Sub-Project 3: Design and Development of an Adaptive Integrated Driver-Vehicle Interface

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Sub-Project 3 Overview

**General Objective:**

*Design, develop and demonstrate an adaptive integrated driver-vehicle interface.*

**Key activities:**

- **Technological benchmarking** and definition of scenarios and use cases.
- **Requirements and specifications.**
- **System architecture** definition.
- **Design** of the adaptive integrated interface.
  - Multimodal HMI and integration of nomadic systems.
  - Intelligence for Interaction Management (Interaction and Communication Assistant).
- Development of **driver-vehicle-environment state (DVE) monitoring modules** (to enable adaptivity).
- **Prototype vehicles** development.
**Sub-Project 3 Partners**

**SUBPROJECT 3: DESIGN AND DEVELOPMENT OF AN ADAPTIVE AND INTEGRATED DRIVER – VEHICLE INTERFACE**

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<th>Leader:</th>
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<td>Institute of Communications and Computer Systems (ICCS)</td>
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<td>Centro Ricerche FIAT (CRF)</td>
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<th>23 Partners!</th>
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<td>8 OEMs</td>
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| BMW | BOSCH | ICCS |
| CRF | MOTOROLA | INRETS |
| FORD | NUANCE | KITE |
| OPEL | SV | TNO |
| PSA | TELENOSTRA | USTUTT |
| REGIENOV | RENAULT | CTAG |
| SEAT | CERTH/ HIT | ERTICO |
| VTEC | VOLVO | DI BE |

www.aide-eu.org
AIDE SP3 Innovation

- Integrated management of all messages and input/output devices within the car interior.
- Dynamic information management.
- Adaptive User Interface (UI).
- Personalisation.
- Real-time monitoring driver/vehicle/environment.
- All traffic scenarios functionality.
- Common architecture.
- New input/output devices.
- Nomadic devices integration.
Key issues:

- Prevent interference between I/O events.
- Adaptation to the driver state and/or the driving situation (DVE).
- Integration of nomadic devices.
- Exploit synergies (reduce HW costs, enhance performance).
The AIDE System

TOWARDS FUTURE AUTOMOTIVE HMI

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

www.aide-eu.org
User centered design (UCD) approach

HMI virtual prototyping and tests

On vehicle HMI design, implementation and on road tests (real scenario, test track)

HMI mockups tests on dynamic and static driving simulators
ARV: Each application has to request the access to I/O devices by an Application Request Vector sent to the ICA.

RV: The Reply Vector defines the form to be chosen for output and the action e.g. postpone, terminate.

RNV: The Request No more valid Vector informs the ICA about the device status.

DVE Vector: The Driver Vehicle Environment Vector informs the ICA and the application on the Detected DVE conditions.
Objectives:  

Design and development of innovative adaptive interface functions and driver-vehicle-environment monitoring techniques for enabling real-time interface adaptivity.

Five modules have been developed and integrated to the AIDE system, in order to assess the Driver-Vehicle-Environment (DVE) status:

- Traffic and Environment Risk Assessment Module (TERA): estimates in real time the total level of risk related to traffic and environmental parameters.
- Driver Characteristic module (DC): defines and estimates the driver typical profiles.
- Driver Availability Estimator (DAE): analyses the primary task activities.
- Driver State Degradation (DSD): monitors the driver's fatigue and hypo-vigilance.
- Cockpit Activity Assessment (CAA): assesses the availability effects of a secondary task.
Interaction and Communication Assistant (ICA)

Manages all interactions between the driver and the various in-vehicle systems in order to:

- avoid the negative impact of the information sources on the driving task (e.g. distraction and information overload);
- avoid interference between different pieces of information.

The management functions include:

- Definition of what type of information should be delivered, when and how.
- Adaptation to the driver and to the environment.
- Personalisation of the adaptive HMI to the individual driver.
An “application request vector” is sent by an application to the ICA each time an information has to be dispatched.

- **Priority Manager**: assigns a priority level to all the messages to be displayed according to the parameters describing each action generated by the applications;

- **Filter**: filters the incoming information according to the DVE conditions and decides if and when it will be provided to the driver (display now/delay);

- **Modality Selector**: applies the adaptation strategy to select the best modality to provide the information to the driver according to the DVE conditions;

- **Channel Selector**: manages the allocation of the I/O channels according to the action’s priority (in case of concurrent actions) and the status of the availability of the I/O devices.
**I/O Device Controls in the AIDE system:**

- LCD displays.
- Head-up displays (HUD).
- Haptic input/outputs.
- Loudspeakers or buzzers.
- Speech recognition system and TTS-engine.
AIDE explored a number of issues related to Nomadic devices use by drivers:

- Safety issues raised by the introduction of the Nomadic Devices in the vehicle.
- Integration of Nomadic Devices and definition of a gateway concept.
- Functional and Technical requirements both from OEMs but also from device manufacturers point of view.

→ The AIDE Nomadic Forum: a success story!
Integration of Nomadic Devices in the AIDE system

**Nomadic Device Gateway:**

- The integration of nomadic devices uses the AIDE Nomadic Device Gateway to connect to the in-vehicle system.
- The functionality of the nomadic device in terms of data, applications and I/O devices can be used by the in-vehicle system and vice-versa.
- The in-vehicle system contains a virtual application software connected to the nomadic device functionality via the AIDE gateway that provides access to the I/O devices.
AI DE Vehicle Prototypes

FIAT Croma

SEAT León

VOLVO FH12
AI DE Vehicle Prototypes

- Prove the technical feasibility of the AI DE system design.
- Use the flexibility of the AI DE system to prove that different individual solutions can be obtained within the AI DE system solution.
- Demonstrate the AI DE functionality.
- Provide test vehicles for the AI DE system evaluation.

The three demonstrators have implemented the entire AI DE system including:
- Adaptive HMI.
- I/O devices.
- Driver Vehicle Environment (DVE) modules.
- Interaction and Communication Assistant (ICA).
- Nomadic device gateway.

Existing in-vehicle functions as well as some real or simulated additional functions have been integrated in the AI DE system solution.
Conclusions

- AIDE improves driver - vehicle interaction in terms of distraction and usability.
- AIDE reduces negative effects of HMI interdependencies preventing interference among different messages.
- AIDE assesses driving situation and driver state to adapt the HMI.
- AIDE integrates nomadic devices in the in-vehicle HMI.
- AIDE solutions allow OEM/vehicle specific design choices.
- AIDE prototype vehicles integrate a number of HMI components that are also deployable separately.
- AIDE prototype vehicles' setups implement AIDE type adaptivity and integration features.
Experience our results...

**Demonstrators:**
- Volvo truck demonstrator.
- FIAT demonstrator.
- SEAT demonstrator.

**Demos:**
- Truck simulator showing AIDE/PReVEnT integration.
- DVE platform.
- Nomadic Device Gateway.
- Speech I/O Device.
- ICA Strategies Evaluation.
- Driver State Degradation module.
- Driver’s Availability Estimator.
- HMI Virtual Prototype.

**Posters:**
- AIDE Architecture.
- Traffic and Environment Risk Assessment module.
- Cockpit Activity Assessment module.
- Driver Characteristics module.
- Interaction and Communication Assistant.
- Haptic Barrel Key.
- Haptic Seat.

[Map of the venue showing SP3]
Thank you for your attention!

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AIDE Integrated Project web site: www.aide-eu.org
Sub-Project 3
Work-Packages

- WP 3.0 Subproject management (ICCS)
- WP3.1 Technological Benchmarking and Use Cases (SEAT)
- WP3.2 Specifications and System Architecture (BOSCH)
- WP3.3 Driver-Vehicle-Environment (DVE) Monitoring Modules (ICCS)
- WP3.4 Adaptive Interface Design and Development (CRF)
- WP3.5 System Integration and Technical Verification (VTEC)
Sub-Project 3
Work-Packages

WP 3.0 Subproject management (ICCS)

Objectives
- To lead the sub-project, co-ordinate the work of the different work packages
- To liaise and interface the sub-project to the other sub-projects and the IP management

WP3.1 Technological Benchmarking and Use Cases (SEAT)
WP3.2 Specifications and System Architecture (BOSCH)
WP3.3 Driver-Vehicle-Environment (DVE) Monitoring Modules (ICCS)
WP3.4 Adaptive Interface Design and Development (CRF)
WP3.5 System Integration and Technical Verification (VTEC)
Sub-Project 3
Work-Packages

- WP 3.0 Subproject management (ICCS)
- WP3.1 Technological Benchmarking and Use Cases (SEAT)

Objective
- To perform the initial “pre-study” activities that provide the basis for the development work in SP3, focusing on performing (1) benchmarking of AIDE related technologies and (2) identifying scenarios

Tasks
- T3.1.1 Technological Benchmarking and User Expectations
- T3.1.2 Scenarios and use cases

Main results
- Technical benchmarking results
- Nomad devices workshop minutes
- Scenarios and use cases definition

- WP3.2 Specifications and System Architecture (BOSCH)
- WP3.3 Driver-Vehicle-Environment (DVE) Monitoring Modules (ICCS)
- WP3.4 Adaptive Interface Design and Development (CRF)
- WP3.5 System Integration and Technical Verification (VTEC)
Sub-Project 3
Work-Packages

- WP 3.0 Subproject management (ICCS)
- WP3.1 Technological Benchmarking and Use Cases (SEAT)

- WP3.2 Specifications and System Architecture (BOSCH)
  **Objective**
  - Specify the technical functional requirements for the different components and functions of the AIDE system, including technical specifications for sensors, I/O devices, computing hardware and software, data exchange protocol and system architecture, but also the basic functional specifications for the adaptive interface functions

  **Tasks**
  - T3.2.1 Requirements and specifications
  - T3.2.2 In-vehicle integration requirements
  - T3.2.3 System architecture

  **Main results**
  - Requirements and specifications for HMI and safety functions
  - Data flow protocol and system architecture definition and design
  - System architecture

- WP3.3 Driver-Vehicle-Environment (DVE) Monitoring Modules (ICCS)
- WP3.4 Adaptive Interface Design and Development (CRF)
- WP3.5 System Integration and Technical Verification (VTEC)
WP 3.0 Subproject management (ICCS)
WP3.1 Technological Benchmarking and Use Cases (SEAT)
WP3.2 Specifications and System Architecture (BOSCH)

WP3.3 Driver-Vehicle-Environment (DVE) Monitoring Modules (ICCS)

Objective
Develop techniques for real-time monitoring of the driver-vehicle-environment state, in order to enable real-time adaptation of the driver vehicle interface.

Tasks
T3.3.1 Real-time sensor set definition and development
T3.3.2 Traffic and environment risk assessment module
T3.3.3 Driver characteristics module
T3.3.4 Driver availability estimator and driver state degradation module
T3.3.5 Cockpit activity assessment module
T3.3.6 Definition and development of DVE monitoring outputs
T3.3.7 DVE monitoring modules verification and functionality tests

Main results
Prototype versions of DVE monitoring modules
Verified DVE monitoring modules

WP3.4 Adaptive Interface Design and Development (CRF)
WP3.5 System Integration and Technical Verification (VTEC)
Sub-Project 3
Work-Packages

WP 3.0 Subproject management (ICCS)
WP3.1 Technological Benchmarking and Use Cases (SEAT)
WP3.2 Specifications and System Architecture (BOSCH)
WP3.3 Driver-Vehicle-Environment (DVE) Monitoring Modules (ICCS)

WP3.4 Adaptive Interface Design and Development (CRF)

Objective
Design, develop and technically verify the adaptive integrated driver-vehicle interface components and functions.

Tasks
- T3.4.1 HMI design and virtual prototyping,
- T3.4.2 Development of user interface layout
- T3.4.3 Development of I/O devices,
- T3.4.4 Prototype nomadic device integration and validation tests
- T3.4.5 Interaction and Communication Assistant
- T3.4.6 HMI technical and functional verification

Main results
- Interaction, communication and harmonisation plan
- HMI components (displays, HUDs, speech I/O, sound etc.)
- Guidelines for safe Integration of NOMAD devices within the vehicle environment
- Technically verified adaptive integrated driver-vehicle interface in simulator
- Validated adaptive integrated driver-vehicle interface

WP3.5 System Integration and Technical Verification (VTEC)
Sub-Project 3
Work-Packages

WP 3.0 Subproject management (ICCS)
WP3.1 Technological Benchmarking and Use Cases (SEAT)
WP3.2 Specifications and System Architecture (BOSCH)
WP3.3 Driver-Vehicle-Environment (DVE) Monitoring Modules (ICCS)
WP3.4 Adaptive Interface Design and Development (CRF)
WP3.5 System Integration and Technical Verification (VTEC)

Objective
- Integrate the system architecture (WP3.2), the DVE monitoring modules (WP3.3) and the adaptive integrated interface components (WP3.4) into three prototype vehicles, one city car, one luxury car and one truck.

Tasks
- T3.5.1 System integration
- T3.5.2 Technical verification
- T3.5.3 Optimisation and support of AIDE system

Main results
- Three technically verified prototype vehicles