Effects of Interdisciplinary Education on Technology-Driven Application Design

Zhilbert Tafa, Goran Rakočević, Djordje Mihailović, and Veljko Milutinović, *Fellow, IEEE*

***Abstract*—This paper describes the structure and the underlying rationale of a new course dedicated to capability maturity model integration (CMMI)-directed design of wireless sensor networks (WSNs)-based biomedical applications that stresses: 1) engineering-, medico-engineering-, and informatics-related issues; 2) design for general- and special-purpose systems; and 3) the creation of synergistic effects that enable formation of entrepreneurial multidisciplinary teams able to organize and implement the development of these health-related pervasive computing applications. Formal education so far still focuses on treating only strictly separated and specialized topic areas. However, as the need for cooperation and mutual learning between students oriented toward different fields grows, the need for a multidisciplinary educational approach becomes more and more important. For a technical education to be complete, it is no longer enough to train scientists and engineers solely in technical areas. In development and implementation of technology-driven applications, multidisciplinary issues should be properly addressed in the academic sense. The interdisciplinary understanding and synergy achieved are tested through examinations and workshops. The transdisciplinary knowledge improvement is also statistically evaluated, using a system of metrics developed experimentally.**

***Index Terms*—Capability maturity model integration (CMMI), education, engineering, healthcare, informatics, interdisciplinary, multidisciplinary, transdisciplinary, wireless sensor networks (WSNs).**

I. Introduction

THE 21st-CENTURY engineer must be able to deal with a rapid pace of technological change, a highly interconnected world, and complex problems that require multidisciplinary approaches and the effective use of human and natural resources. As product design professionals know, effective development of products is an interdisciplinary process [1]. The process of proper technology development and implementation in a specific field generally involves a multidisciplinary environment where a certain level of interdisciplinary education and transdisciplinarity is practiced in order to pass successfully through the systematic and optimized phases of project planning, development, implementation, and market interfacing. Interdisciplinary collaborations require individuals from different backgrounds to come together, overcome seemingly incommensurable values and language patterns, integrate knowledge, and reach a high degree of consensus [2]. It becomes obvious that functioning well in a global, technology-driven, multidisciplinary environment necessitates a more robust educational paradigm in science and engineering [3]. While focused on a multidisciplinary study environment, this kind of educational framework should properly prepare students for the real challenges they are likely to encounter in the global marketplace. In fact, the level of cross-disciplinary integration for a collaborative project can be the main parameter that decides the quality of the final product.

Although these advantages appear to be obvious, graduate-level education so far has not given the proper focus to interdisciplinary issues and methodologies. This paper aims to present a methodology for, and the effectiveness of, a new interdisciplinary educational approach for the development of the technology-driven applications, which builds on existing approaches [3]–[10]. It underlines the advantages of a new methodology in education, based on multidisciplinary student groups within the context of graduate-level education.

For more than 30 years, achievements in information technology (IT), electronics, telecommunications, and biomedical engineering have been used to improve the quality of healthcare delivery [11]. These developments have led to the realization of medical sensors with wireless networking capability (WSNs), which allow medical monitoring to be long-term, mobile, real-time, multifunctional, multiuser, and ubiquitous. Generally, WSNs are networks of small devices with integrated sensing, computing, and wireless communication capabilities that enable unobtrusive and ubiquitous sensing of various physical parameters. As the design and implementation of these systems need a wide range of knowledge, primarily in engineering (hardware and software) but also in nontechnical areas (here, medical issues), these applications are inevitably the product of multidisciplinary teams. Given this need for multidisciplinarity, and the fact that the emerging area of telemedical applications (especially home healthcare) is very challenging, especially for computer engineers, the study described in this paper demonstrates an appropriate multidisciplinary learning process. This process brings together multidisciplinary groups of students, from informatics (INF), computer/electrical engineering (ENG), and medicine (MED), who learn together and collaborate on a project in the remote monitoring of physiological signals, using capability maturity model integration (CMMI) methodology.

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Z. Tafa, G. Rakočević, and V. Milutinović are with the Department of Computer Engineering, School of Electrical Engineering, Belgrade University, Belgrade 11000, Serbia (e-mail: tafaul@t-com.me; grakoceivc@gmail.com; vm@etf.rs).

D. Mihailović is with College of Technology, Arandjelovac ***[Postal code?]***, Serbia (e-mail: mihailovic@fon.bg.ac.rs).

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