**Thesis Project Portfolio**

**Development of Reliable Drive System for Medical Ultrasound Imaging**

(Technical Report)

**The War on Drugs: A Sociopolitical Analysis**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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## Sociotechnical Synthesis

This undergraduate thesis portfolio explores the research, development, and testing of an ultrasound device as part of the senior design capstone component, while also exploring the sociopolitical impacts of the War on Drugs on minority communities in a cohesive timeline for the sociotechnical research paper. The ultrasound device is motivated by a gap in the medical community for cost-effective imaging equipment, allowing more physicians and clinics to offer guided support for epidural injections. While a clear motivation is set for the medical device community regarding the product output, the legislation surrounding the War on Drugs was less apparent, with government officials using the war to enforce their own political agendas. Both of these reports reflect in-depth research and analysis of the topic at hand, and explore function and motivation, whether that be for the internal working of the medical device, or the external factors of legislation.

The goals of the technical capstone project are to aid in the development of the medical ultrasound device in conjunction with Rivanna Medical, working to prototype, implement, and test elements within the fixture to ensure functionality. The main proposed deliverables were to choose an appropriate actuator, develop needed test fixtures, and perform reliability testing. The purpose of the device is to serve as an intermediary for interventional needle procedures into the bone. The actuator was selected and hardwired to support the circuit and motor of the device. Test plans were developed and the proper equipment was attained to test the aforementioned deliverables. The reliability of the device was tested through inspection of the flex circuit, force and noise, and acoustic coupling over the product's lifespan. A flex circuit spooling mechanism was designed and developed to aid in the coiling of the circuit, which was implemented into the

device. This capstone project supported the internal development of the device, and helped the team gain guidance and insight into the medical device community.

The purpose of the sociotechnical paper is to examine the causes and effects of the War on Drugs, analyzing various pieces of legislation under different presidential administrations to determine the motivation for each legal document, and what impact they had on social and political factors. The framework of political technologies by Langdon Winner will be utilized to answer the question of how has legislation been used as a political technology to exacerbate the War on Drugs for minorities in United States. A political timeline of legislation starting from the late 1800's will be presented and built upon, examining the outcome of each on different racial and social communities in America. This research will pose questions of how bias, racism, and classism infiltrate the legal and health system, and how communities have been facing repercussions from the initial push of the drug war. This research also builds an argument of how legislation has been used as a weapon to target communities and demographics to push a political agenda. The outcomes from this analysis are further linked with modern day disparities, mass imprisonment rates, and poverty, all of which are closely linked with sentiment from early government officials imposing strict and biased drug laws.

Over the course of a year, both the technical capstone and the sociotechnical research were conducted simultaneously. By gaining the opportunity to go into the office and work with engineers on a medical ultrasound device to be marketed, I learned valuable information about how the industry functions and the day-to-day workings of an engineer. By diving deep into legislative history regarding the War on Drugs, I gained insight into the United States deep rooted history of bias and racism, and how those policies have impact on modern day issues, such as healthcare disparities. By spending time researching these two topics in depth, I received

awareness of bias within the medical device community, and how important it is to recognize and fix personal biases, or they will have generational impacts. Reading about social, political, and economic factors that are engrained in America's history make it apparent that engineers entering this next decade must work hard to avoid the mistakes made in the past, and to develop devices and technologies that are inclusive and accessible for all.