Provocation 03: Calm.io

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Introduction

With greater pressure to perform and the popularity of social media, life has become increasingly stressful. Modern times have seen rampant rises in cases of anxiety and depression. We live our lives constantly inundated by a barrage of notifications, deadlines, and far-reaching expectations. There's no surprise that we're known as the "anxious generation." It seems that many aspects of the new media we interface with in our everyday lives play a role in perpetuating anxiety. As a result, we strived to create an interactive device that instead, helps people cope with anxiety and stress. In response, we created Calm.io.

Calm.io is an interactive bracelet that mediates grounding practices for relaxation and bodily awareness, to ground users during stressful times. Designed to combat panic attacks for people with anxiety, Calm.io provides on-demand and discrete support. When the user feels overwhelmed, they can regain control by simply turning Calm.io's dial. CalmIO breathes with users by discretely expanding and contracting on their wrist, guiding them to practice mindful breathing. In addition, users can also follow CalmIO's interactive light display to reach a state of calmness– inhale slowly as it glows, then exhale as it dims. This breathing pattern can be made faster or slower as needed by simply adjusting the dial. Calm.io's interaction focuses one's attention on their body, calming their mind, all without announcing their current physiological and psychological status to the world.

Motivation

The main goal of our project was to create a device that helps people with chronic stress or anxiety in daily life, or, any users who wanted to find a way to integrate user-controlled relaxation into their own life. We focused specifically on anxiety, the most prevalent mental disorder, with 40 million adults affected in the United States alone. We were surprised to find less than 40% of people with anxiety seek treatment, but realized that the financial and time cost of therapy is often prohibitive. In an age where people are endlessly connected through social media and smart devices, overexposure to criticism, fear of missing out, and social pressures exacerbates anxiety and stress.

We then set out to create a wearable—something that could be cost effective and easily accessible during daily life—that could be used discretely during anxiety or panic attacks.

Research & Observations

Our research began with us trying to fundamentally understand what anxiety and anxiety-related mental disorders are. Anxiety is a normal emotion that we all feel. It is common to get nervous and feel anxiety during important or tense situations, such as giving a speech or taking an exam. The feeling of anxiety becomes an anxiety disorder when constant and overwhelming worry or fear disables someone and interferes with normal life.

Anxiety disorder is an umbrella term for a group of anxiety-related mental disorders. Some of the more commonly reported anxiety disorders are panic disorder, social anxiety disorder, specific phobias, and separation anxiety disorder. These types of anxiety disorders are triggered by different causes, including genetic linkage, environmental stressor, or sudden changes in the brain. Nonetheless, they all share similar symptoms: feeling panic, fear, and uneasiness, inability to stay calm and still, getting cold, sweaty, or numb, shortness of breath, intense heart palpitations, and tense muscles.

People who are diagnosed with anxiety disorders are often advised to take medication such as antidepressants and anticonvulsants or attend psychotherapy to treat their anxiety disorders. In an survey conducted by American Psychological Association, about 40% of the surveyed population reported that they have attempted at least one of the recommended therapies for anxiety disorders but very few (7%) persisted until their anxiety disorders were completely treated. The most reported reason for quitting therapy was cost.

Both medicinal and counseling methods of therapy are costly and often not included in health insurance plans. The cheapest antidepressant, according to a market research done by National Center for Biotechnology Information (NCBI), is $80. Monthly costs for antidepressants can range from $90 to $300. According to a survey released by National Institute of Health, patients that are prescribed with antidepressant take them for six months to a year on average. One standard session (45-55 minutes) of talk therapy generally costs between $80 and $120. These sessions are recommended at least once a month and are more effective with higher frequency. Since most health insurance plans do not provide coverage on prescription drugs that treat anxiety disorders, the average cost that people pay out of pocket to treat their anxiety disorders completely is $6475, according to the NCBI. With these exorbitant costs for those who suffer from anxiety disorders, many people are stuck with no options and trapped in distress and fear.

With our research on anxiety disorders in mind, we set out to further our research with fieldwork and more investigation. We conducted interviews with UC Berkeley students that report to have anxiety-related mental health problems, researched studies that focus on the impact of anxiety and other similar types of mental disorders in the US, and reflected on our personal experiences to help orient ourselves around the problem. Studies showed that email notifications have been found to make people sweat and the incessant cognitive overload caused by technology has contributed to anxiety. Interviewees reported that they often relied on “focusing on their senses,” “relying on breathing,” or “calling a loved one,” as they were experiencing anxiety. We found that using technology to mediate focus and breathing was the most viable design route. Overall, these methods led us to discover a wide variety of coping mechanisms and therapeutic techniques.

The main theme of these techniques revolves around mindfulness and physical awareness of the body to ground oneself. Techniques that were most interesting to us for a wearable device included intentional deep breathing, taking one’s pulse, guided meditation, and doing activities such as yoga and slow jogging that concentrate on physical sensations. Some of the team had previously used mindfulness apps like Headspace. These apps generally provide the user with instructions to focus on their breathing and to direct their focus to specific areas of the body. We were able to attest to the effectiveness of these practices ourselves during periods of high stress or anxiety. These different techniques informed our choice of interaction.

Inspiration

Hug Machine, Temple Grandin

One of our biggest inspirations was Temple Grandin, probably the most famous person with a public autism diagnosis and animal scientists. After finding the effective of physical pressure as a coping mechanism, she invented a hug machine, a device inspired by a cattle squeeze chute. The hug machine allows the user to apply controlled pressure to their sides with a simple rope mechanism. A study by Stephen Edelson, Meredyth Goldberg Edelson, David Kerr, and Grandin herself confirmed its efficacy in children with autism. As the hug machine is not particularly mobile or realistic to use in daily life, we thought of how we could transfer the same effects in a more feasible fashion.

Like-A-Hug Jacket, Melissa Chow

Initially, we wanted to create a jacket that would help mediate anxiety by providing physical pressure on users, using inflation. However, we found that the work already existed in multiple domains. Melissa Kit Jow developed Like-A-Hug Jacket at MIT Media Lab. The jacket translates every Facebook 'like' into the sensation of a hug through inflation. This project was intended to furthering relationships between people despite physical distance. While the work forced us to pivot the form and mechanism of our wearable, it confirmed that this domain – comfort, physical sensation, and emotional mediation – was viable and compelling.

T. Jacket, James Teh

Another "hugging" jacket we found during research, the T. Jacket is specifically designed for children with mental disorders. The jacket has motion sensors in the sleeves that detect when the child is overstimulated. With the accompanying app, guardians can send controlled and adjustable hugs to the wearer to help calm them down. As a device that targets the same demographic, we used this product as more confirmation that using pressure as a coping mechanism would be helpful. We were inspired by the adjustability of the pressure and wanted to make sure whatever form of support our device provided could be tailored to the user's needs. The jacket also has very targeted areas of pressure, which helped us think about where on the body our device should be used.

Process

Brainstorming

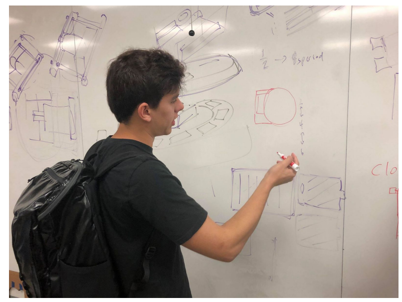
Our brainstorming process started with a design matrix. On the axes, we put types of clothings and input sensors and put together as many different combinations of sensor, wearable, and use cases as we could. We narrowed these selections down to ten ideas, which can be seen in the appendix. After much discussion, we decided to pursue a jacket that could provide pressure to the user.

At this point of our brainstorming phase, we thought there were two interesting use cases for this jacket: giving the wearer hug-like pressure to provide emotional support or using the change in volume as a way to create a thermo-variable jacket for outdoor sports or the homeless. Performing research and competitor analysis helped us make our decision. We were able to find a wide range of temperature changing clothing already on the market and found the emotional support angle more personal and powerful to us.

As we found a variety of hugging jackets as well, we chose to pivot to a more novel idea. As the aforementioned emotion-related wearable devices we saw were generally large, non-portable, or obvious to the outside world. In contrast, we intended our prototype to be reliable, affordable, portable, and discrete.

In addition, we researched the different barriers that keep most users from adopting or retaining use of a wearable. Some of these barriers include: a lack of a persuasive case, style, and lack of discreteness. To address some of these barriers, we set out to find compelling inspiration points and to design the physical form of Calm.io with intentionality.

Concept Development



After we decided to move away from a jacket, we chose to create a watch-like device. This form would allow for discrete and compact packaging, as well as callback to user interviews where we learned about taking heart rate as a coping mechanism with its placement on the wrist. It was extremely important to minimize the footprint of the overall device, to make it as commonplace looking as possible.

We considered different delivery mechanisms to provide physical pressure, such as having the device tap on your arm. Following a class cross critique, we settled on constriction as our mechanism, having the bands of the device move in and out to provide gentle squeezing. Thinking about guided meditation and deep breathing practices, we decided to use our device's constriction to create a calming breathing pattern for users to follow.

Along with the mechanism itself, the trigger for the mechanism was extremely important to consider. We thought of using biosensors, such as a heart rate detector, but were concerned about reliability. Previous work with such sensors yielded inconsistent readings. In addition, we were concerned about cases where the user's natural physical activity would accidentally trigger the device, calibration issues for each individual user, and if the user was having a panic attack without enough of a spike in heart rate. We thus decided it would be best for the user to trigger activation, choosing to use a potentiometer with a deadband to deactivate and activate interactions.

To provide an additional indicator for users to focus on, we chose to add a visual element through the use of LED's. We considered different implementations, such an indicator of how long the user had been using the device for or an actual time telling feature, but ultimately decided on reinforcing the breathing pattern subtly through fluctuating brightness.

We considered incorporating an app interface as well. Our main idea was tracking the usage data for users, similar to a FItBit. As one of our main motivations was combatting the anxiety and stress caused by digital notifications, we decided against implementing this feature as it felt counter to our cause. In addition, while we could imagine the potential benefits of seeing your usage decrease, we were very concerned that seeing spikes in usage could further stress out users.

Initially, we created customizable "watch-faces" that the user could change based on their preferences. However, we realized that this "customization" went against our initial design goals of simplicity and discretion. We did not want our watch to attract the attention of others. The graphic nature of the designs also contrasted too sharply with the minimalist and barely ornamented design of Calm.io. Instead, we hope to emphasize an intentional quietness with a sleek design that speaks for itself.

Modeling

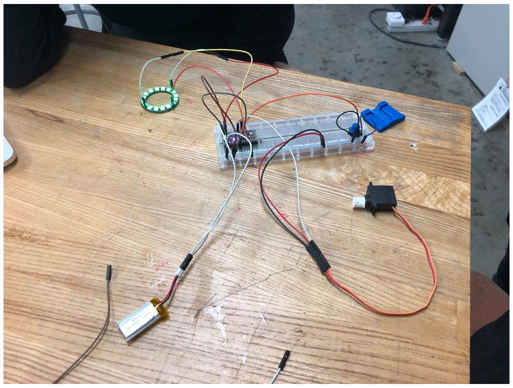
All 3D modeling was done in SolidWorks and Rhino3D.

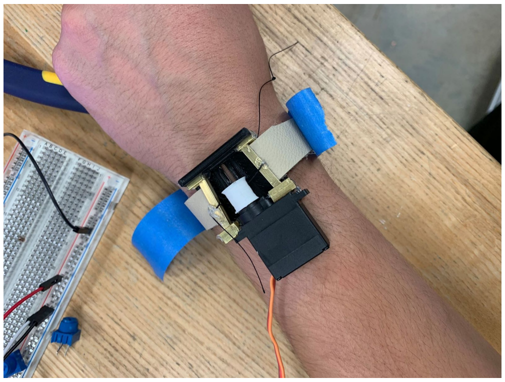
Solidworks was the optimal program to design the moving components in the system as it always generates watertight and fixed geometries. Thus it is easier to more accurately 3D print and fabricate from files made in SolidWorks.

The nonmoving and ergonomic forms were modeled in Rhino3D. The decision to use Rhino was made for two reasons. First, it is the program in which we are most efficient. Secondly, interface of design revolves around using flat planes to create solid geometries. This enabled us to begin by mocking up and wiring our circuit board, and modeling the thinnest possible case around the internal components. So, the case was designed entirely as a thickness-less series of planes, meshed and then thickened to the exact nozzle diameter of the Ultimaker 3 we used. This allowed us to have a wall thickness of only one layer, which sped up the print time and limited the amount of unused space in the case.

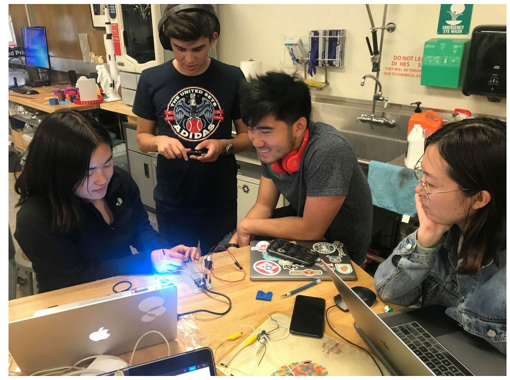
Prototyping

We prototyped the electronics and mechanism independently first. We used a breadboard to try different wirings and configurations of the electronics. We printed two different actuation methods for the mechanism to choose between them, and created a low fidelity mockup to ensure proof of concept. Early prototypes are shown below.





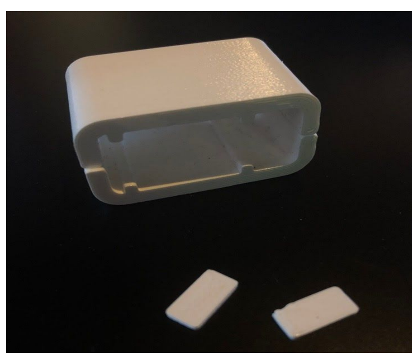
Once the basic electronics were functional, we did a fair amount of tuning in the code to ensure that the rate and extent of motion were both comfortable and actually mimicked the timing of a breathing pattern. In addition, the colors and brightness of the LEDs needed to be tuned. We wanted to ensure the brightness was controlled so it would not strain the user’s eyes with continuous usage. We also chose colors that would be calming to the user, seeking to avoid aggressive saturation with more pastel colors.

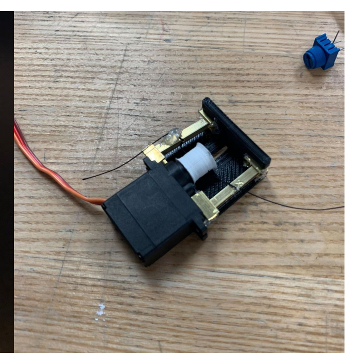


We created many iterations of the device case, seeking to improve the fit and tolerancing of our electronics and continuing to minimize its overall footprint. Thanks to the small size and thinness of the case, it was easy and relatively quick to print, check the fit, redesign, and reprint iterations. The mechanism piece we designed for proof of concept testing was originally separate from the case, and were incorporated directly into the case for the final prototype. Other major iterative changes other than tolerancing included adding registration between the top and bottom and adding a cutout for the lipo to sit in for both registration and to save space.

Design

Mechanism



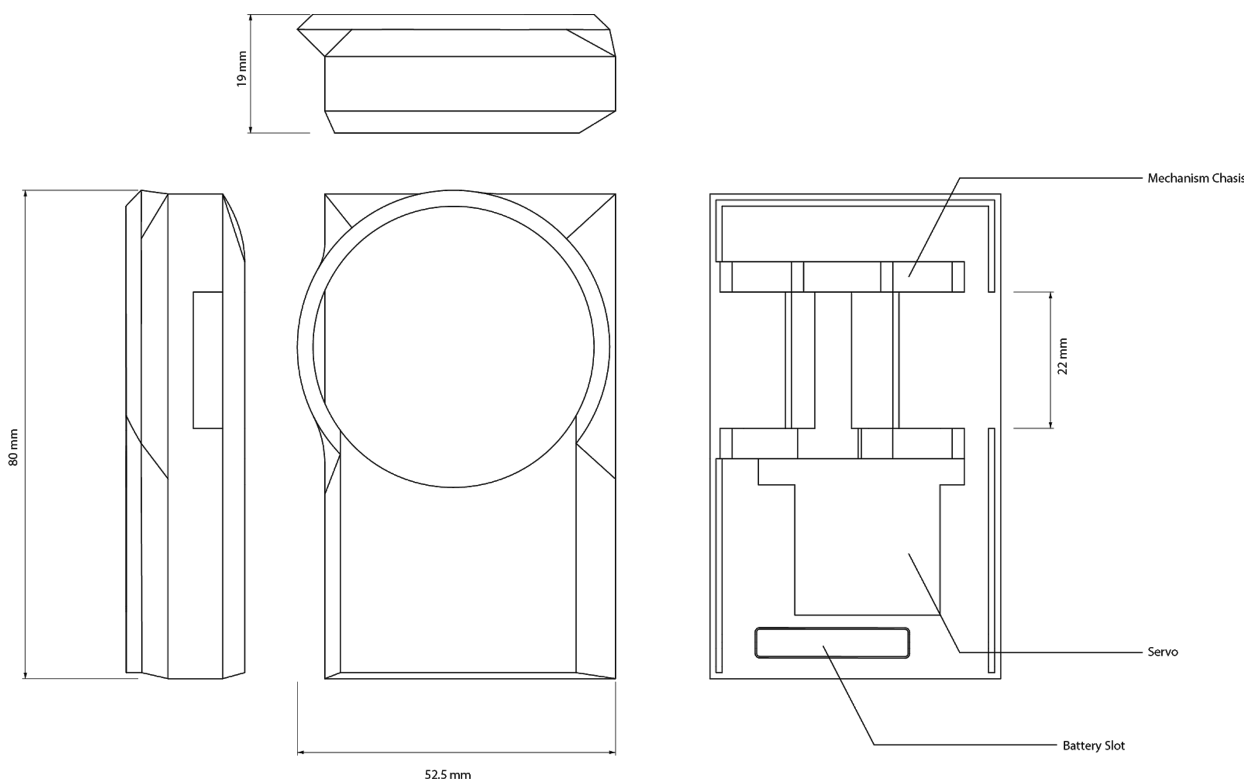


The device uses a small servo and a guitar tuner inspired mechanism to actuate the two watchbands, which sit in guide channels. Initially we prototyped two different mechanisms in parallel, a rack and gear system and the guitar tuner system, which are shown on the right. Due to the small resolution required to 3D print the racks, the 3D printers we had access to were unable to print them.

Because of resolution and compactness, we chose to use the rotating spindle mechanism. In this, a kevlar string winds and unwinds around a 3D printed motor hub (above in white). It then uses the stretching of the silicon bands to propel the unwinding motion. We used a potentiometer to trigger the interactions for both the LED's and the servo.

Industrial Design

The largest stipulation we wanted to emphasize with this project was the compactness our mechanism and case could achieve. We used specific techniques to differentiate between apparent thickness and true thickness, giving the allusion of a slim, highly-engineered device. The sketches below illustrate these strategies and the design of the case.



Here we can see the various components needed to be housed within the case that we designed and 3D-printed. The apparent thickness of the case is around 9mm, while the true thickness is 19. The most difficult piece to fit into the case was the servo motor, so ideally for future iterations, we might seek a smaller servo or motor to replace the current one we used.

Another major design choice we made was to call back to Ridley Scott's "Ripley" SEIKO watch from *Alien*. Almost ironically, Scott, the film's director, aims to "scare the shit out of his audience," while we aim to be a calming force in people's lives with our watch's similar design, yet completely opposite purpose.

However, the design of the watch in the movie perfectly aligned with the aesthetic of an asymmetrical dial to case design. This choice reflects what we see in our user, a dichotomy of emotion. So in order to relinquish a user of imbalanced stress, we need to acknowledge that the imbalance of stress and tranquility exists. Caveat: coincidentally the design was perfect for the off-the-shelf components we had access to.

Gestures & Interaction

To use Calm.io, the user puts it on like a typical watch and fastens the strap tightly. The mechanism requires the band to be taut against the wrist to maximize the sensation. The user turns Calm.io on by turning the dial clockwise until the LED light flashes, indicating the device is on. The interaction is a cycle programmed to lead users to inhale for four seconds and exhale for four seconds. The user initiates the interaction as we wanted to emphasize user control, rather than another electronic device taking over part of your life. Although the device aids with grounding practices for anxiety and stress, the user should always determine what will be the most helpful for them in the moment.

Calm.io provides a breathing exercise through two methods, visual and physical. The visual cue is given by the LED light color and brightness. The LED light gradually increases in brightness and dims to instruct the user to exhale and inhale. The light shifts from green to a light blue as the tempo increases. Physical sensation is given through constriction and release of the watchband. This cycle is also intended to indicate inhalation and exhalation as the watchband constricts and releases. The LED lights and watchband constriction are synchronized to provide one seamless pattern. The cycle lasts four seconds by default and continues until the user turns the device off. By turning the dial, the pace increases, quickening the timing of pulses. The cycle stops when user turns the dial counterclockwise to the end the range of motion.

Instructable Guide

Materials Used

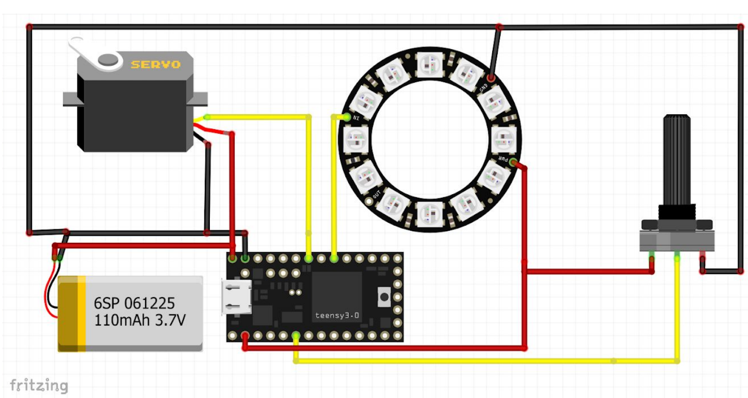
- Electronics
  - Adafruit ItsyBitsy M0 Express
  - NeoPixel Ring
  - Servo
  - Potentiometer
  - 3.7V Lipo Battery
  - Button
  - Jumper wires
  - Prototyping board
- Housing
  - 22 mm watch band
  - String
  - Acrylic
  - Magnets
- Assembly tools
  - 3D Printer
  - Laser cutter
  - Hot glue
  - Soldering iron

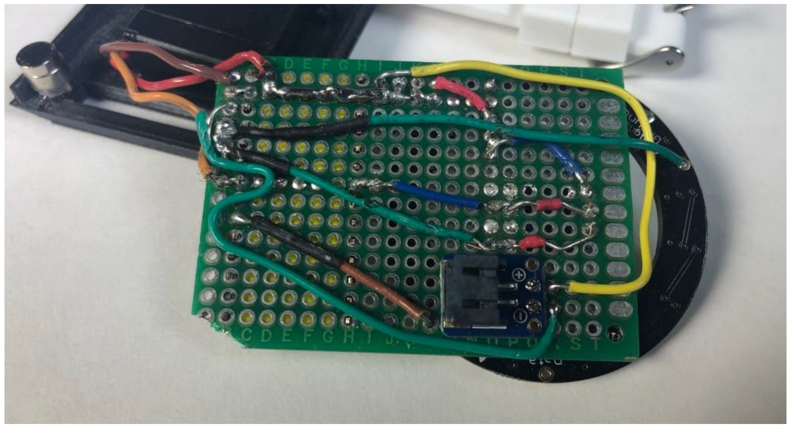
Case

1. Download the following files:
   a. Case top
   b. Case bottom
   c. Dial
   d. Servo Spindle Hub
   e. Cut file
2. 3D print the case top, bottom, servo hub and the dial.
3. Lasercut the device face from acrylic using the cut file provided.

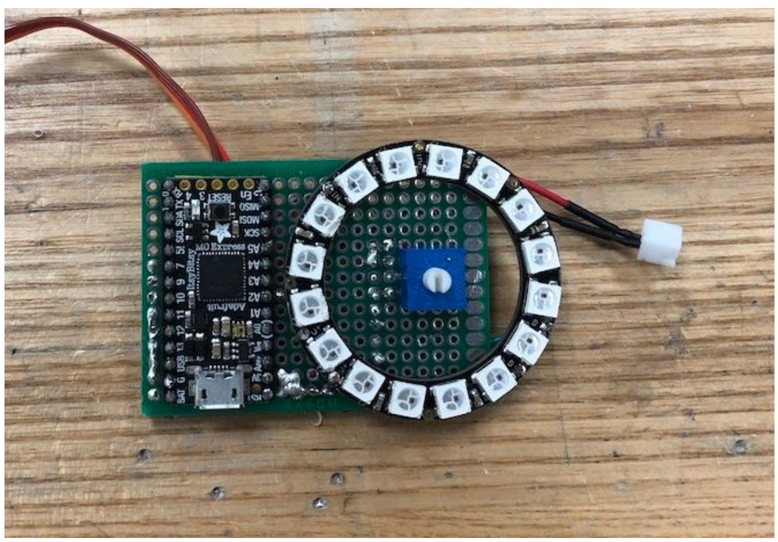
Electronics and Software

1. Download the Calm.io code and upload it to the ItsyBitsy.
2. Connections are routed on the bottom of the board, according to the following wiring diagram. Wires cannot overlap to fit into the case.





3. Ensure the ItsyBitsy is not powered. Place the board on one side of the prototyping board and solder it in place.
4. Secure the Neopixel ring and potentiometer on the other side of the board. The potentiometer should be centered in the ring.



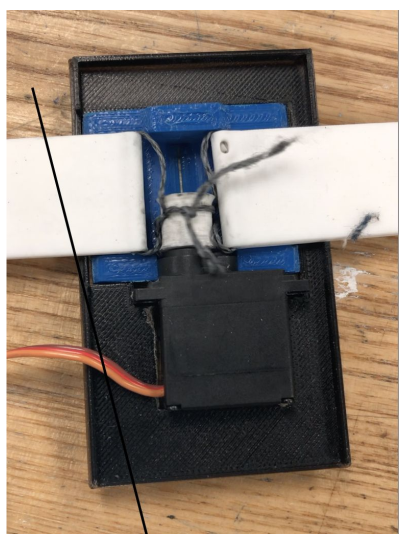
5. Connect the outputs of the devices to the ItsyBitsy.
    a. Potentiometer to pin 2.
    b. NeoPixel ring to pin 7.
    c. Servo to pin 10.
6. Ground all the devices to the ground pin (G) of the ItsyBitsy.
7. Connect the power lines of the devices to the 3V pin on the ItsyBitsy.
8. Lastly, wire in the lipo. Solder the ground line to the ItsyBitsy's ground pin and the power line to the BAT pin on the ItsyBitsy. Calm.io should now be functional.

Mechanism

1. Connect the servo hub to the servo.
2. Thread the string for the mechanism. When finished, the string should form a pair of triangles. Use the following order:
    a. Through one watch band
    b. Through the hole in the servo hub
    c. Through the other watch band
    d. Back through the servo hub
3. Tie the ends together around the servo hub with as little slack as possible.
4. Trim the ends of the string to minimize excess.

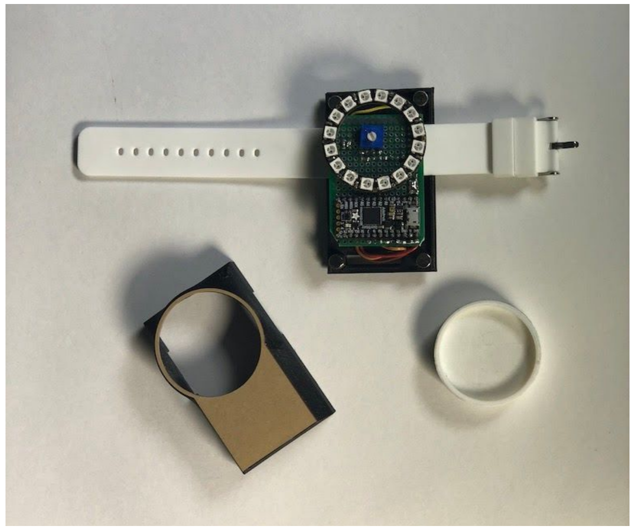
Assembly

1. Place the servo into the designed cavity in the bottom of the case. Make sure the watch bands are within their respective guides.

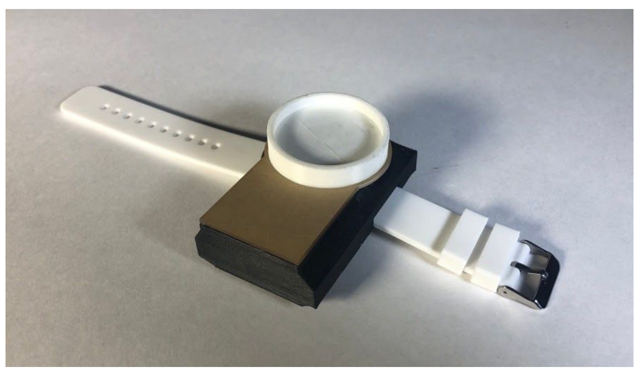


2. Glue magnets to the four corners of the top and bottom sections of the case. These will secure the case together during use.
3. Glue the acrylic piece to the top of the case.

4. Place the board on top of the servo.



5. Secure the case lid onto the bottom. Place the dial onto the potentiometer. Your Calm.io is now complete!



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Appendix

Initial Brainstorming Table

Type of Wearable	Temperature	Heart rate	Proximity	Bluetooth	Orientation	Pressure	Sound
Shirt	Clothes that get warmer/ vibrate based on a partner person's body temperature (wearing the same shirt) – simulates body heat	T-shirt that changes color based on the person's mood				A shirt that people can draw on based on touch (from other people); A shirt that triggers an alarm when touched in certain more private area	
Jacket	Jacket that puffs up/gets thicker/thinner based on the temperature outside	Jacket that provide pressure to hold the user, like a hug, to calm down the user when sensing a stressed mood	Puffs up when people get too close			Puffs up when touched in certain area on a body	
Pants					++Pants that know when you've been sitting down for too long	Tightens or hardens when touched in private area	

					encourages physical activity		
Skirt	Space heater like skirt so you can still wear in cold weather			Floats in a dancing fashion and lights up when triggered in an app			
Socks	Temperature controlled socks						
Shoes		+Change color with heart rate to show how intense your workout is					
Earrings		Earrings that change color based on one's mood (biosensing)					+Spying Earrings as a gift – actually has a camera and records the conversations of your "loved ones" Turn into an alarm and beep loudly when taken off forcefully
Hat			Contains a signal blocker that blocks a certain proximity's connection to encourage in-person connecti				

			on				
Tattoo				Customizable tattoos that light up/having color-changing ink A skin-like patch display that can receive designs electronically and display them			
Textile Displays				Scarf that can style itself based on weather updates, fashion trends, and can change colors			
Watch	That tells the time						
Bracelet				Biosensing bracelet for women's sexual health – for instance, syncing to period apps, logging for hormones/diaries (persona			

				l health data)			
Necklace				Necklace that vibrates if you have a message or notification from someone important (sync with phone)			

10 Ideas Slide-Deck

Final Presentation