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REFERENCES

- [1] Seher G., Linear regression analysis Mir, 1980, P. 456
- [2] Duhov A.M., Mhitarian V.S., Troshin L.I., Multidimensional statistical methods. Finance and Statistics, 2003.
- [3] Antokhin P. N., Comparison of various methods of statistical forecasting of the dynamics of surface ozone concentration, *Optics of the atmosphere and the ocean*, 2013, vol. 26, issue 12, pp. 1082-1089.
- [4] Shreyas R., Predicting popularity of online articles using random forest regression, 2016 Second International Conference on Cognitive Computing and Information Processing (CCIP), 2016, pp. 1-5.
- [5] Tikhonov V. V., Vorobyov S. P., Chernova E. A. Using neural networks to predict enterprise development // Executive editor, 2017. pp. 44-49.
- [6] Abdurakhmanov A. M., Methods for predicting power consumption in distribution networks (review), *Electrical Engineering: Network Electronics Scientific Journal*, 2016, vol. 1, pp. 3-23.
- [7] Abramovich B. N., Barabanova I. S., System for predicting power consumption using an artificial neural network, *Mining science and technology*, 2016, vol. 1, pp. 66-77.
- [8] Ramachandran P., Zoph B., Le Q. V., Searching for activation functions, arXiv preprint arXiv:1710.05941, 2017.
- [9] Guolin Ke, Qi Meng, Thomas Finley, Taifeng Wang, Wei Chen, Weidong Ma, Qiwei Ye, Tie-Yan Liu. LightGBM: A Highly Efficient Gradient Boosting Decision Tree, *Advances in Neural Information Processing Systems*, 2017, vol. 30, pp. 3149-3157.
- [10] Chen T., Guestrin C., XGBoost: A Scalable Tree Boosting System, In 22nd SIGKDD Conference on Knowledge Discovery and Data Mining, 2016.

DEVELOPMENT OF A VIRTUAL LIBRARY OF CULTURAL HERITAGE OBJECTS FOR TAMBOV REGION'S MEMORABLE PLACES

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ABSTRACT

In this work, we have developed a database that is a combination of three-dimensional models of typical objects of cultural and historical heritage and their elements for the most sites of the Tambov region, associated with the famous personalities of Russia. These objects include buildings and structures, household buildings, household items and interiors, household utensils, plants of the central part of Russia, animals, etc. It should be noted, that some real objects have now undergone significant changes up to complete destruction. This database can be used by students, post-graduate students and research instructors. The library of three-dimensional models was used by the authors to create multi-user three-dimensional virtual reconstructions of historically significant monuments at different time periods of their development in such software systems as AutoCAD, Second Life, and others.

Keywords: information system, database, 3D-models, virtual museum, objects of cultural and historic heritage.

INTRODUCTION

Museums are important sources for presenting information about the past. However, real museums have some limitations like time, space, and modes of interaction. Moreover, most museums do not have space and resources to exhibit all of their collections and also some objects are so fragile that museum curators hesitate to make them available to public. Due to an increasing use of computers and advanced technologies, virtual reality museums or digital museums are becoming a good alternative to traditional museums. Users can interact with 3D models of objects in different ways [1].

The digital age has drastically changed the traditional definition of a museum. In the past, the entire experience from visiting a museum included touring an exhibition and getting educated about artefacts on display, whereas museums are now becoming more important as comprehensive social learning spaces. Such a change in the museum's role has led to a variety of discussions about the museum space [2].

As an important part of public service and educational infrastructure for national culture and heritage, a virtual museum gives user an experience of a real museum with virtual guides, and tourists interacting within a prepared digital cultural content by using a mouse, a touch panel, and augmented reality devices. The goal of a virtual museum is to help students and visitors to move around a virtual museum space freely and to experience and satisfaction from observing cultural heritage objects anytime, anywhere and from any device [3].

The work by Fabola et al [4] discusses the methodology of design, development and deployment of a virtual 19th-century Fish Curing Yard as an immersive museum installation. The museum building now occupies the same space where the curing yard was located for over 100 years ago; hence, deployment of a virtual reconstruction of the curing yard in a game engine enables the museum visitors to explore the virtual world from equivalent vantage points in the real world. The project methodology achieves its goal of maximizing user's experience for visitors while minimizing the cost for the museum, and focus group evaluations of the system revealed success of the interactive free design with snackable content. A major implication of the findings is that museums can provide compelling and informative experiences that enable visitors to travel back in time with minimal interaction and relatively low cost systems.

A novel system for automatically generated immersive and interactive virtual reality (VR) environments using the real world as a template is presented in the paper by Liu et al. [5]. The system captures indoor scenes in 3D, detects obstacles like furniture and walls, and maps walkable areas to enable real-walking in the generated virtual environment. Depth data is additionally used for recognizing and tracking of objects during VR experience. Detected objects are paired with virtual counterparts to leverage physicality of the real world for a tactile experience. Presented approach allows a casual user to easily create virtual reality worlds in any indoor space of arbitrary size and shape without requiring specialized equipment or training.

The aim of the study by Romanelli [6] is to provide a conceptual framework to explore how museums contribute to sustaining intellectual capital and promoting value creation moving from designing virtual environments to introducing and managing Big Data to select and follow a data-driven innovation and strategy.

The paper by Lugrin et al [7] presents a novel type of VR application for education and culture: a location-based VR Museum, which is a large-room scale multi-user multi-zone virtual museum. This VR museum was designed to support over 100 simultaneous users, walking in a large tracking system (600 m²) and sharing a ten times bigger virtual space (7000 m²) containing indoor and outdoor dinosaur exhibitions. This work is giving an overview of the system and its main features as well as discussing its potential benefits and future evaluation.

Virtual experience of the Geguti Palace is presented in the paper by Ferrari and Medici [8] in order to demonstrate how it's possible to offer a deep understanding of a space from abroad by absorbing reality into a virtual environment. Starting from digital documentation and 3D survey of this medieval royal palace, developed by the Department of Architecture of the University of Ferrara and Tbilisi State Academy of Arts, in collaboration with the National Agency for Cultural Heritage Preservation of Georgia, the paper stresses the VR issue focusing on several hardware devices and software platforms for digital content management. The case study has contributed to

the analysis of further exploitations of Virtual Experiences for the Cultural Heritage

CREATING A LIBRARY OF VIRTUAL MODELS

The database, created by the authors, is based on the results of works [9]–[13] and contains a collection of three-dimensional models of cultural and historical heritage objects of the city of Tambov, both existing and completely or partially destroyed.

In this work, OpenSimulator software was used as a platform for creating three-dimensional virtual world [14]. OpenSimulator is an international project with the goal to create an open technologic platform for building three-dimensional virtual worlds similar to Second Life. Innovative development of OpenSimulator goes in a new direction of 3D Web. OpenSimulator project has an open source code (under BSD license) and it is distributed free of charge.

Joomla 1.9 Content Management System (CMS) is used to manage dynamic filling of the database. The core of the Joomla database contains 62 tables: jos_assets; jos_attachments; jos_banner_clients; jos_banner_tracks; jos_banners; jos_categories; jos_contact_details; jos_content; jos_content_frontpage; jos_content_rating, etc. When a user sends a request, the CMS generates final representation of information in HTML format based on the information from the database. Among these tables there are tables that are used directly for storing and presenting data, including content manager (jos_content, jos_content_rating), main page manager (jos_content_frontpage), category manager (jos_categories). Fragments of the database structure are shown in Figures 1, and a fragment of the model's database of cultural heritage sites is presented in Table 1. Currently, the database includes information on more than 200 objects and their elements.

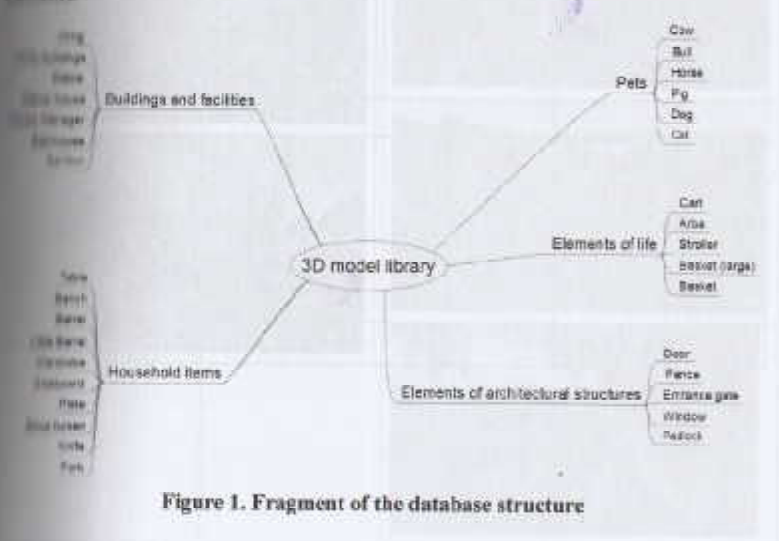
















Figure 1. Fragment of the database structure

Table 1 Fragment of the model's database of cultural heritage objects

Category	Name of the model	Visualization of the model
Buildings and facilities	Manor house	
Buildings and facilities	Wing	
Buildings and facilities	Bathhouse	
Buildings and facilities	Utility buildings	

Category	Name of the model	Visualization of the model
Household items	Table	
Household items	Bench	
Household items	Barrel	
	Cow	
	Horse	

Category	Name of the model	Visualization of the model
Pets	Dog	
Elements of life	Cart	
Elements of life	Basket (large)	
Elements of life	Arba	
Elements of architectural structures	Window	

CONCLUSION

The proposed database is a collection of three-dimensional models of cultural and historical heritage objects of memorable places of the Tambov region, existing and partially or partially destroyed, associated with well-known personalities of Russia, whose life and work are connected with the history and development of the Tambov region.

These objects include elements of the noble estate of the XIX - XX century (manor house, utility buildings, wing), elements of architectural structures (doors, windows, stairs), elements of life (cart, arba, basket), household items (table, knife, plate), domestic animals (cow, horse, dog). It should be noted, that some real objects have now undergone significant changes up to complete destruction. This database can be used by masters, post-graduate students and academic instructors.

The library of three-dimensional models was used to create a virtual museum of urban development history of memorable places of the Tambov region in OpenSimulator and Second Life.

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REFERENCES

- [1] A. Subramanian, J. Barnes, N. Vemulapalli, and S. Chhawri, "Virtual Reality Museum of Consumer Technologies," 2017, pp. 549–560.
- [2] H. Choi and S. Kim, "A content service deployment plan for metaverse museum exhibitions—Centering on the combination of beacons and HMDs," *Int. J. Inf. Manage.*, vol. 37, no. 1, pp. 1519–1527, Feb. 2017.
- [3] Q. Hu, D. Yu, S. Wang, C. Fu, M. Ai, and W. Wang, "Hybrid three-dimensional representation based on panoramic images and three-dimensional models for a virtual museum: Data collection, model, and visualization," *Inf. Vis.*, vol. 16, no. 3, pp. 126–138, Apr. 2017.
- [4] A. Fabola *et al.*, "A Virtual Museum Installation for Time Travel," 2017, pp. 155–270.
- [5] M. Sra, S. Garrido-Jurado, and C. Schmandt, "Procedurally generated virtual reality from 3D reconstructed physical space," in *Proceedings of the 22nd ACM Conference on Virtual Reality Software and Technology - VRST '16*, 2016, pp. 191–200.
- [6] M. Romanelli, "Museums creating value and developing intellectual capital by technology," *Meditari Account. Res.*, vol. 26, no. 3, pp. 483–498, Aug. 2018.
- [7] J.-L. Lugin *et al.*, "A Location-Based VR Museum," in *2018 10th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games)*, 2018, pp. 1–2.

- [8] F. Ferrari and M. Medici, "The Virtual Experience for Cultural Heritage: Methods and Tools Comparison for Geguti Palace in Kutaisi, Georgia," *Proceedings*, vol. 1, no. 9, p. 932, Nov. 2017.
- [9] J. Flotyński, J. Dalkowski, and K. Waleczak, "Building multi-platform 3D virtual museum exhibitions with Flex-VR," in *Proceedings of the 2012 18th International Conference on Virtual Systems and Multimedia, VSMM 2012 Virtual Systems in the Information Society*, 2012, pp. 391–398.
- [10] H. Rua and P. Alvito, "Living the past: 3D models, virtual reality and game engines as tools for supporting archaeology and the reconstruction of cultural heritage – the case-study of the Roman villa of Casal de Freiria," *J. Archaeol. Sci.*, vol. 38, no. 12, pp. 3296–3308, Dec. 2011.
- [11] V. Hill and S. Mystakidis, "Maya Island virtual museum: A virtual learning environment, museum, and library exhibit," in *Proceedings of the 2012 18th International Conference on Virtual Systems and Multimedia, VSMM 2012 Virtual Systems in the Information Society*, 2012, pp. 565–568.
- [12] A. Smolin, "Integration of internet and media technologies at the new stage of Alexandrinsky theatre," in *SGEM International Multidisciplinary Scientific Conferences on Social Sciences and Arts--Published by STEF92 Technica Sofia, Bulgaria*, 2014, pp. 329–335.
- [13] V. A. Nemtinov, A. A. Gorelov, Y. V. Nemtinova, and A. B. Borisenko, "Visualization of a virtual space and time model of an urban development territory," *Ser. Vsk.*, vol. 8, no. 1, pp. 120–132, 2016.
- [14] "OpenSimulator - open source multi-platform, multi-user 3D application [Online]. Available: <http://opensimulator.org>.

DEVELOPMENT OF ALGORITHMS AND SOFTWARE FOR THE SEGMENTATION OF OBJECTS ON MULTISCALE IMAGE SEQUENCES OF NANOSTRUCTURES

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ABSTRACT

The tasks and provisions of multiscale image processing of nanostructures are considered, the feature of which is the use of the concepts of heredity and variability of objects. Heredity refers to the process of preserving traits on a sequence of images of objects as the scale of observation changes. Under variability refers to the process of the signs or the emergence of new signs on a multiscale sequence of images. It is shown that the images of nanostructures on scales at which there is a sharp change in the characteristic features (characteristic properties) are of the greatest interest for analysis.

Algorithms and software for object segmentation, contour extraction and skeletonization of images of nanostructures, as well as their fuzzy counterparts, have been developed. Algorithms for extracting fuzzy features on image sequences have been proposed depending on the choice of the membership function. The possibilities of using the method of self-similarity based on a fractal image model are investigated.

KEYWORDS: image processing, recognition, multiscale analysis, nanostructures.

1. INTRODUCTION

Image segmentation is relevant now. It can be solved in various ways, for example, by the method of increasing regions, by segmentation by threshold (in the case of splitting-merging regions).

Image segmentation is one of the main areas in digital image processing and analysis. The main task of image segmentation is to find a partition of image f into its component parts AR_1, AR_2, \dots, AR_t . If A is the image area, then the segmentation should result in a partition of A into regions AR_1, AR_2, \dots, AR_t .

Various methods can be used to perform segmentation: a method of splitting-merging of regions, threshold segmentation (in the simplest cases), etc. Segmentation algorithms on multiscale image models are widely used [1,2].