Thesis Project Portfolio

Adaptive Trailer Hitch System

(Technical Report)

Digital Safety Systems in Light Passenger Vehicles: a Sociotechnical Analysis

(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

In an era where technology intertwines with our daily lives, understanding the implications of advancing digital integration in vehicle safety and control is paramount. My technical research report provides an overview of research into an Adaptive Trailer Hitch System. This system In a similar vein, my Science, Technology and Society (STS) research paper, “Digital Safety Systems in Light Passenger Vehicles: a Sociotechnical Analysis” looks at the landscape of digital safety features and contextualizes these features both in historical terms and also with future advancements towards fully autonomous vehicles in mind. This paper uses a variety of research methods and analysis techniques to argue that individual safety features should be reviewed independently instead of being treated as homogenous in their social impact. The device which was the focus of my technical project is a digital vehicular safety aid (as well as having a mode to make a driver’s life easier). Research for any digital safety device involves understanding vehicular regulation, technical design, and social impacts, so it correlates with the research performed for the STS paper. While the technical design project does not integrate into a vehicle’s existing signals architecture like most digital safety devices, much of the architecture and socio technical considerations are interrelated.

My technical research was an engineering challenge also related to vehicle safety. When a trailer is hitched onto a truck, it increases the turning radius and poses safety risks due to trailer sway. This results in decreased maneuverability, especially during reversing, and an increased likelihood of accidents on the road. The Adaptive Trailer Hitch System is designed to address these issues. By using a linear actuator, the hitch point can be moved laterally along the truck's bumper, controlled by a yaw measurement. This system aims to reduce the turning radius and mitigate trailer sway, thereby enhancing maneuverability and safety.

This technical report details how my group was able to construct a computer simulation of the system and show a reduction in sway through active mitigation, as well as a reduction in turning radius. We also developed a physical prototype. While this type of system is capable of achieving the stated goals, its application may be better utilized in heavy trucking applications instead of passenger cars and light trucks. There is significant overhead and added complexity with an active system, and the goal to reduce sway could also be achieved with passive dampers. However, as electric semi trucks enter the market, they may need to be longer to accommodate batteries. Therefore, there may be an increasing need for active systems in the heavy trucking market.

In my STS research paper, I explored the question, “How do digital safety systems in light passenger vehicles impact human behavior, safety perceptions, and overall safety outcomes?” In the future, advancements in autonomy for road vehicles have the potential to take these effects to

the extreme. The looming nature of these technologies emphasizes the importance of teasing out the ethics of automotive technological transition and understanding the diverse impacts each technological building block imparts on society along the way. I used assessment of real world advertisements from automotive manufacturers pitching various digital safety systems as well as studies involving driver psychology and reactions. This can help understand the mentality and reactions to changing technology in the automotive industry and ultimately give a cohesive overview of the implications of such systems.

I reviewed real world studies and compared them to manufacturer advertisements to form conclusions about the automotive industry's usage of digital technology in advanced safety systems. I related this to the important context of older safety innovations and drew comparisons and contrasts. Two important conclusions emerged from this study; one that a nuanced understanding of the impacts of digital safety systems, combined with transparent communication and regulation, is essential. Secondly, no two systems, even between manufacturers of similar levels of automotive autonomy, are identical in their socio-cultural impacts. Each system must be analyzed individually for its impacts on society and social behavior.