SOCIOTECHNICAL SYNTHESIS

Within the United States, car-centric city design has deadly impacts on non-vehicular transportation. The International Traffic Safety Data and Analysis Group is a subsidiary of the Organization for Economic Co-operation and Development International Transport Forum and it found in 2020 that between 2010 and 2018, while European countries saw a decline in cyclist and pedestrian death, pedestrian death rates increased more than 40% and cyclist death rates increased more than 80% within the U.S. The technical and STS research topics explore two means of technical intervention in the cycle of car-centric design. The technical research topic aims to intervene at an individual level by providing advanced notification of collision risks to cyclists. The STS research topic examines potential stakeholders in the installation of a multi-use path in Charlottesville, VA to prioritize human-powered transportation in city infrastructure.

The technical research project, completed in December of 2021, addresses the lack of bicycle collision notification systems in the market through designing and prototyping a device to alert cyclists of cars approaching from the rear. The device, developed in collaboration with Brandon Brnich, Julia Graham, Julia Rudy, and Rex Serpe, consists of a display mounted on a bike's handlebars which is powered by a solar-rechargeable battery. The display flashes with increasing urgency as vehicles approach from behind the cyclist to restore agency to cyclists in avoiding collisions arising from their blind spots.

The final prototype was submitted to technical advisor, Professor Harry Powell and fulfills seven metrics designed to verify the efficacy of the device at consistently providing advanced collision notification for cyclists. The prototype is resistant to changes in weather by both protecting sensitive electrical components from damage and maintaining sensing accuracy regardless of environment. The system provides an alert that incorporates speed and distance

signals into an intuitive notification, and the whole system can power the notification through solar energy and a long-lasting backup battery. Overall, the device is a novel approach to advanced collision notification that can be used in nearly all commuting use cases.

The STS research paper explores potential stakeholders in the installation of a multi-use path in Charlottesville for use by cyclists and pedestrians alike. Reducing the overall rate of car usage in the city will necessitate centering human-powered transportation in infrastructure development to overcome the long-standing practice of designing U.S. cities to maximize automotive efficiency. In his 2008 book, Fighting Traffic, Peter Norton provides a historical analysis of U.S. cities as they evolved to place cars at the forefront of traffic design decisions. Examining this evolution through Bruno Latour's 1992 Actor Network Theory framework illuminates the mechanisms by which traffic infrastructure has become a means to discriminate against bicyclists and pedestrians Supplementing Actor Network Theory with Susan Star's 1999 Ethnography of Infrastructure framework shows how mindful development of technology can be used to remedy this discrimination at a societal level.

The city of Boulder, CO has successfully centered pedestrians and cyclists within its urban infrastructure at a societal level by creating multi-use paths completely separated from automotive roadways. Through studying the stakeholders involved in Boulder's multi-use path development, the STS research identifies the analogous actors within Charlottesville to make a recommendation for voices that should be included in Charlottesville's development of a multi-use path to increase the accessibility of human-powered transportation in commuting trips. This research finds that the most critical actors in developing successful technical mediators at a societal level are individual community stakeholders that emphasize the brokenness of the current system.

Taken together, the technical and STS research of this capstone reflects a larger systemic problem: U.S. traffic infrastructure, because of its overwhelming focus on automobiles, creates an ecosystem that harms and even kills cyclists and pedestrians. These theses are tightly coupled through their shared focus on human-powered transportation technology development. Expanding the body of work supporting pedestrian and cyclist mobility is critical in bringing the U.S. up to par with its European counterparts and for protecting cyclists and pedestrians alike.

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An Undergraduate Thesis Portfolio
Presented to the Faculty of the
School of Engineering and Applied Science
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Electrical Engineering

By

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