Thesis Project Portfolio

Student Researched and Developed High Power Rocket

(Technical Report)

Modern Society's Embrace of Social Media

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

Leo Bashaw

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Department of Mechanical and Aerospace Engineering

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Executive Summary

The acquisition, transmission, and analysis of data permeates almost every aspect of modern society; therefore, it is crucial that we investigate the societal impacts of our extensive reliance on data. In my technical research, I develop an avionics system for a stage one sounding rocket which gathers flight data, analyzes it to deploy the rocket's parachutes, and transmits it to ground control. This project was undertaken to develop methods of integrating commercially proven electronic systems into student-designed solutions, and to advance the University of Virginia's Spacecraft Design capstone program in its first year. My socio-technical research focuses on the widespread embrace of social media platforms, their effect on societal health, and the actor-network that ensures their continued existence. I chose to study this topic because I wanted to better understand the consequences of our extensive use of social media at both the individual and community levels.

The avionics system developed for the sounding rocket ensures reliable parachute deployment and serves as a platform to validate our student-designed apogee detection algorithms for future years. The system incorporates an Arduino Nano as its core processing unit and records crucial flight parameters such as temperature, pressure, humidity, acceleration, and attitude. Leveraging the Nano, the system interprets real-time acceleration and pressure data to accurately detect the rocket's apogee and deploy the rocket's two parachutes during its descent. The output of the Nano is compared to that of a commercially proven apogee detection system, which was added since our student-designed system was unproven and could jeopardize the team's safety if it failed. Beginning with small-scale circuit diagrams, the system gradually evolved in complexity as new components and functionalities were integrated under the guidance of our expert faculty advisors.

We conducted numerous tests to validate and finalize our design, all of which were successful. We performed small-scale data acquisition and radio transmission tests and tested the circuitry and power sources responsible for parachute-ejection-charge ignition. Additionally, the system was designed with safety and resiliency in mind: the circuit has multiple power sources and duplicates of the sensors that measure critical flight parameters. Despite several logistical and administrative challenges that forced us to redefine our system requirements during development, we are confident that this circuit is ready for printed circuit board (PCB) design and installation in the rocket for a full-scale flight test. The successful performance of this system at full-scale would serve as a foundational step towards the realization of completely student-developed electronic systems within UVA's Spacecraft Design capstone program.

My socio-technical research addressed the following question: can we trust that large social media platforms (those with billions of users) are truly advancing society? The answer(s) to this question can inform policymakers, users, and platform developers about the societal impacts of large social media platforms. An increased understanding of their impacts would help change regulations, platform design, and user behavior in a way that could push our digital landscapes towards a healthier and more sustainable future. My research made extensive use of actor-network theory, case studies of social media companies, government agencies, and interest groups, and academic literature review.

I found that generally, social media platforms cause harm to society that is vastly disproportionate to the benefits of their use, and that these destructive platforms are kept alive by profit-motivated collaboration between government and corporate actors. These findings are evidenced by the details of the case studies, external research findings, and the numerous lawsuits and scandals involving social media corporations. I conclude that few actors besides

users - when they act en masse - have the capability to truly change these social media platforms for the better, since social media is so deeply entrenched in economics and politics. I add that any serious action to restructure these platforms would be globally disruptive for the same reason.

The synthesis of technical advancements in rocketry and a socio-technical analysis of social media ethics underscores the interconnectedness of technology and society. By addressing the challenges and ethical dilemmas inherent in our digital landscape, this research portfolio contributes to a more nuanced understanding of the opportunities and responsibilities afforded by technological innovation in the 21st century.