Thesis Project Portfolio

Racing Battery Management System (BMS)

(Technical Report)

A Study on the Ethics of AI Content Generation

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My technical and STS research projects are unrelated in their scope. My technical project focuses on battery management systems (BMS). Large battery packs that consist of many cells need a BMS to monitor all the cells to ensure safe operating conditions. Without a BMS, battery cells can quickly degrade. This is extremely wasteful as the battery's materials are environmentally taxing to source and discarded batteries leak toxic chemicals into the environment. In extreme conditions, battery cells can even explode, causing harm to the device and potential users. With a BMS, these conditions can be avoided and the life of the battery pack can be extended. My STS research project focuses on creating and implementing content-generating Artificial Intelligence (AI) tools. Content-generating AI tools are relatively new and their adoption into many forms of media creation has been rapid and noticeable. However, switching from human creative labor to machine output has serious implications for the media being created and for the artists that these AI tools are emulating. These tools are almost entirely unregulated and common unethical practices are currently permitted to continue.

For my technical project, the specific problem my team of four intended to solve was the creation of a BMS that was safe, reliable, and efficient for a student-created electric racing vehicle. To ensure safety for the users, we strictly adhered to IEEE and Formula rules on high-voltage printed circuit boards (PCBs) and BMSs in general. This included wide traces for high currents, the insertion of temperature sensors monitoring every other cell in the battery pack, and markings on the PCB indicating high voltages. To ensure reliability we implemented a well-documented BMS chip and created communication protocols for temperature and cell charges to be relayed to a main control unit. Furthermore, to ensure reliability and energy efficiency we implemented active cell balancing which redistributes charge from weak cells to

strong cells during charging and from strong cells to weak cells during discharging. This increases the lifespan and energy efficiency of the battery pack.

My STS research problem focuses on the creation and implementation of AI specifically for media creation and what it would take for these tools to be ethical. AI tools for content generation allow anyone with access to these tools to easily create misinformation, generally harmful content, and content in a real artist's likeness, but this can be reduced by requiring filters that prevent harmful content from being generated. Training data for these tools is commonly gathered from copyrighted and discriminatory sources which can be addressed through legislation that regulates how training data is collected. Finally, the long-term implementation of these tools can displace artists and increase the quantity of stale media. This is a difficult problem to address with regulations, but when content-generating tools are used to aid creative design and not replace it, it generally makes for a better product.

Creating a BMS for an electric racing vehicle was successful. This project was limited in scope to just the BMS and not its implementation with the other circuits and mechanisms within the electric vehicle. However, further work has already been done by the Formula Racing team as they have implemented the BMS within the racing vehicle and it has passed their safety tests. My research into the conditions for an ethical content-generating AI tool was successful in analyzing societal issues that arise from these tools. This research is limited in its scope to purely content-generating AI tools and their effects, not to general AI tools. Further research can be done on the feasibility of widespread regulation to create an ethical content-generating AI tool.

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