INFORMATION SYSTEM OF LAKES AND RESERVOIRS OF THE SERBIA – SELAR

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ABSTRACT: The Faculty of Science at University of Kragujevac has been developing SeLaR (Serbian lakes and reservoirs) the information system that contains all the relevant data about lakes and reservoirs in Serbia. The information system SeLaR is the first one that provides systematized data about lakes and reservoirs condition in Serbia and presents it to scientific and professional public around the world. The system enables the transfer of information, collaboration among all participants in the management of reservoirs and sustainable exploitation of water resources in whole. It is developed as Internet and Intranet application. Here are presented the basic components of the Intranet application. The structure of the information system and the forms of client-server architecture as the base for its modeling and application projection are presented in this paper. The method of implementation of the information system is explained and the software necessary for installing, starting and using of the system is mentioned. The way of system realization and the home page with the explanation of the central menu are presented. The explanations of the basic elements of forms are given besides the general description of the forms for viewing, editing and adding of data. Its contents are presented and instructions for usage are given. Basic sources used for collecting, processing and input of data in the information system are listed. The data, that is included in this information system, is entered in a language of the literature source from which it is taken and translated into English for the requirements of this paper.

Key words: information system, reservoirs, lakes, Serbia.

INTRODUCTION

The overall amount of available waters on the territory of Serbia is 178 billions of m^3 annually. An important characteristic of water resources in Serbia is the prominent spatial and temporal unevenness. Most of rivers have torrential character, realizing themselves in short periods of time followed by long-lasting periods of small waters, with heavy con-

sequences on quality of water and possibilities of their rational usage (JOVANOVIĆ *et al.*, 1989). For Serbia the information referring to waters that are created, i.e. that well up on its territory is very important. Domicile waters in Serbia amount to 16 billion m^3 annually or just 8% of total amount of available waters (STANKOVIĆ, 2000).

Hydro reservoirs represent for Serbia the solution for water supplying and hydro-energy, which is also the priority for their construction and they are as such necessary. There are about 60 bigger and about 100 smaller reservoirs in Serbia (JOVANOVIĆ *et al.*, 1995; BLAŽENČIĆ, 1997), and according to the draft of Waterpower engineering groundwork of the Republic of Serbia from 1996, 34 reservoirs more are planned to be built. MARTINOVIĆ-VITANOVIĆ & KALAFATIĆ (1999) list the plans for forming 18 regional systems for water supplying, while according to BOGDANOVIĆ & PAVIĆ (2003): "...there are 24 big reservoirs with the volume of 10 millions m^3 and more (34 reservoirs) have the less volume than 10 million m^3 and there are about 100 so-called small reservoirs made by damming small water courses..."

Most reservoirs do not have adequate ecological protection, management with them is irrational and only few of them can boast about the presence of proper monitoring. Few of them are included into complex hydro biological researches (first biological researches match with the construction of first reservoirs, such as the Vlasina (BLAŽENČIĆ 1997), Gruža (ČOMIĆ & OSTOJIĆ 2005), and the existing information is not systematized or available.

One of the basic methods for ensuring adequate monitoring is collecting information about lakes and reservoirs in Serbia within an information system. The Faculty of Science in Kragujevac has been developing SeLaR the information system. The information system SeLaR is the first that provides arranged data about conditions of lakes and reservoirs in Serbia. The system is intended for a great number of users, especially in the field of biology and ecology, but also for the other participants involved in reservoirs management thus enabling their cooperation. It supports all the aspects of management and sustainable exploitation of water sources in whole. It is developed as Intranet and Internet application for the Faculty of Science in Kragujevac. Since the data about Serbian lakes and reservoirs are not contained on any existing world website that deals with the problems of lakes and reservoirs (www.worldlakes.org; www.livinglakes.org; www.ilec.or.jp;), SeLaR the information system is the first one that provides systematized data about this field in Serbia and presents them to scientific and expert public in the world. A part of information available to the public over the Internet can be found on the site of the Faculty of Science in Kragujevac (www.pmf.kg.ac.yu/selar/Andreja/).

INFORMATION SYSTEM OF LAKES AND RESERVOIRS IN SERBIA

INTRANET APPLICATION

The project of the Information system of lakes and reservoirs in Serbia is based on triple layered model of client-server system. The information system uses Microsoft SQL Server 2000 as the data base server, while the client application is realized by using Microsoft Access 2003, or in other words, by using data bank pages for data access (Access Data Pages ADP).

The Information system of lakes and reservoirs in Serbia is aimed at systematizing three general groups of data:
1.   Lakes and reservoirs in Serbia
2.   Biological communities
3.   Systematic categories

The process of manipulating with these groups of data can be viewed as conditionally independent processes, taking into consideration the fact that they complete each other and make an unbreakable whole.

The start-up and layout of application

In order to start using 'Information system of lakes and reservoirs of Serbia' it is necessary that Microsoft SQL Server 2000 as well as Microsoft Office 2003 (recommended versions) is installed on a computer.

In that case, SQL Server 2000 needs to be active, actually activated. By starting the file (SeLaR.adp) the home page opens, as can be seen in the Fig. 1.

The set of options from the central part of the home page represents the central menu. It contains following groups of options:

1.   Lakes and reservoirs
2.   Register
3.   Register of systematization
4.   Register of biological community
5.   Search
6.   Reports

Figure 1. Home page

Lakes and reservoirs

The menu contains: general information, activities in surroundings, dam, occurrence, physical dimensions, -physical and chemical parameters, intervention in reservoir, climate characteristics, land use, location, refinement of waste waters and sewerage, population in surroundings, rivers and channels, biological communities, species.

Register includes 'back-up data' according to which the filling up of the tables of previously listed forms is preformed. Actually, these forms represent the base for filling up the tables of lakes and hydro reservoirs. The menu looks like this: activities, occurrences, physical and chemical parameters, intervention in reservoir, climate characteristics, land use, population in surroundings, units of measurement, types of ecosystems, mixing types, kinds of lakes and reservoirs.

Register of systematics contains data about plants and animals populated in an ecosystem of lake or reservoir. For each individual its complete systematization exists containing Latin as well as folk names. As a matter of fact, each individual possess precisely defined hierarchy: type (phylum) - classis- genera- family- genus- species. The menu looks like this: type (phylum), classis, genera, family, genus, species.

The register of biological community enables uniting of the individuals with same or similar characteristics.

Search enables the user of the system to obtain required data in shape of form or report based on the lake or reservoir name or the type of data the user needs.

Reports enable the user to obtain required data in a legible form, primarily intended for printing.

The user can access to the previously listed options also from the User menu (Fig. 2).

Figure 2. User menu

By clicking on the **Main menu** the following potions appear: home page; insert object; connect to SQL server; settings; view before printing; print; exit;

The menu **Lakes and reservoirs view** contains the same potions as the menu **Lakes and reservoirs** in central menu, as well as the menu **Register**, menu **Systematization and biological communities** and menu **Reports**.

By activating the user or central menu options, we are activating different forms and reports.

The layout of forms

The base of every forms of this system is made of: user menu, navigational keys, control keys, form name, form content.

The User menu has already been explained.

Navigational keys serve for managing the system data. These keys include keys for moving forward or backward, on a first or last record of tables, or on certain record defined by ordinal numbers, shown in the Fig. 3.
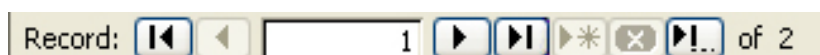

Figure 3. Navigational key

Control keys serve for manipulating data and by means of them, depending on the pressed key, the user can perform the adding of new, editing of existing or deleting of current record. By pressing the Back key, the user returns to the previous form (home page or form-view), as can be seen in the Fig. 4.

Figure 4. Control key

The form name points out to the currently active form, i.e. the one we are currently on. This is shown in the Fig. 5.

Figure 5. Name of form

The form content is made of data and it represents the central part of the form. The Content of the form can be manipulated by means of control keys. As previously said, one can access the forms by using *central menu* and *user menu*.

In the case of the *central menu*, system data are organized in the way that their viewing happens in the separate form (form- view) and in the case that editing of existing or adding of new data is necessary, the appropriate form for adding or editing appears by using the control keys. Thus a certain security of data is provided.

Forms for inputting, viewing and editing of data, activated from the central menu, differ slightly and only in the aspect of control keys. The forms for viewing contain control keys for inputting, editing, deleting as well as for going back. On the other hand, the forms for editing and inputting contain only control keys for returning to the previous page. All the changes made in these last two forms are automatically memorized. Calling out of the form for editing causes the opening of exactly that record whose editing we have initiated. The similar thing happens with the forms of lakes and reservoirs in the case of the form for adding.

In the case of the *user menu*, the layouts of *register and systematics* and *biological communities* slightly differ. These forms have pop-up window layouts and, similar to the previous ones, data are organized so that their viewing happens in the separate form (form- view). In case of necessity for editing existing data or inputting of the new ones, the user opens the corresponding form for inputting or editing from the menu.

What really differentiates the forms of the system is the content.

The layout of lakes and reservoirs forms

General information

Within these forms the manipulation of data, such as the name, origin, description and purpose of lakes or reservoirs, is preformed. Data that can be manipulated is, for example, the type of water mixing and the type of ecosystem the observed lake or reservoir belongs to. By means of control keys, the user decides about the aspect of manipulation: inputting, editing viewing or deleting (Fig. 6).

In the case of viewing, the user selects wanted lake or reservoir by using navigational keys. Besides the possibility of viewing basic data about a lake or reservoir, the user can open the corresponding picture in the bigger format on a new window by clicking on the picture of the lake or reservoir. Any kind of changes of the form content is possible only in the editing mode.

In the case of adding, the user selects the type of ecosystem, the kind of lake or reservoir as well as the type of water mixing from the drop-down list, enters the lake or reservoir name, gives its description and explains its purpose. The user adds the picture of lake or reservoir only after he or she has marked the area intended for the picture, and then from the user menu selects the option *Main menu* and within it the item *Insert object*. In the sequence of the process the user selects the option *Create new* and then in the field *Object type* the option *Bitmap image*. In this way the chosen picture is put into the data base.

In the case of deleting data about a lake or reservoir, after pressing the delete key, the check up of the initiated action is preformed first. In case of confirmation, an accompanying message about successfulness of its performance is given. The editing of data mostly comes down to previously described procedures.

Figure 6. View of General information form

Activities

The manipulation of data that include: data about activities in surroundings, value of that activity in percentage terms as well as the date of observation and evaluation of current lake or reservoir is preformed within the form *Activities* (Fig. 7). Moving inside the form is dual. With the navigational keys the user selects the lake or reservoir, while by using vertical scroll bar one can perform the view of subforms that contain data about previously mentioned activities of selected lake or reservoir.

Adding of new, editing and deleting of the existing data happens in the similar way as with the forms *General information*.

Figure 7. View of forms Activities

The dam

Within the forms *Dams* the manipulation of following data is preformed: lake or reservoir name, the value for height and length of the dam, the size of dam crown, the size representing ratio between crown and height and the length of cupola in crown. With the aim of better presentation of lake or reservoir dam, the addition of dam description as well as the addition of suitable picture of the dam of the observed lake or reservoir is allowed to the user (Fig. 8). The procedure for data manipulation differs slightly from the procedure for data manipulation in the forms *General information*.

Figure 8. View of the forms Dams

Occurrences

The manipulation of data that comprise data about occurrences, i.e. description and date of occurrences, is preformed by means of the forms *Occurrences* (Fig. 9). Moving inside the forms is dual. The user selects lake or reservoir with navigational keys, whereas by using vertical scroll bar he or she can view subforms containing data about occurrences of chosen lake of reservoir. The adding of new, editing and deleting of existing data happens in the similar way as explained with forms *General information*.

Figure 9. View of forms Occurrences

Physical dimensions

The manipulation of data that comprise some general characteristics of observed lake or reservoir is preformed by using forms *Physical dimensions*. These data include: lake or reservoir name, its surface area, volume, maximum depth, average depth, middle annual amplitude, water level (regulated- unregulated), the data of observation, catchment area, width and length of the lake and description of important characteristics. As a form of detailed view, the possibility of adding bathymetric map of a lake or reservoir exists. In the case of data viewing, the user has the possibility to view bathymetric map by clicking on it, but it appears in a larger format on a separate window (Fig. 10). The procedure of data manipulation is similar to the procedure described within the explanation of forms *General information*.

Figure 10. View of form Physical dimensions

Physical and chemical parameters

The form *Physical and chemical paramete*rs includes working with data such as: the name of physical and chemical parameter, the value, location and depth from which the observed sample has been taken, data and name of the river in case that the investigation has been conducted in its course (Fig. 11). Moving inside the forms includes moving about lakes or reservoirs as well as about descriptions of physical and chemical parameters. The manipulation is analogous with the previous explanation and it is conducted by means of control keys.

Figure 11. View of forms Physical and chemical parameters

The intervention in the reservoir

Within the form *Intervention in reservoir* following data can be found: the name of intervention in the reservoir, its description, picture (if available), as well as the data when the observed intervention has been conducted (Fig. 12). Similar to the form *General information*, the user, in the case of data viewing, has the possibility to view the picture by clicking on it, but it appears in a larger format on a separate window. The adding, editing and deleting of existing data is preformed analogously to the previous explanation.

Figure 12. View if form Intervention in reservoir

Climate characteristics

Within the form *Climate characteristics* the following data are manipulated: the name of climate characteristics, its description, diagram (if available) and date (Fig. 13). In this case also, moving inside the forms is dual. It includes moving about lakes and reservoirs as well as about climate characteristics connected with every lake or reservoir. Viewing, adding of new, editing and deleting of existing data is conducted in the same way as in previous explanation. Further, the form for viewing would be presented in detail. In case of data viewing the user, by clicking on the picture, has the possibility to view the same picture but in bigger format on a separate window.

Figure 13. View of form Climate characteristics

Land use

The manipulation of data of the form *Land use* includes working with following data about concrete lake or reservoir: the description of land use, corresponding percentage value of its use

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and the date when the investigation is conducted (Fig. 14). Moving inside the forms is dual here too. It includes moving about lakes or reservoirs as well as moving about types of use for each lake or reservoir. Adding of new, editing and deleting of existing data is the same as in previous explanations.

Figure 14. View of form Land use

The location

By using the forms *Location* the manipulation of data including lake or reservoir name, data about geographical position such as latitude, longitude and altitude is performed. For detailed description the possibility of adding the textual description of location as well as the storage of location map in data base is offered to the user (Fig. 15). The data manipulation procedure differs slightly from the procedure shown with the form *General data.*

Figure 15. View of form Location

The refinement of waste waters and sewerage

The form Refinement of waste waters and sewerage includes operating with data such as the description of refinement of waste waters and sewerage and date when the investigation is conducted (Fig. 16). Moving inside the forms includes moving about lakes or reservoirs as well as about the description of refinement of waste waters and sewerage. The data manipulation is identical with the previous.

Figure 16. View of form Refinement of waste waters and sewerage

The population in surroundings

The form *Population in surroundings* contains data about concrete lake or reservoir such as the population in surroundings value and the date of conducted investigation (Fig. 17). Moving inside the forms is dual. On one hand, it is possible to move around lakes or reservoirs by means of navigational keys, and, on the other hand, the user can move inside the subform containing data about population. The manipulation of existing data comes down to previous explanations.

Figure 17. View of form Population in surroundings

Rivers and channels

The form *Rivers and channels* contains data about the river or channel name and the type the river or channel belongs to depending on whether it falls into or flows out from the observed lake or reservoir, whether it is a flooding river or it is near the observed lake and has some other effect on it, for example, whether it is the channel that connects the like with some other basin and the like (Fig. 18). Moving inside the forms is dual and includes moving around lakes and reservoirs as well as moving inside the subform containing data about rivers and channels. The manipulation of existing data is preformed by means of control keys analogously with previous explanations.

Figure 18. View of form Rivers and channels

Biological communities

In the form *Biological communities* the following data could be found: the name of biological community, the name and value of corresponding characteristic, location, depth, river and date of conducted investigation (Fig. 19). Moving inside the forms is dual and includes moving around lakes and reservoirs as well as moving inside the subform containing data about biological communities. The manipulation of existing data comes down to using control keys analogously with previous explanations. The user can decide for viewing data form the one specific biological community. By selecting the name of biological community form the *drop-down menu* and by pressing the key *Show*, the new form with the data about wanted biological community opens for the user.

Figure 19. View of form Biological communities

Species

The form *Species* includes operating with data such as: the name of species, the name of biological community the observed species belongs to, the type (allochthonous, autochthonous) and the date of observed specimen.

Moving inside the forms includes moving around lakes or reservoirs as well as around data about biological communities, actually around the biological communities of observed lake or reservoir. The manipulation of existing data comes down to usage of control keys, as with previous ones. The user can decide on viewing data about species of certain biological community, By

selecting the name of biological community from the drop-down menu and pressing the key Show, the user confronts with the new form with data about species of certain biological community.

The layout of register of systematics
The content of form for viewing the species (for editing and adding differs slightly from the previously explained ones) is presented in the Fig. 20.

Figure 20. View of form Species

Within the form *Species* the manipulation of following data is preformed: the names of type (phylum), classis, genera, family, genus and species, the description of observed species, the alternative names (the name used by folks and the like) and the name of biological community the observed species belongs to. Within the form for adding the user chooses the names for type (phylum), classis, genera, family, genus and biological community form the drop-down list, adds the name of wanted species, gives its description and alternative names if they exist. Besides that, the user enters also the biological community the observed species belongs to. If necessary data can not be found in drop-down lists, they are to be entered by using previously described forms of systematics. The usage of form for editing significantly relies on the procedures we have already discussed. Deleting alternative name is conducted by means of positioning the cursor first on the name we wish to delete and then initiating the deletion by clicking on key 'remove current record'. Firstly, the check of initiated action is preformed. In case of positive answer, the accompanying message about the successfulness of its performance is given.

The layout of forms of the biological communities register
The form *Biological communities*, started from the central menu, serves for the manipulation of data such as the name, description and characteristics of biological community that besides its name includes also the unit of measurement, if the unit exists. By means of navigational keys, the user makes the selection of desired biological community, whereas the view of corresponding characteristics is preformed by using vertical scroll bar. Adding, editing and deleting can be done by control keys.

The layout of forms of register
The procedure of manipulation of register data is unique for all forms of register, and refers to registers of *Activities, Occurrences, Physical and chemical parameters, Intervention in reservoir, Climate characteristics, Land use, Population in surroundings, Units of measurement, Types of ecosystem, Mixing types and Kinds of lakes and reservoirs.*

By starting a certain register from the central menu, the form for viewing opens for the user. In the case that the user wants to initiate adding, editing or deleting of data, it can be done by using the control menu. The form for adding, editing or deleting of present data opens by pressing the corresponding control key. Deletion of register data directly affects the content of other forms of the system. Removing or changing the value of a piece of register information causes the lost of all system data that are related with it. That is why it is necessary to be cautious with deleting. The forms for viewing slightly differ from the corresponding forms for adding, editing and viewing.

The search

The search is initiated from the home page. The user makes a selection of lake or reservoir, chooses the type of data and the appearance of layout (form or report). This is presented in the Fig. 21.

Figure 21. Search
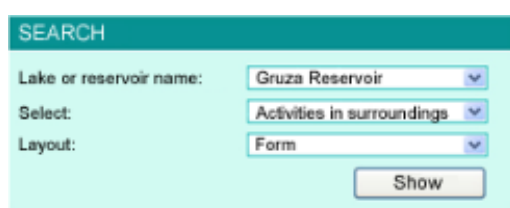
Thus the user obtains the data about wanted lake or reservoir either as a form based on which data manipulation is possible or as a report intended for printing.

The report layout

An example of a report is given in the Fig. 22. It shows the pages of the report from the investigations conducted on the Gruza Reservoir.

Figure 22. Report of general information about Gruza Reservoir

THE PROCESS AND INPUT OF DATA

Data entered in the information system SeLaR is taken from the researches of the Faculty of Science that have been conducted for years as well as from the other available literal data (BLAŽENČIĆ, 1997; IVANC & MILJANOVIĆ, 2003). The contact with the waterpower engineering organizations and with the organizations engaged in management of reservoirs in Serbia and in quality of water that possess valid data has been established. The literature used for the input of data about reservoirs and lakes is listed in detail in the paper RADOJEVIĆ (2007). The form of found data was often unsuitable for inputting in the information system. In many cases they had to be reshaped and adapted according to circumstances. When they were entered unalterable in the information system, the literal source they were taken from was also entered.

Basic data about reservoirs

Basic data about reservoirs is taken from the Tables 1-3 (BOGDANOVIĆ & PAVIĆ, 2003). In the form *General information* the name of reservoir, type of ecosystem and purpose of that reservoir are entered from the mentioned tables, whereas the total volume is entered into the form *Physical dimensions* and the watercourse that makes the given reservoir us entered into the form *Rivers and channels*. Besides the basic data about reservoirs, for most of them are found and added the data about the basic description, dam, physical dimensions, location, activities in surroundings, land use, physical and chemical characteristics, climate characteristics of the area the reservoir is in, interventions in reservoir, refinement of waste waters and sewerage, population in surroundings and specific occurrences connected with the certain reservoir, together with literal sources that are used.

Microbiological indicators

Microbiological indicators for the reservoirs where the valid data are found are put into the information system. The majority of data is found for the reservoir Gruza, then for Vlasina, Bovan, Borkovac, Zobnatica, Sot etc. The data is found in different forms. When found as individual numerical values, it is entered as such, and where graphs and diagrams are found, without individual data they are made of, they are, for lack of better ones, entered as such. In some cases, both types of data are entered.

For the **Gruza** reservoir the greatest number of data is taken from the works of ČOMIĆ (1989), ĆURČIĆ (2003), OSTOJIĆ & ĆURČIĆ (2005), OSTOJIĆ *et al.* (2005).

For the **Vlasina** reservoir the greatest number of entered data is taken from the works of ĆURČIĆ (1994), and ČOMIĆ *et al*. (1997).

For the reservoirs of **Borkovac**, **Sot** and **Zobnatica** the data that refers to microbiological parameters is taken from the work of ĐUKIĆ et al. (1991).

For the **Bovan** reservoir the data is taken from the work of SAVIĆ (2001) and SIMIĆ *et al*. (2006).

Systematics of bacteria and viruses

The systematics of diverse biological communities starting from, in alphabetical order, algae, macrophytes, microorganisms and so on can be seen in the form of register of systematics, and the classification inside a certain biological community can be seen according to the order it is entered in the information system. For this reason, everything is entered in the way it is shown in the literature source the data is taken from.

In the form for adding, in the register of systematics, the **systematics of bacteria** is entered according to HOLT (1984 – 1992). According to this source, the taxonomic division of bacteria includes (on phenotypic basis) four main categories of bacteria. Presently, the possibility for adding the category that does not refer to the systematics (in this case, on phenotypic basis, four main categories) does not exist in the forms of register of systematics. For reasons mentioned, the literature source itself is not completely followed, so the data for the first systematic category, mentioned as first by the literature source, is inputted. The start here is with genera since there is no data for type (phylum) and classis (empty fields with slash are entered).

The overall **classification and systematics of viruses** taken from JERANIĆ (1995) is entered into the information system. For viruses, the input of systematics started from the family (systematic characteristics for higher categories are not found).

DISCUSSION

The information system SeLaR is developed as Intranet and Internet application. The part of information is available to the public by Internet and can be found on the site of the Faculty of Science in Kragujevac (www.pmf.kg.ac.yu/selar/Andreja), whereas the Intranet application is presently available only to a small circle of people.

The information system has provided the necessary forms for input of data with elements of multi-user work and protection, with paying attention to human aspects of information system usage. The reports comprise the needs of all users groups. The current work on the information system primarily takes into account the input of as much as possible data, and then the addition of new contents and processes. In future, except diverse views of combined data, it is supposed to meet the challenges that are important in the process of proper management with water resources, sustainable exploitation and ecological protection, such as the analysis and preparation of information, comparison of different parameters, providing with diverse statistics and predictions and support in making decisions. For example, according to the aspect of microbiological parameters in a reservoir and entered data, it is supposed to determine the following:
- the composition and dynamics of the community of microorganisms,
- to estimate the ecosystem trophic level and
- to suggest the measure of adequate ecological protection for improvement of ecosystem condition cased on acquired results, and the like.

Aside from the mentioned aspects, it is supposed to apply the multimedia presentation of knowledge in the future. The multimedia information system should be in interactive communication with the user, and it is expected to simultaneously use different forms of information such as the text, graphics, animation, steady or moving pictures, music and speech, for which the information system SeLaR possesses well-established base. Everything that is mentioned serves for the programmed gaining of knowledge, analysis and application of information and opens different possibilities for the usage of the information system. The long-distance studying, creation of courses for education by means of computer and the like are just some of the possibilities.

The characterization of Serbian reservoirs/lakes is preformed according to the EU Water Framework Directive (WFD) and the conditions for connecting with the Integrated Water Quality Information System are created.

The foundation on the latest distributed Internet architecture and XML enables the exchange of data and integration with international information systems for the management of water resources quality.

The process of developing SeLaR information system is conducted according to the Rational Unified Process. The adequate software products based on UML are used as tools. It has provided the necessary documentation for each phase based on models, the reduction of risks of errors and the efficient realization. The security of the software for this project includes the evaluation and testing at the end of each phase and subphase of development. The application of quality standard has provided the observance of the established system development, processes of project management and procedures and the quick identification and solution of possible risks and errors.

The security of data is solved by defining the system of security at the level of transfer, data base, application and messages.

The created Information system of lakes and reservoirs in Serbia (SeLaR) provides the informatics base for archiving of available limnologic data in the electronic form and their processing into information necessary for all users. The central part of the information system is distributed data base that contains in itself overall information and enables new, modern, an up-to-date insight into the condition of lakes and reservoirs in Serbia. Such information system creates the conditions for the rationalization and increase of efficiency of limnologic investigation in Serbia.

CONCLUSIONS

There are a great number of information systems in the world that comprise and process the issue of lakes and/or reservoirs. A certain number of them is available on the Internet. Data about Serbian lakes and reservoirs is not contained on any existing world site that deals with these problems. The information system SeLaR is the first one that provides arranged data about lakes and reservoirs conditions in Serbia.

The informatics base established in the framework ensures the future growth of the system in a sense of demands the can be diverse:
- different views of combined data form the data base
- different statistics views
- predictions
- the support in making decisions
- the application of multimedia presentation of knowledge
- the foundation on the latest distributed Internet architecture and XML that enables the data transfer and integration with international information systems
- the necessary documentation for each phase based on models, the reduction of risks of errors and the efficient realization
- security of data
- the application of quality standard that provides the observance of the established system development, processes of project management and procedures and the quick identification and solution of possible risks and errors.

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