CROSS-MEDIA AND UBIQUITOUS LEARNING APPLICATIONS ON TOP OF ICONOGRAPHIC DIGITAL LIBRARY

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ABSTRACT:

Today there are a large number of digital archives, libraries and museums with rich digital collections representing the European cultural and historical heritage. The new challenge shifts from having access to resources to making an effective use of them and avoiding information overload. A possible answer to this challenge is the approach, promoted by the LOGOS project *Knowledge-on-demand for Ubiquitous Learning*. In the frames of this project a learning platform has been developed in which the objects from large-scale repositories of digitized texts, graphics, audio and video materials are being transformed into learning content, taking into account possibilities for cross-media delivery among others. This has proved to be of a great importance when dealing with distributed artifacts. The present paper describes the process of transformation of the digital objects into learning content for the development of various coursewares. For this purpose the authors are using a specific learning scenario, viz. *Access-on-Demand for Studying East-Christian Culture and Art* developed on the basis of the LOGOS Authoring studio and the content of its knowledge repository *Virtual Encyclopedia of Bulgarian Iconography*.

INTRODUCTION

In an attempt to answer the need for presentation and preservation of the Bulgarian iconography, a team from the Institute of Mathematics and Informatics has developed a multimedia digital library called *Virtual Encyclopedia of Bulgarian Iconography* (http://mdl.cc.bas.bg). It was designed so as to provide wide accessibility and popularization of the works of the Bulgarian iconographers, and moreover to enable future precise restoration of the icons at risk.

The team having developed this digital library was involved in the European project LOGOS *Knowledge-on-Demand for Ubiquitous Learning*. The main objective of the project – to contribute to the adequate enhancing and facilitating the knowledge building during eLearning processes, presupposed the existence of large-scale repositories of digitized information and tools for their transformation into learning content. This made it natural to use the already developed *Virtual Encyclopedia of Bulgarian Iconography* as one of the knowledge repositories of the LOGOS platform. The present paper deals with the process of development of courseware on the basis of the information from the *Virtual Encyclopedia* starting with a short description of the digital library itself, than explaining the process of its transformation into LOGOS ontology and at the end – tracing the steps for the development of courseware objects.

THE VIRTUAL ENCYCLOPEDIA OF BULGARIAN ICONOGRAPHY

Up till now the digital library *Virtual Encyclopedia of Bulgarian Iconography* includes approximately one thousand digitized images of Bulgarian iconography by various artists, historical periods and schools. The digital objects are grouped into thematic collections according to their topics. For each object special detailed descriptions are created. They include data about the title, the artist, the period of creation of the work, the school, the dimensions, the technique, the base material, the category, the location, the author (biographic data), comments, etc. An important part of the digital library is the one with the descriptions of iconographic techniques and significant iconographic schools – works and biographies of well-known Bulgarian iconographic artists. A glossary of important terms is also included. The works presented in the library originate from the twelfth to the beginning of twentieth centuries. Amongst them specimens from the following schools and regions of Bulgaria are included: Bansko-Razlog iconographic school, Triavna iconographic school, Samokov iconographic school, icons from Veliko Turnovo, Sozopol, Rila Monastery, Arbanassi, etc.

This digital library contains diverse hypertext-organized collections of information (digital objects such as text, images, and media objects) to be used by many different users. Its main characteristics (e.g. ability to share information, new forms and formats for information presentation, easy information update, accessibility from anywhere, at any time, services available for searching, selecting, grouping and presenting digital information, extracted from a number of locations) are of a great importance for the access-on-demand learning. Using these services depends on the user's preferences, needs and wishes, i.e. there is personalization available, contemporary methods and tools for digital information protection and preservation, ability to use different types of computer equipment and software, etc. (Pavlov and Paneva, 2005).

In the past digital libraries were isolated and monolithic systems limited to access to content of a single provider. The development of the technologies during the last years provides new functionalities and advanced services to contemporary

digital libraries such as specialized services for multi-layer and personalized search, context-based search, relevance feedback, resource and collection management, metadata management, learning content personalization and context awareness, content indexation, semantic annotation of digital resources and collection, etc.

In order that digital libraries could be used efficiently as a source of knowledge in the eLearning specific features and principles are to be formulated. Here follow some examples.

- Digital libraries are expected to provide knowledge resources to the end user on-demand.
- Furthermore, they should provide tools and technologies in support of indexing, cataloguing, retrieving, aggregating, and creatively exploiting different textual, non-textual and complex objects and resources.
- In addition, the new eLearning trends require the implementation of tools for personalized preference-based access to digital libraries. Thus the data presented to the user would be reduced significantly as a result of filtering, extracting and aggregating digital objects in accordance with his/her preferences
- The objects in the digital libraries should be segmented, annotated and semantically indexed so that metadata attached to them could include semantic descriptions based on appropriate domain ontologies.
- The metadata should be written by means of standard description languages and stored in an appropriate metadata repository. The management services should enable a content-search on various parameters including efficient retrieval based on Boolean and similarity queries. It is important that any approach would facilitate the retrieval rather than force the user to search across the entire resource.
- Moreover, digital libraries should establish protocols, standards and formats most appropriate for the use and the assembly of distributed digital libraries and their resources (cf. Pavlov and Paneva, 2006).

THE ONTOLOGY OF BULGARIAN ICONOGRAPHICAL OBJECTS

As already mentioned, the digital library *Virtual Encyclopedia of Bulgarian Iconography* had to be transformed into domain ontology so as to be used as a learning content inside the LOGOS Authoring Studio. This ontology was named *Bulgarian Iconographical Objects*. In the hierarchy of data models of LOGOS architecture the digital objects are media objects accompanied by identification, technical and semantic metadata. Learning objects are (combinations of) digital objects, complemented by educational metadata (Marinchev at al., 2007). Courseware objects integrate learning objects according to schemes of learning experiences (Arapi at al., 2007). Authors of learning materials have access to digital archives. They search for appropriate digital objects, and combine them in learning objects and further – in courseware objects using the services of the LOGOS Authoring Studio. The aim of offering an easy access to digital archives determines the requirements to the *Bulgarian Iconographical Objects* ontology and its development process.

The *Bulgarian Iconographical Objects* ontology was implemented by means of the Ontology Management Tool of the LOGOS Authoring Studio called CoGui (see: http://gforge.lirmm.fr/projects/cogui) and was developed in the Montpellier Laboratory of Computer Science, Robotics, and Microelectronics. CoGui provides functionality to create and maintain multilingual vocabularies of concept types and relation types and also functionality for posing constraints, rules, fact graphs, prototypical graphs, pattern graphs, etc.

During the creation of the *Bulgarian Iconographical Objects* ontology the concepts and properties of CIDOC ontology were observed. Parts of them were used in our ontology, other parts were transformed in order to fit for the iconography domain, and several concepts did not belong to the CIDOC Conceptual Reference Model ontology.

The chosen digital library architecture is a hypermedia digital library. The resources are digital objects of different formats – text, graphics, and other media. They are structured in a hypermedia manner, i.e., some digital objects point to other ones. In this way the user can navigate quickly, in a non-linear fashion, within areas of related topics, using the hyperlinks. In this stage the *Search* service aids the visitors in finding a certain object by the following criteria: icon title, author, period, type, school, region and location. The search can be conducted by one or by more criteria. Our current development provides personalized and context-based search (Paneva at al., 2005, Pavlov at al., 2005, Pavlova-Draganova at al., 2006).

The LOGOS project addresses innovative development of the main components of the learning processes – resources, services, communication spaces. It aims at achieving new functionality of the learning communication spaces by integrated web, digital television and mobile technologies, supporting cross-media learning content. New eLearning management systems based on this integration are orientated towards an improvement and an extension of the learning services within new consistent pedagogical scenarios. The use of annotated and adequately structured knowledge from digital archives enables lecturers/authors to participate in *open source* content development from massive, dynamically growing learning resources (LOGOS).

ACCESS-ON-DEMAND FOR STUDYING EAST-CHRISTIAN CULTURE AND ART

The various project teams, from eight partner countries, generated future usage scenarios related to different user groups, contexts and topics. Scenarios are used in systems design to describe typical or important uses of the system as narratives or stories. They are designed to give designers, developers, users and managers a shared understanding of the purpose of the system and the ways it will be of use in practice (Pemberton et al., 2007).

The scenario we are going to present here is *Access-on-demand for studying East-Christian culture and art*, developed by the team of IMI. It is created according to several learning situations and communication channels. It involved a wide range of users both attached and unattached to formal educational programs. The scenario has several variants and for each of them the following characteristics are specified: learning background (topic area), learning situation, link to curriculum, learning setting i.e. support, place, time, devices used, learner background (age range, role and occupation, motivation type, etc.), planned learning activities, types of material accessed, specific objectives, learning approach, interactive functions needed/used by learner glossary, etc. (Pavlov and Paneva, 2006).

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LOGOS AUTHORING PROCESS

From a user's point of view, one could imagine various authoring scenarios for courseware development for Learners using content residing at external archives. The simplest and straightforward scenario presented here is the bottom-up scenario, starting with the creation of *media objects*. This overall scenario is depicted in Figure 1.
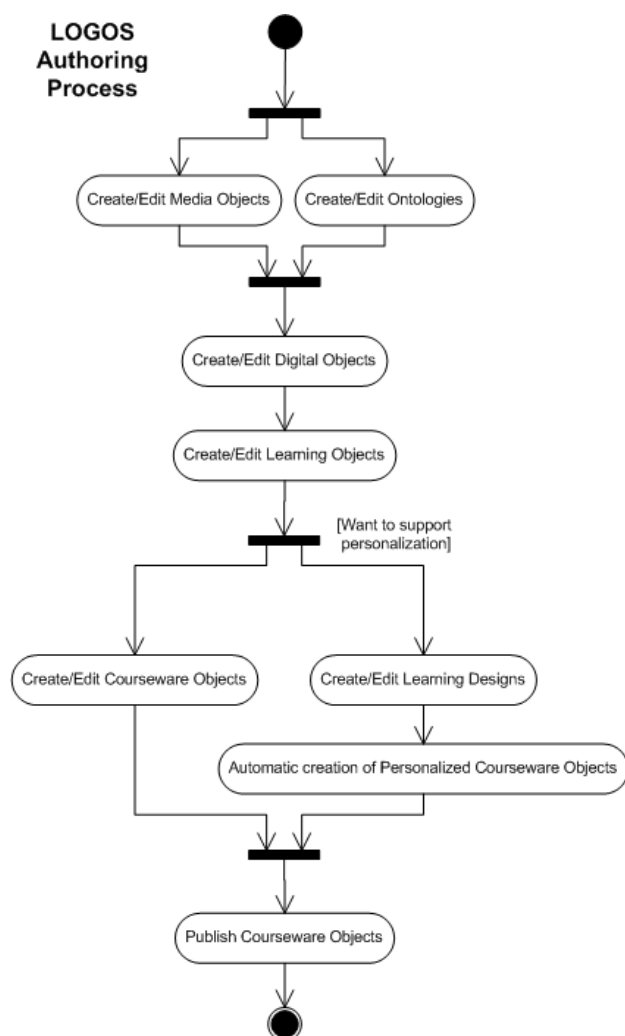

Figure 1: The overall authoring process in LOGOS

The editing process starts with building *media objects* and *ontologies* which form the basis of *digital objects* to be used further to create higher level objects (e.g. *learning objects* and *courseware objects*). Creating *media objects* and *ontologies* can take place in parallel.

The next step in the LOGOS authoring process is the creation of *digital objects*. This activity essentially consist in attaching appropriate metadata to the available *media objects* (or to parts of them) in order to include semantic annotations based on the available *ontologies*.

One can further create *learning objects* as collections of related *digital objects* that can be used to accomplish a specific learning objective. Such collections are further enriched by the *learning object metadata* (LOM).

The usage of *learning objects* in order to create *courseware objects* represents the next step in the process. It can be done in two approaches:

- One can statically create *courseware objects* by defining hierarchies of *learning objects* and by specifying their sequencing and presentation characteristics. (This is the most straightforward option.)
- If one wants to support personalization appropriate *learning designs* should be defined first. These are abstract training scenarios capturing the pedagogical characteristics of a training process for a certain subject without direct reference to the *learning objects* available for implementation of this training process.

The binding of training activities with the *learning objects* is done by an automatic mechanism enabling the creation of personalized *courseware objects* based on information about the user characteristics (this information can be extracted from a *learner profile*). The output of this automatic process represents *courseware objects* similar to the ones created manually in the case of static *courseware creation*.

The final activity in the authoring process is the publishing of *courseware objects* ready to be used by the *learners* by means of different devices (PCs, mobile devices, digital TV). Publishing a *courseware object* essentially means to decide on how the content will be presented to the end-user and what devices will be supported (Pavlova-Draganova at al., 2007).

Let us illustrated the static approach for the development of a courseware object entitled *Leading Bulgarian iconographic schools – style and achievements of the Bansko-Razlog iconographic school*. We used the *Courseware objects editor* to create the courseware objects by defining a hierarchy of the following *learning objects* (LO):

- LO1: Introduction to Bansko-Razlog iconographic school;
- LO2: Famous iconographic characters painted by iconographers from Bansko-Razlog iconographic school;
- LO3: Famous iconographic scenes painted by iconographers from Bansko-Razlog iconographic school;
- LO4: Saint Nicholas painted by iconographers from Bansko-Razlog iconographic school and other famous iconographic schools;
- LO5: *The Nativity of Christ* scene painted by iconographers from Bansko-Razlog iconographic school and other famous iconographic schools.

As it can be seen the *learning objects* follow the natural steps of the learning process: introduction to the iconographic school as a whole, presentation of the images of characters famous for this iconographic school, presentation of iconographical scenes representative of this iconographic school, and orientation between the various styles of representation of one and the same scene or character in the different iconographic schools.

All the *learning objects* are being managed in the *learning objects repository*. They are built on top of digital objects and enriched by *learning metadata*.

To develop the *learning objects* of *Leading Bulgarian iconographic schools – style and achievements of the Bansko-Razlog iconographic school* courseware object we used the

Description tool for learning objects. By means of this tool we created *learning metadata* for digital objects and combinations of such objects. For this purpose we used some *digital objects* (DO), viz.

- LO1:
  - DO1 – School description (shows several specimens created by famous iconographers from the Bansko–Razlog iconographic school);
  - DO2 – Representative specimens' demonstration

- LO2:
  - DO1 – *The Holy Mother of God* (The Virgin Hodegetria) character by D. Molerov, Bansko-Razlog iconographic school;
  - DO2 – *The Blessing Christ* character by unknown iconographer, Bansko-Razlog iconographic school;
  - DO3 – *Saint John the Forerunner* character by unknown iconographer, Bansko-Razlog iconographic school (Figure 1);
  - DO4 – *Saint Archangel Michael* character by I. Terziev, Bansko-Razlog iconographic school;
  - DO5 – *Saint George* character by unknown iconographer, Bansko-Razlog iconographic school;
  - DO6 – *Saint Dimiter* character by D. Sirleshtov, K. Marunchev, Bansko-Razlog iconographic school.
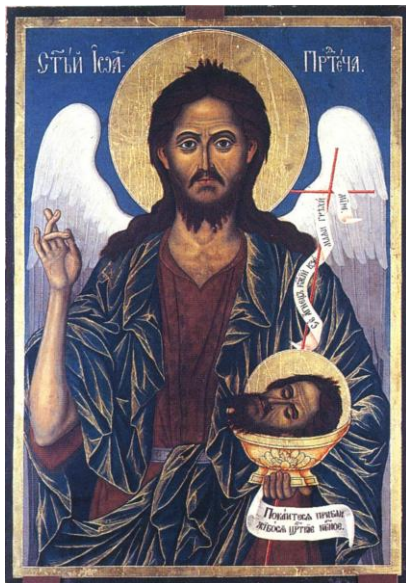

Figure 1: *Saint John the Forerunner* character by unknown iconographer, Bansko-Razlog iconographic school

- LO3:
  - DO1 – *The Holy Forty Martyrs* scene by unknown iconographer, Bansko-Razlog iconographic school;
  - DO2 – *The Ascension of the Prophet Elijas* scene by unknown iconographer, Bansko-Razlog iconographic school;
  - DO3 – *The Elevation of the Venerable Cross* scene by D. Sirleshtov, K. Marunchev, Bansko-Razlog iconographic school;
  - DO4 – *The Ascension into Heaven of Christ* scene by D. Molerov, Bansko-Razlog iconographic school.

- LO4:

- DO1 – *Saint Nicholas* character by D. Molerov, Bansko-Razlog iconographic school (Figure 2);
- DO2 – *Saint Nicholas* character by Ch. Dimitrov, Samokov iconographic school;
- DO3 – *Saint Nicholas* by D.Zograph from Sozopol, Strandja iconographic school;
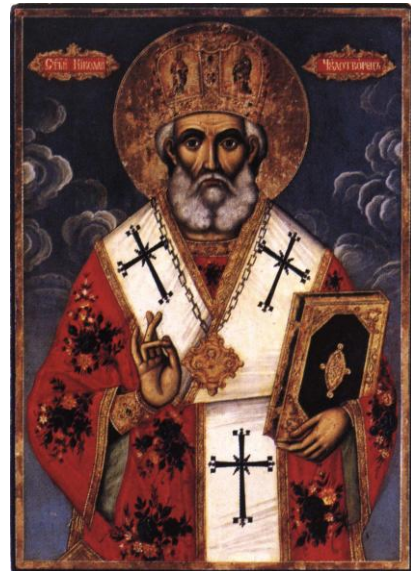- DO4 – *Saint Nicholas* by S. Tsanyov, Tryavna iconographic school

Figure 2: *Saint Nicholas* by D. Molerov, Bansko-Razlog iconographic school

- LO5:
  - DO1 – *The Nativity of Christ* scene by T. Vishanov, Bansko-Razlog iconographic school (Figure 3);
  - DO2 – *The Nativity of Christ* scene by unknown iconographer, Strandja iconographic school;
  - DO3 – *The Nativity of Christ* scene by unknown iconographer, Tryavna iconographic school.
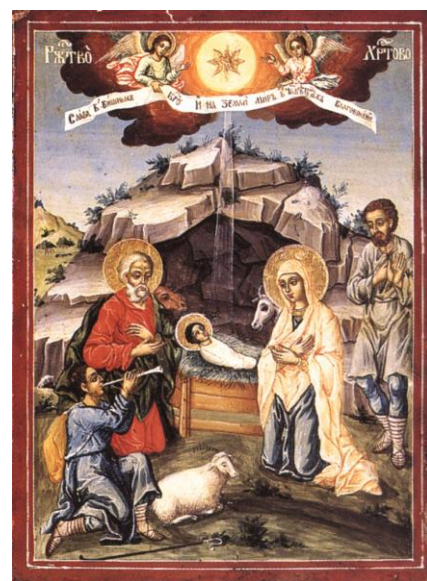

Figure 3: *The Nativity of Christ* by T. Vishanov, Bansko-Razlog iconographic school

All the *digital objects* are managed in the *Digital objects repository*. They are created on top of *media objects* or parts of them, annotated and indexed with administrative and semantic metadata. As far as the *media objects* are concerned, they are being managed in the *Media server*. They are coming from external content archives – in our case the *Virtual Encyclopedia of Bulgarian Iconography*.

We have presented in a nut shell the experience of our team in transforming a digital library into a knowledge repository. During our joint work in the context of the LOGOS project we gained a deeper understanding of the new opportunities the digital libraries offer as a learning resource.

An experimental testing of such scenarios is currently being carried out among university lecturers and students and the analysis of the results will be available in the nearest future.

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