Thesis Project Portfolio

EEG Controlled Robotics

(Technical Report)

Mixing Business With Sexual Pleasure: Heterosexual Women & The Digitalization Of Sex Toys

(STS Research Paper)

An Undergraduate Thesis

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Table of Contents

Sociotechnical Synthesis

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What is the human body in regards to technology? Is it simply something that needs to be optimized, even fixed, by engineering? If so, how much of this optimization would be considered as exploitation? What is the baseline of privacy that should be guaranteed during optimization? I was fortunate to explore this connection in both my capstone project and my STS research paper. In my capstone project I explored the ways of optimizing the human body by utilizing a properly functioning organ to optimize the function of another body part, such as the arms, by training an algorithm to identify when a user wants to move their arms via their brainwaves. Meanwhile, my STS research project explored the implications of using the human body to optimize itself and drive engineering progress and how this optimization can oppress existing minorities. I find both of these projects important in their own regard.

For my capstone project, my team and I utilized reinforcement learning algorithms to help identify brain signals associated with arm movement and intent to initiate arm movement to assist users with neuromuscular disorders. In other words, we used machine learning to associate certain brain waves collected by electroencephalogram (EEG) equipment with gripping and ungripping objects. This was done by creating a program with the reinforcement learning algorithm applied, collecting the brain signals associated with clenching and unclenching the right fist at various patterns through OpenBCI equipment, and then pretraining the algorithm with said brain signals. To improve the accuracy of the algorithm, we also collected data

regarding participants being relaxed or concentrating. Once we had success doing the aforementioned tasks, we then focused on implementing real-time processing so that users can grip and ungrip objects at or near the same time as the associated brain signals are received and then recognized by the trained algorithm. We had some success with the real-time connection, but we were unable to achieve anything close to perfect accuracy. We were limited in the amount of time we had for testing and developing code, which then limited how much data we could collect. Some possibilities for future work include implementing code that allows movement in more degrees of freedom to the system and that specifies which fingers to move at a time; training the model further and on a more diverse dataset; and redesigning the robotic arm to be able to attach to a person.

Meanwhile, for my STS research paper, I explored the implications of smartphone mobile app-utilizing sex toys becoming mainstream within the past ten years. Specifically, I explored the data being exchanged during toy usage and how they commoditize consumers in the process. This was done by relying upon Kean Birch's concept of Automated Neoliberalism, where today's economic interactions are controlled by corporate digitalization and companies treat personal user data as currency. This concept, applied alongside the various commodity chain analyses of notable events, app-utilizing sex toys make consumers, specifically heterosexual women, a labor source and a commodity, which can further demonstrate and then perpetuate gender inequalities and promote certain human bodies over others. This is especially insidious as the sexual exploration done during usage essentially equates to unpaid labor that consumers cannot be compensated for unless they have the resources to take legal action. From my analysis, I then implored experts in the sex toy industry to establish an ISO standard for sex toy cybersecurity and user privacy during usage.

By working on both these projects together, I realized how you can ethically collect data and how you cannot. One project has strengthened my technical skills in data collection and analysis, and another project has strengthened my ability to determine the ethical boundaries in data collection. As data science becomes more and more crucial to engineering projects, it is important to consider how data collection methods, especially vague in what is consensual and what is not, may uphold systemic issues. In my projects, my STS project inciting my reflection on science maintaining the capitalistic status quo influenced how I thought about my capstone project. Specifically, I considered how data collection is essentially the bread and butter of the capstone project as a machine learning project and how participant labor is usually never compensated, as seen in sex toy data collection. This reflection made me appreciate the fact that the data being collected and used would be only from me and my teammates. Overall these projects were very insightful as I prepare for graduation and prepare for entering the workforce as a bright-eyed engineer.