Using UX Design to Integrate AI into an Existing Platform

The Unacknowledged Harms of Electronic Waste in the US

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

Cloud-based log managers allow customers to use their platform for real-time monitoring of security and performance. The companies' infrastructure handles large and complex datasets. Such software may seek to integrate artificial intelligence (AI) into the existing interface yet needs to ensure infrastructure is compatible before integration ensues. By conducting a case-study of a business-to-business log management platform and interviewing subject experts, my team examined how AI integration should be implemented within their existing software. Their platform uses a personal SQL-based query language, inputting code to create visualizations and dashboards of user-deemed relevant information. Users, regardless of experience, face difficulties with the existing infrastructure. New users interact with the query language with varying levels of coding familiarity, leading to mistakes and learning inconsistencies while experts are burdened by excessive knowledge. This results in a high barrier to entry and avoidable mistakes respectively.

The purpose of this project is to make the log management process easier for users of all levels and move beyond query-based processes toward a conversational interaction. The capstone will yield an accessible, redesigned interface with an AI-powered chatbot, aiding users with log searches. The design will provide context-aware suggestions that draw from natural language models to make data analysis more efficient. Users will seamlessly transition between code and natural language based on their specific needs.

Companies that wish to incorporate AI within their business model represent the larger trends seen within the US, which ultimately can lead to harmful environmental practices. In describing the Sustainable Development Goals of the IEEE, Aníbal Monasterio Astobiza and co-authors (2021) analyze emerging technologies against sustainable development goals (SDG) set

by IEEE. The authors specifically address AI technologies, stating that AI design should be constrained by a human rights framework. Another framework measuring environmental impacts of digital spaces is Mightybyte's digital carbon ratings (DCR). In describing what makes a good DCR, Tim Frick (2023) addresses the potential complications with quantifying the digital realm's carbon emissions and offers the company's alternative, transforming technical quantities such as a webpage's "weight", as sourced by HTTP Archive (*State of the Web*, 2023), into a grading scale. Companies' integration of AI should be analyzed using frameworks like SDG or DCR to understand environmental consequences.

One consequence of US corporations' technology developments is their impact on the electronic waste industry, a problem that integrating AI will exacerbate. It's known that metal exposure as a result of electronic recycling can pose a risk to workers' health and safety (Nukpezah et al., 2014). These issues are supposedly prevented with N95s and frequent handwashing, however observations show that these practices are not always enforced (Gravel et al., 2023). There is not enough action being taken to further understand and prevent health consequences, as they continue to happen both within the US and globally.

This prospectus report lays out the groundwork for my final thesis report to conclude my Bachelors in Science in Systems Engineering at the University of Virginia (UVA). I will use a previous thesis written by Emma Peck (2021), a Systems Engineering alum from 2021, to guide my analysis and method construction. My thesis report will describe further in detail my technical capstone project, related to the UX redesign of an existing company's log search algorithm, and my STS topic, or the electronic recycling industry within the United States.

Technical Topic

User experience seeks to optimize the interactions between a user and the system. While the process involves creative elements such as prototyping and heuristic evaluation, the current industry seeks to stay on the forefront of new technologies such as AI. The global AI market is projected to have an annual growth rate of 37.3% from 2023 to 2030 (*Artificial Intelligence Market Size, Share, Growth Report 2030*, 2023) and, with the recent public release of ChatGPT in November of 2022 (*Introducing ChatGPT*, 2022), the demand to embrace AI has become pressing, including within the professional UX community.

The project aims to incorporate user experience with the existing log managament interface to create a well rounded, intuitive platform. The interface will be redesigned using Figma, a cloud-based, collaborative prototyping tool for designers.

My team will consider UX factors when developing and analyzing prototypes. The project will favor knowledge in the world instead of knowledge in the head, two concepts describing users' method of information retrieval. Knowledge in the head forces users to rely on their existing memory while knowledge in the world prompts the platform to guide them, interacting with the interface to collect information (Norman, 2013). The UX redesign will offer user customization opportunities, considering both personalization and customization. Personalization is offered by the system and used behind the scenes and customization consists of changes individual users make to their system. Personalization and customization allow a system to meet a variety of user needs and keep the user engaged, yet these positive qualities cannot save a broken interface (Schade, 2016). These methods must be used thoughtfully, as excessive customization and personalization may overwhelm and upset the user. The two also require extensive implementation and maintenance time, which my team will gauge with

industry experts on their ability to provide monitoring following the project's completion. The team will consider other important UX concepts such as use cases, maintaining consistency, creating a fluid workflow, and accessibility, leading my team to create a meaningful and relevant experience for customers.

While the interface design calls upon technical UX skills, the incorporation of AI will require specialized machine learning model training. The software will build off an existing chat AI such as OpenAI, and help users write queries, correct coding errors, and generate visualizations related to their analysis. The software will use Natural Language Processing (NLP), the transformer between humanistic language and coding language, to conduct analysis. This process poses many difficulties since natural language creates ambiguity for a computer (Chowdhary, 2020). The project involves training the model to adapt to existing terminology and human language as well as reconstructing the training program so users may effectively use the AI. Final software implementation will ultimately be performed by the company itself.

Combining and monitoring these two areas of technical knowledge–UX and model training–is vital to ensure the quality of the project, and integrating AI will prevent customer turnover.

STS Topic

The increased demand for AI hints at broader trends seen in technology. Companies are trending away from physical records and are relying on digital repositories to track information. The move from paper to electronic storage contributes to electronic waste. A study conducted on electronic waste in India found that the business sector accounts for 78% of total installed PCs today (Pinto, 2008). Companies should be concerned about this increase in electronic usage, as

the environmental impacts are not adequately researched and only 25 of the 50 states within the US currently have e-waste regulations (*Regulations, Initiatives and Research on Electronics Stewardship*, 2022).

Studies of electronic waste follow electronic equipment from its disposal to its end-of-life. E-waste breaks down items into common components and materials for potential for reuse. Other materials that are not easily reused are treated separately, including but not limited to plastic, glass, metal, or plywood (Pinto, 2008). In a study concerned with inappropriate e-waste practices, researchers found that 25% of e-waste is properly disposed of with adequate worker protection (Perkins et al., 2014). Improper e-waste recycling creates health concerns for workers, including cuts, metals leaching into groundwater, inhalation, chemicals released from burning, or acid contact with skin and eyes (Pinto, 2008). The long term effects of these risks are not adequately understood.

To understand how humans and technology interact, Susan Leigh Star presents properties of infrastructure (Star, 1999). She coins the term visible when broken as a system not operating as intended and thus being noticed. This is relevant to both UX design and e-waste. This project was motivated by the current log management infrastructure posing visible issues. In an article published to Medium, the author cites that the best examples of UX design are those that are invisible and make the customers' life easier without their explicit acknowledgement (projekt202, 2019). The same can be said for the e-waste industry: those who acknowledge the importance of improving recycling are usually those who see issues with the infrastructure. The infrastructure behind e-waste allows for much to go unnoticed and enables a false sense of security.

Star cites learning as a part of membership as another infrastructure property, or that certain features of infrastructure are not intuitive and need to be learned (Star, 1999). Log management companies currently have guidelines and certification courses available, however the process is lengthy. Companies can instead transform the learning into the infrastructure itself. Recycling, similarly, is learned, however this can lead to resistance to change. Carlson's (2001) article in the California Law Review explains that cultural norms are difficult to change, citing recycling as an example, explaining that there is a "small-payoff [...] if the desired behavior change is relatively inconvenient [...]" (p. 1232). Learning to recycle is not intrinsically known, but instead has to be taught.

E-waste and its link to UX design will also be analyzed using Sara Spiekermann and Till Winkler's (2022) proposal of value-based engineering (VBE), which is a broad perspective requiring engineers to consider risk and quantitative analysis instead of a design-based, conceptual perspective offered by the similar yet contrasting value-sensitive design (VSD). VBE is easily translatable between practice and execution, while its counterpart VSD is not. Considering VBE, I will seek to understand how the current e-waste industry compares to the IEEE 7000 standards laid out by Spiekermann and Winkler. This will then demonstrate the moral lacking in the current e-waste industry and how stakeholders should go about improving the process.

Research Question and Methods

This leads into my research question: how has the increased electronic usage in business changed e-waste management and exacerbated existing problems within the US' recycling industry?

This question is essential to answer since US businesses are projected to increase their computer power and cloud usage within the coming years. The demand of cloud computing due to AI surpasses its current supply. Cloud computing services currently have a small percentage of AI-optimized infrastructure compared to their overall cloud footprint (Bousquette, 2023). With this demand for AI comes an accompanying call for hardware and electronics developments. This increased electronic usage by the business industry may exacerbate the current problems with the US's electronic waste management if existing health risks are not adequately addressed.

I propose analyzing this research question by interviewing workers and management of an electronic waste facility as well as Facilities Management (FM) at UVA. Electronic waste facilities employees are familiar with precautions taken to prevent health risks and management may wish to advocate for their employees health and safety by raising awareness. FM at UVA collects electronic waste from UVA academic halls and libraries. An interview with FM would aid in further understanding of how UVA processes electronic waste and issues related to this collection. I will utilize Leonard Ortolano and Anne Shepherd's report on environmental impact assessments, which addresses the difficulties and uncertainties of properly reporting environmental impacts, to guide the construction of my survey (Ortolano & Shepherd, 1995).

Some questions I will ask include the following:

- What are existing problems within the electronic recycling process and how can they be improved?
- How have these problems been exacerbated in the last 10 years?
- How would you like to see the US government handle electronic waste?

Asking these questions will provide first-hand experiences of the harms of electronic waste and recycling within the US.

Conclusion

Current log search algorithms require users to complete extensive training and learn a specialized coding language, however the user onboarding process is difficult. Log management platforms that seek to incorporate AI call for a redesign of their interface, prompting my capstone team to develop wireframes, prototypes, and conduct a heuristic evaluation. This redesign will offer new users the opportunity to learn the coding language through AI NLP and experienced users the chance to reduce their coding time.

The surging interest in AI, as demonstrated through my technical project, may have rippling effects on society, specifically on electronic waste in the US. To prevent these harmful effects, there must be a push for electronic waste awareness and worker protection. In conducting interviews with people involved in electronic waste, I anticipate speakers will give light to how understudied electronic waste is and urge listeners to advocate for worker protection and government funding.

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