Towards a Community-Oriented Map-Based Portal for Cultural Heritage

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Abstract: - Modern Internet portals to cultural heritage of given nation provide aggregation of multimedia content from digital libraries plus some semantic services but miss support of community collaboration in content enrichment and metadata annotation. The paper presents a new portal for internationalized content authoring, enhancing and annotating, and management of various types of descriptions of immovable cultural monuments. The portal provides community collaboration services in order to encourage and facilitate accumulation of distributed public knowledge about immovable cultural heritage. The conceptual design of the portal is based on ontology and metadata templates for each monument type used for content creation and management with community support. There are explained the software architecture of the portal and the practical realization of its first prototype.

Key-Words: - cultural heritage, immovable monuments, metadata, annotation, templates, portal, maps, community

1 Introduction

Cultural heritage has traditionally opened a waste area of both semantic Internet research and practical challenges in constructing and usage of software tools, platforms and portals for digitization and digital access to content about immovable and movable cultural monuments. It reveals a semantically rich, multicultural domain of public applications being of interests for content providers, professionals, organizations and all the citizens. Content provisioning is very heterogeneous as content is produced for various purposes in different forms, formats, topics, and languages. That fact creates many obstacles to the end users but also provokes new trends in content production and software industry.

Majority of software applications in the cultural heritage domain are semantic Internet portals for aggregation of multimedia content from digital libraries and delivery channels of various organizations [1] providing a global view to heterogeneous, distributed document materials. Such cultural portals known as information portals [2] aggregate either content itself or content metadata only and, thus, they provide effective publication channels and different global search services to the end users. Another brand of semantic portals is that of community portals [3] which create virtual meeting space for people of given community. Many portals also act as service portals by incorporating various services for content provision, re-mastering, search and delivery [4]. Some of them provide object locating services by use of satellite or terrain maps such as Google Maps[1] or historic maps [5].

The paper presents the conceptual design, the software architecture and the first prototype [6] of a community-oriented, map-based, internationalized cultural Web portal with semantic services which is under development at Sofia University, Bulgaria. The portal enables content creation, improvement, annotating and reuse by a community of end users motivated in preservation of cultural heritage in Bulgaria and popularizing it through Internet. The portal users are able to create semantically annotated descriptions of their favorite cultural immovable monuments by means of content template for the given monument type based on metadata organized in ontologies. After selection of a presentation template they will be able to run that content as a Web site. In contrast with Wikipedia, contributors to another's description are not anonymous and need approval by the description

[1] http://maps.google.com/

author for publishing their contribution (content and/or annotation). The distributed multi-user content authoring is combined by centralized control over ontology, vocabulary and monument register. Any guest user is able to do semantic (so called facet-based [7]) search based on selecting one or several monument types within the ontology and, also, metadata annotations available within the content template for a given monument (landmark). By using semantic search and other services similar to these in [8] users may locate a monument on the Google map and browse their content descriptions as a Web site.

2 Motivation and Related Works

When designing a semantic portal, there are at least three issues to be resolved:

- content model – objects' ontology (usually described in OWL [9]), metadata (such as Dublin Core (DC) Metadata [10]) and, eventually, logic rules for derivation new knowledge using metadata and ontology, plus level of confidence in content;
- content creation and management rules – creation and maintenance of ontology, vocabulary, thesauri, semantic annotations, etc.
- portal services – such as semantic (faceted) search, semantic browse and recommendation (of semantically near objects), personalization and context awareness, visualization (e.g., map-based), etc.

There are many prototypes and fully-fledges portals which incorporate some of the features listed over. More of them provide content aggregation with syntactic interoperability by sharing metadata schemas between different data sources, which allows searching on different aspects of the cultural objects. Examples for such portals are many virtual museums such as Artefacts Canada [11] and the Australian Museums and Galleries Online [12]. Other portals provide content aggregation at the semantic level where not only the metadata syntax is shared but as well the various shared metadata vocabularies are mapped each other and therefore have the same meanings. The portal "MUSEUMFINLAND - Finnish Museums on the Semantic Web" and its successor "CULTURESAMPO - Finnish Culture on the Semantic Web" are cross-domain semantic cultural portal integrating distributed, syntactically heterogeneous collections by shared ontologies and providing semantic search and browsing services [1]. Europeana [13] is focused in building a joint network of local and regional digital libraries, museums, archives and audio-visual archives. Integrated, multimodal and multilingual approaches for the presentation of cultural monuments on the Web have been started in almost all the European countries including Romania [14] and Bulgaria [15].

Though the trend of partial convergence between the three portal types mentioned in previous chapter – information, community and service ones, for the moment there is no practical examples for a cultural portal combining main features of these three types in an effective way. The author truly believes in a synergy of such an approach, where the general end user will not only search, browse and download content about cultural heritage but also will create, enrich, share and reuse newly produced content in a distributed way. Good examples of Web 2.0 tools used in social networks are listed in [8], such as:

- Wikies – for creation, edition and linking Web content;
- Blogs – Web sites for chronological, event-oriented content;
- collaborative tagging (folksonomy) - for creating and managing tags to annotate and categorize content
- Multimedia sharing services a la YouTube[2] or Twitter[3]

The map-based portal of immovable cultural monuments presented in next sections merges some features of the information, community and service portals. It incorporates strategies for distributed, community-oriented content authoring and annotating while the control over object ontology and metadata is centralized. It follows an explanation of the portal conceptual model.

3 Conceptual Design of the Portal

This section of the paper is devoted to the conceptual design of the community-oriented, map-based, internationalized cultural Web portal with semantic services. It explained its content model, content creation process and management rules, and portal services.

3.1 Content Model

The content model is based on strong type control based on ontology of objects able to be presented onto the map. The objects are supposed to be immovable cultural heritage but in fact may be of any other type representing a geographical object on the map or so called *mapped object*.

Fig. 1 shows a part of sample ontology of human artifacts. A special part of it is the ontology of

[2] http://youtube.com/
[3] http://twitter.com/

cultural monuments (CMs) shown in dark background. The rectangles present types of geographical objects while the bold interconnected lines depict type inheritance relations known as well as "*is-a"* relationships [16]. The most generic type is the mapped object which is inherited by human artifacts and natural formations. CMs ontology is presented in partial view below the artifact type. In dotted lines are shown relations of reference known as well as "*has-a"* relationships [16]. Reference "*has-a"* relationships denote metadata descriptions annotating given type and may have various semantic. For example, a castle could be nearby to a chapel (fig. 1). These semantic annotations are presented easily in RDF graphs not in OWL ontology description but for content itself and are used for semantic search and browsing (see section 3.3).

It is important to note, that "*has-a"* relationships may be represented as a predicate having parameters of given type. For example, such relationships may model the relation between two object – A and B, where A is "located not farer than distance of N km from" B, where N is an integer. In such a way, "*has-a"* connections are able to depict complex relationships between objects. Once defined, these relationships will be used later for semantic search based on predicates available for given object and using some values for building conditions over the predicates' parameters (e.g., "find all the objects of given type located no far than 20 km from the target object").

Each mapped object type within the ontology is described by its semantic metadata defined by a XML schema for the type. Many implementations such as Europeana [13] used as a base Dublin core standard [10] with proper extensions. Our approach is the same as far as top ontology object type has base metadata descriptions and its successors below extend (or specialized) this metadata by usage of inheritance. Thus, more specialized sub-typed CMs possess more detailed metadata structure. In [16] there is presented an approach dealing with multiply inherited metadata, which is used here, as well. Example for multiple inheritance is the object type 'cathedral-museum' in fig. 1, which interconnects two different ontologies, namely cultural monuments with religious temples.

Fig. 2 presents part of the metadata applied for the type 'monastery'. For each metadata description, the model defines an appropriate GUI control for its graphical presentation, content type, mandatory status (yes or no), order, identifier (name), and titles and default values in supported languages. For the first prototype, only Bulgarian and English languages are supported, however, the data model is sufficiently flexible in order to allow easily addition of any other language.

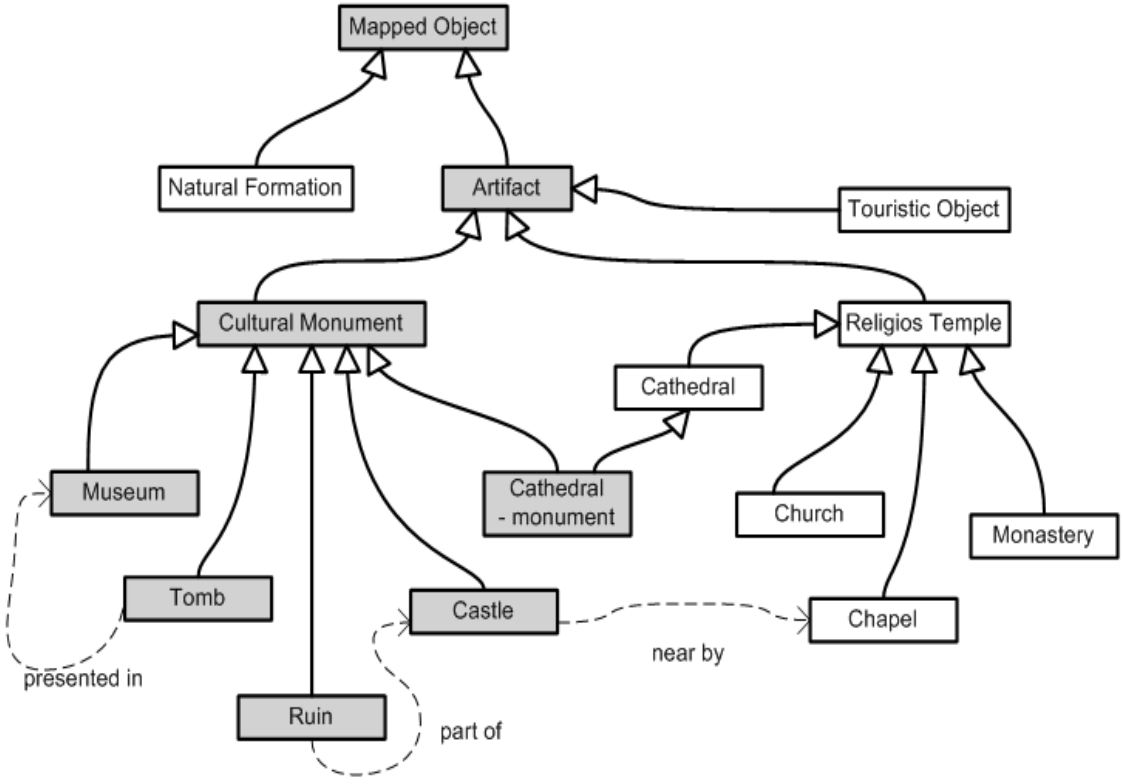

Fig. 1: Sample ontology of artifacts

GUI control	Content type	Mnd	No	ID	BG title	EN title	BG values	EN values
Label	String	Yes	1	type	Тип	Type	манастир	monastry
TextBox	String	Yes	2	title	Име	Title		
CheckBoxList	String	Yes	3	active	действащ	active	да,не	yes,no
TextBox	String	Yes	4	established	основан	established		
TextBox	String	Yes	5	renovated	обновен	renovated		
TextBox	Other	Yes	6	patronalFeast	храмов празник	patronal Feast		
DropDownList	String	Yes	7	femaleMale	тип	type	мъжки,женски	male,female
Multiline	Other	Yes	8	description	описание	description		
Image	Other	Yes	9	photo	снимка	photo	снимка на манастира	monastery photo

Fig. 2: Sample metadata for the ontology type 'Monastery'

3.2 Content Creation and Management Rules

The process of content creation and management is of crucial importance for an information portal especially when it is oriented towards community users. Registered portal authors can enter, locate on the map and create/edit/delete/annotate multimedia information about CMs by using predefined metadata templates and, finally, publish it by choosing a suitable XSLT presentation transformation. The portal offers means for convenient search and localization on dynamic zoomable geographic map with good navigation, with opportunity for searching objects by location and types or other object characters. The object types and all templates with are to be defined by the portal administrators, without any limitation for any object type.

The workflow of collaboration for content authoring and annotation is given in fig. 3. The portal supports three different user roles: visitors (unregistered users), authors (editors) and portal administrators. The administrators can create, describe and manage the CH types, which define available monument type at the portal. As well, administrators support a register of unique CM for the country. The creation of a particular CM object is executed by authors. When an author proposes a new CM, the administrator has to approve it because otherwise several authors may create mapped objects for the same monument. Provided the proposal is about a CM really new for the register, that CM will be registered and the author starts its content creation. For CMs being already registered at the portal, authors may opt between starting a new description for given CM (which will result in a new Web site for this monument) or contributing to existing description. The contribution process builds a real community a la Wikipedia, however, here each contribution is non-anonymous but annotated by the name of its author. Such annotations are visible in Web sites when passing the mouse over the annotated text. As well, contributions are negotiated between the proposing author and the main author of the description. The negotiation process is tracked by the portal and annotated, as well.

After accomplishing any edition of his/her CM description, the main author informs the portal administrator for it. The administrator checks the information correctness and eligibility and approves its official publication at the portal. Only then the new edition replaces the published one and visitors (unregistered users) may view it as one of the Web sites for that monument. As far as there could be many Web sites for a given CH, the portal has to rank them. Ranking may be accomplished automatically by the portal and/or manually by its visitor.

3.3 Portal Services

The community-oriented, map-based, internationalized cultural Web portal supports various types of services available to authors, visitors and administrators. The most important service groups are these for semantic search and community collaboration for content creation and annotation.

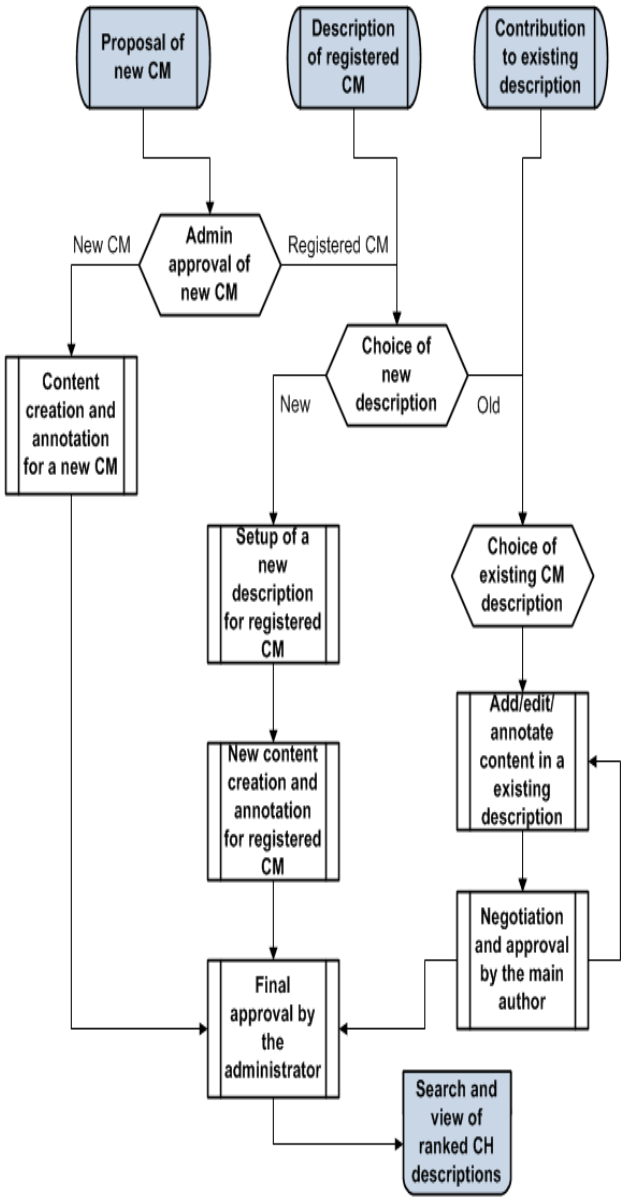

Fig. 3: Workflow of collaboration for content authoring and annotation

There are supported three basic types of search services which may be used in a combined way:

- Location based search – users may zoom in and out the map in order to select the map area where objects are going to be displayed
- Keywords-based search – the traditional form of searching
- Semantic-based search methods – allow searching for content based on its meaning. The portal supports four different ways to do that:
    - Type-based search – within the ontology graph, users may select one or more ontology types of monuments and/or other map objects and find them on the selected map area – by means of using there *is-a* relationships;
    - Semantic search using metadata description fields (facets) of given ontology type and their values – e.g., for the type "Monastery" with metadata given in fig. 2 users may search for female monasteries only thanks to the fact that content of that type is annotated for this metadata;
    - Semantic search using metadata annotations of intertype relationships (shown in fig. 1 in dotted lines of type *has-a* relationships) – for example, search for all the tombs presented in given museum. Note, that such a search may use the parameters of *has-a* relationships;
    - Semantic browsing service – uses metadata annotations of intertype relationships for browsing map objects concerning the meaning of given object.

The services for community collaboration for content creation and annotation allow authors to create and enrich their own content and to annotate it. Meanwhile they may collaborate to another's object descriptions by adding/editing/annotation content providing the object authors agree on the addition and editions of annotations. Thus, the semantic services provide a totally new search paradigm which will change the way of using content portals.

4 Platform Architecture

The software architecture of the portal is based on the conceptual model described in previous chapter. Fig. 4 shows the principal portal architecture. Content authors, portal visitors and administrators have at disposal Web and desktop clients serving correspondingly as tolls for content authoring; search, location and view (used by all the roles) and, finally, administration. For a facile implementation of communication between both the Web and desktop clients and the business components, Web services are used. Thus, Web service layer acts as glue between client layer and business layer. The business layer itself is build by enterprise components exchanging information with the object-relationships mapping layer (ORM) where reside the entity objects. Entity objects represent records from the database repository, which is separated into two stores – one for metadata and ontology, and another for internationalized multimedia content itself. The entity-relation model enables easy addition of new languages for content internationalization.

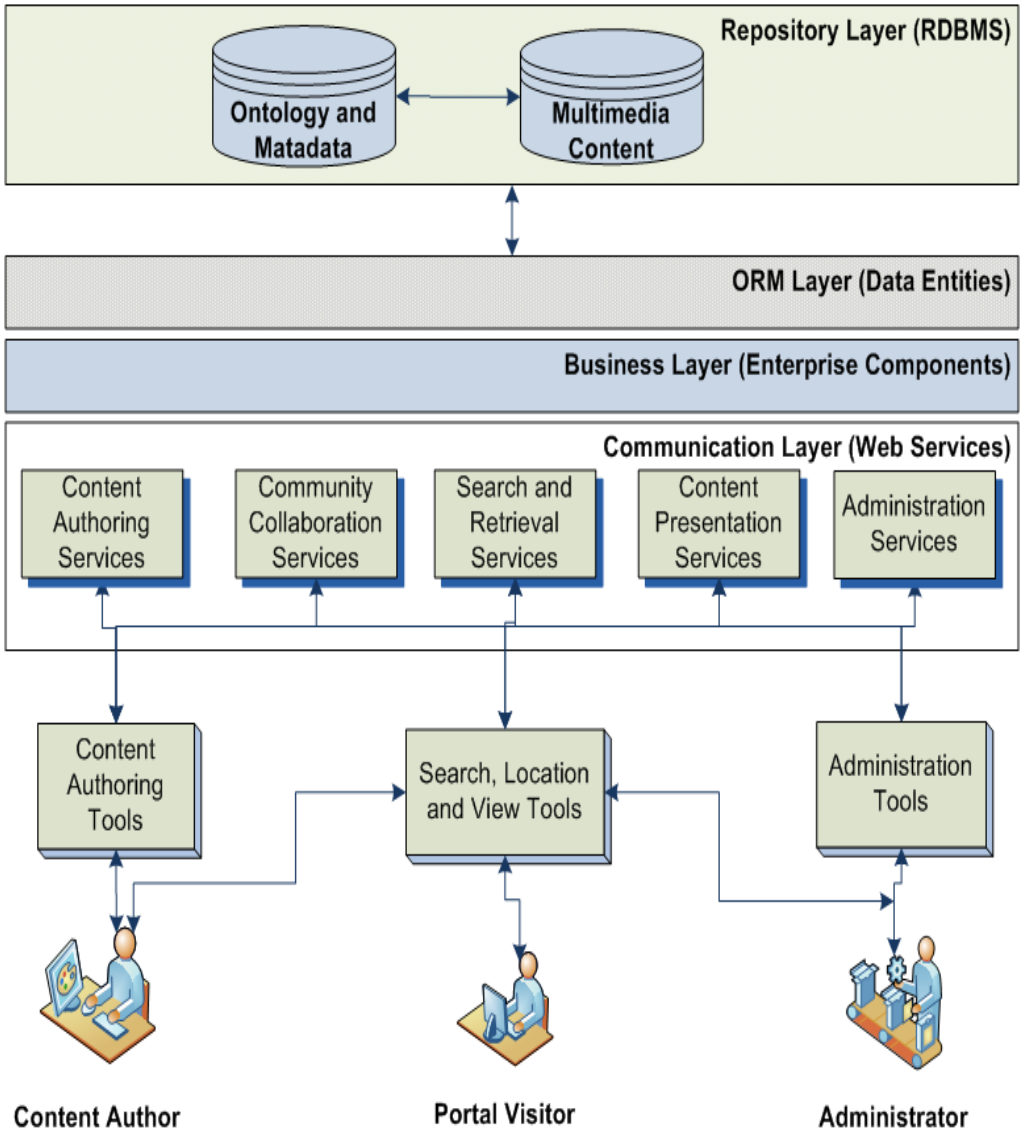

Fig. 4: Principal software architecture of the portal

The ontology and metadata repository plays another role also – it stores XSL transformation (XSLT) documents. As mentioned before, the object type itself is described by content metadata attributes of objects (including image for visualization on the map) and by a XSLT style for representation of the object content (internally stored in XML). The process of creation of an object is separated into five steps (fig. 5): selecting the object type, determining the geographic location of the object, filling values for the objects attributes in supported languages (Bulgarian and English) and choosing of a style for representation of XML content. Finally, XSLT is used for visualization of map object of given ontology type (fig. 6). Thus, authors are able to select two templates for their mapped objects: one for content (metadata template) and another for presentation (HSLT).

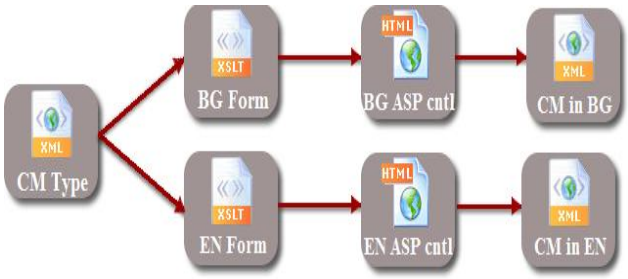

Fig. 5: Creation of map object of given ontology type

Fig. 6: Visualization of map object of given ontology type

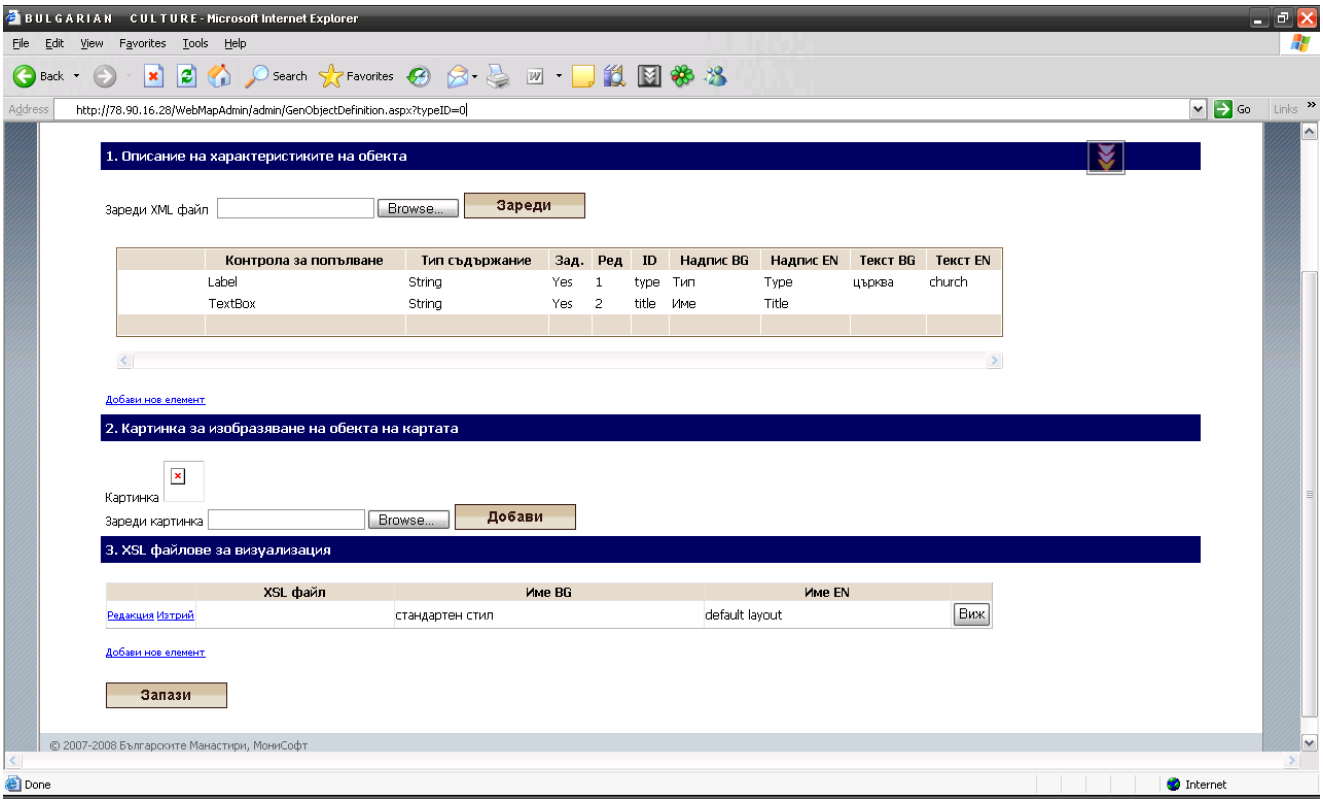

Fig. 7: Creation of metadata of a new ontology type by the administrator

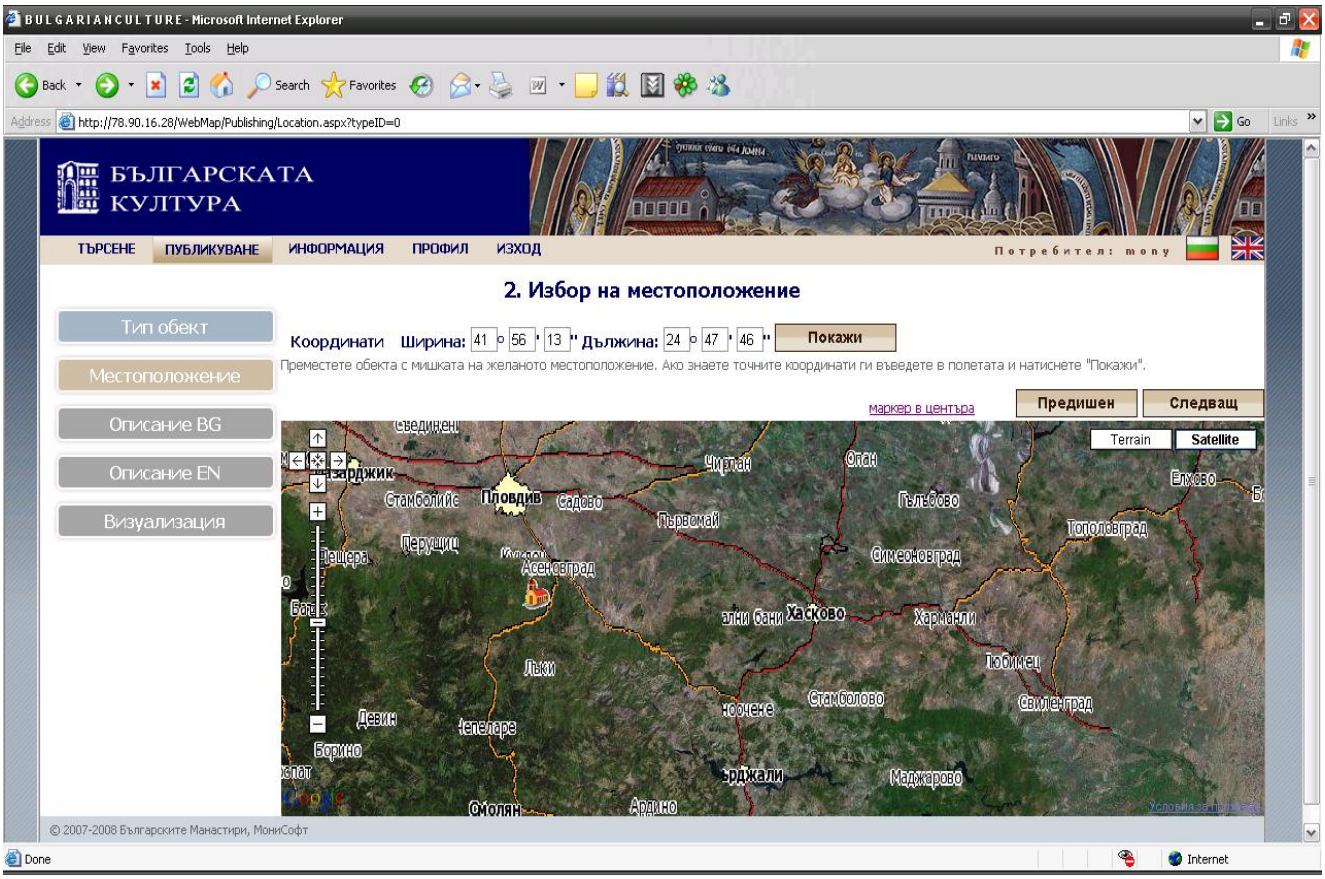

Fig. 8: Choice of geographic location for a map object

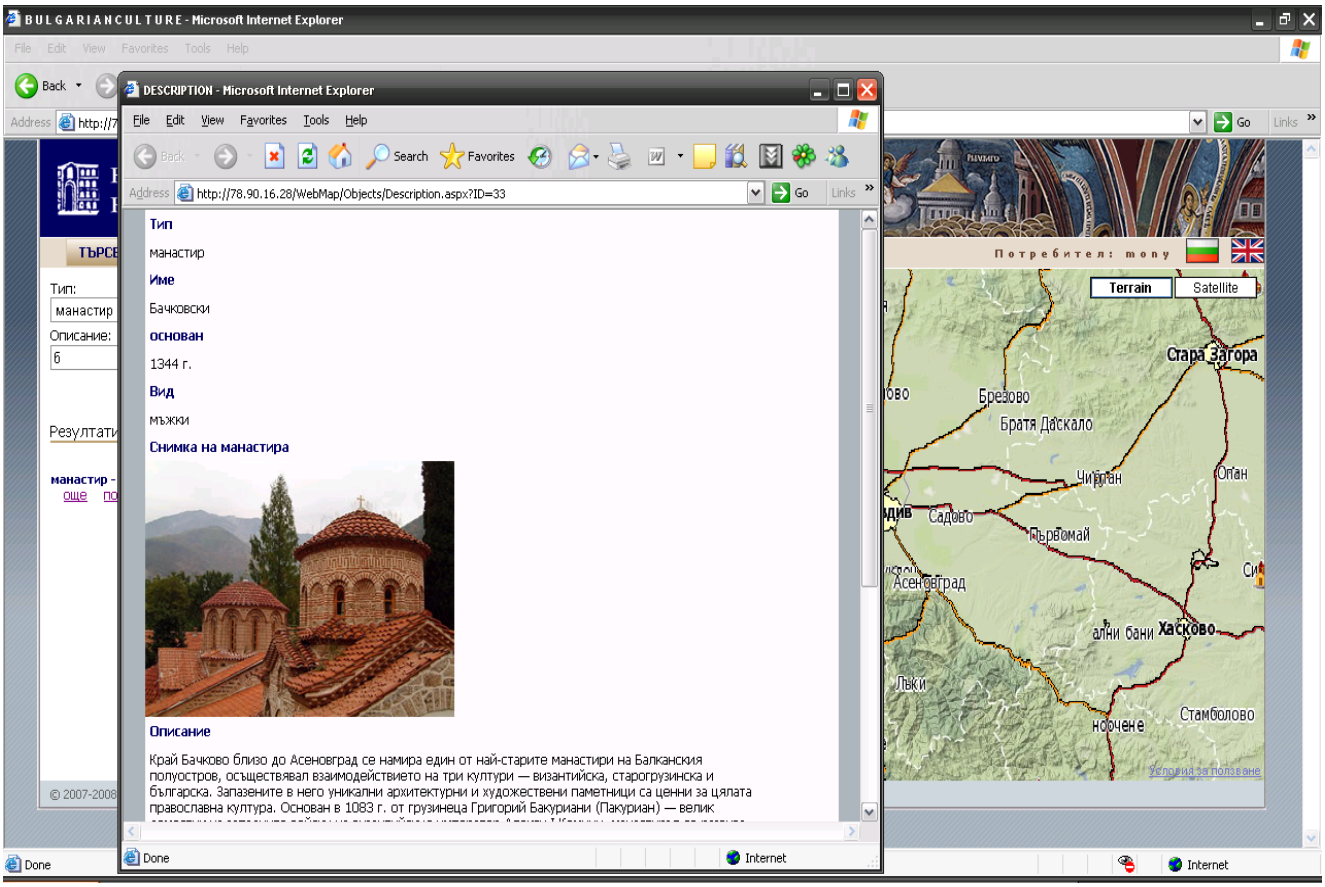

Fig. 9: The Web site of Bachkovo monastery located at the map of Rhodops mountains

5 Construction of first portal prototype

The first prototype of the community-oriented, map-based, internationalized cultural Web portal with semantic services has been developed at Department of Software Engineering, Sofia University, Bulgaria. This prototype misses some of the advanced features of the conceptual model explained in section 3 such as community content collaboration, semantic browsing, description ranking, inter-type 'has-a' relationships and based on them specific metadata search.

Using the first prototype, administrators create metadata template of new ontology types as shown in fig. 7. Authors may create, locate on the map (fig. 8) and maintain their descriptions of given CM according to the specified metadata pattern and choose a XSLT pattern to transform this description into a Web site. Visitors may do search based on location, ontology, and/or template metadata. Founded CM descriptions (Web sites) are shown on the map and by clicking on an icon visitors may view the chosen CM Web site (fig. 9).

The technology used for the first prototype is Microsoft ASP .NET [6]. For providing a dynamic map, Google Map API is used and in addition a second layer is laid over the picture. The layer contains data for settlement, rivers, roads, railroads and lakes in Bulgaria. The additional second layer is used in order to provide detailed information for faultlessly orienting of the users in the territory of Bulgaria.

Though the portal covers the process of definition and publication of CMs it suffers many problems and drawbacks. It is hard or even impossible to select particular Web site of a given monument when there are many descriptions (i.e., many Web sites) for this CM shown at the map. Moreover, these descriptions are not ranked. The prototype misses content collaboration and aggregation, too. The main direction for future development is providing communication and collaboration between authors, semantic browsing service, automatic and user defined ranking of CM descriptions, and 'has-a' relationships and based on them metadata annotations. Unlike Wikipedia, here authorship is going to be set as a grounding principle concerning two issues:

- control over added, changed and/or annotated content by the main author

- registration and citation (presentation) of authors of any accepted content addition, update or annotation.

6 Conclusion

The paper has presented a community-oriented, map-based, internationalized cultural Web portal with semantic services being under development at Sofia University, Bulgaria. Its main objectives could be summarized as follows:

- Creation of information portal for registration, internationalized content authoring, enhancing and annotating, monitoring and management of various types of immovable cultural monuments on behalf of broad end user collaborating community - the register will provide storage for information about immovable monuments of culture depending on their scientific, historic, architectural, territory management and artistic significance.
- Bringing to the wide audience portal services such as map locating, semantic based search, semantic browsing etc. of immovable cultural monuments on Bulgarian territory and their surrounding landmarks described by other ontology and metadata – by using inter-object semantic references as a base for faceted search and semantic browsing
- Exploitation of the register in the National Institute of the Cultural Monuments at the Ministry of the Culture (NICM) of Bulgaria. Experts from the NICM are supposed to enrich metadata schemas and vocabularies for different types of cultural monuments and, as well, to be trained to work with the system.

The results of this work will contribute to the needs of different target groups: civil servants responsible for improvement of monitoring and management of the cultural and historic monuments; experts in cultural and historic heritage, NGOs, owners of the monuments (state, municipalities and private owners), tourists and all representatives of the civil society interested in preservation of the Bulgarian cultural heritage. Its execution will facilitate access and use of digital content, to raise its quality through developing well-structured metadata repository and to assist cooperation between the owners of monuments of culture and users of digital content with multi-language support. The project finalization will also assist development and interoperability of the digital collections of libraries, museums and archives in Bulgaria and Europe.

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