Human-Vehicle Integration in automated vehicles

Human Factors Recommendations for Highly Automated Driving
AdaptIVe
Automated Driving

Budget: 25 Million EUR
European Commission: 14.3 Million EUR

Duration: 42 months
(January 2014 - June 2017)

Coordinator: Aria Etemad,
Volkswagen Group Research

28 Partner: France, Germany, Greece, Italy, UK
Spain, The Netherlands, Sweden
Levels of automation in AdaptIVe

SAE document J3016, “Taxonomy and Definitions for Terms Related to On-Road Automated Motor Vehicles”, issued 2014-01-16
AdaptIVe
Automated Driving

- Development of new functions on cars and trucks for automated driving
- Research covers several scenarios
- Definition of evaluation methodologies
- Addressing the legal framework
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Automated Driving

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Sub Project 3 Partners

- Volvo
- University of Leeds
- WIVW
- DLR
- Ford
- Deutsches Zentrum für Luft- und Raumfahrt
  German Aerospace Center
  Institute of Transportation Systems
//SP3: Human-Vehicle Integration

• Main goals:
  – **Support** partners with Human Factors (HF) knowledge
  – **Homogenize** development by providing HF-recommendations

• Create **use cases** for development and test of functions
• Collect **existing** HF-recommendations
• Develop new **research questions** for Human-Vehicle Integration
• Carry out **experiments** based on the new research questions
• Create **new** HF-recommendations
General workflow in SP3

State of Art

Research Questions

Experiments

HF-recommendations

Demo-vehicles

Demo vehicle owners
- HMI design for
  - Driver assistance in different automation levels
  - Transition between automated & manual driving
  - System uncertainties and limits
- Impact of system failures
Research activity

• A total of 17 experiments were conducted
  – Surveys
  – Simulator studies
  – Field studies
• More than 300 drivers and 2700 participants

• Results from the 1st Round of Experiments
• How many automation levels should be displayed to the driver?
Conclusions:
• Driver showed preference for the two-mode interface
• High traffic density: Shorter time to hands on steering wheel
• After automation failure: Shorter Time to button press and time to hands on in the two-mode design
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**HUMAN FACTORS RECOMMENDATION**

AVAILABLE AUTOMATION LEVELS SHOULD BE RESTRICTED TO THE MINIMUM POSSIBLE NUMBER.
Conclusions:

- Driver showed preference for the two-mode interface.
- High traffic density: Shorter time to hands on steering wheel.
- After automation failure: Shorter Time to button press and time to hands on in the two-mode design.

**HUMAN FACTORS RECOMMENDATION**

*Use additional cues such as sound and haptic cues to indicate mode changes.*
• How to take drivers “out of the loop”?

• How does being out of the loop affect the ability to resume control and respond in dangerous situations?
Conclusions:

• Manipulation by fog is a good way to take drivers “out of the loop”
• More collisions when drivers were out of the loop
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**HUMAN FACTORS RECOMMENDATION**

IF AVAILABLE, USE VISUAL FEEDBACK E.G. A FLASHING STEERING WHEEL SYMBOL TO INDICATE SYSTEM UNCERTAINTY
What kind of parking HMI do users prefer?
Ford

Smartphone app for parking automation
• What kind of parking HMI do users prefer?
  – Is there a difference between a short press versus a permanent interaction solution?

Conclusions:
• No significant difference between short and permanent HMI mode for handling of critical events
Ford

Smartphone app for parking automation
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Conclusions:
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HUMAN FACTORS RECOMMENDATION

SMARTPHONE APP WELL ACCEPTED FOR PARKING AUTOMATION

Permanent interaction

Short press
Ford

Smartphone app for parking automation
• What kind of parking HMI do users prefer?
  – Is there a difference between a short press versus a permanent interaction solution?

Conclusions:
• No significant difference between short and permanent HMI mode for handling of critical events

**HUMAN FACTORS RECOMMENDATION**

SHORT PRESS AND PERMANENT INTERACTION HMI MODES ARE BOTH POSSIBLE
• How does a timely announcement of a traffic situation influence driving behavior at take-over situations
Conclusion:

- System situation announcements rises awareness of approaching system limits
- Help to avoid uncomfortable transitions.
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- System situation announcements rises awareness of approaching system limits
- Help to avoid uncomfortable transitions.

HUMAN FACTORS RECOMMENDATION

THE AUTOMATION SHOULD INFORM IN ADVANCE ABOUT AN UPCOMING AUTOMATION OR VEHICLE LIMIT, SO THAT THE DRIVER WILL BE ABLE TO SAFELY TAKE-OVER THE DRIVING TASK
Conclusion:

- System situation announcements raises awareness of approaching system limits.
- Help to avoid uncomfortable transitions.

**HUMAN FACTORS RECOMMENDATION**

Inform timely before approaching a situational change using visual and auditory feedback.
• How to bring the driver from level 3 into level 2 with peripheral cues
• How to help drivers to anticipate automation behavior and failures?
Peripheral vision is very effective for bringing driver back into supervising task

Indication detected vehicles help drivers to anticipate future maneuvers of the automation

Indication detected vehicles supports drivers in anticipating automation failures
Peripheral vision is very effective for bringing driver back into supervising task.

Indication detected vehicles help drivers to anticipate future maneuvers of the automation.

Indication detected vehicles support drivers in anticipating automation failures.

**HUMAN FACTORS RECOMMENDATION**

*IF AVAILABLE, USE PERIPHERAL VISUAL FEEDBACK TO COMMUNICATE WARNINGS, RECOMMENDATIONS, UNCERTAINTIES AND AUTOMATION LEVELS.*
Peripheral vision is very effective for bringing the driver back into the supervising task.

Indication detected vehicles help drivers to anticipate future maneuvers of the automation.

Indication detected vehicles support drivers in anticipating automation failures.

**HUMAN FACTORS RECOMMENDATION**

USE AN 360° AMBIENT DISPLAY FOR INDICATING DETECTED VEHICLES TO SUPPORT DRIVERS IN ANTICIPATING AUTOMATION MANEUVERS AND FAILURES
Implications for Demo Vehicles: Functional Recommendations

- “D3.3 - Final functional HF recommendations”
  - under development
  - will be finalized in May 2017
See you in Aachen, Germany, at the Final Event on June 28 & 29, 2017.

- Please visit [www.AdaptIVe-ip.eu](http://www.AdaptIVe-ip.eu) for more information coming up soon!
Thank you.

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