PROJECT

SAFEADAPT

Safe Adaptive Software for Fully Electric Vehicles

Funding: European (7th RTD Framework Programme)

Duration: Jul 2013 - Jun 2016

Status: Complete

Total project cost: €9,323,091

EU contribution: €5,528,407

Call for proposal: FP7-2013-ICT-GC

CORDIS RCN : 109530

Background & policy context:

The promising advent of fully electric vehicles also means a shift towards fully electrical control of the existing and new vehicle functions. In particular, critical X-by-wire functions require sophisticated redundancy solutions. As a result, the overall Electric/Electronic (E/E) architecture of a vehicle is becoming even more complex and costly.

The main idea of SafeAdapt is to develop novel architecture concepts based on adaptation to address the needs of a new F/E architecture for FEVs regarding safety, reliability and cost-efficiency. This will reduce the complexity of the system and the interactions by generic, system-wide fault and adaptation handling. It also enables extended reliability despite failures, improvements of active safety, and optimised resources. This is especially important for increasing reliability and efficiency regarding energy consumption, costs and design simplicity.

SafeAdapt follows a holistic approach for building adaptable systems in safety-critical environments that comprises methods, tools, and building blocks for safe adaptation. This also includes certification support of safety-critical systems in the e-vehicle domain. The technical approach builds on a SafeAdapt Platform Core, encapsulating the basic adaptation mechanisms for re-allocating and updating functionalities in the networked, automotive control systems. This will be the basis for an interoperable and standardized solution for adaptation and fault handling in AUTOSAR. The SafeAdapt approach also considers functional safety with respect to the ISO 26262 standard.

SafeAdapt provides an integrated approach for engineering such adaptive, complex and safe systems, ranging from tool chain support, reference architectures, modelling of system design and networking, up to early validation and verification. For realistic validation of the adaptation and redundancy concepts, an actual vehicle prototype with different and partly redundant applications is developed.

Objectives:

#1: Provide novel architecture concepts to enhance robustness, availability, and efficiency of safety-relevant systems while preserving the functional safety in FEVs.

The main objective of the SafeAdapt project is to enrich networked embedded systems in e-vehicles with adaptivity, while preserving functional and non-functional requirements – especially functional safety. Therefore, SafeAdapt will provide the so-called SafeAdapt Platform Core which enables the enhancement of networked embedded systems with runtime adaptation. The SafeAdapt Platform Core provides a novel architecture for adaptive safety-relevant systems. By the use of the SafeAdapt Platform Core the reliability and flexibility of these systems is improved by encapsulating the main adaptation mechanisms. To cope with the increasing complexity of the systems in the domains addressed by SafeAdapt, the SafeAdapt Platform Core provides scalable methods and techniques for controlled adaptation and reconfiguration. The aim is to enhance safety-relevant networked embedded systems targeted for FEVs with generic concepts for failure handling and adaptivity based on dynamic reallocation of functions. Thereby, enabling. Adaptation due to failure (e.g. very fast system recovery after hardware failure), System optimisation during runtime (e.g. joint resource usage, to save costs and

energy), and Adaptation to enable the extension of the system with improved features.

#2: Increased safety and availability by the ability to handle complex failures by the SafeAdapt Platform Core, especially failures where current systems do not degrade gracefully

By adaptation mechanisms, functionalities in a vehicle can be moved to different ECUs in case of failures. In this way, failure of critical, but non-redundant features can be addressed.

For instance, the ESP control can be moved to some other ECU in case of a failure of the ECU or the network. Furthermore, gradual degradation of the functionality is possible by adapting to a different mode with a different software configuration. For instance, in case of an HMI failure, the vehicle may only be allowed to drive at lower speed (i.e. similar to 'compact spare tire' are mounted after a flat tire break-down). Hence, by providing a generic failure handling concept based on safe adaptation in networked embedded systems, FEVs can be enhanced in terms of availability.

SafeAdapt Platform Core designs a new architecture that processes those failures, by adopting the fault

Methodology:

The SafeAdapt project will be executed in several phases. First, use cases and requirements for safe adaptation in FEVs will be collected in WP2. Afterwards, the design process and the runtime enforcement of safe runtime adaptation will be developed in WP3 & WP4. The prototype implementations resulting from these WPs are integrated into a full scale prototype e-vehicle in WP5. Based on this prototype vehicle the evaluation of the SafeAdapt project results is performed. The SafeAdapt work plan is shown in the Figure below:

Overview of SafeAdapt's work packages
Fraunhofer ESK WP1: Project Management: This work package shall cover all managerial tasks as outlined in Section 2.1.

WP2: Scenarios and Requirements: Scenarios, use cases and requirements will be collected in this work package. The work in the following work packages will be performed in parallel and will be iteratively refined in appropriate versions of prototypes.

WP3: Safe Adaptation Runtime Core: WP3 will use the results of WP2 and develop, design and implement the specified runtime control for enforcing safe adaptation in networked embedded systems with respect to safety-critical applications. Also the enforcement of safe adaptation during runtime is specified in this WP. SafeAdapt will manage resources during runtime by means of reconfiguration algorithms.

WP4: Design Methodology & Tools: WP4 will perform detailed specification of the integrated design process and the necessary tool flow for safe adaptation of networked embedded systems for the e-vehicle domain, which will be complemented with the specification of ISO26262 functional safety goals for the runtime adaptation scenario. Furthermore, the tools necessary for the design of safe adaptive systems are adapted, modified or implemented in this WP.

WP5: Prototyping & Evaluation: WP4 will cope with all tasks for building a prototype e-vehicle comprising the evaluation of the achieved results, which are subject to exploitation in the next WP. Metrics for the evaluation of reliability, availability, efficiency, and flexibility will be set up. The results of the WP3 and WP4 will be compared to current state-of-the-art systems in the automotive domain.

WP6: Dissemination, Exploitation and Standardisation: Finally, WP6 will cover all activities concerning the dissemination and exploitation. There are several tasks planned for the dissemination and exploitation of the project results for achieving highest market impact. For exam

Parent Programmes:

FP7-ICT - Information and Communication Technologies

Institute type: Public institution

Institute name: European Commission

Funding type: Public (EU)

Lead Organisation:

Frauenhofer Geselschaft Zur Foerderung Der Angewandten Forschung E.v.

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EU Contribution: €222,360

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EU Contribution: €291,068

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EU Contribution: €65,841

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EU Contribution: €676,682

Technologies:

Safety systems
Technologies to improve road safety

Development phase: Research/Invention

STRIA Roadmaps: Transport electrification

Transport mode: Road transport

Transport sectors: Passenger transport, Freight transport

Transport policies: Decarbonisation, Environmental/Emissions aspects

Geo-spatial type: Other