THIS = THEN = THAT
Prototype report

CART 360 – Physical Computing and Tangible Media
Concordia University

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Github repository:
https://github.com/adelebedard/cart360

➔ **A Non-Technical Written Response which addresses and relates the implicit concerns of *Why Do We Prototype?* & *Fidelity Levels* to the development process of your Physical Prototype.**

The making of the prototype for me has been mainly helpful to understand what I had to do. That has been the biggest challenge. I felt overwhelmed and didn't know how to start or how to proceed. And therefore, I have lost too much time thinking and researching and trying to understand, especially what I had to buy, that I did not have that much time left to actually do it, since my components arrived from the post only two days before the proposal presentation. Therefore, my proposal does not yet communicate in itself for me, nor follows really directly my intention. However, this process has helped me understand more clearly how concretely I am going to achieve my goal and communicate my intention.

I feel like my prototype could have been more elaborate, but I still feel like it is very helpful. Going more into mid-fidelity would have allowed me to test with more accuracy the performance of the ball, as well as its meaning. In fact, the way the ball acts now is very far from what I want to do with my final project. Instead of only outputting one sound, I want to be outputting a sound that fluctuates depending on the IMU's input.

Also, I would have wanted to at least put all the parts together, meaning the IMU, the sound and the design of the ball. For now, I only have those three working separately, but they could have easily been put together if I had a little bit more time.

My prototype is close to low fidelity. I've started by researching a lot on what components I should use. Then, I've drawn circuits of how it should be attached. After, I soldered wires to the components to be able to test them on the breadboard and apply basic code. The code is very much on low fidelity. For now, I am not using the very potential of the IMU in my code, but it is something that I will definitely work on for the final. My circuit however, is closer to mid fidelity, but it's still on the breadboard. It is working (if nothing breaks during…) and will allow me to develop my code further on it. The materiality of my ball is between low to mid fidelity. I have tried with many materials to make the entire thing solid and steady, while the ball is softer. I tried using cotton balls and bubble wrap for filling, felt and rubber for the exterior and isolating certain pieces, and cardboard to create separations. For my prototype presentation, I ended up

finally considering using a metal ball, filled on one side with cotton balls, and with the circuit on the other, held in place by bubble wrap and cardboard.

- ➔ **A Technical Evaluation of Sensors and their associated Affordances which would ideally support your project's proposed Interaction Design Strategy**

The sensor that I use in this project is an IMU. For the prototype, I am using this LSM9DS1. It has 9 degrees of freedom, allowing me values in three axes of three different kind of movements or forces. First, there is the magnetometer. This measures the closeness to a magnetic field in x, y and z. It can help to know the position in space, because our Earth has a natural polarity that can be detected. It can help to find the position of the object in space, by knowing if they get closer or farther from a magnetic field, in all three axes, and therefore infer which direction the object went to. By doing my prototype, I realised that the speakers have magnets at the bottom. This is something that should be considered, because it will alter the values of this sensor, even maybe making it unusable. I think it would still be useable though, because even if the initial values are changing because of that, the variations in magnetic fields would have to be caused by something exterior to the ball, since the position of the speakers compared to the IMU will be constant. I tested that it measures variations when the speaker moves compared to the IMU, but I will need to test with the relative position of the speaker compared to the IMU fixed. The next item is the gyroscope. This measures the rotation of the sensor on itself. It can help measure an orientation. In my case, it will be useful to output different sound dependant on how much the ball spins. Finally, there is the accelerometer. This measures the acceleration, interpreted in gravitational force (1g = 9,80 m/s^2). In the air, as well as when it is static, the ball should output an acceleration of 1g to the ground. However, when it is in the process of being thrown, that is when the values can be interesting, because they will fluctuate. Depending on the final acceleration, we can determine the initial speed of the ball, which can be interesting to use to modulate the sound, because it is something that users can understand, more than the raw acceleration. However, for my prototype, I have just used the acceleration itself. My prototype is quite simple in that aspect: my code plays sound only if the acceleration differs enough from 1g. Therefore, it's like an on/off switch that plays sound if the ball is being moved by the user. I am not sure that I will have time to do test this code prior to the prototype presentation however, maybe it will be even only the examples of the IMU and the FM synthesis that will be able to run, alternately, on my circuit. It is quite far from what I expect from my final

project, but I intend to work a lot on the improvement of the code, so that the IMU becomes very useful in creating the sound. I just wanted to work on a proper circuit first before delving to much into that, so that my code can be tested more easily afterwards. One thing that will affect all my data is that my ball will be constantly turning on itself. Therefore, it will be hard for me, except for the gyroscope that specially calculates that rotation, to use the three axes, since they will always be mixed up. Therefore, I will have to measure the resulting acceleration, for example, with Pytagore's theorem, so that the resulting force is equal to the square root of the sum of the square of the values on each axis.

- ➔ **Has your Project's initial intention or supposed meaning changed over the course of researching and implementing the Physical Prototype? If YES or NO – Explain why?**

The initial intention is still the same: to make people play and gather into a community, whilst creating a soundscape collectively. The execution of it has changed though, so I had to rethink a lot on how I was going to keep the intention and making it go across. Therefore, the original intention has not changed, but I focussed more on the idea of play rather than creating a complex soundscape. Also, the idea of community had to be rethought. At first, I wanted to make three balls that would be related all together to an output Bluetooth speaker. I even wanted all the balls to have an impact on one another in the way they create sound. I rejected that option because I felt like the object in itself was rather inanimate and didn't feel interesting, if we don't have a direct output from it. It would have been confusing for the user, since there would be no direct correlation from the object to the output. Therefore, now, I am only making one ball, that produces sound from into it. So, this sense of community of having to handle many objects is gone. However, I still want to instore this community aspect. My idea is to try to measure if the ball is thrown twice in a similar direction during a small amount of time and do something different with the sound if that's the case. If it is thrown twice in the same direction, it either means that there is more than one person, or that the person who threw the ball first ran to get to the other side of the other person, which, either way, is something that I would encourage.

Materiality

My idea for materiality is to put all the electrical circuit into one half of the ball, protected by bubble wrap, and cover it with cardboard. I tested it and it doesn't move that way with the batteries that I have. Then, I want to cover it with rubber (of a better color than this one).

Circuit