Thesis Project Portfolio

A Space Based Solution to Improve Roadway Safety and Efficiency in Virginia: Real Time Winter Weather Data for Navigation

(Technical Report)

Analyzing the Dark Data Crisis Within the Framework of Value Sensitive Design

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My technical report details a spacecraft design project where we address Virginia transportation issues using remote sensing and data fusion methods. The project requires gathering data on real time weather forecasts and traffic patterns to provide more accurate information on weather and road conditions to drivers, autonomous vehicles, and satellite navigation services. Although frequent data collection is imperative to the success of this project, it is just as important to consider the negative consequences of excessive data collection. Over the past decade, big data has allowed for advancements in industries such as healthcare, banking, retail, and more. Despite these advancements, big data also warrants the need for regulations concerning consumer privacy and safety. The STS research paper explores ideas of excessive data collection and "dark data."

This academic year, my UVA spacecraft design capstone class worked closely with MITRE to use real time weather data to improve Virginia's roadway safety. Although roadway users may rely on weather forecasts, the Virginia Department of Transportation uses road condition measurements that differ from meteorological data reported to drivers. There is currently no transparent method to provide this information to drivers. Our primary mission objectives were to detect and identify snow-covered, ice-covered, or dry highways using remote sensing techniques and effectively distribute this data to roadway users and managers to improve safety using a 6U CubeSat spacecraft. A full conceptual design review detailing mission objectives and constraints, spacecraft subsystems, preliminary designs, financial budget, and risk mitigation strategies has been developed and incorporated in the technical report.

The STS research paper explores the implications of data-driven technologies through a framework known as Value Sensitive Design (VSD). VSD is a design methodology that

advocates for the integration of human values when planning or designing a new technology. User values such as privacy and autonomy are often not considered during the design phase of a new technology, leading to privacy concerns among the public. The research paper conducts a conceptual, empirical, and technical investigation of data-driven technologies and identifies where the value discrepancies between corporations and consumers may lie. Furthermore, the paper explores the idea of dark data, information that organizations may not be able to see or do not know has been collected, and answers how corporations can limit the amount of dark data collected.

The work done so far in the spacecraft design capstone has the potential to improve roadway conditions and prevent weather-related traffic accidents in Virginia, and potentially the United States. While working on this project, I not only refined technical skills in CubeSat design, but learned how to effectively tackle a large problem and communicate with stakeholders through the space mission engineering process. Furthermore, the work I have done in my STS research will ensure that I keep human values in mind while designing technologies in my career in the future. Lastly, I would like to thank Professor Chris Goyne for his guidance in the spacecraft design capstone course and Professor Sean Ferguson for all his feedback during my STS research.