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РОЗРОБКА ІНФОРМАЦІЙНОЇ СИСТЕМИ УПРАВЛІННЯ НАУКОВИМИ ДОСЯГНЕННЯМИ ТА КАР'ЄРНИМ РОЗВИТКОМ НАУКОВО-ПЕДАГОГІЧНОГО СКЛАДУ ЗВО

DEVELOPMENT OF AN INFORMATION SYSTEM FOR MANAGING SCIENTIFIC ACHIEVEMENTS AND CAREER GROWTH OF ACADEMIC STAFF IN HIGHER EDUCATION INSTITUTIONS

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Анотація: *Сучасні тенденції цифровізації освіти та науки вимагають впровадження ефективних інформаційних систем для управління науковими досягненнями та кар'єрним розвитком науково-педагогічного складу закладів вищої освіти (ЗВО). Відсутність єдиного автоматизованого рішення ускладнює облік публікаційної активності, участі у наукових проєктах, міжнародній співпраці та інших показників ефективності наукової діяльності.*

У статті розглянуто проблематику створення інформаційної системи, що забезпечує централізоване зберігання, обробку та аналіз даних про науково-дослідницьку та викладацьку діяльність у ЗВО. Проведено аналіз існуючих систем, що використовуються для управління академічною діяльністю, включаючи міжнародні наукометричні бази даних (Scopus, Web of Science, Google Scholar, ResearchGate), а також внутрішні адміністративні інформаційні системи. Виявлено, що більшість наявних рішень не забезпечують комплексного підходу до управління академічною інформацією, що ускладнює інтеграцію наукових даних у загальну систему керування освітнім процесом.

Обґрунтовано вибір технологічного стеку, зокрема використання фреймворку Yii2 для серверної частини, бази даних MySQL для зберігання інформації та MVC-архітектури для ефективного розподілу функціональності системи. Визначено ключові функціональні можливості, такі як автоматизований облік наукової активності, управління профілями викладачів, формування аналітичних звітів і забезпечення інтеграції з наукометричними платформами.

Розглянуто питання безпеки та конфіденційності даних, включаючи механізми аутентифікації, розмежування доступу та захист від несанкціонованого використання. Запропонована інформаційна система дозволяє значно зменшити адміністративне навантаження, підвищити ефективність управління кадровими ресурсами та сприяти підвищенню прозорості оцінювання наукових досягнень у закладах вищої освіти. Вона також може бути інтегрована в загальнонаціональні ініціативи щодо цифрової трансформації освітнього середовища, сприяючи підвищенню конкурентоспроможності українських наукових установ на міжнародній арені.

Розроблена система може бути використана як у межах окремих університетів, так і на державному рівні для створення єдиної інформаційної платформи, що об'єднує всі аспекти управління науковою діяльністю. Це дозволить ефективно контролювати наукову продуктивність, сприяти розвитку міжуніверситетської співпраці та інтеграції української науки у світовий науковий простір.

Abstract: *Modern trends in the digitalization of education and science require the implementation of efficient information systems for managing scientific achievements and career development of academic staff in higher education institutions (HEIs). The lack of a unified automated solution complicates the tracking of publication activity, participation in research projects, international collaboration, and other key indicators of scientific performance.*

This article explores the development of an information system that ensures centralized storage, processing, and analysis of data on research and teaching activities in HEIs. An analysis of existing systems used for academic activity management was conducted, including international scientometric databases (Scopus, Web of Science, Google Scholar, ResearchGate) and internal administrative information systems. It was found that most existing solutions do not provide a comprehensive approach to managing academic information, making it difficult to integrate scientific data into the overall educational management system.

The choice of technological stack is justified, particularly the use of the Yii2 framework for the backend, MySQL database for data storage, and MVC architecture for an efficient distribution of system functionality. The key functional capabilities of the system are identified, including automated tracking of scientific activity, faculty profile management, generation of analytical reports, and integration with scientometric platforms.

Issues of data security and confidentiality are considered, including authentication mechanisms, access control, and protection against unauthorized use. The proposed information system significantly reduces administrative workload, improves human resource management efficiency, and enhances the transparency of scientific achievement evaluation in HEIs. It can also be integrated into nationwide initiatives for the digital transformation of the educational environment, contributing to the competitiveness of Ukrainian research institutions in the international arena.

The developed system can be implemented both at the level of individual universities and at the state level to create a unified information platform encompassing all aspects of scientific activity management. This will enable effective monitoring of research productivity, foster inter-university collaboration, and facilitate the integration of Ukrainian science into the global academic space.

Ключові слова: автоматизація, база даних, заклад вищої освіти, інформаційна система, наукові досягнення, освітня цифровізація, публікаційна активність, управління науковою діяльністю, цифрова трансформація

Keywords: academic achievements, automation, database, digital transformation, educational digitalization, higher education institution, information system, publication activity, research management, scientific achievements.

1. Introduction

The modern development of science and education requires the implementation of efficient digital solutions for the automation of management processes, particularly in the field of research activities. Higher education institutions (HEIs) face challenges in tracking and analysing the scientific achievements of faculty members, complicating the monitoring of their professional activities, career development planning, and the assessment of research efficiency. The absence of a unified information platform capable of centrally storing and processing relevant data creates difficulties in human resource management, reporting generation, and integration with international scientometric systems.

Currently, most HEIs utilize separate administrative information systems that only partially cover tasks related to monitoring scientific activities. Existing international platforms such as Scopus, Web of Science, Google Scholar, and ResearchGate allow for tracking publication activity but do not provide a comprehensive approach to managing scientific achievements and faculty career progression.

This article examines the development of an information system for managing scientific achievements and career development of academic staff in HEIs. The existing solutions are analysed, the choice of the technological stack is justified, and the key functional capabilities of the system are identified. The proposed database model, which enables centralized storage and processing of information on faculty research activities, aims to enhance the efficiency of research management and facilitate integration into the global scientific community.

2. Analysis of literary data and problem statement

In the modern period of significant transformations in the national higher education system, high demands are placed on academic staff. A modern educator must possess a wide range of competencies, be mobile, organized, punctual, and serve as a role model for others. The development of the information society in Ukraine is one of the key strategic objectives for the near future. The digitalization of education and university management systems is a crucial factor that contributes not only to the automation of administrative processes in HEIs but also to enhancing their societal role as centres for knowledge creation and dissemination [1-2].

On October 8, 2022, the Government approved the resolution "On the Approval of the National Open Science Plan" [3]. This national plan includes six objectives, among which are ensuring open access to scientific results and scientific-technical information, improving the system for evaluating the quality of scientific and scientific-technical activities, as well as raising awareness and developing competencies in open science [4]. The professional activities of university faculty encompass several main areas: teaching, methodological work, research, and organizational activities [5].

The digital transformation of education has become a necessity in today's rapidly changing world. The continuous development of technology has an undeniable impact on society, and its influence on education is evident. Today, digital competencies are a prerequisite for success in the digital society. Most modern professions require not only the ability to communicate and collaborate effectively using digital devices but also the capability to work with large volumes of data, critically evaluate information from the Internet and other media, understand cybersecurity issues, program, and manage "smart devices." In Ukraine, the implementation of information systems in HEIs follows the general trend: each institution typically employs multiple information systems that digitalize specific processes or areas of activity, often without integrated interfaces for data exchange, requiring significant efforts for seamless integration [7].

The relevance of this research topic is particularly high in the context of crisis phenomena, including war and the COVID-19 pandemic, as ensuring proper data management and monitoring of scientific activities amid rapid changes and instability is critically important for the effective functioning of higher education institutions. In the face of global challenges such as war, preserving and developing the nation's intellectual potential is crucial for maintaining the competitiveness of the scientific and educational sector [8]. The application of information and communication technologies in administrative processes creates prerequisites for prompt decision-making, facilitating the adaptation of the education system to modern challenges [9].

The main problems of the subject area, particularly in terms of data management in education and process automation, are complex and interconnected. They reflect the current challenges faced by HEIs in collecting, processing, storing, and utilizing information about academic staff. The modern data management system in higher education institutions is often characterized by fragmentation, data duplication, and a low level of integration between different departments. This leads to difficulties in accessing up-to-date and reliable information necessary for effective decision-making. Data related to scientific achievements, career growth, publication activity, and professional development are often stored in different formats or systems that do not provide proper interaction. Such decentralization complicates both internal record-keeping and the generation of reports for external needs, including accreditation and ranking assessments.

3. Purpose and objectives of the study

The purpose of this article is to develop and substantiate an information system for managing the scientific achievements and career development of academic staff in higher education institutions (HEIs). The proposed system is designed to ensure centralized storage, processing, and analysis of data on faculty research activities, enhancing the efficiency of decision-making, automating report generation, and integrating with international scientometric platforms. To achieve this goal, the article addresses the following objectives:

- analyse existing information systems used for managing scientific achievements in HEIs, identifying their advantages and limitations;
- justify the need to develop a specialized information system tailored to the needs of Ukrainian higher education institutions;
- define the key functional capabilities of the system, including faculty profile management, tracking scientific activity;
- substantiate the choice of the technological stack, particularly the use of the Yii2 framework, MySQL database, and MVC architecture;
- develop a database model that efficiently stores, processes, and analyses information on faculty research activities;
- assess the potential implementation prospects of the system in HEIs and its integration into nationwide education digitalization initiatives.

4. Methods and materials of research

A comprehensive set of scientific methods was used in the research to ensure a thorough analysis of the problem and justification of the proposed solutions:

- analysis and synthesis – examination of existing information systems for managing scientific achievements, identification of their advantages and drawbacks, and formulation of requirements for the new system;
- system approach – investigation of the structure of scientific activity management processes in higher education institutions, enabling the development of a holistic concept for the designed system;
- modeling – development of a database model that ensures efficient storage, processing, and analysis of information about academic staff in HEIs;
- information systems design methods – application of structural and object-oriented design principles for the development of the system architecture;
- software engineering methods – utilization of modern technologies and approaches for web application development, including Yii2, MySQL, and MVC architecture;
- comparative analysis – evaluation of alternative solutions to justify the selection of the optimal technological platform;
- empirical methods – testing of the developed system's functionality and analysis of its compliance with established requirements.

5. Research results

The MVC architectural pattern [10] was used to develop an information system for managing data on scientific achievements and careers of academic staff. It provides a structured organisation of the code, facilitates the support and expansion of the system, and improves the distribution of logic between components. The framework chosen was the Yii2 framework [11], built on the basis of MVC, which simplifies code organisation, the use of presentation templates, and work with the database through Active Record. Yii2 is a powerful PHP framework that provides high performance, flexibility, and ease of use for developing web applications. The main reasons for choosing Yii2 are showed in Table 1.

Table 1 - Reasons to choose the Yii2 framework

№	Reason	Description
1.	Development speed	The framework contains built-in code generation mechanisms that speed up the creation of CRUD operations (creating, reading, updating, deleting data).
2.	MVC architecture	Using the Model-View-Controller pattern helps to separate the application logic, which makes it easier to maintain and extend.
3.	Security	Yii2 has built-in protection against SQL injections, XSS attacks, CSRF attacks, which is critical for the security of academic staff data.
4.	Support for working with databases	Yii2 supports various DBMSs and includes ORM (Object-Relational Mapping) via Active Record, which simplifies database management.
5.	Flexibility and modularity	The system can be expanded by using ready-made modules or creating your own solutions.
6.	Integration with modern technologies	Yii2 supports the REST API, which allows you to create APIs for mobile applications or other services.

The information system has three main types of users, each with different levels of access and functionality (Table 2).

Table 2 - Types of users

№	Role	Description	Features
1.	Guest	An unauthorised user who has access only to publicly available information. The guest is not able to edit or add data, which ensures the security and integrity of information in the system.	View open information on academic achievements of teachers and general statistics.
			Using a search engine to find basic information.
2.	Administrator	A user with the highest level of access who is responsible for managing the system and users.	User management (creating, editing, blocking, deleting accounts).
			Setting the parameters of the information system.
			Control of access rights for different categories of users.
3.	Teacher	A registered user who has the ability to manage their own research profile.	Adding, editing and updating data about your scientific achievements (publications, conferences, projects, etc.).
			Manage personal data and career information.

One of the key stages in the development of an information system for managing scientific achievements and career development of the academic staff of a higher education institution is the design of a database. The choice of MySQL as the main database management system is justified by its performance, scalability, transaction support and the ability to integrate with web applications. The developed database structure provides centralised storage of information on publications, conferences, projects, and academic activities of teachers, which allows automating the processes of collecting, analysing, and reporting. The use of a relational model guarantees data consistency and integrity, which is especially important for multi-user access. The database contains 17 tables, the relationships between which are shown in Fig.1.

The development of the information system began with the installation of the Yii2 project by downloading the archive from the official website and setting up the Apache web server. The information system is multilingual and currently supports Ukrainian and English. As already mentioned, the information system has an MVC architecture. This means that the main logic is located in the controllers that "call" the models to retrieve data from the database, process it in the appropriate execs and pass the information to the views, and then this information is displayed to the user.

The information system is launched in the *web/index.php* file. This file contains the startup script for a web application based on the Yii2 framework. First, the debug mode and execution sequence are set up. *YII_DEBUG* determines whether the application will run in debug mode (true - enabled). *YII_ENV* sets the runtime environment (in this case, dev, i.e. the development environment). Next, the *autoload.php* file is connected (it connects Composer, which loads all the libraries used in the project) and *Yii.php*, the main file of the Yii2 framework, which provides its initialisation. The *web.php* configuration file is loaded, which contains the application settings (path rules, components, database, etc.) and determines the time zone for the correct display of the date and time. And finally, an instance of *yii\web\Application* is created using the loaded configuration and the *run()* method is called, which launches the application and processes the incoming HTTP request.

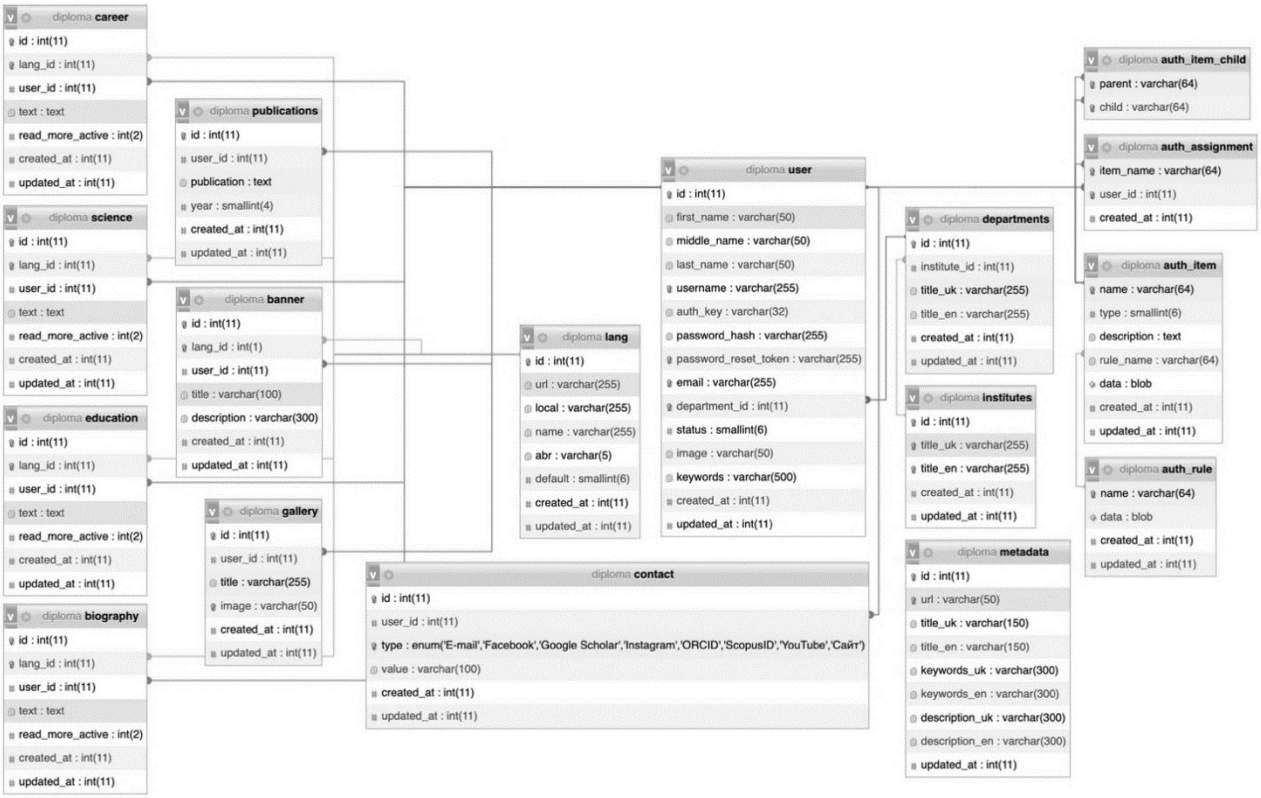

Figure 1 - ER-diagram

The main page of the developed software product is shown in Fig. 2. One of the key advantages of this information system is the ability to work with it anywhere, so it is critical to ensure that the user interface is displayed correctly on all types of devices. We conducted comprehensive testing of adaptability, cross-browser compatibility and code validity. As a result of the test, it was found that the web application is displayed correctly on mobile devices with a screen width of 320 px or more, as well as on tablets and desktop computers. Cross-browser testing was performed for most modern browsers, including their latest 2-3 versions, which covers about 95% of users. The information system functioned without errors in all tested environments.

Figure 2 – Information system homepage

Implementing an information system on Yii2 requires careful planning and proper configuration of the server environment to ensure stable and secure operation of the system. The main aspects of implementation include defining

server requirements, configuring the runtime environment, optimising performance, and security measures. The requirements for the server environment are summarised in Table 3.

Table 3 - Requirements for the server environment

№	Requirements	Characteristics
1.	Operating system:	Linux or Windows Server.
2.	Web server:	Apache (with the module mod_rewrite).
3.	Programming language:	PHP version 8.2 or later.
4.	PHP modules:	pdo_mysql, mbstring, openssl, intl, gd, fileinfo.
5.	Dependency manager:	Composer for managing libraries.
6.	DBMS:	MySQL version 5.6 or later.

6. Conclusions

The conducted research has led to the development of an information system for managing scientific achievements and career development of academic staff in HEIs. The study encompasses an analysis of existing information systems, identification of their limitations, development of system architecture and database model, and implementation of key functional capabilities.

The proposed solution ensures centralized storage and processing of information on scientific publications, participation in conferences, research projects, and other forms of academic activity. The system is implemented using modern web technologies, including the Yii2 framework, MySQL database, and MVC architecture, ensuring operational efficiency, scalability, and ease of future functionality expansion.

Special attention has been given to information security, including authentication and authorization mechanisms, access control to confidential data, and protection against unauthorized use.

The implementation of the developed system will contribute to:

- enhancing the efficiency of scientific activity management in HEIs;
- automating the collection, processing, and analysis of academic staff information;
- reducing administrative workload for faculty and university management;
- integrating with scientometric databases and digital educational platforms;
- ensuring transparency and objectivity in the evaluation of scientific achievements.

Thus, the developed system represents a relevant and necessary tool for the digital transformation of the academic and scientific process. Its implementation will optimize the management of academic activities and promote the integration of Ukrainian higher education institutions into the global scientific community.

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