Thesis Project Portfolio

Development of an Autonomous Campus Vehicle Platooning System
(Technical Report)

The Implications of Cruise Self-Driving Cars on San Francisco

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Development of an Autonomous Campus Vehicle Platooning System

Over the past four years, research teams at the University of Virginia (UVA) have been developing an Autonomous Campus Vehicle (ACV) system. This system currently consists of two golf carts set up in a platooning formation. Platooning describes when vehicles are connected through communication channels and travel together. Benefits of platooning systems include improved travel time, increased lane capacity, and a reduction of congestion on roadways (U.S. Department of Transportation, 2017). The ultimate goal of the development of the ACV system is to provide another means of transportation for students across UVA's Grounds, making Charlottesville's hilly geography more accessible to students who may have trouble getting from one place to another.

The current ACV system consists of a leader cart, which is driven manually by a driver, and a follower cart, which can either be driven manually or controlled autonomously. The main objective of my team's goal this year is to implement a new algorithm into the system that would provide greater safety in the operation of the vehicles, increasing visibility of the system using camera sensors. This new algorithm, based heavily in cooperative adaptive cruise control (CACC) technology, uses tracking cameras to probabilistically determine the distance between the leader and follower carts in the system.

Additional upgrades to the ACV system have been made to increase the efficiency of the vehicles. These upgrades include a new microprocessor to allow for the use of a camera sensor, a redesign of the vehicles electronic boxes, and new WiFi mesh routers. In past years, the vehicles were fully operated through the use of a Raspberry Pi, which controlled the braking, acceleration, and steering systems of the follower cart when in autonomous mode. This year, my

team has implemented the Jetson TX2 into the system as a replacement for the Raspberry Pi. This choice was made because the Jetson TX2 has an NVIDIA graphics card, which is compatible with the ZED2 Camera, the camera sensor we chose to implement. With this design update, the electronic boxes present within both vehicles, housing all components needed to transmit information between the carts, needed to be redesigned to incorporate the Jetson TX2 microprocessors. In addition to these system upgrades, new mesh WiFi routers were integrated on the vehicles to allow more efficient communication between the two, without the need for a main network connection external to the carts.

Once fully developed, the ACV system will serve as another means of transportation across Grounds, improving the quality of life of students and faculty who choose to use the vehicle. However, as a developing technology, this autonomous technology presents various risks in its implementation. I chose to look into the potential consequences of one example of autonomous vehicles in my STS research paper to shine more light on what needs to be improved in regards to this technology in the future.

The Implications of Cruise Self-Driving Cars on San Francisco

My STS research paper focuses on a specific case study relating to autonomous vehicles and their use in society: Cruise self-driving passenger vehicles in San Francisco. Cruise, a company owned by General Motors, focuses on the development of level 4 autonomous vehicles. Under the authority of CEO Kyle Vogt, Cruise was permitted to operate its vehicles publicly in San Francisco in 2022, transporting passengers to the destination of their choosing (California Public Utilities Commission, 2022). However, following a series of disruptive incidents involving these vehicles and members of the public, namely passengers, pedestrians, and other

drivers, Cruise's ability to operate was revoked by the California Department of Motor Vehicles and the California Public Utilities Commision due to safety concerns for the public. As a result of the scrutiny Cruise faced, CEO Kyle Vogt resigned in November of 2023.

Using Actor-Network Theory, I analyze the network surrounding Cruise self-driving rideshare vehicles in San Francisco, which includes the following social and technical actors: the California Public Utilities Commission, Cruise as represented by CEO Kyle Vogt, the autonomous rideshare vehicles themselves, passengers or users of the autonomous vehicles, pedestrians, and other drivers in San Francisco. By referencing news articles and statements made by Cruise representatives, I analyze the relationships between actors in the constructed network and present how these associations weaken or even break completely. This analysis can be used to learn the mistakes made by Cruise officials in order to prevent similar situations from happening in the future.

By analyzing the constructed network surrounding Cruise robotaxis in San Francisco and its ultimate failure of successful integration into society, I learned about important aspects involving the development of autonomous vehicle technology, and how to respond to situations of failure as this is inevitable in most cases of emerging technology. I brought this learned information to the development of my technical project, being aware of the implications my team's system may have on the public once fully complete and integrated into UVA.

Bibliography

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