Knowledge Base for Alternative Tourism - Case Study Devin Municipality

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Abstract. The article presents an ontology for alternative tourism in the municipality of Devin. Although developed for a specific locality, the ontology can serve as a reusable template for others. The technological aspects are briefly described, including classes, individuals, properties, and reasoning, which is a key mechanism for semantic interpretation.

Keywords: Ontology, Protégé, Alternative Tourism, Devin Municipality.

1 Introduction

The experience gained from various ontological projects is leading to a strong interest in developing new semantic models tailored to specific domains. We came up with the idea for the current project during discussions with Sh. Bilyanov, then chief architect of Devin Municipality, whose work is also related to alternative forms of tourism (Madanska, et al., 2024). This initiative builds upon earlier experience in ontology development for the domain of tourism and cultural and historical heritage (Madanska, 2022).

Ontology engineering enables both semantic schema modelling and the development of contextual knowledge base. An initial version of the article was previously published in (Madanska & Bilyanov, 2024).

The aim of the current paper is to expand upon the previous report by focusing on axioms and technical implementation details. The model is designed to be a reusable resource that can inspire adaptation across different localities, with minor context-specific modifications. It is also intended to serve as a database for tourism-oriented applications.

2 Ontology Development

Ontology development is a long-term process that involves ontology engineers, domain experts, practical know-how, modelling with logical consistency and validation of the

axioms. The schema development defined the conceptual foundation of the domain of interest, while the individuals and their supporting axioms constitute the core of the knowledge base, as detailed in the following section.

Protégé Desktop (Musen, 2015) was used for the ontology development and visualisation, and *HermiT* and *SPARQL* were used for validation. *HermiT* as reliable reasoner was used also for inferences based on asserted axioms.

2.1 Conceptual Basis and Domain Scope

To clarify the key term at the core of the project, we reviewed several definitions of alternative tourism. According to (Bulgarian Association for Alternative Tourism, n.d.): "*The alternative forms of tourism combine tourist products or separate tourist services, different from the mass tourism by means of supply, organization and the human resource involved*." The distinction from mass tourism is reflected in the different nature of the service – as it is non-standard, innovative, human-centred and supporting less popular destinations or bringing a different nuance to popular ones.

The classification that we decided to use is part of the Concept for Tourist Regionalization of Bulgaria (2015) (Bulgarian Tourism Government, 2015) and defines several main types of tourism that are not explicitly presented as alternative, but according to our views, the domain and studies on alternative tourism are considered as its subtypes: Adventure and Ecotourism, Cultural Tourism, Health Tourism, Mountain Tourism, Rural Tourism, Sports Tourism, Wine and Culinary Tourism.

The class hierarchy (Fig. 1) is designed using information from the regional list provided in (National Institute for Immovable Cultural Heritage, n.d.). Also we used information provided by the Devin's Municipal Administration (Devin Municipality, n.d.).

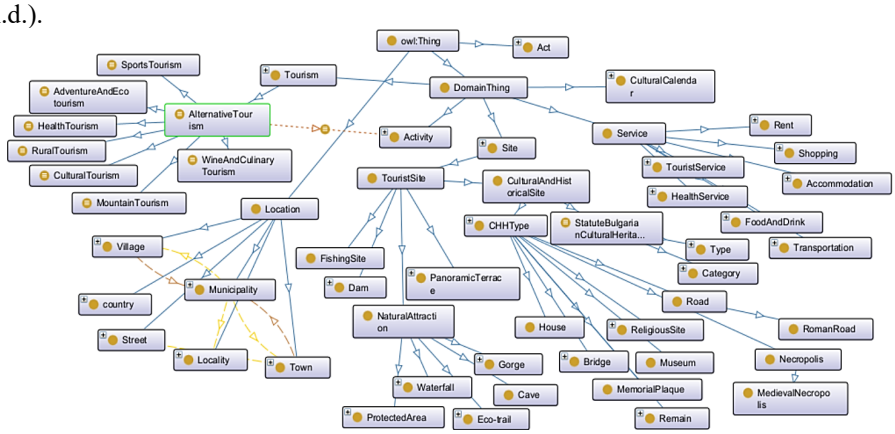

Fig. 1. Part of class hierarchy in the ontology.

More information about the class concepts is mentioned already in (Madanska & Bilyanov, 2024). In brief, here are: class for activities, which the locality Devin Municipality offers; cultural calendar with events; sites, which are categorized (for example *CulturalAndHistoricalSite* class); as well tourism with its varieties (discussed above);

services, which are useful for the tourists, Act class, with its *BulgarianCulturalHeritageAct* individual; and location with subclasses different administrative entities.

2.2 Properties in a Nutshell

For the description of the classes and individuals, object properties and data properties, and annotations included, summarized in Table 1.

Table 1. Ontology's properties

Type	Property	Domain	Range	Characteristic
object	accordingTo	owl:Thing	owl:Thing	–
	hasPlace	Location or Service or Site	Location or Service or Site	transitive
	isAfter	Event	Event	transitive
	isBefore	Event	Event	transitive
	isLocatedIn	Location or Service or Site	Location or Service or Site	transitive
	offers	Site	Activity	—
	relatedTo	owl:Thing	Event or Site	—
	service	owl:Thing	Service	—
data	hasGC	DomainThing	xsd:string	functional
	hasLatitude	DomainThing	xsd:string	functional
	hasLongitude	DomainThing	xsd:string	functional
	hasPhone	DomainThing	xsd:string	—
	workTime	DomainThing	xsd:string	—
annotation	rdfs:seeAlso	owl:Thing	xsd:string	
	rdfs:label	owl:Thing	xsd:string	
	rdfs:comment	owl:Thing	xsd:string	
	dc:creator	owl:Thing	xsd:string	
	schema:image	owl:Thing	xsd:string	
	SocialNetwork	owl:Thing	xsd:string	
	source	owl:Thing	xsd:string	

Since the ontology is currently in its initial development iteration, some of the properties are presented with a broader, more generalized domain and range values to allow greater flexibility. The class *Owl:Thing* is the superclass of all classes and the base concept, and *DomainThing* class is placeholder concept of some classes (Fig. 1). The transitive properties `isAfter` and `isBefore` have `Event` class as both their domain and range. The properties `isLocatedIn` and `hasPlace` are also transitive, and based on the deduction reasoning (using *HermiT Reasoner*), they conclude some inferences about the administrative places. An example is the `isLocatedIn` property, used in the assertion for `VulchiKamakPanorama` (Fig. 2) and due to its transitive object property characteristic, it is inferred that the site is also located in Gyovren, Devin Municipality, Bulgaria.

2.3 Case Study: Devin Municipality: Asserted and Inferred Axioms for the Individuals

Devin is a small municipality with a lot of sites and alternative tourism activities. Some examples of the site individuals, which are described in the ontology will be included on the next figures. `VulchiKamakPanorama` (Fig. 2) and `TsankovKamakDam`

(Fig. 3) are described with annotations (`rdfs:label`) in Bulgarian and English languages. As mentioned, the information was provided with the support of the Devin Municipality's administration. We still have many more instances to describe, which follow the same pattern illustrated below. The inferences made by the *HermiT Reasoner* are highlighted in yellow. Figure 2 shows also *SPARQL* query about the `VulchiKamakPanorama`, as an additional level of validation of the ontology axioms, separately from the validation with *HermiT Reasoner*. The figure demonstrates how the *HermiT Reasoner* validates the ontology, showing the activities offered at `VulchiKamakPanorama`. The `hasGC` property connects the individual `VulchiKamakPanorama` with its geographic coordinates, sourced from Google Maps (Figure 2).

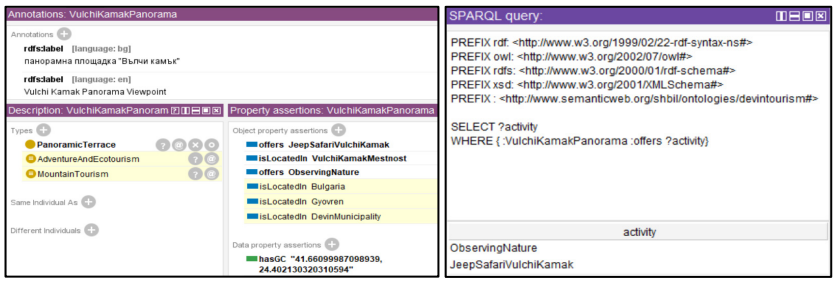

Fig. 2. Axioms describing the individual 'VulchiKamakPanorama' and SPARQL query.

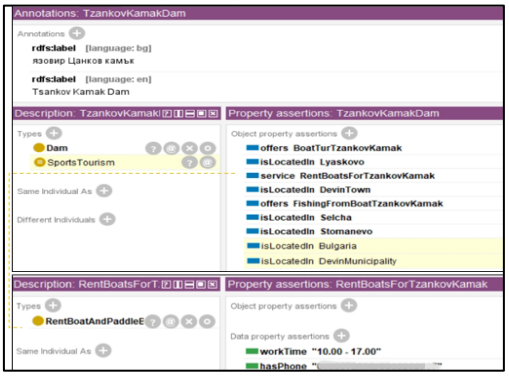

Fig. 3. Axioms for individuals 'TsankovKamakDam' and 'RentBoatsForTzankovKamak'.

The triplets of *object-predicate-subject* are a basic axiom definition. Figure 3 includes the description and property assertions of the individual `RentBoatsForTzankovKamak`, which is linked to `TzankovKamakDam` via the `service` object property. These individuals are interlinked, thereby enhancing the semantic clarity. Some axioms also lead to inferred triplets. For instance, the `SportsTourism` class is inferred for `TzankovKamakDam`, through the `offers` property, based on its connection to an individual associated with the activity of fishing. Also the data properties `workTime`

and `hasPhone` are used to connect the individual with the values, which will provide useful data for tourists when planning their trips.

2.4 Class Definition and Inference Logic

The class descriptions follow a consistent structure. As illustrated in Figure 4, the `Adventure and Ecotourism` class is defined using necessary and sufficient conditions (in the `Equivalent to` section). Based on these axioms, certain individuals are automatically inferred as members of the class. For instance, `StroilitcaKaletoLakata` and `VulchiKamakPanorama` are inferred as class's members because activities association: `StroilitcaKaletoLakata offers Walking;` `VulchiKamakPanorama offers ObservingNature` and `offers JeepSafariVlchiKamak` (Fig. 2). These exact object property assertions satisfy the logical conditions required for the class membership. And because of the reasoning process, here are some inferred axioms for the class and its indirect individuals.

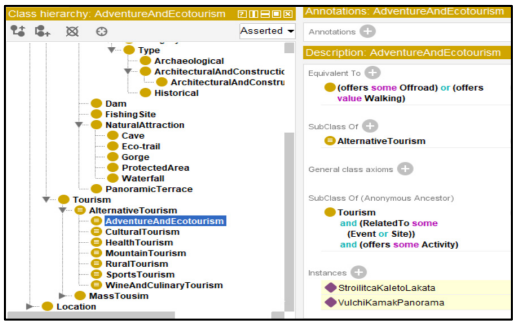

Fig. 4. Class description for some of the subclasses of the AlternativeTourism class.

3 Conclusions

Future work on this project includes several key directions. One of them is including more example attractions and activities, as well as describing the `CulturalCalendar` class with events, which allows the application to recommend events and time ranges that are appropriate to tourist's requirements and interests. We plan to include the ontology for Devin's alternative tourism in the *CHH-OntoNet* ontology network also (Madanska, et al., 2024) to increase the scope of knowledge for *Intelligent Tourist Guide* application. The ontology is a semantic model, integrating knowledge and enabling data extraction by *SPARQL* queries. For instance, `VulchiKamakPanorama` can be queried for activities like jeep safari. Some barely-known destinations, such as the Cave of Zabrol will be indirectly promoted because of the structured data, which will support as well the local economy. The ontology can be a useful data model in AI application, for example the Intelligent Tourist Guide (Madanska, et al., 2024), and it can serve as a kind of catalogue for visitors to plan their trips. Finally, this is a structure

and pattern that can be used to describe other places in Bulgaria or abroad. It could also serve as a database for different applications.

Acknowledgements.

We would like to express our gratitude to the Devin Municipality, particularly the municipal leadership and administrative staff, for the valuable assistance in providing the information necessary for the development of the ontological knowledge base and related initiatives. We also appreciate their readiness to support our idea and their positive attitude towards its implementation.

This research is supported by the Bulgarian Ministry of Education and Science under the National Program "Young Scientists and Postdoctoral Students – 2 – 2".

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Received: March 31, 2025 / Reviewed: May 12, 2025 / Finally Accepted: June 05, 2025