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A Classical Pas De Deux in the style of Physical Computing.

In 1959, CP Snow, a physical chemist, and artist delivered a stimulating talk entitled *The Two Cultures*. In his discourse, he expressed concern regarding ostensibly the arbitrary dichotomy between the arts and the sciences. He asserted that the two disciplines are interdependent. Snow urged that the refusal to acknowledge this claim would result in the stifling of innovation and human development. Since 1959, Snow's assertion of the "two cultures" has been the subject of much debate.

Even today, there are scientists slow to acknowledge the utility that the arts provide to the sciences. As a dancer and a computer scientist, I decided to explore this notion with a research project that attempted to answer two questions 1) How can I leverage my computer science background to enhance a dance performance? - 2) Could such a performance, in turn, influence my computer science practice?

I hypothesized that computer science can be used to enhance a dance performance with the use of physical computing. My second hypothesis was that a dance performance could inform my practice of science under the agency of the art widening the range by which the sciences are practiced.

To test these hypotheses, I collaborated with two of my peers to co-create a contemporary ballet pas de deux with applied physical computing. The project developed into a wearable technology creation, programmed in accordance with Phillip Glass's *Einstein on the Beach* and choreography developed by Boyd and me. My research team and I executed this task by programming LED light strips using a Teensyduino housed on a breadboard with Arduino software. Our work resulted in a functioning LED-light integrated bodysuit programmed to enhance the movement of the dancer and the message of the dance. The light suit created a visual experience that highlighted the dancer's movement as well as a sophisticated portrayal of the choreographers' artistic vision.

This project shed light on an untapped collaboration of two purportedly contrasting disciplines that, when combined, create a remarkable experience for both the artist and the scientist. For this project, I played the role of a dancer, co-choreographer, co-researcher, co-engineer, and co-programmer. My team and I underwent an extensive and iterative research process to develop the technology supporting the suit.

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First, we were tasked with structuring the suit to optimize my mobility as the dancer, as well as, the effect of the LED light strips. To do this, the suit was built in tandem with the choreographic process revealing the inextricably linked nature of the two processes. Figure 1 shows the final sketch of our suit, consisting of strategically sized and placed LED strips. We used this as the model for engineering the suit. The pink lines represent where LED strips are placed and the black lines represent blank spaces reserved spaces on the suit without lights. My peers and I sewed the strips onto the suit and soldered wire connectivity between the +5 voltage, ground-power and input/output (I/O) conduct ports on each strip. Figure 2 shows the fully developed suit.

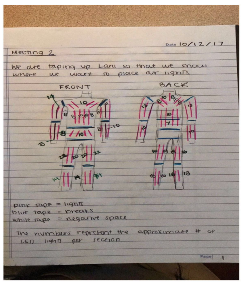

Figure 1. LED suit sketch.

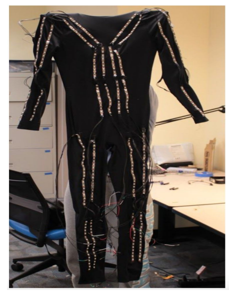

Figure 2. Fully Developed Suit

Once the suit was fully developed, the next task was choosing a processor. We chose the Teensyduino pictured in Figure 3 for its size and speed. The Teensyduino is a compact microcontroller with an impressive processing speed at 1 Mbit/sec. Speed and size were imperative factors when choosing a processor considering the physical and data related demands of the project. My group and I programmed the light pattern for the suit in the Arduino integrated development environment.

Through the Digital Ports on the Teensyduino, data can be read and written to the output of the microcontroller. The controller allowed us to programmatically access each individual LED on the LED strips. The powerful nature of the processor allowed for the seemingly infinite number of light patterns to be produced in correlation with our choreography and music. The process of designing the light patterns consisted of listening to the song and watching videos of the dance repeatedly. My team and I did this to programmatically specify the loop structures of the program facilitating the speed of the light patterns, the RGB color variables dictating the different colors displayed in the patterns, and the light intensity. We structured the program procedurally to have blocks of code execute specific operations. Each procedure yielded a light pattern. In the program code script, the procedures were called in the order in which they appeared in the dance so that the program would execute from start to end in correlation with the dance. Once we were satisfied with the program, we loaded it onto the Teensyduino board. We powered the board with a switch-operated battery pack connected to the breadboard. The battery pack powered the Teensyduino thus running the program.

The LED suit made for a remarkable prototype, but of course, there are improvements to be made. It would be beneficial to work with thinner, more durable wires to solder onto the suit to make the presence of the wires less noticeable. Additionally, the wires that were on the breadboard feeding data to the suit should be soldered onto a beadboard rather than plugged in and taped to the board. In the next iteration of the suit, Bluetooth technology will be used to allow the program to be run remotely from a computer, instead of having the dancer use the switch. The use of Bluetooth will allow the program to be controlled in real time, thus allowing for ample flexibility for which light patterns are shown when.

The research implementation project resulted in a well-received dance performance at a sold-out production at Spelman College. Figure 4 shows a picture from the performance and the performance can be seen at the following link: https://vimeo.com/260436615. The final product of this research implementation project allowed us to conclude that Our physical computing, dance implementation project enhanced the dance performance by providing us with an additional layer to contribute to our creative vision. I observed these results qualitatively in my creative roles on the project. The creative intent of the dance was to bring to life the love story narrated in *Einstein on the Beach* by Phillip Glass. The LED-suit was of immense aid to my artistry for this dance performance as it opened an untapped channel for me to strengthen how I went about story-telling; my favorite part of being an artist. The suit also proved to be a pedagogical tool. Because of the suit, in Spring 2019, Spelman will be piloting a physical computing course as a supplement for the mandated computer science 111 course.

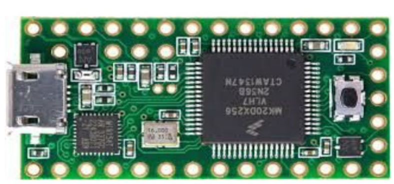

Figure 3. Teensyduino Processor

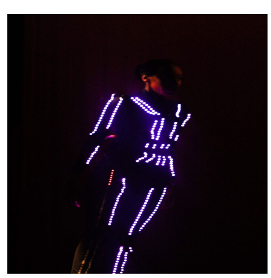

Figure 4. Suit debut at Spelman College performance.