Information technology in agriculture as a successful curriculum for agricultural engineering students

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Abstract

Advances in information technology provide efficient tools to deal with complexity of large systems in agriculture, food processing and environment. A curriculum was developed in the Institute of Agricultural Engineering of the Agricultural University of Poznan, Poland to offer agricultural engineering students an appropriate knowledge supporting development of information systems and their implementation into agricultural practice. Exemplary information systems developed by students were depicted, and coordination processes related to application of advanced information technologies for agriculture, food and the environment were discussed.

Key words: software engineering, soft computing, decision support system, internet application, agricultural engineering curriculum.

1 Introduction

Growing needs for prompt and reliable information dedicated to a farmer, food processing plant, and to any institution of the agricultural sector are related to a development of distributed processing (internet, e-commerce, client-server databases) and its impact on dissemination of information, business efficiency, marketing, and restructuring the agricultural sector. Contribution of IT to solving vital problems of analysis, design and management in agriculture and food production is based on:

- computationally intelligent systems adapting themselves and learning to perform better in changing environments, with the use of neural network and fuzzy logic modeling, and metaheuristics,

- conventional knowledge-based systems,

- internet applications based on distributed databases,

- efficient software engineering with requirements analysis, object-oriented modeling in UML, quality analysis, and rapid application development.

Considering the above aspects of IT suitable for developing information systems for agriculture and food processing, the objectives of the paper were to discuss a curriculum which was developed at the Agricultural University of Poznan, Poland with the intention to offer the agricultural engineering students knowledge and skills of developing information systems supporting agricultural and food production technologies, and to discuss coordination processes facilitating development of information systems for agriculture, food production and the environment.
2 Presentation of the curriculum

An original curriculum was developed at the Agricultural Engineering Institute, at the Agricultural University of Poznan – to offer agricultural engineering students knowledge and skills to develop and administrate information systems in the agricultural sector, and to deliver specialists to that sector: specialists who are highly-qualified, well-prepared for competition and ready to create new jobs. The curriculum, named Informatics in agricultural engineering, has been available since 1995, and has been modified several times. It has been grounded on computer science - full 25 courses on pure informatics, and it has been focused on the needs of agriculture and food production - the agricultural engineering core courses has been preserved (Weres, 1997; Weres et al., 1999; Mueller et al., 2000; Weres, 2004). It takes five years for MSc degree, PE licensure is included.

The curriculum can be characterized by the following core areas:

- methods of software development (software engineering),
- intelligent decision support systems,
- image analysis and computer vision,
- Internet database applications and e-commerce,
- management of web-oriented documents,
- soft-computing, computer modeling and virtual prototyping,
- networking technologies.

On top of the MSc and PhD programs, post-graduate and other training programs in informatics for agricultural engineering have been started at our Institute, as a result of a prospective diminution of number of students, and also growing needs for continuing education for adults.

3 Exemplary information systems

Every year approximately 30 information systems are either developed or upgraded by our agricultural engineering students, and supplied to end-users in agriculture and food production. The systems are used to support research, teaching and extension services, showing how the curriculum meets expectations with respect to efficiency and quality. All the projects were performed according to the software engineering standards, covering requirements analysis, development of UML models, RAD implementation in the Borland C++ Builder and Microsoft Visual Studio .NET environments, testing and quality analysis.

Now, for the sake of brevity, only the following list of the selected information systems developed by our graduate students so far can be given - details are given during the presentation.

- System for finite element modeling of the heat and mass transport processes in biological materials (cereal grain, wood, canned food, etc.). The system modules comprise: the parabolic equation solver – the FEM direct modeling, the parameter identification module and the optimization analysis module – the FEM inverse modeling, the image analysis auxiliary module, the biological product visualization auxiliary module (Weres et al., 2000b; Weres and Olek, 2003; Weres and Kujawa, 2004).

- Decision support system for analyzing, designing and managing drying and storage of cereal grains and rapeseeds (Weres et al., 2000a).

- System for computer vision in the analysis of cereal grain kernel properties.
- System for computer vision in the classification of insects.

- System for 3D modeling and visualization of agricultural and food products during thermal processes and visualization of changes in their properties.

- System for controlling agricultural mobile robots on the basis of neural network classification of images representing agricultural objects.

- Distributed decision support system for protecting quality of a rapeseed plantation (Kozłowski et al., 2003).

- Information system for managing rural areas based on GIS technology.

- System for analyzing and designing thermal energy storage units for in-farm usage, based both on operational structural models and neural network simulations (Majewski et al., 2004; Mueller et al., 2003a).

- System for designing automated plant watering technologies.

- System for predicting sugar beet yield and quality in a wide range of factors with the use of a neural network (Przybył and Kliński, 2004).

- System for predicting crop yield and distribution, based on the neural network approach (Boniecki, 2004; Koszela et al., 2004).

- Internet client-server application for managing research projects at agricultural engineering faculties, institutes and departments (Jarysz et al., 2004).

- Internet system for placing orders for agricultural machines and equipment based on XML and SVG technologies (Mueller et al., 2003).

- Information system for managing agro- and economical evaluation of soil and plant cultivation technologies with respect to methods for reducing soil compaction.

- Computer system supporting measurement and analysis of plant root distribution.

- Software supporting analysis of tractor steering systems.

- Decision support system for selecting desirable tractors and machines for a farm (Łoboda and Lenartowicz, 2004).

- Computer system supporting management of the agricultural transport with the use of stochastic and deterministic computational models.

- Information system supporting analysis of the manure composting process in a bioreactor (Dach et al., 2004).

- Internet client-server information systems for e-teaching and verifying knowledge of students in a form of semester tests and final exams (Mueller et al., 2004; Olszewski et al., 2004; Weres and Rudowicz, 2000).

4 Coordination processes

Coordination processes facilitating development of information systems for agriculture, food production and the environment, with respect to funds, roles and responsibilities, have been established on several levels: a) department, faculty and university levels; b) governmental level: Ministry of Science and
Informatization, Ministry of Agriculture and Food Economy; c) governmental and local advisory centers for agriculture and rural development; d) Committee for Agricultural Engineering of the Polish Academy of Sciences – Section of IT in Agriculture; e) Polish Society of IT in Agriculture, Food and the Environment; f) International Commission of Agricultural Engineering – Section VII: Information Systems; g) International Network for IT in Agriculture and European Federation for Information Technology in Agriculture, Food and the Environment; h) The World Agricultural Information Centre of FAO and AgroWeb Network.

An analysis of all the activities supporting development of information systems for agriculture shows that a very important support from the governmental institutions and a commitment of extension officers, cooperating informally with academics, cannot substitute formal coordination processes established by universities represented by professional associations and societies.

5 Conclusion

Combining computer science and agricultural engineering in an educational program resulted in a rapid growth in developing professional applications of advanced information technologies for agriculture. Students, well educated both in agricultural engineering and in computer science, have been deeply involved in developing information systems for all possible processes in agriculture and production of high quality food. It is particularly important for rural areas because of the need to create new jobs.

In the area of coordinating development of information systems and providing valuable, dedicated information to the sector of agriculture on the Internet, a support from governmental advisory institutions cannot substitute formalized coordination processes established by agricultural universities and professional associations and societies.

6 References


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