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Master's Thesis

Enabling Cooperative HuTL-Experiments for VRU in the Virtual Cycling Environment (VCE)

We built the Virtual Cycling Environment (VCE)[a] [1] to investigate driver assistance systems for Vulnerable Road Users (VRU) like cyclists. Within the system, a human test person can use a physical bicycle to ride through a virtual 3D environment, while realistic road traffic and Vehicular Communication (V2X) between traffic participants is simulated. In this way, we can study the behavior of the test person and how they use newly developed assistance systems in a realistic but safe environment in a so-called Human-In-The-Loop (HuTL)-Experiment.

[a]https://www2.tkn.tu-berlin.de/software/vce/

■ Goals of the Thesis

The system currently only allows a single participant to ride through the virtual environment. However, the ability to have multiple people (e.g., two cyclists or a cyclist and a car driver) in the virtual environment at the same time would enable us to develop and study more advanced and cooperative assistance systems and their impact on the individual human road user. Therefore, the idea of this thesis is to extend the existing VCE system with "Multiplayer" support, allowing more than one person to ride through the virtual environment at the same time.

In order to complete the thesis, you need to do the following tasks (among others):

- Extend the Virtual Cycling Environment to provide "Multiplayer" support.
- Create corresponding 3D graphics for visualizations of cyclists and car drivers.
- Design & conduct a small psychological study to demonstrate the functionality of the extension.

■ Required Knowledge

You should have a basic understanding of *Vehicular Networking*, *Unity 3D*, *GNU Linux*, *Python*, and *C++*.

■ Keywords

Cooperative Driving, Vulnerable Road Users, Driver Assistance Systems, Virtual Cycling Environment, Human-In-The-Loop, Psychological Studies

[1]   J. Heinovski, L. Stratmann, D. S. Buse, F. Klingler, M. Franke, M.-C. H. Oczko, C. Sommer, I. Scharlau, and F. Dressler, "Modeling Cycling Behavior to Improve Bicyclists' Safety at Intersections – A Networking Perspective," in *IEEE WoW-MoM 2019*, Washington, D.C.: IEEE, Jun. 2019. DOI: 10.1109/WoWMoM.2019.8793008.

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