DIGITAL LIBRARY FOR ORTHODOX ICONS COLLECTION OF REGIONAL HISTORICAL MUSEUM – BURGAS

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ЦИФРОВА БИБЛИОТЕКА ЗА ПРАВОСЛАВНИ ИКОНИ ОТ ФОНДА НА РЕГИОНАЛЕН ИСТОРИЧЕСКИ МУЗЕЙ – БУРГАС

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Абстракт: *В отговор на необходимостта от осигуряване на по-широка достъпност до православни икони, част от фонда на Регионален исторически музей – Бургас, експертен екип от Института по математика и информатика разработи и внедри мултимедийна цифрова библиотека „Виртуална колекция от икони“. Тази разработка цели да обезпечи адекватно и комплексно представяне, документиране, каталогизиране, съхранение и опазване на православните икони посредством използването на модерни технологии и решения. Статията представя семантичното описание на обектите на иконографското изкуство, архитектурата и функционалността на изградената цифрова библиотека.*

Keywords: *Multimedia Digital Library, Virtual Museum Collections, Functionality, Services.*

1. INTRODUCTION

The study and applications of knowledge-based methods for the creation, integration and development of multimedia digital libraries with applications in cultural heritage are a result of long-standing interests and work in the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (IMI–BAS) on the technological developments in information systems, knowledge processing and content management systems. Orthodox (East Christian) iconographical art is recognised as one of the most significant areas of Bulgarian cultural heritage and the main aim of the developers was the creation of a complete web-based environment for registration, documentation, access and exploration of Bulgarian iconographical artefacts and knowledge, providing wide accessibility and popularization of the East-Christian iconographical art works [6].

Research and protection of the rich history, archeology and still preserved nature of the Burgas region are among the main activities and priorities of the Regional Historical Museum - Burgas (RHM-Burgas). One of the main directions in this regard is related to documenting, cataloging, preservation and adequate exposure of the icons of the museum fund in hyperspace through the use of modern information and communication technologies. This Internet-based environment becomes a place where iconographical objects of different kinds and origins could be documented, classified, and „exhibited" in order to be widely accessible to both professional researchers and the wide audience. Rare specimens and collections in a risk environment or unstable conditions, etc. are appearing for new e-

exposition [11]. The transfer of innovative technologies from IMI-BAS to RHM-Burgas is a good example for cooperation in the area of cultural heritage digitasation [10, 12].

In this paper we present the release of digital library for orthodox icons collection of Regional Historical Museum – Burgas – Digital Library „Virtual collection of Icons" (DL-VCI, (http://www.burgasmuseums.bg/bidl/), passing from the semantic description of the iconographical art content to the DL-VLI architecture and functionalities, offered to the end users. During the DL-VLI development our main objectives are to give the users a tool, providing opportunity to access, observe and compare valuable Orthodox iconographical specimens of RHM-Burgas in their historic contex[1] (

The digital library for iconographic icons, developed in IMI-BAS, provides services for registration, documentation, access and exploration of a practically unlimited number of Orthodox iconographical artefacts and knowledge [5, 7] and the end users could use this rich knowledge base through its interactive preview, objects complex search, selection, and group. The first release of the digital library for iconographic icons was developed ten years ago during the national project „Digital Libraries with Multimedia Content and its Application in Bulgarian Cultural Heritage" (contract 8/21.07.2005 between the Institute of Mathematics and Informatics, BAS, and the State Agency for Information Technologies and Communications). Until now, the library is used in several cross-media, ubiquitous and technology-enhanced learning applications and projects in development [1, 3].

The key for the current release of digital library for iconographic icons is the efficiency and the provision of strictly designed functionalities, powered by a long-term observation of the users' preferences, cognitive goals, and needs, aiming to find an optimal functionality solution for the end users of RHM–Burgas. A special attention was pay to content creation, preview, search and administrative services, trying to cover a wide range of possible solutions. Moreover, the semantic content description orders the specification of unique descriptive scheme for iconographical art content, covering the rich semantic, identification and technical features of the iconographical objects.

2. DOMAIN ONTOLOGY FOR THE EAST CHRISTIAN ICONOGRAPHICAL ART

The domain ontology for the East Christian Iconographical Art, develop by the team of IMI-BAS for the solution of the problem for effective retrieval of the icons, is used for the semantic metadata description and indexing of the iconographical art content. Similar work for determination of semantic classification for the Byzantine icons is done in [9].

Several problems in „Icons" domain formalization appeared. The conceptualization and formal presentation of the iconographical art semantic posed specific challenges for our team of ontologists, art domain specialists and DL content creators, mainly related with: determining the set of separate ontological sub-structures of the iconographical object domain, the iconographic school, the author of iconographic objects, the iconographic character/scene, etc.; determining in an unique way the descriptors of the different types of iconographical objects (icon, wall-painting, miniature, plastic iconographic object, etc.) according to accepted canons of the Orthodox painting; reducing the complexity of the

[1] Project BG161PO03-1.2.02-0022-C0001 „Creation of an office for transfer of innovative technologies in enterprises of South-East Region", Operational Programme „Development of the Competitiveness of the Bulgarian Economy". The digital library „Virtual collection of icons" was developed by a team of Institute of Mathematics and Informatics – BAS: Prof. Radoslav Pavlov, Assoc. Prof. Desislava Paneva-Marinova, Assist. Prof. Lilia Pavlova, Assist. Prof. Detelin Luchev, Assist. Prof. Lyubomil Draganov and PhD student Maxim Goynov.

structures that describe different aspects of the iconographical object domain (especially for technological specifics, hierarchy of characters, descriptions of scenes, etc.) without loss of important content; presenting relations between classes and constructing their complete network; defining in an unique way the domain rules, axioms, constraints and facts (because of the incompleteness, inaccurateness or subjectivity of the existing information, presenting iconographical art domain); creating standardized and consistent descriptions of iconographical objects following the available standards for cultural heritage content presentation; etc.

The iconographical art world is described by three „thematic entities" (also called levels of knowledge) in the developed by the team of IMI-LAS ontological model. Every one of these entities is enriched with a set of sub-levels, covering wide range of characteristics. The first one is the „Identification" entity, which consists of general data identifying aspects such as IO title, type, author, its clan, iconographic school, period, dimensions, current location and source, and IO object identification notes, author's clan and biography, and iconographic school description. The second entity covers information concerning the descriptive details of the theme and forms of representation, providing a better understanding of the content. The third entity includes technical information revealing iconographic techniques, base materials, varnishes, gilding, etc., used in the creation of the iconographical object/collection, and also concerning examinations of the condition, such as diagnosis or history of the conservation treatment. These main entities and their metadata values are supported, documented and provided by the scientific diagnosis, which has been applied to the iconographical objects and collections [8].

Because the goal is to maximize the reusability and portability of the designed ontological model, the iconographical knowledge interpretations are not considered isolated from the standards and specifications in the field of representation of cultural information. The most significant development is the CIDOC Conceptual Reference Model (CRM), „object-oriented domain ontology" for expressing implicit and explicit concepts in the documentation of cultural heritage. During the creation of the „East Christian iconographical art" ontology we observe the conceptualization approaches of CIDOC CRM ontology. We use part of its concepts and properties in our ontology. We extend another part in order to make it fit the iconography domain. For example, our „Iconographical Object" class is a sub-class of CIDOC CRM E22 - Man-Made Object, our „IO Author" is CIDOC CRM E21 - Person, our „Clan" is CIDOC CRM E74 - Group, etc. The juxtaposing approach and a rich set of examples are included in [2].

To represent efficiently the iconographical annotation framework and to integrate all the existing data representations into a standardized data specification, the „East Christian iconographical art" ontology need to be represented in a format (language) that not enforce semantic constraints on iconographic data, but can also facilitate reasoning tasks on this data using semantic query algebra. This motivates the representation of this ontological model in Web Ontology Language (OWL). OWL facilitates greater machine interpretability of Web content than that supported by XML, RDF, and RDF Schema by providing additional vocabulary along with a formal semantics. Knowledge captured from iconographic data using OWL is classified in a rich hierarchy of concepts and their inter-relationships. OWL is compositional and dynamic, relying on notions of classification, reasoning, consistency, retrieval and querying. We investigated the use of OWL for making our ontology using Protege OWL Plug-in.

3. THE ARCHITECTURE OF DIGITAL LIBRARY „VIRTUAL COLLECTION OF ICONS"

The architecture of the DL-VLI contains two main service panels Object data management and Administrative services (see figure 1), jointed to a Media Repository and a User Profile Repository.

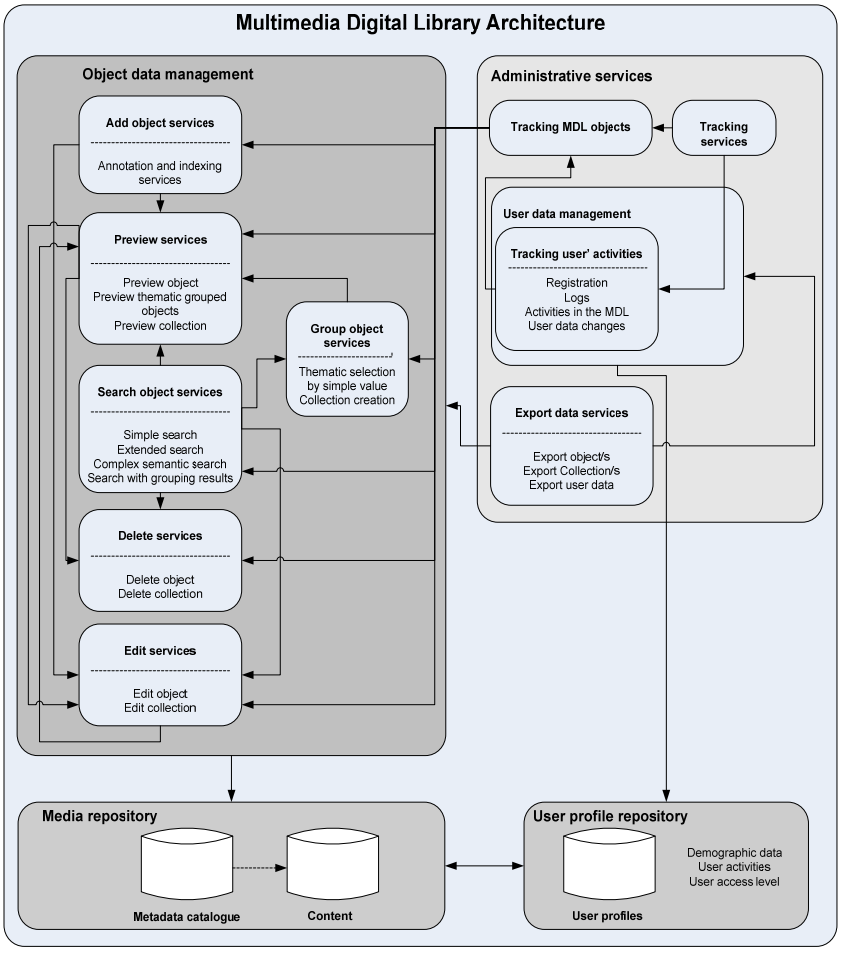

Figure 1: DL-VLI architecture

The Object data management panel refers to the activities related to content creation: add (annotate and semantic indexing), store, edit, preview, delete, group, and manage multimedia digital objects; manage metadata; search, select (filter), access and browse digital objects, collections and their descriptions.

The Administrative services panel mainly provides user data management, data export and tracking services. User data management covers the activities related to registration, data changes, level set, and tracking of the user. The export data services provide the transfer of information packages (for example, packages with DL-VLI objects/collections, user profiles, etc.) compatible with other data base systems. For example, with these services a package with objects could be transported in an XML-based structure for new external use in e-learning or e-commerce applications. The tracking services have two main branches: tracking of objects and tracking of users' activities. The tracking of objects watch the activities of add, edit, preview, search, delete, selection, and group of objects/collections in order to provide a wide range of statistic data (for frequency of service use, failed requests, etc.) for internal use and generation of inferences about the stability and the flexibility of the work and the reliability of the environment. The tracking of users' activities monitors user logs, personal data changes, access level changes and user behaviour in the DL-VLI.

For every object all semantic and technical metadata are saved in the Media repository. These metadata are represented in catalogue records that point to the original media file/s associated to every object.

The User profile repository manages all user data and their changes.

4. DIGITAL LIBRARY „VIRTUAL COLLECTION OF ICONS" FUNCTIONALITIES

4.1. Content Creation

The main part of the content creation process is the annotation and semantic indexing of digital objects in order to add them to the library repositories. The entering of technical and semantic metadata for a multimedia digital objects in the Digital Library „Virtual Collection of Icons" is implemented through different automated annotation and indexing services [4].

The technical metadata, expressed in Dublin Core, are attached to every multimedia object automatically. They cover the general technical information, such as file type and format, identifier, date, provider, publisher, contributor, language, and rights.

An annotation template is implemented for the semantic description of iconographic objects. The template provides several options for easy and fast entering of metadata:

- Autocomplete services (All used (already entered) field values are available in a special panel for reuse.) (see fig. 2);
- Automated appearance of dependencies coming from the relations of the defined classes' (concepts) in the Ontology of East Christian iconographical art. (All main relations and rules expressed in the iconographical ontological structure are incorporated during the development of the annotation template);
- Bilingual data entering with automated relation between the relevant values in different languages;
- Automated appearance of the number of the used field value, providing regular data tracking;
- A tree-based structure of the annotation template. Only checked fields are displayed for entering metadata;

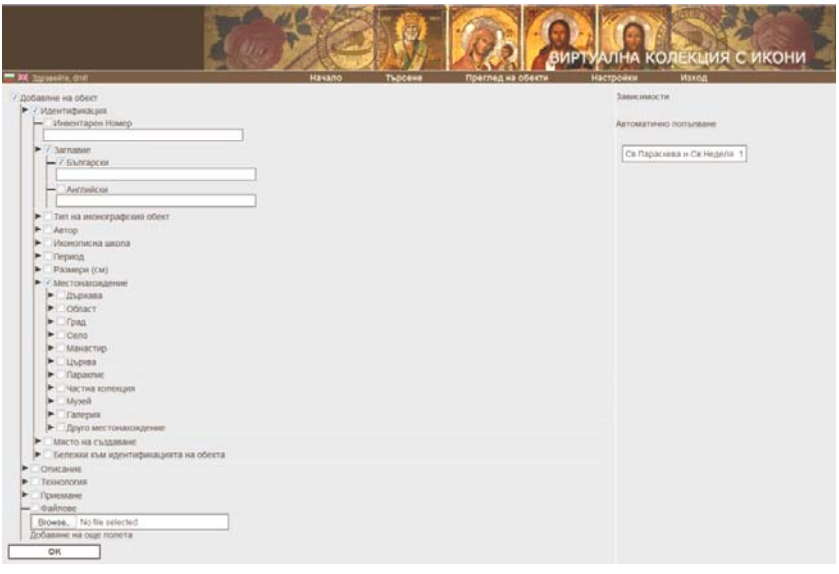

Figure 2: Part of the annotation template for an iconographical object

- Possibility for adding more than one media for one metadata description in order to create rich multimedia digital objects;
- Reuse of an already created annotation for new iconographical objects: the new media object has to replace the older one, the annotation is kept and the new iconographic object appears after saving;
- Automated watermarking of the image and video objects;
- Automated resizing of the image and video objects;
- Automated identification of file formats;
- Automated conversion of the audio, video and text objects in a format suitable for Web-preview.

4.2. Content Presentation

In order to satisfy the user's needs, during the development of the content presentation services a profound analysis was made of content selection and preview possibilities. First we had to determine the preview possibilities of a separate iconographical object and its components and after that the preview of grouped objects [4]. Figure 3 depicts the view of separate iconographical object.

The left frame of the preview window shows the description of the iconographical object. In the right frame the media/s object/s is/are situated. There appears a link to the original media source.

The shown media object is stamped through watermarking technique.

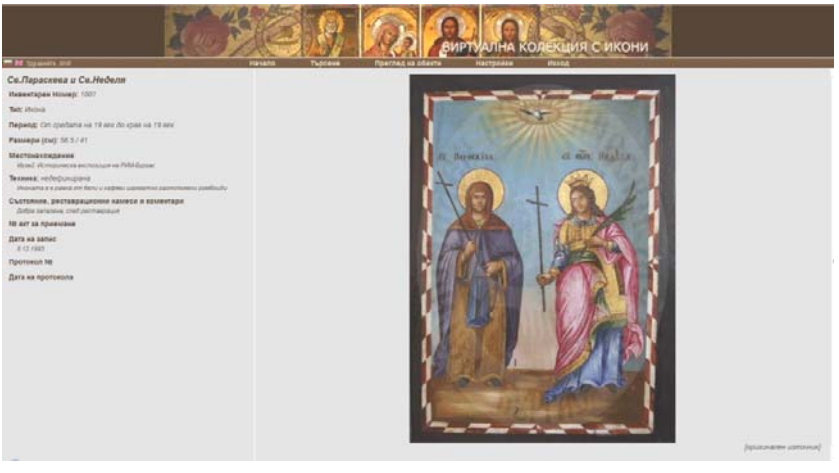

Figure 3: Saint Paraskeva and Saint Nedelya

The main iconographic ontology classes are selected as object grouping criteria. For example, there can be a preview of the available iconographical objects, grouped according to their title, author, iconographic school, used technique or base material. Using another grouping option the user can see separately a list of all the iconographers (authors), and selecting one of them he can see additional biographic information and the collections of their work.

An authorised user can create his private collection of selected objects after search activity. Rich search possibilities are available in order to assist collection creation. The user can write the collection's title and short description. He/she can also select its status: private or shared with other users. New objects for a collection appear automatically after their entering.

4.3. Content Search

Digital Library „Virtual Collection of Icons" provides a wide range of search services, such as keyword search, extended keyword search, semantic-based search, complex search, and search with grouping results. Their realization was based on querying action to the DL-VLI knowledge base using mainly the structural branches of the „East Christian iconographical art" ontology. Moreover, five types of conditions for the results set are meant:

- „objects having value = V for characteristic C"
- „objects having value ≠ V for characteristic C"
- „objects having numeric value ≥, ≤, >, <, *or* = *v* for a characteristic C". In the search templates you could search iconographical objects with precise date or period.
- „objects having characteristic C"
- „objects NOT having characteristic C"

The search services support content request and delivery via index-based search and browse of managed content and its description.

4.4. Administrative Services

The Administrative services panel mainly provides user data management, data export, tracking services, and analysis services. The user data management covers the activities related to registration, data changes, level set, and tracking activities of the user. The tracking services have two main branches: tracking of objects, tracking of user' activities. The export data from the administrative services panel provides the transfer of information packages (for example, packages with DL-VLI objects/collections, user profiles, etc.) compatible with other systems managing data bases. For example, with these services a package with DL-VLI objects could be transported in a XML-based structure for a new external usage.

5. CONCLUSION AND FUTURE WORKS

This paper presented Digital Library „Virtual Collection of Icons" (http://www.burgasmuseums.bg/bidl/) development and application for the iconographical collection of Regional Historical Museum - Burgas. DL-VCI will facilitate the process of providing the services by the RHM-Burgas and their quality. Services for electronically provided information will significantly improve the access to one of the significant funds of the RHM-Burgas. Digitization of unique iconographic collection of RHM-Burgas, which is one of the richest in the country, will provide maximum and safety accessibility of the artefacts and will facilitate and enhance traceability, analysis and study of the history and culture of Burgas region from antiquity to the present days.

REFERENCES

1. Monova-Zheleva M, R. Stewart, Y. Zhelev, Coins from the Burgas Bay. 2014. Creation of a New Digital Numismatic Content in the Internet, Representing the Economic and Cultural Development of Burgas Region from Ancient Times to the Present Days, In: Proceedings of International Conference „Digital Presentation and Preservation of Cultural and Scientific Heritage /DiPP/, Veliko Tarnovo, September 18-21, 2014, pp. 247-256. ISSN 1314-4006
2. Paneva, D., Pavlova-Draganova, L., Draganov, L., 2007. Towards Content-sensitive Access to the Artefacts of the Bulgarian Iconography. In: Proceedings of the Fifth International Conference „Information Research and Applications" - i.Tech 2007, Varna, Bulgaria, Vol. 1, pp. 33-38. ISSN 1313-1109
3. Paneva-Marinova, D., Pavlova-Draganova, L., Draganov, L., Pavlov, R., Sendova, M., 2009. Development of a Courseware on Bulgarian Iconography for Ubiquitous On-demand Study. In: Proceedings of Open Conference „New Technology Platforms for learning – Revisited", Budapest, Hungary, pp. 37-46. ISBN 978-963-87914-1-2
4. Pavlov, R., Paneva-Marinova, D., Goynov, M., Pavlova-Draganova, L., 2010. Services for Content Creation and Presentation in an Iconographical Digital Library. Serdica Journal of Computing, 4(2), pp. 279-292. ISSN 1312-6555
5. Pavlov, R., Pavlova-Draganova, L., Draganov, L., Paneva, D., 2006. e-Presentation of East-Christian Icon Art. In: Proceedings of the Open Workshop „Semantic Web and Knowledge Technologies Applications", Varna, Bulgaria, pp. 42-48.
6. Pavlova-Draganova, L., D. Paneva-Marinova, R. Pavlov. 2011. Ontological Presentation of East-Christian Iconographical Art Domain, International Journal „Serdica Journal of Computing", Vol.2, 2011, pp. 101-114, ISSN: 1312-6555

7. Pavlova-Draganova, L., Georgiev, V, Draganov, L., 2007a. Virtual Encyclopaedia of Bulgarian Iconography. Information Technologies and Knowledge, 1(3), pp. 267-271. ISSN 1313-0455
8. Pavlova-Draganova, L., Paneva, D., Draganov, L., 2007b. Knowledge Technologies for Description of the Semantics of the Bulgarian Iconographical Artefacts. In: Proceedings of the Open Workshop „Knowledge Technologies and Applications", Kosice, Slovakia, pp. 41-46.
9. Tzouveli, R., Simou, N., Stamou, G, Kollias, S., Kalomoirakis, D., Foukareli, G, Fyssas, N., 2008. Sacred Figure Recognition based on Byzantine Iconography Knowledge. Digital Heritage in New Knowledge Enviroment: shared spaces & open paths to cultural content, Hellinic Ministry of Culture, Athens.
10. Желев, Я., А. Тошков, Е. Николова, М. Желева. 2015. Развитие на икономика, базирана на знания и иновации, чрез изграждане на Офис за Технологичен Трансфер: Необходимост, концептуален модел и логическа рамка (втора част), списание „Бизнес посоки", 2015, 1, 88-100, ISSN 1312-6016
11. Монова-Желева, М., Р. Стюърт, Я. Желев. 2014. Изграждане на виртуална експозиция с икони от фонда на Регионален исторически музей – Бургас, Конференция „Иновации за развитието на бизнеса в Югоизточен Регион", 20 ноември 2014, 161-179. ISBN 978-954-8468-97-8
12. Стюърт Р., М. Монова-Желева, Я. Желева. 2014. Цифровизиране на музейните фондове – ИТ отрасъла в помощ на българското културно-историческо наследство, Конференция „Иновации за развитието на бизнеса в Югоизточен Регион", 20 ноември 2014, 127-143. ISBN 978-954-8468-97-8

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