John Baylies - sousastep.com

THIS TUTORIAL IS MOSTLY FINISHED

All the info you need is here. I'll tidy it up one day.

Last updated 7/30/2020

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It took me about two years to figure this out, with lots of help from the Brooklyn College Sonic Arts program and the Performance And Interactive Media Arts program.

Here's a compilation of short clips I recorded while I was making the bell:
https://www.youtube.com/watch?v=K3kPgxQ373U

If you haven't soldered before, Nic Collins' book Handmade Electronic Music is a great way to learn how: https://www.nicolascollins.com/handmade.htm

and Adafruit has a soldering guide specifically for LEDs
https://learn.adafruit.com/make-it-glow-how-to-solder-neopixels-a-beginners-guide

If you are unfamiliar with Max/MSP, check out the tutorials: https://docs.cycling74.com/max8

Also check out Jay Converse's LED bell because it's cool too:
https://www.facebook.com/TubaGuyFairfax

Materials:

- One dedicated sousaphone bell (this is a permanent installation)

I used a fiberglass bell spray-painted black. the LEDs will stick to a lacquered bell just as well, but keep in mind that the LEDs will be soldered while they're on the bell, which would not do the lacquer any favors.

- Condenser clip-on mic
  https://www.audio-technica.com/cms/wired_mics/8b8850105bdc46d6/index.html

My max patch currently only uses amplitude data from the mic. It's definitely possible to use a much cheaper mic, or even solder your own.
https://learn.adafruit.com/adafruit-agc-electret-microphone-amplifier-max9814

- Audio interface https://www.shure.com/en-US/products/accessories/x2u-xlr-usb-interface

This is the cheapest interface I could find. I've had it for 6 years, but I recently realized the gain knob aged poorly. Its sweet spot is microscopic. Maybe buy a slightly better interface than this for reliability's sake. On the complete opposite end of the spectrum is the RME Babyface Pro, which is flawless.

- Max/MSP https://cycling74.com/ OR Ableton Live Suite https://www.ableton.com/en/shop/live/ Ableton is not necessary for this project but it is useful, and Suite comes with Max/MSP.

- Teensy 3.2 https://www.pjrc.com/store/teensy32.html
- OctoWS2811 https://www.pjrc.com/store/octo28_adaptor.html
- Header pins https://www.pjrc.com/store/header_14x1.html
- Sockets https://www.pjrc.com/store/socket_14x1.html

- WS2812b RGB LED (200 LEDs needed for this tutorial, but definitely buy extras. Even the pros sometimes have trouble sourcing good ones that won't burn out quickly) https://www.amazon.com/Programmable-Aclorol-Individually-Addressable-Raspberry/dp/B07BKNS7DJ

WS2812 LEDs were released to the world 7 years ago, and they've been improved upon since then. You can read more about other types of LEDs here: https://hackaday.com/2019/03/26/can-you-live-without-the-ws2812/

- 5V 50W PSU https://www.aliexpress.com/item/4000221993487.html

- Soldering Iron (I bought a cheap soldering iron, hated it, then splurged on the Weller, which is great) https://www.testequipmentdepot.com/weller/soldering/soldering-stations/digital-we-soldering-station-120v-70w-we1010.htm
- Helping hands https://www.amazon.com/Neiko-01902-Adjustable-Magnifying-Alligator/dp/B000P42O3C
- lead solder (leadless solder is a PITA) https://www.amazon.com/WYCTIN-Diameter-Electrical-Soldering-Purpose/dp/B071WQ9X5K
- Electrical tape and Gorilla tape
- Micro USB cable https://www.digikey.com/short/zb93pw
- USB extension cable https://www.digikey.com/short/zb93z3
- Barrel extension cable https://www.digikey.com/short/zb934t
- XLR cable https://www.monoprice.com/product?p_id=4754
- CAT6 cable https://www.monoprice.com/product?p_id=9789
- Stranded wire 22 AWG https://www.pololu.com/product/2640
- Projector and tripod (the tripod matters more than the projector. It *must* remain *completely* stationary for however long it takes you to place all of the LEDs on the bell.)

Method:

1. Follow the instructions here https://www.pjrc.com/store/octo28_adaptor.html on how to connect the OctoWS2811, the Teensy 3.2, the power supply, and the LEDs. This is for testing purposes to make sure everything works before it's installed on the bell.

2. Download this folder o' files (new files added as of 7/30/2020) https://drive.google.com/drive/folders/1zNywJd1qFBDvmCKHP6uyBZwvYQ1FHMPt?usp=sharing

3. Upload success.ino to the teensy by following the instructions here: https://www.pjrc.com/teensy/teensyduino.html

   This part of the code is the most important, and may need to be changed.

   ```
   const int ledsPerStrip = 26;
   const int numStrips = 8;
   ```

   Open testpatch1.maxpat
   Turn the patch's audio on.
   Clear the serial ports and locate the teensy.
   Enable jit.world
   And the LEDs should light up...

   Here's how I got the coordinates for remappedLEDcoordinates.txt

I found this website
http://iwant2study.org/lookangejss/math/Series_Numbers/ejss_model_FibonacciSpiral/

Clicked "table"

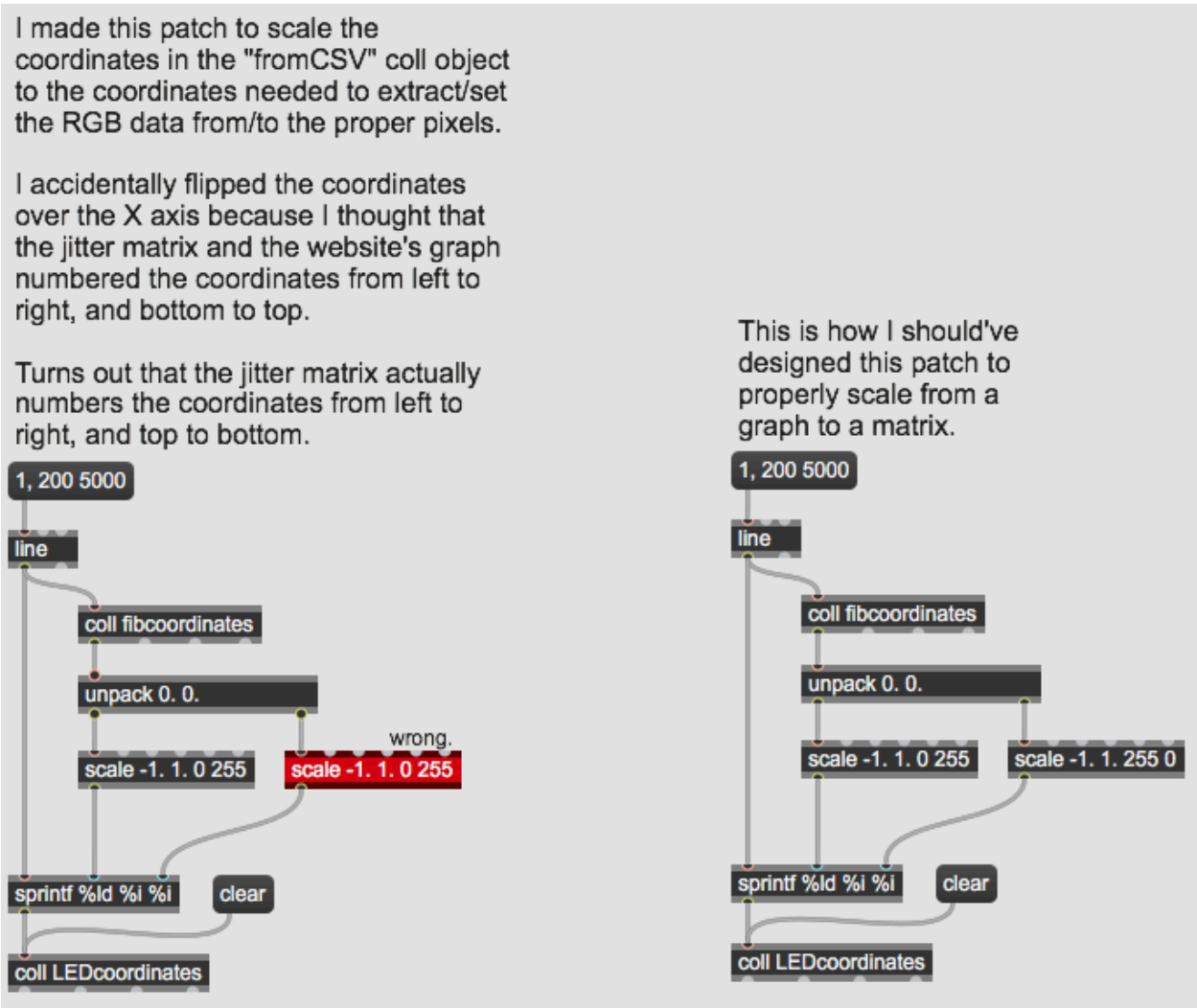
Selected the first 200 coordinates

Copy-pasted them into google sheets

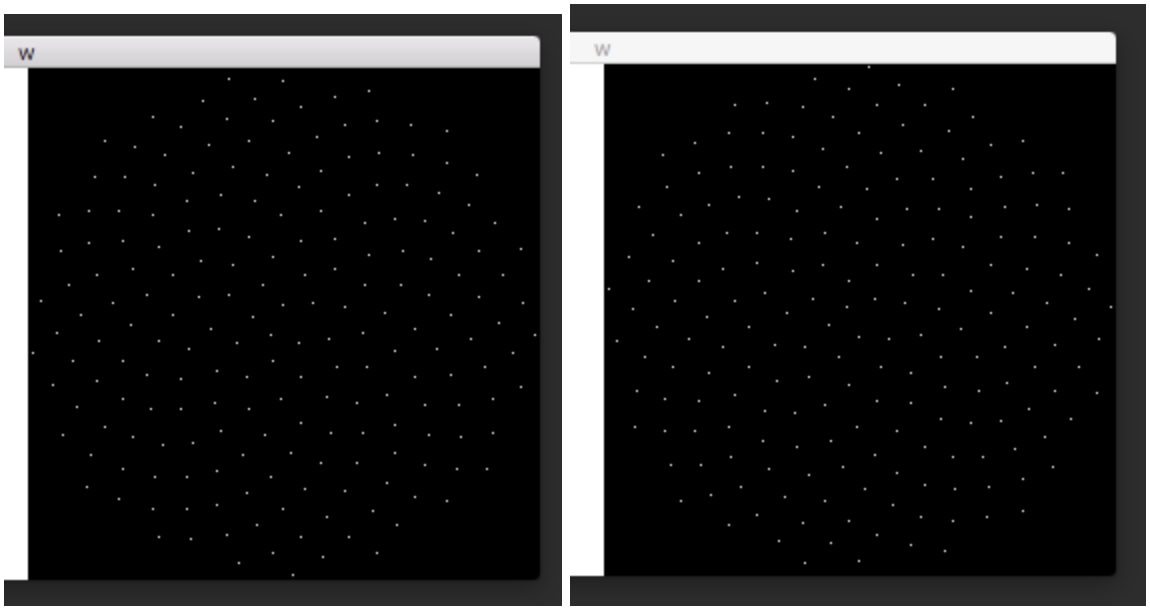
Exported the sheet as a csv file

Used Justin G's max patch to convert the csv file into Max's coll object
https://cycling74.com/forums/importing-from-excel-csv-questions

then,



This patch will get the Fib. Spiral showing up properly in jit.world



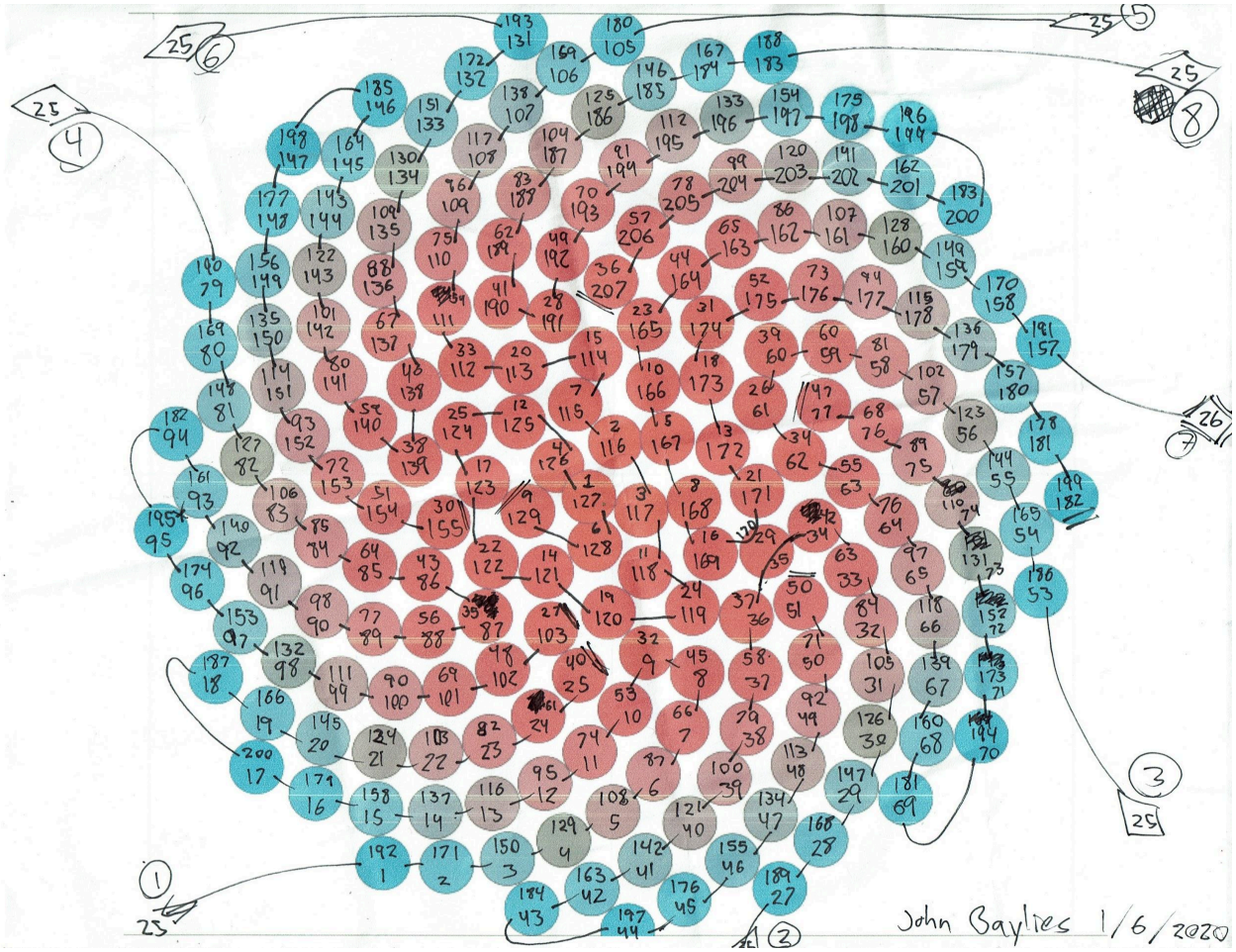
Left, incorrect, flipped on x-axis. Right, correct.

(challenge: turn the coordinates 90 degrees. It'd look more symmetrical.)

Now take a screenshot of the spiral in jit.world (or use the one provided above), and use a projector to project it onto your sousaphone bell. This will be where you place your LEDs. I found that it is easier to place the LEDs while the projector is on than it is to mark the spots with a marker and then put the LEDs on top of the marked spots. Once completed, the bell will look best from the point of view of where the projector was while you were placing the LEDs

One problem I faced is that I placed half the LEDs, then took a break for a few days, and when I tried to set up the projector again I learned that realigning the projector perfectly is impossible. This led to one speck of light hitting the flare of the bell the first time, and the throat of the bell the second time, which made me place one extra LED, which led to much confusion later on.

You'll want to wire the 200 LEDs in eight groups of 25. You should use your own discretion to do this as efficiently as possible. You can use my wiring diagram below as a guideline, but be warned that it's flipped on its X axis, and I had to account for one extra LED. Fibonacci index #29 corresponds to wiring index #35 *and* #170.



I used this diagram to reorder the coordinates from the Fibonacci spiral order to my wiring order.

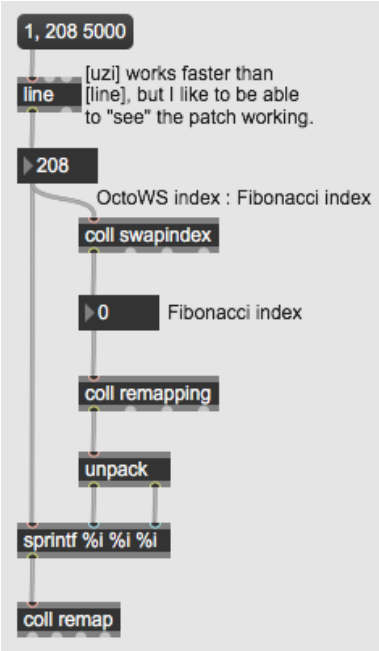
The top numbers are the Fibonacci indices, which can be obtained from http://iwant2study.org/lookangejss/math/Series_Numbers/ejss_model_FibonacciSpiral/ by clicking ‘number’. The bottom numbers are the wiring indices.

I did not plan out the wiring indices in advance. I simply turned on the first LED in each of the eight chains and wrote down the wiring indices on the above chart.

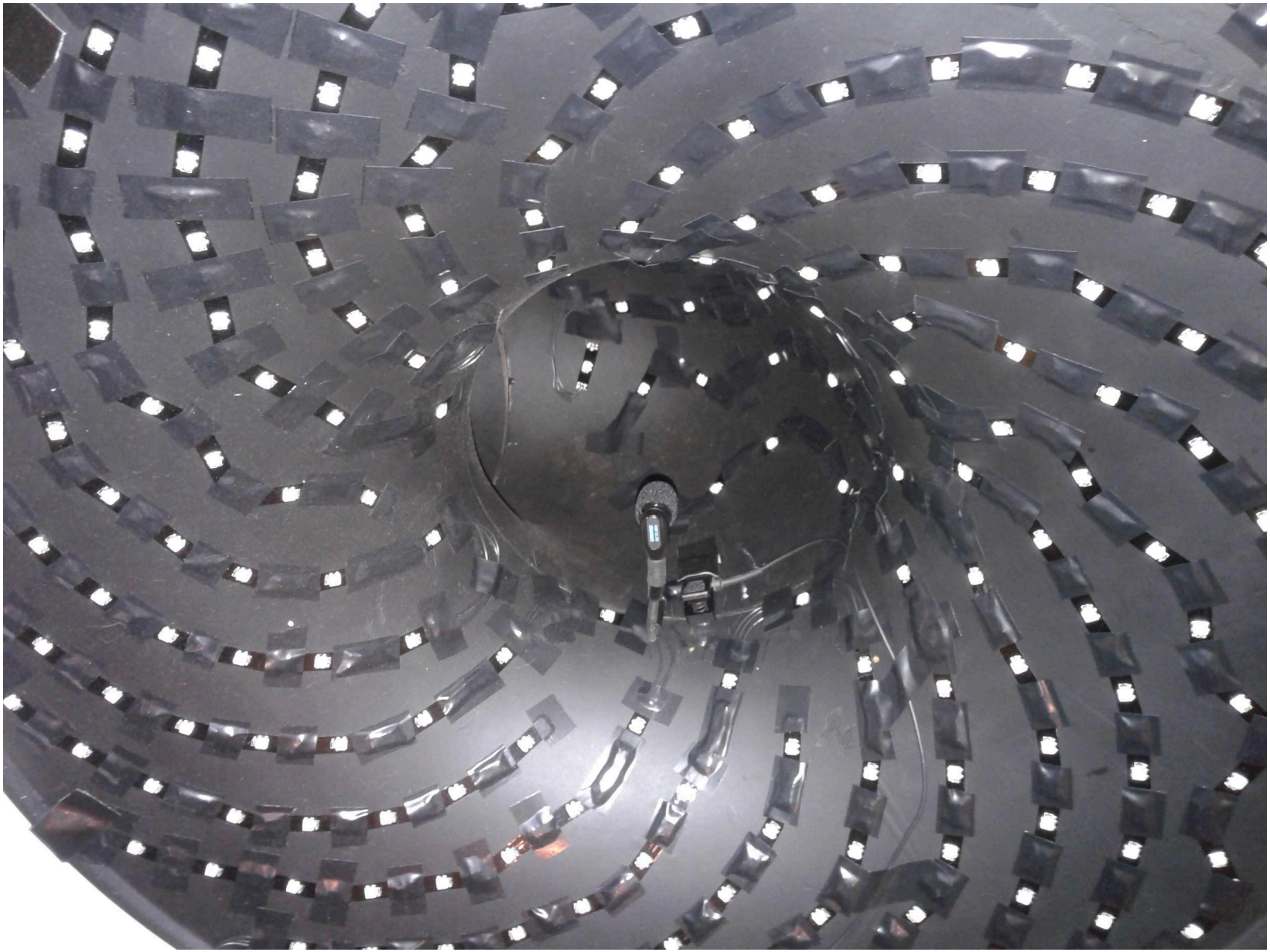
Then I typed all of those indices into a coll object.

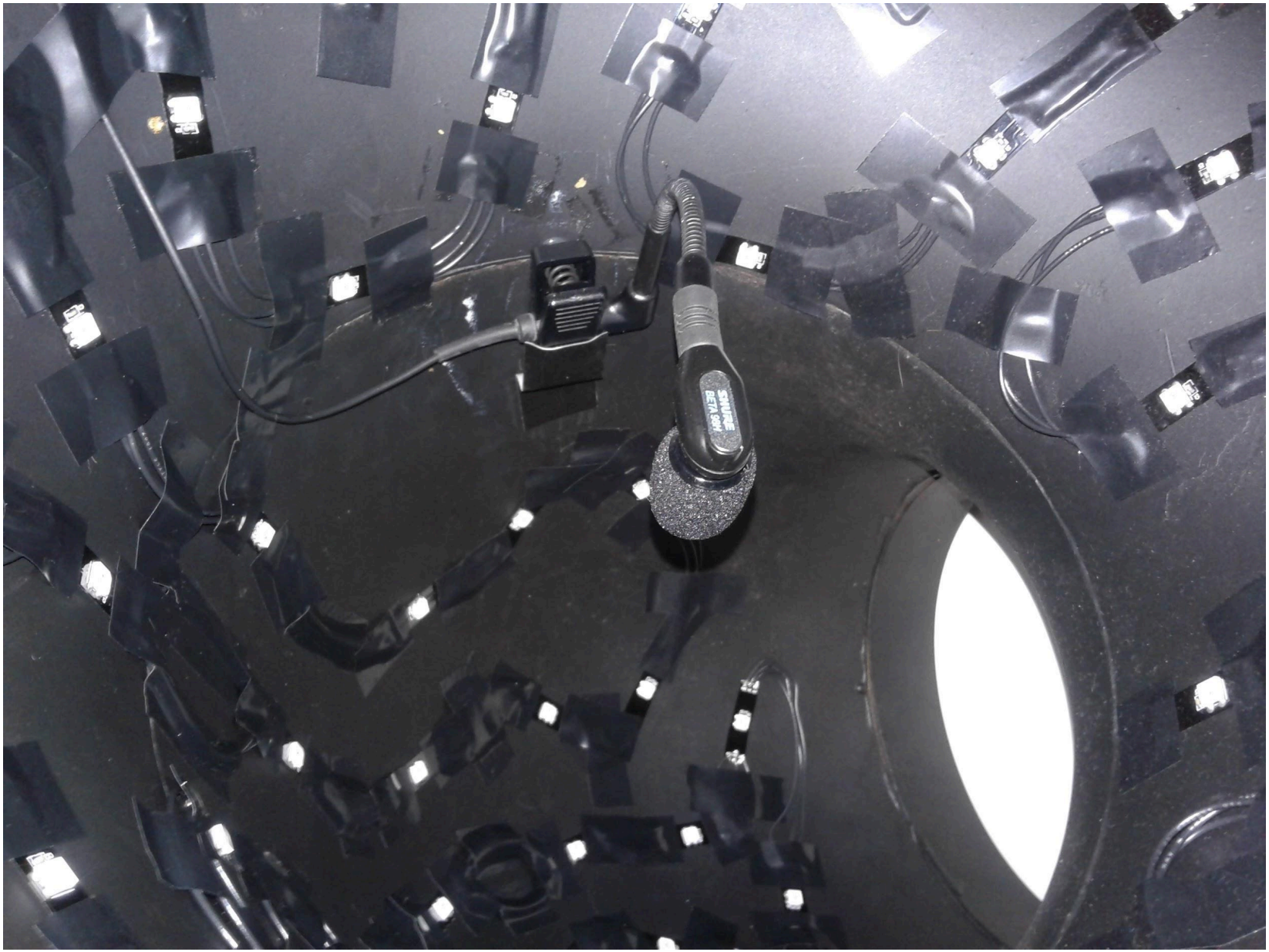
```
swap
1, 192;
2, 171;
3, 150;
4, 129;
5, 108;
6, 87;
7, 66;
8, 45;
9, 32;
10, 53;
11, 74;
12, 95;
13, 116;
14, 137;
15, 158;
16, 179;
17, 200;
18, 187;
19, 166;
20, 145;
21, 124;
22, 103;
23, 82;
24, 61;
25, 40;
26, 0;
27, 189;
28, 168;
29, 147;
30, 126;
31, 105;
32, 84;
33, 63;
34, 42;
35, 29;
36, 37;
37, 58;
38, 79;
39, 100;
40, 121;
41, 142;
42, 163;
43, 184;
44, 197;
45, 176;
46, 155;
47, 134;
48, 113;
49, 92;
50, 71;
51, 50;
52, 0;
53, 186;
54, 165;
55, 144;
56, 123;
57, 102;
58, 81;
59,
```

which allowed me to reorder the coordinates properly using the patch pictured below, which essentially makes the whole thing a big, low-resolution TV screen.

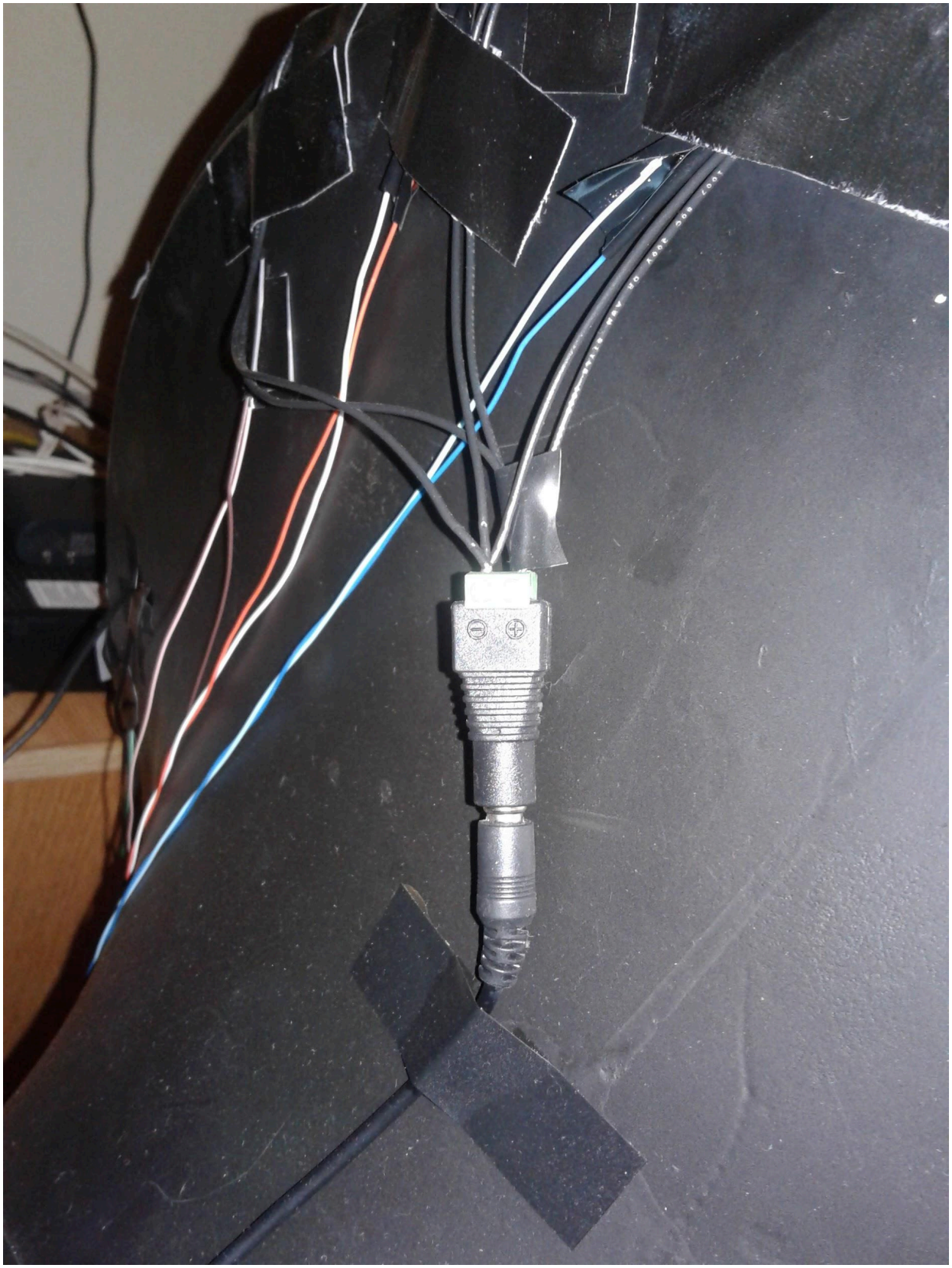


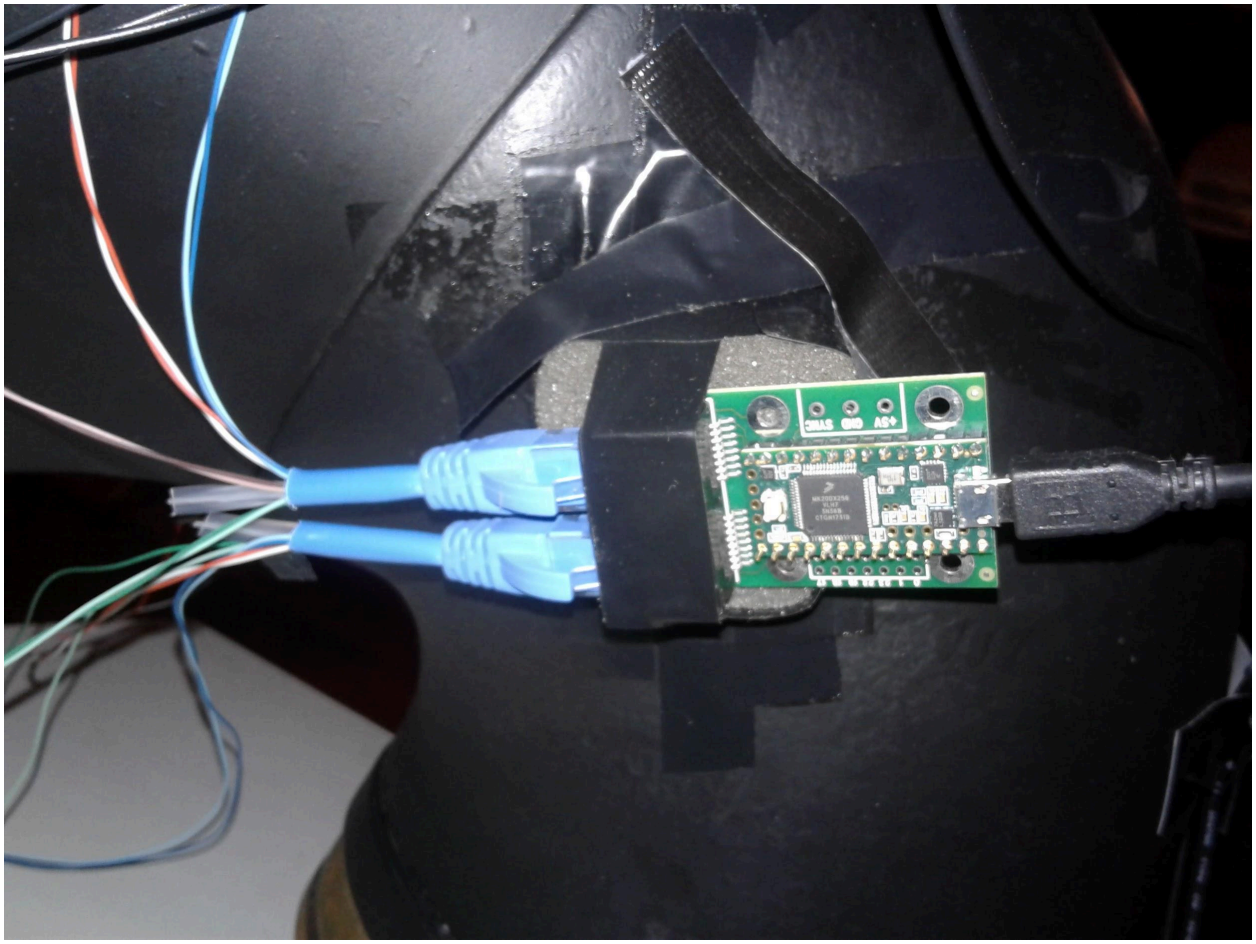
...and that's all the info you need to do this yourself! I'll be working on tidying up this tutorial over time, and eventually it may make its way over to Cycling74's website.




SHURE
BETA 98H


AC/DC ADAPTER
5V 50W




SWCLK
GND
+3V

Susie, Eyebrows, and Mousse.