Thesis Project Portfolio

Development of a Novel Fetal Heart Rate Monitor for Multiple Gestation Pregnancies

(Technical Report)

An Analysis of the Edison Blood Analyzer via the Social Construction of Technology

(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

Roman Ramirez

Spring, 2023

Department of Biomedical Engineering

Table of Contents

Sociotechnical Synthesis

The current standard for external fetal heart rate monitors (fHRs) utilizes Doppler ultrasound (US), a sound-based, non-invasive technique. However, the current standard of US fHRs cannot identify and locate heart rates (HRs) of multiple gestation pregnancies. In addition, most fHR monitors secured around the waist also obstruct the lower back, which is the location where an epidural is administered. My capstone group developed a novel fHR monitor, measuring the frequencies of multiple heart-rate replicas in a phantom gel using an array of microphone pickups. With the continued development of this project, healthcare would have an accessible, non-invasive, safe, and accurate way of measuring multiple fHRs, which is unattainable with the current clinical standard of monitors.

Since their introduction to the public, there have been concerns regarding the possible safety implications of using these devices. For this reason, it is important to consider the human and social dimensions of this technology. In addition, to the direct implications of inaccurate fHR monitoring, these monitors also bear heavy political implications, such as topics on abortions and eugenics.

While my technical project measured heart rates for multiple gestation pregnancies, I analyzed the dynamics of the Edison blood analyzer (EBA) against various social groups using the social construction of technology (SCOT) theory. The EBA was a technology developed by Elizabeth Holmes at Theranos, now a bankrupt entrepreneur and a defunct company, respectively. It was the hasty development of the EBA and the deception from their investors and agencies that resulted in such a collapse. While many have used SCOT to create a socio-technological network regarding successful products, I studied the contrary: I sought to develop the network of the social groups involved in the development of the EBA, and I carried this out through prior literature and online media sentiment analysis. From prior literature, regulatory agencies, media outlets, and key individuals are highlighted as impactful social groups. In terms of sentiment analysis, there exist trends in certain online searches over time similar to that of Theranos, and some of those related searches will be companies participating in VAM development, such as Sight Diagnostic Inc. and Karius. This research has supported the way in which my Capstone project is developed: if the implications of how my technology is developed are ignored, then the greater ultrasound market and users of the device could be greatly affected, just as how the EBA impacted the blood analyzer market.