DEL

Driving Experience Lab

In our joint project "Mensch in Bewegung" of Technische Hochschule Ingolstadt (THI) and the Catholic University of Eichstätt-Ingolstadt (KU), the Driving Experience Lab (DEL) was developed. The car trailer has a driving simulator lab (mockup) incl. operator room, which can be moved freely on land and is intended to serve as an information platform for automated driving for the public. In addition, the lab will be used for research purposes requiring special target groups (children/students, seniors, persons with disabilities, good mix in the overall population, etc.) directly at the location of the respective target group.

In addition to mobile operations, the DEL also serves as a supplement for the execution of student research projects and theses at the THI. Especially in the context of master theses and project work, research goals can be validated here. The laboratory is also available for service partners in the context of third-party funding by industry.

Advantages of the DEL setup:

- Provision of a mobile platform for informing a broad public about current research topics
- Knowledge transfer in the field of automated driving
- Final theses through studies in the trailer on HCI and HF
- Third-party contracts through industry

Built-in technology

By embedding a wide variety of components (tactile driver's seat, vibration steering wheel, windshield display) into the mobile driving simulator, a highly immersive (real) driving experience can be achieved. The DEL consists of a "driving simulator room" with mockup and flap and a "control room" with a server rack in the back. Inside the mockup, subjects can experience a virtual drive in the driving simulator, which is controlled by the operator room. The operator room contains the computing infrastructure (server rack), a 3-monitor workstation, and cabinets for storage. The following figure gives an overview of the main areas of the DEL.

Figure 1: Overview of the Driving Experience Lab, left – mockup with open hatch, right – control room with a server rack.

Mockup

The equipment used is modular and can be expanded. In the mockup, the equipment for the steering wheel, pedals via Arduino microcontroller, and displays via different interfaces, e.g.

the Senso-Wheel via CAN2USB are integrated. The driving simulations are created and operated via IPG CarMaker as well as a specially created middleware.

Currently, the following devices are in use:

- Active Senso-Wheel force feedback steering wheel
- Digital displays for rearview mirrors
- Visualization and simulation PC
- NAS, UPS, and Sound-AMPs
- Arduino-Microcontroller
- Windshield display with Intel® NUC Mini-PC

Figure 2: Vehicle cockpit mockup of DEL driving simulator room with visualization.

Extension

To further increase the immersion of the Driving Experience Lab in the future, the following further developments are planned and partly already being implemented (Figure 3):

- Increased use of vibration feedback in the steering wheel and driver's seat, e.g. to announce obstacles

- Dynamic (ambient) interior lighting, e.g. for simulating tunnel driving or backlighting

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- Analysis of driver behavior through facial recognition, drowsiness detection, and eye-tracking and influencing of adaptive systems

- Extension of the scenarios for the SAE automation levels 1 to 5 (e.g. influence by other road users incl. pedestrians) or integration of weather effects and road conditions (day, night, snow, rain, fog)

- High-fidelity implementation of ambient noise (e.g., applied audio signal with convolution reverberation, Doppler effect, and frequency shift during tunnel ride)
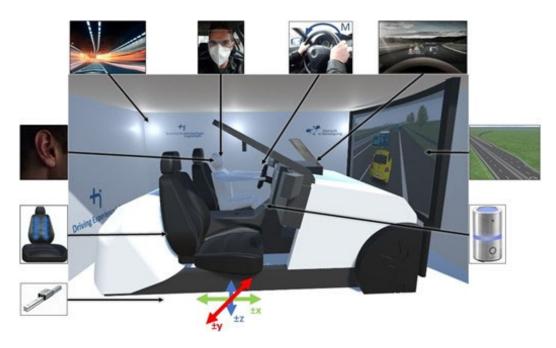

Figure 3: Concepts for the further development of the DEL.

Possible scenarios in our DEL

Our mobile driving simulator gives you the opportunity to experience levels 2 to 5 of automated driving. The following scenarios await you in our driving simulator:

All journeys start at the hard shoulder in the city center. In levels 2 and 3, you maneuver the vehicle onto the motorway yourself and here you can activate the automation. In level 4 the automation can be turned on at the beginning of the ride and in level 5 you become a passenger from the start.

Today: Your journey is supported by the driver assistance systems (level 2). Using the adaptive cruise control and coupling them with the automatic lateral guidance, you can let

the vehicle take over the steering, but you have to recognize dangers and problems yourself.

Tomorrow: In level 3, the vehicle can drive independently on the freeway. You can use your time to work, read or make phone calls. At a construction site, the vehicle will ask you to take over the steering (TOR – Take Over Request). You steer the vehicle through the construction site and then hand over the control again.

The day after tomorrow: You set off from the city center in a level 4-capable vehicle. If the automation is activated, you can sleep while driving or deal with tasks such as reading, watching a film, or working. If a problem arises while driving and the vehicle does not know what to do, it will bring itself to a safe state. It pulls onto the hard shoulder and stops.

Future: The ultimate goal, fully automated driving at level 5, is still a long way off. You will be picked up by a fully automated vehicle without a steering wheel or pedals and dropped off at the desired location.