Thesis Portfolio

Racing Battery Management System
(Technical Report)

How Electric Vehicles Are Raising Ethical Concerns in the Name of Saving the Climate
(STS Research Paper)

An Undergraduate Thesis

Presented to the faculty of the School of Engineering and Applied Science

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In Fulfillment of the Requirements of the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Introduction

At UVA I have had the unique opportunity to double major in Computer Engineering and Computer Science. As such I worked on two separate technical capstone projects each with their own challenges, ethics, and social impact but with a general focus on the automotive industry. My CpE technical paper discusses the creation and integration of a high-performance battery management system for a student built electric racecar. My CS technical paper focuses on the longitudinal control (throttle and brakes) of a full-size autonomous racecar. For the sake of simplicity, I have decided to correlate my STS research to my Computer Engineering technical research paper and as such my STS research paper focuses on the ethical and societal concerns regarding the widespread adoption of electric vehicles.

Project Summaries

In my STS research paper titled "How Electric Vehicles Are Raising Ethical Concerns in the Name of Saving the Climate," I explore the complex ethical implications of the United States' transition towards electric vehicles (EVs) as a strategy for combating climate change. This transition, while beneficial for reducing carbon emissions and improving public health, is fraught with social and ethical challenges, particularly concerning the sourcing of battery materials like lithium and cobalt from regions marked by labor exploitation and environmental degradation. The paper delves into the broader societal norms and practices influencing this shift, highlighting the need for a holistic approach that considers not just technological advancements but also the ethical dilemmas arising from material extraction, environmental impacts, and the disposal of internal combustion engine vehicles. Through an STS framework, I aim to shed light on the

social barriers hindering the adoption of EVs and propose solutions that encompass informed policymaking, corporate responsibility, and public engagement to ensure a sustainable and ethically sound transition to electric transportation in the U.S.

In the technical portion of my portfolio, I present the comprehensive development and realization of a Racing Battery Management System (BMS) designed to optimize the performance of electric race vehicles by managing the conditions of the battery pack under the rigorous demands of competitive racing. Our team, comprising members with diverse expertise in electrical engineering, software development, and embedded systems, collaborated to create a BMS capable of monitoring and balancing cell charge distribution, ensuring efficient operation and longevity of the battery. We navigated challenges including cost constraints, design and manufacturing limitations, and stringent external standards to deliver a prototype that successfully monitors each cell's temperature and voltage, performs active cell balancing, and implements safety features for over-voltage, under-voltage, and over-temperature conditions. Through a mix of hardware design, embedded programming, and real-time data communication, we achieved a functional system that not only meets the physical and performance specifications required for the intense environment of electric vehicle racing but also lays a foundation for future enhancements. This work underscores the critical role of interdisciplinary collaboration and innovation in advancing automotive technology, particularly in the pursuit of sustainable and high-performance electric vehicles.

Conclusion

Working on both the technical project of developing a racing BMS and the STS research paper on the ethical considerations of EVs offered a comprehensive learning experience that brought ethical considerations to the forefront of engineering and design. The practical

challenges faced during the BMS development provided concrete examples of how ethical considerations play out in engineering decisions, particularly around safety, sustainability, and performance. This combined experience highlighted the critical role of ethics in engineering, showing that the goal of technological development should be not only to innovate but also to contribute positively to society and the environment. Through these projects, I learned that integrating ethical thinking into the engineering process is essential for creating technology that is not only advanced but also responsible and beneficial for the wider community.

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