Biblid: 1821-4487 (2016) 20; 4; p 182 - 185 Expert Paper
UDK: 631.51.022 Stručni rad

WEB BASED APPLICATION FOR OPTIMAL GREENHOUSE PRODUCTION SYSTEM SELECTION

VEB BAZIRANA APLIKACIJA ZA IZBOR OPTIMALNOG SISTEMA GAJENJA BILJAKA U KONTROLISANIM USLOVIMA

Ilija KAMENKO[*], Aleksandra DIMITRIJEVIĆ[**], Filip KULIĆ[*], Perica NIKOLIĆ[*]
[*]University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovića 6, 21000 Novi Sad, Serbia
[**]University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11000 Belgrade, Serbia
e-mail: kamenko@uns.ac.rs

ABSTRACT

In this paper is shown a description of the application based on the latest web technologies for optimal greenhouse production system selection. Web application is based on pre-formed expert model implemented in the web application with parameters stored in a database for easy maintenance. Using latest web technologies is achieved massive scale and availability of such expert knowledge to anyone with the Internet access and with standard web browser. The application in a very intuitive way to an agricultural producer, based on his initial idea and implemented expert model, guides throughout the process of selecting the optimal greenhouse production system and system parameters.

***Key words**: web, database, application, greenhouse, plant production.*

REZIME

U ovom radu je dat opis aplikacije bazirane na najsavremenijim veb tehnologijama za izbor optimalnog sistema biljne proizvodnje u kontrolisanim uslovima. Veb aplikacija se oslanja na prethodno formiran ekspertski model izbora tehnološko–tehničkog sistema gajenja u kontrolisanim uslovima. Model je implementiran u okviru veb aplikacije dok su parametri modela smešteni u bazi podataka radi lakšeg održavanja. Razvijena veb aplikacija je bazirana na najnovijim veb i internet tehnologijama koje omogućavaju masovnost i dostupnost takvog ekspertskog znanja do svakog ko ima pristup internetu i standardni veb pregledač. Aplikacija na veoma intuitivan način krajnjeg poljoprivrednog proizvođača, na osnovu njegovih početnih ideja, vodi kroz postupak izbora optimalnog sistema. Sam postupak je organizovan u koracima radi lakše interakcije sa korisnikom. Na osnovu željene biljne kulture i raspoložive površine, oslanjajući se na ekspertsko znanje implementirano u modelu kao i dodatnih zahteva korisnika, aplikacija daje predlog u obliku izveštaja. Izveštaj sadrži predlog tipa konstrukcije i orijentacije objekta, tehnološkog sistema gajenja, tehničko-tehnološkog sistema ventilacije, grejanja i navodnjavanja kao i njihove kapacitete, površine neophodnih pratećih objekata i površine predviđene za buduće proširenje. Svaki generisani izveštaj korisnik može sačuvati za kasniju upotrebu. Na taj način korisnik može upoređivati dva ili više predloga aplikacije i doneti konačnu odluku o podizanju sistema biljne proizvodnje u kontrolisanim uslovima po predloženoj specifikaciji.

***Ključne reči**: veb, baza podataka, aplikacija, objekti zaštićenog prostora, gajena biljka.*

INTRODUCTION

Without web technology cannot be imagine modern life, widely embedded within all aspects of life, widespread, integrated with all modern communication devices are the perfect basis for the implementation in many fields such as control and monitoring (*Nikolić et al., 2011*), motor fault detection (*Kamenko et al., 2011*), improving soil quality (*Kamenko et al., 2012; Kamenko et al., 2015*) and many industrial and nonindustrial applications.

Considering the growth of human population, global climate change and economic crises there is a need for a constant increase of food production. Greenhouse production is a way of intensifying vegetable production. Since of introduction of greenhouse production system many researchers have been working on new covering materials, new construction and new production system in order to have more energy and ecology efficient plant production. All that innovations and expert knowledge about greenhouse production is not available to ordinary agricultural producer. Nowadays, researcher working on model that can guide agricultural producer throughout selection of an optimal greenhouse production system (*Dimitrijević et al., 2012*). Implementing such model in web application, expert knowledge can be available to every agricultural producer that have standard web browser and the Internet access.

The paper will put the emphasis on using new web technologies for creating web application based on pre-formed expert model with parameters stored in a database for easy maintenance.

MATERIAL

The web based application described in this paper is interface part of the system for optimal greenhouse production system selection. It is based on the latest information and communication technologies and is fully web oriented. The core of the system is web oriented software with multilayer architecture. The first layer is the database and expert knowledge model, the second layer is a web server and the third layer is a web based graphical user interface. Block scheme of the system can be seen in Fig. 1.

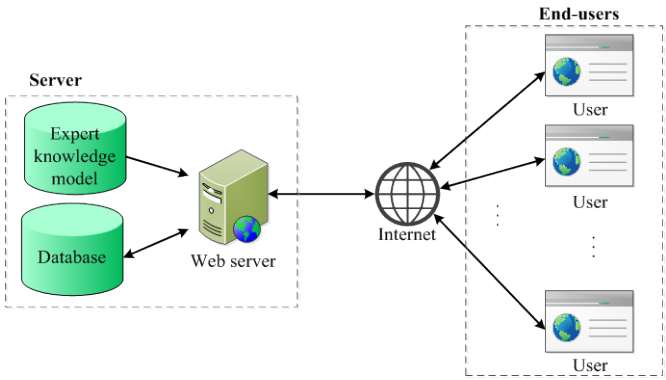

Fig. 1. Block scheme of the system

Web server is hosting all services and modules. In the concrete implementation, Microsoft Windows Server 2008 is used. The database is used to store data about registered agricultural producers, all parameters about greenhouse production, and final reports. In the concrete implementation, Microsoft SQL Server 2008 is used. Web application is relying on a previously formed expert model about greenhouse production. Access to the software is provided through a graphical interface using standard web browser. For designing and implementation of user interface is used ASP.NET technology.

Expert knowledge is based on four segments model of greenhouse production. The first segment is related to the desired fruit/vegetable production and the production surface. The propose of this segment is formulating the type of greenhouse construction, its dimensions and orientation. The second segment is related to the production technology, time of harvesting and soil quality. The propose of this segment is to provide the information about planting time and the production technology that should be used. The third segment is related to construction, covering material, production technology. The propose of this segment is to provide the information about the technical systems and their capacities. The fourth segment is related to the production area with propose to provide the information about the additional surface for storages, protective areas, parking areas etc. (*Dimitrijević et al., 2012*).

ASP.NET is a web application framework developed and marketed by Microsoft that enables programmers to build dynamic websites, web applications and web services. ASP.NET web pages, known officially as web forms, are the main building block for application development. These pages typically contain static (X)HTML markup, as well as markup defining server-side web controls and user controls where the developers place all the required static and dynamic content for the web page. ASP.NET aims for performance benefits over other script-based technologies by compiling the server-side code to one or more .dll files on the web server. This compilation happens automatically the first time a page is requested. This feature provides the ease of development offered by scripting languages with the performance benefits of a compiled binary (*MacDonald and Szpuszta, 2005; MacDonald and Szpuszta, 2006*).

Internet Information Services (IIS) is a web server application and set of feature extension modules created by Microsoft for use with Microsoft Windows. It is an integral part of Microsoft Windows Server family of products (*Schaefer et al., 2008*).

Microsoft SQL Server is a relational database server, developed by Microsoft. It is a software product whose primary function is to store and retrieve data as requested by other software applications on the same computer or on another computer across a network or the Internet. There are at least a dozen different editions of Microsoft SQL Server aimed at different audiences and for different workloads ranging from small applications that store and retrieve data on the same computer, to millions of users and computers that access huge amounts of data from the Internet at the same time. (*Paul, 2008*).

DISCUSSION

Web interface is designed to provide the possibility a registered user, using standard web browser, at any time and from anywhere, to have access to the application. Web application relies on a database with already an enviable number of parameters about greenhouse production. By accessing to the system opens the initial web page (*pocetna.aspx*). Web page provides general information about the system and welcome message. After entering the required login information, the user is redirected to the home page of the system with new links in navigation menu and full access to all possibilities of the application.

Main part of the application is web page for calculation (*proracun.aspx*) with the wizard based on expert knowledge that guides the user throughout the process of greenhouse production system selection. Links to the wizard steps are in the navigation menu, and the current step is highlighted. The movement forward is enabled by clicking the next button only if the form is completed and if the data is entered correctly for the current step. At any time, the user can go back one step by clicking the back button. Appearance of each form is adjusted in real time depending on the entered or selected data. The wizard consists of introduction step, six main steps and final report step.

The first step of the wizard represents the part for choosing the type of greenhouse construction and can be seen Fig. 2. Based on entered desired production surface, the wizard suggests types and possible dimensions of the greenhouse construction.

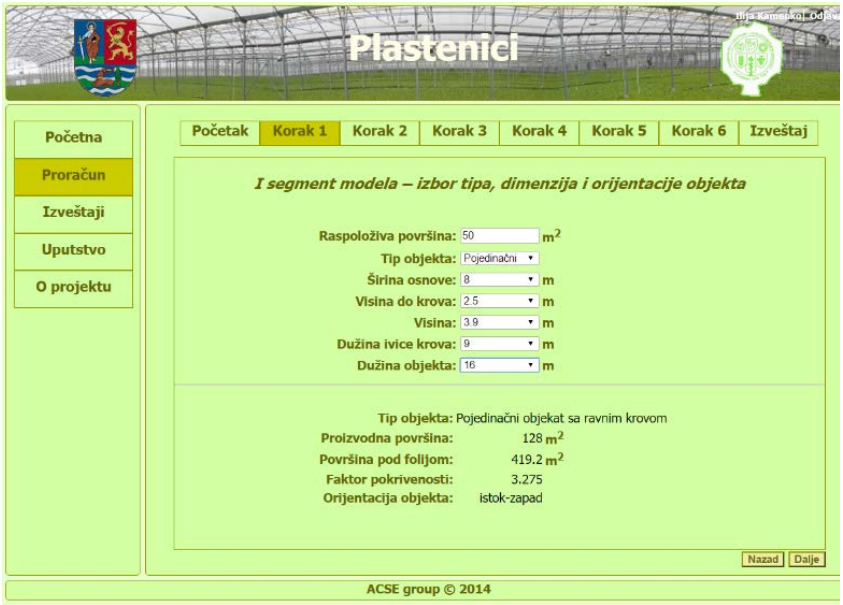

Fig. 2. Selection of greenhouse construction parameters

The Suggestion includes the most commonly used construction of greenhouses and their basic dimensions that are currently offered in the market. The user then selects the type of greenhouse and the dimensions of the object. Based on the entered data, the wizard suggests orientation, calculates production surface and gives the covering material. The calculated data is displayed in the current web form and used for further steps in the wizard.

The second step of the wizard represents the part for choosing the production season and technology and can be seen in Fig. 3. Based on entered desired plant culture, time of harvesting and the basic parameters of the soil quality (organic matter content, levels of nitrogen, phosphorus, potassium and pH level), the wizard suggests and displays the number of plants, the time of planting and the production technology. The calculated data is used for further steps in the wizard.

The third step of the wizard represents the part for choosing technological and technical system of ventilation. In this step the wizard already has all data required for calculation so is not required user input. Based on previously entered data about type and dimensions of the object, the wizard calculates and displays required total capacity of the ventilation system and the number of fans with their capacities.

The fourth step of the wizard represents the part for choosing technological and technical system of heating and can be seen in Fig. 4. The wizard in this step suggests types of covering materials and types of heating system. Based on entered wind speed typical for the region, selected type of covering material and selected type of heating system, the wizard calculates and displays the heat losses of the greenhouse.

The fifth step of the wizard represents the part for choosing technological and technical system of irrigation and can be seen in Fig. 5. The wizard in this step suggests types of irrigation systems concerning selections in previous steps. Based on selected type of irrigation system and entered number of irrigation cycles per day and its length, the wizard calculates and displays the total daily required capacity of the system and pump power enough to serve the chosen system.

The sixth step of the wizard represents the part for defining area needed for the storages, working offices and protective area. Based on entered area of current ancillary facilities, the wizard calculates and displays the required area for upgrade of ancillary facilities.

The final step represents the overview of calculated data in previous steps and can be seen in Fig. 6. The report can be stored in the database and accessed later on the reports web page (*izvestaji.aspx*).

The reports web page (*izvestaji.aspx*) enables the user to manipulate with the previously saved reports and can be seen in Fig. 7. In the upper part of the web form is a

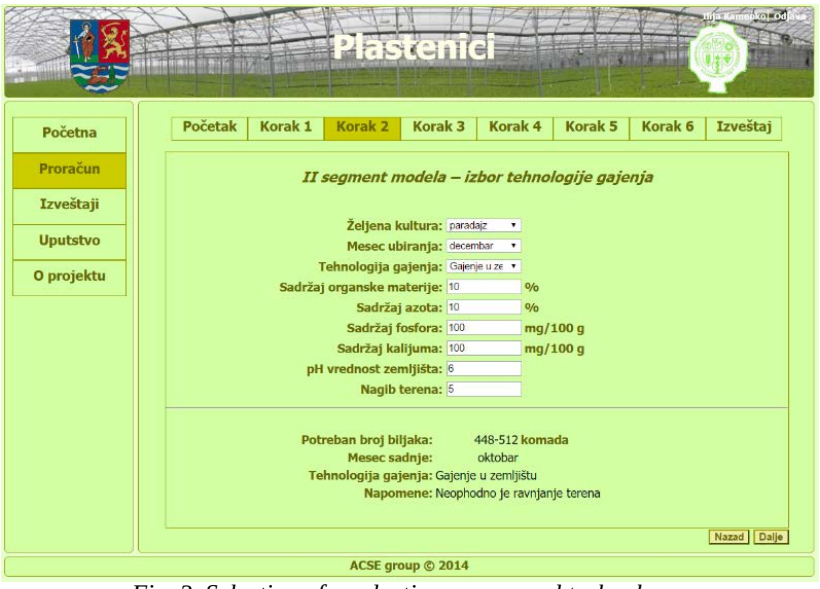

Fig. 3. Selection of production season and technology

Fig. 4. Selection of technological and technical system of heating

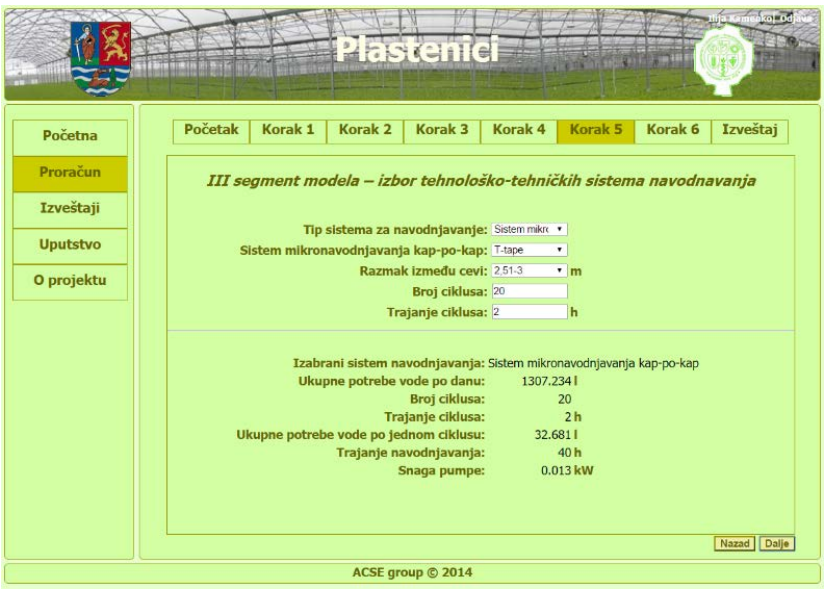

Fig. 5. Selection of technological and technical system of irrigation

list of reports with basic information while the lower part is a detailed review of the reports highlighted in the previous list. User can view each saved report and optionally delete unwanted report.

Fig. 6. Working with reports

Fig. 7. The final report step of the wizard

CONCLUSION

Greenhouse production is a very complex production system that needs to be maintained well and with great attention. The decision about starting this kind of business involves large number of variables that need to be analyzed. Existing expert knowledge about optimal greenhouse production is not available to every agricultural producer. The proposed web application implements such expert knowledge and makes it available to every interested user with the Internet access and with standard web browser. Each generated report can be saved for later use. In this way, the user can compare two or more proposed solutions and makes a final decision on raising greenhouse production system at the proposed specification.

ACKNOWLEDGMENT: The Ministry of Education and Science (Government of the Republic of Serbia) supported this research under grant number TR-32018.

APPENDIX

The above-described web application can be accessed on web address: http://147.91.176.34/plastenici/.

REFERENCES

Dimitrijević, Aleksandra, Bajkin, A., Zoranović, M., Ralević, I. (2012). Decision support model for energy efficient greenhouse production system. Journal on Processing and Energy in Agriculture (former PTEP), 16 (2), 57–60.

Kamenko, I., Bugarski, V., Nikolić, P., Čongradac, V. (2011). Web based approach for storing and displaying diagnostic motor data: 16th International symposium on Power electronics - Ee 2011. Novi Sad, Serbia.

Kamenko, I., Nikolić, P., Matić, D., Kulić, F. (2012). Web interface of expert system for improving the soil quality. Journal on Processing and Energy in Agriculture (former PTEP), 16 (3), 120–122.

Kamenko, I., Jakovljević, B., Kulić, F., Nikolić, P., Bugarski, V. (2015). Web based application for visualization of geospatial data in agriculture. Journal on Processing and Energy in Agriculture (former PTEP), 19 (2), 108–111.

MacDonald, M., Szpuszta, M. (2005). Pro ASP.NET 2.0 Website Programming. Apress, New York City, United States.

MacDonald, M., Szpuszta, M. (2006). Pro ASP.NET 2.0 in C# 2005 (1st edition ed.). Apress, New York City, United States.

Nikolić, P., Matić, D., Bugarski, V., Kamenko, I. (2011). Using Web Technology in the Control and Supervision of Energy Consumption. Journal on Processing and Energy in Agriculture (former PTEP), 15 (2), 103-105.

Paul, S. (2008). Pro SQL Server 2008 Replication. Apress, New York City, United States.

Schaefer, K., Cochran, J., Forsyth, S., Baugh, R., Everest, M., Glendenning, D. (2008). Professional IIS 7. Wiley Publishing, Indianapolis, United States

Received: 13. 03. 2016. Accepted: 25. 11. 2016.