Ethical and Environmental Analysis

Year: 2018 Semester: Spring Team: 16 Project: Track-on-track

Creation Date: 4/4/2018 Last Modified: April 4, 2015

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Assignment Evaluation:

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| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Environmental Impact** |  | x6 |  |  |
| **Ethical Challenges** |  | x6 |  |  |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** |  | x2 |  |  |
| **Formatting and Citations** |  | x1 |  |  |
| **Figures and Graphs** |  | x2 |  |  |
| **Technical Writing Style** |  | x3 |  |  |
| **Total Score** |  | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

Comments:

1.0 Environmental Impact Analysis

While in operation, the Track-on-track device poses very little threat to the environment. However, the device does have some environmental impact both during manufacture and at its end-of-life state. Individually, the components of the device that pose the biggest environmental threat are the PCB, the lithium-ion battery, and the LCD display.

During manufacture of the components that go into the Track-on-track device, several processes are used that have a significant environmental impact. The process of creating a PCB is particularly dangerous for the environment. For starters, a tin-lead alloy is commonly used to coat the copper of the PCB to protect it from oxidation [1]. Once the patterning is complete, the tin-lead alloy is removed by using a strong acidic liquid, but this leaves a waste product which consists of a highly acidic solution with tin and lead dissolved in it. This waste solution cannot be reused more than a few times, and once it is done, it is almost impossible to dispose of it responsibly [1]. In addition, the creation of vias in the circuit board requires the electroplating of copper onto the sides of the new holes. This process involves the use of a solution containing metal ions, chelates, and formaldehyde [1]. Typical disposal of the waste solution from this product involves diluting it with water until the particle levels meet regulation standard, but this is already expensive and with increasing regulation standards, it may soon become unviable. All these processes also use a lot of water, which puts a burden on local waterways.

The lithium-ion battery is another component that has an environmental cost to produce. Most of the world’s lithium comes from Chile, Argentina, and Bolivia, and the mining process itself is destructive to the environment [2]. Another problem is that the amount of lithium coming out of this area is not longer enough to satisfy the worldwide demand. New mines have been opened in Australia, but the lithium mined there is in a form that requires more processing before it can be used in batteries, which means it wastes a lot more energy, which in turn puts greater stress on the environment [2].

Liquid crystal displays (LCDs) were originally marketed as being more environmentally friendly than CRT displays; however, they still have an impact from mercury and arsenic, both of which are potentially dangerous to humans and the environment.[3] Mercury requires special regulation for disposal in certain countries and the various gases (NF3, SF6, SiH4, etc.) used during the manufacturing process also release hazardous emissions but are cheap to use. [3] Besides requiring environmentally damaging compound for manufacturing, LCD panels, compared to other displays, exhibit the highest inefficiency. They filter white light from a background source to allow only certain colors to be displayed, which is highly power consuming, and roughly 10-20% of the light energy produced by the source is used in the actual display after filtering. [3] The end-of-life period for a LCD introduces the potential for toxic chemicals to find their way to soil and water in tropical conditions. Moreover, LCD panels are very difficult to biodegrade and the liquid crystal itself can emit toxic gases under high heat. [3]

Earlier this year, a new recycling process for lithium-ion batteries was introduced by researchers at the University of California San Diego and Los Angeles that uses half the energy of the conventional process. [4] This new procedure produces compounds that are ready to be implemented in a new battery, whereas, the old process broke down cathodes into separate elements that would later have to be rebonded. The standard procedure involves crushing the batteries and then either melting or dissolving them in acid, which is also potentially dangerous to the environment. The new method requires removing the cathode material, soaking it in hot lithium, drying it to create a powder, quickly heating it to 800°C, and then finally slowly cooling it back down. [4] This process restores and reintroduces lithium into the cathode’s atomic structure. After testing this procedure on batteries that had lost half their energy storage capacity, the researchers found the recycled cathodes had the same energy storage capacity, charging time, and lifetime as the original cathodes. [4] In addition to the research team at the University of California, two other companies are also pursuing similar lithium-ion battery recycling techniques while also trying to scale up the process.

If we were to implement such a recycling process for our batteries, then we would have a potentially lesser impact on the environment. Warning labels should also be printed on the device indicating to users not to dispose of the device by throwing it in the trash, which is common in almost all consumer electronics. This will help alleviate some of the dangerous chemicals and compounds from entering landfills. It is most likely that the battery will be the first component to degrade in our device; therefore, implementing the battery in a way that will make it easily replaced by the user will allow our product to have an increased lifespan.

1. Ethical Challenges

By using our device as intended, no ethical concerns are to be raised; however, our device has the potential to be used with malicious intent. While our project is intended to be used as a tracking device for personal luggage and bags, it also has the potential to be used as tracking device for any other situation. Its small size and ability to retain a battery charge for a significant duration, only assist in its ability to be used as a malicious tracking device that’s commercially available. This includes, but is not limited to: stalkers tracking victims, criminal assailants tracking victims, and general tracking of persons unknowingly without their consent. Unfortunately, there is no effective way to prevent this kind of use, other than try to mitigate it by placing warnings in the product manual that clearly outline the lawful actions that will be taken if used with ill-intention.

Another concern is for the possibility of the included lithium-ion battery to be tampered with or used in an inappropriate environment. With the potential to be used as an explosive, it’s very important that the proper warning labels and cautions are provided to the end user. By implementing the battery in such a way that makes it hard for the user to access, these concerns could be lessened; however, this then conflicts with our environmental concerns to make the battery easily replaceable, so a whole device doesn’t require replacement when the battery reaches its end-of-life.

3.0 Sources Cited

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