Submission ID: 111

Lund, Sweden
10-12 November 2021
iCSC International Cycling Safety Conference

Validation of a Bicycle Simulator in Virtual Reality for the Study of Bicyclists' Perceived Safety

Erin Robartes and T. Donna Chen

Keywords: Bicyclists, Virtual Reality, Perceived Safety, Technology Validation

A persistent challenge to studying bicyclist safety is the lack of robust data sources, demanding innovative strategies to assess bicyclist safety. Recent advancements in virtual reality (VR) technology have created potential opportunities for lower cost and lower risk ways to study bicyclists' perception of safety and the impact of roadway environments on bicyclist comfort. With VR, we can study human behaviours in settings/scenarios that (1) we have limited or no access to (e.g., design of a new intersection that has not been built yet) or (2) are considered high-risk environments for collecting real-life data (e.g., bicyclist safety or crash rates at an intersection). The long-term goal of this research is to achieve a better understanding of perceived safety and acceptance as it relates to bicyclists and unique bicycle infrastructure in the road environment.

In this study, a bicycle simulator has been developed wherein a study participant can ride a standard hybrid bicycle situated on a stationary bicycle trainer while wearing a VR headset. The simulator is built using a hybrid Trek bicycle, a Wahoo bicycle trainer mount, an HTC Vive eye tracking headset, and a Huawei smartwatch. Data on participants' speed, braking, steering, heart rate, eye-tracking, and field of view can be collected. Using the VR headset, participants are immersed in a virtual roadway environment where their behaviour can be observed. The virtual environment used in this study is a replica of a multimodal corridor in Charlottesville, Virginia, US. The street was chosen because it has high volumes of pedestrians and bicyclists, has a Level of Traffic Stress of 3, and has been identified as a corridor that needs improvement by the city. Video recordings of this corridor (six days of 12-hour videos taken over two weeks) have been collected and analysed for data about bicyclist behaviour. The first stage of this research benchmarks the bicycle simulator using data from both the replicated VR environment and the real-world corridor. The benchmarking will be achieved in two ways: 1) Participants will ride on the bicycle simulator and report the degree to which they feel various aspects of the environment are realistic through questionnaires and 2) Participants' behaviour in the replicated VR environment (speed, lane position, rate of compliance with traffic rules, head movements) will be compared to the behaviour of bicyclists on the real-world roadway as determined through analysis of the video-recordings. In this way, the simulator will be validated through comparison to real world bicyclists and through the perception of simulator users. Successful validation of VR as a feasible technology to replicate real world environments introduces a host of opportunities to study various existing and innovative bicycling infrastructure design.