interactIVe

Accident avoidance by active intervention for Intelligent Vehicles

Deliverable D1.5 | Use cases and requirements Executive Summary

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SEVENTH FRAMEWORK PROGRAMME

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Executive Summary

This deliverable presents the overall process of requirements definition as a starting phase for interactIVe, which begins with a description of hazardous traffic situations to be addressed and goes all the way from target scenarios, use cases to the definition of functional requirements with different levels of hierarchy. The requirements – no less than totalling 207 for the applications - defined will serve as an input to following work in architecture and specifications, and consequently to the actual development work. Architecture and specifications will be presented in a dedicated deliverable D1.6.

Numerous accident statistics and in-depth studies carried out over the years yield generally a very uniform picture of road traffic accident causation. Human error as almost a sole principal causative factor in traffic accidents has been quoted repeatedly for decades. The limitations of road users are well known and recognized.

interactIVe is addressing this problem by developing next generation safety systems able to compensate driver errors and mitigate the consequences of collisions. Consequently, the project belongs to the family of intelligent vehicle projects, aiming to develop advanced technologies for a safer and cleaner traffic.

These goals have been set by the EC, numerous member states and different stakeholders separately. The past calls in the 7 FP as well as in the 6 FP have dealt with the integration of different safety applications targeted to better lateral and longitudinal control of the vehicle, pre-crash and accident mitigation. The interactIVe project addresses the development and evaluation of next-generation safety systems, also based on active interventions. Safety technologies have shown outstanding capabilities for supporting the driver in hazardous situations. Despite their effectiveness, currently available systems are typically implemented as independent functions. This results in multiple expensive sensors and unnecessary redundancy, limiting their scope to premium-class vehicles.

While the Integrated Project PReVENT made the first comprehensive attempt towards realising the vision of a safety zone around vehicles, interactIVe advances this work by developing affordable integrated safety systems penetrating all vehicle classes.

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.” While similar types of objectives were already present earlier in PReVENT, interectIVe will advance PReVENT work especially in the following areas:

- Offering a continuous support to the driver, integrated as a natural and well accepted part during ordinary driving.
- Implementing the full capability of collision avoidance.
- Improving performances in the interpretation of the environment, so that the typology of situations covered can be extended.
- Optimising the integration of multiple functions in terms of communication, data processing, and driver interaction, with a good trade-off between cost, redundancy and usability.
- Extending active safety systems more strongly towards lower vehicle segments.

Consequently, interactIVe will design, develop, and evaluate a number of integrated ADAS applications. These will be introduced on specific demonstrator vehicles that are six passenger cars and one truck.

The general structure of interactIVe is composed of seven sub-projects. Three sub-projects (SP4-*SECONDS*, SP5-*INCA*, and SP6-*EMIC*) constitute application oriented developments**,** also called *vertical sub-projects*. These aim at developing and evaluating the integrated functionalities considered within interactIVe.

These activities are supported by cross-functional activities, the so-called *horizontal sub-projects*, which deal with technical or methodological aspects common to all applications. The three horizontal sub-projects are: SP2-*Perception*, SP3-*IWI Strategies*, and SP7-*Evaluation*.

An additional sub-project, SP1-*IP Management*, is included for handling project coordination, links to external activities, dissemination, and general administration.

For the time being, it can be predicted that the number of ADAS applications will grow in the coming years. It is obvious that the number of sensors cannot be increased in the same way as the number of applications is increasing. Instead, sensors of different technologies have to be combined by using sensor data fusion algorithms. There is still a significant work to be done in this area of sensor technologies to have a fully reliable representation of the environment for various safety applications. The ideal situation would be to use only 2-3 different type of sensors in vehicles, while using robust sensor fusion algorithms for safety applications. interactIVe will address these issues too, in agreement with the general vision and the interest of all stakeholders.

The general idea behind the methodology for requirements specification was to start from the key problems to be addressed by the interactIVe functions, that is, the *target scenarios*. Based on these target scenarios, complemented by an assessment of major user needs, a number of *use cases* were developed: these define, in general terms, how the problems are tackled by the intended applications. In the last step, the use cases then served as the basis for defining the *functional requirements*. In interactIVe, the target scenarios and functional requirements were investigated by the vertical sub-projects (SP4-6), while the use case definition was under the responsibility of SP3.

The use cases definition starts from the flow of events characterising a target scenario (and the associated problem) and describes how the intended function, by means of interaction with the driver and/or direct interventions, can prevent or mitigate any undesired outcome. The key role of the use cases is thus to provide a fairly general description of the intended functionality of the envisioned systems, with a time sequence of events, as a basis for the more detailed specification of the functional requirements. The requirements themselves are hierarchically organized, starting from an indication of what the needed function has to do. This can be further specified by defining the operating conditions and then describing in more detail aspects pertaining to various aspects such as performance, operation or usability. The requirements have further prerequisites in terms of their importance, validation, and responsible partner.

So, to sum up, requirements form an intermediate process between the problem definition and the specification phase enabling the actual development work. In this process, some specific aspects related to the project work were described.

Furthermore, a user expectation assessment was carried out, using advanced techniques based on a so called “theatre system”: in this study, users could drive in a simulator through the key target scenarios and their expectations were discussed regarding the functionalities of the interaction with the envisioned systems. This helped especially with the design of the HMI and identification of possibly problematic areas.

In addition to these specific studies, a large German accident data base and a European in-depth database for trucks were used, enabling a comprehensive picture of accidents and isolating the most critical types.

The requirements were specified with the aim to obtain the greatest possible and realisable benefit in accident reduction, and taking into account both heavy vehicles and passenger cars. Three major functionalities have been considered, according to the project concept: (i) Continuous driver support (ii) Collision avoidance and (iii) Collision mitigation. These functionalities constitute a time-wise continuum. The first one aims at assisting drivers also during normal driving, so that the ADAS ‘closer to an accident’ (avoidance, mitigation) does not need not to be put on trial. In more critical situations, then the two other systems can intervene: these systems can take direct control of the vehicle for a short period of time. Compared to previous developments like in Prevent, the logic is more focused on active interventions.

Considering the above mentioned approach, the focus of the present report is on requirements at the application level. Perception requirements are treated in a specific deliverable (D2.1) and they are only summarized here to maintain readability of the document. The more specific IWI requirements are the subject of on-going work and will be detailed later on in the project.

In conclusion, through a systematic analysis of accidents, a definition of respective target scenarios and deriving related use cases, it was possible – with earlier user involvement - to define a set of requirements for the new generation of ADAS targeted by interactIVe. The emphasis is now on active intervention of vehicle safety systems considering that drivers very often are late in their responses to critical situations, or carry out erroneous manoeuvres. An additional relevant aspect is the principle of a common usage for sensors, making the systems eventually more affordable to customers.