Thesis Portfolio

Human-Powered Vehicle

(Technical Report)

Solution development to the challenges of autonomous vehicles

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

The technical project is designing and manufacturing a Human-powered vehicle (HPV) for a contest held by ASME. However, due to the coronavirus, the project halted halfway, but most of the vehicle was completed. The STS research paper explains why autonomous vehicles are needed and what impact they might bring to society. Even though autonomous vehicles seem to have a bright future ahead of them, many factors are discouraging them from entering into the market. The STS paper explores factors that stop autonomous vehicles from being deployed, causes of those barriers, and how industries can facilitate the deployment of autonomous vehicles. Frameworks of normalized deviance, trading zone and mental model were used in the paper. These frameworks can also be applied to the technical project: designing a Human-powered vehicle (HPV). The social challenges of autonomous vehicles are similar to the HPVs'.

The ethical concern raised in autonomous vehicles, as seen in the social challenges of STS research paper, won't occur in the case of HPV since drivers of HPV drivers still have control over their vehicles. Drivers are capable of making the decision while driving their vehicles on the road.

Normalized deviance comes to play a crucial role when designing the HPV. The normalization of deviance is defined as: "The gradual process through which unacceptable practice or standards become acceptable. As deviant behavior is repeated without catastrophic results, it becomes the social norm for the organization." (Boe, 2013) When designing the vehicle, the team was primarily focusing on winning the contest but not thinking too much about the usage of vehicles in everyday life, which is also a goal of designing the vehicle. The vehicle is not fully covered with fairing, which may make riders getting wet on rainy days. The vehicle was only designed for sunny days. Also, the vehicle was only designed for people ranging from 63 to 73 inches, which is the height range of team members who will participate in the contest. If this HPV needs to be commercialized, a broader range should be used for riders. The road regulation on HPV is also needed to be considered if this vehicle needs to be deployed on the road. The HPV designed by the team is larger than the bicycles and may not fit well to the bicycle lane of the road. HPV's slow speed makes it not capable of running on the vehicle street. The team can not take the vehicle running on the road as legal for granted, considering road regulations as well.

The concept of the mental model can also be used in HPV designing. A mental model is an explanation of someone's thought process about how something works in the real world. It is a representation of the surrounding world, the relationships between its various parts, and a person's intuitive perception about his or her own acts and their consequences. Mental models can help shape behavior and set an approach to solving problems (similar to a personal algorithm) and doing tasks. (“Mental model”, N.A) The team may not be capable of discerning every driving condition that the HPV might encounter even though ASME's rules do cover ranges of tasks that the vehicle needs to achieve, such as going up hills and turning. The team members may not acquire the same knowledge as the users of the HPV vehicles and will eventually make a vehicle not functioning comprehensively.

To develop a more comprehensive HPV and to prevent potential dangers from occurring, the concept of trading zone, which refers to the situation where different parties with different

backgrounds come together to exchange their thoughts,(Galison, 1997) can come to play a role. The team had trading zones formed with other groups when developing the HPV. The team consulted the manufacturer in Lacy Hall, the manufacturing building of the HPV, for advice on how to make a good HPV. The team also has the potential opportunity of forming a trading zone with a government representative to make a vehicle operate on the road legally. The team can consult other bicycle manufacturers to consider every road condition that the vehicle might encounter.