Thesis Portfolio

Closed-Loop Feedback System for Controlling Renal Perfusion Pressure via LabVIEW
(Technical Report)

Ethical Considerations of Cognitive Enhancement:
Conventions and Controversies
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Sciences
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science in Biomedical Engineering

Author

Pai Li
May 01, 2020

Table of Contents

Sociotechnical Synthesis

Renal perfusion pressure (RPP) plays a key role in pressure natriuresis, which in turn plays a key role in the long-term regulation of blood pressure. However, despite its importance in renal research, accessible methods of controlling RPP have been lacking. This project furthers the development of a LabVIEW program for controlling RPP from a proof of concept prototype into a working product. Telemetric RPP readings are sent from the transmitter via Excel to the LabVIEW program, which then infuses or withdraws a syringe attached to an aortic occluder directly upstream of the renal arteries. High RPP readings cause the program to infuse the syringe, inflating the aortic occluder and pinching the aorta, leading to lower downstream blood pressure and ultimately lower RPP. For low RPP readings, the reverse process occurs. While the original prototype was functional, it suffered from a number of design flaws that made troubleshooting and development difficult. The most notable consequence of these design flaws was the fact that the prototype's functionality could not be validated without the use of a live rat for RPP data. The current project improves upon the prototype design by removing bloat and modularizing subcomponents, allowing for hardware-independent unit testing of each individual component. The current iteration's design makes for a much more robust piece of software that is not only more accessible, but also easier to work with, develop, and troubleshoot.

Much of what defines the human condition involves a continuous drive and desire towards a better existence. Technology as a whole can be categorized as a means for people to live better, more secure lives. However, the success and pace of technological progress have left many doubts about the ends towards which this progress is aimed. The primary question is no longer "can we?" but "now that we can, should we?" Human cognitive enhancement embodies this distinction perfectly in that recent technologies have developed faster than the ethics surrounding them, leading to a great deal of concern about the ethical implications of such technologies. Yet historically, many enhancement technologies have been accepted as convention. This being the case, what exactly are the ethical distinctions between conventional and unconventional cognitive enhancements? In order to clarify these distinctions, a conventional enhancement, prenatal supplements, and an unconventional enhancement, germline gene therapy, were chosen as the bases for comparison. A systematic literature review of the public discourse surrounding these modalities was performed, and the resulting ethical considerations were framed through the disparate ethical frameworks of acceptance rule consequentialism and neo-Aristotelian naturalism. Public discourse was obtained by proxy via news articles from a conservative religious source (*Christianity Today*), a techno-progressive source (*Science Daily*), and a reputable, relatively objective source (*The New York Times*). Iterative sampling of these sources ($n = 9$ for each modality, 3 from each source) was conducted until no new ethical concerns were raised. In this manner, the nature of the ethical considerations surrounding cognitive enhancement convention can be categorized, and the differences between conventional and unconventional modalities made explicit. Clarification of these differences can then provide the foundation for a more comprehensive hypothesis on the ethical factors surrounding enhancement convention and, eventually, a normative model or theory that addresses human cognitive enhancement independent of the specific modality in question.