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When everybody is watching

Tangible media - CART 360
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Abstract

When everybody is watching is a headpiece that visually represents biodata of the wearer as a physical movement. Refer to the main website to access the complete documentation[1].

Design Narrative

The project revolves around playing with the fact that people will often display different mannerisms, habits and pieces of clothing to blend in or stand out in different social contexts, constructing different performed identities that shift quickly. Inspired by Judith Butler's theory of a preformed identity, we wanted to explore how adornment, in this case a headpiece, could perhaps enhance and shift a social experience. With the help of various biosensors, we worked on displaying internal feelings and emotions with a physical movement of the adornment. The movement itself is bio-mimicking how certain animals would use ears, tails or feathers to communicate emotions.

The project is inspired by Aposema, a master's thesis project from Interactive Architecture Lab. Using muscle sensors and an inflatable system, they created a silicone mask that reacts to the wearer's facial expressions. Another main inspiration is the work of Jose Chavarría from the Copenhagen Institute of Interaction Design. She designed mask iterations exploring how to enhance human consciousness defined by the neuroscientist Böjrn Merker.

By displaying elements that are either invisible or ambiguous to the human eye, we intend to shift the attention of the wearer and the viewer towards internalised feelings. Human-centered design requires a lot of iterations, and is particularly reliable on user's feedback. At this stage of the design, further exploration and experimentation will continue to refine the intended experience further. As of now, the wearer is invited to wear the piece in different social settings and to study the effects on their interactions with others. How are they perceived by others and what does the headpiece communicate?

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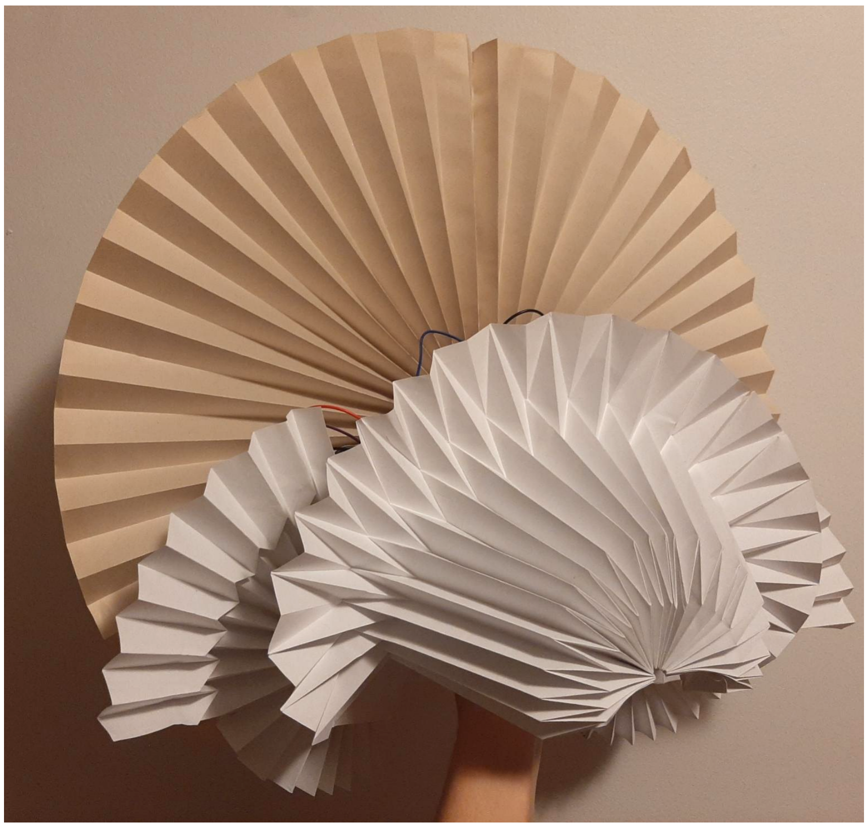
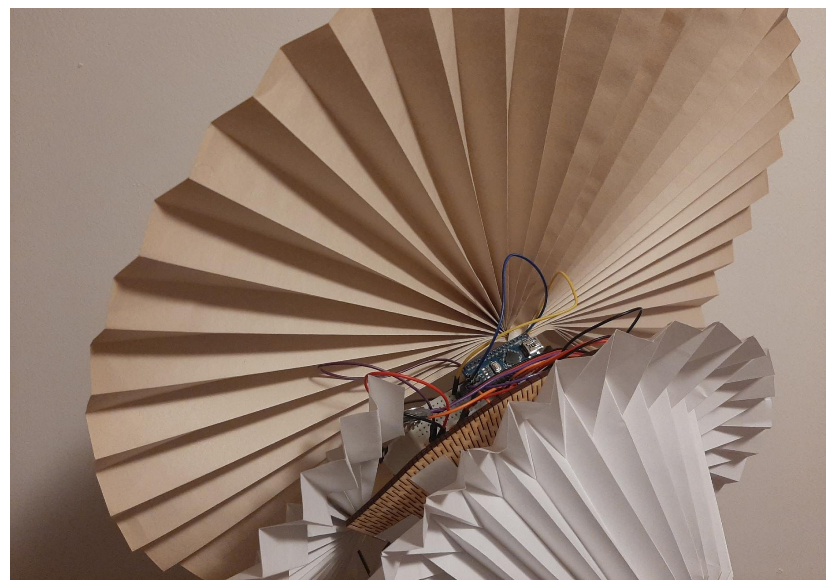
[1]https://github.com/TheWizDotBiz/CART360-ThomasNoemie.git

Prototype Process

This semester-long process was full of challenges. Even if the said design is a clear improvement from the prototype stage of the project, it would still require a lot more work to be considered a finished piece. Putting everything together revealed a lot of possibilities for improvement. We designed by iteration, refining the meaning and the experience depending on the results of our tests.



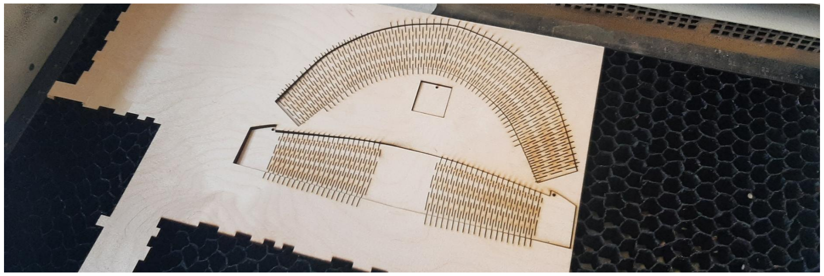


Final Artefact

The final piece is a lightweight structure built to catch the attention in a room. It communicates visually the data from two biosensors, a pulse sensor, picking up heartbeat, and a muscle sensor, picking up movement of the eyebrow. The electronic components are mostly hidden behind the paper pieces, but remain accessible for repairability.

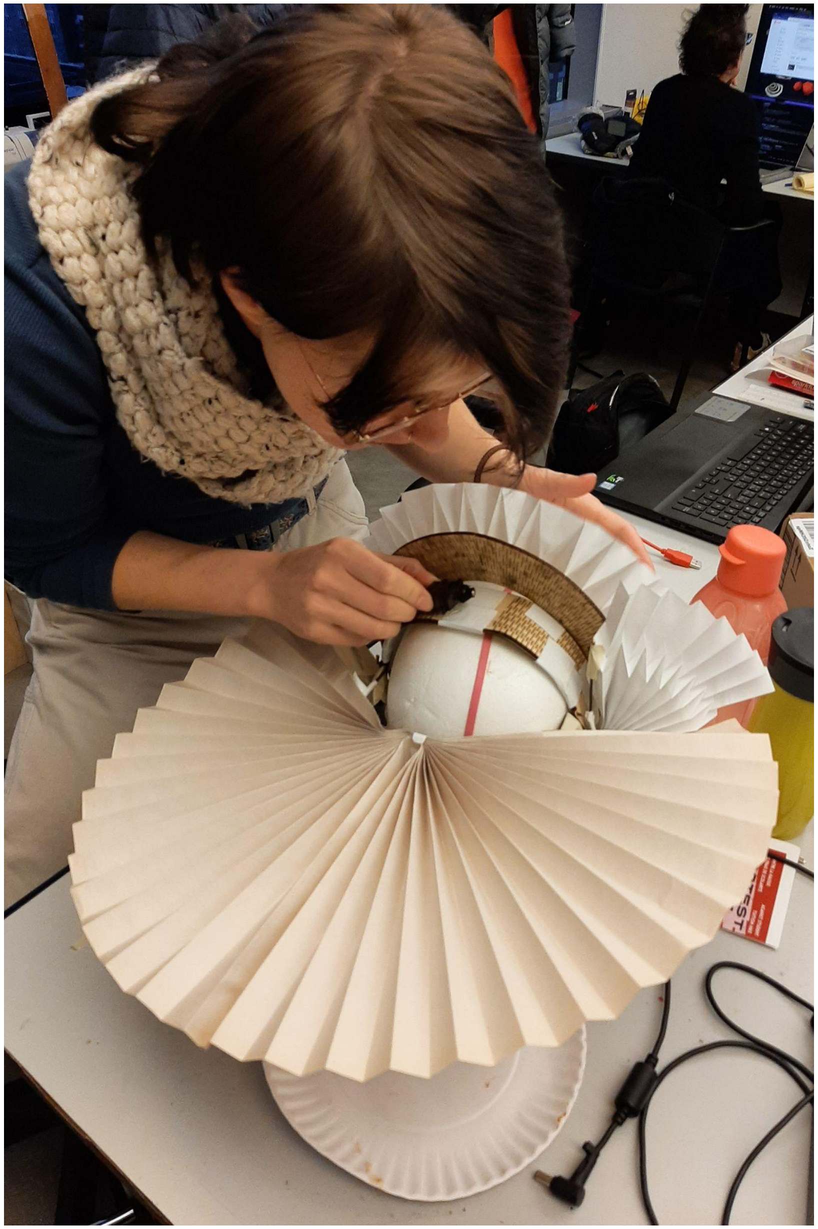
The choice of origami allowed us to explore moving designs with lightweight materials. They were inspired by the series of books on origami by Paul Jackson[2]. The design resembles folding fans, for their simple eye-catchy movement. Each of the pieces are intentionally designed to redirect the regard of the viewer following the folds to the center of the face. Certain parts can be folded or rotated like a peacock or cat's ears. The intended material is textile instead of paper, to bring a visual and tactile richness to the piece. Some material samples were made to explore the liability of that option. By adding corn starch based stiffener to a cotton canvas, we made paper-like textile. To fold them, we pressed the canvas in between two identical paper designs.The textile origami structures would behave almost identically as paper, but had a bit more bounciness. The present design is made of paper simply because paper allows for quick iterations.

The structure is made of upcycled metal wires for solidity as well as malleability. It supports the middle paper structure and guides the movement, but still requires a solid component to hold the motors. A headband shaped piece was added, made of laser cut bent wood. Incisions along the design allowed the wood to bend. We soaked it in warm water and let it dry overnight wrapped around a round object to ensure it would stay in the desired shape. In future iterations, It would be possible to better integrate the electronic structure within the wooden headband, but for now, it holds mostly with the help of tape.

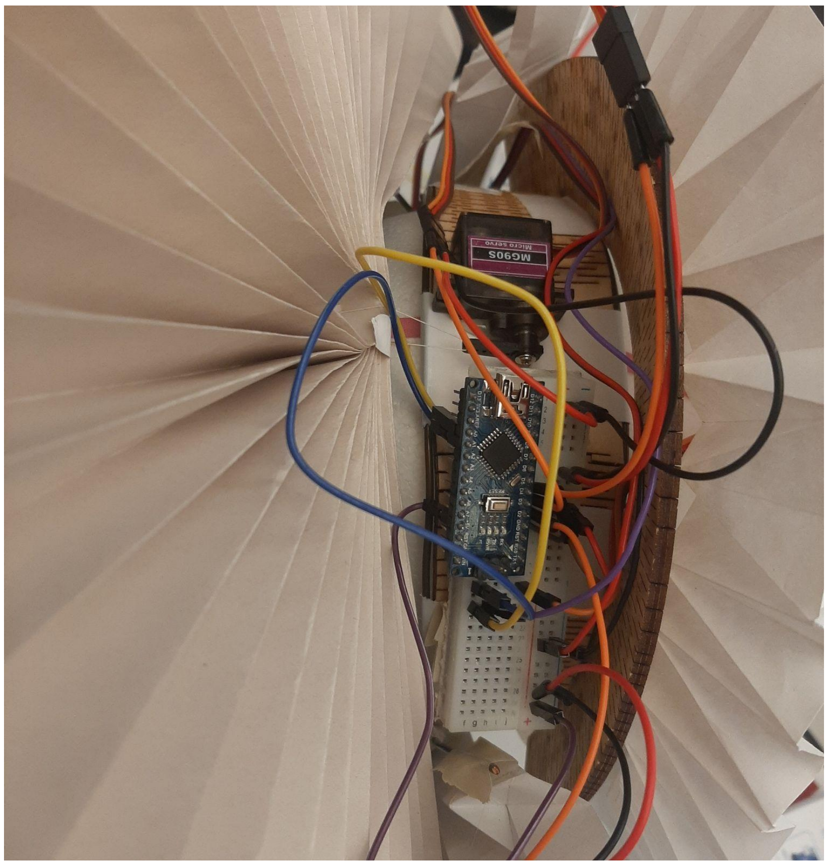


[2] Jackson, Paul. 2011. *Folding Techniques for Designers : From Sheet to Form*. London: Laurence King Pub.

The last minute change of motor models required us to make quick modifications. We started with small, silent and continuous rotary motors (N20 DC), but ran into some challenges. Originally, every component was to move supported by pulley systems: a thread would pull on the structure to make it move. Unfortunately, once the thread is mounted, the only limitations are the code, so it requires the code to be perfect. After we had trouble controlling the motor reliably, we opted for motors that were physically restricted to 180 degrees. Servo motors are used for all three moving parts: Left and right servos are simply elongated with a metal wire and use the movement of the motor as is, and the center servo is attached with wire, limiting it to only a fraction of its possible movement. The front of the design is purely decorative, hiding the electronics components. The structure is relatively comfortable to wear and light, thanks to the small components.



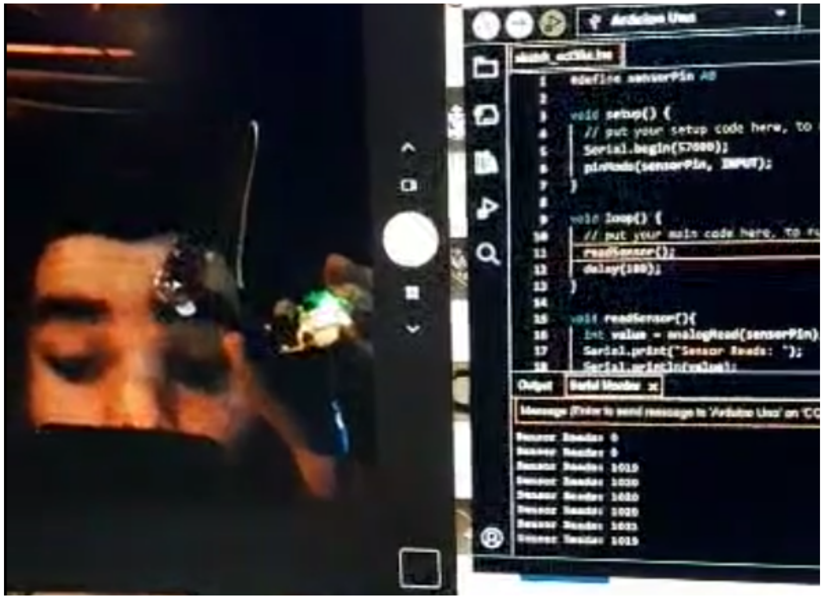
Our choice of biosensors was influenced by reliability and price. Following our experiments at the prototype stage, We opted for the pulse sensor and the muscle sensor. The sides of the headpiece rise and lower at the rhythm of the heartbeat. We went with a big, rapid movement to create an amplified visual reaction to pull the attention of the viewer to internal phenomena. The middle part starting position is up, and lowers towards the back of the head when the wearer raises an eyebrow, to imitate how a cat would lower its ears when sensing danger.



Code explanation

While the code went through several iterations and variations through the development of the artefact, the final code is actually very simple. This mainly due to the last-minute decision to switch from rotary motors to servo motors.
The N20 motors required one or more libraries to properly operate, specifically [L293]() and [RotaryEncoder](). Not only is the documentation mediocre but the callbacks tend to not be intuitive and some of the setup doesn't add up with how some of the physical components operate. These motors also require multiple voltage sources as well as a much more complicated circuit to operate, jumping between two digital pins, to a motor driver, to a motor encoder that needs to feed back into the arduino, the sheer number of pins required to operate the motors worried us about the artefact's stability and weight. On the other hand, [Servo]() is wildly simple and accurate to use: just specify an angle and the servo will rotate to it automatically, and the motor requires only a single digital pin to send a signal and can function on relatively low voltage shared by the arduino.

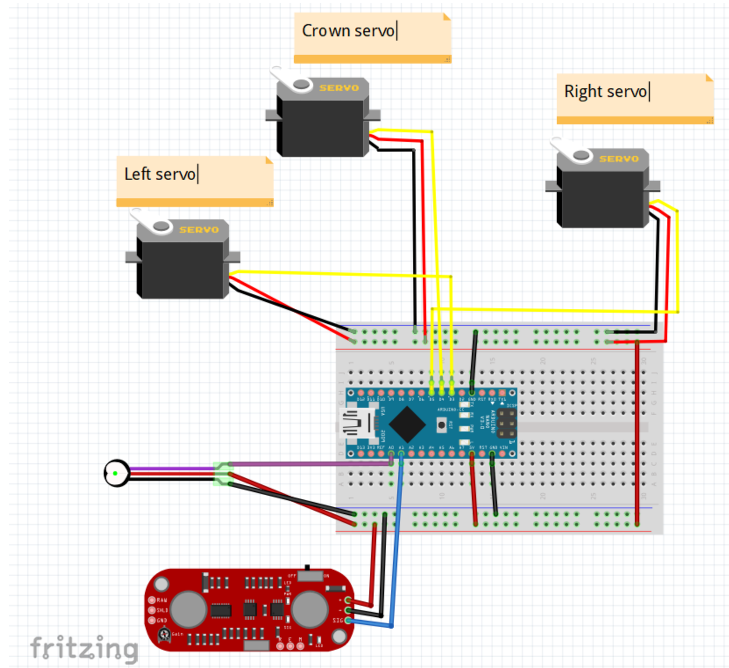
The code simply manages two sets of servo motors using this library: one of the side fans and one for the back crown. When the [PulseSensorPlayground]() attached to the heart pulse sensor reads a new heart beat (using sawStartOfBeat()) it runs a function that changes the angle value of the side servos and clamps it to fit between 0 to 90 degrees. This is so it could support varying incrementation speeds but we finally opted to jump between 0 to 90 between beats as it demonstrates the feedback much better.



The crown motors function slightly similarly, it clamps and changes the values like the side servos. However, instead of only moving when a sensor reads a value, it perpetually tries to move upright 90 degrees unless the muscle sensor reads HIGH, in which case it will attempt to rotate back to 0 degrees. This function runs every cycle to detect any change in the signal and behave appropriately.

This culminated in a very simple circuit. Every element has a relatively low voltage intake and only requires one pin from the arduino to function, and is connected to the arduino's 5V outtake and to its ground. Making it easy to set up and place within the artefact as well as coding the functionality.It's worth mentioning that some basic arithmetics are done for the servo's angle calculations. Simply put, two facing servos must have the “opposite” angle in order to “point” in the same direction (which we acquire by subtracting the angle value from 180, the maximum possible value on these servo-motors).

It's also worth noting that the fritzing and the final artefact work on 3 servos, while the code runs for four servos. This required virtually no changes code-wise to replace the crown's movement to two servos holding the side of its metallic base in place to a single servo pulling the middle of the metallic base using a piece of string. This resulted in a slightly more discrete movement of the crown. Where it used to go from 90 to 0, laying flat and horizontal, it now inches slightly from its 90 degree straight up position to a very small tilt of 85 to 70.



Observations

The headpiece was presented to classmates from the tangible media class at concordia. The physical design, even if the big structure was a risk for big movements and wind, It successfully drew the attention of many. The headpiece did not evoke a peacock to the viewers, instead the feedback shared that it looked like an aura, borrowing from religious symbolic charge. Even if the structure was light and comfortable, the weight was slightly unbalanced, which made the long term wearing uncomfortable.

We intended to bring biodata to the foreground of social interactions, but not obstruct the said interactions. Unfortunately, the sound of the motors made exchanges difficult. Since it is the most important element of the intended experience, further exploration in that sense will be required. Exploring different motors, but also different movements could help. The rhythm of the heartbeat was so uniform that people did not instantly realise that it was the actual heartbeat of the wearer.

The muscle sensors were unfortunately not working for the demonstration, but we discovered that the structure of the piece was in part supported by the forehead, which made eyebrow movement uncomfortable. Even if it makes the installation of the piece a tedious task, we believe that more reliable sensors would be interesting to use as input to accentuate emotions. Muscles around the face are the most used way to express feelings in a social context, we intend to further develop around that.

Future Directions

The n20 motors are the first thing we intend to successfully integrate, since they allow for more possibilities of movement. The sound is also a sensory element we will explore further to use at our advantage. Not only the motors are more silent, but the control of the speed would allow for various vibration frequencies, allowing to create different pitch perceivable by the wearer and the people close to them.

Origami allowed us to discover potential for various movements, more subtle but also drastic, that we could harness by creating more iterations. The use of textile instead of paper would also allow for hand sewing to the structure instead of taping it. We intend to integrate it to future iterations to enhance the tactile and visual experience. Multiple, more reliable biosensors would also allow for a more rich representation of emotions. Considering we are working with humans as inputs, the experience will be further defined with the help of multiple feedback from the users, and different iterations.

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