UVA PINBALL

HOW THE MODERN ELECTRONICS INDUSTRY VEILS ITS MANY ABUSES

A Thesis Prospectus
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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.

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Introduction

The sociotechnical topic that I am addressing with my STS research is the question of how the development of modern, smaller, and more powerful electronics (due to the application of Moore's law) has led to a rise in slave and child labor in foreign countries because I want to find out why the media and general public are silent on or ignorant of this tragedy. This is important because not only is it necessary to bring light to this topic, but I believe it is necessary to understand not only why many are ignorant of this issue, but why those individuals or groups who are cognizant of the situation choose to "push it to the side." The technical dimension of this problem has to do with the advancement of modern electronics, particularly those that require precious metals to run efficiently. With electronic devices becoming smaller and smaller (yet more powerful), the demand for such potent machines has risen significantly, as they are now common household devices with most families/homes having (many) more than one. This rise in demand has inevitably led to the rise in demand for precious metals which these machines use that are not widely available and require mining/hard labor to obtain and produce. The human and social dimensions of this problem involve the rights of the exploited workers/children and human labor rights in general. It also involves the cause and effect of the rise of an institution/system that uses this method of labor exploitation as its standard of operation. Furthermore, it involves the people that are looking in from the outside on this issue, those who are unaffected and ignorant, and those who are unaffected and cognizant of the issue. The human and social dimensions of this problem tie together quite seamlessly. Firstly, the demand of precious metals in modern, powerful, accessible, and handheld electronic devices has led to the rise in human rights abuses associated with the labor practices and production process surrounding the manufacturing of these devices. Also, these modern devices themselves being

such a commonality and, dare it be said, necessity and craze today could very well influence the average person to associate and define a tragedy such as this as a “distant” and “insignificant” step in the designing of these devices. A statistic from Cross River Therapy says that 48% of adults “‘couldn’t live without’ their phones” (Zauderer, 2023). People may also be influenced to ignore (as described in the above) by the lack of conversation and publicization surrounding this issue. While it may on the surface seem insignificant with respect to the STS topic I have laid out, there nevertheless is a connection between my technical project and the STS topic. For my capstone project, I am working with a team of 19 people (including myself) to construct a University of Virginia-themed pinball machine from scratch.

Now what problem is this project addressing/how does it connect to the STS research? It is not addressing a specific problem per se, rather, the integration of electronics, which includes many semiconductors and cheap electrical parts made in China, points to the awareness of the overlooked problem that plagues the electronics industry of where do these parts come from? How are they made? Who made them? Rather than overlooking these things, I believe they can be brought to light in the context of a pinball machine that is being made in a fast manner because, in the context of modern-day electronics, demand and speed is the common driver of the human rights abuses that I will further address in the “The problem with modern electronics” section.

A UVA Pinball Machine

The playfield is complete with flippers, slingshots, ball locks, ball plungers, UVA-themed art, ramps, lots of LEDs, and references to iconic UVA locations (including a rotating rotunda). The scoreboard itself is filled with a 80s digital scoreboard display, a stained glass rotunda art piece, and a retro (but modern) feel to it. The playfield will be made from a CNCed

1.8” thick slab of wood, with an 1/8” thick aluminum plate underneath the slab for easily mounting parts below the playfield.

The overarching technology and discipline that inspires the entire machine is the field of Mechatronics. Mechatronics, as defined by dictionary.com, is “the combination of mechanical engineering, computing, and electronics, as used in the design and development of new manufacturing techniques” (Dictonary.com, 2023). Essentially, it is the direction in which modern Mechanical Engineering, which I am majoring in, is headed in. As stated by UC Riverside’s blog post on the “5 Engineering Career Paths of the Future”: “One promising development for mechanical engineers is the rise of the Internet of Things, the vast network of interconnected devices and sensors” (University of California, Riverside, 2023). As a hypothetical example, what if in the past you had to make a complex gear system to do one motion, and then you were asked to make an entirely new gear box to make a motion that is incredibly like the former but actuates at a slightly different angle? Well, the solution in the past would be to go back into your complex gear system an change something substantial, or even make an entirely new gear box instead! In mechatronics, the time to create this new motion can be exponentially decreased as a simple line of code can carry out the same job as the one described above. That is simply a rudimentary example, but there are so many applications of this not just with the integration of computer science with mechanical engineering, but with modern electronics as well such as microcontrollers, integrated circuit chips, transistors, etc. Now one can perform a large number of actuations with a motor in the matter of seconds (as a typical microcontroller performs lines of code at fractions of a second [16 million times in a single second, as a fact] (Eliassaf, 2020) while in the past it would have taken possible weeks to

manufacture something to mimic the complex motion that can be done with electromechanical parts in minutes. This is the power of mechatronics.

Going back to the definition as provided by dictionary.com, a pinball machine meets all its requirements. There are sensors, controllers, and electro-mechanical actuators present in a classical game of pinball.

The problem with modern electronics

So, what is the problem at hand? As mentioned above, my STS research question is "How has the development of modern, smaller, and more powerful electronics (due to the application of Moore's law) led to a rise in slave and child labor in foreign countries and why are the media and general public silent on or ignorant of this tragedy?" I will admit, the construction of a pinball machine seems to be completely foreign and separate from this problem, but I believe that the hands-on construction of a machine that uses copious amounts of electrical devices can bring light and awareness to the research of the science of this idea. In theory, the intentional usage of mass-produced electronic devices leads to a greater understanding of them, where they came from, and how they were made.

The question itself is an important one and one that I argue is seldom spoken today of modern machines. To elaborate on the importance of this issue, several sources provide detailed information about the widespread virus of human rights abuses with regards to labor surrounding the production of critical parts of modern electronic devices. The first comes from an article published by The Atlantic, in which the fundamental argument presented is that the backbone of the electronics industry is built on an ugly foundation of forced labor that unfortunately is the driving force in the machine (Ramchandani, 2018). The primary argument is further supported

by a statistic that it presents. The statistic comes from a study done by a group called “Verité” in which 400 Malaysian migrant workers were surveyed and it was found that a whopping 32 percent of them were doing work against their will (Verité, 2014). The article particularly focuses on these human rights abuses in Malaysia, but it also argues secondly that when a country is regarded as having a “booming economy,” it can often be a facade for the concealed truth of human rights abuses that may be happening to run the “machine” that its economy might be built around. In sum, a country can be doing well economically and financially, but it doesn’t say anything about their internal practices/methods. This article provides strong evidence for my prospectus proposal of the presence of human rights abuses and how they can be covered up with sly fashion.

To further emphasize the importance of the issue and to provide more background information, an article from the Guardian shifts the focus to abuses happening in the Democratic Republic of Congo, where men, women, and children undergo severely harsh conditions for no pay in cobalt mines (Kara, 2018). Cobalt itself is used in every rechargeable lithium-ion battery which is found in countless electronic devices (more on that below). According to the article, it is found that China runs and supervises many of the cobalt mining sites in the DRC, which they then use to supply big tech companies that use their technology in the process. In sum, China uses exploited labor to harvest materials needed in modern electronics (particularly lithium-ion batteries) which they then sell to big name electronic companies that we know today. According to another article published by NPR News, the DRC produced about 74 percent of the world’s cobalt in the year 2021, and “Some 20,000 people work at Shabara artisanal mine in the DRC, in shifts of 5,000 at a time,” to put it into context (Gross, 2023).

Now to address the difficult task of "proving a negative" by claiming that the public and media are ignorant of this tragedy. While this task is difficult, I don't believe it is impossible, but it can never be fully "proved" that Americans are ignorant of this tragedy. It may be the case, however, that Americans and the public are somewhat cognizant of the issue, but most choose to purchase these 'tainted supply-chain' products that exist everywhere today regardless of their knowledge. From this point on, and supported by the following evidence, I now make the claim that there isn't a pandemic of ignorance, but rather of indifference from the public side of things. One could say that in my research question I now commit my research on the side of "silence" more than "ignorance" with the "what" behind the public's attitude (I will touch on how I will analyze the media side of this issue in my discussion of research methods section). To push this hypothesis further, I will present an article from Georgetown University that provides a study from a Georgetown University business professor that "finds that people are likely to ignore the fact a product was made at a sweatshop if they really want it" (Georgetown University, 2013). The same logic can be applied to those who know how their electronics are made and possible atrocities being performed in the middle of their supply chains, and I would argue the statistic carries over.

All of the above is just a piece of evidence I will be using to answer my STS research question. Furthermore, the evidence will be analyzed using an approach that considers human actors and parties as both subjects and objects that considers both their perspective as subjects but also the rights due to each as objects with dignity. Considering the source of the evidence, it will come from online resources (particularly mainstream media outlets and also smaller study-based outlets) and scholarly articles (those that address this issue head on) and will be interpreted in an objective manner (i.e. I will keep an eye out for all facts, not just those that support my

proposed hypothesis of the situation). In sum, I will consider all of the facts, not just picking and choosing what sounds the best for my research/ not only that which would slam the electronics industry. Finally, regarding my attempt to try and "prove a negative" and claim that people are ignorant of this topic, I will attempt to gather the frequency in which this topic is talked about. The goal is to put into context the history of the situation juxtaposed with the amount of news articles published throughout that period of history.

Conclusion

To conclude, I will provide once again the rhetoric behind my problem statement: ""How has the development of modern, smaller, and more powerful electronics (due to the application of Moore's law) led to a rise in slave and child labor in foreign countries and why are the media and public silent on or ignorant of this tragedy?" I also want to reiterate the tremendous impact that this situation has on society; it is the driving force behind cheap and accessible electronics and the engine, so to speak, of future endeavors in modern electronics. I expect to uncover some daunting truths for myself and for readers in greater awareness of this tragedy.

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