interactIVe

Accident avoidance by active intervention for Intelligent Vehicles

News | 03

March 2012

www.interactIVe-ip.eu

During the Annual EUCAR Conference Volkswagen represented the interactIVe project with one of the demonstrator vehicles.

Dear reader,

All demonstrator vehicles are fully equipped with the hardware and are now being prepared for the evaluation phase: the functions are being implemented and validated step by step. We will now take a quick look at the functions to be tested.

While workshops are one of the essential means of collaboration, the project has also been advanced in experimental studies, tests, and other gatherings.

The first three studies on information, warning and intervention strategies were concluded. The research shows which warning and information means are best accepted by drivers. Improving the assistance functions is a core task of interactIVe.

The project expert for continuous support and leader of the interactIVe sub-project SECONDS (Safety Enhancement through CONtinuous Driver Support), Andrea Saroldi from Centro Ricerche Fiat, gives insights into his field of research.

Autonomous braking and steering interventions still pose complex intricate legal challenges. In interactIVe a sub-project dedicated to this field seeks answers to current questions. Project members met at the German Federal Highway Research Institute (BASt) to discuss legal aspects in interactIVe.
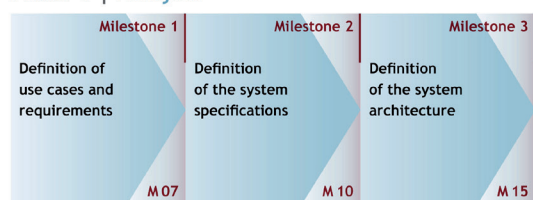
Only a vehicle that comprehensively and correctly perceives its environment is able to perform active safety functions appropriately. The interactIVe sub-project Perception advances the software modules for the perception platform.

This year's winter will soon be over and the project invites you to a special summer activity: the interactIVe Summer School from July 4 to 6 on the Greek island of Corfu.
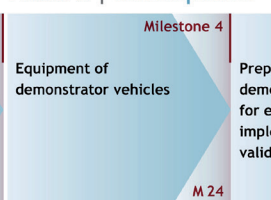
For now, I wish you a pleasant reading. For more information please also visit the website: **www.interactIVe-ip.eu**
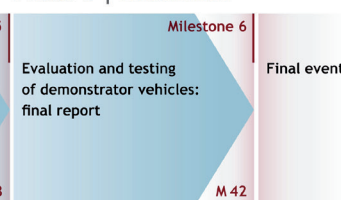
March 2012, Aria Etemad, Coordinator

Phase 1 | Analysis   **Phase 2 | Development**   **Phase 3 | Evaluation**

Milestone 1	Milestone 2	Milestone 3	Milestone 4	Milestone 5	Milestone 6	
Definition of use cases and requirements	Definition of the system specifications	Definition of the system architecture	Equipment of demonstrator vehicles	Preparation of demonstrator vehicles for evaluation: implementation and validation of functions	Evaluation and testing of demonstrator vehicles: final report	Final event
M 07	M 10	M 15	M 24	M 33	M 42	

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Eleven interactIVe functions will be tested and developed in three sub-projects that equip seven demonstrator vehicles. These functions will be part of the tests:

interactIVe | Sub-projects and their functions under development and test

SECONDS (Safety Enhancement through CONtinuous Driver Support):

Continuous Support, Curve Speed Control, enhanced Dynamic Pass Predictor, Safe Cruise

INCA (INtegrated Collision Avoidance and vehicle path control for passenger cars and commercial vehicles):

Lane Change Collision Avoidance, Oncoming Vehicle Collision Avoidance / Mitigation, Rear-end Collision Avoidance, Side Impact Avoidance, Run-off Road Prevention

EMIC (cost-efficient Emergency Intervention for Collision mitigation):

Emergency Steer Assist, Collision Mitigation System

▸ Experimental studies on IWI strategies completed

Three experimental studies have been conducted until December 2011 at Volvo Technology in Sweden, the German Aerospace Centre (DLR), and at Centro Ricerche Fiat in Italy. The studies focused on

▸ Driver reactions to active steering interventions to avoid a collision.

▸ Driver reactions in situations where collisions are inevitable and the system mitigates the impact via steering.

▸ Distinguishable warnings (auditory, visual, haptic via steering wheel, accelerator pedal, seat belt) against different lateral and longitudinal threats.

The results

The **braking and steering system** acts faster compared to a human driver without the help of an active system. The overwhelming majority of the test persons, both car and truck drivers, would like to have the system.

Drivers do countersteer the **system intervention**, some even with considerable force. Most interestingly, only a very small number of the participants of the study noticed the system interventions. The study suggests that drivers respond to the intervention subconsciously.

Of all the **communication channels** analysed, signals containing a visual component seem to be the most effective and informative.

Visual information and warnings and haptic warnings via pedal as well as the combination of visual and acoustic warnings are well accepted. The haptic feedback on the seat belt is generally perceived as less desirable. Along with the blind-spot detection, multimodal feedback seems to be preferred over single modality feedback.

Future studies in the course of the project will address topics like pedal haptics, the design of pre-warnings, and emergency steering interventions.
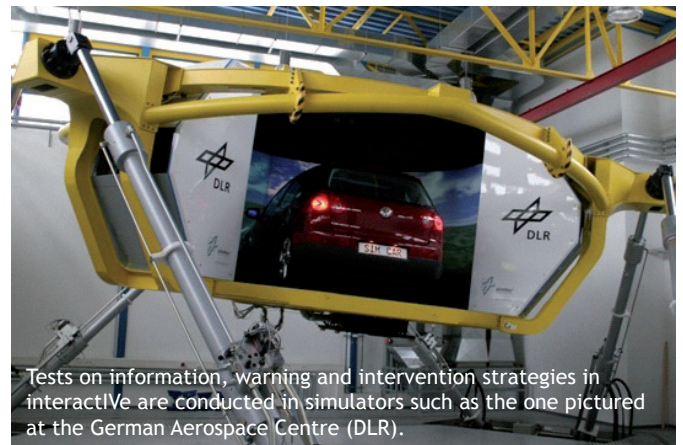
Tests on information, warning and intervention strategies in interactIVe are conducted in simulators such as the one pictured at the German Aerospace Centre (DLR).

▸ **Interview with Andrea Saroldi, specialist on support functions**

Andrea Saroldi

[Centro Ricerche Fiat (CRF), leader sub-project SECONDS — Safety Enhancement through Continuous Support]

Mr. Saroldi, what is the specific task of your sub-project in interactIVe and what are the particular challenges of your work on driver support technologies?

Andrea Saroldi: Inside interactIVe, the sub-project SECONDS is dedicated to prototyping and in-vehicle tests of the Continuous Support function.

Deep integration between the system modules

The goal is to conceive and implement a driver support function that is able to assist in many different situations with unified driver interaction interface. The idea behind that is of a driver companion that is usually silent but can advise or even intervene when there is a risk.

In my opinion, the most challenging task here is to make technology "transparent": the drivers are not interested in sensor-data fusion or optimal manoeuvring planning; they just want to drive safely. This implies two guidelines for development: select the technologies that better fit the driver needs, and build a deep integration between the system modules, not just an overlap of different driving assistance functions.

What difference will the developments in interactIVe make compared to existing technological solutions? How does the support look, sound, and feel like?

Andrea Saroldi: First of all, as output from the sensor data processing part (called Perception Platform) we obtain a unified description of the scenario around the vehicle including all key elements: obstacles, road, and environment. This scenario description is used to generate an optimal manoeuvre that is the best manoeuvre to be followed as computed by the system, considering safety, comfort, and fuel consumption simultaneously.

Find the optimal manoeuvre

The optimal manoeuvre computed by the system is then compared with the actual manoeuvre executed by the driver. When there is a mismatch, the driver is prompted to change the trajectory with a strength that is increasing with the danger level.

The most difficult development tasks are therefore related to obtaining an accurate description of the road scenario, a reliable optimal manoeuvre, and good strategies to invite the driver to follow it, also in dangerous situations. This deep integration between modules is a key new aspect of interactIVe.

The Fiat demonstrator vehicle is under preparation for functional tests.

▸ Active intervention from a legal point of view

On November 24, 2011, about twenty project members of interactIVe met at the Federal Highway Research Institute (BASt) in Bergisch Gladbach, Germany, for a workshop on legal aspects. They discussed aspects of vehicle type approval, road traffic laws and product liability on the EU level relevant to interactIVe applications.

The basis for discussion was the project deliverable "Legal Aspects", which will be available on the interactIVe website in autumn 2012.

Driver control is required

Regarding type approval, process intervention by steering is critical, because steering interventions are only allowed for a limited duration and in order to maintain the basic desired path of the vehicle. Especially functions that are intended to prevent collisions during a lane change or which perform a lane change to prevent an accident raise the question what the desired course of action is.

Interventions by braking are allowed as long as they are declared to the technical service during the approval process.

National road traffic codes in the EU reflect vital rules of the Vienna Convention on road traffic. These rules include the basic idea of permanent controllability, assigning the driving task to the driver. Therefore, the driver's control should be put forward as far as possible. This could be achieved by means of a function design which provides for corresponding warning strategies and which allows the driver to override the automated interventions.

Functions intervening in an area which is beyond human capability to react represent a special case: These interventions do not run contrary to the Vienna Convention.

Consider product liability

With respect to product liability law according to the Product Liability Directive 85/374/EEC — implemented into national laws, by all EU member states — the producer is strictly liable for damages caused by a defect in its product. A product is defective when it "does not provide the safety which a person is entitled to expect".

It is not the Product Liability Directive itself which obligates the producer or manufacturer but the respective national product liability laws which means that the jurisdiction concerning product liability cases has to be regarded on a national level. For instance, according to the German version the product has to comply with the state-of-the-art of science and technology. In order to be able to prove that this was adhered to the relevant standards e.g. RESPONSE 3 Code of Practice or ISO 26262, should be incorporated into the design, construction, and production process.

Adhering to technical standards is necessary but not sufficient in order to comply with the state-of-the-art in science and technology. From a product liability perspective it is also advisable to follow the basic idea of controllability and to design the functions in a way that enables the driver to override automated interventions at any time.
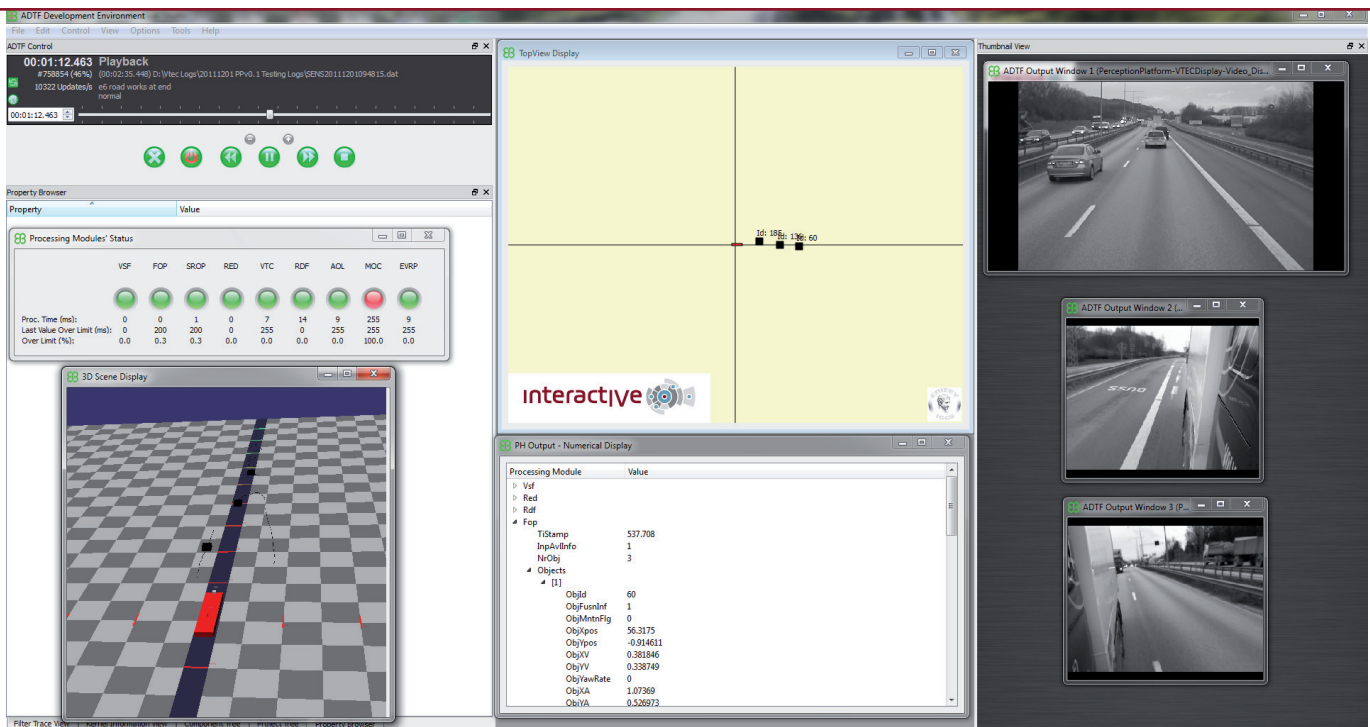
Reference Perception Platform auxiliary displays; snapshot from the Frontal Object Perception (FOP) module implementation.

► The perception platform: software modules advance

The sub-project Perception continues to develop the Perception Platform (PP). The software engineers are now focusing on the Reference Perception Platform (RPP) implementation.

The RPP is a software environment in which the perception modules are integrated and their algorithms are executed within a common framework. The RPP design takes into consideration the functional, software, hardware and Perception Horizon (PH) requirements for Perception Platform modules as they were derived in co-operation with the testing partners.

A high-level functional architecture overview of the RPP layer is presented below. The actual physical allocation of each PP module in the RPP is presented in the diagram. It figure reflects the specific architecture design followed for interactIVe demonstrator vehicles based on the selected set of physical and logical sensors.

The platform cycle is triggered centrally every 100 milliseconds. In addition, the internal sequential processing levels are also triggered centrally at fixed time intervals. During one PP cycle, module outputs are transmitted via the PH physical CAN bus as soon as they become available.

In addition to the basic RPP components, several auxiliary components have been implemented that provide tools for visualisation and monitoring of the platform outputs. A snapshot of the RPP auxiliary displays (numerical, diagnostic and video) is shown on the previous page, depicting the output of the Frontal Object Perception (FOP) module.
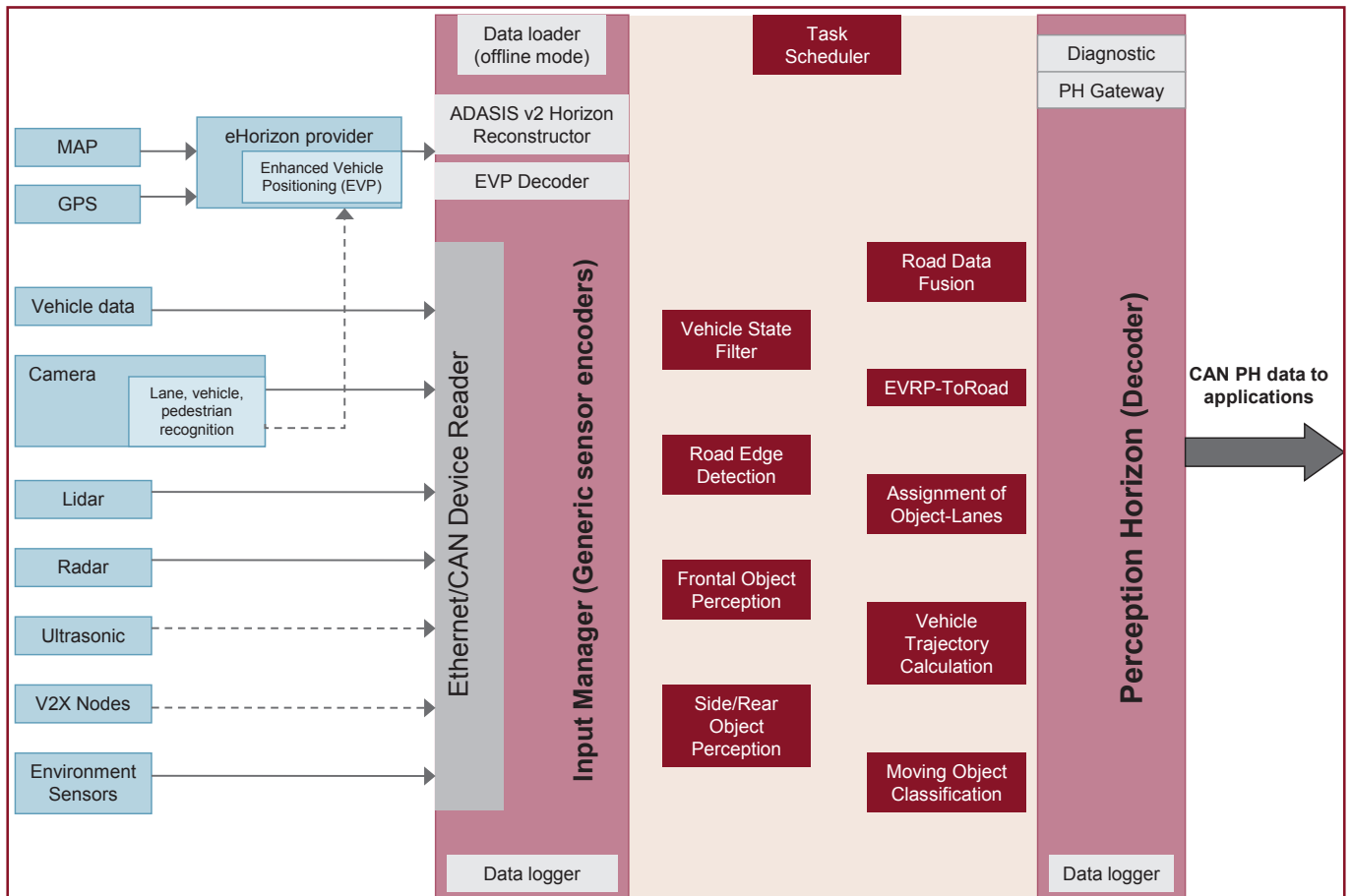
High-level software functional components of the Reference Perception Platform (RPP).

▸ interactIVe at the Annual EUCAR conference

During the annual EUCAR conference 2011 (November 8 to 9), hosted on the premises of Autoworld Brussels, Volkswagen presented one of the interactIVe demonstrator vehicles to Siim Kallas, Vice President of the European Commission.

Prof. Dr. Jürgen Leohold, head of Volkswagen Group Research and a member of the EUCAR Council, stated that "Volkswagen sees the project as an important contribution to further reduce fatalities and injuries on the roads. The stated corporate goal is to improve the systems for accident avoidance and severity reduction in the smaller vehicle classes. Thus, the Volkswagen Group assumes its responsibilities in contributing to the democratization of vehicle safety."

As an extension of the emergency braking systems Volkswagen develops in interactIVe a system for accident mitigation, with the additional possibility of a steering intervention. This steering action intends to minimize the consequences of an accident when the driver can no longer act to avoid it.

In addition to reducing the collision speed it also improves compatibility with the collision opponents. A major challenge is the consideration of collision scenarios that go beyond rear-end collisions. Accidents with oncoming traffic and cross traffic are considered.

In a high accident risk situation, the driver is first warned of an impending collision to facilitate a human response to avoid the collision. If this response fails to materialize and the collision becomes unavoidable, the system decides, based on a variety of parameters, on a damage-minimizing trigger strategy to control steering and brakes a few hundred milliseconds before impact.

## ▸ Workshop on collision warning and autonomous braking systems

More than 60 participants gathered from September 27 to 28, 2011, for the first ActiveTest workshop hosted by interactIVe partner ika in Aachen. ActiveTest is a support action attempting to increase road safety by supporting the introduction of active safety functions targeted at mitigation and avoidance of accidents.

The objective of this first workshop was to assemble all initiatives addressing longitudinal assistance systems.

The focus of all presentations and discussions was the definition of the next research steps for developing comprehensive test and assessment methods for collision warning and autonomous emergency braking systems.

interactIVe and other initiatives such as ADAC (Allgemeiner Deutscher Automobil-Club), AEB (Autonomous Emergency Braking), the ASSESS project, and vFSS (Advanced Forward-Looking Safety Systems) presented their approaches and statuses.

interactIVe was represented by its partners Ford, Volkswagen, ika, and TNO. Representatives from major OEMs, research institutes, legislative and regulatory bodies also joined the event, including guests from the University of Michigan Transportation Research Institute. Their visit made it possible to discuss international test realisation.

A look inside the trunk of one of the interactIVe demonstrator vehicles from Volkswagen.
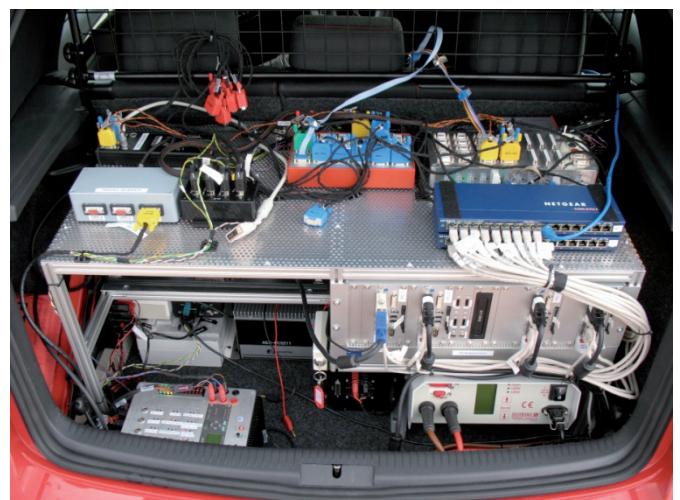
▸ interactIVe: Summer School 2012

As announced in the interactIVe news | 02, interactIVe invites you to a Summer School this year. The Summer School will take place from July 4 to 6, 2012, on the Greek island of Corfu.

The three days will focus on perception systems, advanced driver assistance systems and human-machine-interfaces for safer and more efficient driving.

The agenda including all speakers will be published soon on the interactIVe website. For initial interest and to receive further information please contact Dr. Angelos Amditis (a.amditis@iccs.gr) or Mrs. Evi Brousta (p.brousta@iccs.gr).

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interactIVe is a project of leading European Original Equipment Manufacturers, suppliers, research institutions and small enterprises. interactIVe is co-funded by the European Commission, DG Information Society and Media under the Framework Programme 7 and is supported by EUCAR, the Council for European Automotive R&D.

In interactIVe the **next generation of Advanced Driver Assistance Systems** (ADAS) for **driver support** and **emergency intervention** is developed. **interactIVe systems** will

increase the perception horizon: environment information is recognised through a new integrated and comprehensive sensor platform.

improve decision strategies for ADAS: the systems are using new prediction techniques and integrating advanced human-machine-interface (HMI) concepts, balancing human and system interventions.

suit the ordinary driver: several tests enhance the knowledge about driving behaviour and impact of the systems.

be affordable: system cost is reduced by the implementation of low cost sensors and the integration of previously independent functions.

apply to all vehicle classes: six passenger cars of different vehicle classes and one truck are being built.