AutoAFM System Construction And Testing
(Technical Paper)

Sociotechnical Analysis of the Rise of Blank Street Coffee
(STS Paper)

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By
Alexa Pittaro

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Technical Team Members:
Alexa Pittaro

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.
Signed: Alexa Pittaro

ADVISORS

Benjamin Laugelli, Department of Engineering and Society
Thomas Barker, Biomedical Engineering, Department of Cell Biology, School of Medicine

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Introduction

The process of data collection in laboratory settings is oftentimes inefficient and time consuming. Automating manual processes within the scientific research space is often done for the purpose of making menial tasks more efficient and saving time. One such example of this is data collection using atomic force microscopy (AFM), which measures the stiffness of a tissue sample. Data collection for a single sample takes 2-3 hours. Automation of this process is a much welcome and positive innovation in this sphere. As with most technological advancements, a large range of social implications comes along with the process of eliminating the need for active human labor. Some implications are mixed, particularly concerning combining businesses with automated processes. For example, automation can increase efficiency, however, those without access to that technology can lose the ability to compete with those who possess the technology. It is important to examine the variety of implications in different spheres that automation brings about.

In order to improve the process of data collection I will reconstruct and improve on an AutoAFM design, which automates the process of gathering data with an AFM. Additionally, I will commit to making this design and the construction process open-source so that other labs can utilize this technology. This will help improve efficiency for researchers, which will allow them to make further innovations.

My technical project focuses on the implications of automation within a niche environment on a smaller scale, while my STS project examines the implications of automation on neighborhoods and the workforce. To examine such complex relationships, I will draw on the STS framework of Technological Politics to examine how the technology of an Eversys super-automated coffee machine unintentionally empowers certain groups while marginalizing

others. Attending to both technical and social aspects of the need for automation provides a more comprehensive and holistic, and thus more effective approach to addressing the sociotechnical challenge because it allows engineers to more thoroughly consider the implications of automation technology in the process of designing and constructing such technologies. Because automation and eliminating the need for human operation is sociotechnical in nature, it requires attending to both its technical and social aspects. In what follows, I elaborate two related research proposals: first, a technological project that describes the AutoAFM and an STS project that examines both the social and technical implications of the utilization of the Eversys super-automated coffee machine by Blank Street Coffee. The insights gained from my STS project can be applied to visualize the future implications of the AutoAFM more effectively and create a more socially responsible design.

Technical Project Proposal

Stromal stiffening and intratumor heterogeneity (ITH) often lead to poor outcomes in cancer patients. Medical researchers are working to determine if there is a relationship between cancer heterogeneity and tumor phenotype, which could eventually improve the quality and success of treatment for patients (Caswell & Swanton, 2017). Currently, atomic force microscopy (AFM) is the gold standard for spatially analyzing stromal stiffness within tumor samples. AFMs use a probe to measure forces in order to determine stiffness on the surface of a tissue sample. This is done in order to construct a 3D profile of the tissue sample surface and its stiffness (Bullen & Wilson, 2020). However, using AFM to analyze tissue samples is time-consuming and spatial registration could be improved, meaning it is difficult to overlay data sets so that they match in a meaningful way. This method of measurement is also susceptible to experimenter bias, as the 3D profile may be negatively impacted if researchers are concentrating

data collection in convenient locations on the tissue sample. Data analysis of the ITH is somewhat inhibited due to the pitfalls of this methodology. In addition, if researchers are spending excess time on menial tasks, less time is going towards their more critical and impactful work.

Luckily, an update to this technology has been made. Connor Stashko sought to combat these issues by designing an automated AFM device (AutoAFM) for his PhD. This technology automated the AFM device by 3-D printing custom extensions for the microscope and using them to attach servo motors to the knobs of the microscope in order to automate sample collection. Arduino code was used to control AFM movements. This device has had proven success, as the measurements that the AutoAFM obtained were validated (Stashko et al., 2023). The aim of this technical project is to use prior work that has been made available on GitHub to reconstruct this device for use in Dr. Barker's lab in order to improve the process and quality of data collection (Stashko, 2022/2022). Additionally, this project aims to create a highly detailed set of assembly instructions that will be uploaded to GitHub for the construction of this device in other labs. By successfully reconstructing the AutoAFM device to improve upon the AFM device in Dr. Barker's lab, it is expected that the efficiency of data collection for tissue samples will be greatly improved. The open-source nature of this design will also allow other labs to have access to this innovation.

This technical project is divided into two subprojects to be developed concurrently. A Gantt chart has been generated in order to appropriately plan out the different portions of the project. The first subproject is the construction of the AutoAFM device. This subproject has several phases as well. The first phase will be dedicated to the 3-D printing of the custom microscope extensions. The second phase will involve the assembly of those microscope

extensions. The third phase will involve debugging the Arduino code and using servo motors to motorize the device. The last phase of this sub-project is to obtain measurements using the AutoAFM and validate those measurements. The second subproject is developing a detailed set of assembly instructions for uploading to GitHub in order to facilitate the construction of this device in other labs. During the construction process for this device, detailed documentation will be made for the purpose of creating high quality device assembly instructions. This will include creating instructions for the physical assembly of the device as well as commenting extensively on the Arduino code.

Initial designs for the AutoAFM will be utilizing Connor Stashko's AutoAFM design and the accompanying documentation. Improvements to this design will be made as necessary. Each of the phases in this project rely on the success of the prior phase. The success of this project as a whole will be determined when the data gathered by the AutoAFM is validated. After that the detailed instructions for the creation of this device can be trusted by researchers.

STS Project Proposal

The intersection of technological automation with human-performed jobs and the accompanying analysis has been a longstanding source of fascination for many. Reactions range from finding the technology interesting to fearing that robots will eradicate jobs for humans. The latest piece of technology that these debates indirectly center around is the Eversys machine, a highly specialized coffee machine that is utilized by a coffee chain called Blank Street Coffee. The Eversys Super Traditional Shotmaster s-pro can make 8 espresso shots at a time at a rate of 700 shots per hour (*Eversys SA | Super Traditional Coffee Machines*, n.d.). This is a super-automatic coffee machine, meaning that a shot of espresso can be made solely with the press of a button. Semi-automatic and automatic espresso machines both require the active

involvement of the barista in the process in order to grind the coffee and tamp the puck (Vittitow, 2021).

In short, this technology is understood to allow users to make shots of espresso with increased speed and efficiency without sacrificing the quality of a shot of espresso made by a barista. This is true, however, this technology also performs significant social and political work. For example, Blank Street Coffee hires fewer employees per shift and has salaries starting at $23/hr. Workers earn an average of $28/hr with tips (Moskin, 2022). Minimum wage in New York City, where Blank Street Coffee has more than 40 locations, is $15/hr. In addition, Blank Street Coffee claims to serve high-quality coffee at a lower price, making it more affordable for the masses to enjoy. However, it's important to note that this machine costs nearly $50,000. In 2021, Blank Street Coffee amassed approximately $67 million in venture capitalist funding (Ryan, 2023). Providing each location with a Super Traditional Shotmaster s-pro would likely not be attainable without venture capitalist funding. As a result, some argue that this coffee chain is contributing to the gentrification of neighborhoods, as local coffee shops are simply not equipped to compete with venture capitalist funding (Talukder & Christo, 2022).

There have been a few attempts to analyze the rise of this new coffee chain, however, prior analyses focused mostly on the founders rather than the implications of the technology (Ryan, 2023). These analyses fail to analyze the impact of society and technology working together by utilizing a sociotechnical framework. The thesis to be developed here utilizes an aforementioned sociotechnical framework in order to concurrently analyze the social and technological implications of Blank Street Coffee. Drawing on Langdon Winner's Technological Politics (TP) Framework, I argue that Eversys' Super Traditional Shotmaster s-pro performs political work by privileging the founders and employees of Blank Street Coffee while

marginalizing the owners and employees of local neighborhood coffee shops. Winner argues that technological artifacts have "politics", which he defines as arrangements of power and authority in human associations and the activities that take place within those arrangements (Winner, 1980). He also argues that specific features within the design of a device can provide a means for establishing power and authority within a given context. This can affect arrangements of power within a given group by empowering some and marginalizing others. This is the section of his argument that I will utilize for my analysis of the aforementioned technology.

To support my argument, I will draw on additional evidence from the sources cited above, which include interviews with the founders as well as information about the specific technical elements of the Eversys machines. Those sources contain details that will be very useful for the STS project that are beyond the scope of this prospectus. Additionally, I will conduct field research by visiting a Blank Street Coffee location to obtain a better understanding of the customer experience. I plan on interviewing a barista during that visit as well.

Conclusion

The reconstruction of the AutoAFM, along with detailed instructions will help advance the goal of increased automation in laboratory spaces in order to save time for researchers. The STS project will deliver a better understanding of the implications of this automation, particularly in relation to the workforce and neighborhoods. The insights from the STS project will help improve the understanding of the potential implications of the AutoAFM, particularly relating to the open-source nature of this design. Both of these projects contribute to the larger goal of implementing and understanding automation and what it means for technological industries and societies at large.

Word Count: 1828

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