

TRAVELLING FOR ALL

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ABSTRACT

Travelling is listed as the top difficulty for people with limitations, impairments or disabilities in their day-to-day activities. This paper demonstrates the barriers people face when they are travelling and reviews the current approaches or projects that are trying to enhance travelling for people with special needs. After exposing the limitation of these approaches, such as the lack of universal standards and methodologies, various isolated data and barriers of data achievement, this paper demonstrates the advantages of a linked data approach, namely dramatic data growth, domain specified data integration and automatic linking and reasoning to other resources. Therefore, it proposes a possible solution to build an accessible travelling service application to benefit travelling for all people.

KEYWORDS

Accessible travel; linked data; inclusive society

1. INTRODUCTION

According to the statistics of Family Resource Survey 2010/11¹, there are more than 11 million people with a limiting long term illness, impairment or disability in Great Britain. And most of them have some difficulty in day-to-day activities due to low income, inaccessible public services, poor educational qualifications, economically inactive and harassment or hate crime (Improving the Life Chances of Disabled People 2005)². They are facing the problems of housing, transport and working, and the most affected capacities are mobility, lifting or carrying and manual dexterity (Disability Prevalence Estimates 2010/11)³. According to the examples stated by Equality Act 2010, the day-to-day activities include leaving home without assistance, walking a short distance, travelling in personal cars or public transport and visiting an unfamiliar place. The social research concerned with people with disability could be divided into a social model and a medical model (Office for Disability Issues)⁴. The medical model which is no longer supported is related to people's medical condition or impairment. The social model which is recommended by the Office for Disability Issues and benefits an inclusive society includes the environment, attitudes and organisations. However, nearly 43% of disabled people in the US participated in less than one daily social activity due to the difficulties and barriers they are facing (Taylor & Hodapp 2012). The ICF (CAD 2001) states that all people have the equal right to be involved into social activities, no matter what kind of the limitations, impairments or disabilities they have. They are strongly encouraged to go out of their home and get in touch with the other people in the society, which would benefit their health.

Most public facilities are required to be built as accessible as possible due to the Equality Act 2010. However, there are still some problems and barriers disabled people face during their travelling, such as personal assistance, travelling time or delays and accessing public transport services and other travel information. Accessible travel information is not only important for people with disabilities, but also benefits all travellers, such as the passengers carrying heavy luggage or a baby carriage. Due to the complexity of interaction between individual and transport services, such as functional limitations, individual's need and various transport conditions, accessible travelling for people with a disability should involve people's profile

¹ <http://odi.dwp.gov.uk/disability-statistics-and-research/disability-facts-and-figures.php#gd>

² <http://www.disability.co.uk/sites/default/files/resources/Improving%20Life%20Chances.pdf>

³ <http://odi.dwp.gov.uk/docs/res/factsheets/disability-prevalence.pdf>

⁴ <http://odi.dwp.gov.uk/docs/res/research/involving-disabled-people-in-social-research.pdf>

or special needs. User profile modelling, travelling service information, real time public data and complex interaction, are significant characteristics that should be involved in the accessible travel information base. This paper reviews the current approaches that are trying to enhance travelling for people with special needs and also demonstrates the advantages and challenges of linked data approach as well as the possibility to build an application that could benefit travelling for all people.

2. CURRENT APPROACHES AND PROBLEMS

The dramatic development of information and communication technologies (ICT) brought the benefit of knowledge spreading and sharing, which makes information available for the people around the world. With the openness feature of the Web, people could access the desired information at home via their Internet-based devices. However, the current Web is still not accessible for all people. Although a few research studies related to accessibility have tried to improve the Web and make it as accessible as possible, such as web content accessibility, effective assistive tools and web browsers, it is still inaccessible for some scenarios. For example, if a wheel chair user wants to plan a journey with some advice on accommodations, price comparison of different plans, traffic levels and accessible facilities information such as parking or step-free stairs of both public transport services and planned visiting places, he needs to search several websites to check as some information might not be available online or even inaccessible. It is also not easy for him to find nearby accessible facilities during the trip. In order to achieve accessible travelling, there are a few related approaches and projects described in this section.

User sensitive inclusive design is one mainstream approaches for achieving accessibility in both the web and real world. Semantic User and Device Modelling Framework (Ackermann et al. 2012) proposed a semantic framework based on user's devices and preferences for Web2.0 application developers to create adaptive user interfaces. User-oriented design is also applied to the project (Tektonidis & Koumpis 2012) to manage and monitor user's health, social care and situations based on the personal sensor data, which aims to enhance the daily independent life activities of disabled people. There are some projects using a semantic metadata and ontology driven approach that aim to improve web accessibility. Accessibility Common (Kawanaka et al. 2009) proposed the web based approach for metadata integration, storage and sharing of accessibility related annotations. The Social Accessibility project (Takagi et al. 2008) demonstrated the social collaborative method to create and manage semantic metadata for application developers to benefit to the people with disabilities. However, these projects are facing the challenge of various data formats and linking among different metadata resources, thereby leading to the isolation of metadata and other resources. The Semantic Web Application framework (Kouroupetroglou et al. 2006) exposed the advantages of semantic web and role-based classification to contribute to application developers. The problems for this project are domain specified vocabularies and automatic annotating. There are also other projects trying to address the accessible challenges of day-to-day activities for the people with limitations, impairments or disabilities. OASIS (Open architecture for Accessibility Services Integration and Standardisation) is a project aiming to integrate accessibility related ontologies and semantic services, which could link all services from different specific domains and benefit aged people with their daily life. AEGIS project investigated the use of semantic web for accessibility and developed ontologies to map the interactions between the disabled people and different devices or assistive tools. Nevertheless, the high level modelling and special interactions lead to the complexity of ontologies modelling and reasoning. Semantic Matching Framework project (Kadouche et al. 2009) applied the Web Ontology Language (OWL) into modelling and reasoning people's profiles and environment to improve the interaction mapping between the users and their house facilities. Similarly, another project based on the Location Based Services used semantic modelling of user preference and assistive services as well as environment data (Ghorbel et al. 2007). ASK-IT (Wiethoff & Sommer 2007) proposed the approach to improve accessibility of people's social activities and travelling based on user's preference and the functional limitations. This project combines the action and active theory and ontology driven user modelling to understand a user's special needs for both pre-travel and on-travel information.

The primary challenge for these projects is how to achieve and interconnect the large amount of accessibility travelling information, such as public transport services, real time services, hospitals, shops and other related travelling data. How to model, map and automatic reason the interactions between the user's

profile and these data is another challenge due to the lack of the universal methodologies or standards, although some projects and approaches described above have already done some relevant research.

3. LINKED DATA : OBJECTIVES AND METHODOLOGY

Linked data is a large scale platform for linking the data to other relevant or related sources on the Web. The advantage of linked data is not only it is machine readable, but it also integrates all domain data into a global space. The development of datasets in Linked Data Cloud is dramatic with it rising from nearly 95 datasets in 2009 to 295 in 2011, which covers a few domains such as media, life sciences, geographic data (Bizer 2009). As the additional data layer to the current web, linked data exposes the advanced features, like standard data format and presentation, domain specified knowledge management, linking and sharing, openness as well as real-time reasoning (Bizer et al. 2009). All these characteristics provide the solutions to address the problems stated in the previous section, namely achievement and linking of the large amount of accessibility travelling information, global data integration as well as automatic mapping and reasoning.

For the problem of data modelling in linked data for accessible travelling, there are some existing ontologies for transport information and people with limitations or disabilities, such as the World Health Organization-ICF Ontology⁵, ASK-IT ontology, OASIS Ontology Repository for Assistive Technology (ORATE) and Ordnance Survey Topographic ontology. Nevertheless, these ontologies are focused on different domains. ICF ontology is describing the general classification and functionality of disability, while ASK-IT ontology demonstrates a different classification of functional limitations and user actions (Bekiaris et al. 2007). ORATE is constructed for assistive technologies and Topographic Ontology is presenting the geographical data of Great Britain. Therefore, how to integrate these different domain ontologies and conduct a general way to describe the user's profile, special needs and his surrounding environment is the first issue to overcome. The ontology matching proposes the essential method to address this issue. An effective matching method would improve the quality of user modelling as well as data integration and reduce the time consumption for reasoning.

Data achievement and publishing is another challenge for developing a travelling service application for all people. As an advantage of linked data, the UK government has published certain public data as open data and free access for everyone, including the transport data, hospital data and other public data, such as National Public Transport Access Nodes (NaPTAN)⁶, Accessibility Statistics⁷ and National Travel Survey⁸. These data are published by government departments or statistics organizations, which are well structured and in good formats (XML, CSV or JSON). Some of these data are published in EXCEL, HTML and PDF, which needs to be converted into a standard format (RDF) and published as linked data. This problem is also existing in RailGB (Li et al. 2012), a linked data driven mobile application using its own ontology to publish existing London tube station facilities data to benefit tube travelling for people with disabilities. Moreover, it also indicates that some accessible data is not available as open data or linked data (DBpeida, Ordnance Survey et al.). Therefore, creating and publishing both new and existing data into linked data is the second step to achieve accessible travelling for all. One suggested approach for creating and updating new data is to use a social collaborative application to involve the individual.

Semantic mapping is an advantage of linked data approach, which provides the automatic reasoning between different resources. Mapping and reasoning is also a challenge, which could be divided into the rule layer for ontology (Semantic Web Rule Language et al.) and the rule on query language (SPARQL et al.). For example, RailGB has developed a query agent implementing the mapping rules in SPARQL to get the information based on a user's requests. It is difficult to write the rules to map and reason the interactions between users and complex transport services condition. Therefore, using a method to involve the rules in mapping and reasoning is the third step for implementation of the travelling service for all people.

⁵<http://bioportal.bioontology.org/ontologies/1411>

⁶ <http://data.gov.uk/dataset/naptan>

⁷ http://data.gov.uk/dataset/accessibility_statistics

⁸ http://data.gov.uk/dataset/national_travel_survey

4. CONCLUSION AND FUTURE WORK

With the dramatic growth and advanced characteristics of linked data, it provides the innovative way to address the issues of accessible travelling and benefit to all people. Although there are still some challenges such as essential metadata, versioning and provenance to overcome (Goodwin et al. 2008), the power of information achieved and shared through linked data should not be underestimated. Travelling is one of most difficult barriers faced by the people with limitations, impairments and disabilities. Currently, those people who want to know more about the accessible information of their surrounding environment, assistive tools and service for their travelling often find that the data is out of date, and useful content is missing or not suitable for their needs. People with limitations or disabilities also have to spend extra money and need more information about special diets, travelling costs and special clothing. A linked data approach would not only benefit accessible travelling for all, but also brings a possible way to integrate the accessible data from different domains and isolated systems into a global space. The future research work would expose an application for creating and publishing related data into linked data as well as rules for mapping and reasoning. Asocial collaborative methodology (such as social networking) is also considered into the application to contribute to the updating of accessible data as well as feedback for evaluation. As a result, the proposed linked data approach for enhancing accessibility in the real world would not only benefit those with disabilities but also contribute to the development of smart cities.

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