

## **DAAD Project proposal "Embedded System Design"**

### **Global goal**

Increasingly, digital circuits are being used for much more than implementing general-purpose computers. More and more new applications convert analog signals to digital ones, and run those digital signals through customized digital circuits, to achieve numerous benefits. Digital circuits found inside applications other than general-purpose computers are often called embedded systems. The goal of this project is to provide a transfer of knowledge and improvement of technical expertise level related to embedded systems design acquired at Brandenburg University of Technology, BTU Cottbus, Germany to South-East European (SEE) Faculty of Electronic Engineering Nis, Serbia, Faculty of Electrical Engineering Skopje, Macedonia, and Faculty of Electrical Engineering East-Sarajevo, Bosnia and Herzegovina. The transfer should be useful for a broad range of researchers and professionals coming from academia and industry involved in the evolution of new design concepts and nanotechnologies. Today we meet embedded systems in wide area of different applications including telecommunications, electro-medicine, industrial process control, etc. A comprehensive transfer of knowledge and design experience in all previously mentioned areas is almost impossible. Therefore, the project's transfer will be limited to the following two, currently very actual, fields of embedded systems design and applications:

1. **Wireless Sensors Networks, WSNs,-** WSNs consist of a large number of sensor nodes that may be randomly and densely deployed over some area capable of sensing the environment including temperature, light, humidity, radiation, seismic vibrations, specific types of computer data, and more. This part of the project is expected to capture the current state of WSNs, and specifically address the architecture, applications, and design of such networks. Several hot themes will be considered including sensor node and network architecture design, development of communication protocols for WSNs at MAC, routing and application level, implementation of efficient techniques for micro-power consumption, security and privacy protection, programmability and applications of WSNs.
2. **System-on-Chip (SoC) design:** SoC is a complex integrated circuit which combines the major functional elements or subsystems of a complete end product into a single entity. A comprehensive introduction to the SoC concept, and several very actual topics and design issues which deal with on-chip high speed communications, Global Asynchronous Local Synchronous (GALS) design, and asynchronous digital circuit design will be analyzed and critically considered from aspects of system performance. During this special care will be devoted to the implementation of on-chip interconnection, data transfer and communication architectures for SoCs, Network-on-Chip (NoC) architectures, and new methodologies for the design of reconfigurable low-power logic.

### **The benefit and significance of the introduction of this project**

Numerous different activities will be conducted during the realization of this project. We can classify (identify) them according both to event chronology and objectives that would be achieved:

- Firstly, in all three SEE countries, it will begin first with perceiving the specifics, real state, needs and current possibilities for acceptance new knowledge and development tendencies in embedded systems design for involving them in educational process as well as in research activities.

- Next, in respect to University of Coburg, the current curricula and research methodologies in SEE countries will be critically analyzed and restructured with aim to achieve a compliance, harmonization and better quality.
- Further, collaboration at a DAAD project will provide to the teaching and research staffs coming from SEE countries possibility to make (establish) and strength personal and professional connections with colleagues from corresponding German institutions. Without a doubt, this opportunity will allow them to bridge the gap related to preparing SEE institutions, in a near future, to be actively included in realization of FP7 projects.

### **Direct results**

Concrete results which deal with a realization of this project will be the following:

- a) Curricula improvements concerning Embedded Systems Design courses.
- b) Involvement of new methodologies in research processes and becoming familiar with possibility of using and working with contemporary Electronic Design Automation tools intended for development of hardware and software modules for embedded systems.
- c) Through organization of several specialized courses the young teaching staff will be trained to improve the quality for giving teaching instructions, while the PhD students will be qualified to be included into research activities.
- d) Through organization of several short study staying (sojourns) in corresponding German institutions the young research staff will get an opportunity to be included in realization of current projects, while the young teaching assistants to take active part in a process of preparation multimedia presentations for teaching purpose at German universities.
- e) Finally, the results achieved in curricula restructuring will represent a solid background for applying a proposal for projects from Tempus program, while the results achieved in a research will qualify the PhD students to be included in realization of some common application within FP7.

## Work plan of the project

We have planned five different activities in the framework of this project. The goal of those activities is to improve the curriculum of the embedded design courses in SEE countries. Additionally, we want to improve research cooperation and exchange of the knowledge between Germany and SEE countries. The activities are following (in the chronological order):

No.	Type of activity	Location	Duration	Description
M1	Training "Current Trends in Embedded System Design"	SRB	5 days	This 5-day training has a goal to describe the current trends in the related field. During this training lecturers from Germany will focus mainly on two topics: Wireless Sensor Networks and SoC design. The target audience is PhD students from SEE countries but the training will be open also to the master students and senior teaching staff. The objective of this training is to further improve and actualize the knowledge of the students. Additionally we want to show the real examples and possible applications of the related methodology.
M2	Study stays in Germany	D	15 days-2 months	We want to organize the short study stays in Germany of the PhD students. They will be included in two major activities. One is support for teaching activities of the German lecturers. The other is support for the ongoing research projects. The objective of this activity is to give a chance for students from SEE countries for practical experience in research and teaching. We want to introduce to the students the teaching methodology used in German universities. Additionally we want to include them in the work in the framework of the actual research projects and help them to increase their expertise.
M3	Meeting regarding curriculum improvement	BH	3 days	This meeting will be organized to improve curriculum for the subjects related to the embedded system design. As a result we want to generate the plan on how this improvement will be done. The participants from SEE side will be senior teaching staff.
M4	Workshop "Presenting research results and experience exchange"	MAZ	4 days	We want to organize the workshop where we will present the current research results of the partners from D and from SEE countries. The objective of this activity is to exchange the knowledge and intensify the research collaboration. This workshop will be a good opportunity to initiate the talks about the possible future common research project proposals. The target audience from SEE side will be senior teaching staff and PhD students.

M5	Final meeting	D	2 days	At the end of the project we will organize the final meeting in D. The goal of this activity will be to summarize the results of the project and to discuss about the future common activities regarding research and teaching. The target audience from SEE side will be senior teaching staff.
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## **Further development of the project**

It is planned that this project is a basis for further cooperation of the related institutions in the field of embedded systems. There are two major directions where we see the possibilities for further project development.

- In order to improve educational level of SEE universities we consider after finishing the DAAD program application for EU financed TEMPUS project.
- In order to strengthen research collaboration an application for the research project in EU FP7 program will be considered.