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Information Environment a for Industrial and Scientific-Cognitive Tourism with Application of GIS

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Abstract

The subject of the stated research is conditioned by the need to develop modern methods and technologies of information support of the tourism industry of the regional profile taking into account its specifics and features. Awareness and comfortable conditions of tourist service are the key factors of successful promotion and sustainable development of this sphere. In the near future, domestic tourism has great prospects, it concerns many territories of the country, and the Southern Urals is no exception.

The article is a continuation of research work related to the collection and analysis of geodata, as well as the visualization of the information environment. This study shows how to graphically visualize information on the basis of the development of an interactive scheme project with the possibility of overlaying it on a scalable satellite map in the field of industrial, scientific-cognitive tourism and architectural tourism on the example of a separate layer "Country of Cities" for the objects located in the South Urals.

In the research on the basis of the program utility "Grid cartogram of reference archaeological objects" the design concept of the interface functionality of utility "KROT-1.0" ("Cartogram of reference objects of tourism. Version 1.0") is developed and tested as an interactive cartogram on Internet platforms.

Methodology wise, the research process consists of 2 stages: pre-project or data collection with the formation of a database catalog and design and research, with the implementation of results, consisting in the development of the design concept of the utility and its integration with a web resource developed on the platform of non-commercial CMS; analysis and comparison of the results obtained on different platforms, publication or placement of the developed interactive schemes on internal servers and Internet platforms with further prospects for the development of mobile applications for the provision of information environment in different spheres of regional tourism.

Keywords: information environment, geodata visualization, cartogram of reference objects of tourism, information environment, architectural tourism, scientific-cognitive tourism, navigation, South Urals, Chelyabinsk region.

1. Introduction

Despite the fact that recreational, excursion and ecological tourism has been developing in the Ural region for a long time, the Southern Urals also has its own unique specificity - this is the so-called industrial tourism, which began to develop not so long ago, but has already gained great popularity. For example, the territory of the Chelyabinsk region is rich in the in-

dustrial heritage of the past - these are the ancient prehistoric “paleo-metallurgical” complexes of the South Ural “Country of Cities”, historical Ural city-factories with their unique history and architecture, and the latest clusters of metallurgical and mechanical engineering production in modern developing industrial cities of the region. Since this type of tourism is attractive for its regional specifics, in order to solve the problems of the social-economic specifics of the region, it is extremely important to ensure attractiveness and comfort in the development of this industry, which will be fully facilitated by the creation of new methods of information support using the most up-to-date technologies, which will make it possible to achieve the required result.

The announced research project “Development of information environment for industrial and scientific tourism in the Chelyabinsk region using GIS” proposes to develop a software utility for information support for the environment of industrial and scientific tourism in the

Chelyabinsk region using up-to date geographic information systems (GIS). The results of the study will be aimed at improving laboratory methods for collecting, analyzing and synthesizing data necessary for navigation support of excursion routes, information support for tourism objects, using modern means of navigation along tourist routes and territories with functional interactive visualization of information.

At this stage, a design concept for software utility “KROT-1.0” (Cartogram of reference tourism objects. Version 1.0) is being developed to fill the information environment and provide navigation along a specific thematic route, compiled from a structured and systematized cartographic layer of tourist objects. It is proposed to implement the results obtained using the example of the formation of thematic tourism cluster “Land of Cities”. It is planned to comprehensively equip the software module with interactive and auxiliary functions for the work of client service specialists.

The purpose and objectives of the study are to improve the information and technological support of *architectural tourism*[1], industrial and scientific tourism in the Southern Urals, and to create greater attractiveness for investment. Developing a comprehensive information support for the environment taking into account modern requirements and technologies in the development of this industry is the main objective of the study.

The scientific problem that the project is aimed at solving: the development of modern methods of information and technological support for the tourism industry in the regions, with the development of cartograms of thematic routes available for tourists to visit, using GIS technologies.

The scientific significance and relevance of solving the identified problem: the topic of the stated project is determined by the need to develop an information environment for navigation along tourist routes and tourism sites in the region and for information support of tourism activities in general. A tourist awareness is a key factor in the successful promotion and development of the industry.

The scientific novelty lies in the fact that for the first time, for the development of *architectural tourism*, industrial and scientific-educational tourism in the Southern Urals, the following are being developed: an interactive information and educational environment using GIS; cartogram of reference tourism objects. A methodology is used based on the author’s method of collecting information, analyzing and visualizing geodata. The capabilities of the proposed method make it possible to widely use the developed schemes in GIS navigation and specialized mobile applications for working with satellite maps.

One of the main, predominantly significant practical results of using the utility in practice is instant and targeted receipt of up-to-date information about target tourism sites and existing routes over a fairly wide area in the “single window” system.

Considering in general the problems of research of the prospects for the development of popular science and industrial tourism in the regions both in Russia and abroad, it is worth

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[1] Architectural tourism is a modern type of tourism aimed at organizing tourism infrastructure involving architectural objects as the main objects of tourism [3, C.4].

noting the works of Krylova E.A. [10], Volkova S.K. [5], Glazycheva V.L. [7], Kohl O.D. [8], Koroleva A.Yu. [10], Mironenko N.S. [13], Oborina M.S. [14], Tyaglova S. G. [17], Allan J.R., Venter O. [at all] [20]; Gorelick N., Hancher M. [at all] [22]; Weiss D. J., Nelson A., Gibson H. S. [24]. Scientists from Chelyabinsk and Yekaterinburg are working on the development of scientific, educational and industrial tourism in the Urals: Beklenishcheva M.V. [2] and specifically in the Chelyabinsk region, scientific and educational tourism is becoming in demand and begins to develop with the discovery of architectural and archaeological monuments of the Bronze Age of the Ural "Country of Cities" and other archaeological complexes of a later period [19], industrial tourism for the region is a new trend, the beginning of which can be considered the "Stone Belt" project program in the Middle Urals, uniting the historical industrial cities of the Urals into a single route. In the Chelyabinsk region, industrial tourism is planned to be developed on the basis of both existing enterprises of the metallurgical and mechanical engineering complex and on the basis of the non-functioning historical industrial architecture of factory cities. The latest, currently relevant developments and publications in the direction of the stated topic can be considered educational publications and scientific articles by Bulatova E.K. [3, 4], Kizima A.V. [9], Zyryanova A.I., Koroleva A.Yu. [etc.] [15]; Degtyareva A. N., Usmanova Yu. I. [etc.] [16]. Research related to the prospects for the development of popular science and industrial tourism in the Urals and specifically in the Chelyabinsk region, competing works on the stated topic can be considered research by employees of design institutes and universities: UralNIIproekt, Chelyabgrazhdanproekt, Chelyabinsk State Historical and Cultural Reserve "Arkaim", South Russian State University and a number of other public and private organizations.

The problem of using modern information and technical support tools in the study of tourism development prospects is still poorly addressed in Russian science, with the exception of the field of eco-tourism. Methods of applying GIS technologies and the use of UAVs in the tourism sector can still be considered as an innovative area. In this area, the following works can be noted: Gvozdenko A.A. [6], Ulchitskiy O.A. Bulatova E.K. [at all] [23], which consider issues of similar specificity in historical-archaeological [21] and historical-architectural studies, environmental activities, cartography, and cadastral activities. General issues of using GIS technologies in tourism were considered in the works of: Bulanova M.V., Sliva I.V., Zhukova Yu.P. [et al.] [1]; Lesher O.V. [and others] [12], Kuzmina G.V., Makarina I.V. [and others] [12], Tsvetkova V.Ya. [18] and others.

2. Research methodology

One of the ways to solve issues related to the visualization of georeferenced data on satellite maps by creating images from any text files, consisting of several sequential steps, in particular for working with Yandex maps, without the involvement of graphic editors using the PHP programming language as an example, is disclosed in the study by N.N. Voronina [30]. However, in our development we use methods that combine both text-based cryptographic programming and specialized 2D graphic editors such as CorelDraw and Photoshop.

The research uses methods for linking developed cartograms to satellite maps, working with map geogrid editors, working with graphic editors for image processing and developing a graphical interface for the utility. For precise coordination of reference tourism objects (RTO) and localization of objects on satellite maps, aerial photography from different years and topographic survey are used. The process of creating a cartogram and a graphical interface project for the utility consists of successive stages of work.

Stage one:

1.1. initial collection of informative data: localized aerial photographs, satellite coordinates, satellite maps with terrain, and other auxiliary data;

1.2. creating a database for a cartogram of a layer of objects on Joomla or Wordpress platforms;

1.3. design development of the “Country of Cities” layer with its overlay on a satellite map in a graphic editor using the zoom function;

1.4. design visualization of RTO anchor points using specialized graphic editors.

Stage two:

2.1. processing the obtained results, export of the obtained cartograms to GIS system editors such as GIS software utility GeoLink 3.14.0013 [29];

2.2. linking the generated database to cartogram layers;

2.3. development of functionality and graphical interface of KROT-1.0 utility in test mode;

2.4. testing the beta-version of KROT-1.0 utility.

As a result of the final stage of work, software utility “KROT-1.0” was implemented. A cartogram linked to a database has been integrated into the graphical interface development (Fig. 1). During the utility development, it is necessary to foresee in advance a possibility of editing the data that is entered into the base of cartogram layers in case of correcting errors or updating data. As an example of practical implementation in the application of utility development, sites of architectural and archaeological complexes located over vast territories and at a considerable distance from each other are considered. It is proposed to transfer the generated RTO database into the form of a graphic cartogram using GIS software utility with the method of polygonal construction of a high-precision coordinate grid on satellite maps.

To work with RTO, a modified grid is used, constructed using the utility for triangulation of complex two-dimensional areas Gridder2D. The constructed cartogram makes it possible to visualize the contents of RTO database against the background of a real geographical situation with reference to a satellite map in real time, in the conditions of the terrain and current cartographic data - isolines, land surface marks, river edge marks, etc. Processing of graphic images, as well as the graphical interface of the utility is carried out using 2D editors: CorelDraw 2017 Academic Edition, D-504-18 dated 04/25/2018 [27] and Adobe Photoshop CS 5 Academic Edition, K-113-11 dated 04/11/2011 [28].

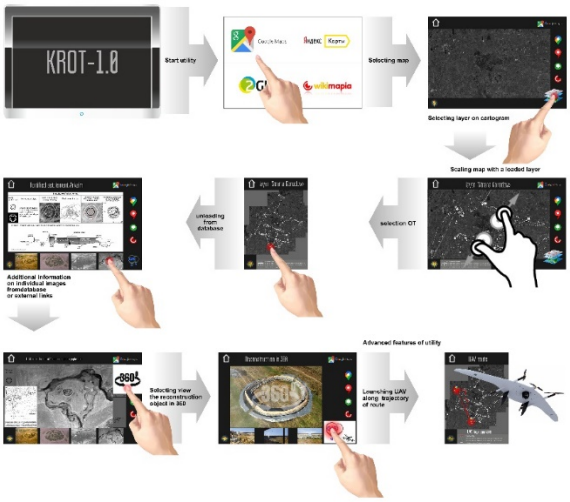

Fig 1. Concept project for the functionality of the interface of “KROT-1.0” utility (developed by O.A. Ulchitsky).

3. Approbation of the method and development results

Approbation of the method for constructing a cartogram layer was implemented as part of the educational process for students to complete a task as part of team work. The research was interdisciplinary in nature.

At the first stage data was collected to study the features of reference architectural and archaeological monuments. The database includes: panoramic aerial photographs, satellite images, digital models based on the analysis of the microrelief of monument ruins, our own and previously developed graphic reconstructions of architectural and archaeological monuments,

incl. performed by 3D modeling and visualization using graphics packages, materials from various sources.

The interactive block in the “scroll” contains all the necessary information about the tourism object: name, images, basic information, additional data: hyperlinks, concierge service data, auxiliary Internet links, etc. Graphic display of information on the interactive diagram provides an exhaustive amount of visual information “single window” data with expanded visualization capabilities and submission of information about objects linked to the cartogram.

Arkaim

Location and dating: Chelyabinsk region, Bredinsk district, located near the village Alexandrovka. Dates from the 18th-16th centuries. BC.

Shape, size, orientation relative to the cardinal directions, preservation and degree of research of the monument: a round fortified settlement, diameter 145 m, area 16,500 sq. m. The structure is oriented NW relative to the main entrances. The monument is in a good state of preservation. Found in 1987, opened and half examined.

Additional information: the structure consists of a central area of 25x27 m, two ring defensive structures inscribed into each other from a log-pound part and a wooden parapet, an outer wall with a diameter of 145 m, an inner one 85 m, two circles of dwellings, divided into sectors, adjacent to the ring walls of defensive structures, between the inner wall and the dwellings there was a ring street combined with a storm drain. The remains of rooms and niches have been found inside the defensive walls. These rooms could be accessed from the dwellings. In the outer circle, four entrances to the settlement are clearly visible; they are oriented to the cardinal points. The wall structures were based on log frames or two longitudinal wooden walls. More than 60 dwellings were identified in the settlement, they were located in a circle, had a trapezoidal shape in plan, the area of the buildings was 90-140 sq. m., the inner circle was 110-180 m. The width of the residential structures was 6-8 m, the length was up to 20 m. Houses were built close to each other and had common long walls. These houses had no windows. Natural lighting of the premises was presumably provided through a specially made light and smoke opening in the roof.

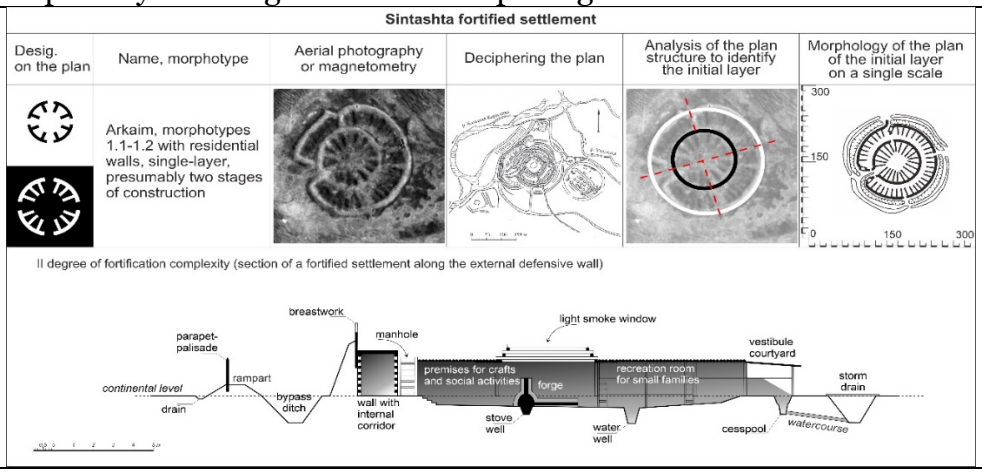

Fig. 2. Database grid for KROT using the example of one of the reference objects.

At the first stage, within the framework of the Design Activity discipline, a database catalog of 25 folders for reference objects was created. For each object there are tables (Fig. 2) created for interactive anchor points. The volume of each table was no more than 300 KB of data. In addition to the interactive tables, auxiliary photographic materials, images with graphic reconstruction of objects, and the ability to view an object in the 360° panoramic editor are loaded. All URL links are linked to the cloud service. Folder catalog structure: 1) Ålandskoe;

2) Andreevskoe; 3) Arkaim; 4) Bakhta; 5) Bersuat; 6) Zhurumbai; 7) Isiney; 8) Kamenny ambar; 9) Kamysty; 10) Kizilskoe; 11) Konoplyanka; 12) Kuysak 13) Paris; 14) Rodniki; 15) Sarym-Sakly; 16) Selek; 17) Sibarkul; 18) Sintashta-1; 19) Sintashta-2; 20) Stepnoe; 21) Ulak-1; 22) Ustie; 23) Chekatai; 24) Chernorechye: 25) Shikurtau. An additional section of the catalog with materials “Operation and Update Process” was also created.

At the second stage, within the framework of the discipline Content Management for Web Applications, 4th year students completed design developments on CMS (Content management system) Joomla! and WordPress (WP) based on Linux OS on the internal server of the Federal State Budgetary Educational Institution of Higher Education “MGTU named after. G.I. Nosov". The first team developed the project on WP, and the second on Joomla!

Student teams, conventionally named after CMS used, distributed the following project roles among themselves: Team Manager, System Analyst, Designer, Web Resource Architect, Content Manager, Copywriter, Developer, Tester. For each project role, depending on its content, there were from 1 to 3 students. Each team independently used the method of expert assessments to identify and rank the requirements of a conditional Customer (O.A. Ulchitsky was a Customer) for the design, structure and functionality of the web resource being developed. E.K. Podobreeva, E.K. Bulatova and O.M. Veremey acted as Experts in determining the priority of user requirements. Requirements for data organization and resource architecture were developed, analyzed and submitted for approval to a conditional Project Manager (Yu.V. Kocherzhinskaya acted this role). Trello by Atlassian was used as a communication platform for project participants (Fig. 3).

As a result of the work of each team, a version of the cartogram was developed, which was analyzed by metrics and compared, as a result, the main problematic and positive aspects when using each of the CMS were identified. Initially, both solutions with a test version of KROT project for the territory of the Southern Urals were posted on the site provided by “G.I. Nosov MGTU” own server space, where the appropriate CMS was installed. The Yandex.Maps concept was chosen as a sample for display on the main screen, as it is most familiar to a potential user.

The students presented the results of the solution to colleagues from another team and a commission consisting of the Customer, Experts, Project Manager and independent listeners from among the teachers and students of the university. During the defense, students justified the solutions used on the database architecture, the design of the user web interface (Fig. 4, 5), and the format for content presenting. Based on the results of the defense, as a result of voting, the work of WP team was recognized as the most appropriate to the Customer’s requirements, as well as in terms of parameters such as scalability in the future, and ease of support (Fig. 4).

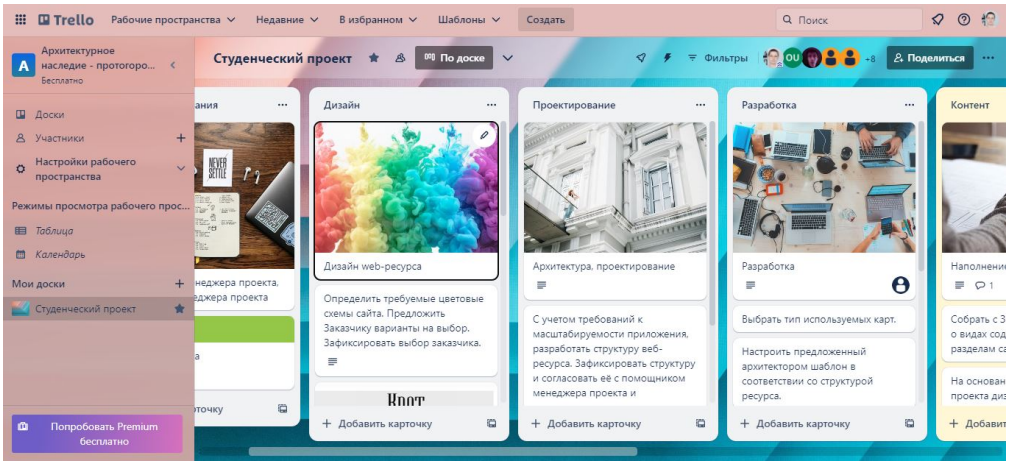

Fig. 3. Fragment of work on the communication project based on Trello platform

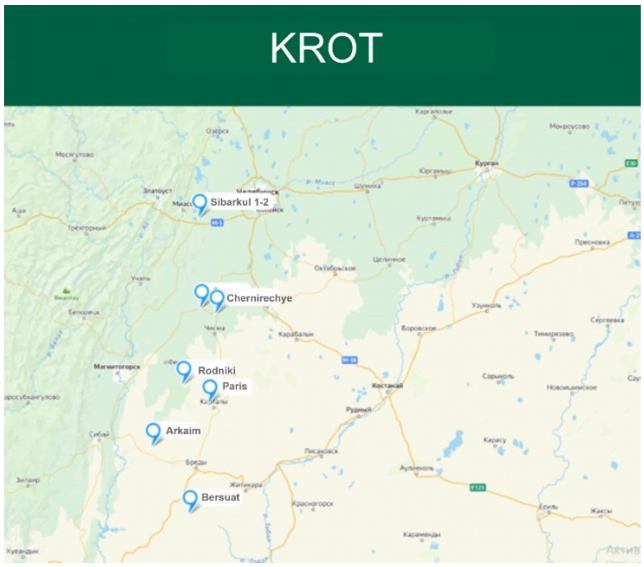

Fig. 4. KROT interactive module. Beta version of the utility on CMS WP [26].

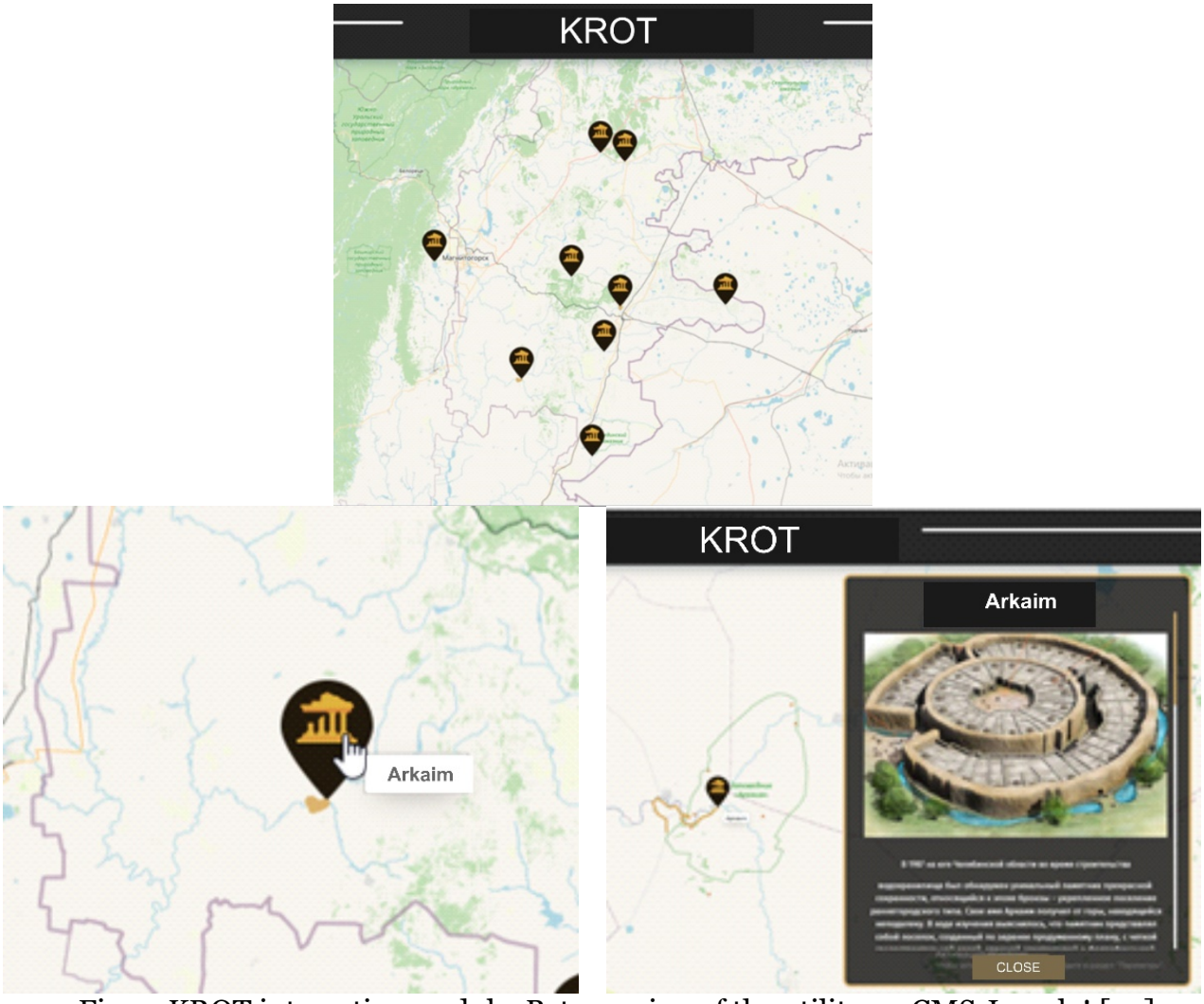

Fig. 5. KROT interactive module. Beta version of the utility on CMS Joomla! [25].

This option was chosen for placement with subsequent modification on hosting on a thematic web resource. The quality of development was assessed based on parameters such as usability (UX), copywriting, and design. While Joomla! solution was considered more aesthetically attractive, it was not optimized for use on mobile devices. The decision to use a par-

ticular CMS is based primarily on the design and UX components, which was noted when assigning the final grade.

Conclusions

As a result of the work performed, a software utility was obtained to provide an information environment - filling it with routes, information about reference objects and navigation through the created “Land of Cities” layer. In addition to designating the tourist sites themselves, the cartograms can display linear inter-object connections from point “A” to point “B”, information on transport services and walking routes, additional information and infographics on tourism sites, territories and routes in an interactive form: when hovering cursor on any of the anchor points, a “scroll” with information appears. The interactive block in the “scroll” contains all the necessary information about the anchor point: name, images, basic information about the object, additional data: hyperlinks, service data, auxiliary Internet links, etc. Graphic display of information on the interactive diagram provides a comprehensive amount of visual data in the "single window" system.

As a result of the research, a database catalog was formed for the layer “Country of Cities”, a design concept for the functionality of “KROT-1.0” utility interface was developed, which in the future can be applied on various platforms, incl. in mobile applications to provide an information environment for architecture, industrial and scientific tourism. As a result of testing, two experimental versions of the interactive module were obtained on WP and Joomla platforms, which were placed on the university’s internal servers and on the Internet.

The capabilities of the developed information environment contribute to widespread introduction of innovative technologies in the field of tourism infrastructure: transport, hotel, recreational, educational, information and other areas of service of tourist routes in regions.

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