AUTONOMOUS PLATOONING CART FOR SHORT DISTANCE CAMPUS TRAVEL

HUMAN-MACHINE INTERFACE IN AUTONOMOUS VEHICLES

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SOCIOTECHNICAL SYNTHESIS

Human-machine interface is a key element in the design of any autonomous vehicle. This year, mechanical engineering students worked to design and develop an autonomous platooning vehicle system. The purpose of this system is to create an alternative method of campus transportation for disabled students using the safest and most efficient methods available. The science, technology, and society (STS) project analyzes human-machine interface (HMI) technology and assesses its effect on safety in autonomous vehicles. The information gained in the STS research will be used to implement sufficient HMI in the technical project to ensure the safest system is developed.

The technical project goal is achieved through the use of two golf carts to create a leader-follower system. The first step in creating a leader-follower system is to localize the position of both carts in the global reference frame. This is achieved by using ZED and LiDAR sensors on the leader cart to localize it in the global frame and an infrared sensor on the follower cart to determine its position with respect to the leader cart, thereby localizing the follower cart in the global frame. Then, autonomous controls are implemented on the follower cart in order to smoothly follow the path of the leader cart and maintain a predetermined following distance.

Localization was successfully achieved for the leader cart through the use of RTAB-MAP software. The Recursive Bayesian Estimation technique of the particle filter was used to localize the follower cart, but the localized position was not as accurate as that of the leader cart. The velocity controls that were applied to the follower cart were successfully able to maintain a steady speed behind the leader cart, but steering controls were determined to be too inconsistent to be usable. The final system demonstrated successful straight-line following of one golf cart behind another.

The STS project aimed to answer the question: how can HMI technology be implemented to ensure the safety of autonomous vehicles? The use of Pinch and Bijker's Social Construction of Technology theory is used to determine the influence of different social groups on the development of HMI technology. While the driver will be the one most affected by the technology, the automobile company is the group responsible for implementing it and regulatory agencies will ensure that companies have guidelines to follow for the development of HMI on their vehicles. Current laws and attitudes concerning autonomous vehicles were assessed to determine the gaps in safety that exist with autonomous vehicles. Additionally, case studies of various existing HMI were analyzed to determine their effect on safety.

Autonomous vehicles are already safer than human-driven vehicles, but situations such as the transfer of control between the vehicle and driver in semi autonomous vehicles and the potential for system malfunctions in the vehicle create risks for the driver. These risks can be mitigated through the use of HMI techniques such as warnings of system failure and auditory announcements guiding the transfer of control. Regulatory agencies have the ability to ensure companies implement HMI to ensure the safest vehicle possible, but definitive data must be presented in order to justify legislation requiring its use. This is due to the fact that legislation requiring certain HMI has the potential to cause roadblocks for further advancements in autonomous vehicles.

Autonomous vehicles have the potential to increase efficiency and accessibility of travel, but it is vital that this technology is implemented with safety in mind. While autonomous vehicles will be safer than human-driven vehicles, the gaps of safety in autonomous vehicle technology need adequate HMI. While the driver will be experiencing the end effect of the HMI technology, it is the responsibility of the vehicle designer to ensure the safety of the vehicle.

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