Development Platform for Safe and Efficient Drive

D71.3 Workshop Report (1)

Deliverable n.	D71.3		
Sub Project	7	Dissemination and Exploitation	
Workpackage	7.1	Dissemination	
Task n.	7.1.3	Workshops	
Author(s)	S. Fruttaldo (ICOOR) Contributions by SP leaders	File name	D71 3_1st_Workshop_report_13
Status	Final		
Distribution	Public (PU)		
Issue date	2014/07/21	Creation date	2014/01/01
Project start and duration	1st of September, 2012 – 36 months		

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REVISION CHART AND HISTORY LOG

REV	DATE	AUTHOR	REASON
01	January 7 2014	S. Fruttaldo	Early draft version
02	January 10 2014	S. Fruttaldo (ICOOR), H. Blume (Uni Hannover) M. Kutila (VTT) P. Van Koningsbruggen (Technolution), N. Pallaro (CRF)	Update after web meeting (on January 10 2014) with SP leaders and H. Blume
03	January 24 2014	S. Fruttaldo (ICOOR),	Update receiving potential paper titles from SP leaders
04-05	February 2014	S. Fruttaldo (ICOOR) + contributions by SP leaders and abstract authors	Update receiving abstracts of potential paper titles from SP leaders
06-08	April - May 2014	S. Fruttaldo (ICOOR) + contributions by SP leaders and paper authors	Update after final paper submission
10	5 June 2014	Matti Kutila (VTT)	Minor adjustments
11	15 July 2014	Matti Kutila (VTT)	Questions added concerning the special session activities
12	21 July 2014	Matti Kutila (VTT)	Proof-reading
	29 July 2014	Jens Klimke (IKA)	Peer review
13	4 August 2014	Serena Fruttaldo	Final release including peer reviewers' (IKA) comments

EXECUTIVE SUMMARY

The Deliverable D71.3 Workshop Report (1) is conceived as a report to inform about activities carried out in the first project workshop which was organized on July 15th 2014.

The main section (Event organization) includes the following main sections:

1. Event overall description
2. Programme overview
3. Target groups
4. Dissemination and promotion

Annexes include the agenda of the event, an abstract of the papers and the announcement of the event.

INTRODUCTION

As reported in the DESERVE Technical Annex, a project workshop was planned at M18.

Project partners decided to organize it in July 2014, in order to include it as a Special Session within the International conference on embedded computer systems: Architectures, MOdelling and Simulation in Samos, Greece, July 14-17 2014.

The Special Session title was "Embedded Driver Assistance Systems – Mid-term Results of the DESERVE Artemis-JU-project". It was held on July 15. 13 people from the DESERVE project joined to the workshop for disseminating the DESERVE outcomes after 1.5 years working (Figure 1).

Figure 1. The DESERVE team joining to the SAMOS workshop

General information about the SAMOS conference could be found on the following website: http://samos-conference.com/.

In this occasion the DESERVE Consortium presented the outcome of the first two years of studies.

EVENT ORGANIZATION

1.   Event Overall Description

The event was organized as a Special Session within the International conference on embedded computer systems - Samos (Samos, Greece, July 14-17 2014).

Figure 2. Presentation in the SAMOS workshop

The DESERVE Special Session title was "Embedded Driver Assistance Systems – Mid-Term Results of the DESERVE Artemis-JU-project".

It took place on July, 15 from 8.30 to 11:15.

Figure 2 shows one of the presentations.

More than 30 persons joined to the Session (see Figure 3).

Moreover, social events were also an import occasion to continue discussions on project issues and interactions.

Figure 3 Audience in the SAMOS workshop

Participants included international technology experts, telecommunication industry representatives, vehicle and device manufacturers, service providers, infrastructure operators, end users, industry and research representatives as well as the project partners. All joined a multi-perspective debate enriching an already diverse and exciting agenda.

During the Session the following presentation were made, dealing with the core issues of the project:

1. The DESERVE project: Towards future ADAS functions – *Matti Kutila (VTT)*

2. A Comprehensive ASIC/FPGA Prototyping Environment to Explore Embedded Processing Systems for Advanced Driver Assistance Applications – *Florian Giesemann (Leibniz Universität Hannover)*

3. Development and design of a generic platform for ADAS application - *David Gonzalez (INRIA)*

4. Vehicle-Hardware-In-The-Loop System for ADAS Prototyping and Validation – *Romain Rossi (IRSEEM)*

5. Instruction Set Extension for an ASIP based SIFT Feature Extraction - *Nico Mentzer (Leibniz Universität Hannover)*

6. Definition of an embedded driver model for driving behavior prediction within the DESERVE platform – *Jens Klimke (RWTH Aachen University)*

7. Massive parallel computing challenges for a driver assistant prototype framework – *Frank Meinl (Robert Bosch GmbH)*

Questions and Answers were allowed, in order to stimulate a debate with audience.

The following questions were received during the special session:

1. The DESERVE project: Towards future ADAS functions
   a. No questions

2. A Comprehensive ASIC/FPGA Prototyping Environment to Explore Embedded Processing Systems for Advanced Driver Assistance Applications
   a. Is there frame rate reduction due to bit-stream from camera to the FPGA module?
   b. How long is the latency due to ICAP filter before FPGA circuit?

3. Development and design of a generic platform for ADAS application
   a. What kind of warning is showed in the vehicle HMI when impaired driving performance or possible accident is detected?

4. Vehicle-Hardware-In-The-Loop System for ADAS Prototyping and Validation
   a. Is there any verification that the selected MobilEye environment perception system performs accurate environment measures?
   b. Is there special reason to increase the outside view of the out-looking camera?
   c. However about adverse weather conditions may influence to the camera system?

5. Instruction Set Extension for an ASIP based SIFT Feature Extraction
   a. Did you measure the whole power consumption including also the power of additional devices connected to ASIP?
   b. Is there special read and write memories or registers allocated for codes?
   c. Have measured performance rate of the ASIP system depending on number detected features?

6. Definition of an embedded driver model for driving behavior prediction within the DESERVE platform
    a. How close are the simulations to real traffic and vehicle?
    b. How long the system can be predict the up-coming incidents?
    c. Would it be better to influence directly to behaviour of driver instead of intervening?
    d. What about waiting for driver reaction first and then intervene if needed in order to prevent surprises for the driver?
7. Massive parallel computing challenges for a driver assistant prototype framework
    a. Can you operate with different types of wireless channels?
    b. Does it influence to measures if there more than one target in the measurement view at the same time?
    c. How to extract different objects in the same signal?

Details on the event are available in the next pages.

2.   Programme overview

A detailed programme of the Special Session is available as an Annex to this document.

Below the title of the papers with core issues of the Session are listed:

- The DESERVE project: Towards future ADAS functions (Kutila, Koningsbruggen, Perez et al)
  This was an overview paper presenting the project in general.

- A Vehicle-Hardware In The Loop System for ADAS Prototyping and Validation (Galko et al.)

  This paper presented some technical details about a real hardware setup for the testing of automotive systems.

- Instruction Set Extension for an ASIP based SIFT Feature Extraction (Mentzer, von Egloffstein)

  This paper presented technical details about a driver assistance algorithm (feature extraction and camera calibration) and the realization of these computational intensive methods within a dedicated application specific instruction set processor.

- A Comprehensive ASIC/FPGA Prototyping Environment to Explore Embedded Processing Systems for Advanced Driver Assistance Applications (Giesemann, Limmer)

  This paper presented the technical concept of how to combine a high level algorithm description tool like ADTF and accelerating hardware like FPGA boards.

- Development and design of a generic platform for ADAS application – a DESERVE approach   (Pérez, Rolfsmeier, Kunert et al.)

  In this paper, a description of the ADAS development platform in DESERVE project framework is presented.

- Definition of an embedded driver model for driving behavior prediction within the DESERVE platform (Klimke et al)

- The paper presented an approach to use driver model concepts for the real-time prediction of surrounding traffic Massive parallel computing challenges for a driver assistant prototype framework – a case study with a MIMO-Radar (Meinl et al)

This paper presented technical results how to implement a very challenging new MIMO radar system within a car. As MIMO radar requires huge computational capacities.

3. Target groups

Participation to the event was subject to participation to the SAMOS conference.

Participants included international technology experts, telecommunication industry representatives, vehicle and device manufacturers, service providers, infrastructure operators, end users, industry and research representatives as well as the project partners.

4. Dissemination and promotion

4.1. Pre-event promotion

4.1.1. Project website

A special section on the Event was created on the DESERVE website, containing relevant information on the Session. The News section was updated as well.

An announcement of the DESERVE special Session was published on the project website (Section "Tracks and Topics", Sub-section "Special Session). After the event presentations shown by speakers were uploaded.

4.1.2. Conference website

The Session was mentioned in the Conference Programme and on the Conference website.

An announcement of the DESERVE special Session was published on the official SAMOS conference website (Section "Tracks and Topics", Sub-section "Special Session).

4.1.3. Announcement and promotion to other projects and contacts

An announcement of the event has been created, published on the project website and distributed to the DESERVE Consortium and networks of the project partners.

4.2. After the event

After the event the DESERVE website was updated with main info and outcomes from the event.

The full articles have been made available in the conference proceedings and IEEE Xplore.

Also an international press release has been announced by VTT according to the results of the DESERVE workshop results.

ANNEXES

A. Agenda of the DESERVE workshop 1 (sequence of presentations)

The DESERVE session was held on July, 15 (Tuesday), 8.30 am.

The general organization included:

- 4 presentations;
- coffee break;
- 3 presentations.

The sequence of the presentations in the Special Session on ""Embedded Driver Assistance Systems – Initial Results of the DESERVE Artemis-JU-project" is presented below.

SS1-1	The DESERVE project: Towards future ADAS functions	M. Kutila, P. Pyykönen, P. van Koningsbruggen, N. Pallaro, J. Rastelli
SS1-2	A Comprehensive ASIC/FPGA Prototyping Environment to Explore Embedded Processing Systems for Advanced Driver Assistance Applications	Florian Giesemann, Guillermo Paya-Vaya, Holger Blume, Matthias Limmer, Werner Ritter
SS1-3	Development and design of a platform for arbitration and sharing control applications –a DESERVE approach-	Joshué Pérez, David González, Fawzi Nashashibi, Fabio Tango, Nereo Pallaro, Gwenael Dunand, André Rolfsmeier
SS1-4	Vehicle-Hardware-In-The-Loop System for ADAS Prototyping and Validation	C. Galko, R. Rossi, X. Savatier
SS1-5	Instruction-Set Extension for an ASIP-	Nico Mentzer, Guillermo Paya-Vaya, Holger Blume, Nora von

	based SIFT Feature Extraction	Egloffstein, Werner R. Ritter
SS1-6	Definition of an Embedded Driver Model for Driving Behavior Pre-diction within the DESERVE Platform	Jens Klimke, Philipp Themann, Christoph Klas, Lutz Eckstein
SS1-7	Massively parallel signal processing challenges within a driver assistant prototype framework First case study results with a novel MIMO-Radar	Frank Meinl, Martin Kunert, Holger Blume

The chairman of the Session was Professor Holger Blume (University of Hannover).

Time allowed for each presentation was 15 minutes. Time for Questions and Answers was planned.

B.   Abstract of the papers

The full articles will be available in the conference proceedings and IEEE Xplore.

They will be available on the project repository as well
(https://workspace.vtt.fi/sites/deserve/Shared%20Documents/Forms/AllItems.aspx?RootFol
der=%2Fsites%2Fdeserve%2FShared%20Documents%2FSP7%20Dissemination%20and%2
0exploitation%2FWP71%20Dissemination%2FT7%2E1%2E4%2E%20Publications%2FSAMO
S%20XIV%2C%20Greece%2C%2014-
17%20July%202014%2FArticles%2FSAMOS_full_paper&FolderCTID=0x012000EA6AAF454E
8C634DAE13F96201966248&View={AADE7889-4753-4535-A57A-
87DAEB7302E7}&InitialTabId=Ribbon%2EDocument&VisibilityContext=WSSTabPersistence)
.

DESERVE overview

The DESERVE project: Towards future ADAS functions

Authors:

Kutila, M., Pyykönen, P., van Koningsbruggen, P. & Pallaro, N., Rastelli, J.

Abstract:

This article introduces the objectives and structure of the European research project DESERVE that is co-funded by the ARTEMIS-JU and national funding bodies. The project started in September 2012 with a duration of 3 years. The project aims to establish a new embedded SW and HW design by using a more efficient development process (including the enabling general platform concept and tool chain) in order to overcome challenges in reducing component costs and development time of future ADAS functions for modern vehicles. Both the process and the platform concept will be demonstrated with innovative ADAS functions in 3 passenger cars, 1 truck and 1 motorcycle.

Embedded hardware and software units have been developed for improving electronic horizon band of vehicles by detecting objects in front. Moreover, driver/motorcycle rider awareness is analysed by monitoring his/her actions online. The systems need to be robust and reliable in different environment conditions (night time, rain, etc.). The DESERVE platform distinguishes three layers of intelligence: perception, application and intervention&warning control. The demonstrators will be based on software development tools from Elektrobit (ADTF) and Intempora (RTmaps). These tools are used to create 10 innovative ADAS applications as part of an integral ADAS development platform, following a new design and development process. Since the project is highly application oriented, the requirements have been adapted mainly from the ISO 26262 standard and the AUTOSAR framework which ensures compatibility with the existing automotive software environment.

Keywords: automotive, ADAS, function, driver monitoring, camera, traffic safety, embedded systems

Sub Project 1

A Comprehensive ASIC/FPGA Prototyping Environment to Explore Embedded Processing Systems for Advanced Driver Assistance Applications

Authors:

F. Giesemann, G. Payá-Vayá, H. Blume – Institute of Microelectronic Systems

M. Limmer, W. Ritter – DAIMLER AG

Abstract:

The development of complex algorithms for advanced driver assistance systems is a challenging task due to the high innovation rate and the high processing demands in this field of applications. The development is usually supported by a software development framework that provides an infrastructure (e.g., access to sensor data) and allows simulating and evaluating the algorithms. One problem, especially with computationally intensive algorithms, is the slow simulation speed. In this paper, we present a prototyping environment that connects a software development framework with an FPGA-based hardware platform. This allows to implement computationally intensive tasks in hardware. The proposed rapid prototyping system not only reduces the simulation time, thereby allowing the software designer to evaluate algorithmic parameters with quicker feedback, but also allows verifying and evaluating hardware modules for rapid prototyping. A case study, in which a traffic sign detection algorithm is implemented on a soft-core processor, is presented. By using the hardware implementation, the simulation could be sped up by a factor of 65 compared to the pure software implementation.

Keywords: rapid prototyping, FPGA, design space exploration, hardware-software-co-simulation

Sub Project 2

Development and design of a generic platform for ADAS application –a DESERVE approach-

Authors:

J.Pérez, A. Rolfsmeier, M. Kunert, N. Pallaro, F. Badstuebner and G. Dunand.

Abstract:

In this paper, a description of the development platform for ADAS in the framework of DESERVE project is presented. This work is framed in the Sub Project 2 (Development platform) of DESERVE project, and it is divided in 6 different and complementary lines of work. Most of the functions described in the Tools and development systems, perception layer and the platform system architecture show the modularity and scalability of our proposal. Moreover, based on vehicle modelling, driver behaviour and intention, a first approach for arbitration and control strategies, which can anticipate the priorities on the control in emergency situations, is described. Furthermore, some simulations will allow the virtual testing for the future implementation in demonstrators. The presented work is the core of DESERVE project, and it is developed in parallel with Driver behaviour and HMI activities (SP3). This work presents some of the achievements in SP2, mainly the integration the application platform of one the demonstrators and the arbitration and sharing control based on intelligent techniques (Fuzzy logic). Simulation shows the feasibility of proposal. This approach will be tested, integrated and validated in a real vehicle in the next stages of the project.

Keywords: ADAS; Embedded Systems; Arbitration; Control; Virtual testing, modelling.

Instruction Set Extension for an ASIP based SIFT Feature Extraction

Authors:

Nico Mentzer, Guillermo Payá Vayá, Holger Blume -Institute of Microelectronic Systems

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Nora von Egloffstein, Werner R. Ritter

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Vision Enhancement

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Abstract:

Recovering the geometry between two or more views is one of the key problems in computer vision. A feature-based approach to solve the challenge of finding matching points in different views is the scale-invariant feature transform (SIFT).

The complexity of SIFT requires an accelerated extraction of features and a low energy solution to meet the strict constraints of advanced driver assistance systems (ADAS) in power consumption, processing speed and flexibility for future algorithms. This paper presents an application-specific instruction-set extension for a Tensilica Xtensa LX4 ASIP to accelerate a SIFT feature extraction and its evaluation. Basic elements of digital image

processing and specialized SIFT processing tasks are accelerated to reach a significant speed-up factor for arithmetic functions of x1.300 in contrast to the same arithmetic functions processed on an ASIP without any extensions. At the same time the accuracy

of the SIFT features is preserved. For the overall speed-up for SIFT feature extraction on an extended processor, a factor of x167 could be achieved compared to the base processor. In addition the proposed processor extensions sustain the full flexibility of an ASIP for a fast integration of future feature extractors for advanced driver assistance systems.

Keywords—ASIP; video processing; scale-invariant feature transform; tensilica.

A Vehicle-Hardware In The Loop System for ADAS Prototyping and Validation

Authors:

C. Galko, R. Rossi, X. Savatier (IRSEEM)

Abstract:

Abstract—This paper introduces an innovative system easing prototyping and validation of Advanced Driver Assistance Systems (ADAS) for automotive applications. This system, based on a chassis-dynamometer and a multi-sensor simulation software, act as a virtual reality platform for intelligent vehicle. This system allows to test and validate complex ADAS systems under various simulated environmental conditions and scenario without the cost, complexity and hazard associated with test-drives. It can also be used early in the design process to test and validate the integration of multiple ADAS in a vehicle. This system is being used for the Virtual Testing applications in the DESERVE project.

Keywords: Advanced Driver Assistance System, Simulation, Vehicle Hardware In The Loop, DESERVE

Sub Project 3

Definition of an embedded driver model for driving behavior prediction within the DESERVE platform

Authors: Jens Klimke, Christoph Klas, Lutz Eckstein

Abstract:

This paper describes the methodology of using driver models on embedded systems. The driver model is implemented on a dSPACE MicroAutoBox II to predict the behaviour of objects detected by camera and radar sensors within a given time interval.

The use of driver models within advanced driver assistance systems (ADAS) allows anticipating the driving behavior of the vehicle and all traffic participants in the close vicinity. This valuable information could considerably improve the performance as well as the acceptance of ADAS. Consequently complex driver models need to be integrated in embedded systems. This work, first of all, aims to summarize important driver models described in literature. Based upon this a suitable approach to implement a driver model on an embedded system is derived. The model used, focuses on the longitudinal driving and lane change behavior of drivers. The system architecture is derived and optimized for real-time execution. The driver model is analyzed in detailed simulations. Test drives in a small scale naturalistic driving study are used to validate the driver model. This paper defines a standard driver model to be implemented as part of the DESERVE platform within the Artemis project "DESERVE". As embedded automotive hardware the dSpace MicroAutoBox II is used. The paper summarizes approaches and examples to use the generated prediction data in ADAS like ACC.

Keywords: driver model, driving behaviour, prediction

Sub Project 4

Massive parallel computing challenges for a driver assistant prototype framework – a case study with a MIMO-Radar

Authors:

F. Meinl, H. Blume, M. Kunert

Abstract:

Real-time constraints, mounting space and power limitations of a radar sensor and its corresponding signal processing needs are always in conflict with the available computational requirements. In this paper a prototype design for a heterogeneous MIMO-Radar system that automatically scales with the amount of prevailing data throughput is presented. An important measure is to partition the different processing units of the radar system according to the characteristics of the consecutive signal processing steps. These characteristics range from low-level, massive parallel number crunching to very complex, more stream-oriented and often branching high-level tasks with sophisticated reasoning and decision taking. The handling and real-time processing of extremely high data-rates in the order of tens of Gigabit per second is a new aspect that can only be solved outside of the well-known and typically used PC-based development platforms. A new hardware framework is introduced that enables rapid prototyping of a computational very intensive real time system on a FPGA based processing unit. With the help of cost model based design space exploration (DSE) techniques it becomes possible to estimate the hardware effort of such a system already in a very early development stage. The necessary cost models for a DSE of the challenging signal processing blocks of a MIMO radar will be derived in future work to further improve the design process.

Keywords: automotive radar, MIMO concept, fast chirp sequence modulation, software defined radar, real-time computing, FPGA, rapid prototyping framework.

C.   Announcement

Figure 4 - Screenshot of the announcement