The HAVEit project
Multiple levels of automation

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Outline

- The EU-project HAVEit
- Multiple levels of automation: HMI challenges and the HAVEit approach
- Generic design schemes and application examples in HAVEit
- Summary and Outlook
The EU-project HAVEit

- HAVEit: Highly Automated Vehicles for Intelligent Transport
- EU IP-Project led by Continental Automotive
- 17 partners from industry and research institutes
- 17 Million Euros EU funding, total budget of 28 million Euros
- January 2008 to July 2011
- 7 vehicles showing an integrated concept for different automation levels
**Driver interface components**

to assess the driver state and to integrate the driver in the automation loop

**Command layer**

to define maneuver, trajectory and automation level and to generate the safe motion control vector

**Execution layer**

to perform the safe motion control vector

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**Perception layer**

for real-time scene recognition

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**Driver**

- Driver monitoring

**HMI**

**Environment sensors**

**Vehicle sensors**

**Sensor data fusion**

**Co-Pilot**

- maneuver trajectory

**Mode selection unit**

- automation level

**Command generation and validation**

**Drivetrain control**

- Steering
- Brakes
- Engine
- Gearbox

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HAVEit: Multiple automation levels - 30 July 2012 - 6

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Multiple levels of automation: HMI challenges & the HAVEit approach
Challenges for the HMI design

- **Easy to understand** interaction for the driver
- **Combination** of different assistance functions already available (like ACC) with higher levels of automation
- Interface that **reduces complexity** for the driver
- **Alignment** of the interaction design for the involved HAVEit vehicles
Design and evaluation process in HAVEit

Initial demonstrator concepts

Generic concepts and interaction schemes

Driver Only | Driver Assisted | ACC | Highly Autom. | Fully Autom. | Automation

Design with theater-system
Design and evaluation process in HAVEit

Initial concepts

Generic concepts

Implementation

Migration to vehicle(s)

Iterative refinement

Design with theater system

Validation by simulation

Validation by simulation

HAVEit: Multiple automation levels > 30 July 2012 > 13
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Generic design schemes and application examples in HAVEit
Definition of the levels of automation

Driver Only  Driver Assisted  ACC  Highly Autom.  Fully Autom.
Levels of automation in HAVEit and BaSt

BASt Definition (Gasser et al. 2011)
Generic interaction scheme: Display

Automation Scale

- Highly automated
- Semi-automated
- Driver Assisted

Automation Monitor

- OR

Message Field

Take over control!
Generic interaction scheme: Display
Generic interaction scheme: Transitions
Generic interaction scheme: Transitions

Prototype A

Prototype B

Prototype C

HMI Workshops
Simulator study
Alignment

with turn indicator

Schieben et al. (2011)
Generic interaction scheme: Transitions

Driver initiated transitions

Driver Only | Driver Assisted | ACC | Highly Autom. | Fully Autom.

- Accelerating
- Braking
- ACC < 130km/h
- ACC > 130km/h
- With turn indicator
- Without turn indicator
Transitions: Mode Confusion
Generic interaction scheme: Interlocked transitions

- Explicit transition design
- Hand-over of control only with confirmation by the other partner („Interlocked Transition“, „Handshake“)
Example: Take-over requests

Driver

Driver Only

Driver Assisted

ACC

Highly Autom.

Fully Autom.

Driver does not react

Minimum Risk Manoeuvre
Example: Take-over requests

- Try to bring the driver back in the loop
  - Acoustic & visual alarms
- Check if driver takes over as intended
  - Hands-on check
  - Attention monitor
- If driver does not react, bring vehicle to a safe stop
  → Minimum Risk Manoeuvre
Summary: What we achieved in HAVEit

- **Integrated HMI concept** and **alignment** between demonstrators
- **Iterative approach** for defining **generic interaction schemes**
  - Integration of single functions into **levels of automation**
  - **Automation scale** as underlying structure
  - **Explicit transition design** e.g. by interlocked transitions
- **Migration path** from already existing assistance functions to highly automated driving
Outlook: Further research questions

- **Human factors research** on the design and the effects of highly automated driving e.g.:
  - **Take-over-time** of the driver
  - **Interaction design** for transitions
  - **Integration and alignment** of several functions → one concept
- **Cooperative behaviour:**
  - Driver/ automation within the vehicle
  - Interaction with other traffic participants
Thank you for your kind attention!

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Thanks to all HAVEit partners:

www.haveit-eu.org
References


