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REGATTA – REGIONAL AGGREGATOR OF HETEROGENEOUS CULTURAL ARTEFACTS

Abstract: This article presents a project which addresses the building of a collection of significant amount of heterogeneous digital materials (presenting a wide range of movable and immovable cultural heritage, e.g. historical buildings, archaeological sites, museum and art galleries objects, etc.). The project has a twofold objective, to make the digital collection usable locally and also to meet the requirements of Europeana for subsequent aggregation. Our approach is based on open access solutions and offers opportunities for personalization of the repository interface. A particular difficulty we had to address was the lack of an aggregator identified for museum and immovable heritage content in Bulgaria, and due to specific conditions of introducing digitization in Bulgarian cultural heritage institutions, aggregation of museum and immovable heritage content is not done on large-scale level.

Keywords: Cultural Heritage, Heterogeneous Digital Objects, Europeana, Aggregators.

1. Introduction

Digital libraries offer modern technological solutions for presenting the artefacts of cultural heritage and providing semantic access to them. The main prerequisite for their effectiveness is the structuring of content through the preparation of standardized collections of metadata. The European digital library called Europeana plays a major role in bringing together cultural heritage content from various countries. One of the issues it faces is the distribution of uneven materials from different countries. While Europeana has already developed its strategy to include new digital objects through a network of aggregators and there are projects which prepare objects of specific types, the relatively low presence of objects from some countries could be explained by lack of a digitization strategy and respectively, a critical mass of digitized resources.

In current times, the new technologies allow creating "digitized images" of cultural artefacts and introducing them into our cultural space through the Web. As suggested in [1] "research on significant cultural and historical materials is important not only for preserving them but also for preserving an interest in and respect for them". The geographical disposition, relief and climate of the Bulgarian lands, especially the Upper Thracian valley, has turned it into an attractive living place many years ago. Because of this, from the Chalcolithic age till now many cultural layers have piled up. The creation of a common space for present-

ing different epochs and different types of cultural marks gives the opportunity to receive a complex notion.

Within the frame of the D002-308 project, funded by the Bulgarian National Science Fund, in the last three years we have studied the state of the art of world practice in metadata standards for presenting different kinds of digitized cultural artefacts. In parallel we have studied current state of the art in Bulgaria in the field of digitization of the cultural heritage. A particular difficulty we had to address was the lack of an aggregator identified for heritage content in Bulgaria – neither for museums and galleries nor for immovable heritage.

The article presents the results of work done in 2010-2011 on designing, developing and maintaining a repository of digitized collections of cultural objects. The concrete task is to create an environment for the maintenance of various collections through the aggregator in order to integrate them into the European digital library Europeana on one hand and to establish a good common environment for representing the regional cultural richness in this part of Bulgaria, on the other hand.

2. Europeana and Bulgarian Keepers of Cultural Heritage

Europeana is becoming the largest European digital repository of objects of cultural heritage. For the description of cultural heritage artefacts, Europeana uses a few metadata, making it a good basis for the creation of digital repositories for various types of sites and descriptions of museums, galleries, archives and libraries. Several projects connected with Europeana address different aspects of presenting European Cultural Heritage, for instance ATHENA (whose final goal is to bring together relevant stakeholders and content owners from all over Europe, evaluate and integrate *standards* and tools for *facilitating the inclusion* of new digital content into Europeana), EuropeanaLocal (aimed to improve the *interoperability* of the digital content held by *regional and local institutions* and make it accessible through Europeana and for other services), APENET (which try to provide EU citizens, public authorities and companies with a common portal, *accessing the archives* of Europe), MICHAEL (aimed to provide access to the *digital collections* of museums, libraries and archives from different European countries; focused on implementing an innovative multi-lingual open-source platform equipped with a search engine), CARARE (focused on making the digital content for the *archaeology* and *architectural heritage* that they hold available through Europeana; aggregating content and delivering services, and enabling access to 3D and Virtual Reality content through Europeana).

Naturally, the efforts of the relevant institutions in Plovdiv are directed towards incorporation into Europeana. The process comes in two stages: combining the resources of several institutions and shaping of the so-called aggregator, and then providing the aggregated digital content to Europeana. But till now, only a few institutions have some readiness for regional data transfer to Europeana.

As a conclusion of the survey done [2], we can say that the libraries are in a more advanced stage in the process of digitization of cultural heritage and achieving some interoperability with common standards. For instance, the librarians in Plovdiv and in the country use the MARC-standard and have developed virtual catalogues of bibliographic descriptions. The Regional National Library "Ivan Vazov" has already made several digitized book collections in the field of old-printed and unique editions. Under the project of the Ministry of Education and the World Bank in 2002, all the six libraries of the state universities in Plovdiv created a common Virtual Union Catalogue.

The processes of describing cultural artefacts in Plovdiv museums and galleries are at different developmental stages. Usually the electronic catalogues do not follow international

standards [3] (for example – Regional Historical Museum) and are not supported by relevant system (for instance, Regional Archaeological Museum used Excel-tables, following the MARC-standard). The other very important process – the process of digitization of cultural artefacts, is still at its very beginning. For instance, the Plovdiv galleries do not have digital versions of their owned and presented collections of paintings.

3. The Prototype REGATTA–Plovdiv

The imminent task was to create a regional aggregator of digital artefacts, based on the standard used by Europeana. The aggregator is presumed to be accessible for each regional cultural and historical institution (for storing digitized artefacts) and end users (for resource detection. The creation of a regional aggregator is the first step towards presenting and promoting the rich heritage of Plovdiv and the region in the European digital space.

The open structure of the aggregator permits the creation of data models for various types of digitized cultural objects. This allows the presentation of different types of collections, including museum collections, archaeological sites, immovable heritage from Ancient, Mediaeval and National Enlightenment periods in Bulgaria. The selected approach supports the idea of preserving the valuable national monuments in the European area of culture keeping their identity and specificity. The experimental "**REG**ional **A**ggregator of he**T**erogeneous cul**T**ural **A**rtifacts" (REGATTA) is the basic practical outcome. Currently the first version of the REGATTA is applied for the Plovdiv region and can be accessed on http://www.plovdiv-eu.com. Five content providers are registered – Plovdiv Regional Ethnographic Museum, Kabile National Archaeological Reserve, Pazardzhik Historical Museum, Asenovgrad Touristic Information Centre and Plovdiv Touristic Information Centre. Over 4400 digital artefacts are incorporated in the aggregator.

The Prototype REGATTA-Plovdiv is developed using PHP+MySQL platform [4, 5], free JavaScript/css tools for text editing [6], HTML text and galleries viewing [7], modelling of tab-panels [8, 9], drop-down menus [10] and calendar pop-ups [11].

The main features of the system are:

- multiuser – users with different roles are organized in a hierarchy, which determines access rights to services;
- multilingual – objects can be introduced in one or more languages;
- establishing catalogues of objects – the standard options for entering, editing and deleting objects and different types of searches (keywords, categories, dates) are established;
- defining categories of objects – the standard opportunities for input, edit and delete categories from the administrator are provided. In the near future there will be open possibilities for creating categorization of objects by content providers;
- modelling of the collections – some opportunities for modelling collections using the basic scheme have been put into effect. A module for dynamical addition of custom fields with different types is under construction;
- managing own sites – "MySite" module is under construction. It allows the user to configure its own site containing the user' artefacts and other information.

Since there is no "open source" system that meets all the requirements, we have created our own proprietary technology. Our technology allows the development of web sites where business logic is separated from the language-dependent texts and from the data presentation.

The functional structure of REGATTA follows the framework suggested in the Open Archival Information System (OAIS) [12] which had also been adopted as the international

standard ISO 14721:2003. This model finds its successful implementations as a common framework with concretizations in application areas for the so-called GLAM (Galleries, Libraries, Archives, Museums). Figure 1 shows the functional schema of REGATTA conforming with OAIS.

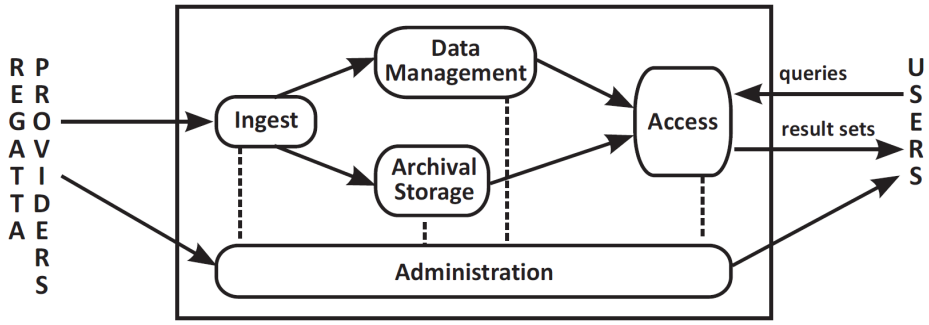

Figure 1. REGATTA Functional Entities

The aggregator for digital collections is a web-based technology, offering the numerous different users the possibility not only to publish objects on the Internet but also to create their own models of data, related to these objects [13]. All the objects with the same data model are combined in a collection.

Treating collections as part of the model is very natural for GLAM institutions and is something which differs in the case of REGATTA from the approach of Europeana. Browsing within a specific collection is natural to visitors of cultural institutions and also has a number of benefits in the digital space because it contextualizes the objects and allows to easily discover multiple objects which are thematically or chronologically related.

A good example in this direction is Ireland's gateway to Irish digital collections and resources DHO:Discovery (http://discovery.dho.ie). It supports the interdisciplinary and inter-institutional sharing of knowledge throughout the Humanities Serving Irish Society (HSIS) consortium and across digital research collections of Irish interest [14]. A key requirement of DHO web site development was the need to support both the development of thematic research collection project web sites, led by the partners and focusing on a single collection of resources, and the need to provide a generic cross collection interface to discover and re-use resources across the whole repository.

The goals of creating REGATTA were similar – to keep the specificity of each collection in order to assure the most colourful representation of each object in its natural environment on one side, and to build a common frame, which allows different kinds of objects that have some semantic connections in different levels to correlate easily.

In the case of uniform collections different kinds of producers usually apply the same metadata model. Here the collections present different objects. For instance: texts and images for movable artefacts; 3D representation for immovable sites; music or video for representing folklore and customs, etc. and each object of these different types is supplied with a corresponding metadata description. Because of this, REGATTA allows the producers to add their own object characteristics. The incorporated technology that reflects the specifics of data input includes [15]:

- creation of a basic scheme for object description. The basic scheme of the REGATTA includes fields, defined in Europeana standard [13], and additional fields in accordance with "Scientific passports of movable cultural artefacts in Bulgaria" [16];
- hiding some of the fields from the forms during data input. When creating a new collection model, some fields of its basic scheme can be suspended from the list;

– adding supplementary specific fields/characteristics from the producers;
– defining names of the models.

The creation of data models ensures additional categorization of the objects and facilitates data input.

A collection in the sense of the created technology is a set of objects with an identical data model. Using the data modelling mechanism, different institutions can create a collection of object descriptions based on already existing metadata schemas or put their own schemas.

In the REGATTA aggregator several roles are defined:

– *content provider/producer* – there are two types of registered users that supply content into the system – ordinary users and institutions. They can create, edit and delete categories, collections, web sites;
– *assistant* – each institution may determine assistants for entering of objects. When an institution activates an object, it becomes inaccessible for the assistant who entered it. Such assistants could be students or employees temporarily engaged in the institution;
– *administrator* – controls the major categories and collections of the portal as well as the objects created by ordinary users;
– *unregistered user* – can only browse the content of the site;
– *external web applications* – these are web applications of institutions, which use different types of access to their own data (xml; generated by the aggregator html; other web services).

The use of the REGATTA aggregator includes 5 main processes: ingest, archival storage, data management, administration and access (Figure 1).

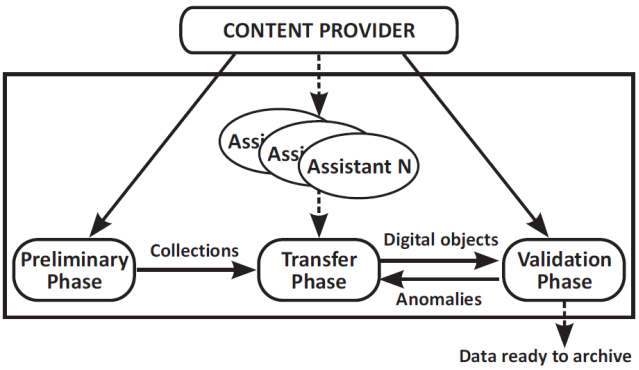

Figure 2. REGATTA Ingest

Ingest: The process of incorporating digital objects into REGATTA takes place in three phases: Preliminary Phase, Transfer Phase, and Validation Phase (Figure 2). The Preliminary phase includes identification of information for objects that will be presented in the aggregator. The content provider creates a model of the collection or selects any of the already defined models in the REGATTA collections. This is also the process where the assessment of resources (time, human, financial) is made. In the transfer phase, the data input is done. Each assistant can manage only objects stored by him/her. The content providers can monitor the work of their assistants. In the presence of well-structured digital information by the provider, we can prepare a tool for automatic transfer, by defining the appropriate mappings. The Validation phase includes verification of the data entered and removing errors and omissions. Only after this phase, digital objects become part of the public record of REGATTA and can be accessed by users.

Archival Storage: This module provides services and functions for storage, maintenance and restoration of digital objects. This includes receiving digital objects from the Ingest and adding them to the backup repository, performing routine and special checks for faults, periodical backup (duplication) of data for recovery after a system failure.

Data management: The module provides services and functions for implementation, maintenance and access to both descriptive information which identifies the owner of the archive, and to the administrative data used to manage the archive. This includes functions for managing database records updating the archive, performing operations on data retrieval efficient sets and generating relevant reports, and more.

Administration: Administration module provides services and functions for the overall functioning of aggregator: registration and maintenance of accounts, defining collections, data entry in the aggregator (digital objects and descriptive information), management of providers' standard sites, search, retrieval, formatting data, and more.

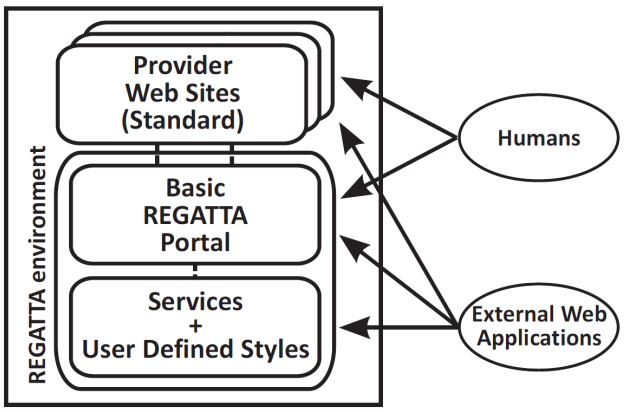

Figure 3. REGATTA Access

Access: Regarding access to the aggregator, there are two main types of users (Figure 3): humans and robots. Humans use the REGATTA-content through the base portal. Each content provider has a standard web site, containing his objects and additional information, which is also accessible for humans. The second types of users are web applications, which extract data from the aggregator and process it further. The simpler types are different kinds of search engines that use data directly by the basic model. The more sophisticated web applications use data and links, given by the aggregator for incorporating into static or dynamic web sites, 3D-tours, virtual excursions, etc. For these purposes REGATTA ensures standardized services for generating content. There is an option to define user styles, which is used by REGATTA to return formatted content, which can be incorporated directly into the external web-application without additional processing.

Using the developed tools for modelling of the collections, we created six basic data models:

- Europeana (BG, EN) – the object of such collection has all the standard features of Europeana in Bulgarian and English language;
- Europeana SHORT (BG, EN) – it is based on the previous model, but some rarely used metadata fields are excluded;
- Scientific passports (Europeana+) (BG, EN) – passports of digital objects, in accordance with Europeana [13] and "Scientific passports of movable cultural artefacts in Bulgaria" [16];
- Three additional models based on the above ones – Europeana (BG), Europeana SHORT (BG), Scientific passports (Europeana+) (BG) – created to facilitate the introduction of digital objects for which information is available only in Bulgarian (most common case in our practice).

4. Example of Successful Migration to REGATTA

Regarding the technical interoperability [17], the processes of migration from different kinds of artefacts' presentations towards REGATTA have to be decided on a case by case basis. But the first question is: "Is there any compatibility between the fields of Europeana and the fields in the existing passports of the objects?"

Although the aggregator was created a short time ago, the automatic transfer of data concerning the objects from the collection of the Ethnographic museum was successful [18]. The digital information was kept into Excel files, which contain the so-called "Scientific passports". The passports are made in accordance with the state requirements [16]. They present the metadata that are mandatory for Bulgarian museum institutions, and are also compatible to the MARC standard.

The comparison made between the characteristics of the object in accordance with the Europeana standards and *the passport of movable cultural valuables* shows a great percentage of compatibility [2]. It allows automated transfer from existing resources to the database [15]. Table 1 shows the bijection between fields of the scientific passport and REGATTA-metadata on the example of one particular exhibit (shown in Figure 4) of the museum. The Excel-files were easily transferred to a database table (in this case – MySQL).

More than 4000 objects from the fund "Crafts" at the Ethnographic Museum have been introduced in the catalogue till now.

Table 1. Scientific passport N4501 of Plovdiv Regional Ethnographic Museum and correspondence to aggregator metadata

Passport fields	**Values**	**Aggregator metadata**
Section	Crafts	Created by the administrator
Collection	Wrought Iron	Created by the administrator
Name	Wall candlestick with two arms	dc:title
Informal name		dcterms:alternative
Inventory number	4501	dc:identifier
Dating	2005	dc:date
Number of exemplars	1	
Material	Wrought Iron	dcterms:medium
Sizes	H=78 cm, W=38 cm	dcterms:extent
Weight		dcterms:extent
Carats		dcterms:extent
Object is one with inv. numbers		dc:relation
Place of production	Plovdiv	
Place of storage	Craft Fund of REM-Plovdiv	
Author of the original	Georgi Manolov	dc:creator
Technique	Craft mastering	
Technology		
History of the object		dcterms:provenance
The object belongs to the group of	Professional	

Condition	Very good	
Conservation and restorations		
Object description	Wrought-iron wall candlestick with two arms; examination work of Georgi Manolov before a committee of ZMNHZ (Society of Masters of Traditional Arts and Crafts) to obtain a master's degree (2005).	dc:description
Literature		dcterms:references
Surrogates	no	
Object moving		
Remarks		
Passport maker	Sonya Semerdjieva	
Appointment	Chief organizer	

Automatically for this object the system filled:

europeana:isShownAt	http://www.plovdiv-eu.com/object.php?id=3
europeana:isShownBy	http://www.plovdiv-eu.com/images/user_objects/3/137442258712903139 9.jpg
europeana:type	IMAGE
europeana:provider	In progress

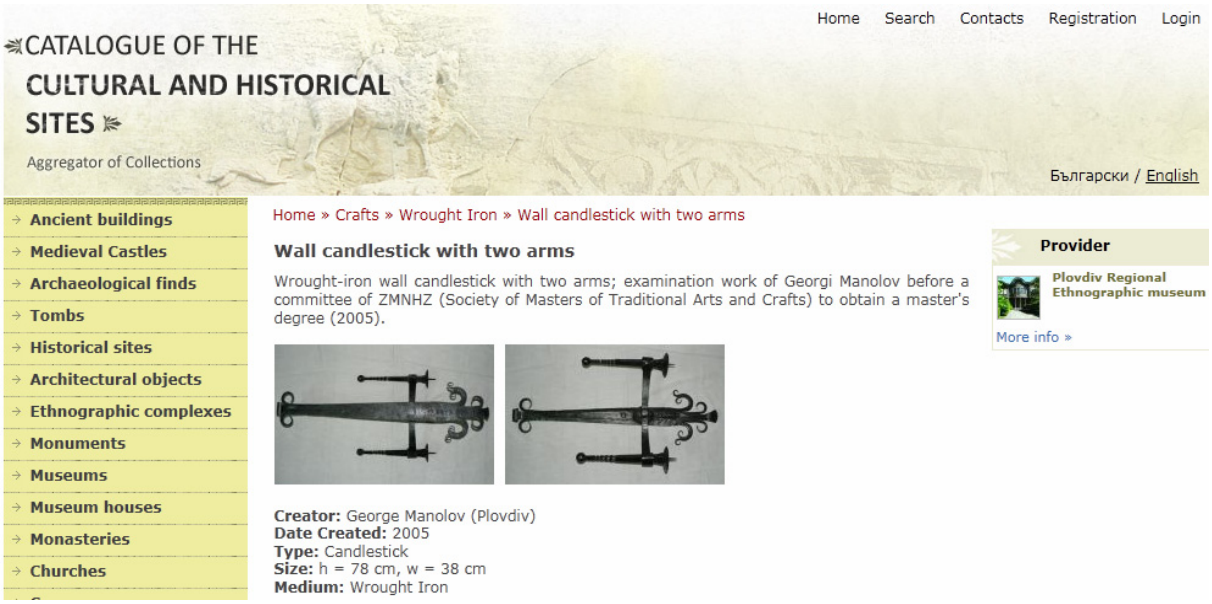

Figure 4. Exhibit N 4501 of Plovdiv Regional Ethnographic Museum

5. Presentation of Immovable Sites in the Aggregator

The information about currently presented immovable historical, cultural and natural sites is provided with the kind co-operation of Asenovgrad Touristic Information Centre as well as other cultural institutions, such as Kabile National Archaeological Reserve. The information about this type of immovable sites is still in the process of unification and enrichment. At this stage, the immovable sites are not presented in a proper manner in our digital space. Now, the available data about the objects are short descriptions of the places and their usage in the years, pictures and links to the contributors of information. There are plans to present this kind of objects with 3D-presentation in the future. There is an ongoing process for providing

rights to represent immovable sites in digital form and this process affects different institutions, such as the Ministry of Culture, the Saint Synod, municipalities, etc.

The successful examples of integrating the learning process with opportunity for collaboration to develop a shared syllabus and associated teaching and learning resources for humanities visualization, such as the educational and research project Second Life, presented in [19], gives us confidence to start programs in the informatics specialties in Plovdiv Universities for using 3D and VR-representation of these sites as practical works.

The first steps for presenting immovable sites have already been made [20]. 3D and VR representations of the Plovdiv Regional Ethnographic Museum have been created. The connections between VR representation and digitized craft collection have been established. Now, the process of incorporating these resources in REGATTA is in progress. In parallel, the construction of the collections that represent immovable sites is expanded with the information in correspondence with [21] in order to establish easy incorporation into Europeana.

6. Conclusions and Trends for Future Work

The development of an aggregator for online cultural and historical objects continues through the creation of additional new opportunities for both rounds of consumers – the museum curators and other visitors with diverse interests. In this direction our interests are focused on the enforcing of data management with the tools that can increase resource detection.

In the frame of the D002-308 project, which supports the implementation of the REGATTA aggregator, several tools were invented that use different kinds of data mining techniques for automated metadata extracting and categorization.

An approach for indirect spatial data extraction by learning restricted finite state automata is presented in [22]. It uses heuristics to generalize initial finite-state automata that recognizes the positive examples without extracting any non-positive examples from the training data set. The implemented system InDES was tested over extraction of spatial metadata from web sites and shows promising results. It gives us assurance that such approach can be used for metadata extraction from objects descriptions, thus used in the process of migration from older representations of the objects in cases when the descriptions are in non-structured form.

Association rule mining (ARM) is a popular and well-researched method for discovering interesting rules from large collections of data. One approach for association rule mining, which uses the possibilities of the multidimensional numbered information spaces as a storage structures is presented in [23]. The algorithm ArmSquare is realized in data mining environment system PaGaNe [24]. The possibilities of extracting frequent item-sets can be used for enforcing connections between metadata elements within a created ontology.

Based on similar techniques, but in the field of categorization, are class-association rules (CAR) algorithms. Compared to other classification methods, associative classifiers hold some interesting advantages [25]: very efficient training; easy handling of high dimensional training sets; fast classification; high accuracy; easily interpretable classification model. The created algorithm PGN [26], which is a kind of CAR-algorithm, is also implemented in PaGaNe. It was implemented in the field of analyzing semantic attributes, extracted from art images using content-based image retrieval. The rules, extracted by PGN, form the semantic profiles of the examined movements [27]. Within the frame of the data management and the access of the aggregator the classifier PGN can be used for enforcing information detection.

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