About Semantic Knowledge for Accessibility

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Abstract. The paper presents an interdisciplinary research project "Digital Accessibility for People with Special Needs: Methodology, Conceptual Models and Innovative Ecosystems". The research is focused on research and creation of innovative methodology for building accessible environments and systems and improved performance for people with disabilities. One of the main tasks of the project is to create optimal and applicable conceptual models for digital accessibility.

Keywords: Accessibility, Semantic Web, Ontology.

1 Introduction

In modern times, the processing and dissemination of information is a basic prerequisite for the development of society.

Many authors have studied the process of retrieving and managing digital information and gaining semantic metadata with different applications (Dimova, Paneva-Marinova, & Pavlova, 2018), (Marty, 2008), (Paneva-Marinova, Goynov, & Luchev, 2017), (Grigorova, et al., 2012).

There are even researches of the cognitive nature of the present-day Web (Dimitrova, 2007).

This article describes the interdisciplinary research done with the the project "Digital Accessibility for People with Special Needs: Methodology, Conceptual Models and Innovative Ecosystems". The research project is in the field of information technology and partly in the humanities and social sciences. The expected result is improved digital accessibility of diverse sites and gathered knowledge for people with visual impairments. The research is focused on research and creation of innovative methodology for building accessible environments and systems and improved performance for people with disabilities.

One of the tasks of the project is to create optimal and applicable conceptual models for digital accessibility. The team includes researchers with different disabilities, which increases the reliability of the presented scientific methodology for digital accessibility and will add a unique asset to the expected results.

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The research project will use interdisciplinary research approaches and technologies in the field of informatics and robotics and in the fields of the additional thematic areas (social sciences and others), in particular:

- Methods and techniques for the implementation of interfaces for people with visual impairment;
- Analysis, synthesis and evaluation of technologies for accessibility in the field of art and entertainment;
- Web accessibility standards for project-relevant sites for people with sensory deficits;
- Research and analysis of modern approaches and methods for creating new interfaces for human-robot interaction;
- Methodologies for analysis, synthesis, design and evaluation of socially based information and innovative ecosystem systems in terms of multi-paradigm modelling;
- Methodologies for assessing the acceptability of information and innovative ecosystems from the perspective of the system user.

Figure 1 presents main modules and submodules of the project.

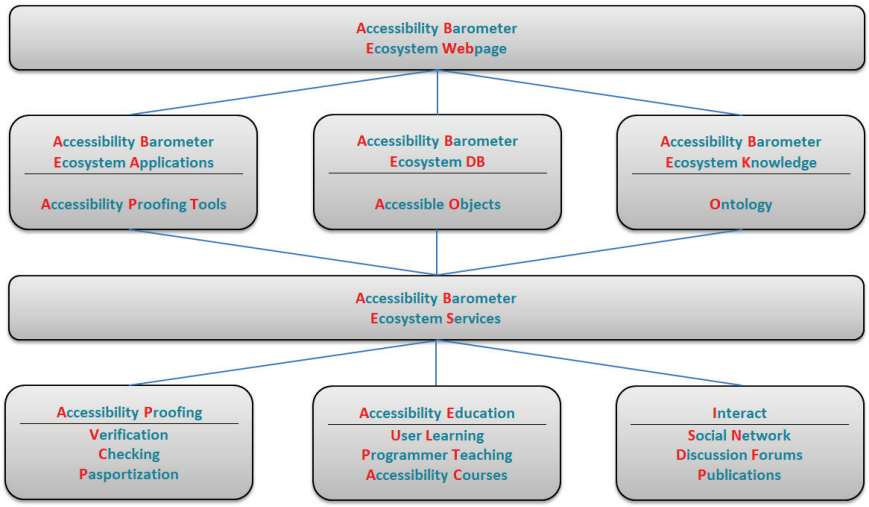

Fig. 1. Accessibility Barometar Project scheme.

2 Knowledge Representation

2.1 Semantic Knowledge

In the artificial intelligence literature, "ontology" is a term used to denote formally represented knowledge based on a given conceptualization. Conceptualization presup-

poses the description of many objects and concepts, knowledge about them and connections between them. Ontologies are a key tool for realizing the idea of the Semantic Web, as they offer solutions to four main challenges in creating a functional digital repository: semantic search by different criteria; interoperability, knowledge sharing; knowledge reuse / reusability (Berners-Lee & Fischetti, 2001), (Bartolini, 2016), (Antoniou & Harmelen, 2009).

Modern semantic networks are based on ontologies and they are essentially systems for organizing knowledge. The main purpose of knowledge management systems is to organize and manage disparate information and there are three types of such information:

(1) classification schemes that organize materials in the most general terms
(2) subject headings / subject ontologies, controlled dictionaries, which provide together a more detailed description on a given topic
(3) official information that describes / connects different syntactic versions for geographical and personal names.

The semantic network built on RDF and RDFS has the main purpose to facilitate the publication and use of disparate information resources. The SKOS format offers a model of the basic structure and content of disparate data through taxonomies, classifications and a controlled dictionary. The role of controlled dictionaries in SKOS is to indicate synonyms, homonyms, and thus to ensure the consistency of the ontology, in order to facilitate the creation of links and labels.

2.2 Formal Knowledge of Subject Area

Formally, knowledge of the subject area is described vertically using different levels of description or areas of knowledge. These levels are arranged vertically, starting from the first basic level and are arranged as follows:

- Primary basic descriptive level - describes objects and facts from reality, contains examples, objects, terms and facts from reality.
- Second level of relationships - adds connections and relationships between individual facts, concepts and actions to complement objective knowledge.
- Third logical level - adds to the relationship between concepts and objects more rules and restrictions, with which to draw logical conclusions.

3 Ontology for Accessibility

Some the project participant already have an experience in creating specialized thematic ontologies (Bogdanova, Todorov, & Noev, 2017), (Todorov, Bogdanova, Noev, & Sabev, 2019).

Semantic knowledge of accessibility includes various concepts, connections, rules, constraints, individuals and facts. The selection of basic concepts is based on real statements, situations and reality. A description of many facts, objects and situations, with which the individual objects (individuals) are related, emerge in the process of studying the objects and that necessitated the structuring of separate ontological substructures

for the subject area, as follows: Ontology of Accessibility; Ontology of Accessibility of Digital Objects; Ontology of Accessibility Requirements; Ontology for Accessibility to Learning Materials and Learning Processes; Taxonomy of Accessibility.

Ontology of Accessibility: This is an ontology oriented to a specific subject area. The purpose of this structure is to describe accessibility as knowledge of accessibility, to explain concepts, definitions and facts for the specific subject area. It defines the scope and objectives for achieving or increasing accessibility.

Ontology of Accessibility of Digital Objects: This is an ontology focused on solving a specific task. Namely, to define the accessibility to digital resources. To describe what it is, to describe different approaches and methods for processing the accessibility of digital resources and to provide various options for overcoming emerging difficulties in ensuring accessibility.

Ontology of Accessibility Requirements: This is an ontology that complements the Accessibility Ontology by expanding the scope of knowledge and the subject area. This structure adds knowledge to identify different accessibility needs, to supplement knowledge with different physical, mental and digital needs that require specific solutions.

Ontology of Accessibility to Learning Materials and Learning Processes: This is an ontology focused on solving a specific task. The purpose of this ontology is to describe the accessibility to teaching materials, teaching methodology (accessibility of training), the accessibility to the content of teaching materials and other activities in the field of training.

Taxonomy of Accessibility: This is a glossary of terms used in the field of accessibility with added links between them. The purpose of the taxonomy is to describe all the concepts and terms used to define, describe and achieve accessibility used in the above ontological structures.

Figure 2 presents basic relationships between individual terms in taxonomy.

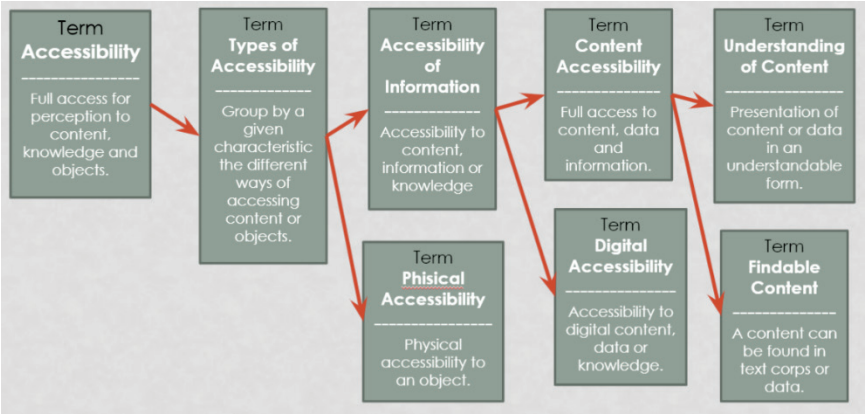

Fig. 2. Relationships in taxonomy

4 Conclusion

This paper describes some aspects of the basic framework behind the project "Digital Accessibility for People with Special Needs: Methodology, Conceptual Models and Innovative EcoSystems".

Different teams included in the project will start to work in the following months on the tasks included in the modules of the project.

The paper also presents initial conceptual scheme, related to semantic and ontological model for digital accessibility.

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References

Antoniou, G., & Harmelen, F. (2009). *Web Ontology Language: OWL. Handbook on Ontologies. International Handbooks on Information Systems*. Springer, Berlin, Heidelberg.

Bartolini, C. (2016). Mutating OWLs: semantic mutation testing for ontologies. *Proceedings of the workshop on domain specific model-based approaches to verification and validation*, (pp. 43-53).

Berners-Lee, T., & Fischetti, M. (2001). *Weaving the Web: The original design and ultimate destiny of the World Wide Web by its inventor*. DIANE Publishing Company.

Bogdanova, G., Todorov, T., & Noev, N. (2017). Creating and representing semantic knowledge of bell objects. *International Journal of Applied Engineering Research, Volume 12, Issue 19*, 8986 - 8994.

Dimitrova, M. (2007). The educational media of the web: Levels of cognitive involvement. *Proceedings of SOLON–Sofia Lectures of Ontology.*

Dimova, M., Paneva-Marinova, D., & Pavlova, L. (2018). Towards better understanding of ancient civilizations by storytelling and gaming. *TEM Journal, 7(3)*, 658-661.

Grigorova, V., Sotirova, K., Naoumova, V., Sameva, A., Dobreva, M., Ivanova, K., & Stanchev, P. (2012). Digitization of old mathematical periodicals published by the Institute of mathematics and informatics, Bulgarian academy of sciences. *Digital Presentation and Preservation of Cultural and Scientific Heritage*, (pp. 222 – 227).

Marty, P. (2008). Museum websites and museum visitors: digital museum resources and their use. *Museum Management and Curatorship, 23:1*, 81-99.
Paneva-Marinova, D., Goynov, M., & Luchev, D. (2017). Multimedia digital library as a constructive block in ecosystems for digital cultural assets. *Digital Presentation and Preservation of Cultural and Scientific Heritage*, (pp. 31 – 40).
Todorov, T., Bogdanova, G., Noev, N., & Sabev, N. (2019). Data management in a holter monitoring system. *TEM Journal, Volume 8, Issue 3*, 801 - 805.

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