

EMBEDDED DSP INTENSIVE PROJECT 2010

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ABSTRACT

In this paper, we describe the first Embedded DSP Intensive Project (eDSP IP) held on August 2010 in Helsinki Metropolia University of Applied Sciences. The general idea was to bring together teachers from four European University to integrate their high expertise on different electronics and IT engineering fields, thus creating and delivering a series of multidisciplinary lectures. This intensive project was supported by the funds of the Erasmus Intensive Programme of the European Commission.

KEYWORDS

Multicultural Project, Multidisciplinary Project, Intensive Project

CONCEPT DEVELOPMENT AND FUNDING

Embedded technology industry has a demand for skilled engineers, who have strong knowledge of hardware, software, systems, and digital signal processing as well as experience of team-work in multicultural environments. The realisation of this demand was the centre point behind the first eDSP Intensive Programme which focused on integration of multidisciplinary skills in an environment resembling an industrial design environment. Multidisciplinary and an international environment was achieved by bringing together students of various cultural and academic backgrounds (Technology, Electrical and Information Engineering, Mechatronics, and Electronics), while the teaching methods were based on the concept of CDIO.

The concept of the project was initially put forward by the coordinating institution the Metropolia University of Applied Sciences (Coordinating Institution) and later developed with

representatives of Partner institutions through online and onsite meetings, in total three pre-project meetings took place [2]. Partners' network was built upon already existing collaboration; this allowed not only to expand the scope of cooperation but also to combine several activities thus funding pre-project planning. The other partners were Coventry University (United Kingdom) [3], Frankfurt am Main University of Applied Sciences (Germany) [4], and Vilnius Gediminas University of Technology (Lithuania) [5].

Planning of the Intensive Project was done in close collaboration. For instance the first two meetings dedicated to the planning of the project were arranged during a summer school and a teaching exchange visit. Additionally regular network follow up meetings were arranged to ensure all preparations were ready in time.

Once the concept of the project was fully developed an application for project funding was submitted to the European Commission within the frames of the LLP/ERASMUS Intensive Programme by the Coordinating Institution [6]. The eDSP Intensive Programme project was approved. Total duration of the project is three years, however funding is to be allocated on a yearly basis, and requires a submission of intermediary reports and sub application for each consecutive year.

Upon approval of the project the preparation for the first wave of mobility was started. A Project web page managed by the Vilnius Gediminas Technical University was created and used for common document storage area or management board [1]. Promotion of the project to the students (using posters, website and other means) was begun, continuing with the selection of the participants.

During the intensive project lecturers from each partner institution delivered lectures and supervised laboratory work of 50 students from project partner institutions. Students who passed the required parts of the three week long IP were entitled to 10 ECTS points as a part of their professional specialization studies which were recognised at their home institutions.

PROJECT CURRICULUM

In order to study Embedded Digital Signal Processing from an engineering point of view the design, implementation, and operation of a light weight, radio controlled hovercraft was selected as a learning platform. Daily work schedule (please see table 1 for schedule and lecture titles) consisted of lectures and laboratory work in multicultural teams of 3 to 5 students. The total duration of the project was three weeks.

During the first week, the teams had to design and construct the platform using provided materials (two thrust-motors, LiPol-battery, polystyrene sheets, tape, glue, and a sharp knife). At the end of the week, a competition was conducted to determine which design was the fastest. During the second week the teams had to design and implement an electronic control for their platform, which they had to demonstrate at end of the week.

During the last, third week the groups concentrated on the improvement of their platforms for the final, three-stage competition, used as an evaluation method. The first stage was the competition for speed. The second stage involved tests on stability and controllability. The last and most demanding stage involved a line following task, which was a big challenge due to the high instability of the almost zero-friction platform.

Table 1
Class Schedule of the IP

week 32	Mon Aug. 2	Tue Aug 3	Wed Aug 4	Thu Aug 5	Fri Aug 6	Sat Aug 7	Sun Aug 8
9:00-10:30	Welcoming: Introduction to embedded systems: Antti Piironen	Electronic circuits: Andrius Usinskas	AVR lecture: Andrius	PSoc lecture: Antti	Interfaces: ADC, PWM, SPI: Andrius		no work
10:45-12:15	Intro to DSP and digital control: Manfred Jungke	Competition: rules and regulations of the platform: all	AVR lab: Andrius/assistant	PSoc lab: Antti/Juho/Joe	Interface lab: Antti/Juho/Joe/Vilius		
12:15-13:15	lunch	lunch	lunch	lunch	lunch		
13:15-16:30	Group work primer: Antti Piironen	Designing the platform: T.A.'s	Building of platform: Juho	Building: Joe	Testing: Fast track competition (15:00) Juho/Anssi		

week 33	Mon Aug. 9	Tue Aug 10	Wed Aug 11	Thu Aug 12	Fri Aug 13	Sat Aug 14	Sun Aug 15
9:00-10:30	Digital Control: Wolfgang Stief (FH FFM)	Mini workshop: groupwork (Panos + John)	Digital Control: Wolfgang Stief (FH FFM)	Digital Control: Wolfgang Stief (FH FFM)	Signal Conditioning (Antti)		
10:45-12:15	Digital Control: Wolfgang Stief (FH FFM)	Radio interface: SPI+ (Juho)	Digital Control: Wolfgang Stief (FH FFM)	Optical Sensors and Encoders (John Evans)	Implementing: following a line	Heureka, self organized tour @ 11:00am	Cultural activity: Sauna experience (international office)
12:15-13:15	lunch	lunch	lunch	lunch	lunch		
13:15-16:30	Platform design: Power control, steering	Radio interface lab (Juho + Joe + Nicolas)	Groupwork	Labs for line follower + groupwork	Review: Line follower @ 14:00		

week 34	Mon Aug. 16	Tue Aug 17	Wed Aug 18	Thu Aug 19	Fri Aug 20	Sat Aug 21
9:00-10:30	Mini-workshop: collision prevention (Antti)	Digital Control: Wolfgang Stief FHFFM	Group Work	Info for final two days	Presentations: max 15min each	Departure
10:45-12:15	Group work	Digital Control: Wolfgang Stief FHFFM	Group Work	Preparation for final competition	Competition: all previous tasks on one system	
12:15-13:15	Lunch	Lunch	Lunch	Lunch	Lunch	
13:15-16:30	Group Work. Line Follower Competition @ 15:00	Group Work	Group Work	Preparation of presentations	Competition: all previous tasks on one system	
					Farewell party: announcing the winner (all)	

PROJECT IMPLEMENTATION: CHALLENGES AND GOOD PRACTICE

During the project implementation the participants have encountered a number of challenges the majority of which have arisen from the fact that for most students the concept of CDIO and work in international teams was new. Both students and lectures have experienced difficulties due to the fact that students were of different academic background, this on one hand created a real life experience but on the other slowed down progress and sometimes caused frustration within student teams.

In order to resolve these issues academic staff members and lab assistants were always present in the laboratories in order to assist with technical matters as well as provide counselling and act as mentors in case of conflict. The only exception to the rule was the industrial visit for instructors, which was organized on the last Wednesday. Irrespective of encountered difficulties the students have emphasised the development of communication skills as one of the main benefits of the project. They have also positively evaluated the ability to share knowledge and experience different approaches to problem solving.

Another challenge was the evaluation of the work done by the students. The use of competitions as a way to assess achievement has proven valuable; however the predefined

rules had to be adjusted since achievements of the students would vary from week to week. This meant that considerable flexibility and monitoring of the students' progress was needed at all times to make sure that the set rules are corresponding to the work done and fair.

RESULTS AND CONCLUSIONS

Project results were assessed in two stages: 1. Student feedback questionnaire initiated by Fachhochschule Frankfurt am Main University of Applied Sciences [5] conducted in the middle of the IP and immediately after the IP [1]. 2. The Internal Evaluation report carried out by the Vilnius Gediminas Technical University in the form of Interviews with students, lectures and the coordinators during the last two days of the project.

Both evaluation techniques have shown that the students assessed the IP very well (about 4 on scale 1-5), although some concerns regarding "the amount of work" and "The scheduling" were mentioned as well as some challenges mentioned above. The majority of students "Would recommend this intensive program" to fellow students (4.4 on scale 1-5) which indicates that the eDSP IP was very successful and corresponded to the needs of the students. The participants were particularly glad that the project helped enhance their communication, problem solving, team work and other soft skills which lie in the core of Industrial design project and modern engineering processes.

The lecturers participating in the project have positively evaluated the possibility to interact and share experience with colleagues from other Institutions as well as work with students of various academic and cultural backgrounds.

Links to other projects were established. The visiting teachers had excellent networking opportunities with other European teachers, since the IP was organized during our traditional International Summer School, where the teachers are coming mostly from other European countries. We organized teacher's industrial visit to a sensor manufacturing company.

The first eDSP IP was a great success. The feedback from both students and instructors was very encouraging, and we also received a plenty of very good ideas how to improve the IP. During the writing of this paper the planning was going on for the second IP to be held in Coventry on August 2011 and the authors were waiting to get funding decision for the third IP to be held in Vilnius on August 2012.

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Biographical Information

Antti K. Piironen is the Head of the Degree Programme in Information Technology at Helsinki Metropolia University of Applied Sciences, Finland. His current work focuses on curriculum development of international ICT programmes and international co-operation in the field of embedded engineering education.

Juho Vesanen is an embedded engineering lecturer of the Degree Programme in Information Technology, Helsinki Metropolia University of Applied Sciences, Finland. His current interests are on embedded systems networking and local connectivity.

Malcolm Blake is a director of European Programmes at Coventry University. He also is an Erasmus Faculty of Engineering and Computing Coordinator.

John Evans MSc C.Eng MIET is a Principal Lecturer in the Faculty of Engineering and Computing at Coventry University. Johns initial academic area of interest was in telecommunication systems. He later developed expertise in Electronic systems, specialising in Electronic Instrumentation and automation systems. In addition to student supervision he now works within the European Development group advising and assisting incoming students wishing to study at Coventry or outgoing students wanting to study abroad in mainland Europe.

Panos Abatis is a Senior Development Officer in the Faculty Of Engineering and Computing at Coventry University. His current work focuses upon the design and development of embedded systems used for teaching, research and consultancy activities. Other areas of research work include Computer Forensics and Intelligent Home Systems.

Manfred G. Jungke is a professor at the department of Computer Science and Engineering at Fachhochschule Frankfurt am Main - University of Applied Sciences, Germany. His major interest is in the field of research and teaching of Digital Signal Processing. In the recent years he organized a Finnish-German short term Intensive Programm of Challenge Based

Education for engineering students with majors in electrical engineering, information processing and automation building a serial hybrid racing cart prototype.

Wolfgang Stied is a professor at the department of Computer Science and Engineering at Fachhochschule Frankfurt am Main - University of Applied Sciences, Germany. His major interest is in the field of research and teaching of System Control Theory.

Andrius Usinskas is a Assoc. Professor at the Department of Electronic Systems at Vilnius Gediminas Technical University, Lithuania. His current research focuses on image processing and embedded systems.

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