PROJECT PROFILE

17006 | Providing on-board computational and communication power and functionality for safe autonomous driving [HiPer]

The HiPer project will develop an automotive-grade HPVC computer system capable of handling level 5 autonomous driving and providing new electrical architectures which ensure sufficient compute power and the necessary communication interfaces. This will also mean fundamental changes to connectivity, computational power and safety in vehicle technologies.

Road travel and transportation are notoriously disadvantaged by the effects of traffic and congestion: not only the pressure and irritation caused to drivers and passengers, but also energy inefficiencies and, crucially, accidents and fatalities. Even though the newer generation of vehicles already support drivers with such niceties as route planning and guidance, assisted or automated parking and real-time traffic information, these functions and features do not go far enough: they cannot replace the human driver or provide highly flexible, efficient and safe travel; and neither do they really contain the volume of traffic. To address these issues and also create a new quality of driving comfort, autonomous driving (AD) could be the answer.

The Society of Automotive Engineers defines six levels of automation for autonomous cars, where each level has a specific set of requirements that a vehicle must meet before it can be considered to operate at that level. AD at level 5 requires truly high-performance vehicle computers (HPVC) to perform a multitude of complex functions, such as comprehensive vision processing, object recognition, intelligent traffic system and task dispatch between different electronic control units (ECUs) in the car. The HPVC system must be capable of safely handling all driving situations autonomously.

However, there are no automotive-grade HPVC modules and systems, and even though the first necessary components could become available shortly, they are not expected to be designed for the use in the harsh conditions of real vehicles. Furthermore, essential technological obstacles need to be overcome before solutions can qualify as 'regular' products at affordable prices. These are typical areas the HiPer project will focus on in its work to close these gaps.

Delivering automotive grade level-5 HPVC computer system

The main deliverable of HiPer will be an automotive-grade HPVC computer system capable of handling level 5 autonomous driving and providing new electrical architectures which ensure sufficient compute power and the necessary communication interfaces. This will mean fundamental changes in vehicle technologies with respect to connectivity, computational power and safety. Importantly, the project consortium will also validate all of this by demonstrating the HPVC system in a passenger car by creating an HPVC demonstrator and an automotive-grade, in-car, high-speed network.

This calls for three tightly linked innovation paths and validation activities:

1. Computation path: will tackle the thermal challenges by new highly reliable automotive-grade cooling concepts based on advanced heat-path engineering with integrated spreader and heat-pipe technologies, as well as, novel 3D-printed micro channel and direct liquid cooling approaches. The work in this innovation path will require the introduction of new materials, and new heat transfer components and technologies in the vehicle;
2. Communication electrical connectivity path: will develop new HPVC interfaces that allow a data throughput of more than 10 Gbit/s as required on-board for all time-critical applications. New multi-channel, high-speed connectors and wiring harnesses solutions will become the future standard in autonomous cars. Furthermore, Ethernet chips, high-speed AD converters and a time-sensitive networking (TSN) protocol suite will be developed to increase the quality of service through, for example, high bandwidth, predictable low latency, and prioritisation of data streams;
3. System integration path: will improve HPVC thermo-mechanical reliability and functional safety in harsh automotive environments, achieving a lifetime of 50,000 hours in contrast to the current 8,800 hours. This will include: the development of an innovative mould underfill technology (equipment, process and simulation); the application of new accelerated testing and qualification methods; functional safety by prognostics and health management (PHM); new design for reliability (DfR) simulations; and reliability concepts developed in intense cooperation with the computational/thermal innovation path.

KEY APPLICATION AREAS

Transport & Smart Mobility

Safety & Security

ESSENTIAL CAPABILITIES

Systems and Components Architecture, Design & Integration

ECS Process Technology, Equipment, Materials & Manufacturing

PARTNERS

IMEC - Interuniversitair Micro-Electronica Centrum vzw

Interflux Electronics nv

Materialise

AUDI AG

CHEMNITZER WERKSTOFFMECHANIK

Dynardo GmbH

Fraunhofer Institute for Electronic Nano Systems

GLÜCK Industrie-Elektronik GmbH

NXP Semiconductors Germany GmbH

Robert Bosch GmbH

Technical University of Chemnitz

Advanced Packaging Center BV

Boschman Technologies BV

Delft University of Technology

Eindhoven University of Technology

Fastree3D

NXP SEMICONDUCTORS NETHERLANDS BV

COUNTRIES INVOLVED

Belgium

Germany

Netherlands

PROJECT LEADER

Frank Pelz
Robert Bosch GmbH

KEY PROJECT DATES

June 24, 2019 to June 23, 2022

In particular, the following key requirements will be addressed:

- Much higher computational power at the highest functional safety-level. Based on most modern technologies, powerful processors generate up to 300W;
- Comprehensive perception of the surrounding environment in real-time. This can only be achieved by deploying multiple video/radar/lidar/ultrasonic sensors in the car, which will generate much more data than in today's vehicles. Final data fusion will be done in centralised HPVC units. Therefore, the on-board communication network needs to ensure much higher data-rates and guarantee quality of service (QOS). New connectors, wiring harness solutions, as well as, communication chips and AD converters, are needed;
- On-board communication system and HPVC electronics need higher reliability and security/safety than currently available to protect human life in routine, and also difficult, traffic situations. This means that reliability and functional safety of AD electronic-systems must be increased substantially because the active human driver, who is constantly monitoring the driving behaviour of the car, will be replaced by a passive passenger, who leaves all control functions to the electronic system.

Societal, economic and environmental benefits

European society will massively benefit from AD technologies: reduced numbers of accidents and fatalities; better deployment of existing road infrastructure through harmonised and increased traffic flows; and a new quality in driving comfort and reduced fuel consumption and emissions. Europe will also benefit economically from the wealth generated by the continuing success of its automotive industry – in which it has a leading position and must be defended.

Engaging European industry

Fundamental changes have strong impact on the European automotive industry. European OEMs (or original equipment manufacturers, companies that produce parts and equipment that may be marketed by other manufacturers) need to be able to offer AD cars, so as not to lose their important market positions to America or Asia. Hence, European suppliers and OEMs need to firmly support and push towards new car IT architectures. Thanks to decades of experience and expertise in integrating electronic devices into vehicles, these newly centralised, standardised, safe secure HPVCs will be Europe-first creations.

According to MarketWatch's 2018 report, the global self-driving car market is expected to expand at a CAGR of 36.2%, leading to global revenue of US$173.15 billion by 2023. By creating an HPVC demonstrator and an automotive-grade, in-car, high-speed network – the two key technologies required for AD cars – the HiPer project will enable European car manufacturers to offer new efficient mobility solutions, and enable the European automotive industry to stay at the leading edge of this worldwide market.

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