A11 - Ethical and Environmental Analysis

Year: 2023 Semester: Fall Team: 8 Project:Smart Seat System

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Assignment Evaluation: See the Rubric in the Brightspace Assignment

1. Environmental Impact Analysis

The environmental impact of our smart seating occupancy sensor can be outlined across its life cycle ( manufacturing, normal use, disposal ), starting with manufacturing. Our PCB and sensors like FSR, thermal, and ultrasonic introduces concerns about the use of hazardous chemicals during manufacturing. [5] For instance, PCB’s are typically made of copper and other various materials. The fabrication process involves using acids, solvents and other chemicals for etching and soldering. These substances can pose environmental risk to the environment if not handled well. To address this issue, exploring alternative materials, and employing cleaner production might minimize the environmental effects. Secondly, the use of lithium-ion batteries poses a threat in the manufacturing process. The manufacturing process of lithium-ion batteries is energy intensive [6].It involves multiple stages, including mining, processing and assembling. Chemicals such as lithium cobalt oxide and lithium nickel cobalt can pose environmental risks and if it is not properly managed during manufacturing it may cause release of toxic substances into the soil and water. Thirdly, our smart seating occupancy sensor has a wooden board that holds the PCB and all the other sensors. This might be a small issue but in a large scale production case, this may have environmental issues as the wood needed comes from trees. This can be improved by using polymers such as plastic or other materials but may have severe impact during disposal. Finally,our design uses a fair amount of wire connection as the PCB and the sensors are separated and connected by cables. In large production of our design, a high number of wires involve extraction and processing of copper metals. Mining these materials can lead to soil erosion, and habitat disruption. Moreover, the manufacturing process may involve energy-intensive procedures. One possible solution might be making a better PCB with all the components in one board. Although this solution might advance the first problem, overall the manufacturing might lower its environmental effect.

During normal use, the reliance on single-use batteries ( Lithium Ion batteries ) becomes an environmental challenge. [7] Firstly, monthly replacement of these batteries contributes to electronic waste which becomes an environmental concern. Secondly, while lithium-ion batteries have become a popular and efficient energy solution, they do have negative environmental impacts. For instance, lithium-ion batteries are susceptible to thermal explosion or fire. These safety concerns pose a risk. To solve this impact, transitioning to rechargeable batteries or exploring alternative power sources that offer a longer lifespan. Reducing the frequency of replacements might lessen the environmental effect however there are still down sides. While rechargeable batteries are recyclable, it is power intensive. This can contribute to greenhouse gas emission and environmental degradation. One solution to this might be using solar power ( renewable energy ), while the cushion has to be cleaned, the cushion can be set under the sun and recharge by itself.

In terms of disposal and recycling. [6][7] Single use batteries ( Lithium Ion batteries ) contain hazardous materials ( lithium cobalt oxide and lithium nickel cobalt manganese oxide ), these can pose environmental risks if not properly managed during disposal as the release of toxic substances into the soil or water may impact the ecosystem and potentially harm human health. Burning or incineration is also one of the methods of disposing of e-waste. Burning PCBs release harmful pollutants in air, The combustion of electronics produces dioxins posing threat to any living organism [4]. To improve PCB disposal, new improved techniques should be used such as mixing precious metal with acid or smashing the PCB into powder form. Although all the above techniques are an improvement, it does have side effects such as noise pollution, release of harmful industrial dust into the environment, and heavy and expensive equipment.

1. Ethical Challenges

Our smart seating occupancy system that allows users to check seat availability through their phone presents various ethical challenges that includes privacy, security and user autonomy. Below are some of the examples of ethical challenges and how we overcome them.

* Privacy concerns: collecting and storing data about user seating may raise privacy concerns, users might be uncomfortable with the idea that their location or activity information is being tracked. The ACM ( Association for computing machinery ) emphasizes the importance of respecting the privacy of individuals and protecting their personal information ( Principle 13 ). [2]
* Solution: Our design is a live checking system meaning that our device does not store information but collects information every interval of time to ensure if the user is seated. Moreover, to follow ACM principle 13, we have used a specific sensor ( FSR, Ultrasonic, pressure) that does not harm the user’s privacy in any way.
* Informed consent: Ensuring that the users provide informed consent for the collection and use of their data is crucial in our system. Users should be fully aware of what data is being collected, how it might be used and also have choice. This comes from the IEEE Code of ethics where it says to respect the privacy of others and ensure informed consent ( Canon 4 and 5 ). [3]
* Solution: To ensure that users are informed with the collection of data, the first thing the user will see when the app is downloaded is the consent form where the users are communicated with all instructions and data that is being used, they will a also have the choice to choose to opt in or out.
* Data Security: Safeguarding the data collected by the smart seating system is one of the most important as one cannot have power over the data. If the data is not kept safe than manipulation of seating arrangement and confusion to the users might occur. The ISC2 code of ethics highlights the responsibility of information security professionals to protect and secure information ( Code 1 ). [1]
* Solution: to safeguard the data used in our cloud base system, our team has created a very safe software environment that is very hard to hack.

Addressing these ethical challenges requires a multidisciplinary approach. It is essential to consider the societal implication and values to ensure the responsible development and deploying the smart seating system.

3.0 Sources Cited

[1] (ISC)². "Code of Ethics," [Online]. Available: https://www.isc2.org/ethics

[2] ACM. "ACM Code of Ethics and Professional Conduct," [Online]. Available: https://www.acm.org/code-of-ethics

[3] IEEE. "IEEE Code of Ethics," [Online]. Available: https://www.ieee.org/about/corporate/governance/p7-8.html

[4] Ewaste1. "How Does Recycling Electronics Help the Environment?" [Online]. Available: https://www.ewaste1.com/how-does-recycling-electronics-help-the-environment/#:~:text=E%2Dwaste%20Contains%20Toxic%20Substances&text=When%20e%2Dwaste%20is%20exposed,both%20land%20and%20sea%20animals.

[5] PCBNet. "PCBs and the Environment," [Online]. Available: <https://www.pcbnet.com/blog/pcbs-and-the-environment/>

[6] Institute for Energy Research, "Environmental Impacts of Lithium-Ion Batteries," [Online]. Available: https://www.instituteforenergyresearch.org/renewable/environmental-impacts-of-lithium-ion-batteries/#:~:text=The%20production%20of%20lithium%2Dion,vehicles%20populate%20the%20world's%20roads.

[7] Underwriters Laboratories (UL), "Environmental Impacts," [Online]. Available: https://ul.org/research/electrochemical-safety/getting-started-electrochemical-safety/environmental-impacts.