Thesis Project Portfolio

Anatomically personalized ML model predicts target temperature in focused ultrasound brain treatments

(Technical Report)

The Technological Momentum of AI Medical Devices Under the 2021 European Union Medical Device Regulation

(STS Research Paper)

An Undergraduate Thesis

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

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2024

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Socio-Technical Synthesis

My technical project and STS thesis are connected through artificial intelligence (AI) in the medical industry. My technical work uses machine learning, an application of AI, a process that uses a mathematical model to train a computer. Artificial intelligence is a broader term, where computers and machines are taught to mimic human cognitive functions. The applications of AI also differ between my two pieces of work. My research project focuses on the regulations surrounding AI in medical devices while my project uses AI to help with medical treatment. Both include the novel use of AI in the medical industry, connecting their topics.

My technical project uses machine learning to predict the temperature reached in the brain for focused ultrasound treatments. Focused ultrasound works by focusing beams on an area in the brain and ablating the target region. Currently, physicians can only accurately predict the temperature reached in the brain with prior testing, which puts the patients through unnecessary rounds of treatment. Our model is trained on data collected from UVA's Focused Ultrasound Center, given to us by the Focused Ultrasound Foundation. In addition to the model, we built a graphical user interface, which allows users to input their parameters and our model will predict the temperature reached in the brain. Focused ultrasounds are a newer medical treatment and artificial intelligence is rarely used in this industry. The Focused Ultrasound Foundation will hopefully continue to work on our model which will help physicians in the future, showing the potential of AI in the medical industry.

My STS research also looks at the growing use of AI in the medical industry, with a different focus. My research focuses on the European Union's 2021 Medical Device Regulation, which includes stricter regulations, affecting AI medical devices. I look at the timeline of this technology, looking at how the social impact the technical and how regulations can slow down

the growth of technology. I use Hughes' theory of technological momentum to undergo this analysis. Technological momentum is the theory that there is a time-dependent relationship between technology and society. As the system matures, society becomes more enmeshed. My claim is that the MDR is representative of the social control in the technological system, which caused an initial lag in technological development. Throughout my argument, I analyze the relationship between society and technology and its impact on the technological momentum of AI medical devices. The goal is to provide a better understanding of the current and future momentum of this growing industry.

Working on both of these projects gave me a better insight into how technology and society interact. While working on my technical project, I was able to understand how society could impact our project. This gave me a more personal perspective when performing my STS research as I could understand the AI medical device engineer's point of view. It also gave me a better understanding of the impact of regulation on a project. We were a small team and having to do more paperwork would have slowed our progress significantly, which gave me a better understanding of the impacts of regulation on technological momentum. Overall, the interactions between society and technology were clearer to me because of my personal experience and my research for my STS project. This will benefit me in the future and give me a better understanding of how society and technology have a time-dependent, important relationship which can help to understand the future of technology.