

Work in Progress: Modernizing Laboratories for Innovative Technologies in Automotive

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Abstract — Automotive industry is one of the fastest growing fields adopting the information and communication technologies (ICT). Responding to the needs of the automotive industry requires improving the education in ICT fields. This paper describes the recently started project with goals to modernize laboratories and develop graduate-level curriculum and study materials for automotive software engineering.

Keywords — automotive; engineering education; automotive software; curriculum development; learning materials

I. INTRODUCTION

Rapid expansion of information and communication technology (ICT) sector, although promising, does not have a satisfactory business environment support that can adapt fast to trends and demands, for sustainable economic growth. In addition, one of the leading European employers, the automotive industry, has included in its focus the software and embedded systems. As a result, there is a growing need for engineers with adequate skills and ICT companies that can respond to the demand [1]-[2]. Simultaneously, the University roles are shifted to take active part in creating healthy business environment via technology transfer oriented research, provision of services that utilize infrastructure, courses oriented to better employability of prospective students and trainings that support lifelong learning. Common problems in the targeted regions, such as workforce attrition caused by challenged economy, or low employability and income, can be solved faster and with higher efficiency if opportunities, such as for example the changes mentioned above, are timely recognized and seized.

In order to respond to the fast growing needs of automotive industry and enhance the competitiveness of the region in education of future engineers specialized for automotive software and hardware, the new project idea was proposed. University of Novi Sad, Faculty of Technical Sciences (FTN), Serbia and Faculty of Electrical Engineering, Computer Science and Information Technology (FERIT) in Osijek, Croatia have joined in a cross-border cooperation project

“Modernizing Laboratories for Innovative Technologies” (DRIVE) as part of the European Union’s INTERREG IPA program. The aim of this project is to equip the two partner institutions with latest laboratory equipment for development of automotive software and develop the curriculum with study materials for graduate-level education of computer engineers to specialize them for engineering in automotive industry. The project has started on 15 July 2017 and it will last for 29 months, until 14 December 2019.

The rest of this paper is organized as follows: section 2 gives a brief overview of the project objectives and timeline. Section 3 discusses benefits this project will have for the region and the automotive software community. Section 4 concludes the paper.

II. PROJECT OVERVIEW

The main objective of DRIVE project is to enhance institutional infrastructure and services and thus to fortify the development and competitiveness of the cross-border business environment. The enhancement enables cooperation between the partner institutions with companies, clusters and young professionals in the emerging and fastest growing field of embedded systems in automotive industry.

The following are the main touchable outputs that the project will produce:

- The partners will set four laboratories that can support the embedded engineering in automotive industry;
- The partners will create accompanied materials, such as books and tutorials and update existing courses to keep track with the latest developments in automotive industry;
- Workshops will be organized for engineers that require additional knowledge to successfully integrate existing pool of engineers and companies in the ICT segment of the automotive industry;

- Curriculum component for automotive software engineering will be developed and added for new generations of students at the partner institutions;
- The partners will increase collaboration with research institutions and enterprises; constant consultations with automotive industry experts will foster development of course materials synchronized with trends and industry needs.

After consultations with industry experts, and consulting the existing curricula related to ICT for automotive industry [3], the partners have identified the study fields that will be the core components of the curriculum, for which study materials will be developed. An automobile is a very complex system and the traditional computer science and engineering education does not provide sufficient knowledge of the topics important for automotive engineering; especially in the field of software, for which standards and processes are very different from traditional software development, due to high levels of safety the automotive systems must satisfy. To prepare the student for a career in automotive industry, the following is the list of topics identified as essential for study:

- software development processes for automotive industry;
- networking and protocols in automotive;
- engineering of safety-critical software systems;
- artificial intelligence and deep learning in automotive software systems;
- digital signal processing in automotive systems, with focus on image processing;
- multimedia systems in automotive systems, i.e. development of infotainment unit;
- methodologies for testing and verification of software systems in automotive industry;
- at least one course covering non-software fields important for understanding the automobile as the system: e.g. electronics, mechanical engineering, thermodynamics.

The project will output study materials for all the mentioned fields and as such provide the complete solution for graduate-level education of computer scientists and computer engineers specializing in the development of automotive software systems.

The laboratories will be equipped with the latest equipment for development and verification of automotive software systems:

- equipment that supports automotive application development in Automotive Open System Architecture (AUTOSAR) for automotive electronic control units (ECU) and supporting software,
- advanced driver assistance system (ADAS) development boards and supporting software,
- equipment for automotive application testing based on hardware-in-the-loop (HiL) simulation.

The timeline of the project is given in Table 1, listing the major milestones. The project will last for 29 months, with reporting periods every three or six months to ensure timely implementation of all tasks.

The first major milestone was achieved. In the kick-off meetings held in both locations, i.e. Novi Sad and Osijek, the start-up activities were finalized: project team was established, activities and dissemination plan was finalized and the procurement preparation was initialized. The project team consists of nine professors and assistants from the Faculty of Technical Sciences in Novi Sad and nine professors and assistants from the Faculty of Electrical Engineering, Computer Science and Information Technology, University of Osijek. Selected project team members were meeting once a month in each location to discuss implementation steps and prepare procurement documentation, which is the first major task of the project.

At the time of writing this paper, procurements were in progress for the largest equipment purchases. The procurements will be completed and laboratories equipped by April 2018 as planned in Table 1. After purchasing the equipment, it will be installed and used for teaching staff training by the end of academic year 2017/18. Trained teaching staff will be able to develop workshop and course materials during the academic year 2018/19.

In the first half of 2019, workshops will be organized for engineers from interested companies in the region. The goal of these workshops is to educate engineers to be trained to work on the latest automotive equipment that is not available to the companies in the region due to its high cost. This will allow regional companies to be more competitive in the fast-growing industry of automotive software. In parallel with the workshops, course materials will be finalized.

Academic year 2019/20 is targeted to be the year of the first cohort of students taking the courses prepared in DRIVE project. The courses will be added to the existing master studies in computing and control engineering at FTN in Novi Sad and to the new master program in automotive computing at FERIT in Osijek.

TABLE I. PROJECT TIMELINE

Period	DRIVE project timeline	
	Major milestone	Month
1	Start-up activities; dissemination plan	October 2017
2	Laboratory equipment purchased	April 2018
3	Laboratories established; training of teaching staff completed	October 2018
4	Workshops and course materials completed; curriculum finalized	April 2019
5	Workshops organized for all targeted groups; preparation for the first cohort of students completed	October 2019
6	The first generation of graduate students enrolled; project ends	December 2019

III. BENEFITS

The project will offer faster integration and economic growth of the region toward the values of well-developed European regions, thus decreasing the discrepancies that now exist between the regions in Europe. Embedded engineering in automotive is a relatively new area and engineers in this area have less than 20 years of experience. However, it is also one of the fastest growing areas, with the highest impact on economy in terms of Gross Domestic Product (GDP) [4]. The industry faces challenges like updating the infrastructure for product development and hard-to-find people with desired information technology (IT) skills. The development suffers if the infrastructure does not keep pace with the market demands. Still, the infrastructure cannot be developed without skilled people. Skills are best acquired through formal studies, which stresses the importance of quality education programs.

In addition to strengthening the region and providing young generations an opportunity to learn current technologies and have practical experience on high-end and latest laboratory equipment, this project will benefit the entire automotive community by providing materials for study over the entire proposed curriculum for automotive software engineering. The published materials, such as books and practicums, will be a valuable addition in this developing automotive area and will be a benefit for both professionals and students. Curriculum and syllabi for courses and laboratories will be publicly available and shared on request to interested teachers, students and professionals. Workshops, although with limited capacity for live participation, will generate materials that will also be publicly available by the end of the project.

Expected measurable outputs of the project will be [5]:

- four modernized and equipped laboratories for automotive software engineering, two in Novi Sad and two in Osijek,
- at least 4 new courses which use the new equipment and cover the field of automotive software engineering,
- at least 40 students educated in the first cohort of students, using the new equipment in the laboratory exercises, gaining skills needed to work in the fast-growing field of automotive software engineering,
- at least 100 engineers from at least 3 companies in the region attending the workshops, gaining new skills and experience on the latest automotive equipment not currently available to the companies due to its high cost.

The project is expected to continue benefiting the region after its official end. Education of the new and existing automotive software engineers will help in regional development and benefit companies that are aiming to position themselves in the competitive automotive industry. IT clusters and start-ups will have access to the expensive equipment in collaboration with the universities, benefitting both sides. Trained experts from universities will be able to help them get a kick-start in the automotive industry. Services could even be offered to companies outside the region. Laboratory equipment at universities will be constantly upgraded since the new modules can be financed from the services given to companies.

IV. CONCLUSIONS

This work-in-progress paper gave a brief overview of a project that started in mid-2017 with the aim to modernize laboratories and develop curriculum and study materials for graduate-level study of automotive software engineering. The laboratories equipped through this project will be the best-equipped laboratories for automotive software development in the region and to the best of our knowledge, one of the best-equipped laboratories in the world. This will allow students and engineers from the region and beyond, to acquire high-end knowledge and skills in the fast-growing field of automotive software engineering and be ready for high demands of the automotive industry.

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