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## *EDUIR & BADNAK* INTERNET INFORMATION SYSTEMS APPLIED IN THE PROCESSES OF EDUCATION & RESEARCH MANAGEMENT IN AGRICULTURAL ENGINEERING

*Summary*

*Considering dynamics of educational processes, their teaching goals and organizational forms and also research management, faculty members face increasing requirements. Consequently, time devoted to research activities becomes gradually reduced. Implementing specific information systems that assist educational processes and research management may improve the situation while increasing efficiency. In this work Internet applications supporting teaching of agricultural engineering and also research management, were developed. Providing sequential educational materials prepared by agricultural engineering faculty members, the program allows them to verify in various forms students' achievements and to analyze the teaching process. Learning goals as well as verifying tests are based on static and dynamic pictures. Systems implementation was preceded by object modeling in the UML notation. Both latest Internet technological inventions, PHP 5 and ASP.NET, were selected. The two applications work with the SQL Server 2000 database system, supported by an original safety system developed for data confidentiality.*

## WYKORZYSTANIE INTERNETOWYCH SYSTEMÓW INFORMATYCZNYCH *EDUIR I BADNAK* W PROCESIE KSZTAŁCENIA I ZARZĄDZANIA BADANIAMI W INŻYNIERII ROLNICZEJ

*Streszczenie*

*Proces kształcenia, z uwagi na swoją dynamikę obejmującą treści nauczania jak i jego formy organizacyjne stawia coraz większe wymagania pracownikom nauki. Konsekwencją tego jest permanentne uszczuplanie czasu przeznaczonego na badania naukowe. Częściową poprawę tego stanu rzeczy, przy jednoczesnym zwiększeniu efektywności nauczania możemy osiągnąć poprzez wykorzystanie specjalistycznych systemów informatycznych wspomagających proces kształcenia. Autorzy podjęli udana próbę budowy aplikacji internetowej pomocnej w nauczaniu studentów w obszarze inżynierii rolniczej. Wspiera ona organizację procesu kształcenia, udostępnia sekwencyjnie materiały edukacyjnych przygotowane przez wykładowców, pozwala na różnorodne formy weryfikacji wiedzy studentów oraz dokonuje analizy procesu nauczania. Treści nauczania jak i pytania testowe bazują na stycznych i dynamicznych obrazach. Etapy poprzedzające implementację systemu obejmowały modelowanie obiektowe w notacji UML, czego efektem były wielopoziomowe diagramy przypadków użycia oraz diagramy klas. Jako narzędzia programistyczne wybrano jedną z najnowszych technologii internetowych, jakim jest PHP 5. Aplikacja współpracuje z systemem bazodanowym SQL Server 2000, a zaproponowany oryginalny system zabezpieczeń gwarantuje poufność danych.*

### Introduction

Research and teaching process management in the field of agricultural engineering can no longer be effective without the support of specialized IT systems. The main difficulty results from rapid changes in curricular content and the growing complexity of research processes due to the total approach to such research. A large proportion of the changes are driven by fast advances in information technology which has supplied new useful tools for research as well as education and the functioning of society, although it has forced people to continue expanding their knowledge of IT and its utilitarian products.

Research management is increasingly influenced by the ever-greater flows of various kinds of more or less complex information that is processed and recorded. This is particularly true for research centers which cater to the needs of the agricultural sector and is due to the nature of their activities and the mobility of employees. The lack of a highly specialized IT system complicates the work of such organizations making it more time-consuming.

In the field of education, in addition to the fast emergence of new fields knowledge which is to be acquired by both lecturers as well as students, difficulties arise from an excessively liberal approach to the forms of expressions that students are allowed to use. The developments substantially complicate student evaluation, especially in new areas of knowledge. This is because the existing concepts in such areas are continually redefined while new notions are developed, often by adding new meanings to colloquial words. A convenient solution to this problem, although not a perfect one, is to use tests available in both soft and hard copy formats. Electronic tests are more costly as they require the construction of an IT system whose architecture is typically distributed. Such systems, however, provide a number of benefits as they offer more ways to formulate questions and answers that come with still or video images and as well as audio tracks. This is particularly valuable in fields on the borderline of technology and agriculture. A less significant advantage of using electronic tests is the option of generating a separate set of questions for each student and full automation of the evaluation process and score notification.

**System design**

While university education is generally known to be closely linked with the research work conducted by individual university organizational units, the two are seen as separate for the purposes of IT system development. Since the same people teach and conduct research, the systems require a certain degree of integration. At the stage of compiling the needs of potential system users, the authors defined application architecture specifications. It appeared that a three-layer distributed architecture would best suit the intended purpose. To ensure safety, based on the knowledge of network topology, a decision was made to develop applications whose architecture is based on that of the Internet and intranet. Documented user requirements were reflected in multi-level use case diagrams generated by means of the UML graphic notation (Booch G., Rumbaugh J., Jacobson I., 2001). The actors that have been identified and the related use cases are presented in Figure 1. The highest priority diagram applies to the BADNAK IT system that supports the management of research conducted by research institutes.

An identical procedure that involves step-by-step definition and mapping of functional specifications with the use of UML-based graphics was during object-oriented modeling of the second multi-module IT system designed to support the EDUIR 2005 teaching process.

Meanwhile, the structures of future applications were modeled to create multi-level class diagrams made up of identified classes equipped with attributes, operations, interfaces and recognized links in between – see Fig. 2 (Booch G., Rumbaugh J., Jacobson I., 2001). The classes shown in the diagrams cover both patterns of non-durable structures, i.e. objects that exist only while applications are in use and the durable objects which are stored in the DBMS (Data Base Management System).

In the course of designing the IT system, databases were subject to logical modeling based on results of prior conceptual modeling which, as mentioned earlier, has been carried out with the use of the UML language. At the modeling stage, the authors needed to select a data architecture model. Considering the type of data to be stored and the project budget, a decision was made for the IT systems to rely on a relational database. In effect, classes needed to be converted to relations, which are the only structures dealt with in the RDBMS (Relational Data Base Management System). As a result of partitioning, the operations that define classes were located on the end of the application. The links between classes were, on the other hand, mapped in relational structures with the use of primary and foreign keys (Gunderloy M., Chipman M., 1999).

**Programming tools**

The systems' implementations were carried out with the use of two different Internet technologies, whereas data integration was achieved at the DBMS level as both of the applications are compatible with the SQL Server 2000. The difficulty of using the two different technologies of .NET and PHP 5 (Trachtenberg A., 2004) was to help compare the techniques in terms of both the speed of their development as well as the quality of the resulting IT product.

The IT system designed to support BADNAK research management by way of full documentation of the research carried out by the institute and complete registration of the flow of funds financing such research, was built based on the Visual Studio .NET environment. The application's Internet nature allowed for the use, in its construction, of the ASP .NET technology whose integral component is ADO .NET (Worley S. 2003), which constitutes a programming interface for accessing data that is not necessarily located in the DBMS. Of some significance in the selection of the said platform for the dynamic generation of web-sites was the fact that the platform was upgraded to support XML (Griffin J. 2002). The option of retrieving selected data in the form of XML documents helps further customize processing without the need to expand the existing IT system.

A significant programming advantage of the Visual Studio .Net environment with the integrated ASP. NET technology is that the code, which can be created in nearly any language, is separate from user interface at the time of application development (Worley S. 2003). As a result, programmers gain better control over the product they are making and certainly find it easier to enter modifications.

The other EDUIR 2005 Internet-based IT system that supports teaching in the field of agricultural engineering mainly in the organizational respect, was developed based on the free PHP 5 technology (Trachtenberg A., 2004). The dynamic web sites created with the use of the application contain data retrieved from the same database server that supports the former application. For both systems to operate correctly, a number of different IT components are required that are located on the end of the server, as shown in an overview in Table 1.

Table 1.

|  | **BADNAK** | **EDUIR 2005** |
|---|---|---|
| Serwer – system | *Windows Server 2003* | *Linux* |
| Serwer - WWW | *IIS* | *Apache* |
| Serwer - moduły | *. NET Framework* | *PHP 5* |
| Serwer – bazodanowy | *SQL Server 2000* | *SQL Server 2000* |

**IT system supporting research and teaching**

The complexity of the two systems and their structures does not automatically translate into difficulties in their operation. Their well-thought-out, hierarchically arranged and unified forms and sub-forms enable the user to move within and between the applications in a smooth and easy-to-understand manner. In order to safeguard data confidentiality, user identity is established based on names and passwords before either program can be launched. If the identification in BADNAK is successful, the system offers access to a form, as shown in Fig. 3, which serves as a control panel and features action buttons that allow one to view and edit research project data and retrieve research results. The "conference" button displays a list of all conferences contained in the database (Fig. 4) and offers a complete range of operations that can be executed in the database at a given level of authority.

Similar ways of navigating around the grouped forms of data can be used with respect to registration and modification of data concerning publications, which are relatively durable forms of research result presentation.
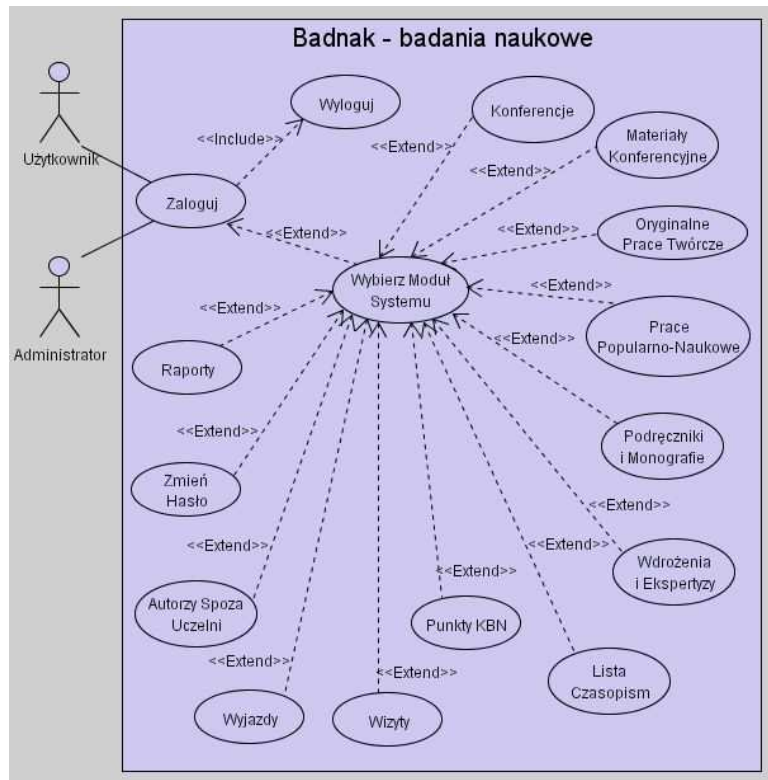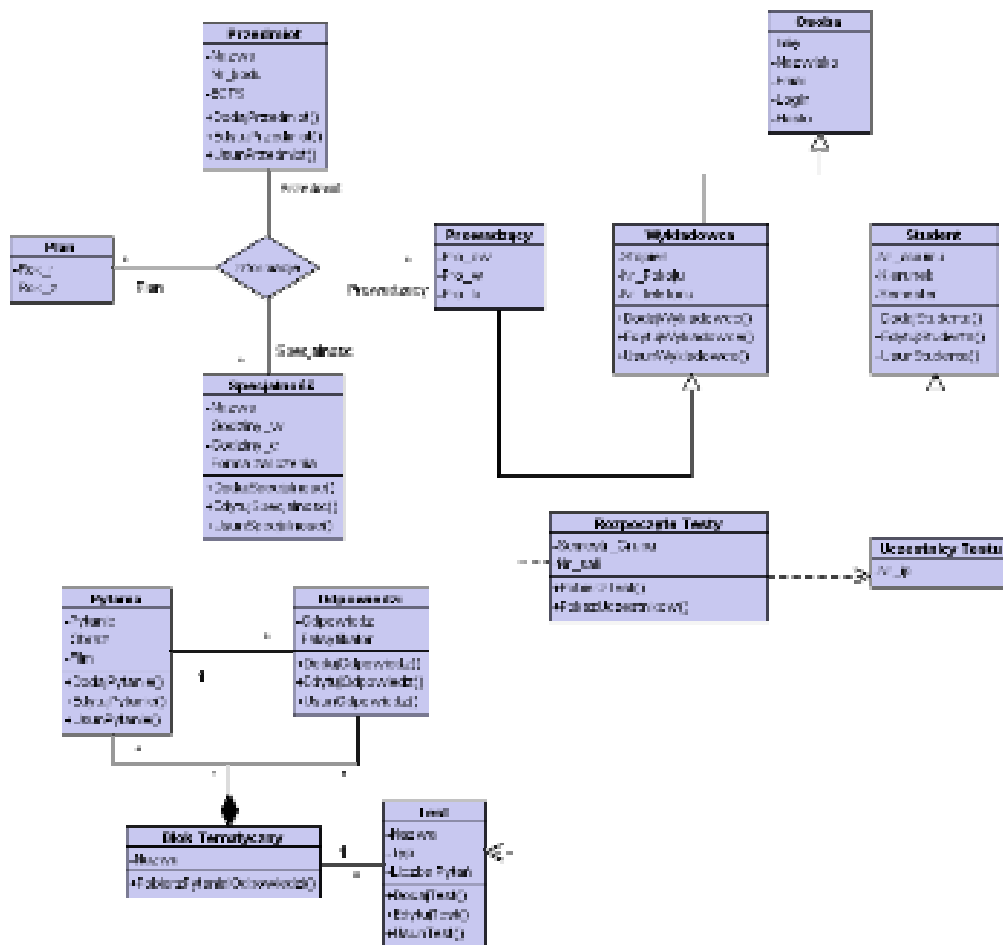
Fig. 1. General use case diagram



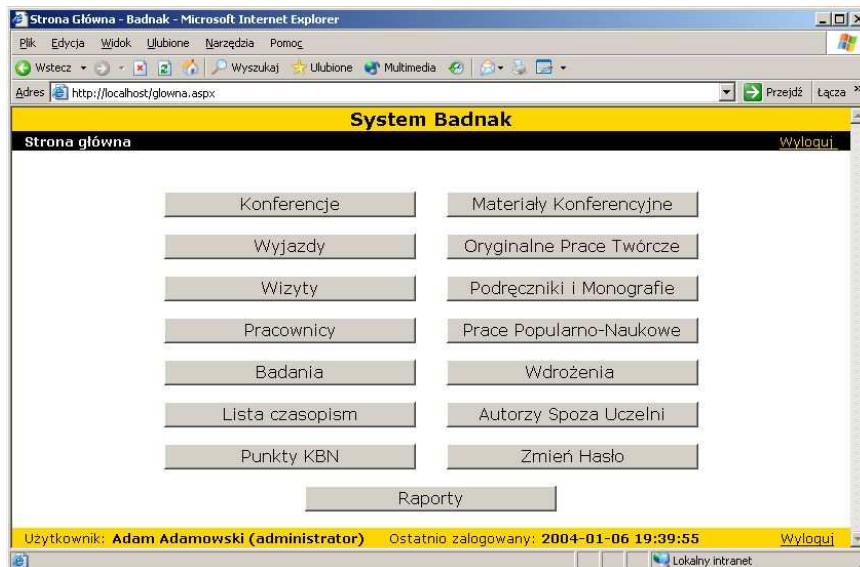Fig. 2. Detailed class diagram designed for student evaluation
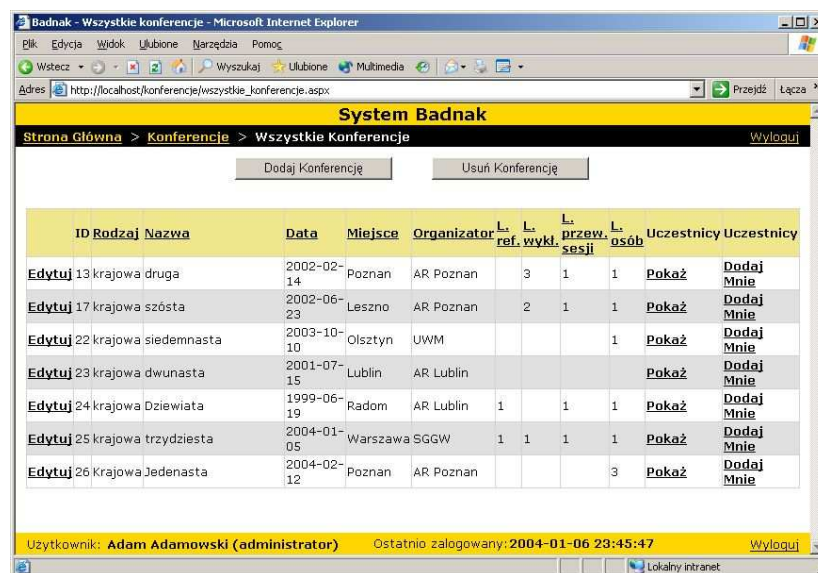
Fig. 3. The Badnak home page
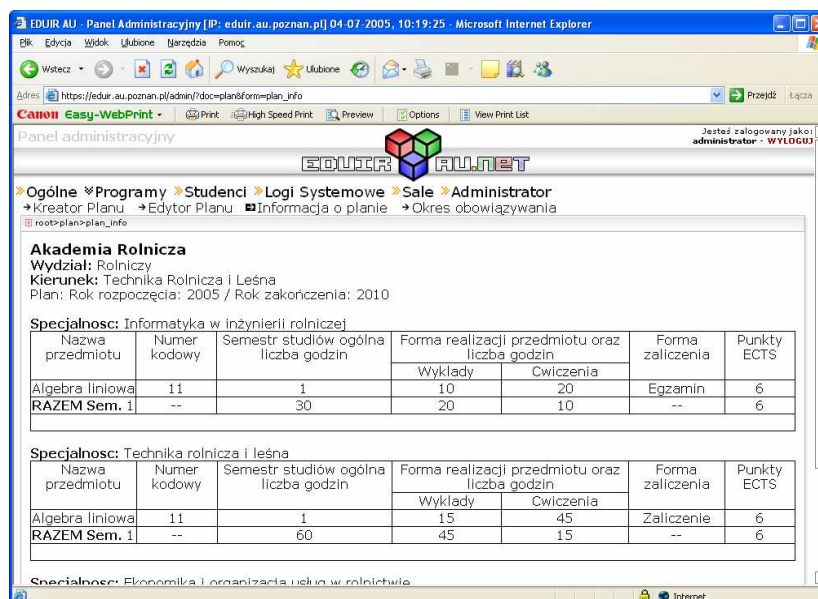


Fig. 4. The "All conferences" form



Fig. 5. Administrator panel

Since results can be retrieved in a wide range of formats, a number of different information packages may be used to save or modify data, making it necessary to use a wide range of forms.

Some of these forms allow for data presentation as XML documents allowing the user to process the data further in a customized way and save it to a different database. Another way of obtaining collective information on publications, conference attendance, etc. is to use reports. The information batches obtained in this manner vary by access authorization level.

A limited number of users are allowed to access the research budget management support module. To protect the information, data replication mechanisms were applied that form an integral part of the SQL Server 2000 (Waymire R., Sawtell, 2002).

The other application that supports the teaching process at the department of agricultural engineering is also made up of modules. Its modules are:
• study programs,
• student evaluation,
• and teaching.

The most extensive options of manipulating these varied data sets are available by using the administrator control panel shown in Fig. 5. The administrator is the only user allowed to modify the existing and enter new study programs. Other users of the system include faculty members and students, who use it in a variety of ways. Both users groups run the application nearly simultaneously at the time of electronic student evaluation.

## Conclusions

Based on the processes carried out at the stages of designing, producing and testing IT systems that support research management and teaching and rely on the latest Internet-based technologies, the author has formulated the following comments and conclusions:
• The use of the visual programming environment Visual Studio .NET facilitates and boosts the effectiveness of generating complex, specialized, Internet-based IT systems relying on the ASP .NET technology.
• The absence of a visual integrated programming environment for the PHP 5 language is partially compensated by its low cost and the fact that the technology works under any system platform.
• The use of a distributed web-browser-based application model helps access the systems it generates and simplifies their administration.
• The use of the XML technology for data presentation allows for customized data processing.
• Due to their functionality, the applications may well be used by other teaching and research organizations.

## References

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