

Thesis Project Portfolio

Outside the Box – The “Tap” Box

(Technical Report)

Multi-Level Perspective as a Method to Explore Potential Mitigating Strategies Regarding Environmental Harm From Consumer Electronics and Transitioning to a Better System

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis (Executive Summary)

Mitigating the Negative Impact Consumer Electronics Have on the Environment

“The only technology that helps to create a plethora of business and employment opportunity while promoting the green environment, is serving good for the society and, therefore, the sustainability”

- Anuj Somany

Consumer electronics are arguably the most convenient innovation of recent history. However, they cause an obscene amount of harm to the environment. They require mining of rare Earth minerals which require fossil fuels. Also, about 40 million metric tons of electronic waste are produced globally because of poor disposal practices. However, society is at a place now where life without these products is unrealistic. This STS research topic is meaningful to me because there are benefits to finding solutions whereby we can save the planet and also enjoy the devices we use on a daily basis. This STS research is not related to my technical portion. The technical portion is called the “Tap Box”. It is a wooden box that unlocks when a knocking sequence is input via the sides of the box. This project was meaningful to my team and I because it is a secure way to store valuables in an unassuming everyday object, and it let us build on our knowledge from previous classes by learning new things along the way. Part of this project required using consumer electronics. It was impossible to complete without them. Although there is no direct relation between my technical and STS projects, there is relevance of STS to my engineering practice: how could I have done my technical portion if it were not for the assistance of consumer electronics, which harm the environment, and are the very things I am trying to find solutions for in my STS research? There is a clash here where I must consider ethical ramifications.

As stated, the technical portion of my thesis produced the “Tap Box”. Security is

paramount for our valuables, so our group created an inconspicuous enclosure that is only unlocked with a certain sequence of knocking patterns on its surface. By taking the shape of an everyday, unassuming object, and requiring a unique unlocking mechanism, the chances of unwanted access to the box are minimized.



Figure 1: Prototype of the Wooden Enclosure of the “Tap Box” that Holds all Electrical Components Inside

The box uses two piezo sensors to recognize the knocks, a Wi-Fi application, and a rechargeable battery powering all components. A user inputs the correct sequence of knocks, upon which the box’s door opens, allowing access. For practical use, we chose this project to provide a novel and distinct authentication system from traditional security systems (door locks, numeric keypads, touch ID) where the input method is apparent and thus more susceptible to attacks. From a technical standpoint, we chose this project because of the course-relevant applications involved: a piezoelectric input, a microprocessor, and an extra layer of security access provided via Wi-Fi and a web application.

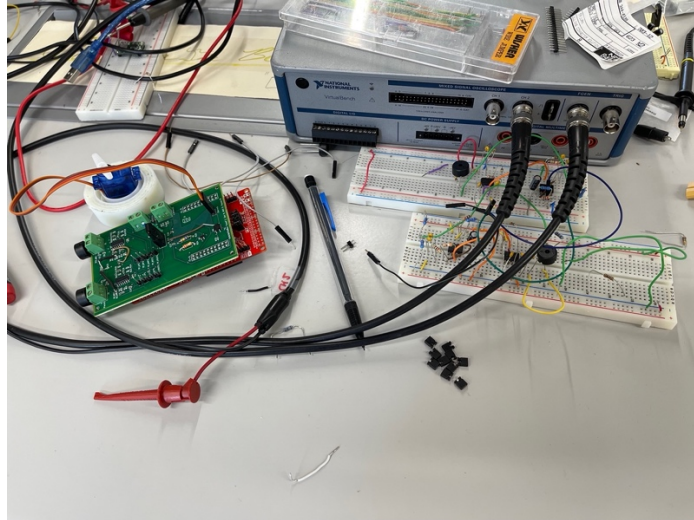


Figure 2: All Electrical Components Involved Including the Manufactured PCB (Green) and Microprocessor (Red), Along with the Breadboards (right) for Preliminary Testing

In my STS research, I wanted to investigate solutions that would mitigate harm to the environment from consumer electronics. Before starting my prospectus in 4500, I did not know if a solution was possible since society values its products so much. It seemed impossible to find a middle ground. However, after deconstructing the issue via a sociotechnical diagram which included actors and motivations, it led to the prospectus and my thinking evolved. I learned that a middle ground is possible. When drafting in 4600, I sought to find STS frameworks that set ideal conditions for solutions to come about. We covered Geels' "Multi-Level Perspective on Sustainability Transitions". Geels mentions how to transition sustainably in a way that is beneficial to the environment. However, a couple conditions must be met: goal-oriented transitions, and solutions that "... do not offer obvious user benefits..." My STS research explored the most optimal solutions for the environment based on these conditions from Geels' framework. These include efficient data centers and mining practices, and relying on people detoxing from their products, as media becomes more invasive.

My project as a whole puts an emphasis on both sides of the consumer electronics

argument. On the technical side, we used consumer electronics to help us in our project deliverable. However, on the STS side, I am analyzing the harm that consumer electronics have on the environment. The STS perspective allows me to think critically on the issue of consumer electronic use. Although I used consumer electronics in the creation of the technical project, the STSRP has allowed me to find solutions to the issue of still using those items but with minimal impact on the environment. By doing this analyzation, I can practice ethical responsibility in relation to engineering practices, specifically by finding the most environmentally efficient methods of creating consumer electronics. Despite the interest clash, both projects enriched each other, as I appreciated both sides of the argument.