Advanced Physical Computing

<Final_Project>

Blog Link:

https://github.com/s-mallat/Portfolio_of_Work/tree/main/WEEK_10_Final_Project

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MSc Creative Computing
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Device & How it Works

https://youtu.be/0Q_KSNYUGjA

Project Concept

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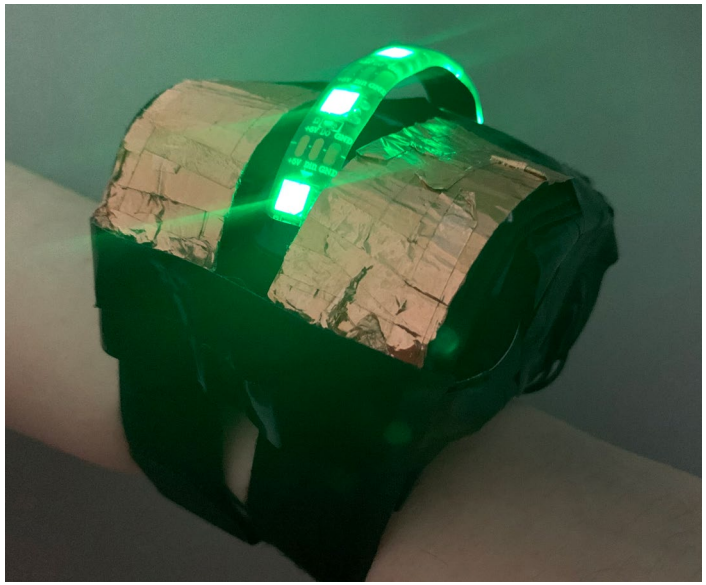
To better explain the inspiration behind my project, I'd like to tell a short story about my journey with anxiety and panic attacks. For years I was overcome with bouts of panic attacks and back then, I was desperately looking for some way to make them instantly stop. Back then, I would resort to my endless list of bookmarked web pages full of writings / breathing techniques / distraction exercises to make alleviate the panic.

Mental health issues are still heavily stigmatized in many parts of the world and as such, many people out there are still afraid to seek help due to fear of being labelled "crazy" or "weak minded." After all, if there's nothing physically wrong with you, *then you must be imagining things!*

Yes! A doctor said that to me once.

Therefore, I wanted to create a device that helps people who find themselves often trapped in their own negative thoughts becoming spectators of the outer world while they remain bystanders held back by an invisible bubble.

In other words, this device measures the user's stress levels & attempts to ground them (make the user focus on external stimuli as a way to distract them) and help them overcome high levels of agitation and stress.



Project Objectives

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Conceptual Objectives:

_____ To create a device that helps alleviate high stress levels / agitation and panic attacks.

_____ To reduce the fear factor associated with panic attacks which plays a huge part in triggering them to begin with. This is done by showing people that panic attacks aren't really that scary once one learns how to control them using specific exercises.

_____ To normalize seeking mental health advice & having devices or games catered towards helping people overcome them in a similar fashion to how we have many devices that help with alleviating physical health symptoms.

_____ To shift the mental image of fear and distress that is associated with negative emotions. In other words, create a more colourful image using colourful LEDs and cool gadgets.

Technical Objectives:

_____ To design and create a device that integrates several inputs and outputs to reach a better understanding of Arduino, sensors, motors and so on.

_____ To develop a stronger familiarity with schematic drawings and how to move from a circuit diagram to physically building the device and putting it together.

_____ To create a complex interaction between different inputs and outputs through wiring & coding.

_____ To transform a soldered circuit into an actual usable device by creating an appropriate housing for it and showing how the user can interact with the device.

Challenges

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_____ One of the biggest challenges I had in this project was moving from the regular Arduino Leonardo to the Arduino Nano. I remember freaking out when my circuit didn't work as I initially transferred it to the Nano board. I especially had an issue with the motor as it would not work at all with the Nano even though I had all my inputs and outputs powered using 3.3V on the Leonardo just to make sure that they would work later on.

The solution to this problem was to create a relay circuit and use a MOSFET transistor and a 9V battery to power the motor separately from the rest of the components in my circuit.

_____ Another challenging aspect was soldering the circuit on a strip board. Since my project is a wearable device, I had to design my soldered circuit on paper before attempting to solder it. My circuit is a two level circuit with the Arduino, MPR, battery attached to one strip board and the motor, LEDs attached to another strip board which is placed on top. Then I had to add the GSR to the side vertically and extend the GSR electrodes outside the circuit so I can attach them elsewhere. The easiest way to create this circuit was to take a picture of a strip board, print it and draw on it what I wanted to do. Then having multiple Grounds and Power columns so that the wires wouldn't be too condensed in one area on the strip board.

_____ Last but not least, I think every part of this project has been challenging but extremely fun at the same time. As someone who started this semester with no prior knowledge of Arduino and C++ coding, I thoroughly enjoyed the process of creating this project. I've learned so many new things from soldering properly, to using a hot air gun, to becoming much more familiar with making circuits and using sensors and motors. Somehow, it feels like I can create any device at this point!

Future Possibilities

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_____ When I was putting the circuit together, I kept thinking about how cool it would be if this device can go from a being bracelet to a full body interactive experience. I'm just imagining a device that can be worn around the body & once the user is stressed or agitated it would cover them with LED light patterns that respond to the GSR values being recorded. In a way, the user would become a walking art piece and that will most definitely distract the user from their worries as they will be too focused on at device and recording the patterns it creates.

To further elaborate on this point, it would also be fun to connect the device to a screen via bluetooth. This screen creates or plots colorful patterns using the GSR values. I'm thinking along the lines of something extremely colorful and fun to look at. For example, designs that are similar to GLSL fragment shaders.

_____ Another direction I can think of is adding different distraction exercises to the device. For now, the device uses LEDs as a slow breathing exercise for the user and the vibration motor to create a shock stimuli. However, I can easily envision this device with a sound element to it along with simple games. For example, creating a game where the user is required to touch different areas around their body to turn off the LEDs (similar to Whac-A-Mole arcade game but involving touch only)! This can easily be done using a capacitive touch library or even the MPR121 which is already being used in this project to control the vibration motor.

The Circuit

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https://github.com/s-mallat/Portfolio_of_Work/blob/main/WEEK_10_Final_Project/PCOMP_Final%20Circuit.pdf

Circuit Components

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Arduino Nano 33 BLE Sense
Strip Board

NeoPixel RGB LED Strip (Output #1)
Mini Vibration Motor (Output #2)

Galvanic Skin Response Sensor (Input #1)
MPR121 12 Capacitive Touch Sensor (Input #2)

Diode 1N4007
MOSFET Transistor
9V Battery
Wires & Conductive Tape

Circuit put together using
a Soldering Iron

Final Circuit

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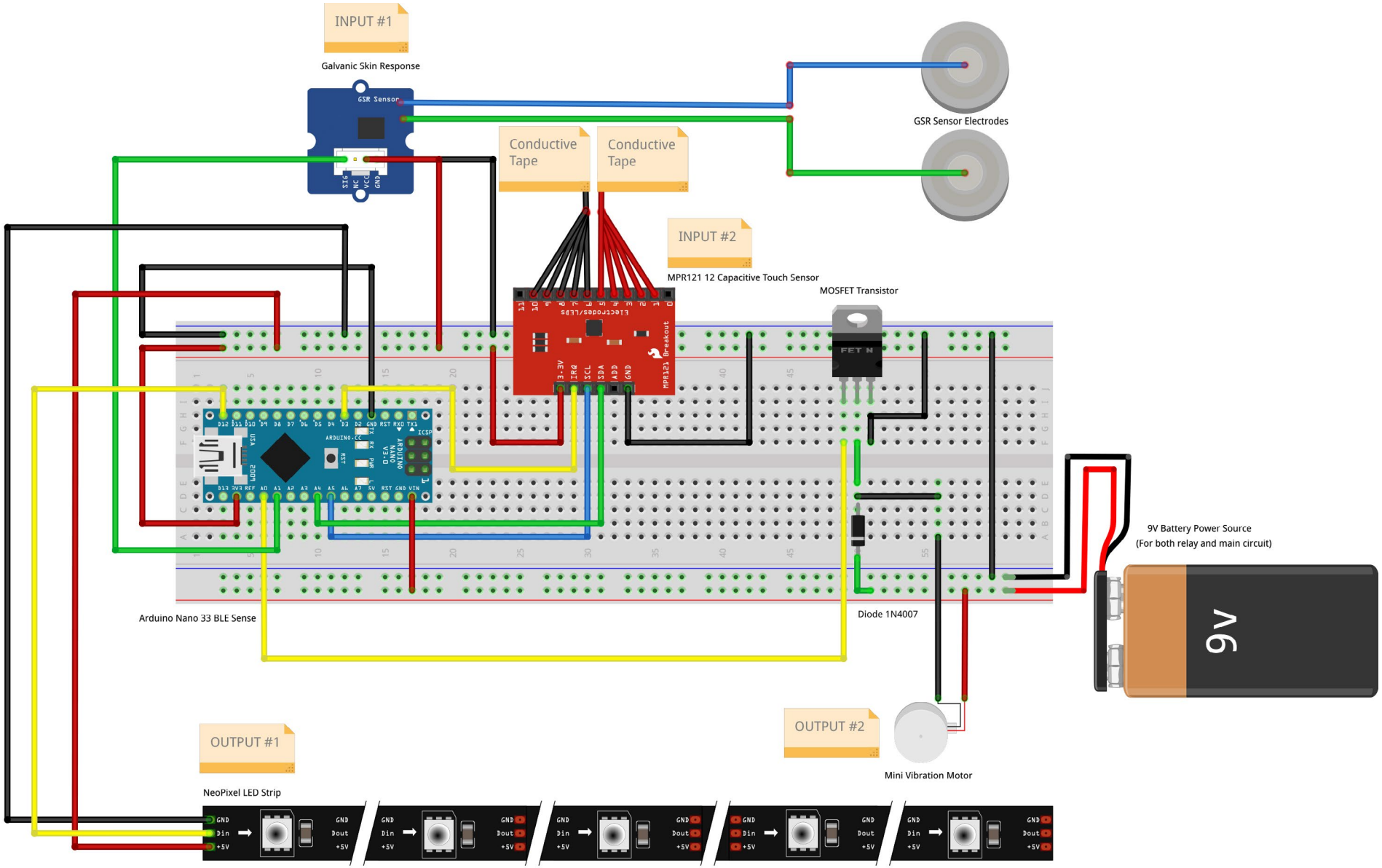

A Closer Look at the Soldered Circuit

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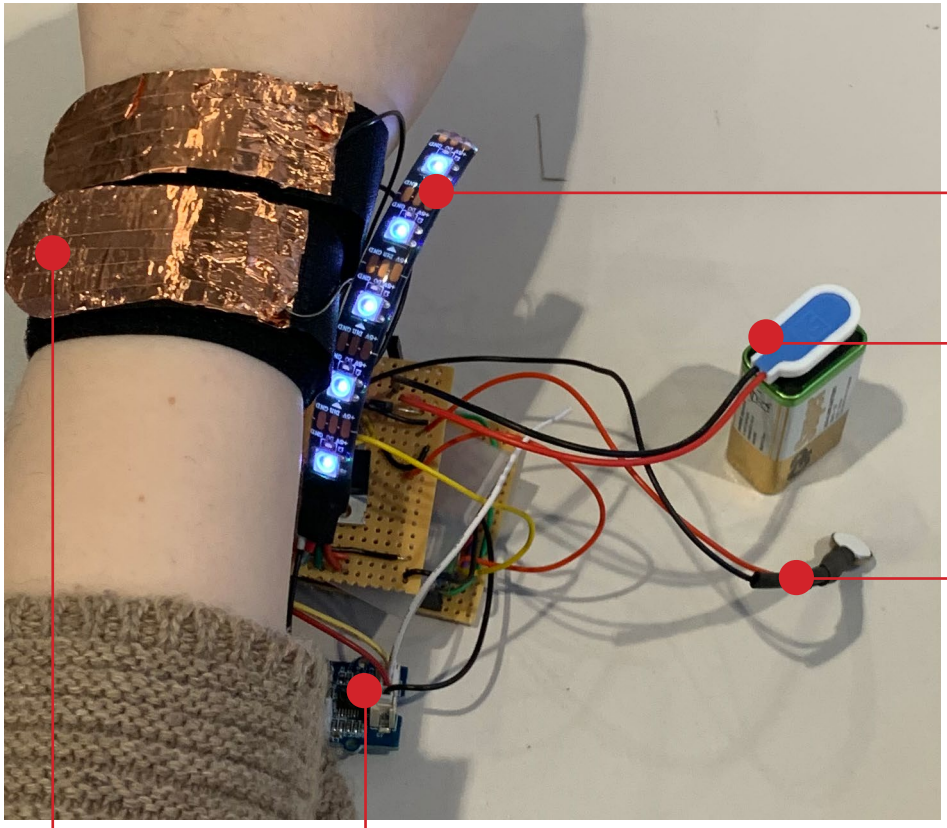

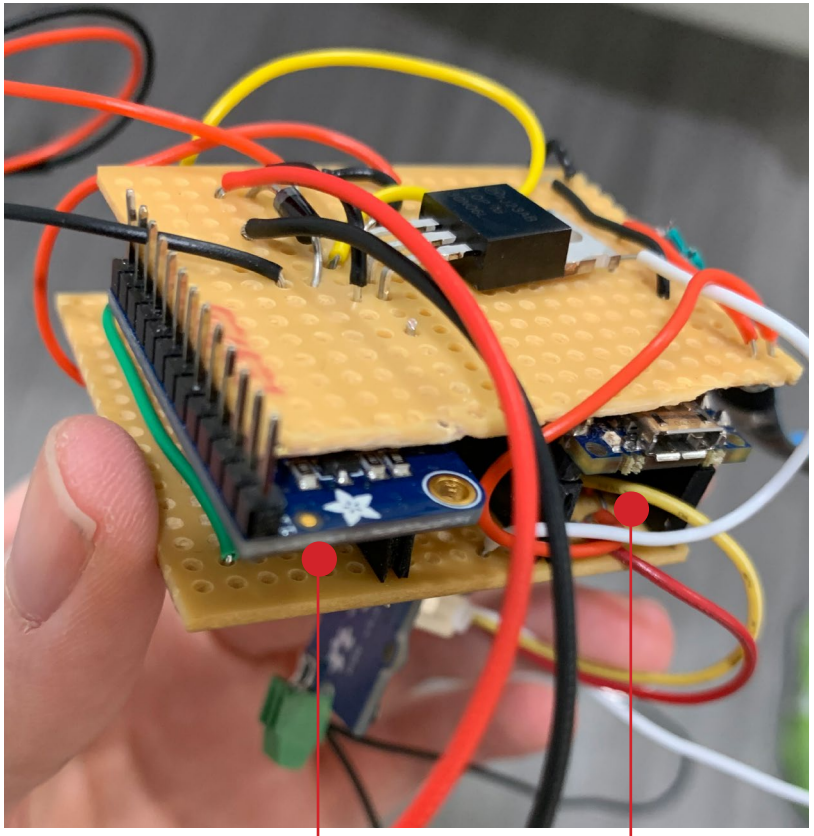

The Code

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https://github.com/s-mallat/Portfolio_of_Work/blob/main/WEEK_10_Final_Project/Final_Code_2021.11.30.ino

Weekly Documentation

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https://github.com/s-mallat/Portfolio_of_Work/blob/main/WEEK_10_Final_Project/02_Weekly%20Documentation.md

Week 06

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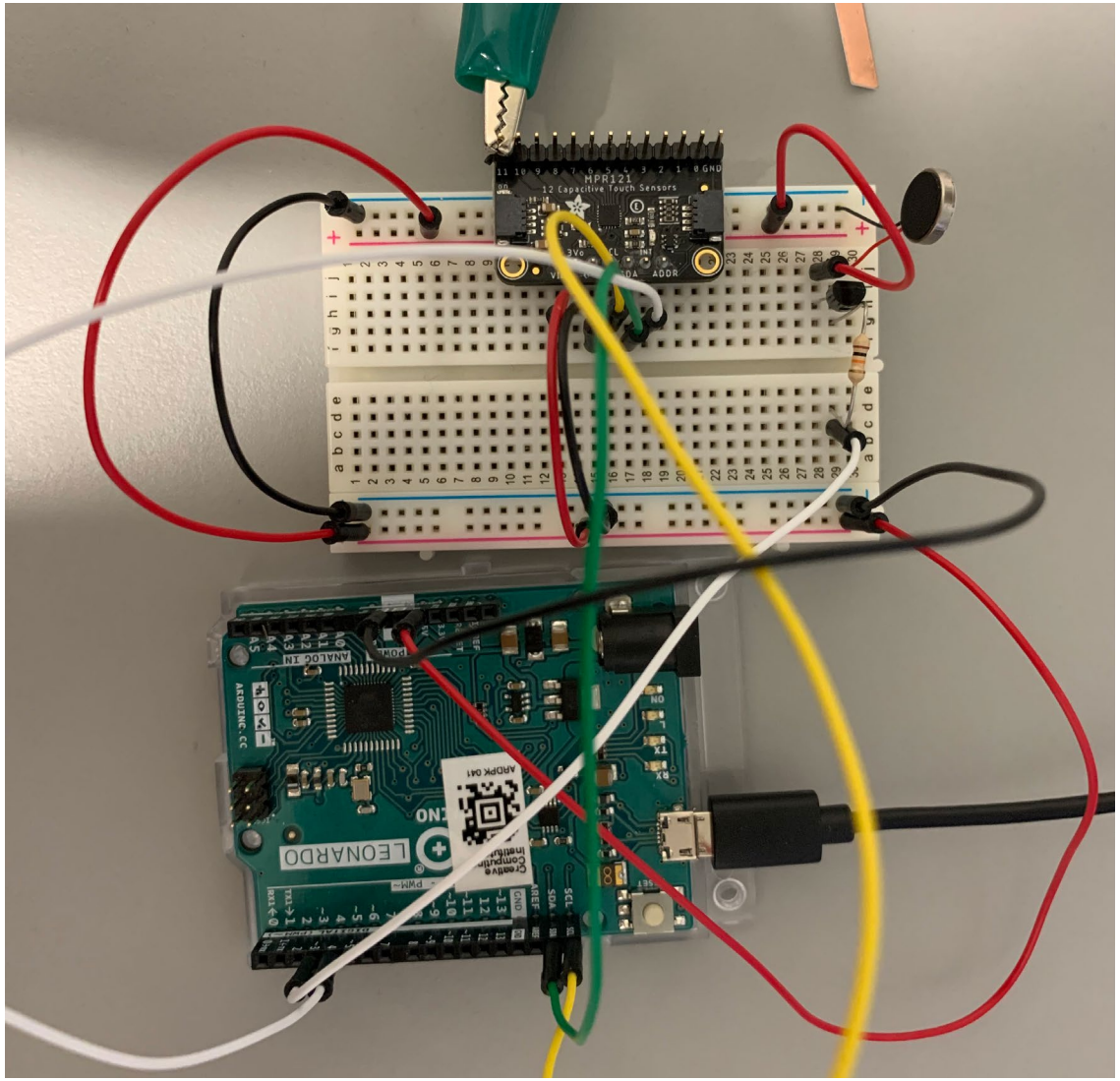
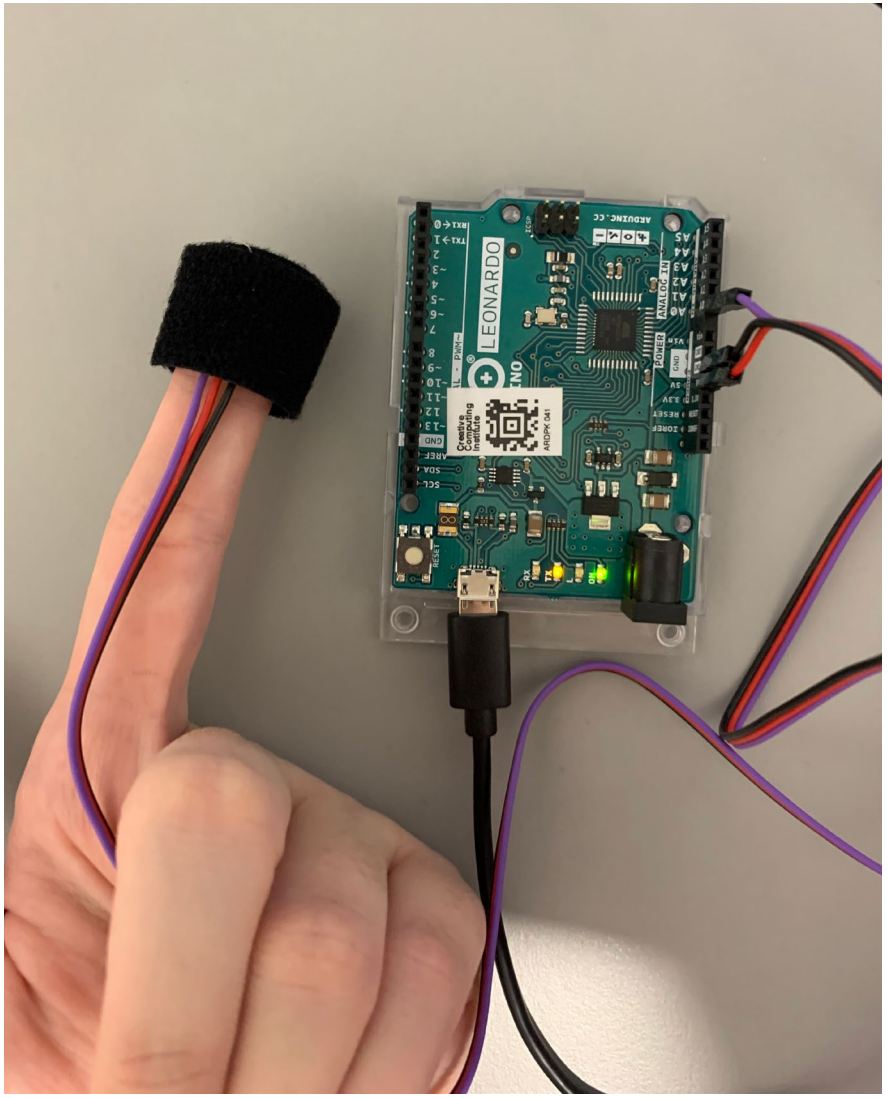
This week was dedicated towards familiarizing myself with different sensors, how to use their arduino libraries, and putting the circuit together on the regular Arduino Leonardo. I initially started using the Pulse Sensor, then later switched to the Galvanic Skin Response instead.





Week 07

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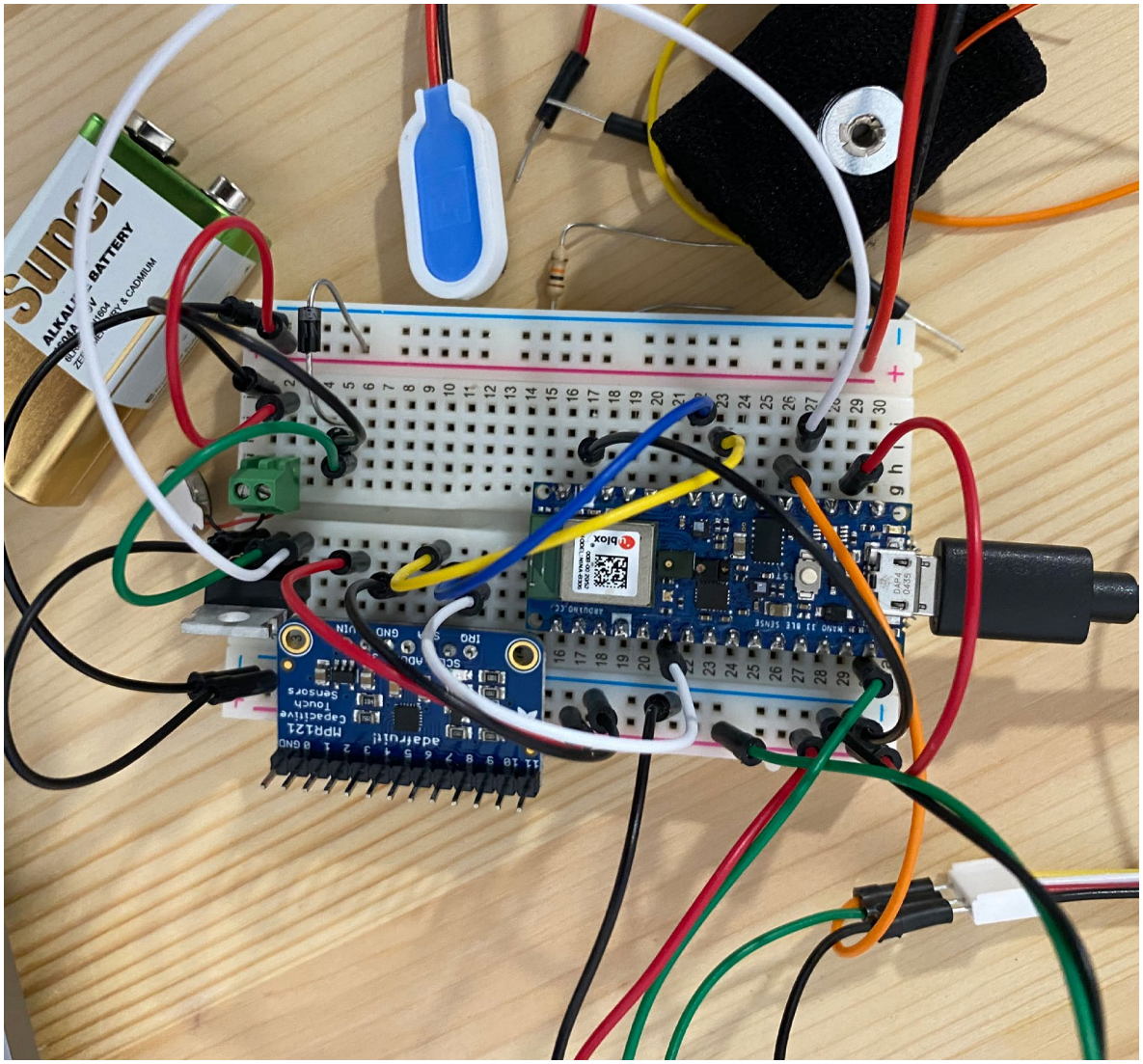
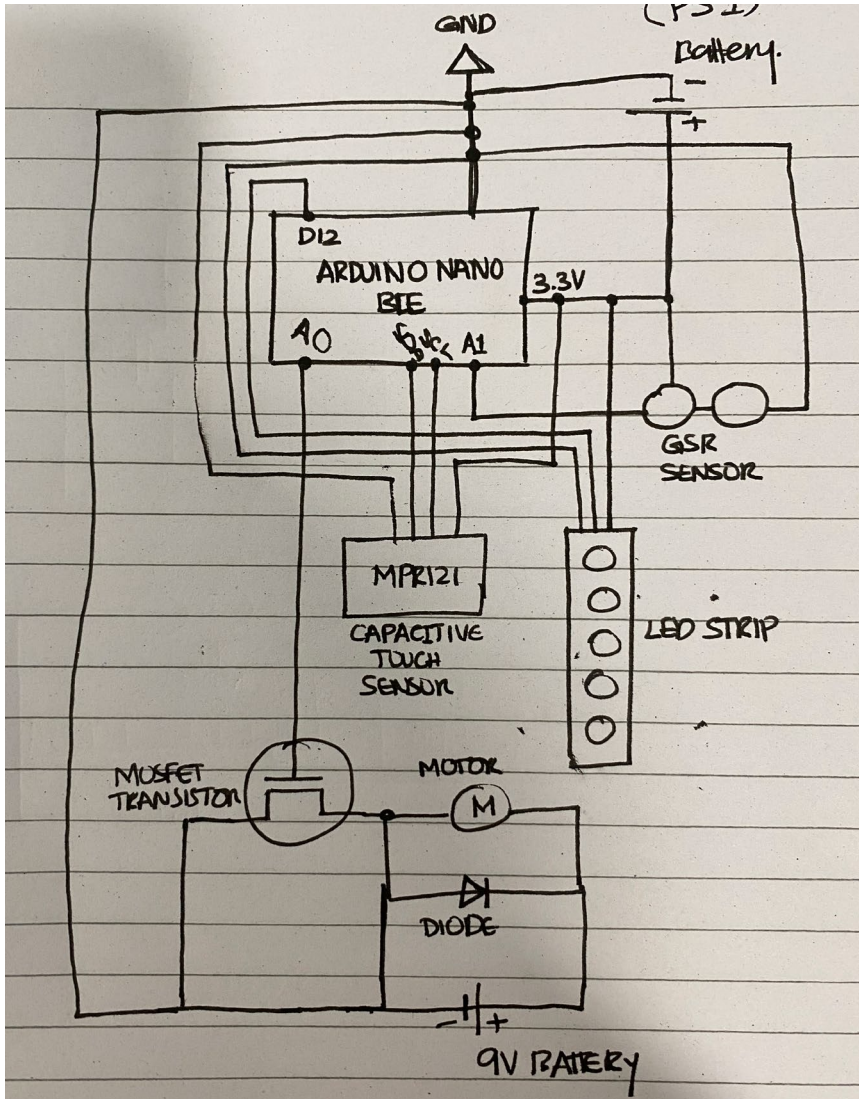
In week 07, I started switching to the Arduino Nano BLE. Unlike the Leonardo, the BLE only worked with 3.3V power and so I had to be very careful not to damage it with the 9V battery. The biggest challenge in this week was getting the motor to work on the BLE board. In the end, I created a relay circuit just for the motor so it can be powered separately from the rest of the components.





Week 08

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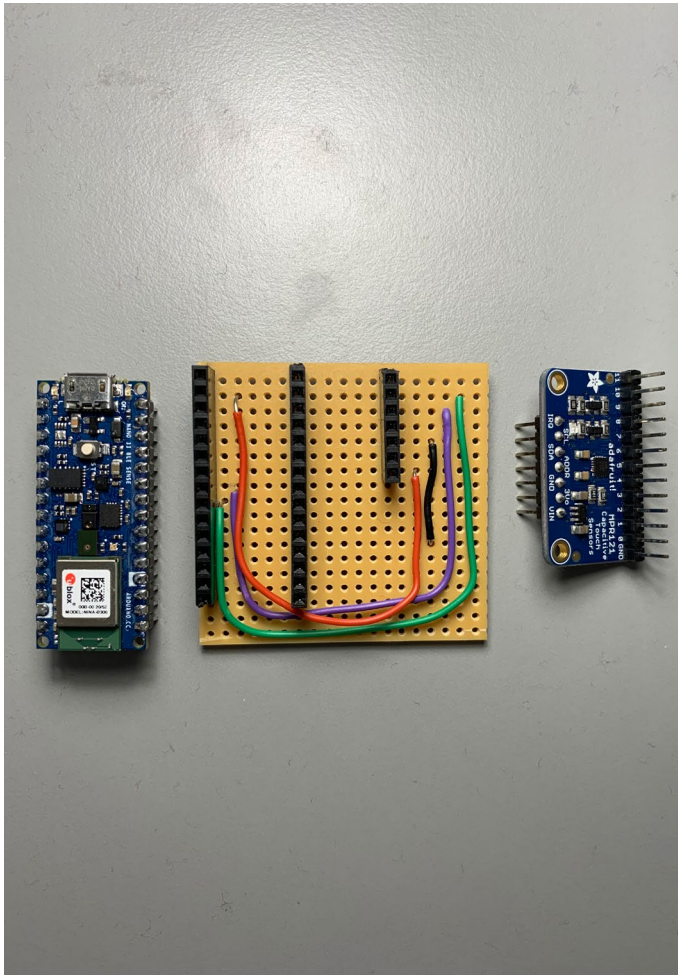
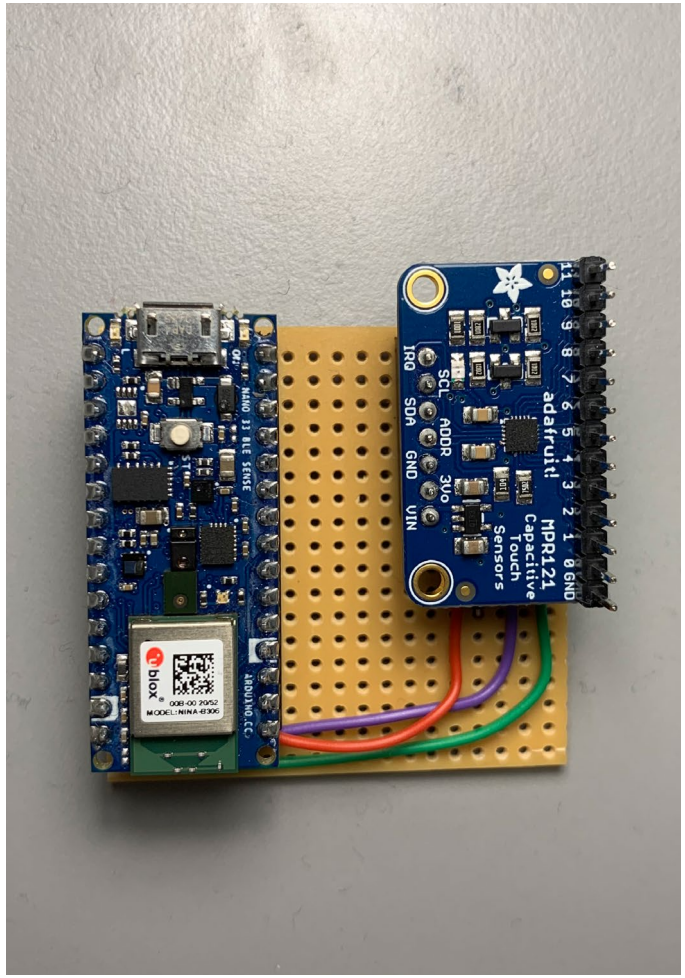
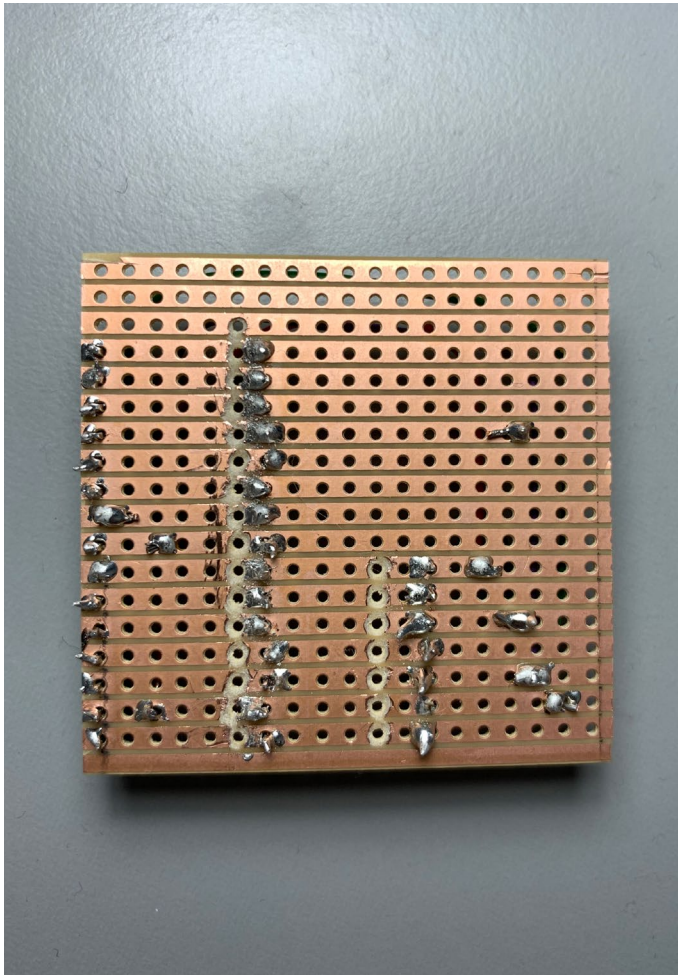
In this week, I finally started soldering my circuit. The challenge wasn't the soldering itself but where to place the wires on the strip board. Since the Arduino Nano is small and already had soldered pins on it from both ends, I had to design my strip board into two levels to be placed on top of each other. The strip board had to be small as well, since my project is a wearable device so there was a lot thinking behind the placement of each wire and how many Power & Ground columns I had and how many pins can be placed in each column.







Week 08 (Continued)

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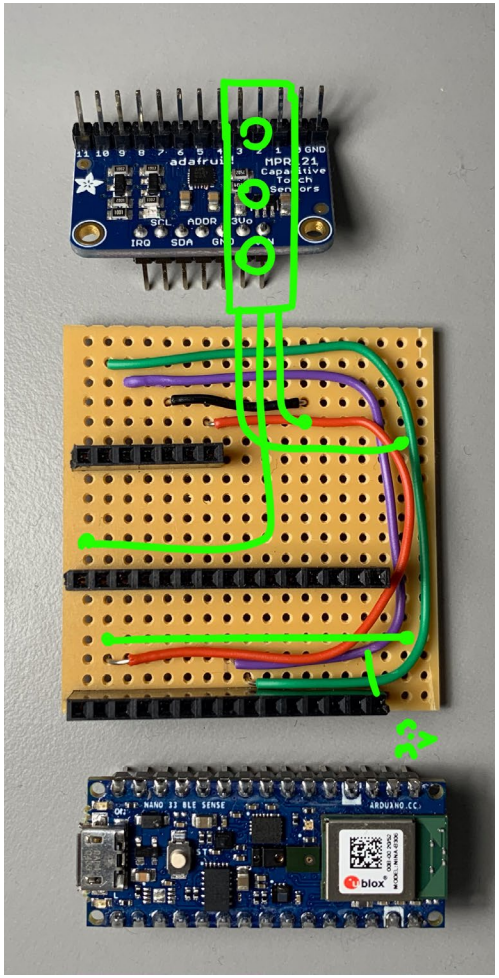
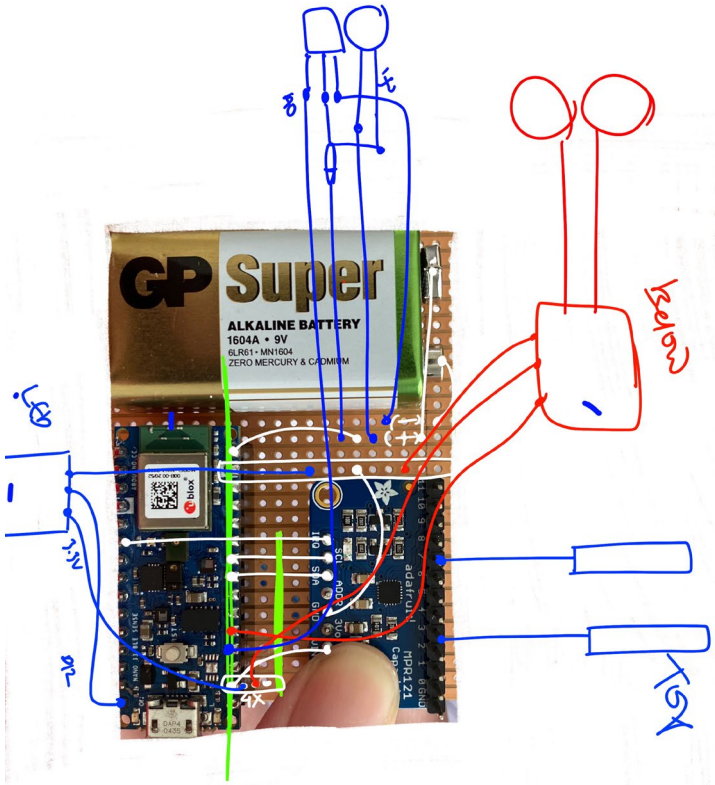
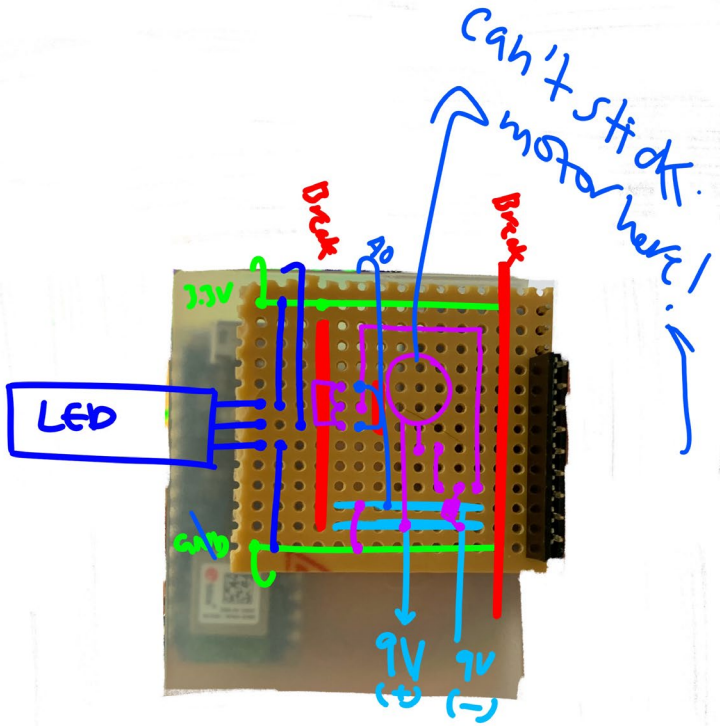
Below are some sketches I made of the strip board that really helped me decide how and where to solder different components. Even with all that though, I still made a few errors in calculating how the final outcome would look like! For example, I could've used more LEDs on the exterior of the bracelet and soldered in on the lower strip board so it wraps around the whole design.







Week 09

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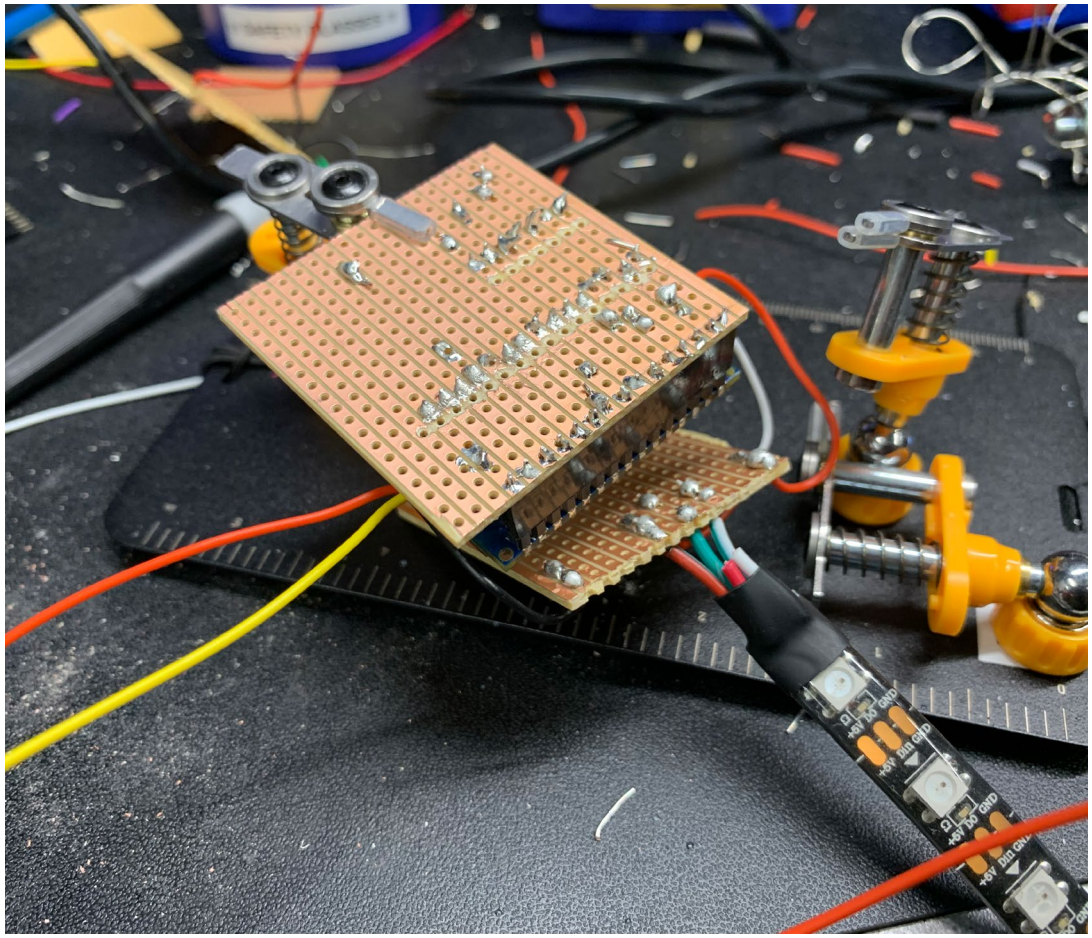
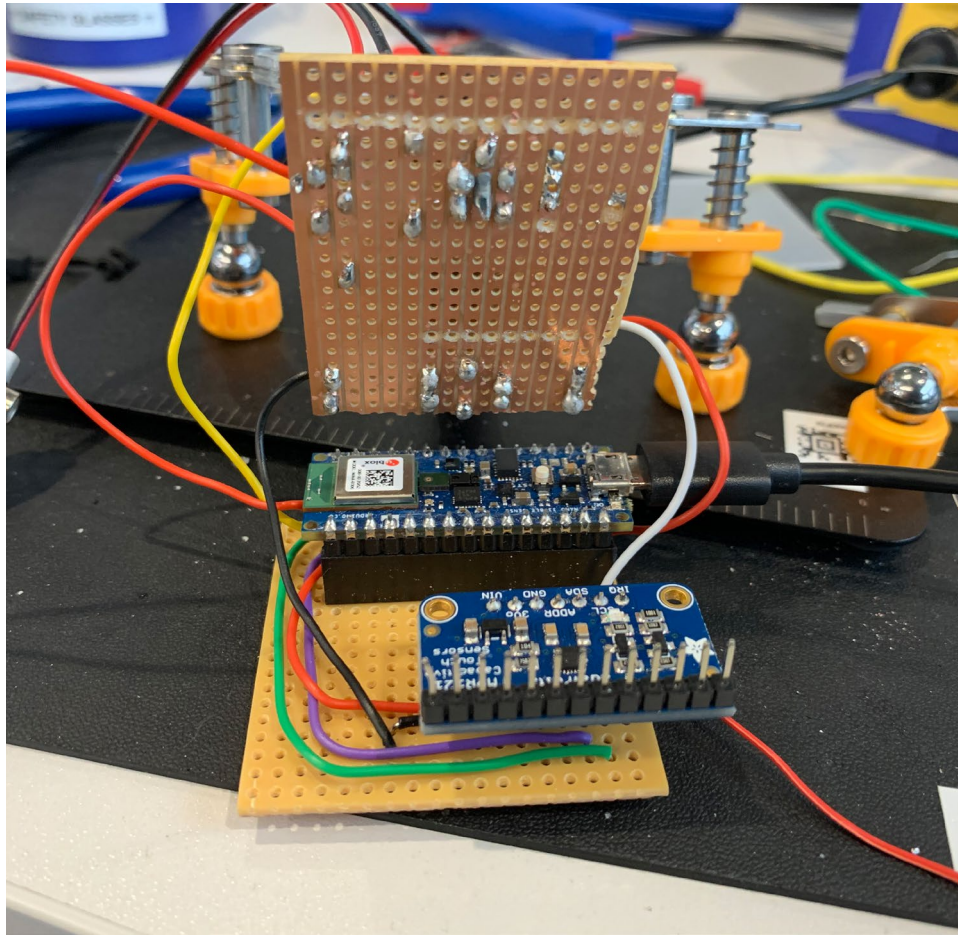
I think it took me overall two weeks and a half to finish all the soldering completely. To be honest, I think I spent more time designing the inside of the device than the outer aesthetic of it. In week 09, I started working on the second level of my circuit. This level included the battery power and ground lines, the relay circuit including the motor, diode, and MOSFET transistor. Lastly, this level also included a second set of power and ground lines for the LEDs and GSR to be connected to the 3.3V pin on the first level strip board.





Week 10

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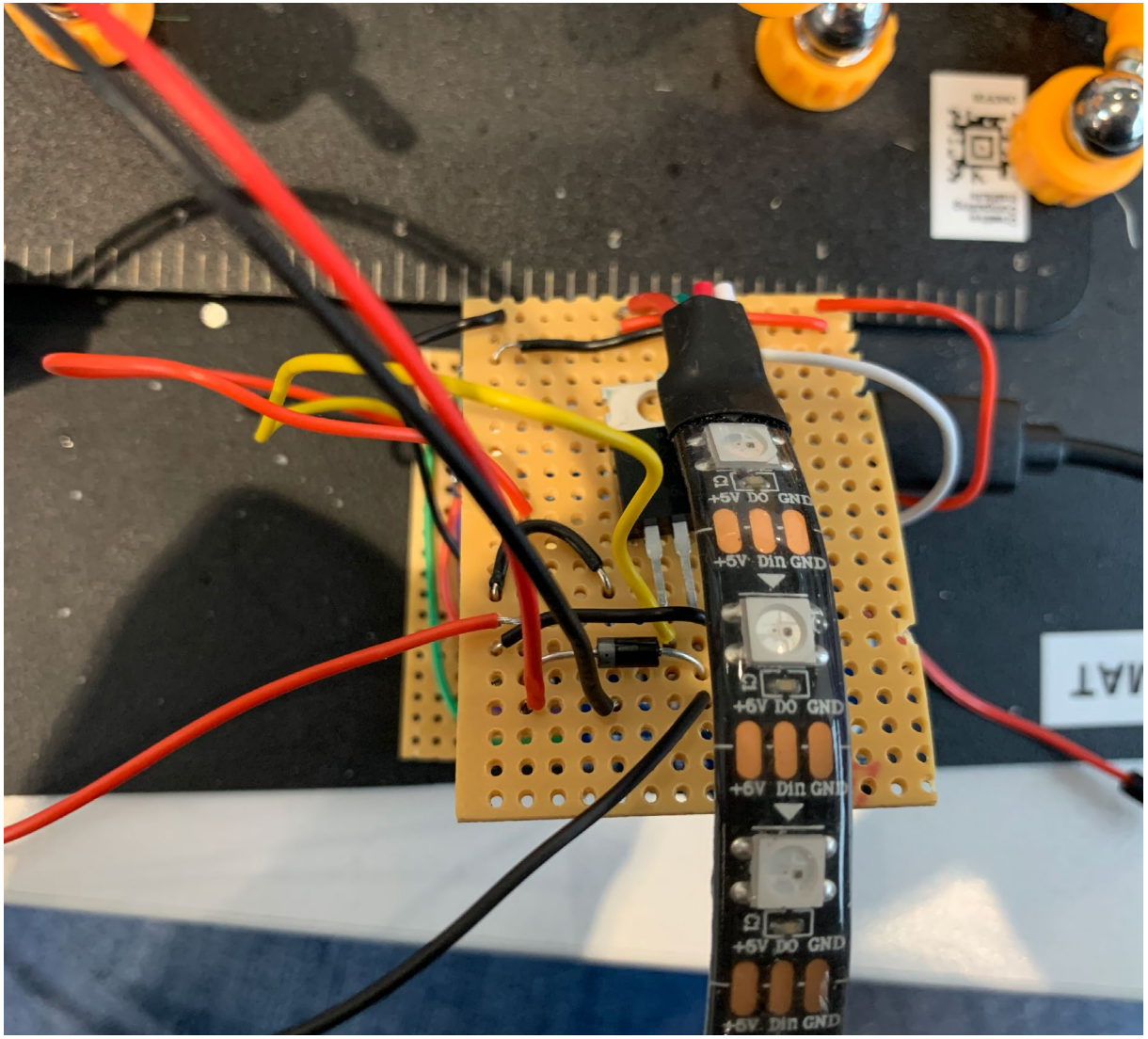
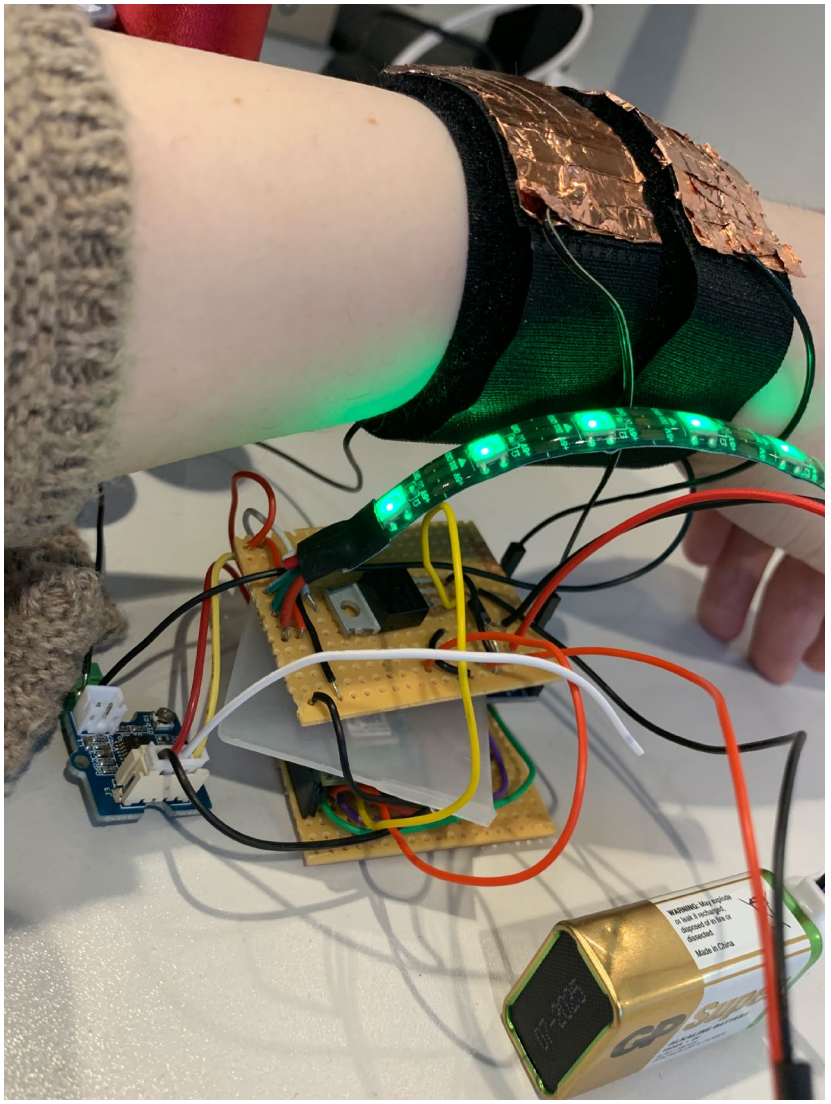
This week included some re-soldering since I made a few mistakes last week. It also included reattaching the LED strip since I accidentally ripped off one of the wires while creating the final bracelet design. After doing all that, I finally put the circuit together as well and turned it into a bracelet for final documentation.





Week 10 (Continued)

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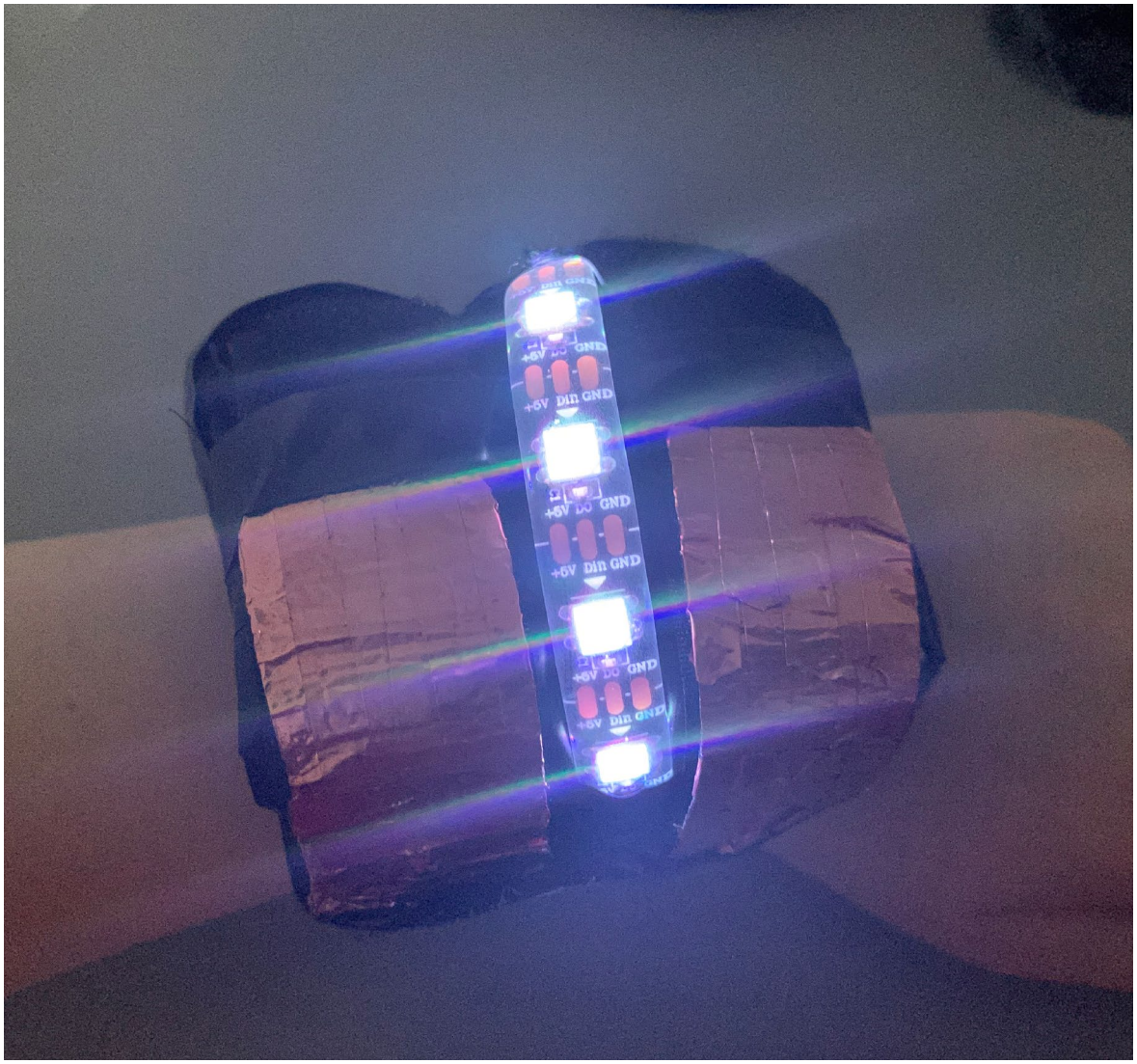
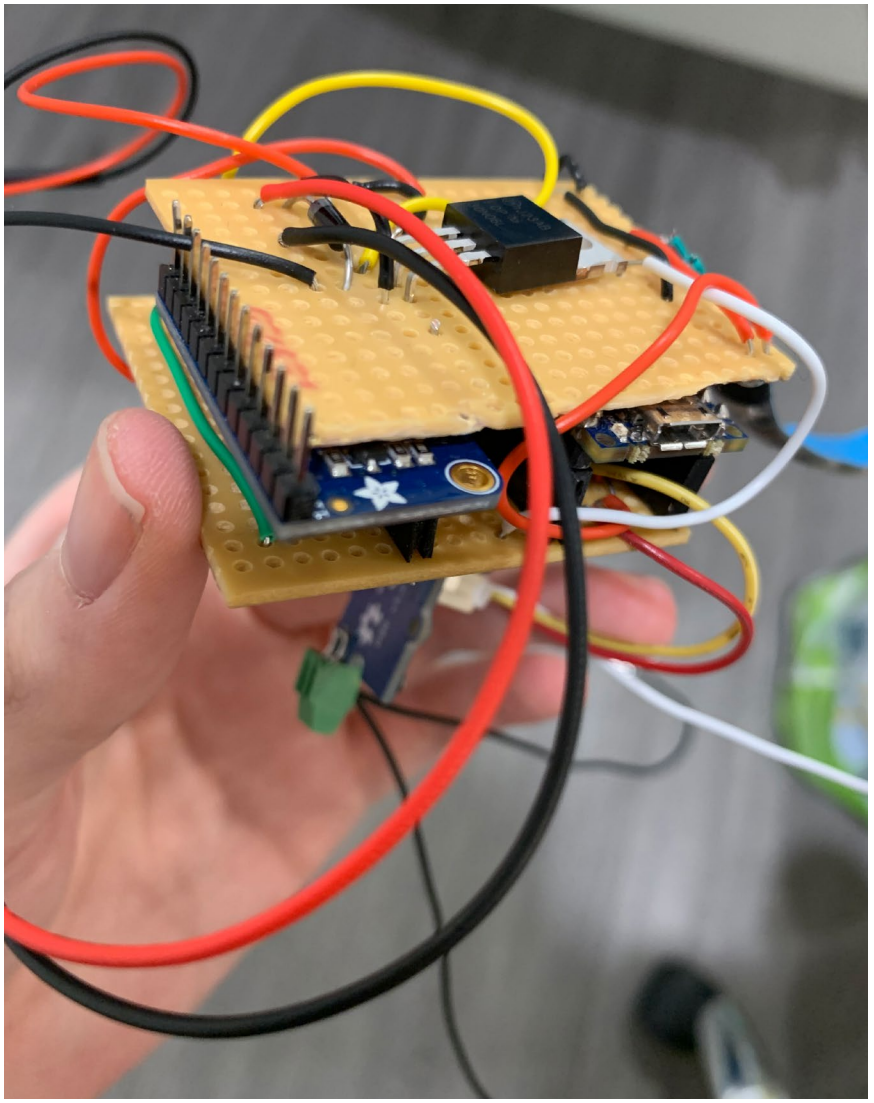
Below are final images of the bracelet on the left, and the final circuit on the right before wrapping it into a bracelet.





GitHub Repository

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