



# INPUT and OUTPUT Devices

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# Input and Output (I/O) devices for HMI integration



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- Approach taken in AIDE's HMI I/O was to consider the same I/O devices for the same functions as much as possible from all prototype work to the eventual demonstrators later
- This approach reflects the integration and adaptation strategies developed in the AIDE project
- Nonetheless, certain subtle differences in the design and use of the HMI components exist among the prototypes owing to the nature of the vehicle types themselves (i.e. city car vs. luxury car vs. truck) and the brand they carry



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# HMI components, developed, tested and demonstrated



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## ■ Active Safety & Driving Comfort

- Vulnerable road users/ pedestrian detection system (APALACI)
- Adaptive Cruise Control (ACC)
- Forward Collision Warning (FCW)
- Lane Keeping Support (SAFELANE)
- Attention Support/Distraction Warning
- Curve warning
- Parking support
- Traffic signal recognition

## ■ Information and Communication

- Navigation and dynamic map system
- GSM phone
- Nomadic devices
- Infotainment
- Radio
- Fleet management
- Climate
- Vehicle status monitoring
- Trip computer
- Traditional info ("standard functions")



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# Input and Output (I/O) devices for HMI integration



**Overall input and output devices developed and tested in AIDE.** This table lists the major input and output modalities considered in the AIDE project. The suitable types or formats (possible controls and displays) per modality are also given together with actual devices that can be used.

	Modality	Type/ Format	Device
Input	Visual	<ul style="list-style-type: none"> <li>○ Eye tracking</li> </ul>	<ul style="list-style-type: none"> <li>○ Camera</li> </ul>
	Auditory (Voice)	<ul style="list-style-type: none"> <li>○ Speech-based controls</li> </ul>	<ul style="list-style-type: none"> <li>○ Speech recognition</li> </ul>
	Tactile /Haptic	<ul style="list-style-type: none"> <li>○ Standard controls                             <ul style="list-style-type: none"> <li>○ Buttons</li> <li>○ Switches</li> <li>○ Dials</li> <li>○ Knobs</li> </ul> </li> <li>○ Touch screen</li> <li>○ Haptic switch</li> </ul>	<ul style="list-style-type: none"> <li>○ Stalks</li> <li>○ Toggle switches</li> <li>○ Rocker switches</li> <li>○ Key pad</li> <li>○ Discrete rotary knob</li> <li>○ Continuous rotary knob</li> <li>○ Push-buttons</li> <li>○ Slides</li> <li>○ Levers</li> <li>○ Push-pull knob</li> <li>○ Three-position toggle</li> <li>○ Thumb wheel</li> <li>○ Haptic barrel keys</li> <li>○ Touch display</li> </ul>



# Input and Output (I/O) devices for HMI integration



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	Modality	Type/ Format	Device
Output	Visual	<ul style="list-style-type: none"> <li>○ Symbol-based                             <ul style="list-style-type: none"> <li>○ Telltales</li> <li>○ Icons</li> </ul> </li> <li>○ Text-based                             <ul style="list-style-type: none"> <li>○ Alphanumeric strings</li> <li>○ Phrases</li> <li>○ Sentences</li> </ul> </li> <li>○ Camera images                             <ul style="list-style-type: none"> <li>○ Real-time</li> <li>○ Recordings</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>○ Head Up Display (HUD)</li> <li>○ Configurable TFT displays</li> <li>○ Standard TFT displays</li> <li>○ Standard analogue and digital displays</li> <li>○ Light-emitting diodes (LEDs)</li> </ul>
	Auditory	<ul style="list-style-type: none"> <li>○ Artificial speech</li> <li>○ Sounds                             <ul style="list-style-type: none"> <li>○ Informative</li> <li>○ Warning</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>○ Text-to-speech</li> <li>○ Buzzer</li> <li>○ In-vehicle speakers</li> </ul>
	Tactile/Haptic	<ul style="list-style-type: none"> <li>○ Steering wheel vibrations</li> <li>○ Force-feedback                             <ul style="list-style-type: none"> <li>○ Steering wheel torque</li> <li>○ Switch vibrations</li> <li>○ Switch resistance</li> </ul> </li> <li>○ Seat vibrations</li> </ul>	<ul style="list-style-type: none"> <li>○ Haptic steering wheel</li> <li>○ Haptic switch (barrel keys)</li> <li>○ Haptic seat</li> </ul>



# Shared I/O devices for HMI integration



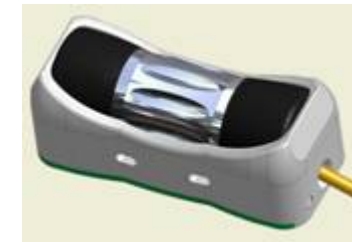
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- Shared I/O devices
  - CIC=Configurable Instrument Clusters
  - SID=Secondary Information Display
  - HUD=Head-Up Display
  - Haptic Barrel Keys
  - Speech I/O
  - Nomadic devices integrated in the in-vehicle HMI
- Shared sensors:
  - Standard vehicle sensors (speed, SW angle, etc), Forward looking radar, Lane tracker, Eye/head tracker, GPS and map data



Nomadic devices



Haptic Barrel Key



Configurable Instrument Cluster  
Truck



Configurable Instrument Cluster  
Car



Secondary Information Display  
Truck



# DVE monitoring and HMI adaptivity



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- DVE (Driver-Vehicle-Environment) monitoring:

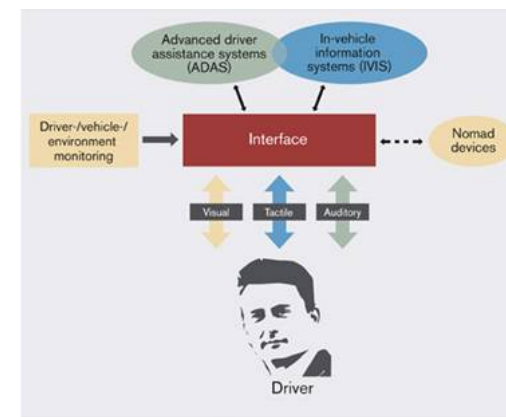
- Driving demand
- Distraction and drowsiness
- Traffic/environment risk
- Driver's strategies/abilities/preferences

DVE state knowledge is used for:

- Postponing, simplifying, intensifying, adapting e.g. information modality, timing and ADAS sensitivity
- Central prioritisation and scheduling through the ICA (Interaction and Communication Assistant)
- Incoming messages from nomadic devices are also filtered through the ICA



Problem: Increased functionality



Solution: Adaptive Integrated Driver-vehicle Interface



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# Conclusions



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- Work succeeded in determining the HMI components (i.e. displays, head-up displays, speech I/O, sounds etc) => used as basis in deciding the final versions for installation in the AIDE vehicle demonstrators (truck, city and luxury cars).
- Novelty and innovativeness attained based on how these components were grouped, as well as how their modalities were combined and prioritised to present information in a safer and highly usable manner
  - This approach reflects the integration and adaptation strategies developed in the AIDE project
  - Exemplified also by the subtle differences in the design and use of the HMI components exist among the prototypes owing to the nature of the vehicle types themselves (i.e. city car vs. luxury car vs. truck) and the brand they carried



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