ИНТЕЛИГЕНТНА СРЕДА ЗА ГЕНЕРИРАНЕ НА ЕЛЕКТРОННИ УРОЦИ ЗА КУЛТУРНО-ИСТОРИЧЕСКОТО НАСЛЕДСТВО НА БЪЛГАРИЯ

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DEVELOPMENT INTELLIGENT ENVIRONMENT FOR GENERATING AN E-LEARNING LESSONS ABOUT CULTURAL-HISTORICAL HERITAGE OF BULGARIA

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Abstract:
This paper presents the general notion for developing an intelligent environment for generating an e-learning lessons about cultural-historical heritage of Bulgaria. The concept represents the idea of lifelong learning and it is part of development of VES. The environment contains an intelligent agent that processes the knowledge base and generates appropriate lessons depending on what the user is looking for. The knowledge base is represented by multiple ontologies which are describing cultural-historical heritage of Bulgaria and are based on CCO standard.

Key words: *ontology, CCO standard, e-learning, intelligent agents*

1. Introduction

DeLC (the Distributed eLearning Center) provides education services and e-content which is personalized for each and every student at the Faculty of Mathematics and Informatics at Plovdiv University [1, 2, 3, 4]. The DeLC project has evolved in to VES (Virtual Education Space) [5,6] on account of the modern trends of transforming Internet into Internet of Things [7] and the development of the Semantic Web [8, 9]. VES is an intelligent, context-aware, scenario-oriented and controlled infrastructure maintained by various assistants which are implemented as intelligent agents [10,11].

One of the interesting projects in VES is connection between lifelong learning and cultural-historical heritage of Bulgaria. The idea that we present in this paper is to create an e-lessons about the Bulgarian culture according to the wishes of the learner. For this reason we create ontologies about different cultural-historical heritage of Bulgaria as we take in to consideration CCO (Cataloging Cultural Objects) [12] standard. Generation of the e-lessons will be performed by the intelligent agent that will use the ontologies as a knowledge base. In this paper we discuss in more details a knowledge base that is created as hierarchy of different ontologies.

2. The CCO Standard

Bulgaria is a country with a lot of historical events, places, many archaeological and cultural artefacts. Most of the cultural-historical heritage is saved in different communities like museums, galleries. Presenting information about all events, items, artefacts in digital version requires using a standard that will unify the structure of the data. That way sharing this data between different communities will be easier.

One of the main things that we use and relay on for developing the environment is CCO (Cataloging Cultural Objects) standard. It is a standard for describing and documenting works of arts, architectures, cultural artifacts and their images. The main purpose of the standard is to provide rules for describing all these kinds of works. The usage of CCO standard makes easy to discover and access different types of information used and stored in systems for describing works. It is used by various types of communities and organizations like museums, libraries, galleries etc. Another advantage of using this standard is that it provides better way of sharing data between communities.

The CCO standard covers almost every kind of information that might be needed for presenting different types of work. The individual work that is described and documented in systems is called work item. There is lots of various types of work items and each of them has its own specific characteristics that should be kept. All this data is supposed to be managed in a way that it is easy to be shared between communities. That is why CCO standard sets up several elements to unify the way data is structured and presented. Some of these elements presents important information about the work item and are required. We can summarize them into couple

groups like elements that define type of work, language, source; another group of characteristics about creator, location; about measurements, materials, techniques of creation, style, culture and so on. Since all objects have similar elements, CCO standard offers values of these elements to be stored into dictionaries called authorities. There is several authorities admitted by CCO standard grouped into different subjects.

First authority, called Personal and Corporate Name stores information about all kind of people related with the works. It contains names and biographic data of creators and artists, interesting facts about them. Also there might be included different corporate bodies like architectural firms, museums and other groups of individuals that worked together.

Another authority is Geographic Places, which stores information about important places that are related with the works and creators as well. This authority includes natural places like rivers, mountains, continents and so on. It also covers administrative geographic entities such as countries, cities, empires, nations.

Each individual work has its specific terminology. This information should be placed in different authority called Concept Authority. It stores description of work types, materials, styles, activities related with the works, abstract concepts, physical attributes and so on.

The last authority is about historical events, mythological or religious characters or themes. It is called Subject Authority in CCO standard.

3. Ontologies

As we mention above Bulgaria is a country with long and rich history. Storing all this information into database want be efficient for the purpose of the e-learning and goals we have. Our goal is to give the user proper information with enough details according to what he or she is searching for. So if the user wants just the main information about some artefact we want show him details that he is not interested about. But we want to give him an option to see other items or information that might be interesting to him. That is why stored information should be processed in a semantic means and to accomplish this we are using ontologies.

Presenting all data with one ontology will be hard for maintenance and may cause bad performance. Because of this the domain of cultural-historical heritage of Bulgaria is divided into several smaller subdomains. Each subdomain is presented by separate ontology. Since most of the terms described by the ontologies are related to each other all ontologies are linked together. That way connection is established between terms in different ontologies and searching the proper information will be easy and efficient.

There is ontologies that represent authorities from CCO standard and other that are used for storing knowledge of variate of cultural-historical items. Figure 1 shows ontologies that we assumed to have for representing the information.

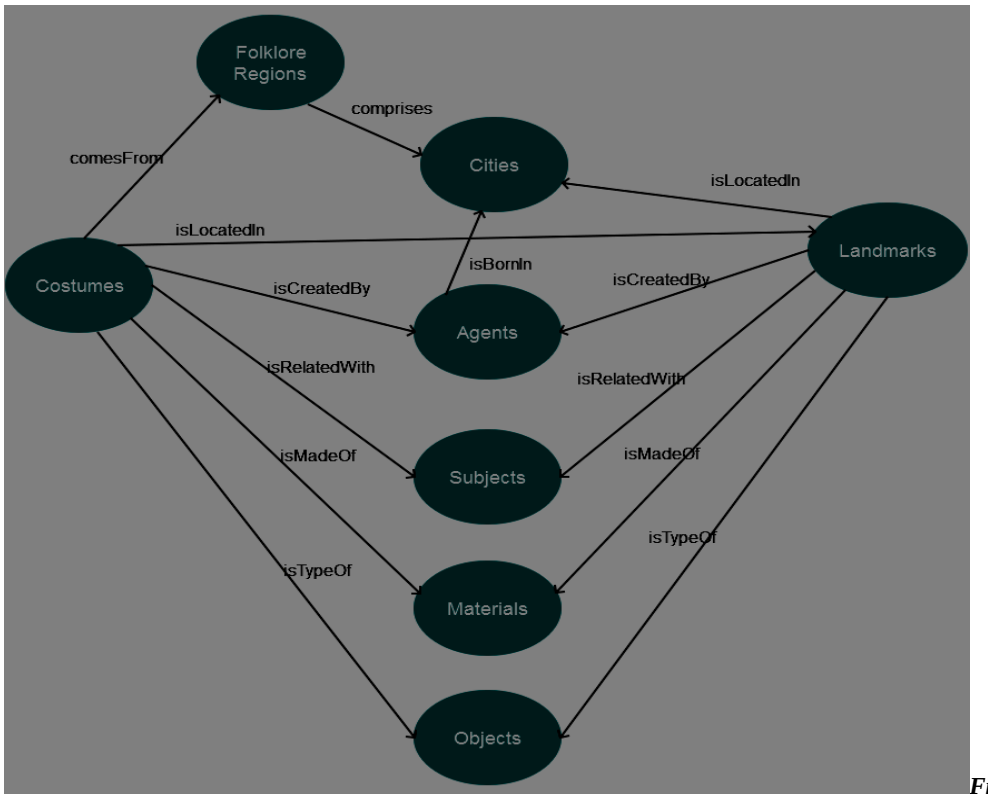

Figure 1: Ontologies

First we are going to talk about Cities ontology. It is used for presenting knowledge of all cities that are related with work items, creators, corporations or communities. This ontology keeps data like city names, location and other important information that is need by the other ontologies.

When we talk about Bulgarian cultural-historical heritage we can’t pass over the fact that Bulgaria has unique and very interesting folklore. Each part of the country has its own specific characters. We can say that Bulgaria is divided into seven Folklore regions. Each of them has individual typical national music, musician instruments, dances, costumes, work tools etc. The geographic boundaries of the regions are different from the administrative and each region contains several cities. Knowledge of folklore regions is defined in ontology called Folklore Region. The main purpose of it is describing the geographic boundaries of the regions, names and other specific information and also all the cities that are part of each region. Here is important to note that the information about the cities comes from the first ontology Cities.

The next ontology that will be described in this paper is Landmarks. It contains knowledge about different types of landmarks that are part of Bulgarian cultural-historical heritage. This includes churches, monasteries, museums and so on. This ontology covers information about the architecture of buildings or landmarks, location, creators and all other specific data. Most of the data like locations, information about the creators comes from other ontologies.

Objects is another ontology that will be described in the paper. It represents all types of items that could be work items (according to CCO standard). This object types could be furniture, paintings, sculptures, musician instruments, work tools, costumes and so on. This ontology covers main information about all types that are part of the cultural-historical heritage of Bulgaria. Here is the place where these items are presented as group and their characteristics are defined. This ontology contains knowledge about the purpose of items, materials that usually are used for creating them, where they are supposed to be stored. So this ontology needs information about materials, locations and it is linked to ontologies like Landmark, Material.

Since Objects ontology keeps main information about all work items, the full knowledge of specific groups of items is presented by different ontologies. So the next one that will be described is Costumes. It is about Bulgarian national costumes and describes different types of costumes according to the Folklore region they belong to. Ontology contains data like specific parts of costumes, how they are combined into full costume, differences between usual and formal costume and all other characteristics of this item.

Another ontology that is used by the intelligent environment is about materials. It contains knowledge of kind of materials used for creation of different objects or even landmarks.

Agent’s ontology defines types of people with similar activities or interests, social role or condition (architect, writer, painter, etc.). Also it includes descriptions about different persons like names, biographic data,

interesting and important facts about them. Knowledge about communities their names, locations and other needed data is part of this ontology too.

The last one is Subject ontology and it is about historical events, dates, mythological persons or themes related with work items.

One of the goals of the environment is data presented by knowledge base to be shareable that is why all ontologies above are designed based on CCO standard *Figure 2*

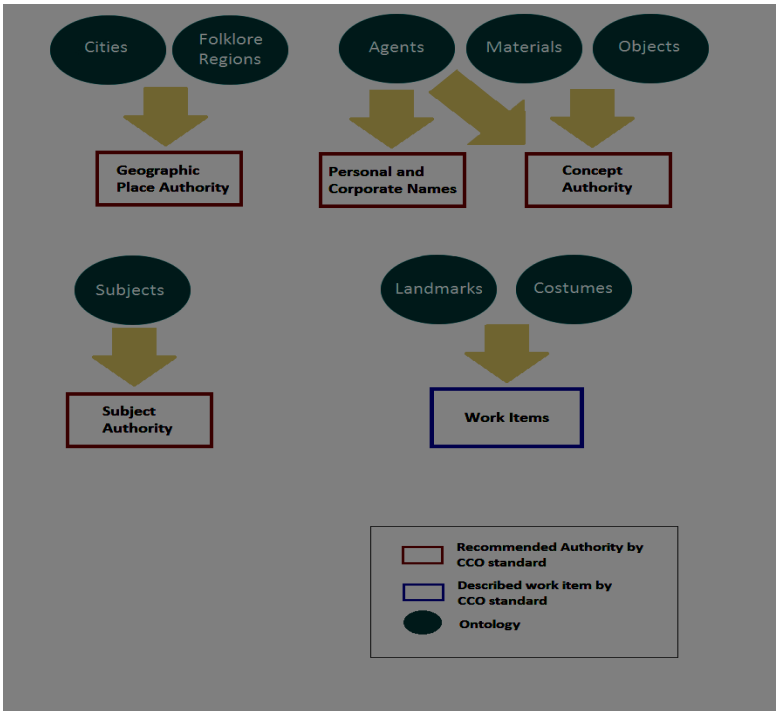

Figure 2: Ontologies and CCO standard

The first two - Cities and Folklore regions express Geographic places authority. Having terms about different types of geographic places and location defined in just one place in a separate ontology makes them reusable and easy for maintenance. Knowledge from these ontologies are used by the other ontologies and that is why they could be assumed as dictionaries about locations and places like the authority purpose is.

As we mentioned before Agents ontology defines terms like author, painter, and architect. According to CCO standard all this term are part of the Concept authority. So we can say that with this ontology we are representing the Concept authority. Agent's ontology also contains information about different persons or communities that are part from Personal and Corporate Names Authority from CCO standard. Knowledge from Agents ontology is supposed to be used in other ontologies like Landmarks, Costumes and all other ontologies describing different work items.

Materials and Objects are storing information that is be part of Concept Authority. Knowledge from Materials and Objects is needed in Landmarks and Costumes ontology. Subject Authority is represented by Subject ontology.

4. Intelligent environment

Another part of the environment is the intelligent agent. Its work is to find the information that the user wants, to process it and return the results back to the user. The agent is able to look into all ontologies for retrieving the data. Depending on different criteria the agent looks into separate ontologies. It founds the connection between them and continues the searching into that one the needed information is in. After the agent gets the knowledge from the ontologies the data is processed and shown to the user.

5. Conclusions

The ontologies presented in this paper are based on the CCO standard and serves as a knowledge base of the intelligent agent that generate e-lessons. This environment is intend to support lifelong learning and is a part of VES. The next step of our work will be to develop the agent prototype and integrate it in digital library of VES.

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