BRUSHLESS DC MOTOR FOR TEACHING

EXAMINING INTERDISCIPLINARY INNOVATIONS IN ENGINEERING UNDERGRADUATE LABORATORY

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SOCIOTECHNICAL SYNTHESIS

Improving engineering education means improving the professionals and technology that will underly the future of society. The technical research topic aims to improve the engineering lab education at the University of Virginia (UVA) by providing a brushless DC motor for students to examine and experiment with. By incorporating educational elements into the design, the motor helps students explore applied electromechanical concepts. The science, technology, and society (STS) topic argues for an interdisciplinary approach to engineering lab education that includes non-technical skills such as communication. The STS research demonstrates the success of these class concepts at other universities, then makes an argument for the application of these innovations to the University of Virginia. The technical and STS concepts are strongly coupled, with both focusing on the evolution of engineering education and seeking to apply broader lessons to UVA.

The brushless DC motor developed in the technical portion of this project meets a specific need of the UVA Power Lab for a motor for educational use. The motor not only allows students to see such a motor in action, but also provides a demonstrative screen and lights to show students the forces at work in the motor. The physical motor was designed with computer-aided design (CAD) tools, the software was developed with the Code Composer development environment, and the electronics were designed with the Multisim and Ultiboard applications.

The motor was successfully built, along with the planned indicators and screen for enhanced educational value. While the exact software process behind motor commutation differed from the original design, the overall logic and electromechanical design was retained. The motor will be placed in the UVA Power Lab as intended, and has several ports available if future software modifications or control implementations are desired.

In service of the project goal of evolving engineering education, the central question of the STS research was: how can modern engineering laboratory be innovated to better prepare students for modern work? The research suggested that interdisciplinary courses with emphasis on communication skills will provide the next step in engineering education. To arrive at this conclusion, the lab structure itself was treated as a technology. Viewing lab in this way allowed the Social Construction of Technology (SCOT) framework developed by Pinch and Bijker to be applied, treating lab as a technology that evolves through its application to problems by social groups. By looking at the history of engineering lab and current innovations in course structure, precedent for interdisciplinary courses with emphasis on communication skills was found.

The tension between technical and theoretical emphasis found throughout the history of lab education suggested that no consensus on that matter will be found. Instead, the STS research focused on common themes, such as communication and the desire to prepare students for the workplace. Shortcomings in technical documentation and requirements elicitation suggested that these themes were not being properly emphasized in lab education, prompting a search for courses that approached them differently. Innovations at MIT and Northwestern University suggested that an interdisciplinary introductory course with emphasis on communication would be of value, leading to an argument for UVA to adapt these lessons to an undergraduate course.

The overall goal of the project, to improve engineering education, was sought through the application of both physical resources and theoretical analysis to courses at UVA. Beyond whether or not these research arguments will be adopted, the larger conclusion that the project has taught is that every student has the power to enrich their engineering experience by thinking critically about the structure of their learning, and how they can be active participants in the social construction of their education.

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