Thesis Project Portfolio

AutoAFM: A Simple Modification to Traditional Atomic Force Microscopy Enabling Automation

(Technical Report)

Coffee, Culture, and Commerce: A Sociotechnical Investigation of Blank Street Coffee's Growth

(STS Research Paper)

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Executive Summary

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In an increasingly modern world, the technical and societal implications of automation are a subject of both celebration and concern for engineers and society at large. Automation can replace menial tasks, however, the elimination of these manual tasks could lead to the replacement of workers. In order to examine all facets of this issue, this portfolio details a technical project and a research project that are tied together by the common thread of automation. The technical project focuses on the reconstruction of Dr. Connor Stashko's AutoAFM device, which automates atomic force microscopy (AFM). The science, technology and society (STS) project examines Eversys super-automated coffee machines within the context of a fast-growing coffee chain: Blank Street Coffee. Sample collection utilizing AFM is time-consuming and inefficient, therefore, the primary motivation behind reconstructing the AutoAFM is to turn the aforementioned process from an active one to a passive one via automation. The technical report for this project, which provides ample information about the process and product, is enclosed. The primary motivation behind examining the usage of the super-automated coffee machines by Blank Street is to examine the larger implications of automation on society outside of a research lab. The final STS product, which is a research paper that seeks to examine how the Eversys super-automated coffee machine unintentionally empowers some groups while marginalizing others, is enclosed in the portfolio.

Currently, AFM is the gold standard for spatially analyzing varying stiffness within tumor samples. AFMs use a probe to measure forces in order to determine stiffness on the surface of a tissue sample, which is utilized to construct a corresponding 3D profile. However, using the AFM to analyze tissue samples is time-consuming and it is difficult to overlay data sets to match

them in a meaningful way. Moreover, if researchers are spending excess time on menial tasks, less time is going towards their more critical and impactful work. Dr. Stashko sought to combat these issues by designing an automated AFM device (AutoAFM) for his PhD. This technology automates the AFM device via 3-D printed custom extensions that attach servo motors to the knobs of the microscope in order to automate sample collection. Arduino code is used to control AutoAFM movements. This device has had proven success, as the measurements that the AutoAFM obtained were validated. The goal of this year's work was to use prior work to reconstruct this device for use in Dr. Tom Barker's lab in order to improve the process of data collection for tissue samples. Additionally, lessons can be learned from the process of constructing this device in a novel location that could be applied to the construction of this device in other labs, particularly in the form of more detailed assembly instructions for this device. Widespread implementation of this device would allow for analysis of a greater number of patient tissue samples, which could lead to a quicker establishment of a therapeutic pathway based on physical characteristics of tumors.

As for the STS project, it examines the latest epicenter for debates surrounding automation, which stems from an unlikely source: a fast-growing urban coffee chain by the name of Blank Street Coffee. What sets this chain apart is substantial venture capitalist funding and Eversys super-automated coffee machines that make 8 espresso shots at a time at a rate of 700 shots per hour. Local coffee shops are rightly worried that they can't keep up. Some even call the quick takeover of Blank Street Coffee gentrification. An important question arises from these events: how does the Eversys super-automated coffee machine unintentionally empower certain groups while marginalizing others? In order to answer this question, my research draws on Langdon Winner's STS framework of Technological Politics and examines the impacts of the

technology on different stakeholders. Through my research, I found that the Eversys super-automated coffee machine empowers the founders and employees of Blank Street Coffee, as well as business owners who purchase the technology, while marginalizing skilled baristas and local coffee shop owners. Within the field of STS, this research examines the sociotechnical implications of an increasingly relevant technological development.

Overall, this portfolio examines both the technical advancements within scientific research and societal ramifications of automation when applied to a business environment. The AutoAFM increases the speed of medical research discoveries by automating data collection processes. The Eversys machine allows baristas to make drinks without any high-level coffee making knowledge, however, this has an arguably negative impact on local businesses and urban coffee culture. Working on these two projects simultaneously provided further insight into each individual project that would not have been possible to obtain otherwise. The STS project helped reveal the wider implications of the application of the type of technology that the technical project aimed to popularize. The technical project revealed the appeal behind the automation technology and why that appeal might outweigh negative implications for the business owners in the STS project. Together, these projects both contribute to understanding the full breadth of the impact of automation on society in different settings. In doing so, this portfolio invites further reflections and discourse on newer examples of automation that are sure to arise.