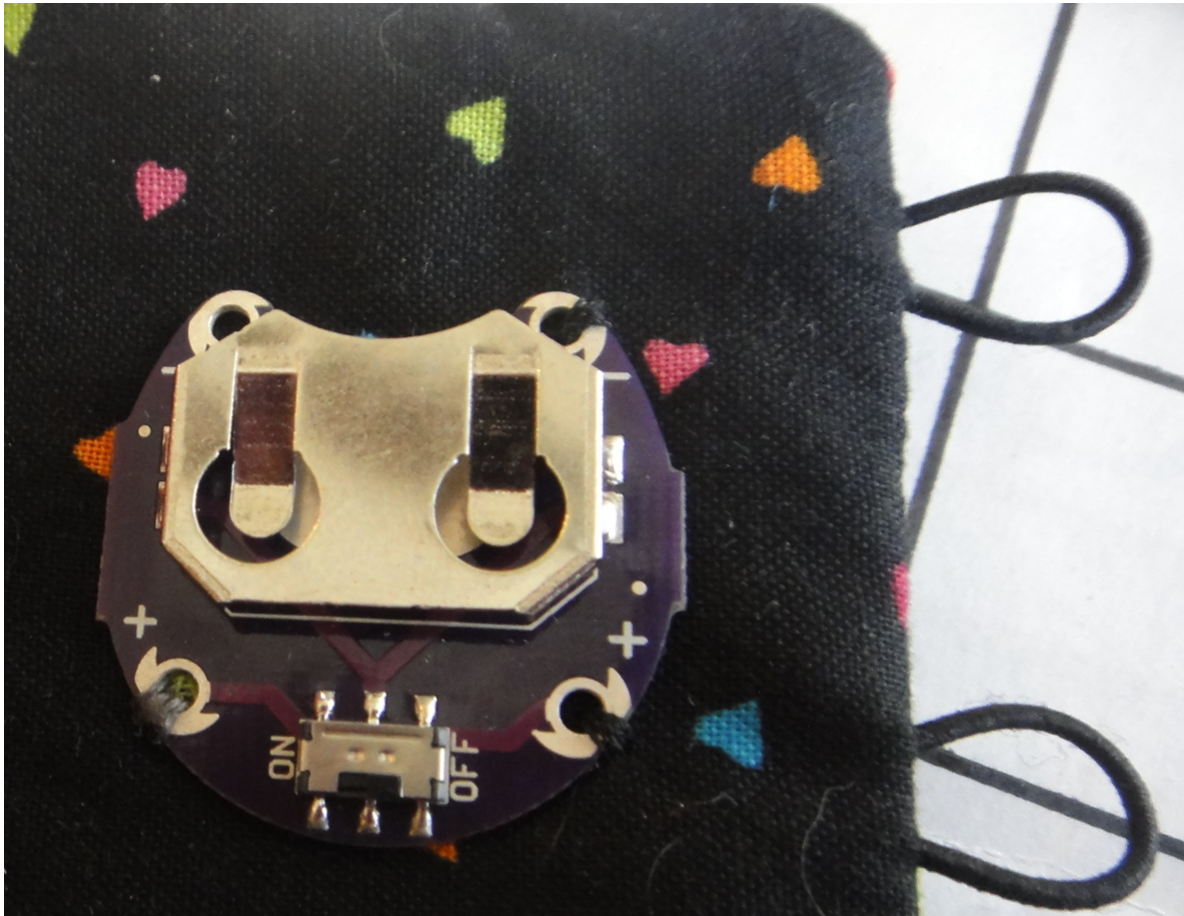


Wrap the cuff around your wrist to get a sense of which area will be on top of your wrist. You can mark the boundaries of the area where you want your lights to appear with a fading ink pen or a bit of chalk. Lay out the battery holder, Twinkle and LEDs to get a sense of where you want to place things.



Your life will be much easier if you position your components so that the positive and negative pins of the battery holder and Twinkle are facing one another. Similarly, be sure to place your LEDs so the positive pins face toward the Twinkle board

Make sure your coin cell battery holder does not have a battery in it and it is switched off. Position it on right side of your cuff, on the end near the loops. Make sure one positive and one negative pin are facing toward the length of the cuff. Using regular matching thread (the non-conductive kind), and sewing through the top layer of fabric only, sew down the positive and negative pins closest to the short edge of the cuff.



If time allows, use your fabric glue to glue down the battery holder before you sew. Make sure it is dry before you start sewing.

Lift up the top layer of fabric. Underneath the top layer, on top of the interfacing, position the Twinkle board and LEDs. If you have time you can glue them down, but this is not critical. Use a separate piece of thread for each connection, with knots at beginning and end, and only sew through the interfacing: Sew each of the positive LEDs pins to a different one of the numbered pins (0-3) on the Twinkle board. Sew around each pin three or four times to ensure good contact.



If, like me, you hate hand sewing, you may be tempted to use giant, long stitches.

Using multiple smaller stitches, rather than longer stitches helps to keep the thread in place so it won't slip around. If the threads touch, this will cause problems with your circuit.



You'll need a really long piece of conductive thread. Start with the LED closest to the open edge of the fabric (the one connected to the 3 pin on the Twinkle board pictured). Sew through the interfacing only, through the negative pin. Do not tie off. Use the same piece of thread to sew around to each negative pin, 3-4 loops in each one. Eventually make your way to the negative pin on the Twinkle board. This next part is not pictured: From the negative pin on the Twinkle board, stitch in the direction of the negative pin on the battery holder that's up on the top layer. Once you are close enough to go through the negative pin on the battery holder, begin sewing through both the interfacing and the top layer of fabric, connecting the negative pin on the Twinkle board with the negative pin on the battery holder.



Using a new piece of thread, sew through the positive pin on the Twinkle board and connect it to the positive pin on the battery holder. As with the negative pin, you will go through both the interfacing and the top fabric layer. Notice here you can't see the stitches on the top fabric, except right where they wrap around the battery holder pins.





You are done sewing your circuit! Turn everything inside out and make sure that on the back of the interfacing, none of your threads are touching. If everything looks good, flip it back to right side out. Insert your coin cell battery, flat side up and switch it on! All four LEDs will blink on very quickly before the Twinkle starts its random pattern so you should be able to see right away if everything is connected correctly. If you chose a lightweight fabric, you should be able to see your LEDs through the fabric. If you can't or can't see them very brightly, don't worry. We can deal with that in a few steps.



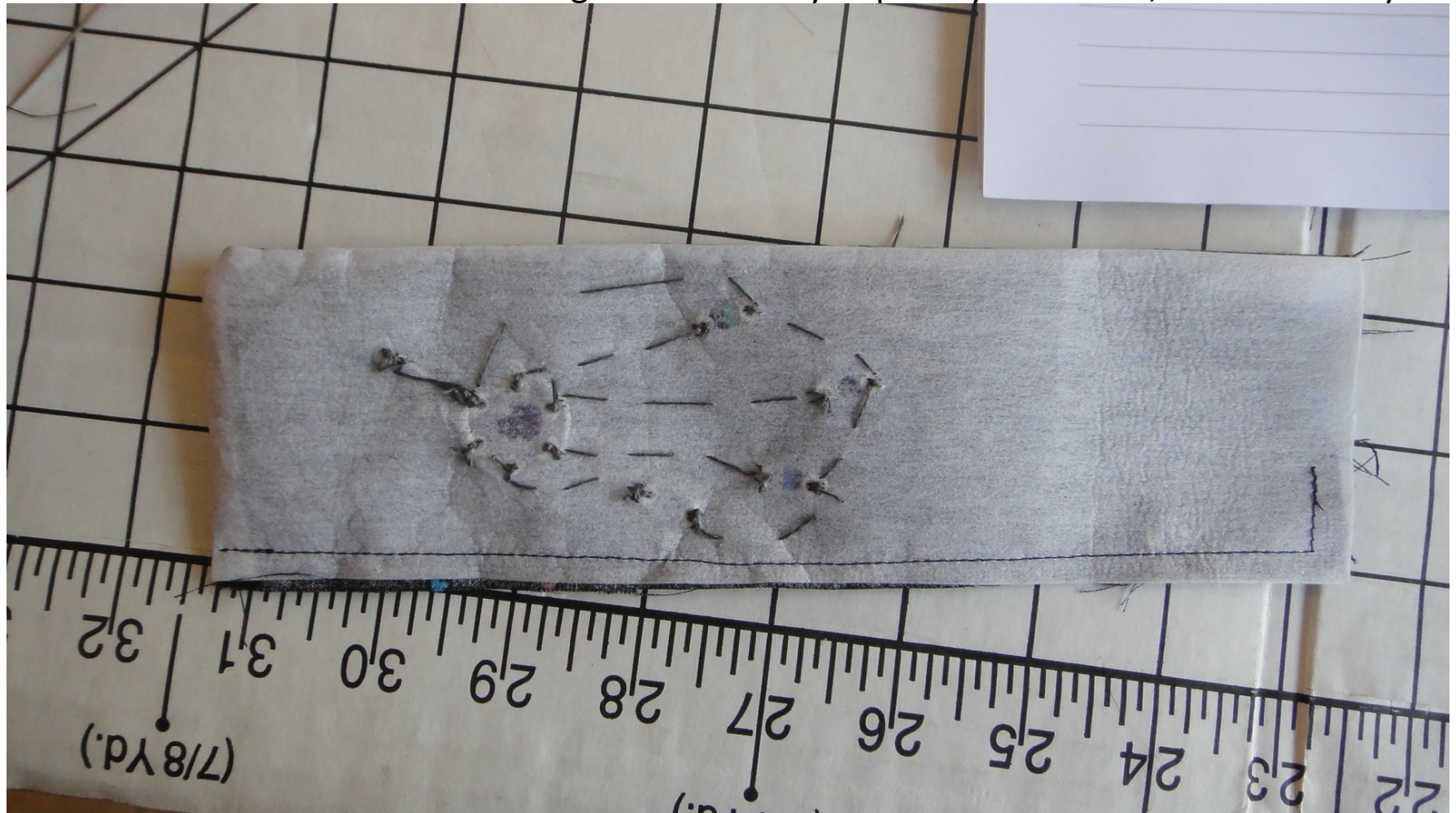


You can see that in order to prevent the threads touching, I cut the tail of each knot pretty short. If you are worried about the knots coming undone, you can apply a small dab of glue to each one. Allow it to dry before moving on.





As long as your electronics are working, it's time to finish sewing the cuff. Remove the battery from the older and make sure it is switched off. With everything inside out, sew down the other long side of the cuff. You can see that I turned and also sewed partially down the last short side. I don't think it was necessary and may have even made it more difficult to turn it right side out. If you press your seams, do so carefully.



Turn your cuff right side out.



The corners on the far end may be tough to turn thoroughly into their right angles. You can use a wooden dowel or a chopstick to manipulate the fabric in the corners until they are square again.



Once you have the shape you want, reinsert your battery and test everything again. If all is working, you are ready to finish sewing the cuff. Fold the edges that are still open so that the cut edges are tucked inside. Top stitch down the short edge.



If you want to cut through the top fabric to expose the LEDs underneath, this is a good time to do it. Consider this carefully as this could be the point where you undo all of your work and depending on the fabric, it may not be a very big difference.

You will have to feel where the highest point on each LED is and mark it with a piece of chalk. Then hold the top layer of fabric away from each LED as you work. I used a seam ripper to make a very small first incision and then used small scissors to make the holes wider. You could also use an exacto knife. No matter what you use, you should be very careful to not cut your LEDs, or yourself!

If you have any fray check, you can use it around the holes. Just be sure to test it on the fabric first.

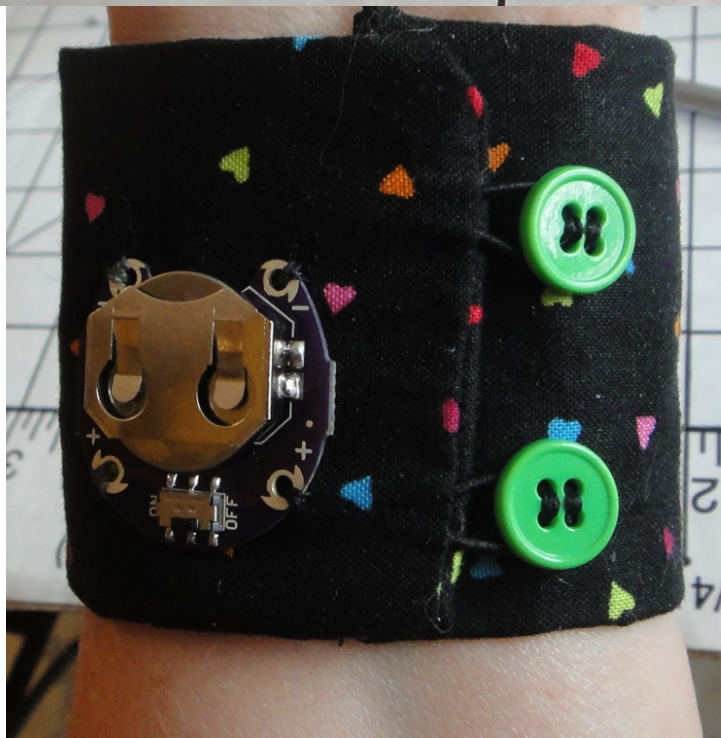
Wrap the cuff around your wrist, with the end with the elastic loops overlapping the other end. Note where the loops fall and mark it on the other end. This is easiest if you have a friend help you. Sew your buttons on the spots you marked.



### Sewing a strong button:

Pull out about two feet of your non-conductive thread. Double it up so you are sewing with 2 strands. On the first spot where you marked the fabric, sew an "X." Lay the button over this spot and insert the needle from underneath through one of the holes. Lay another needle or a toothpick across the top of the button to create a bit of extra height. Sew over the toothpick into the hole directly cross from the first. Repeat in the second set of holes. Repeat six or eight times. Remove the toothpick. Insert the needle from behind, pull it through to the front of the fabric but not through the button. Pull the button up slightly. Wrap the thread around the stitches between the button and the top of the fabric 6 – 8 times. Put the needle back through the fabric and tie off the thread in a knot.







If your workspace looks like mine, use a lint roller to remove all of the cat fur from your finished wrist cuff.



Video: <http://www.youtube.com/watch?v=rG6aVKOGRsA>



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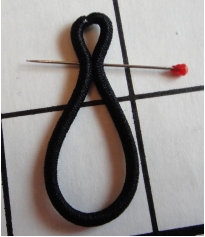


# Tips for Workshops or Groups

I made these and wrote this tutorial in preparation for leading a group of high school aged girls through the project in a summer camp session. Here are a few strategies I developed for approaching the wrist cuff in that context:

- Within a 4 hour workshop, 2 hours were allotted to introducing theories of open source, and doing some rudimentary coding and rapid prototyping with larger Lilypad boards and LEDS. This left only 2 hours for completing the wrist cuff. To make sure we had plenty of time, I completed all of the steps through page 6 in advance. This allowed the students to sew the complete circuit and sew a few seams on the machine.
- Choosing fabric for a group of high school aged girls was a bit daunting. To keep it simple I limited the selection to two fabrics. Because I could not be sure how many students would prefer each one in advance, I used one 3" x 9" strip of each fabric, so every cuff had both fabrics. The students just had to work with the one they preferred.
- It quickly became apparent that adding the elastic loops for 30 of these was going to be tedious at best, insanely frustrating at worst. Rather than trying to tie each loop, I bought some small fabric covered hair bands to use instead:

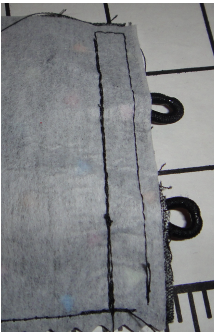
# Tips for Workshops or Groups



Use a straight pin to create a 2 asymmetrical tear drop shapes in the band. Make sure the join in the band is in the smaller part.



The bands slip around a bit when sewing. To secure them, place two dabs of fabric glue on the the right side of your fabric. When placing the glue, keep in mind that the lower edge still has a seam allowance. Set the bands in the glue, with the smaller drop sticking out of the fabric layers. Allow to dry.



Once the glue has dried, remove the pins. Position your needle on the so it will not go through the glue. Stitch down the edge and across the bands 3 times. At the bottom of the cuff, turn the fabric and stitch over toward the edge. Stitch at least one more seam along the edge.