Thesis Project Portfolio

Adaptive Mobile Sensing: Leveraging Machine Learning for Efficient Human Behavior Modeling

(Technical Report)

The Implementation of Makerspaces in Schools

(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

The focus of my technical research was the efficient collection, storage, display, and analysis of cell phone sensor data for use in predicting illness. This research not only benefited the study I was involved in, but also mobile sensing as a whole, as our techniques are widely applicable. For my STS research project, I researched the impact that makerspaces have on students' creativity and problem-solving skills when implemented in schools. This research became very meaningful as I studied a local high school (Albemarle High School) and examined their unique approach to providing a maker program while also eliminating the tensions that usually arise from such a program.

In the technical project, our team focused on developing a strategy that balanced the need to collect a complete and robust dataset, with the need to conserve battery life on phones that were running our software. Our proposed solution involved a dynamic adaptive sensing approach, which would use machine learning to determine when to turn on sensors to collect the greatest volume of relevant data. This research is important as it is a step forward for all mobile sensing efforts that need to collect large amounts of data while conserving phone battery.

For my STS research, I first digested literature which explored the implementation of makerspaces in schools, their outcomes, and the tensions they create. Following this, I interviewed local teachers and makerspace administrators to better understand the various perspectives contributing to makerspaces' design and placement. I then performed a case study on Albemarle High School, and examined their unique maker program "MESA" (Math, Engineering, and Science Academy). I found that this program, by integrating itself within the standard school curriculum, was able to produce the positive outcomes of traditional makerspaces (creativity, problem solving, technical skills, etc.) while avoiding the common tensions that other maker programs have experienced.

Due to the pandemic, my technical research group didn't complete everything we set out to accomplish as we couldn't acquire participants for a larger study of our final proposed adaptive sensing model. That said, given those constraints, we were still able to create a model that we believe will perform well once participants can be acquired. In addition, we created a robust solution for storing and visualizing the raw time series data, so overall I would say that the technical research was successful. The STS research was even more successful, and I was able to uncover some of the hidden logic behind the structure of the MESA program, a program I was already familiar with before starting this research. I feel that my research was able to represent the interests of the conflicting parties when it comes to makerspaces in schools, and I feel that the study on the MESA program shows what can be accomplished with an outside-the-box hybrid program.

I'd like to thank Professor Ferguson for assisting me with my STS research as well as my other professors who helped me attain technical skills needed to complete my projects.