Incubator Platform for Multidisciplinary Innovation in Research and Education

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ABSTRACT

In this article, an incubator platform concept is presented to demonstrate the authors’ approach in meeting the enormous challenges faced by future multidisciplinary research and education. The abstraction level of laboratory projects needs to be raised to a level where the researchers and students have the opportunity to deal with hands-on real-life system-level problems and decisions, while simultaneously various fundamental key technologies of the information society are integrated into the systems. Their approach is concretized by an Incubator experimental platform. Facilitated by this environment, researchers, engineers and students can join their efforts in developing next-generation products in a well-organized manner. The targeted products must meet the increasingly important special characteristics required for the digital era – self- and context-awareness, built-in information security, distributed networking, enormous scalability and device interoperability. Many projects are today developed by distributed multicultural teams, so it is a necessity that the development can also be implemented in co-operation of several universities in different countries, in order to promote the career skills of the students. The incubator platform proposed in this article is able to provide viable answers and solutions to all the mentioned challenges in engineering research and education, coupling the curriculum tightly to top-class academic research.

Keywords: ICT-Curriculum Design, Incubator Platform, Multidisciplinary Engineering Education, Project-Based Learning, Technology Innovation

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1. INTRODUCTION

Technology is changing very rapidly and continues to revolutionize the world around us. Engineers are vital forces in developing technology, supporting its operation and helping society to understand and utilize it effectively. It is essential that the choice of problem solutions is strictly guided by the extremely wide-range of technical resources available today, and by their known limitations. This strongly suggests that the engineers in charge of principal decisions should have multidisciplinary knowledge, be increasingly aware of the environmental changes and give prompt and adequate responses to newly arising issues. Owing to this, the focus of a traditional engineering education system on a single specific area of competence is not appropriate any more (Paris, 2010). Besides the promotion of multidisciplinary competence and development of inter-disciplinary skills, educational institutes should foster an active mindset of constant innovation in engineering students. The latter can be achieved by encouraging students to act as an integral part of the decision making process, teaching them project management skills, involving them in creative problem solving and imparting the sense of fast-paced environment in the entire process. An alarming developing trend, caused perhaps partly by the observed explosive growth of information flows, is the general decline of student’s enthusiasm for independent work and depletion of active self-study effort. In addition to more active utilization of electronic learning platforms, facilitating self-study tasks and assisting group work (Virtanen, 2008, 2009), the key driver of more active student work habits is cohesive with opportunities of hands-on project work in real-life scenarios. The major duty of the educational system is to install the motto “once a student - always a student” in students, that is, to lay the foundation for independent learning and to cultivate commitment to life-long education. Students must be able and willing to continually improve, refine, and broaden their skills and competencies in the face of rapidly evolving technologies and global needs. For example, in Sanford and Sztandera (2007) the authors have identified the need to leave a significant part of the information required to fulfill the IT curriculum for independent search by a student, as opposed to provision of all the information by the instructor, via lecturing or by other means. The importance of motivating students to do more independent work has also been supported in Al-Mubaid (2008), where the authors present an experiment based on self-regulated learning theory, and conclude that the experiment produced more successful learners. An educational system transformation where these issues are adequately addressed will produce better engineers, qualified for the solution of the most pressing issues and problems of society.

We are reforming the Information and Communication Technology (ICT) education in our department. As technological innovation requires engineers with capabilities to tackle real-world problems, which are intrinsically multidisciplinary (Paris, 2010), the reform focuses on providing multidisciplinary education. For example, a multi-agent sensor network as a high-end application of robotics immediately brings into the spotlight a number of disciplines: wireless communications, digital signal processing, networking, localization (including indoor mechanisms not based on GPS), aspects of distributed computation, artificial intelligence, and so on. The goal of the reform is to equip students with multidisciplinary expertise as well as inter-personal and social skills. The introduction of a multidisciplinary large-scale project work, which enhances students’ system level thinking, hands-on-abilities, cross-course linkage and team work, is one of the major steps in the reform. At the same time, it couples the educational curriculum significantly more tightly to on-going academic research, benefiting both the students’ and the faculty members’ motivation. The reformation is supported by a concrete experimental environment accessible to students and educators for a wide diversity of courses, projects and master theses. The experimental environment provides opportunities for students and researchers to perform hands-on
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