Knowledge presentation in the content management system eLab-Science

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***Abstract*—A short overview of Belarusian content management system (CMS) eLab-Science on the basis of framework eLab is given. eLab is a free software based laboratory information system with elements of electronic document management. This is an electronic system of client-server architecture based on Debian GNU/Linux, the Apache Web server, the Firebird database server, the PHP application server. The system runs under Windows and Linux. The work is carried out through the Web-interface in multi-user mode with the sharing of access rights through widely used browsers.**

CMS eLab-Science was developed to create educational and scientific portals of various profiles such as electronic portal of nuclear knowledge BelNET https://belnet.bsu.by/ and the scientific portal CoExAN https://coexan.bsu.by.The next step is development of Belarusian electronic scientific Archive on the basis of cited CMS. So, knowledge presentation in these portals in the frame of CMS eLab-Science is described.

***Keywords*—content management system, knowledge, taxonomy, electronic scientific archive**

I. Introduction

Currently, free software occupies a large niche at the world information technology market, providing the user, in contrast to proprietary (licensed, commercial) software, four basic freedoms and rights: unlimited installation, free use, modification and transfer of software [1]. The free software has a number of advantages, facilitating its certification, since source codes and full technical documentation are available for free. The use of such software is the real way to increase the protection of information. This is the reason for the recent trend of IT market towards free software – both in the West and in the post-Soviet space.

This article gives a short overview of Belarusian content management system eLab-Science on the basis of framework eLab. eLab is a free software based laboratory information system with elements of electronic document management. This is an electronic system of client-server architecture based on Debian GNU/Linux, the Apache Web server, the Firebird database server, the PHP application server. The system runs under Windows and Linux. The work is carried out through the Web-interface in multi-user mode with the sharing of access rights through widely used browsers. The eLab main features are the separation of database into system and user databases, he preservation of the current state of user interface, the system operation in real time, with the opening of data pages in less than half a second when working in the internal (corporate) network.

The first modification of the framework eLab was developed for automation of registration and quality control of fuels and lubricants in the Armed Forces of the Republic of Belarus. Since 2012, the "Electronic system for quality control and inventory management of fuel and lubricants eLab-Fuel" stands on alert at 202 Chemistry Center for fuel quality of the Armed Forces of the Republic of Belarus [2]. This center is an accredited testing laboratory in accordance with ISO/MEC 17025. More than 50,000 laboratory tests have been conducted and logged using the system eLab-Fuel over the past time.

Currently, after development of prototype of the software for accounting and control of ionizing radiation sources of eLab-Atom, the work is underway on the Intellectual Information System of the Gosatomnadzor of the Republic of Belarus to control (supervision) on nuclear and radiation safety [3], [4].

Let us point out that the system eLab is built on the basis of the process system approach [5], [6]. It means the identification, understanding and management of interrelated processes in the organization, as well as authorities and responsibilities in business processes managing (sustainable, repetitive activities) that transforms resources at the input to output results. This is necessary to realize the effective functioning of accredited testing laboratories of various types on the basis of key provisions of ISO 9001 and ISO 17025 [7], [8].

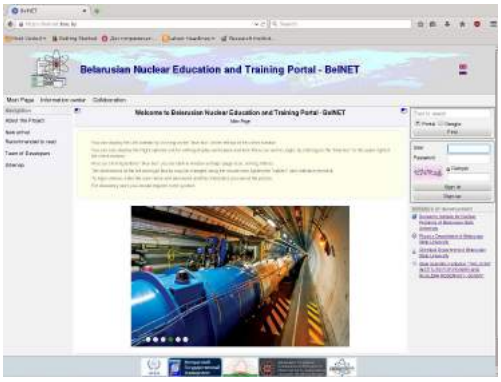

Figure 1. Portal BelNET

On the basis of framework eLab, an original content management system (CMS) eLab-Science was developed to create educational and scientific portals of various profiles.

Figure 2. Portal CoExAN

The electronic portal of nuclear knowledge of educational institutions of the Republic of Belarus BelNET (Belarusian Nuclear Education and Training) was developed and available now https://belnet.bsu.by/ [4]. Also on the basis of CMS eLab-Science the scientific portal of the project of the program Horizon 2020 "Collective Excitations in Advanced Nanostructures" CoExAN was developed https://coexan.bsu.by. The start pages of both portals are given in “Fig. 1” and “Fig. 2”.

Thus, the framework eLab has proved to be flexible and easily customizable for different purposes and projects. The system is in constant development and improvement.

II. Composition of software

Let us describe the composition of software eLab. The system is hosted on a virtual machine (VM) of the VMWare ESX server. It can be hosted on a physical server. The system server is based on the following system components: Apache web server, PHP5 application server, SQL server Firebird 2.5. The users can work both inside the corporate network, and through the Internet, and, if necessary, using VPN (Virtual Private Network). “Fig. 3” shows the organizational structure of the software. Here the system is divided into the Web-server Apache and the Database Store.

The root directory of the system contains libraries (ADOdb, XAJAX) and the following folders:

- **System Core** with the basic files of systems such as libraries of classes and functions;
- **Common files** with ready-made components of the system for use (insertion) in various visual representations (pages) without duplicating the corresponding code;
- **EventLog** with a library for displaying errors and debugging messages;
- **Special** with special modules of the system;
- **Etc** that is a folder in which the connection string to the system database is stored in an encrypted form.

System Core contains modules in PHP, JavaScript and CSS, which provide the overall functionality of the system for all users in a single format: authentication, page design, user controls (buttons, lists, tables), templates, report generators and more. It provides with specialized modules centralized

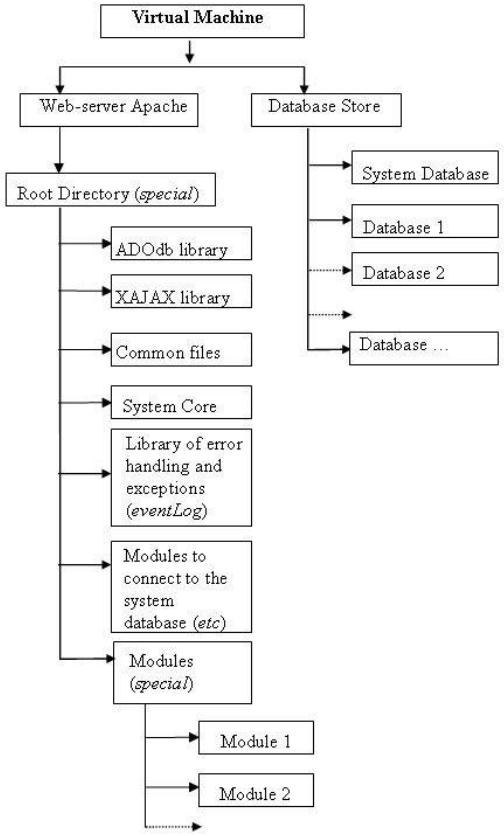

Figure 3. Organizational block diagram of software eLab

validation of input (HTTP requests) and output (HTTP-responses) data, protection from unauthorized code injection, user authentication and access to content in accordance with established permissions for users. The main purpose here is the centralized and fast generation of content pages to display them in different browsers according to stored data, the response to events from different users and corresponding modification of the content and stored data. The content of pages depends on incoming requests and is coordinated with the database of corresponding software product.

Requirements for security in the system eLab, taking into account its implementation in the Armed Forces of the Republic of Belarus and Gosatomnadzor, are increased and implemented as fol-lows. At first, the eLab system provides access to the HTTPS protocol. Secondly, user remote access in the system via VPN is organized. Encryption provides improved eLab security.

III. Content management system eLab-Science

As mentioned above, the original Belarusian content management system of scientific and educational portal eLab-Science developed on the basis of framework eLab was used in portals BelNET https://belnet.bsu.by/ and CoExAN https://coexan.bsu.by. eLab-Science implements all necessary functions of the portal, including the possibility to remote edit the portal structure and document and resource entering,

various sorting and filtering, as well as several levels of access to documents depending on user rights, the original mechanism of testing during students laboratory works. eLab-Science provides the following editors for formation and organization of access to resources:

- editor of portal sections,
- resource type editor,
- resource editor,
- systematization of resources,
- access to files,
- portal structure editor,
- content resource editor, including pictures and LaTeX-like formulas input,
- editor of control questions of laboratory work tests,
- editor of answers to the test control questions.

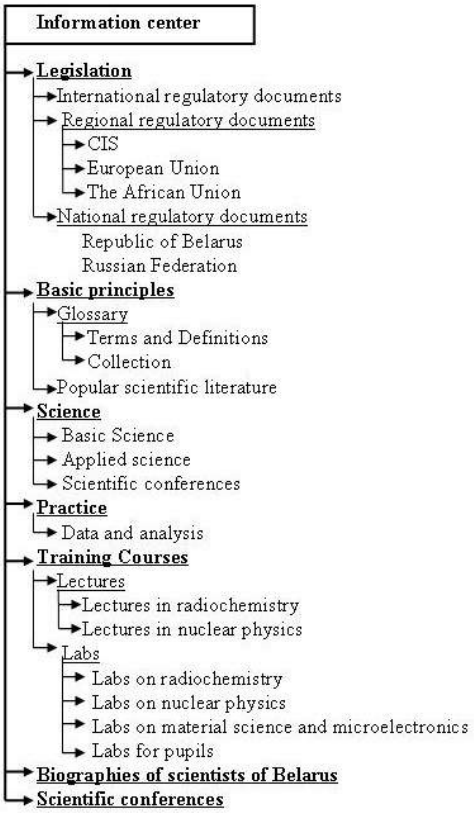

Figure 4. Taxonomy of BelNET

Let us display well-known CMS providing such possibilities. The system Moodle https://moodle.org/ is a learning platform on the basis of free software designed to provide educators, administrators and learners with an integrated system to create online learning sites and personalized courses. The Cyber Learning Platform for Network Education and Training (CLP4NET) http://clp4net-nkm.iaea.org/ was developed on the basis of Moodle as an online platform of educational resources under the aegis of IAEA. MediaWiki https://www.mediawiki.org/wiki/MediaWiki is a free software open source wiki package written in PHP, originally for use on Wikipedia. It is a content management system for different wiki projects and now it is also used by many other projects. Other widely distributed CMS allow to insert formulas as pictures made by some external editors. So, along with the generally recognized CMS like Moodle and MediaWiki, eLab-Science provide the possibility of developing complex scientific texts.

Let us consider one of the fundamental conception in any scientific and educational portal development. This is the taxonomy (from Greek taxis meaning arrangement or division and nomos meaning law) [9]. It is a hierarchical structure with information or knowledge categorized, allowing an understanding of how these various parts relate to each other. Taxonomies are used to organize information in systems, thereby helping users to find it [10]. The main part of the taxonomy of portal BelNET in presented in “Fig. 4” Taxonomy of CoExAN is in the “Fig. 5” Their difference is explained by the different goals and objectives of the portals.

Figure 5. Taxonomy of CoExAN

IV. Online submission, distribution, and archival scientific services in the world

Let us examine the possibilities of online submission, distribution, and archival services in the world in the field of science and technology. arXiv http://xxx.lanl.gov/ is a well-known e-print service in the fields of physics, mathematics, computer science, quantitative biology, quantitative finance, statistics, electrical engineering and systems science funded by Cornell University Library, the Simons Foundation and Los Alamos National Laboratory. ChemRxiv https://chemrxiv.org/ is a free online submission, distribution, and archival service for unpublished preprints in chemistry and related areas developed by the American Chemical Society. bioRxiv https://www.biorxiv.org is a free online archive for unpublished preprints in the life sciences. It is operated by Cold Spring Harbor Laboratory. In these services preprints are in English and available free. The Russian information system "Scientific Archive" https://научныйархив.рф/, as stated there, contains more than 2 million documents (articles, dissertations,

author's abstracts) in all areas of scientific knowledge. In this system language is Russian and there is no free access to documents. Search service here raises many questions. There is practically no another archival online scientific services in the world, especially in Russian-speaking countries.

Work on Belarusian electronic scientific Archive on the basis of CMS eLab-Science is at the beginning. eLab-Science has all necessary functions for such task. The Archive features are the following. Archival online service is oriented for publications scientific articles, including preprints, prepublications of the natural and humanitarian profile. Languages of publications are English, Russian, Belarusian with a mandatory summary in English. Service allows to create full-fledged Internet pages on scientific topics with formulas, graphics, drawings, video.

The purpose of the Archive is to promote the dissemination of scientific knowledge, to increase the effectiveness of scientific research, to improve the quality of scientific communication and the transparency of the scientific environment. Draft taxonomy of Archive is given in"Fig. 6". It is clear that this taxonomy should be expanded.

V. Conclusion

So, Belarusian CMS eLab-Science portal gives possibilities to modern style of knowledge presentation. Development of Belarusian electronic scientific Archive on the basis of eLab-Science will be the important step in Belarusian science.

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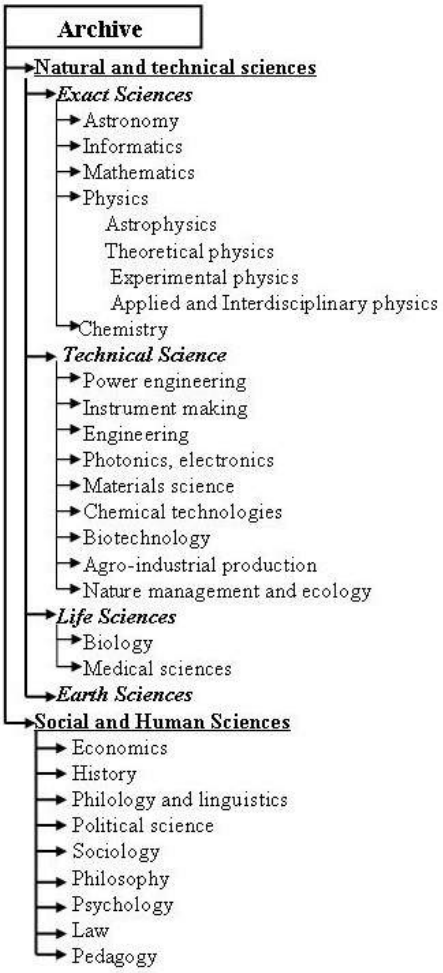

Figure 6. Taxonomy of Belarusian electronic scientific Archive

ПРЕДСТАВЛЕНИЕ ЗНАНИЙ В СИСТЕМЕ УПРАВЛЕНИЯ КОНТЕНТОМ eLab-Science

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Дается краткий обзор белорусской системы управления контентом eLab-Science на основе фреймворка eLab. eLab – это лабораторная информационная система с элементами электронного документооборота на базе свободного программного обеспечения. Это электронная система клиент-серверной архитектуры, основанная на Debian GNU/Linux, веб-сервер Apache, сервер баз данных Firebird, сервер приложений PHP. Система работает под Windows и Linux. Работа выполняется через веб-интерфейс в многопользовательском режиме с разделением прав доступа через широко используемые браузеры. eLab-Science была разработана для создания учебных и научных порталов различных профилей, таких как электронный портал ядерных знаний BelNET https://belnet.bsu.by/ и научный портал CoExAN https://coexan.bsu.by. Следующим шагом является создание на ее основе белорусского электронного научного архива. В работе описывается представление знаний на этих порталах в рамках системы eLab-Science.