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LINKED DATA FOR ACCESSIBILITY: FROM TECHNIQUES TO USERS

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ABSTRACT

The advanced characteristics of Linked Data drive the dramatic growth of accessible public data. With very few accessibility research projects applying Linked Data , this paper reviews the challenges of accessibility and proposes the approach to use Linked Data to link the user preference and real-time environment data to address issues like user focus, data integration and isolated systems. Further research on Linked Data for accessibility would not only benefit people with disabilities but also contribute to the development of smart cities.

KEYWORDS

Accessibility, linked data, semantic web

1. INTRODUCTION

Most research currently related to accessibility is focussed on separated areas, such as social science, laws and information technologies, which would lead to the unmatched mapping between user experience and standards or guidelines. User focus and personalized usability should be the significant research approach for enhancing accessibility due to the gap between the user experience for disabled people and technical accessibility guidelines (Cooper et al. 2012). Disability is a complex social and medical issue. Accessibility requires providing the data and services for people with disabilities or special needs within their expected cost and time constraints. Current approaches to address the accessibility issues are focussed on accessible services such as accessible web content, authoring tools, user agents and assistive technologies regardless of environment data and user preferences in the real world.

Linked Data is creating the relationships from the data to other sources on the Web. These datasets are not only accessible by human beings, but also readable for machines. As an additional layer to the current Web, Linked Data has some particular beneficial features, namely separated data format and presentation, knowledge sharing and accessing, real-time linking, metadata annotation, openness and standardization (Bizer et al. 2009). The growth of Linked Data has been dramatic, rising from approximately 95 in 2009 to 295 datasets in 2011 in the Linked Open Data Cloud. These datasets could also be classified in groups: Media, Life Sciences, Geographic Data, Cross-Domain Data Sources and User-Generated (Bizer 2009). This paper investigates the use of Linked Data to model the user preferences and profiles to link with real time accessible environment data to address the accessibility issues.

2. RELATED WORK

The dramatic development of the Web brought several accessibility challenges. As there is no global solution to address these issues, researchers are exploring the advanced features of the semantic web and proposing some innovative approaches, namely: semantic metadata, semantic modelling and accessibility frameworks.

Accessibility Common (Kawanaka et al. 2009) provides a flexible approach of metadata integration, storage and sharing for web accessibility. The essential features are similar to the Linked Data mechanism, such as URI and element addressing, semantics knowledge sharing and management. The challenge to

support many metadata formats would be addressed by the feature of document format standardization (RDF) in Linked Data. The Social Accessibility (Takagi et al. 2008) is focused on semantic metadata authoring using the collaborative approach to provide accessible metadata for people with disabilities. However, this system could not address the linking issues among different metadata resources, which meant that each group of metadata annotations was isolated from other resources.

Semantic modelling approach mainly proposes the modelling of user profile and preference, environment data and assistive technology. User profile and assistive services are two major components for semantic modelling (Ghorbel et al. 2007). Ghorbel et al. explored users' location and environment data as well as profiles to generate better assistive services. Similarly, Semantic Matching Framework project (Kadouche et al. 2009) involves the Web Ontology Language (OWL) for modelling and reasoning people's profiles and environment data to improve the interaction mapping between users and real world facilities.

AEGIS project (http://www.aegis-project.eu/) has investigated the use of ontology for accessibility situations research. It has developed ontologies to map the interactions between the disability conditions and devices. Nevertheless, the high level modelling of special interactions leads to the complexity of ontologies modelling and reasoning. Semantic User and Device Modelling Framework (Ackermann et al. 2012) proposed an adaptive User Interface of Web2.0 applications based on their own vocabularies and WAI-ARIA annotations to model devices and user's preferences. User-oriented services for monitoring users' health, social care and emergency situations has been proposed (Tektonidis & Koumpis 2012)**.** These projects could benefit from applying Linked Data, because of such characteristics as standard format data and resources, large scale linked data cloud, real-time reasoning and linking.

3. RESEARCH OBJECTIIVES AND APPROACHES

Approaches associated with the semantic web would improve the accessibility in different ways. However, there are a few challenges faced during development, which include the difficulty of accessing public datasets related to accessibility issues, complex rules for ontology reasoning and mapping between disability requirements and accessibility data (Li et al. 2012). Therefore, this section will explore approaches to address these problems.

Accessibility Data is the data related to accessibility, which could include Open Accessibility Data (OAD) and Closed Accessibility Data (CAD). OAD mainly presents the accessibility information in public datasets, such as public transport stations, hospitals, supermarkets and other public facilities. However, there are some problems for OAD. The published tube stations data related to accessibility does not provide enough information for developers to use and some public datasets are not of high quality or in structured formats (Li et al. 2012). There are three kinds of accessibility datasets. Firstly, the accessibility dataset requested by users does not exist or is not accessible. Secondly, data related to accessibility is of low quality and poorly structured or in various different formats. The third type is datasets that have been published as Linked Data, but with no accessibility information provided. There are three suggested approaches for access to OAD on Linked Data: completing accessibility data for the existing dataset published in Linked Data through social authoring tools; transforming unstructured datasets into high quality and well-structured datasets and suggesting the data publishing organizations publish the datasets associated with accessibility data or develop a framework to use ontology based extraction to find accessible data from the current Web of documents. CAD is related to private properties, such as private houses information, private devices data and other personal data. These datasets are 'access controllable' and only open to trusted users or services. For disabled people, CAD provides anonymous access to the information and services.

User Modelling normally describes the user's profile as a data model and contains user's preferences, disabilities and capabilities data. There are some challenges for profile modelling, such as the classification of disabilities and capabilities, interactions description and access control. It is felt that it would be advantageous to offer a classification that has sections that could be divided into several subsections based on the capabilities. For instance, visual impairment includes blindness, low vision and colour blindness. There are huge differences in the way those who have these impairments will access materials and services. However, there are only a few popular ontologies related to the classification of disability. Therefore, ontology matching is a suggested approach to use to link these ontologies as well as access control attribute. Interactions description is also a challenge for user modelling due to the complex activities between users and

environment factors. Categorised interactions based on the type of disabilities could benefit the user modelling and ontology reasoning (Ghorbel et al. 2007). A suggested approach to use interaction description as an attribute of user profile associated with impairments would reduce the complexity of user modelling and ontology reasoning.

User and Accessibility Data Mapping is the main challenge after modelling the user's profile and environment. Due to the complexity of real world conditions and limited accessibility environment data, the mapping of profile and accessibility data could transform to the mapping of accessible environment data and interactions associated with impairments. The interaction description would be the bridge to connect users and environments or assistive technologies. Therefore, the classification of interaction attributes leads to the quality of mapping and ontology reasoning. A proposed classification is based on the daily life of people with impairments, which includes travelling, eating, drinking, learning, clothing and housing, as well as shopping and Internet accessing. Each section would include several subsections related to normal daily living activities. This daily living activities based classification of interactions would be examined and demonstrated in further work. The use of social software is recommended to provide feedback on accessibility data and mapping mechanism to improve the mapping accuracy and data quality. A Linked Data based approach would also drive the updating and mapping of real-time accessibility data, such as updating the availability of accessible seats on a user's preferred bus.

4. CONCLUSION

With the fact that the dataset scale of Linked Data has been increased dramatically, the power of information gained through linked data should not be underestimated. At present those who wish to learn more about the accessibility of their environment, technologies and services often find data that is out of date, lacks useful content and is not suitable for their needs. Linked data could provide a personalised service, which is appropriate to a user's skills and environment. The next stage of the research would explore a framework for completing and publishing accessibility data, interaction classification as well as reasoning rules to address the mapping issues. A Linked Data approach could integrate the accessibility data from different isolated systems or projects. As a result, the research of linked data for accessibility would not only benefit those with disabilities but also contribute to the development of smart cities.

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