interactIVe

Accident avoidance by active intervention for Intelligent Vehicles

News | 06

December 2013
www.interactIVe-ip.eu

Picture 01: interactIVe driving demonstrations at Ford Proving Ground in Lommel/Belgium

Dear interested reader,

After four years of work, the integrated project interactIVe - Accident avoidance by active intervention for Intelligent Vehicles has reached its completion, marking major progress towards the realisation of advanced safety systems for Intelligent Vehicles. At the Final Event in Aachen and Ford Proving Ground in Lommel the project members showed the results of their research. “Advanced driver assistance systems belong to the future of driving. We combined many different sub-systems — Continuous Driver Support, Collision Avoidance and Collision Mitigation — into one integrated solution: advanced research and engineering for a small city car as well as for a large commercial truck. This is our contribution to an accident-free-world.” With this last edition of our newsletter we want to present you the final research results and thank you very much for your support and interest.

We wish you and your families a wonderful holiday season and a healthy and peaceful New Year.

December 2013, Christoph Kessler, Coordinator

▸ The research concept: integrated solutions for intelligent vehicles

State-of-the-art assistance technologies in vehicles have shown outstanding capabilities for supporting the driver. Existing systems are effective, but are typically implemented as independent functions.

The overall objective of interactIVe was to develop integrated and affordable ADAS applications for all vehicle classes. Its aim was to enhance the intelligence of vehicles to promote safer and more efficient driving. In this context, the project emphasised the exploitation of all information sources for high situational awareness, such as multiple sensors, maps and communication with the outside world. A special focus was the transition from existing information and warning systems to new systems, able to intervene on the vehicle controls under well-defined conditions. interactIVe developed new assistance systems based on a three pillar concept that addresses increasing degrees of hazard, from normal driving all the way to crash scenarios.

Picture 02: Crash timeline

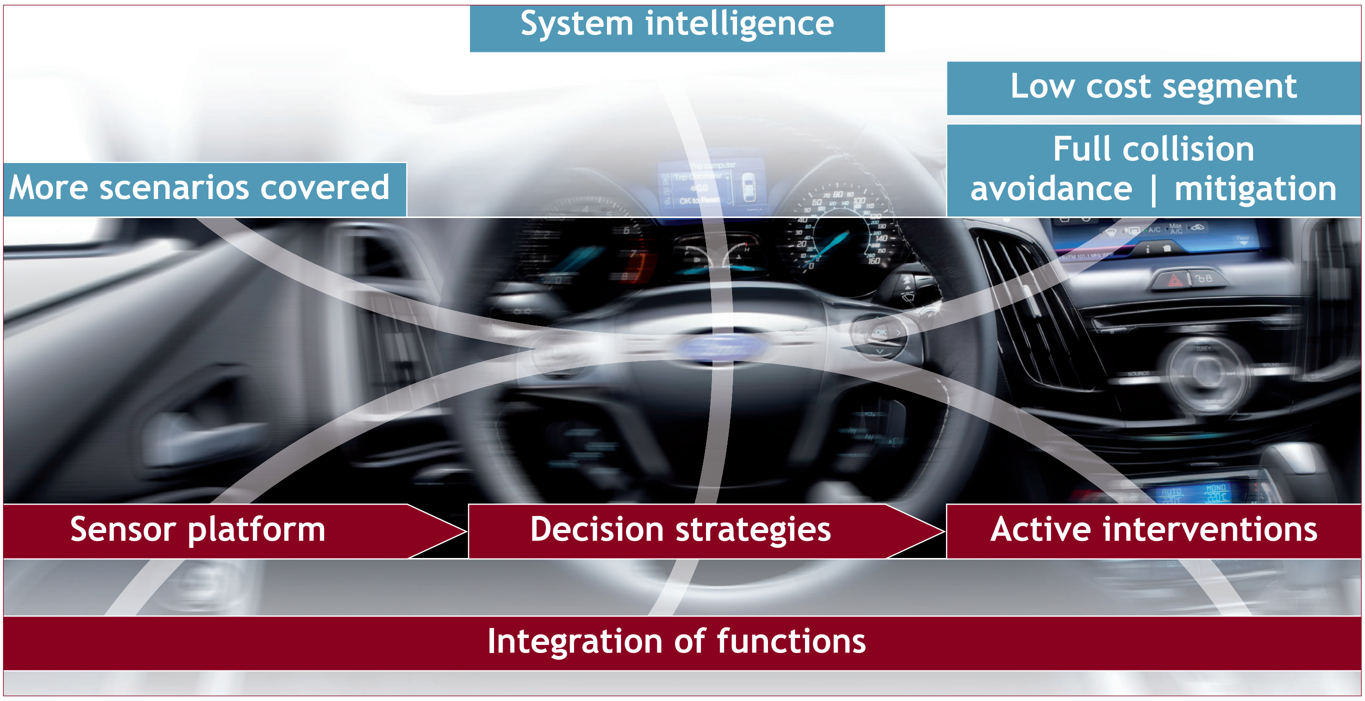
interactIVe went beyond the existing accident scenarios covered by previous research:

the combination of lateral and longitudinal active interventions by autonomous braking and steering offers new possibilities to support the driver.

A comprehensive human-machine interaction design increases the usability. Intervention strategies always integrate the driver.

The perception platform significantly increases the intelligence of the system by providing a complete view of the environment and thus understanding the situation as a whole.

‣ The characteristics: contribution to the broad deployment of ADAS



The vision of interactIVe is accident-free traffic realised by means of affordable integrated safety systems penetrating all vehicle classes, and thus accelerating the safety of road transport.

interactIVe designed, developed, and evaluated three groups of functions to be implemented in dedicated demonstrator vehicles: Continuous Driver Support, Collision Avoidance and Collision Mitigation. These vehicles are six passenger cars of different classes and one truck.

- interactIVe developed and integrated a research set of functions to support the driver.
- interactIVe showed that the systems can be implemented in all vehicle classes.
- interactIVe systems are affordable, as low cost sensors were implemented and previously independent functions were integrated.
- interactIVe systems expand the perception horizon, because a new integrated sensor platform perceives the environment information.
- interactIVe systems improve decision strategies for ADAS, because new prediction techniques and advanced human machine interface concepts are used to balance human and system interventions.
- interface concepts are used to balance human and system interventions.

▸ The intercatIVe functions

The three vertical sub-projects SECONDS, INCA and EMIC addressed the specification, design, and realisation of the respective interactIVe functions.

The basic concept behind the development of SECONDS continuous support functions is a virtual codriver who is usually silent, but gives advice to the driver whenever suitable. In dangerous situations, the co-driver can even take over control of the vehicle. The driver can take over control of the vehicle at any time.

The INCA sub-project combines lateral and longitudinal active interventions by autonomous braking and steering. The aim is to extend the operation domain of collision avoidance and collision mitigation systems on the market today. For this purpose, an integrated collision avoidance system is developed by using information not only from a forward-looking sensor, but also from all sensors around the vehicle.

Affordable collision mitigation concepts could have a significant impact on the reduction of accident severity. Therefore, known collision mitigation concepts for reducing accident severity are extended by the EMIC sub-project, with specific attention to vehicle architectures in the low and medium segments.

SECONDS-Safety enhancement throgh continous driver support

Continuous Support (CS)	assists the driver in all driving situations.
Curve Speed Control (CSC)	allows cornering at comfortable and legally allowed speed, using information from the digital maps.
enhanced Dynamic Pass Predictor (eDPP)	supports the driver during overtaking manoeuvres.
Safe Cruise (SC)	implements automatic following of vehicles on main roads at a safe distance.

INCA-Integrated collision avoidance and vehicle path

Lane Change Collision Avoidance (LCCA)	assis warns the driver if a vehicle is rapidly approaching from behind during the lane change. It provides counter torque to remind the driver not to change lane.
Curve Speed Oncoming Vehicle Collision Avoidance (OVCA)	supports the driver to prevent collisions with oncoming vehicles by warning, braking and/or restricting the possibility to overtake in cases of oncoming traffic.
Rear End Collision Avoidance (RECA)	issues a warning if a lead vehicle suddenly brakes. If the driver does not react, the system brakes or steers to help the driver to avoid the situation.

Side Impact Avoidance (SIA)	issues a warning when another vehicle is in the blind spot during an overtaking manoeuvre. If the driver does not notice the warning, the system assists the driver by steering the host vehicle back into its lane.
Run-off Road Prevention (RoRP)	avoids an unintended leave of the road by steering the vehicle back into its lane.

EMIC-Cost-efficient emergency intervention for collision mitigation: development and implementation

Emergency Steer Assist (ESA)	aims at supporting the driver during a steering manoeuvre by increasing the stability of the vehicle.
Collision Mitigation System (CMS)	perceives its environment through a camera and a radar sensor and uses this input to assess the situation. Based on this assessment the function determines whether a collision is imminent. If an unavoidable collision is detected, the function calculates the probable point of impact and possible alternative impact points. The system can then take over control of the brakes and the steering system

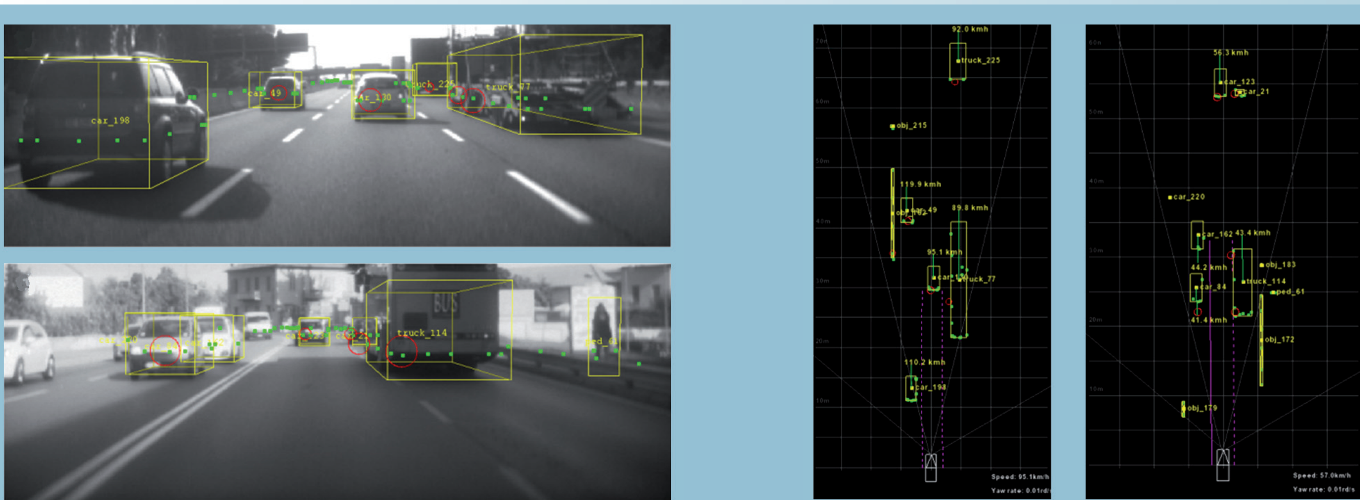
Picture 03: The demonstrator vehicles at Ford Proving Ground in Lommel/Belgium

The main achievements

Picture 04: Volvo cars testing facilities

The main achievement is the creation and evaluation of integrated ADAS, characterised by outstanding capabilities for supporting the driver in varied traffic scenarios, and specifically for avoiding hazardous situations. The developed functions of these integrated ADAS rely on data elaborated by the perception layer and embed IWI strategies in order to support drivers by warning, active braking and steering whenever necessary.

Along with the outcomes at the functional level, specific results were achieved for the perception-sub-system, for the intervention strategies and for evaluation methodologies.



Picture 05: Experimental results

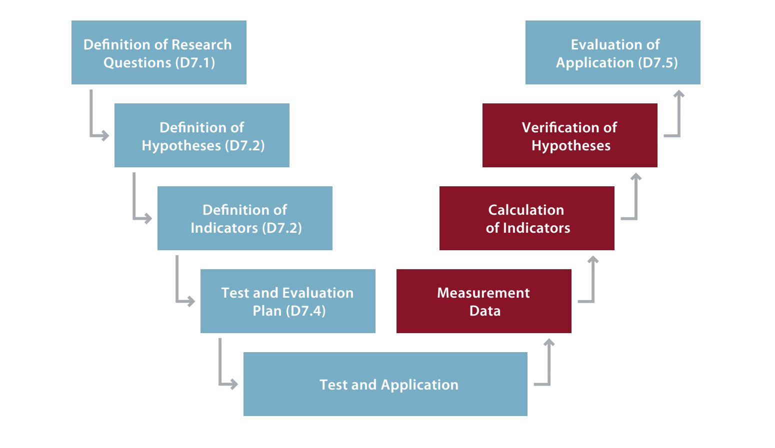
Perception platform: The development and evaluation of an integrated multisensory data fusion platform, with generic

I/O interfaces, is the key outcome of the perception team. This platform hosts a variety of perception algorithms, from

sensor level to object and situation level, and offers map-matched environment perception shared by multiple safety applications.

This is performed for the first time in a generic architecture framework.

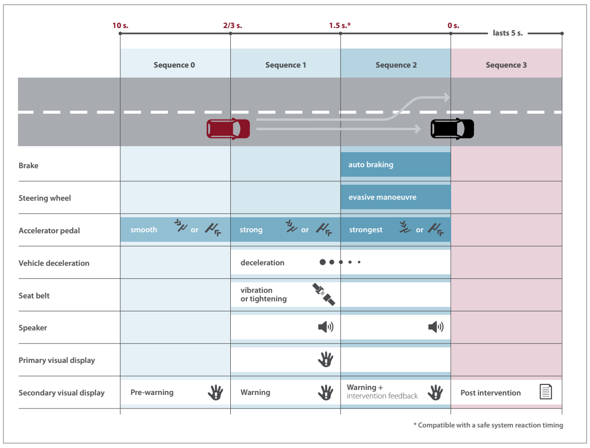
This framework integrates all types of sensors or information sources. At the same time it serves the needs of demanding interactIVe safety functions to interpret the highly dynamic and complex driving environment and advance the state-of-the-art in this field.



Picture 06: Evaluation process in interactIVe

Evaluation and legal aspects: The final phase of the project involved testing and evaluation of all developed functions according to the defined evaluation methodology. Test data were obtained by testing the addressed scenarios on test tracks or on public roads. Along with the technical aspects, the potential user acceptance of the functions as well as the interaction between users and functions were evaluated in driving simulator studies and on public roads. In general, the users found the interactIVe functions useful and showed a high willingness to use them. The evaluation was completed by an assessment of potential safety impacts of the individual functions. Especially in rear-end conflicts the interactIVe functions showed high potential to avoid accidents or at least to mitigate their consequences.

Information, Warning and Intervention (IWI) strategies: The IWI strategies defined the functions from a driver's perspective and can be seen as design guidelines. They refer to how, when and where driver information, warnings, and interventions need to be activated. The IWI strategies include functional decision strategies and the driver-vehicle interaction by different means such as via the actuators steering, braking) as well as visual, audio and/or haptic information and warnings. In order to come up with appropriate strategies, human factors issues related to active safety and automation were evaluated in 10 simulator and test track experiments as well as in additional experiments jointly run with the vertical sub-projects. Common haptic, graphic and sound elements were developed.



Picture 07: Interaction sequence for longitudinal control

Imprint: interactIVe | News | 06 | December 2013

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This research project ran from January 2010 until November 2013 and was co-funded by the European Commission Directorate General for Communications Networks, Content & Technology (DG CONNECT) under the Seventh Framework Programme (FP7) for research and technological development. The final results were presented in Aachen, Germany 20-21 November 2013 through technical presentations and a respective.

Project Partners:

Co-funded by the European Union

Supported by EUCAR