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A Model for Educating Real-Time Software Engineers On-Demand

Janusz Zalewski[1]

[1] Department of Computer Science
Florida Gulf Coast University
Ft. Myers, FL 33965-6565, USA
zalewski@fgcu.edu
http://www.fgcu.edu/zalewski/

Abstract. This paper discusses educating software engineers at the undergraduate level to prepare them for taking immediately available jobs in industry, in response to the industry demand in the area of real-time systems. It is focused on the innovativeness of organizational aspects of the educational process, involving its stakeholders, rather than on the curricular aspects, traditionally considered first.

1 Introduction and Background

In the era of prospective significant mismatch between the demand for engineers and the number of graduates who could fill all available positions and be well prepared for entering the job market, some unconventional steps have to be taken to reverse the negative trends. In other words, radically new models of engineering education have to be proposed, built and verified, which would address the concerns and issues currently considered detrimental to the engineering education. Since the author's expertise is from the domain of Real-Time Software Engineering, this discipline is used as a vehicle to convey new ideas, but it is believed that the essential concept is not limited to any single engineering discipline.

Briefly speaking, the author proposes "Education On-Demand", which would address several most significant aspects of the educational process and its interaction with stakeholders, and lead to producing graduates and educators, who would act as a "rapid response force" in meeting the immediate needs of employers. The three crucial aspects in this process are considered to be:

(1) *local awareness*, that is, enforcement of interactions among the local communities, such as the university, being the "producer" of graduates, high schools, being the "feed" of talent to universities, and industry, being the recipient of graduates;
(2) *global awareness*, that is, taking advantage of the fact that we all live in McLuhan's global village and both students and graduates, faculty and administration, should be prepared to interact with other stakeholders worldwide, for example, faculty teaching a course in the US from Europe, project being developed in a lab in Florida by a team of students located in four different countries around the globe, flexible curricula combining for-credit courses from best programs in the discipline around the world, etc., and

(3) *cross-disciplinary interaction*, which means not only blending traditionally different and disjoint engineering disciplines (a good example of which is mechatronics), but also reaching across the boundaries of engineering to such disciplines as psychology, biochemistry, economics, social and decision sciences, etc.

The author is actively pursuing all three aspects in building the proposed model in a variety of ways, for example:

(1) engaging local high school students and teachers by periodically visiting high schools with college projects' demos (such as remote wireless data acquisition, robots, modern web design); engaging industry leaders in presentations called "Distinguished Lecture Series";
(2) engaging faculty and industry worldwide in his web-based courses to address student questions; developing (under a government grant) a web-based real-time software engineering lab;
(3) initiating collaborations with faculty in traditionally non-engineering disciplines, by submitting joint papers and grant proposals to involve those disciplines in revitalizing computing education.

Since the space in this paper is very limited, we will discuss here sample student projects, which were brought to the classroom by the leading software companies from the area.

2 Sample Projects

To illustrate the scope of the educational activities, we discuss below a sample of multiple student projects that were conducted for the last couple of semesters in EMbedded Systems Programming and Senior Software Design courses.

2.1 Robotics

The two robots used, a small wheel bot and a robotic arm are shown in Figure 1. The experimental task was to apply alternative programming methods to improve performance.

Figure 1. Ridgesoft Intellibrain bot and UMI RTX Robotic Arm.

The smaller robot's interface was changed from serial cable to Bluetooth, which allowed remote control of behavior and full operation with sensors. The robotic arm's control algorithm was improve to allow time optimal motion control. More specific information is included in a report available upon request.

2.2 Sensor Networks

This project relied on configuring a sensor network from Crossbow, to read light sensor and other sensor data and make them available through a server to the Internet. A sample network configuration is shown in Figure 2.

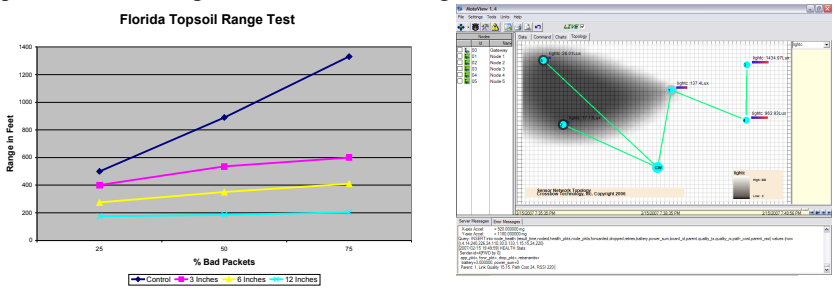

Figure 2. Sensor Network Topology Map Showing Operation of Light Sensing (left) and Sample results from the ZigBee Network Range Test (right).

Another project of that sort was conducted with the use of a ZigBee-based sensor network from MaxStream, and aimed at testing the range of the network for taking some soil measurement. Result sof the test for various types of Florida soil are shown in Figure 2. The distances vary from 0 to 1400 feet and the increase in packet loss is reflected on the diagram.

2.3 RFID Network

The final project involves a small RFID network to track paths of a certain fish species in the local river. A diagram of the server part is shown in Figure 3. The fish are implanted with RFID chips, which generate signals detected by the antenna.

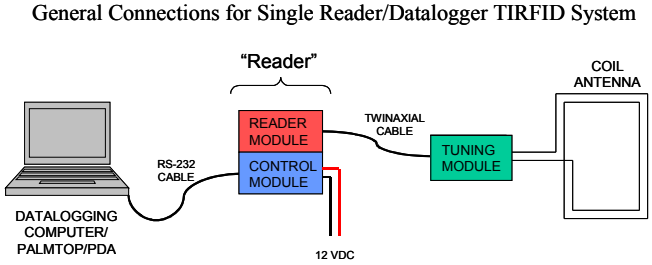

Figure 3. Illustration of the RIFD Fish Tracking System (Server Part)

3 Conclusion

The metaphor used in the title obviously comes from the "video on-demand." The model is based on presumption that there is a market for Software Engineers, just like

there is a market for videos, and there are customers who want to "retrieve" them on demand, making sure that the product meets customer's expectations regarding the functions and quality. Consequently, there should be an aggressive industry (understood as a societal mechanism) formed, which would "produce" such graduates, just like an industry has been formed to produce and deliver electronics goods, in particular, video on-demand. That way, the "On-Demand" aspect of engineering education will be met. Following this analogy further, the author believes that such mechanism, if sustained, would ultimately lead to making software engineers a commodity. If successful, this model can be extended to educate engineers in the majority of professions.

Acknowledgement

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