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TECHNISCHE UNIVERSITÄT
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RESEARCH PROJECT

Group Project: Bluetooth Low Energy (BLE) Beacons for Protecting Vulnerable Road Users (VRUs)

Motivation and Background

In times of climate change and congested cities, alternative forms of transportation are encouraged. One of these is cycling, which requires way less infrastructure than motorized vehicles and is also climate-neutral. However, many people are discouraged from cycling by the feeling of unsafety in traffic. It is therefore important to improve the subjective and objective safety to promote cycling.

The improvement of motorized traffic's safety has been pursued with great effort, introducing V2X, which basically introduces the capability of vehicles to communicate with traffic participants in their surroundings. While there are approaches to incorporate vulnerable road users in V2X [1, 3, 2], field operational tests focusing on bike-to-bike information exchange and collision avoidance have not yet been conducted.

Research Project Goals

The goal of this research project is to create a system based on Raspberry Pis that allows for the exchange of periodic beacons using Bluetooth Low Energy. This system sends location data to a central server. The central server is supposed to detect possible critical situations and send out warnings accordingly. The warnings should be visualized, e.g., by an LED on the bike, on a small screen or via beeper. For this, the location of the system needs to be mapped to a central representation on the server. This research project is supposed to be taken by a group of 2-4 students.

In addition to the practical implementation part, a literature overview of relevant publications will be created by the group.

Required Knowledge (or willing to learn)

- Programming experience in a suitable language (Python/ Bash/ etc.)
- Usage of a statistic evaluation language (e.g., R)
- A basic understanding of wireless communication principles and technologies
- Scientific literature review, and writing

References

[1] J. J. Anaya, E. Talavera, D. Gimenez, N. Gomez, F. Jimenez, and J. E. Naranjo. Vulnerable road users detection using v2x communications. In *2015 IEEE 18th International Conference on Intelligent Transportation Systems*, pages 107–112, 2015.

[2] S. Fickas. V2x: Bringing bikes into the mix. 2019.

[3] M.-C. H. Oczko, L. Stratmann, M. Franke, J. Heinovski, D. S. Buse, F. Klingler, and F. Dressler. Integrating haptic signals with v2x-based safety systems for vulnerable road users. In *2020 International Conference on Computing, Networking and Communications (ICNC)*, pages 692–697, 2020.