International Co-operation on Theories and
Concepts in Traffic Safety

COLLISION ZERO
- Automated XR accident simulation in a real 3D infrastructure environment to sensitise and protect vulnerable road users

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Despite preventive efforts, fatal accidents remain alarmingly frequent. The evolving traffic landscape, compounded by distractions (such as smartphones) and increasing traffic volume, poses significant risks. A recent study by the General German Automobile Association revealed that 50% of parents fear their children's safety in traffic accidents. Consequently, parents increasingly opt for the "parent taxi" approach, limiting their children's independent participation in road traffic. Unfortunately, this hinders children's development into self-reliant and secure road users while also needlessly impacting the environment.

Current training methods inadequately address the varying developmental stages of children and adolescents. Additionally, traffic education lacks appeal. However, the use of virtual reality (VR) in previous projects demonstrated significant success to train perspective shifts as part of accident prevention.

The overarching objective of the ongoing project 'Collision Zero' is to eliminate accidents through the innovative use of VR. Children and other users enter a route into an app or web application and the accident scenarios along the route are visualised in VR glasses or directly in the web application. The insights gained through VR focus on real-world connections to the accident locations. A generated 3D map material visualises the accident locations. The automated reconstruction of accident scenarios within these 3D environments makes it possible to visualise the raw data provided by the authorities. Users will experience these scenarios firsthand through VR perspectives.

Collision Zero seeks to revolutionize traffic safety education by merging technology, real-world relevance, and personalized experiences to protect the youngest road users. The project addresses real-world context by developing an XR (extended reality) online platform (web-application) around accident hotspots in school and residential areas. By creating a sense of personal relevance and everyday familiarity, it aims to promote safe behaviour among children and adolescents. 3D map data is used to generate and animate accident scenes in specific geographical sections. This approach makes it possible to reconstruct accidents and understand their dynamics. A criticality algorithm enables critical areas (e.g. school zones) to be visualised, evaluated and safety measures prioritised.

This project involves the orchestration of several data modules, each responsible for enhancing and transforming raw data through algorithms. These interlinked modules form the backbone of a holistic XR application. The key modules include a data extender, which forwards data

from authorities to the Fraunhofer Institute and enriches it using algorithmic processes. The criticality module identifies accident-prone zones and derives safety measures from them. The 3D Map Creator module generates 3D map data and provides the spatial context for accident scenarios. The animation module creates dynamic visualisations and animates reconstructed accident sequences. The Accident Illustration module automates the mapping of accident details and thus ensures accurate visualisation.

The envisioned website and XR app aim to seamlessly integrate as an innovative and appealing tool within both existing and new preventive measures. This integration extends across various contexts, including classroom education, home environments, and active participation during school commutes. The interactive XR experience will engage young learners, fostering a deeper understanding of road risks and safe behaviours. Families can use the XR application at home to analyse accident scenarios together for a future route, reinforcing safety discussions and encouraging responsible road habits. Parents and children can explore accident scenarios together, enhancing their collective awareness. The combination of real-world infrastructure data and experiential accident information becomes furthermore valuable for cities and municipalities. Urban planners can identify accident-prone areas, optimize traffic flow, and enhance safety measures based on tangible insights.

In summary, Collision Zero strives to revolutionize traffic safety education, making it engage, data-driven, and accessible to all, ultimately working toward the vision of reducing accidents to zero.

Figure 1: Development process: From the map data (left) to the VR environment (right)

At the time of the conference, we can demonstrate first scenarios in the VR glasses as this is an ongoing project.