UDC 004.13.8
DOI https://doi.org/10.32782/2663-5941/2024.1.1/18

Hrabovskyi Ye.M.
Simon Kuznets Kharkiv National University of Economics

Bondarenko D.O.
Simon Kuznets Kharkiv National University of Economics

Ushakova I.O.
Simon Kuznets Kharkiv National University of Economics

USAGE OF ADAPTIVE DESIGN TECHNOLOGIES FOR THE DESIGNING OF A WEB APPLICATION FOR ANALYSIS OF THE EFFICIENCY OF SOLAR PANELS

The article proposes a practical implementation of the adaptive layout technology for the development of a web application for analyzing the efficiency of solar panels, within the framework of which the web application design was developed. The practical result of this research is the adaptive layout of a web application for analyzing the efficiency of solar panels. The article presents the concept of adaptive web design in accordance with the issues of web application development. The purpose of this article is to improve the mechanisms of application of adaptive layout technologies for the development of a web application for analyzing the efficiency of solar panels. The object of the study is the process of applying adaptive layout technologies to the development of a web application for analyzing the efficiency of solar panels. The subject of the research is adaptive layout technologies for the development of a web application for analyzing the efficiency of solar panels. A web application theme diagram was developed to analyze the performance of solar panels according to the site structure, dynamic page requirements and the required Word-Press theme structure. The article provides the database schema of a WordPress web application for solar panel performance analysis. The architecture of a software complex of a web application for analyzing the efficiency of solar panels is proposed. Special attention is paid to the organization of the logic of the architecture of the software complex by the layers of the web application for the analysis of the efficiency of solar panels. Guidelines are provided to guide the design process of each layer of data access. Here are the WordPress files that are required for the correct functioning of the theme and the web application for which this theme is activated. The developed design of the web application for analyzing the efficiency of solar panels is original and has no similar analogues on the Internet, as a result of which a custom WordPress theme was developed for the relationship. The originality of the study consists in determining the main parameters of adaptive layout technologies for the development of a web application for analyzing the efficiency of solar panels. The practical value lies in the development of adaptive layout techniques for the development of a web application for analyzing the efficiency of solar panels.

Key words: *responsive layout, solar panels, data access, methodology, performance analysis, WordPress.*

Formulation of the problem. The increase in the number of used solar panels and the increase in the number of regions in which they are operated has significantly increased the share of electricity generated by them in the total amount of electricity generation. In order to further increase the amount of electricity generated by solar panels, it is necessary not only to introduce new solar stations, but also to improve their operational characteristics and increase the efficiency of their work.

There are different classes of solar panels. The most common are fixed solar panels, which, once installed, spend their entire service life in one place and in an unchanged position. Another class can be called movable or mobile solar panels. Mobile solar panels are part of mobile power plants. Mobile power plants change their geographical location during their service life and are adapted for repeated installation and dismantling (rolling/unrolling). They are used by rescuers, geological exploration expeditions, gold prospectors, military, mobile work groups and all those who need electricity, but perform their functions in isolation from centralized power lines and autonomous power supply centers.

The implementation of solar energy supply systems requires the consideration of a set of additional factors that should be taken into account in the process of choosing rational industrial sites for the placement of

photovoltaic and solar energy stations. In this sense, as a set of additional factors, we are talking about the economic, ecological, and social features of each of the regions of Ukraine.

Therefore, an urgent task today is the development of a web application that uses data from weather stations and allows analyzing the results of the use of solar panels and solar systems in the regions of Ukraine.

Modern web applications have become quite functional, contain a large amount of high-quality multimedia content (resolution, colors, clear sound) and many interactive elements. Therefore, as part of this thesis, adaptive layout technologies are used for the developed web application in order to better present the application on different devices.

The user of the web application can be any person interested in alternative energy sources who may not know the specific climatic details of their region. Thanks to the adaptive layout, it is possible to choose an arbitrary point on the map of Ukraine and calculate, based on weather data, which equipment would be appropriate to obtain the required power.

Analysis of recent research and publications. Research on the flexible development of requirements for web applications is given in scientific papers [1–3]. Adaptive algorithms, based on which web applications are developed for analyzing the efficiency of solar panels, are presented in works [4, 5]. In the studies [6, 7], recommendations are given regarding adaptive layout for creating a web application interface in real time for navigation in a virtual environment. Scientific works [8, 9] contain methodological recommendations for substantiating an innovative strategy for the development of information technologies as a basis for designing web applications for analyzing the efficiency of solar panels. Practical recommendations regarding the use of Workflow to optimize the operation of web applications are given in studies [10, 11].

The analysis of literary sources shows that there are no methodological recommendations in the specialized literature regarding the use of adaptive layout technologies for the development of a web application for analyzing the efficiency of solar panels.

Purpose and task statement. The purpose of this work is to improve the mechanisms of application of adaptive layout technologies for the development of a web application for analyzing the efficiency of solar panels.

The object of the study is the process of applying adaptive layout technologies to the development of a web application for analyzing the efficiency of solar panels.

The subject of the research is adaptive layout technologies for the development of a web application for analyzing the efficiency of solar panels.

Presentation of the main research material. Responsive layout is a common web design that can adapt to any screen resolution, including for mobile to make it convenient for the user to browse the pages of the resource. A solution to the problem is to create a mobile version of the site.

Work on creating an adaptive web design begins with a check on Google services. Usually, the service issues a list of improvements that need to be completed to switch to the mobile version. With adaptive layout on WordPress, changes are made to css files, and a meta tag with the viewport attribute is written inside header.php in the head part, which allows you to adjust the content of the interface to the screen size.

Responsive web design is an approach to web design in which site elements are adjusted according to screen and browser sizes to increase readability, provide user experience and reducing page loading times.

According to the structure of the site, the requirements for dynamic pages and the required structure of the Word-Press theme, a theme scheme was developed for the solar panel performance analysis web application. The scheme of the developed topic is presented in fig. 9.

In the scheme, each section of the site – header, footer, styles, content and additional functionality – corresponds to separate files. The content corresponds to several files, because this section includes the main page, internal dynamic pages, a template of static, fillable CMS pages and pages with a separate entry (Fig. 1).

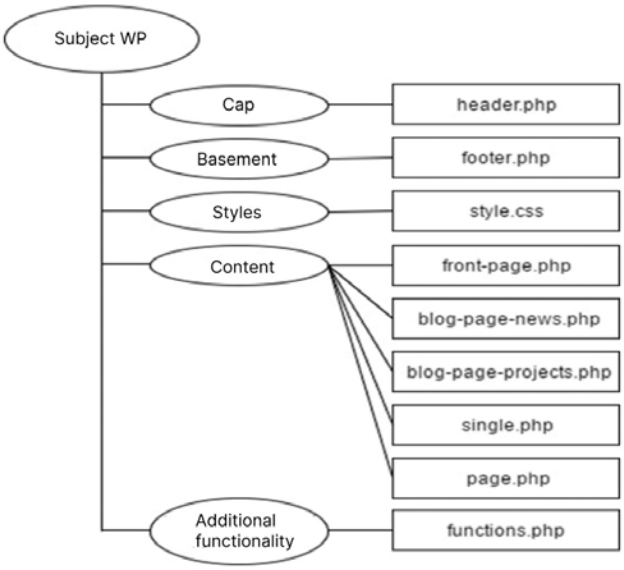


Fig. 1. Theme structure of a web application for solar panel performance analysis

WordPress users, especially the less experienced, the thought of working with a database can seem intimidating, so most tend to leave any database-related tasks to the more technically savvy. But databases contain all the content of a website, and learning even the basics of managing them can go a long way in improving your overall skills. This will make using WordPress more comfortable and help you quickly perform everyday tasks, as well as easily fix some of the most common WordPress errors.

In fig. 2 shows the diagram of the WordPress database.

The architecture of the software complex is a set of significant decisions regarding the organization of the web application software system, a set of structural elements and their interfaces, with the help

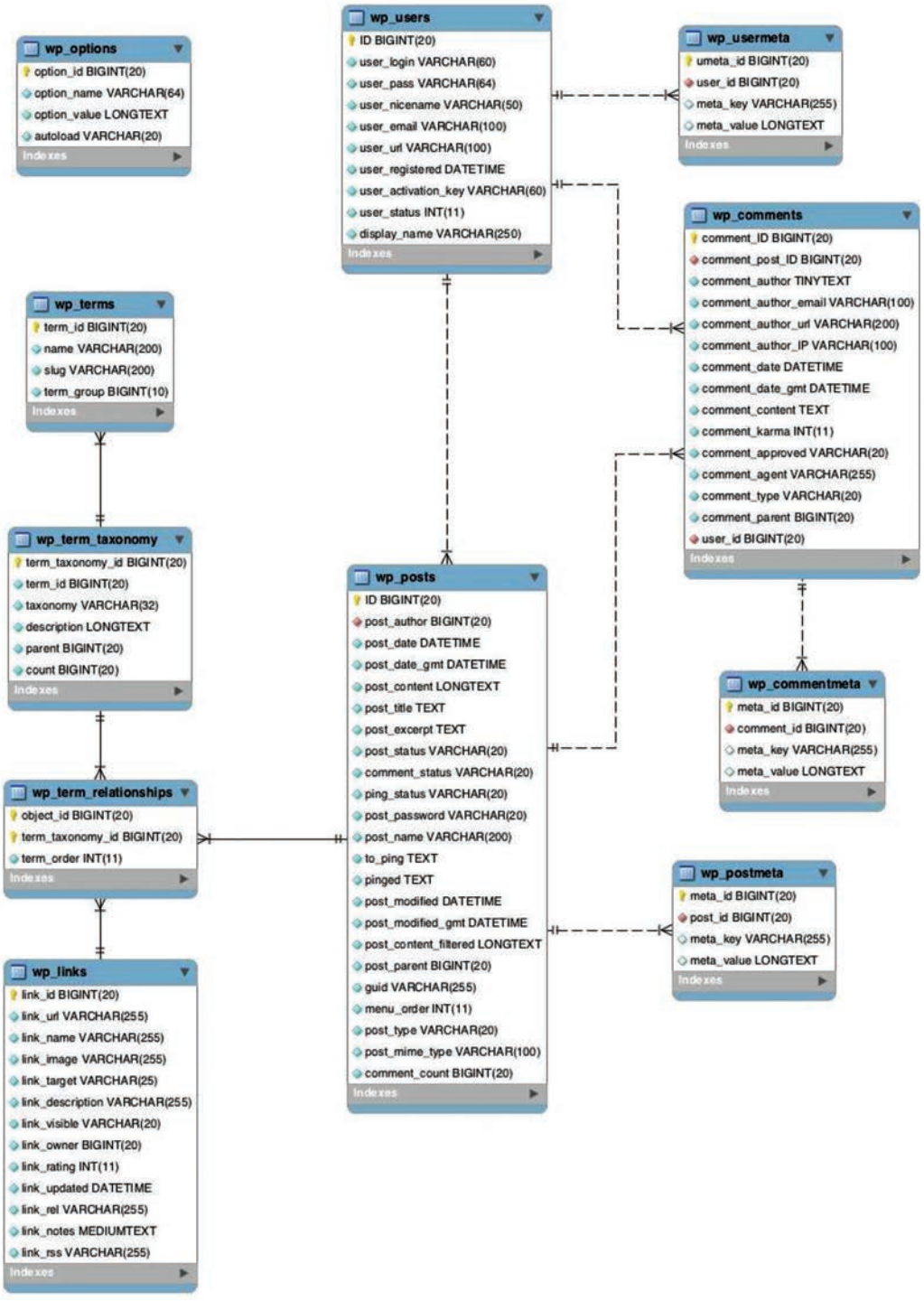


Fig. 2. WordPress database schema

of which the system should be composed, together with their behavior, as determined by the interaction between these elements, the composition of elements into subsystems that are gradually consolidated, as well as the architectural style that guides this organization – the elements and their interfaces, interactions and layouts.

The architecture of the software complex of the web application for analyzing the efficiency of solar panels must contain at least one project. In this case, all the logic of the program is contained in one project, compiled into one assembly and deployed as one element.

In a single– project scenario, task division is implemented using folders. By default, a template includes separate folders for MVC template responsibilities (models, views, and controllers), as well as additional folders for data and services. With such an organization, the details of the data presentation are placed as much as possible in the views folder (Views), and the details of the implementation of data access should be limited to the classes contained in the data folder (Data). At the same time, business logic is placed in services and classes located in the Models folder.

Despite its simplicity, a monolithic solution with one project has certain drawbacks. As the size and complexity of the project increases, the number of files and folders will increase. Tasks related to the user interface (models, views, controllers) are placed in different folders that are not ordered alphabetically. With the addition of user interface-level structures, such as filters or model binders, to separate folders, the situation only worsens. Business logic is lost in the Models and Services folders, as a result it is impossible to clearly define which classes in which folders should depend on other classes. Such inefficient organization at the project level often results in poorly structured code.

To solve such problems in the process of developing web applications, they are often organized in the form of solutions consisting of many projects, where each project is placed in a separate layer of the program. Such a scheme of the architecture of the software complex should be implemented for the designed one as well a web application for analyzing the efficiency of solar panels.

As the complexity of the web application for solar panel performance analysis increases, a breakdown of duties and tasks can be applied to effectively manage it. This approach follows the principle of separation of tasks and helps keep the organization of the extensible code base, so that developers can quickly determine where certain functions are implemented. Layered architecture also has a number of other advantages.

By organizing code using layers, common low-level functions can be reused throughout the application. This is very important, because this approach requires a smaller amount of code and, due to the standardization of the application at the level of one implementation, corresponds to the principle of "Don't repeat yourself".

In applications with a multi-layered architecture, restrictions on the interaction between layers can be set. This architecture helps sell encapsulation. When changing or replacing a layer, only those layers that work directly with it will be affected. By limiting the dependencies of the layers on each other, you can reduce the impact of making changes, so that a single change does not affect the entire application.

The use of layers (and encapsulation) allows you to significantly simplify the replacement of functionality within the program. If the application properly encapsulates the storage implementation at the logical layer, this SQL Server layer can be replaced with a new one that implements the same open interface.

In addition to the possibility of replacing implementations due to subsequent changes, the application of layers also allows you to change implementations for testing purposes. Instead of writing tests that apply to real data or user interface layers, during testing they are replaced by dummy implementations that demonstrate known response to requests. As a rule, this makes writing tests much easier and faster than testing in the real application infrastructure.

Regarding the web application for analyzing the efficiency of solar panels, the organization of the logic of the architecture of the software complex by layers is shown in Fig. 3.

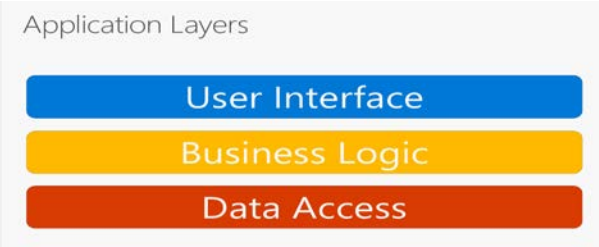


Fig. 3. Organization of the logic of the architecture of the software complex by layers of the web application for analyzing the efficiency of solar panels

The data access layer of a solar panel performance analysis web application must meet application requirements, operate efficiently and securely,

and be easy to maintain and expand as business requirements change. When designing the data access layer, you should be guided by the following general recommendations:

– Correct choice of data access technology. The choice of data access technology depends on the type of data that will have to be worked with and how it is expected to process the data in the application. For each scenario there are the most suitable technologies.

– Using the data access interface. This approach can be implemented by defining front-end components, such as a gateway with well-known input and output parameters that converts requests into a format understood by layer components. In addition, interface types or abstract base classes can be used to define a shared abstraction to be implemented by interface components.

– Encapsulation of data store access functionality in the data access layer. The data access layer should hide the details of accessing the data source. It should provide connection management, query formation, and mapping of application entities to data source structures.

– Mapping of program entities with data source structures. The type of entity used in an application is the primary factor in deciding how to map these entities to data source structures. Domain templates are usually used for this Model or Table Module or mechanisms of Object-relational mapping (Object / Relational Mapping, O/RM).

– Reduce the number of calls and requests to the database. Consider grouping commands into one database operation.

– Performance and scalability requirements. For the data access layer, scalability and performance requirements must be considered during design. For a web application to analyze the efficiency of solar panels, it is the performance of the data access layer that will be the “bottleneck” of the application. If the performance of the data access layer is critical, profiling tools should be used to understand and then reduce the number or break up resource-intensive data operations.

Since the developed design is original and has no similar analogues on the Internet, it is necessary to develop your own theme for WordPress. For the correct functioning of the theme and the web application for which this theme is activated, the WordPress core files are required. The following files were created and populated:

1. Site header template header.php.

According to the developed layouts, the header should contain the name of the web application; logo of the “5–100” project, as well as a link to the project page; drop down menu.

The menu is created using a standard WordPress feature wp_nav_menu (); whose argument is the name of the menu in the WordPress theme. The adaptability of the menu and its presentation in the form of a button that opens the menu on mobile devices is provided using the navbar and navbar– default classes framework bootstrap and CSS styles [18].

Next, each template uses a header connection using the following code: <? php get_he adder();?>.

2. Footer template web application – footer.php.

In the footer web application located contacts, Google Analytics, links to pages in social networks.

Like the web application header, the footer is attached to each template page using the <? php get_ fo oter();?>.

3. Functions file, which are connected – functions.php.

This file implements the connection of fonts using the function function enqueue e_styles(); the following code implements the connection of the menu to the theme: if (functi on_exists (‘add_ theme_sup port’))

{ add_theme_support (‘menus’); }.

In the theme folder, there are subfolders “js” “and” “css”, which contain the bootstrap.min.js and bootstrap.min.css files. The functions.php file implements the bootstrap connection by connecting these files as a script file and a style file respectively.

The creation of types of news records using the function function is also implemented here register_post_ type pe() [14]. The complete listing is shown in fig. 4.

Similarly, the creation of a type of records for projects, as well as for records in the carousel on the main page, is implemented.

In addition to its own types of records, this file describes the implementation of its fields for records, for example, an additional description field.

4. The template of the main page of the site is front-page.php.

The main page includes the sections “News”, “Projects” and the carousel “Did you know...?”. The content of all sections is determined dynamically – the latest entries such as news, projects and didYouKnow are displayed, respectively. The implementation of creating record types is described above (functions.php).

When creating a record, all its fields are entered into the database in the "wp_po sts" table. Accordingly, in order to obtain data about a record for placement, this table must be queried. Using the function <? php $ query = new WP_Query ("post_type=‘news’"); ?> [13] we get data about all records of the news type. Further, with the help of the $query-> the_post ();?>

```
add_action('init', 'news_post_register');
function news_post_register()

{

  $labels = array(

       'name' => ' News ',
       'singular_name' => ' News ',
       'add_new' => Add news ',

       'add_new_item' => 'Add news ','edit_item'
       => 'Редагувати новину', 'new_item' => 'Add
       news ',

       'view_item' =>'Watch the news',
       'search_items' =>'Find News', 'not_found'
       =>'No news found',

       'not_found_in_trash' =>’Not found in news basket’,

       'menu_name' => 'News');

  $rewrite = array('slug' => ' News ', );

  $args = array(

       'labels' => $labels,
       'public' => true,

       'publicly_queryable' => true,
       'show_ui' => true,
       'show_in_menu' => true,
       'query_var' => true,
       'rewrite' => true,
```

Fig. 4. Listing function for creating a new record type *news*

```
<?php

            $n=4;

            $type="news";

            $recent = new WP_Query("showposts=$n&post_type=$type");
            while($recent->have_posts()) : $recent->the_post();

        ?>

<div class="row">

        <div class="col-lg-3" style="margin-top: 20px;">

        <a href="<?php the_permalink() ?>" rel="bookmark">

        <?php

            $media = get_attached_media( 'image', $post->ID );

            $media = array_shift( $media );

            $image_url = $media->guid;?>

            <?php echo '<img class="blogimage" src="'. $image_url
```

Fig. 5. List of display of posts in the news feed

function, we get data about each subsequent record of this type, and the_t itle(); and the_exc erpt(); allow you to get data about the header and excerpt fields, respectively.

5. News feed page template – blog-page-news.php.

This template implements the retrieval of all news– type posts from the database using the function $ recent = new WP_Query ("showposts=$n&post_ type=$type"). The parameters specify the type of records and the number of posts displayed on the page. Next, the loop displays the main fields: the attached media file, the title field, and the annotation field.

The listing is shown in fig. 5.

Project page template – blog-page-projects.php.

The principle of obtaining data from the database is similar to the previous point. The difference

between the templates in the display: the received project records are filtered by completed and ongoing. The filter is implemented by adding an html form to the page : when the filter value is changed, the page is updated, displaying only records whose type is specified in the filter.

The type of record (completed project or ongoing) is indicated when it is created with CMS: an arbitrary record field is implemented. This field is also user editable from the CMS.

7. The template of the record page is single.php.

This template is designed to display the full text of a news or project type entry. In addition to the full text, the page contains a large version of the photo attached to the entry. Implemented mapping by getting the current database record. To improve the indexing of the site by search engines, the full text of the displayed record will be wrapped in the <main> tag.

8. The page template is page.php.

Such a template is used by default for pages for which the CMS does not contain a special template. The page is fully populated from the CMS and the template code only contains fetching the page title, image and main content.

The main menu of the web application for analyzing the efficiency of solar panels is shown in Fig. 6.

In the web application for the analysis of the efficiency of solar panels, which is being developed, the key component of the user's office is the menu for managing solar activity data in a section of certain regions of Ukraine. This solar activity data management menu allows the user to create, edit and delete solar radiation indicators for each region of Ukraine. In fig. 7 shows the solar radiation control menu.

A generalized view of the terrain, which allows you to make a web application for analyzing the efficiency of solar panels, is shown in Fig. 8.

Red and orange colors indicate more solar radiation, while yellow and blue tones indicate less. North-facing roof slopes have blue-yellow tones because they typically receive less solar energy than south-facing slopes. Also, roofs blocked by trees or other buildings sometimes receive very little solar energy.

To determine suitable solar roofs, the user must consider three criteria:

• Suitable roofs should have a pitch of 45 degrees or less because steep slopes tend to receive less sunlight. To determine the slope of the roof, the user must create a raster layer of slopes.

• Suitable roofs should receive at least 800 kWh /m^2 of solar radiation. The user can evaluate this criterion using a raster layer of solar radiation.

• Suitable roofs should not face north because north facing roofs in the northern hemisphere receive less sunlight. To determine the orientation of the roof, you need to create an exposure raster layer.

In the web application, there is an option to add a new raster layer with gradients. Each cell in this layer contains a slope value ranging from 0 to 90 degrees. Lighter colors represent gentler slopes, and darker colors represent steeper slopes.

Raster layers can then be used to find areas that meet the criteria for installing solar panels. First, it is necessary to remove areas from the raster layer of solar radiation, the slope of which will be greater than 45 degrees.

All raster layers use the same grid of cells. Therefore, it is possible to compare values in layers of solar radiation and slope. To do this, create an expression in the Condition tool that checks whether each slope value is less than or equal to 45.

If the slope of the cell is steeper than 45 degrees, its value will change to "No Data" in the source layer. Otherwise, the cell will be assigned the corresponding solar radiation value. The result will be a raster layer of solar radiation that does not include slopes greater than 45 degrees.

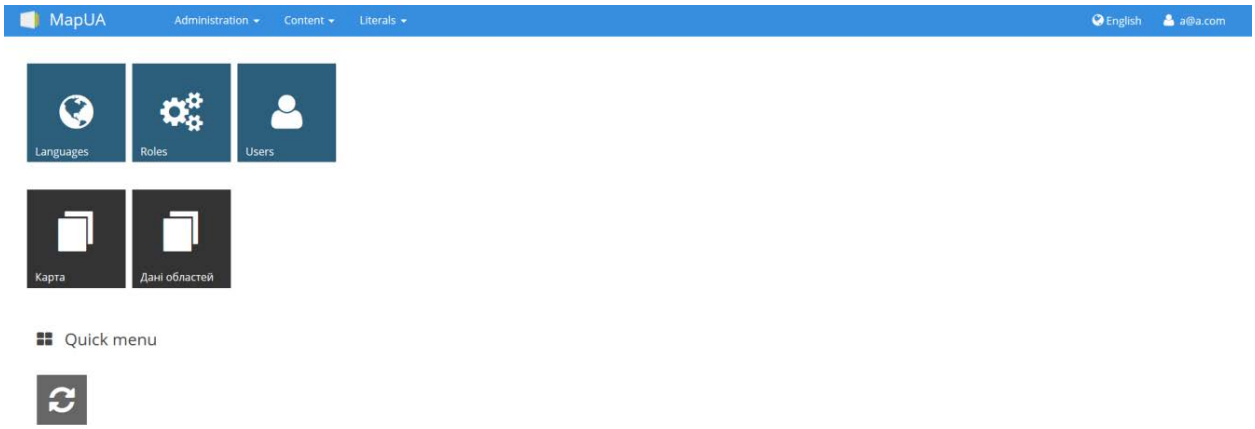
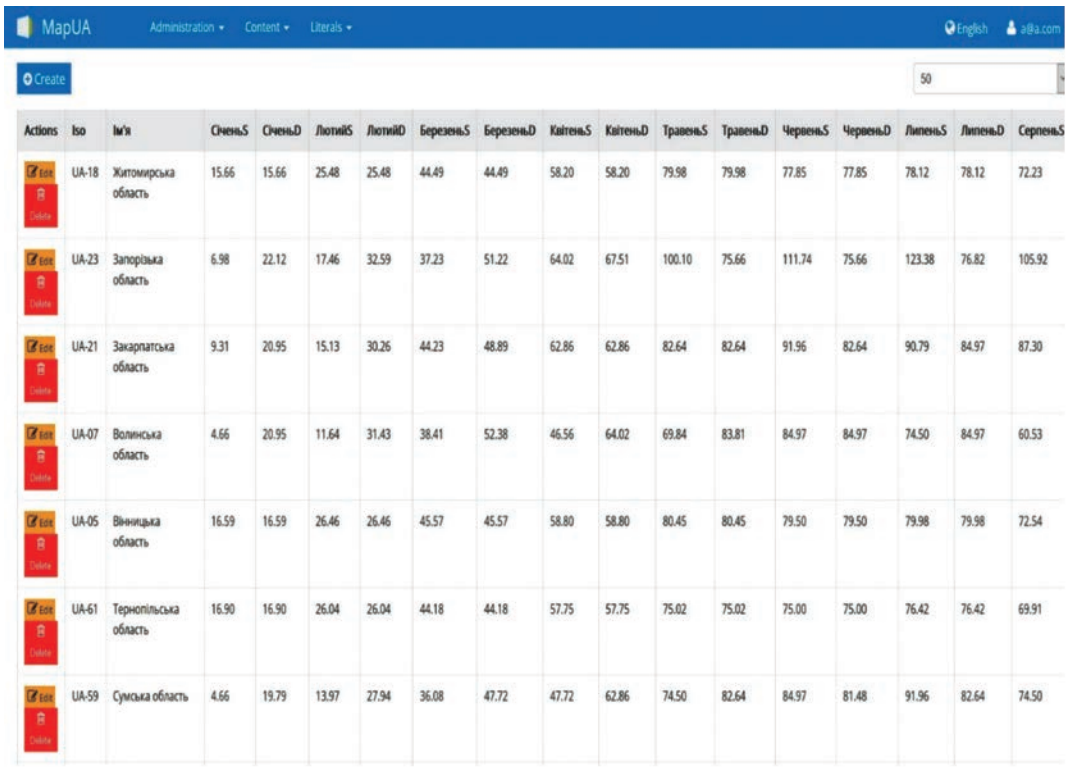


Fig. 6. Main system menu



Actions	Iso	Ім'я	СіченьS	СіченьD	ЛютийS	ЛютийD	БерезеньS	БерезеньD	КвітеньS	КвітеньD	ТравеньS	ТравеньD	ЧервеньS	ЧервеньD	ЛипеньS	ЛипеньD	СерпеньS
Edit Delete	UA-18	Житомирська область	15.66	15.66	25.48	25.48	44.49	44.49	58.20	58.20	79.98	79.98	77.85	77.85	78.12	78.12	72.23
Edit Delete	UA-23	Запорізька область	6.98	22.12	17.46	32.59	37.23	51.22	64.02	67.51	100.10	75.66	111.74	75.66	123.38	76.82	105.92
Edit Delete	UA-21	Закарпатська область	9.31	20.95	15.13	30.26	44.23	48.89	62.86	62.86	82.64	82.64	91.96	82.64	90.79	84.97	87.30
Edit Delete	UA-07	Волинська область	4.66	20.95	11.64	31.43	38.41	52.38	46.56	64.02	69.84	83.81	84.97	84.97	74.50	84.97	60.53
Edit Delete	UA-05	Вінницька область	16.59	16.59	26.46	26.46	45.57	45.57	58.80	58.80	80.45	80.45	79.50	79.50	79.98	79.98	72.54
Edit Delete	UA-61	Тернопільська область	16.90	16.90	26.04	26.04	44.18	44.18	57.75	57.75	75.02	75.02	75.00	75.00	76.42	76.42	69.91
Edit Delete	UA-59	Сумська область	4.66	19.79	13.97	27.94	36.08	47.72	47.72	62.86	74.50	82.64	84.97	81.48	91.96	82.64	74.50

Fig. 7. Menu management indicators sunny radiation

To create a responsive web application for analyzing the efficiency of solar panels using WordPress based on Bootstrap 3, the following algorithm should be implemented:

Unzip Bootstrap;
Customize Bootstrap;
Copy the code;
Customize the HTML template;
Customize Header and Footer;
Adjust the display of recommended publications;
Make a list of categories;
Configure the display of recent entries and authors.

The solar panel efficiency web application can be tested on devices with the following permissions:

Personal computer – 1600 by 992 pixels;
Laptop – 1280 by 802 pixels;
Tablet computer – 768 by 1024 pixels;
Cell phone – 320 by 480 pixels.

Testing of the adaptive layout technology based on the WordPress system was carried out. The test results indicate the correctness of the web application for analyzing the efficiency of solar panels.

Conclusions. The result of this work is obtaining a scientific and practical result in the form of improvement of the mechanisms of application of adaptive layout technologies for the development of a web application for analyzing the efficiency of solar panels.

In the work, an analytical review of the current state of the problem was carried out, key concepts and the subject area of research were analyzed, methods and tools of adaptive layout were investigated for the

Fig. 8. Generalized view of the area
In the web application, it is possible to enlarge the image to better see the surfaces of the roofs (Fig. 9)

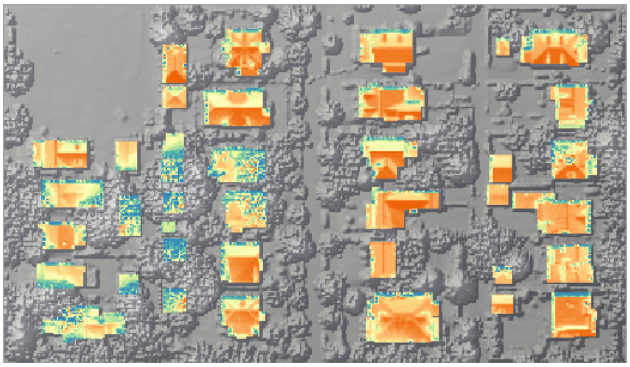


Fig. 9. Ability to enlarge the image

development of a web application for analyzing the efficiency of solar panels.

The analysis of the WordPress system as a tool for adaptive layout was carried out, the specifics of the WordPress database and the specifics of theme development in the WordPress system were investigated, the architecture of the software complex was selected.

The practical implementation of the adaptive layout technology for the development of a web application for the analysis of the efficiency of solar panels is proposed, in the framework of which the design of the web application was developed, the implementation of adaptability based on the WordPress system was carried out, and the testing of the adaptive layout technology based on the WordPress system was carried out.

The practical result of this research is the adaptive layout of a web application for analyzing the efficiency of solar panels.

Next direction research is an assessment of the effectiveness of technology application adaptive layout regarding development of a web application for analysis efficiency solar panels.

Bibliography:

1. Schön, E., Thomaschewski, J. and José, M. Agile Requirements Engineering: A systematic literature review, Computer Standards and Interfaces, 2017, №. 49, pp.79-91. DOI: https://doi.org/10.1016/j.csi.2016.08.011

2. Starkova, O., Bondarenko, D., Hrabovskyi, Y. Providing software support for economic analysis. Technology Audit and Production Reserves, 2023, № 5 (2 (73)), 34–39.

3. Al'boschiy, O., Dorokhov, O., Hrabovskyi, Y., Naumenko, M. Automated balancing method of vector illustration and its software implementation. Bulletin of the Transilvania University of Brasov, Series III: Mathematics and Computer Science, 2022, 2(1), pp. 177–192. DOI: https://doi.org/10.31926/but.mif.2022.2.64.1.12

4. Safonov I., Kurilin I., Rychagov M., Tolstaya E. Adaptive Image Processing Algorithms for Printing. Heidelberg, 2018, 304 p.

5. Martin, R. Twenty challenges for innovation studies. Science and Public Policy, 2016, № 43(3), p. 432–450.

6. Mitchell, D. , & Ream, R. Professional responsibility. Springer International Publishing, Switzerland, 2014, 256 p.

7. Vultur, O. M., Pentiuc, S. G., & Lupu, V. Real-time gestural interface for navigation in virtual environment. In 2016 International Conference on Development and Application Systems (DAS), *2016, p.* 303–307.

8. Hood, N. Quality in MOOCs : Surveying the terrain. Burnaby: Commonwealth of Learning, 2016, 40 p.

9. Hrabovskyi, Y., Kots, H., Szymczyk, K. Justification of the innovative strategy of information technology implementation for the implementation of multimedia publishing business projects. Proceedings on Engineering Sciences, 2022, № 4(4), pp. 467–480. DOI: https://doi.org/10.24874/PES04.04.008

10. Ushakova I., Hrabovskyi Ye. Methodology for developing an information site with Workflow support for publishing articles. *Development management.* 2022. № 20(3). P. 20–28. DOI: 10.57111/devt.20(3).2022.20-28

11. Ushakova I. Modeling and selection of a distance learning system for a higher education institution based on the method of hierarchy analysis using the DSS / I. Ushakova, Ye. Hrabovskyi, D. Bondarenko // Вчені записки ТНУ імені В.І. Вернадського. Серія: Технічні науки. 2023. Т. 34(73). № 2. С. 246–253.

Грабовський Є.М., Бондаренко Д.О., Ушакова І.О. ЗАСТОСУВАННЯ ТЕХНОЛОГІЙ АДАПТИВНОГО ДИЗАЙНУ ЩОДО ПРОЄКТУВАННЯ ВЕБ-ЗАСТОСУНКУ ДЛЯ АНАЛІЗУ ЕФЕКТИВНОСТІ СОНЯЧНИХ ПАНЕЛЕЙ

У статті запропоновано практичну реалізацію технології адаптивної верстки щодо розроблення веб-застосунку для аналізу ефективності сонячних панелей, в рамках якої проведено розробку дизайну веб-застосунку. Практичним результатом даного дослідження виступає адаптивна верстка веб-застосунку для аналізу ефективності сонячних панелей. У статті наведено поняття адаптивного веб-дизайну відповідно до проблематики розроблення веб-застосунку. Метою даної статті є вдосконалення механізмів застосування технологій адаптивної верстки щодо розроблення веб-застосунку для аналізу ефективності сонячних панелей. Об'єктом дослідження є процес застосування технологій адаптивної верстки щодо розроблення веб-застосунку для аналізу ефективності сонячних панелей. Предметом дослідження є технології адаптивної верстки щодо розроблення веб-застосунку для аналізу ефективності сонячних панелей. Було розроблено схему теми до веб-застосунку для аналізу ефективності сонячних панелей відповідно до структури сайту, вимог до динамічних сторінок та необхідної структури теми Word-Press. У статті наведено схему бази даних WordPress веб-застосунку для аналізу ефективності сонячних панелей. Запропоновано архітектуру програмного комплексу веб-застосунку для аналізу ефективності сонячних панелей. Окрема увага наділяється організації логіки архітектури програмного комплексу по шарах веб-застосунку для аналізу ефективності сонячних панелей. Подані рекомендації, якими слід керуватися у процесі проектування кожного шару доступу до даних. Наведені файли WordPress, які необхідні для коректного функціонування теми та веб-застосунку, для якого активовано цю тему. Розроблений дизайн веб-застосунку для аналізу ефективності сонячних панелей є оригінальним і не має схожих аналогів у мережі Інтернет, внаслідок чого для за стосунку було розроблено власну тему для WordPress. Оригінальність дослідження полягає в визначенні основних параметрів технологій адаптивної верстки щодо розроблення веб-застосунку для аналізу ефективності сонячних панелей. Практична цінність полягає в розробленні методики адаптивної верстки щодо розроблення веб-застосунку для аналізу ефективності сонячних панелей.

Ключові слова: *адаптивна верстка, сонячні панелі, доступ до даних, методика, аналіз ефективності, WordPress.*