

Undergraduate Thesis Prospectus

Autonomous Platooning Golf Cart for Short Distance Campus Travel

(Technical research project in Mechanical Engineering)

Opposition to Autonomous Vehicles as Threats to Employment

(Sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem

How can disruptions caused by automation be reduced?

Artificial intelligence and robotics are extending automation to new categories of employment. According to Schwab (2016), the job market may become divided into “low-skill/low-pay” and “high-skill/high-pay” jobs. The polarization of the job market could exacerbate existing economic inequalities (Schwab, 2016). Some workers are worry they may lose their job to automation. According to McKinsey Global Institute, automation could cause 400 to 800 million workers to lose their jobs globally by 2030; 75 to 375 million of these workers are expected to develop new skills to change occupations (Manyika et al., 2021). Workplaces are expected to undergo significant transformations, as a third of the activities in 60 percent of the occupations can be automated (Manyika et al., 2021). While the exact impact of automation is uncertain, it may cause major disruptions in the labor market.

Autonomous Platooning Golf Cart for Short Distance Campus Travel

How may a golf cart be adapted for autonomous operation and to pick up and drop off passengers?

My capstone project advisor is Professor Tomonari Furukawa from the Mechanical and Aerospace Engineering department. My team members are Gregory Breza, Janani Chander, Sara Khatouri, Zachary Kim, and Charles Rushton. The technical project is about developing an automated golf cart for transportation on grounds. Club Car, a golf cart manufacturer, has provided four golf carts for this project. The primary goal of the project is to develop a leader-following system, in which one golf cart can pick up and drop off passengers, while autonomously following a human controlled golf cart. If the primary goal is achieved, the

secondary goal of the project is to develop a single autonomous golf cart that can transport passengers. The golf carts are to operate without using GPS.

Over the last two decades, autonomous vehicles (AVs) have gained widespread popularity. These vehicles use sensors to scan and map the surrounding environment. The software then processes the data from sensors and makes decisions to drive the vehicle. Automation is steadily increasing in newer vehicles with driver assistance features like cruise control, lane change assistance, auto park, etc. The Society of Automotive Engineers (SAE) describes vehicle automation on a scale ranging from level 0 (no automation) to level 5 (full automation) (NHTSA, n.d.). According to SAE, full automation is a vehicle, which is “capable of performing all driving functions under all conditions” (NHTSA, n.d.). AVs may have positive economic and safety impacts. The National Highway Traffic Safety Administration (NHTSA) reports that every year motor accidents result in more than 35,000 deaths in the United States (NHTSA, n.d.). According to NHTSA, AVs could significantly reduce crashes and increase mobility for the disabled (NHTSA, n.d.).

In transportation, AVs are a fast-growing area of research. AVs are not limited to just personal vehicles, but also come in the form of public transportation and ridesharing fleets. COAST Autonomous is a company developing autonomous shuttles for public transportation (Knight, 2020). These shuttles are equipped with LiDAR and cameras to map the environment and the company tested the shuttles for a week by transporting students at the University of South Florida (Knight, 2020). However, public perception of safety, vehicle communication with passengers, and regulations remain some of the biggest challenges with the deployment of AVs (Knight, 2020). Companies in the trucking sector are developing platooning systems. In a platoon, one or more automated vehicles follow a human controlled vehicle using wireless

communication. Peloton Technology has developed a level 1 system called Platoon Pro, which controls the acceleration and braking, but the driver controls the steering (Roberts, 2019).

Recently, the company has unveiled a level 4 automated following system, which does not need drivers to control the following vehicles (Roberts, 2019). Complex environments and weather conditions pose challenges to autonomous systems. The technical project will require the adaptation of platooning to modify a golf cart for autonomous transportation. The project will also explore public perception of AVs in a campus environment.

The golf carts will be equipped with sensors such as LiDAR and camera to map the surrounding environment. Based on the data processed from these sensors in Robot Operating System, the following golf cart will autonomously control its acceleration, braking, and steering. It will also maintain a safe following distance from the leading golf cart. During the development, the initial testing of golf carts will happen at the Observatory Mountain Engineering Research Facility (OMERF). Final testing will occur on Engineer's Way. At the end of the project, an automated golf cart will pick up and drop off passengers, while following a human driven golf cart. It will drive on a set route and avoid hitting any objects and pedestrians in its path. The successful development of this system will improve mobility around grounds for students and faculty. Lastly, it will contribute to the development of a fully autonomous golf cart, while adding to the research on AVs.

Opposition to Autonomous Vehicles as Threats to Employment

How are professional drivers responding to automation's threat to their jobs?

Over the last decade, the performance of autonomous driving systems has improved markedly. According to Pettigrew et al. (2018), AVs may eventually reduce collisions and

emissions, and relieve traffic congestion. In long-range trucking, automation may be simpler to achieve, yielding efficiency and safety improvements (Viscelli, 2018). However, transportation drivers across the truck, taxi, and delivery industries fear losing their jobs to automation.

Researchers have investigated the possible employment effects of AVs and unions' means of protecting workers from automation. Viscelli (2018) contends that most high- to mid-wage driving jobs are at risk, and that automation is likely to take the jobs of 294,000 long-distance truck drivers. Analyzing truck drivers' perception in a Reddit truck group, Orii et al. (2021) found drivers "expressed fear of job loss due to automation"; 17 percent of the comments questioned the feasibility of autonomous trucks in complex environments. Through a public opinion survey in Australia, Pettigrew et al. (2018) found that 60 percent of respondents were "moderately concerned with job losses" due to AVs. Nissim and Simon (2021) contend that unions "could play a major role in designing the emerging new labor market" to protect workers, promoting workers' "health, safety, and privacy" in workplaces with increasing automation.

Throughout the transportation sector, unions representing drivers have opposed efforts to introduce AVs. In a letter to Congress, the Transportation Trades Department (TTD), representing 33 unions and millions of transportation drivers, opposed what it condemned as "anti-worker, anti-safety automated vehicles proposal" (Reagan, 2021). It has also requested the Congress to "mitigate projected job losses and changes to jobs from automation" through legislation (Reagan, 2021). Similarly, the Teamsters union has lobbied the Congress to slow down the integration of self-driving vehicles (Denton, 2018). Its goal is to "ensure that automation is not used to take advantage of workers" (Denton, 2018).

Taxi drivers have organized to oppose the advent of autonomous ridesharing vehicles. Taxi companies in New York formed the Upstate Transportation Association (UTA) to fight

Uber and Lyft's push for AVs (Colon, 2017). In a letter to Governor Cuomo, the president of UTA requested a ban on self-driving cars for the next 50 years to protect taxi and transport driver jobs (Colon, 2017). The Independent Drivers Guild (IDG), a group representing 35,000 Uber drivers in New York City, has also opposed Uber's self-driving cars (Huston, 2021). The founder of IDG warned that the union will "aggressively fight" to keep the current legislation banning self-driving cars (Huston, 2021).

Other unions and organizations have opposed driverless vehicles through protests. The Transport Workers Union (TWU) launched a campaign called "People Before Robots" in Ohio to prevent "unchecked and dangerous automation" in transit transportation (TWU, 2018). President Samuelson of TWU International stated that bus driver jobs are "important to the safety of riders" and essential for "working class families" (TWU, 2018). America Without Drivers (AWD) is an advocacy committed to raising awareness about "the effects of autonomous vehicles on the displacement of driver's jobs" (AWD, 2021). Will Cook, the founder of AWD, helped organize the protest "MayDay" in Washington, D.C., to object to threat to jobs (TNN, 2021).

References

- AWD. (2021, Oct. 6). America Without Drivers. <https://americawithoutdrivers.com/#news-archeive>.
- Colon, D. (2017, Jan. 5). Upstate Taxi Lobby Wants Cuomo To Ban Self-Driving Cars Until 'At Least' 2067. Gothamist. <https://gothamist.com/news/upstate-taxi-lobby-wants-cuomo-to-ban-self-driving-cars-until-at-least-2067>.
- Denton, J. (2018, April 26). Are the Teamsters trying to kill driverless tech, or save the truck drivers? Pacific Standard. <https://psmag.com/economics/trucking-teamsters-driverless-tech>.
- Huston, C. (2021, Sep. 8). Uber drivers go to war against self-driving cars. IDG. <https://driversguild.org/uber-drivers-go-war-self-driving-cars/>.
- Knight, R. (2020, Aug. 21). Autonomous Shuttles: Rolling toward efficiency. Inside Unmanned Systems. <https://insideunmannedsystems.com/autonomous-shuttles-rolling-toward-efficiency/>.
- Manyika et al. (2021, July 2). Jobs Lost, jobs gained: What the future of work will mean for jobs, skills, and wages. McKinsey & Company. <https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages>.
- NHTSA (n.d.). National Highway Traffic Safety Administration. Automated Vehicles for Safety. <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety>.
- Nissim, G., & Simon, T. (2021). The future of labor unions in the age of automation and at the dawn of AI. *Technology in Society* 67 (Sep.), 1-9.
- Orii, L., Tosca, D., Kun, A., & Shaer, O. (2021). Perceptions on the Future of Automation in r/Truckers. *CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '21 Extended Abstracts)* (May), 1-6.
- Pettigrew, S., Norman, R., & Fritschi, L. (2018). The Potential Implications of Autonomous Vehicles in and around the Workplace. *International Journal of Environmental Research and Public Health* (Aug.). Web of Science.
- Regan, G. (2021, May 12). Transportation Labor opposes anti-worker, Anti-Safety automated vehicles proposal. TTD. <https://ttd.org/policy/letters-to-congress/transportation-labor-opposes-anti-worker-anti-safety-automated-vehicles-proposal/>.
- Roberts, J. (2019, July 17). Peloton announces level 4 driverless truck platooning system. Fleet Management - Trucking Info. <https://www.truckinginfo.com/336328/peloton-announces-level-4-driverless-truck-platooning-system>.

Schwab, K. (2016, Jan. 14). The Fourth Industrial Revolution: What It Means and how to respond. World Economic Forum. <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>.

TNN (2021, March 10). Truckers plan 'mayday' rally to sound alarm about threat of job losses to self-driving trucks. Transportation Nation Network. <https://www.transportationnation.com/truckers-plan-mayday-rally-to-sound-alarm-about-threat-of-job-losses-to-self-driving-trucks/>.

TWU (2018, Sep. 20). The TWU launches statewide coalition against driverless buses in Ohio: People Before Robots! Transport Workers Union. <https://www.twu.org/the-twu-launches-statewide-coalition-against-driverless-buses-in-ohio-people-before-robots/>.

Viscelli, Steve. (2018, Sep.). Driverless? Autonomous Trucks and the Future of the American Trucker. Center for Labor Research and Education, University of California, Berkeley, and Working Partnerships USA. <http://driverlessreport.org>