

Steps in creation of educational and research web-portal of nuclear knowledge BelNET

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Abstract

Belarusian State University is currently developing the educational and research web portal of nuclear knowledge BelNET (Belarusian Nuclear Education and Training Portal). In the future, this specialized electronic portal could grow into a national portal of nuclear knowledge. The concept, structure and taxonomy of BelNET portal are developed. The requirements and conditions for its functioning are analyzed. The information model and architecture of the portal, as well as algorithms and methods of software are realized. At present, BelNET software implemented all the basic functions of this portal, including the ability to remotely (via the Internet) open content editing, sorting, filtering, etc. Filling the BelNET by knowledge is at the beginning.

1 Introduction

The International Atomic Energy Agency (IAEA) [1]–[4] pays close attention to the problems of nuclear knowledge management. Nowadays, numerous national and international portals of nuclear knowledge were created in Europe, Asia, Africa and America under the patronage of the

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IAEA. It is planned to develop an international network of information resources on nuclear knowledge. This means that a unified information space in the field of nuclear knowledge is being formed in the world. Every developed country with its own nuclear industry has to create and maintain a national portal of nuclear knowledge, integrated into a global system of nuclear knowledge management. In the light of creation of Belarusian nuclear industry and construction of Belarusian nuclear power plant, development of electronic portal of nuclear knowledge is an insistent need for Belarus.

The development of computer technology, new requirements for the volume, complexity and speed of information transfer, as well as the rapid growth of mobile applications with specific requirements on the amount and form of presentation of information demand new effective algorithmic, architectural and software solutions. The portal of nuclear knowledge should be a complex programming system based on such modern technologies. Also, in the light of rapid growth of popularity of free software in the world, it would be good if the portal was developed on the Belarusian free software. So, creating such a portal is not just the development of a simple website, like such as millions in the Internet. The portal must meet the requirements of safety, reliability, efficiency and performance and reflect the national features of nuclear knowledge content.

The educational and research web-portal of nuclear knowledge BelNET (**B**elarusian **N**uclear **E**ducation and **T**raining) has the following objectives: acceleration of search and access to necessary data and information, creation of new knowledge, promotion of participation in research, education and training programs in nuclear industry, management of information resources, knowledge and competencies of nuclear industry in Belarus.

The basis of BelNET software is “Electronic document management system eLab” [5] developed on free software by the Laboratory of analytical research of the Research Institute for Nuclear Problems of Belarusian State University. eLab is implemented in the educational process of leading Belarusian universities: Belarusian State University, Belarusian State Technological University, Belarusian National Technical University. It is introduced in the Chemical-toxicological laboratory of the Minsk Drug Treatment Clinic. eLab has been a basis of management of specimens, measurements and passports of fuels and lubricants of Belarusian Army since 2012 and Belarusian branch of Russian company GazPromNeft since 2013. Software eLab is protected by four Certificates of the National In-

Intellectual Property Center of the Republic of Belarus.

eLab software is an electronic system of client-server architecture, designed on the basis of free software: Debian GNU / Linux, Web-server Apache, the Firebird database server using the application server PHP. It works under Windows and Linux through widely used browsers reliably without interruption. It is also completely secure from unauthorized access. eLab has a fast response to user requests, providing visibility and accessibility of information through a single interface for a wide range of integrated applications for users with different rights of access. It proved to be a system easily upgradable to conditions of the project.

2 BelNET principles of operation

In Fig.1, the main principles of BelNET operation are depicted in a simple form. Users with different rights of access from high school and university students to university professors and specialists visit on-line BelNET portal from their computers and laptops. Depending on the rights of access they can read documents available in open access, limited access or restricted access areas. With a user name and a password with appropriate rights, one can enter new documents on-line, or edit the existing ones etc.

BelNET components presented in Fig.2 as eLab system architecture are as follows:

- 1) Control computer (application server) running Linux, Unix or Windows;
- 2) Database server – cross-platform database management system (DBMS) Firebird;
- 3) User databases (DB);
- 4) Server of web-applications – Apache HTTP Server;
- 5) Code of web-application in PHP and JavaScript;
- 6) Library of access to databases ADOdb for PHP;
- 7) XAJAX library for building interactive user interfaces and web-applications;
- 8) Explorer (web-browser of client) for the following user categories: user with restricted access, user with limited access, user with open access;
- 9) eLab administrator;
- 10) System administrator.

Data streams in eLab are the following:

- A. Data streams between the database server Firebird and user DB;

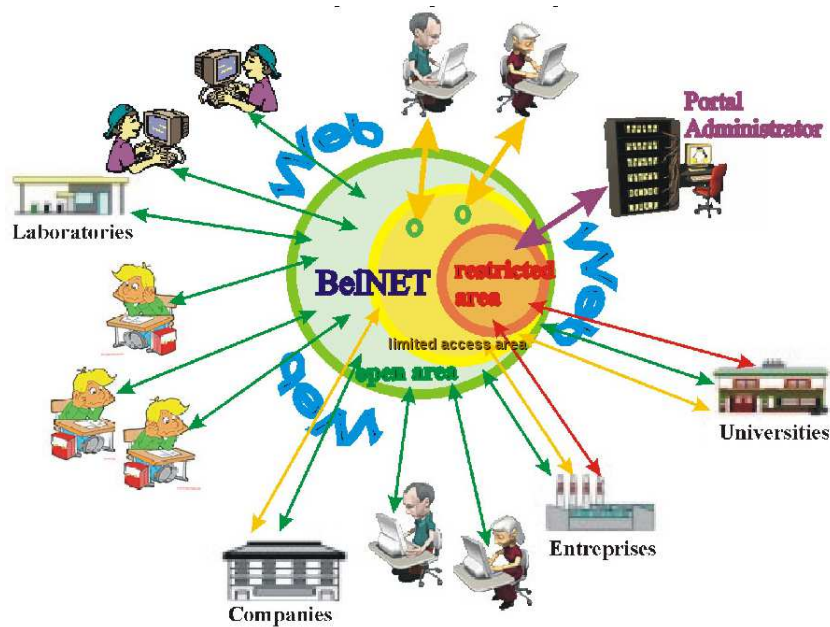


Figure 1: BelNET principles of operation

- B. Data streams at ADOdb library and the DBMS Firebird;
- C. Interaction of web-based applications eLab with user DB through ADOdb library and the Firebird;
- D. Implementation of XAJAX library in web-application eLab;
- E. Formation and processing of HTTP(S) requests by server of web-applications Apache;
- F. Data transfer from the server to the client and back through the web-server of applications;
- G. Interaction of eLab administrator with eLab system;
- H. Interaction of system administrator with the application server and eLab.

The interaction of these data streams (from Fig.1) are presented in other form in Fig.3.

BelNET and data content are placed on the host computer of the network (the application server) by the system administrator. The system administrator has a full and direct access to the application server, including BelNET with its databases. The system administrator is responsible for operation, safety, and protection of server applications and data.

BelNET users, including the administrators of web-application (portal

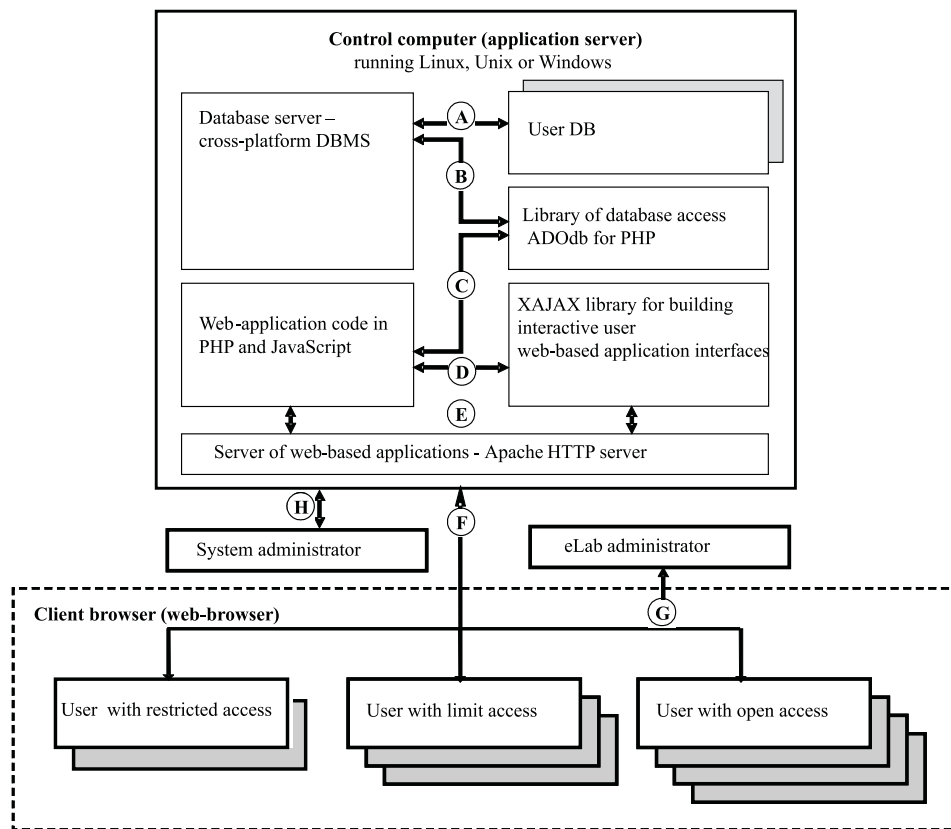


Figure 2: eLab system architecture

administrators) are clients of the system. They interact with the system and data over the Internet or the internal (corporate) network through a browser that is installed and used on the user's workstation. Personal desktop computers, laptops, tablets, or smartphones can be used as a workstation. Data streams between clients and web-application in both directions are carried out via the web-server Apache which provides validation, filtering and redirection of HTTP(S) requests. An interactive user interface is generated on the application server and displayed in a browser window on a workstation via the server (in PHP) and client (in JavaScript) of the interlayer XAJAX in accordance with the HTTP(S) user requests. The interface includes custom elements: links, buttons, lists, tables and other DOM-elements. Dynamic calls to the server with technology AJAX are supported allowing the modification of contents of the browser without

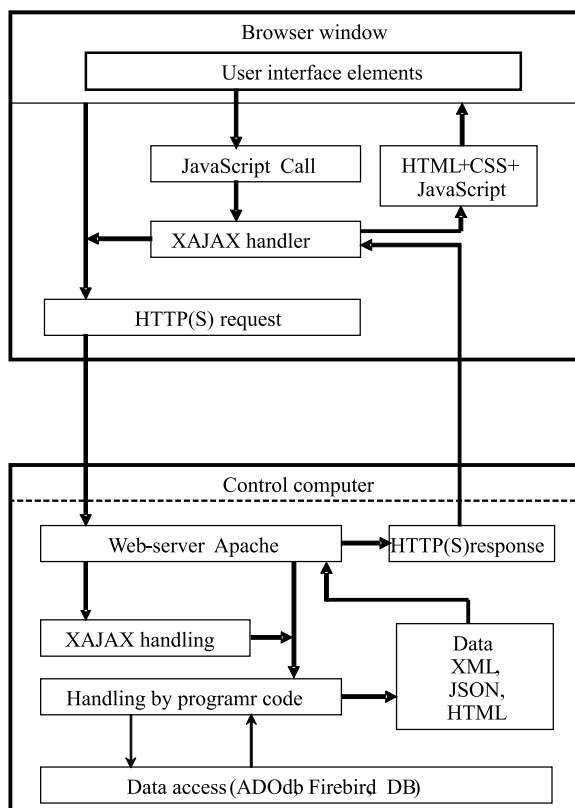


Figure 3: eLab data streams

reloading the entire page (the window contents).

3 Pilot version of BelNET

The pilot version of BelNET is depicted in part in [6]–[9] and available here: <http://lar.inpnet.net/el/belnet/> (see screenshot of its start page in Fig.4).

At present, BelNET software implements all basic functions of the portal, including the ability to remotely (via the Internet) open content editing, different sorting functions, filters, etc. (see Fig.5–6). So, we can say that in the frame of this work the original content management system (CMS) was created. It includes the possibility to input texts and formulae in LaTeX-similar form and load different types of files, references, video,

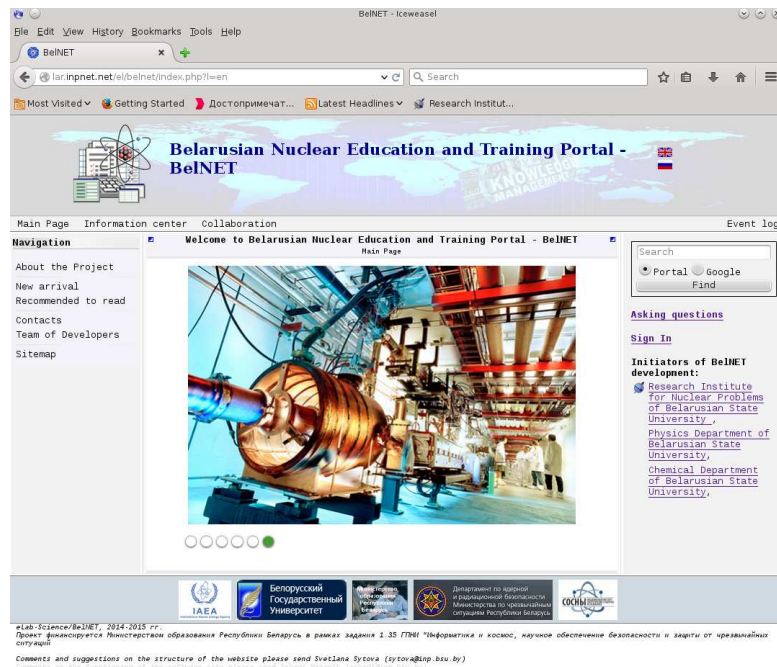


Figure 4: Start page of BelNET

photos and pictures. On the basis of this CMS educational and scientific portals of various profiles can be created. Filling BelNET with information is underway.

4 Lab practice for students

We emphasize that filling the portal with information as well as developing special materials for a distance learning system is a time-consuming and long process. In this sense, the work on BelNET is at the beginning.

Currently, a glossary of nuclear physics runnibg term and lab practice for students are developed. Definitions included in the glossary are formed on the basis of traditions prevailing in the scientific community, national and interstate regulatory documents with the account of the IAEA recommendations and the views of draftsmen. The articles contain term definitions, area of application and, if appropriate, analysis of differences between the given definitions and common or standard ones.

In high school, nuclear physics is traditionally presented only by a small

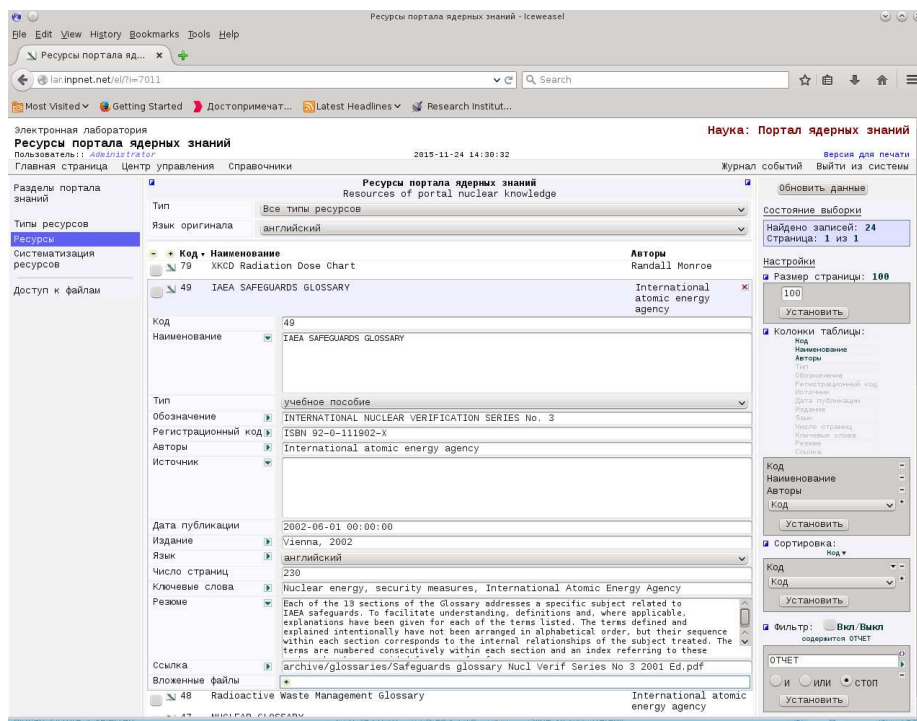


Figure 5: Editing of BelNET resources

theoretical section, which does not provide for implementation of lab work because the sources of ionizing radiation are forbidden by sanitary norms. However, the practical skills that students receive in performing lab work allow them to better understand the characteristics of ionizing radiation passing through matter and the dangers associated with the use of radioactive substances and principles of radiation protection. This is very important because of ionizing radiation and radioactive sources are widely used in medicine, engineering and other areas. Now requirements for basic knowledge of radiation principles and its impact on the environment are high in the light of development of nuclear industry in Belarus. The necessity to the general public of at least a minimum level of knowledge in this area was confirmed by the history of the Chernobyl disaster.

As a part of BelNET content, it was decided to develop a series of on-line guides for lab work on ionizing radiation passing through matter. These lab works are oriented to high school and university students as well as to anyone interested in this topic. The general part of the series is an

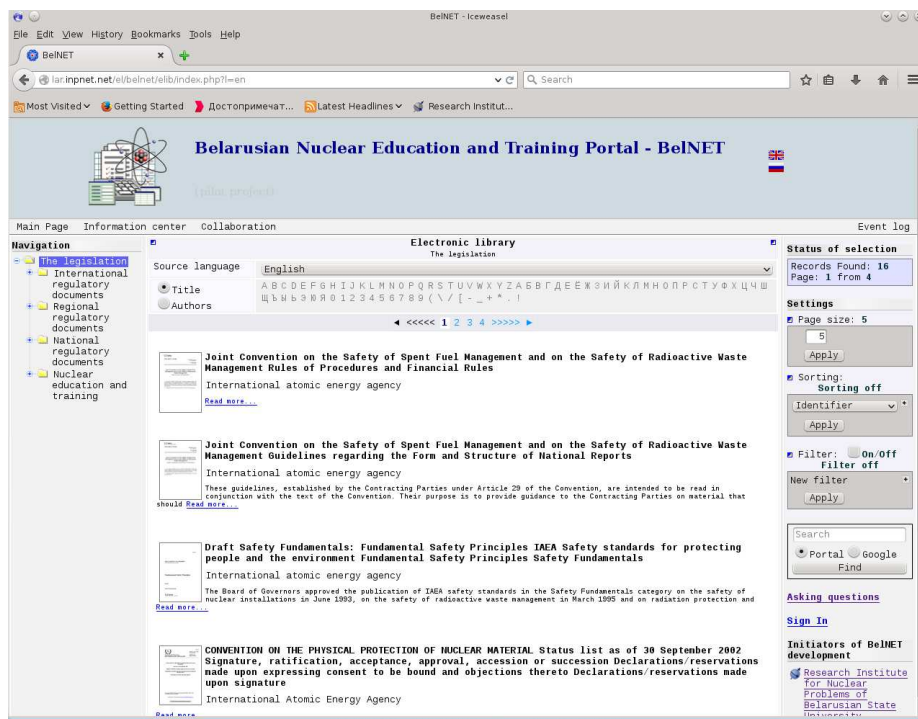


Figure 6: BelNET- Informations center - Legislation

introduction with brief information on nuclear physics and nuclear spectrometry. It includes the description of main features of the phenomenon of radioactivity. The work of detectors of ionizing radiation is explained as well as the principles of formation and interpretation of experimental energy radiation spectra. The formulae for estimating statistical errors of the experiment are given. Practical part includes five lab works: "Determination of the activity of radioactive source by a relative method", "Absorption of electrons in matter", "Absorption of gamma rays in matter", "Study of the penetrating power of gamma rays of different energies", "Natural decay chains". Each practice includes a brief description of the studied processes, necessary for understanding the experimental part of the work, as well as analysis of the obtained results. As a separate section of each work, a guide on the order of experimental data processing, calculation and analysis of finite quantities is given. The experimental data (energy spectra of specific ionizing radiation) obtained using the spectrometer of ionizing radiation of the Department of Nuclear Physics of Belaru-

sian State University are available in the form of text files. Video files demonstrate the spectrum set-up. This allows performing the lab work using only a computer with a standard set of programs. Using a computer calculator (eg. MS Excel), one can process the experimental spectra, calculate the necessary values and present the obtained results in graphical form. At the end of the series a test program is given in order to check the correctness of obtained results, as well as the level of understanding of the studied processes by the user and his willingness to use the results, for example, to estimate the parameters, necessary for protection against ionizing radiation.

5 Conclusion

Belarusian educational and research portal of nuclear knowledge BelNET is developed by the efforts of the best experts and professorate in the field of nuclear knowledge of the Republic of Belarus. The aim of the work is the promotion of nuclear knowledge, the formation positive image of nuclear science and attraction here the most able young people. Created original CMS allows developing educational and scientific portals of various profiles.

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