Model of Taxonomy for Accessibility Ontology

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Abstract. Digital accessibility to educational and informational resources for people with disabilities is an important part of contemporary life. Semantic organization of knowledge in the domain of accessibility provides a convenient way of extracting and organizing data. The paper focuses on semantic design techniques and related taxonomy models that could be used in the digitization process of resources intended of people with disabilities usage.

Keywords: Accessibility, Semantic Knowledge, Taxonomy.

1   Introduction

A European directive initiates the unification of the various legal norms and practices in the countries regarding accessibility of the web environment. The objects of these norms are public organizations sector. With the set minimum requirements and the change of the national one's legislation in sync with the requirements of European legislation the field of accessibility of websites and applications, people with disabilities have the opportunity to provide feedback on their accessibility. On this one way they find themselves in the position of explaining what problems are present, to what extent information they do not have access to, where are the barriers to accessibility (Basel, Bataineh, & Kamoun, 2013), (Paciello, 2000).

Semantic organization of data provides a convenient way for knowledge extraction in various domains. Some researches about specialized ontologies in the field of accessibility are presented in (Paneva-Marinova, et al., 2019), (Nalepa, Bobek, Kutt, & Atzmueller, 2021), (Bogdanova, Todorov, & Noev, 2017) (Sirichanya & Kesorn, 2021).

Some ontological models related to accessibility are described in (Masuwa-Morgan, 2008), (Todericiu, Şerban, & Dioşan, 2021), (Jęśko, 2021), (Engelhardt, Gluszak, Kosiedowski, Kramer, & Urbanski, 2019).

The presented work examines the issue of digital accessibility to educational and informational resources for people with disabilities. The second section presents the

role of the taxonomic structure for accessibility of knowledge and the developed ontologies for the purposes of a socially oriented ecosystem for people with special needs (Accessibility Barometer). The third section examines the developed model of taxonomic structure in more detail.

2 Role of Taxonomy Structure at Accessibility Knowledge

2.1 Research Background

The research in the article is focused on the problems in the field of digital accessibility technologies for people with special needs in Bulgarian conditions. The study is part of the project "Digital Accessibility for People with Special Needs: Methodology, Conceptual Models and Innovative EcoSystems", aimed at improving digital accessibility for four types of heterogeneous objects (documents, sites, software, and games) for two groups of people with disabilities (visual and cognitive). Project contractors are an interdisciplinary team of nine participants, representing three institutions.

Methods and tools are explored in relation to the development of a research toolkit for building the conceptual models of an accessible knowledge repository and open access software environments for accessibility, as well as a multifunctional ecosystem of accessibility. The taxonomy of accessibility is the basis of the construction of the ontology of digital accessibility for people with special needs, and semantic and digital methods were used in its creation.

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.

2.3 Semantic Knowledge of Accessibility

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 taxonomy is to describe all the concepts and terms used to define, describe, and achieve accessibility used in the above ontological structures.

2.4   Taxonomy Definition

Taxonomy describes a connected structure of classes of objects in a knowledge area using a vocabulary of terms. Formulating a taxonomy provides user with additional capabilities for classification of information and to find needed information and knowledge (Data Taxonomy).

Important requirements that should be followed in taxonomy development are:
- Hierarchical organization proper naming convention of objects and relations;
- Completeness and clearness of the rules;
- Good extensibility that eases additions of new objects;
- Appropriate mechanism of properties inheritance.

A data taxonomy is a hierarchical structure separating data into specific classes of data based on common characteristics. The taxonomy represents a convenient way to classify data to prove it is unique and without redundancy. This includes both primary and generated data elements.

Defining and using a taxonomy can offer additional benefits in that users of the system will be categorizing content and assets using a controlled vocabulary. This controlled vocabulary can be utilized as an integration reference point between different business systems.

Organizations apply taxonomies to:
- Improve data and metadata organization;
- Support the work of data controlling authorities;
- Help machine learning algorithms and extract data patterns.

3   Model of Taxonomy Structure

A taxonomy contains a term as an element, and for each term there is an annotation, keywords, category, and links to other elements:
- The annotation element contains a detailed textual explanation of the term, a set of explanations for its meaning, and examples of usage.
- The Keywords synthesize the most important short meanings of the term, helping to index it and speeding up semantic text processing.
- The category element helps bring together a set of terms from a single domain of meaning.
- A relations element contains a list of links and semantic relationships with other terms in the taxonomy.

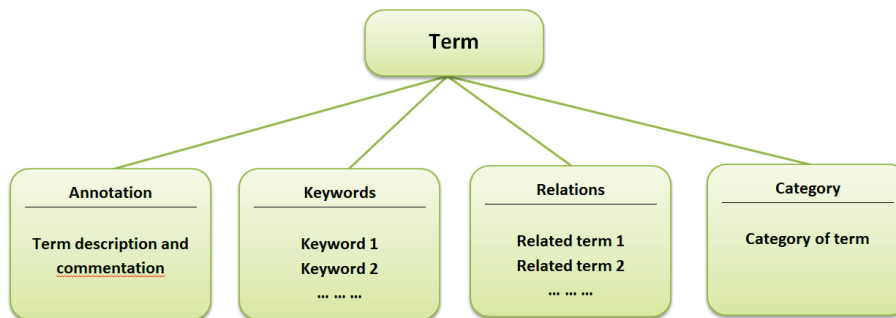The basic elements of a taxonomic model are presented in fig. 1.

Fig. 1. Taxonomy model.

Ontological models (Ontology of accessibility; Ontology of accessibility of digital objects; Ontology of accessibility requirements; Ontology of accessibility of learning materials and learning processes) developed for the purposes of the socially oriented accessibility ecosystem are based on this taxonomic model of accessibility. Fig. 2 presents

a vocabulary built into the project portal representing terms from the accessibility taxonomy. The figure shows several terms listed with their taxonomy elements (term, annotation, keywords, category, and relations) and buttons at the bottom that allow the terms to be grouped by keywords and categories. The built version of vocabulary is bilingual and represents terms in Bulgarian and English, as well as the translation between the languages.

Fig. 2. Accessibility web page of taxonomy vocabulary.

4   Conclusions

The paper examines issues of digital accessibility to educational and informational resources for people with special needs disabilities and the semantic organization of accessibility knowledge, providing a convenient way to retrieve and organize data. European directives recommend equal rights for all people, incl. and regarding the accessibility of the web environment. For the purpose of the project, the role of the taxonomic structure for the accessibility of knowledge and the inaccessibility of such a taxonomy for the developed ontologies in a specialized ecosystem Accessibility Barometer for people with special needs was investigated. Emphasis is placed on semantic design techniques and related taxonomic models. The taxonomy can be applied in the process of digitizing resources for the needs of people with disabilities.

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