Being-With

Prototype Progress Report — by Maxime Gordon & Sarah Al Mamoun

Related links

Project Proposal

Table of Contents

Introduction

Being-With is an embodied interactive sound system and augmented performance that utilizes data from our bodies and movements to create a dynamic soundscape. We are primarily concerned with notions of trust, collaboration, and the often hidden effort it takes in maintaining equilibrium in relationships. We aim to expose the inner and underlying effort it takes to reach this equilibrium and convert the tension between us to give sound to the void. We want the audience to perceive the performance as an extension to ourselves and our sense of being through sound and movement.

The artifact provides the opportunity to address performative interactions that include bodily movements. We explored different interaction design strategies that include Human-Centered Computing, Data Sonification and Sound Computing. Design interaction in our performance will be kinaesthetic-centered through measuring tension and movement.

We also are interested in the effects of the performance/sounds/movement on our body. As we move around and enter different states of tension and rest our heart rate will fluctuate - beating faster or slower depending on physical movement as well as our own personal emotional states.

More active bodily movement will create more active sensor readings. We want an honest reading and for the soundscape generated to reflect that. The resulting sound will rely on us tuning the incoming data and giving space/meaning to a variety of results.

Written Response

The initial concept of the live *Being-With, Seeing-With, Hearing-with* performance was meant to focus on the notions of trust, collaboration, equilibrium, and connectedness between two people by translating the performers' pulse and muscle data while pulling on a rope to form a sound/light-scape. During the development of this project, we were able to identify elements that are best abandoned and not included in our final performance. Prototyping helped us test and streamline this process.

We then wanted to think of alternate ways of giving meaning to the role of the rope that connected us to each other. Upon researching different methods of implementing this, we thought of attaching the LED strip onto our rope, but after unpacking this idea it came with a whole lot of problems. We thought that as we will pull on the rope until it's taut, we would also be applying tension to both ends of the LED strip and basically destroying it. We thought of attaching the LED strip on arms, but that wouldn't translate correctly with the meaning behind our performance. After reflecting on the performance part of this project, we questioned whether the audience members would be able to focus on all the aspects of this performance or if they would be overwhelmed with both the light and sound. We decided to omit the light-scape entirely and only translate the pulse and muscle data into sound. The title of the piece changed to *Being-With.*

The role of the rope was still vague at this point. Our muscle data when the rope is stretched or resting would have created the soundscape but the role would essentially be a tool that allows our muscle data to be sonified. We knew we had to brainstorm and rethink the way our artifact is built. We then got the idea to measure the changes in tension directly from the rope and had to change the programming in our project and the way our artifact produces sound. We integrated pulse and omitted muscle data.

During testing and protoyping, we were focusing on the design process and the concept of the performance. We aim to make all the components of our project presentable by hiding the lace and wiring from the audience member by attaching another layer of fabric on the side of the fabric.

An updated description of the bare-bones of the performance is as follows: The performers are attached to each other by a stretch and motion sensing rope and each wear a pulse sensor on their index finger. The pulse sensors attached to each performer's finger measures the performer's bodily reaction to their movement as well as the movement of the performer opposite them. As the performers move and walk in different directions and move away and come closer to one another, it measures the tension and motion between the performers. Motion, stretch (tension/release), and pulse gets translated into a real-time dynamic soundscape that aims to show equilibrium, and hidden and not so hidden work it takes to maintain a relationship with another person.

Technical Evaluation of Sensors

Here is a list of the sensors and microcontroller we used and their functionality:

Arduino Uno microcontroller (x1)

- Conductive Yarn, Pulse Sensors are currently connected to an Arduino Uno supplying power at 5 volts.
- Data from the sensors and Arduino is sent via serial connection to Max/Msp. All data smoothing, timing and counting is done within Max as well as all sound processing.

Conductive Yarn (crocheted into lace) (x1)

- https://www.adafruit.com/product/603
- The conductive yarn gives us information about the movement of the performers by measuring the stretch of the rope between the performers
- as the rope is stretched the resistance decreases and voltage increases
- read on pin A0 of arduino

Pulse sensors (x2)

- https://pulsesensor.com/
- The pulse sensors give us information on the emotional state of each performer as well as their movement (more vigorous movement more elevated heartrate)
- each performer's pulse is read as an analog signal
- In max bpm is calculated using the sync~ object
- read on pin A1 of Arduino

Prototyping process

The first step of this process was to look at a way of measuring the stretch of the rope between the two performers. We looked online at some examples of wearable and soft body sensors and found that conductive yarn could work well for this purpose. We first tried connecting both ends of a strip of conductive yarn, but it wasn't really contracting and stretching the way we wanted it to reflect through the values. We decided to make a crocheted lace to allow for the stretchable aspect and it gave us nice values, We even made two rows of crocheted yarn to make it thicker. It gave us a nice range of values to work with.

Stainless thin conductive yarn

Conductive lace

Next, we tested out attaching the lace in different ways and places on our non-conductive, stretchable rope. The difficulty we faced here was trying to find the right spot to attach it. After a couple of tests, we found that by stretching the rope then attaching the lace while taut was the appropriate way of doing this. This was important because attaching the if attached in the wrong way, we would damage the lace upon stretching. It would not give us good values to work with.

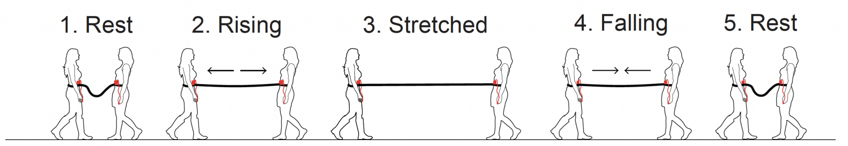
We secured the lace on the base using two needles on each end, and made sure that it won't easily come off.

Demonstrating stretchability

Connected to power

Thinking About Performance

While we have yet to fully determine the choreography of the performance we have identified importance motions that will occur in the piece - importantly we developed a lot of logic for our code from what we call 'a stretch cycle'.



A typical complete stretch cycle.

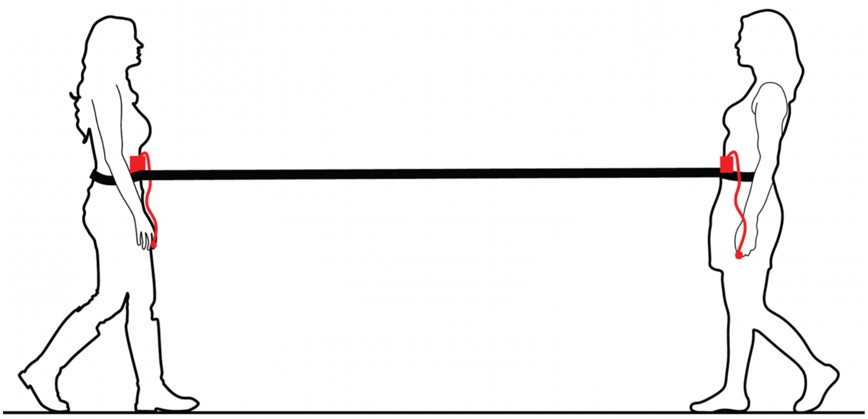


Diagram of the performance. The stretch and motion sensing rope is rendered in black and the pulse sensors are rendered in red.

Rope Stretch States + Cycle

1 - Rest

- Resistance in ohms measured over conductive lace at highest value
- As resistance increase across the lace the voltage decreases, therefore in this state the analog value read by the Arduino is at its **max low**

2 – Rising

- Resistance in ohms of the lace decreases
- Analog value read by Arduino increasing

3 – Stretched

- Middle point of the stretching cycle
- Resistance in ohms of the lace at lowest value
- Analog value read by Arduino at **peak (or max high)**
- Stretched state is not always reached – it only occurs if the performances keep a prolonged steady maximum stretching of the lace.

4 – Falling

- Resistance in ohms of the lace starts to increase
- Analog value read by Arduino decreasing

5 – Rest

- Once again at the beginning of the stretching cycle (the cycle loops through steps 1-4)

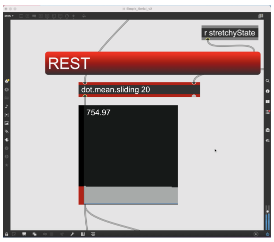
Note: There are other combinations of states that can and do occur. For example:

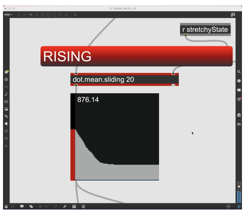
Rest ->Rising-> Falling -> Rest (Stretched not achieved)

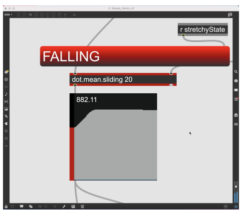
Max/Msp + Sound

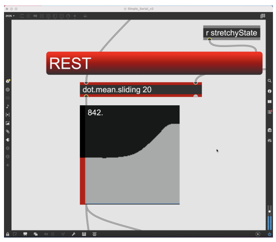
Data filtering and smoothing is done using the 'Digital Orchestra Toolbox' Max Objects. Minimal Arduino code has been used but in our next phase of development we plan to offload much of the data filtering to the Argon board.

All sound is also generated in Max. If/else statements and counters determine when certain sounds are played as well as what effects are applied to the sounds.









Stretch → Sound Mapping

Click Synth (heard in all 4 stretching states)

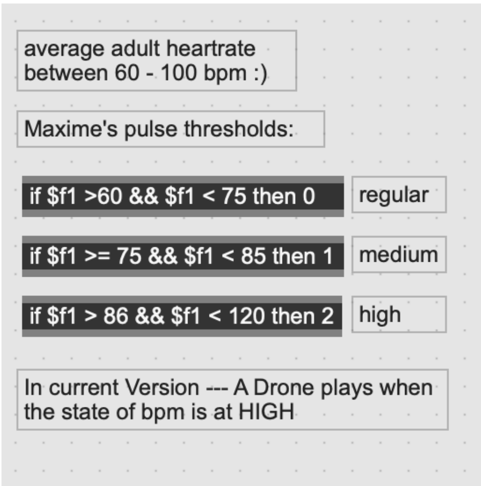
- simple clicking synth sound is heard throughout duration of performance
- as the rope is stretched the rate at which the clicking sound is played back increases as well as the pitch of the sound increases - this is directly mapped (and scaled) using the analog pin value

Crackle Granular Synth (heard only in stretched state)

- Once the rope is fully stretched and maintains an equilibrium a new sound comes in which sounds like crackling static - this sound is overlayed over the click synth
- As soon as the stretch state ends this sound is abruptly cut off

Pulse States

In Max we have programmed thresholds for Maxime's bpm giving us 3 states to work with: 'regular', 'medium', 'high'. In the current prototype we only activate sound when the pulse state is 'high'.



Screenshot of max/msp showing logic for bpm and pulse states

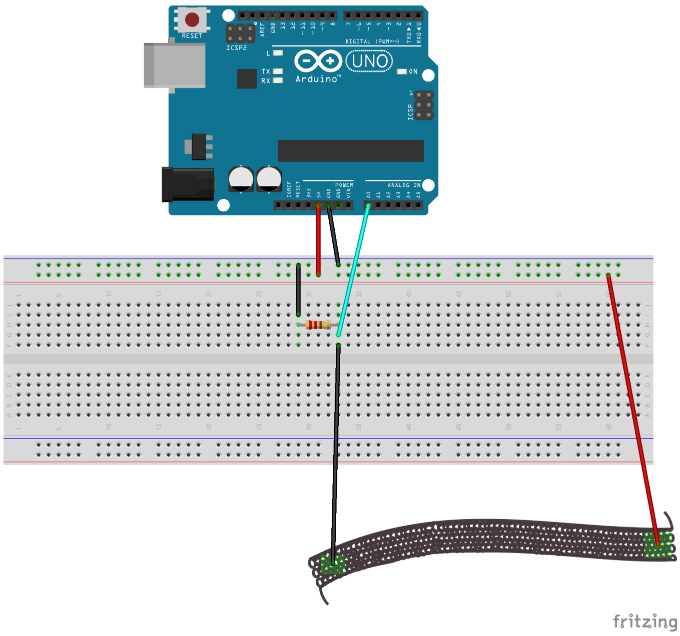
Pulse → Sound Mapping

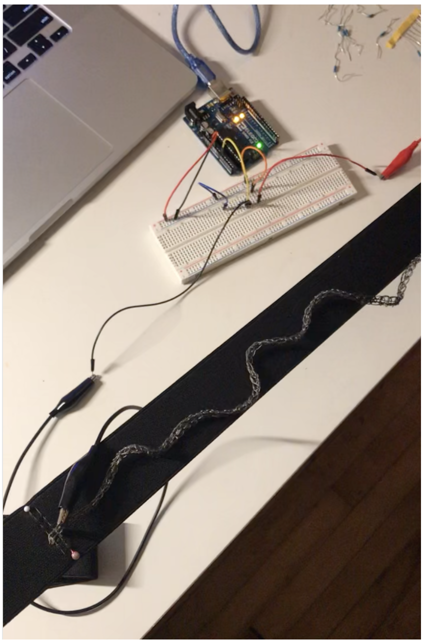
Drone Synth (heard when pulse state is 'high')

- When Maxime's pulse rate is 'high' a low drone sound comes in and is overlayed over the soundscape
- We aim to implement more use of these states as well as add a second pulse sensor for Sarah

Circuit

Fritzing diagram and the actual wiring





Arduino Code

```
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int heartValue = analogRead(A1);
  int stretchValue = analogRead(A0);

  //Serial values get sent to Max/Msp over usb connection
  Serial.print(heartValue);
  Serial.print(" ");
  Serial.println(stretchValue);
  delay(1);        // delay in between reads for stability
}
```

Next Steps + Reflection

While we are happy with the current state of the prototype we still have a lot of work to do to make the rope and electronics into a performance ready tool.

Microcontroller

For our prototype we decided to create our circuits and communication code using Arduino as it was the board we are most familiar with - but this is not ideal for our final project as we need as much mobility as possible without wires getting in the way. So, we will use 2 Particle Argon boards to make sending our data to Max/Msp wireless (over wifi) instead of hardwiring our connections with an Arduino.

Rope + Wearable harness

The rope in our current prototype is very low fidelity - the wiring is quite cumbersome and the way we fasten the rope to our bodies is not in line with our aesthetic vision for the project. To address these issues we will develop the rope to be more of a wearable object that can be easily attached/detached from our bodies using fastening clips. Built in to each wearable harness will be the argon board - the central node that all our sensors will be attached to.

The conductive lace and all the wiring is currently exposed and visible which creates too much busy-ness and draws the audience eye away from the actual performers. In our final we will make sure that the lace and wiring are hidden to the audience members by attaching another layer of fabric on the side of the lace.

Sensors

Acceleration + Gyroscope

While there is a one-dimensional data of stretching gained from the conductive lace there is a lack of information for how each performer is actually moving. To address this we will implement an accelerometers/gyroscope on each performer to gain important movement data of the performers. This

- https://www.amazon.com/gp/product/B00KKR9ORI?psc=1&redirect=true&ref_=od_aui_detailpages00
- one will be attached to each performer via a wearable harness
- we will map motion features of each performer ie. moving slow, moving fast, at rest, to various sound parameters

Pulse

After evaluating how the pulse sensor worked in some tests we determined that it is quite unreliable for getting meaningful results in a performance setting. If the performer is nervous their bpm might be exaggerated and high which could affect the performance negatively. We will continue testing these sensors and decide if they will be used in the final. We still want some way of measuring from the body directly - but having acceleration/gyro data might be sufficient in this case.

Performance

We have created the foundation of the logic/code and sound for our project but this code/sound only addresses simple movements of stretching. In our final we imagine a 5 minute performance with a clear beginning, middle and end that incorporates a lot more movement than a simple one dimensional walking back and forth. As we develop our choreography the code and sound will change to reflect our movements. We will code in a way that creates a clear narrative of sound and movement events.

References

- https://www.arduino.cc/en/Tutorial/BuiltInExamples/AnalogReadSerial
- https://github.com/malloch/digital-orchestra-toolbox
- https://www.adafruit.com/product/603
- https://pulsesensor.com/
- https://www.kobakant.at/DIY/?p=3536