Linked Data-Driven Decision Support for Accessible Travelling

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ABSTRACT
With the aim of addressing the gap between users' needs of accessible travelling and complex environmental barriers of physical places in the real world, this paper summarizes the research of investigating the use of Linked Data principles for enhanced accessible travelling decision support. Firstly, this paper reviews current research and projects to identify some problems and challenges. Then a conceptual model and the reference architecture of Linked Data-driven decision support system (DSS) for accessible travelling are proposed to address such problems to enhance the accessible travelling for people with disabilities (PwD), especially for people with mobility difficulties. As a result, this research would not only benefit PwD, but also contribute to the research of a novel model to address accessibility information barriers by applying the Linked Data principles to DSSs for enhanced accessible travelling.

Categories and Subject Descriptors
K.4.2 [**Computer and Society**]: Social Issues – *Assistive technologies for persons with disabilities*; H.3.5 [**On-line Information Services**]: Data sharing and Web-based services

General Terms
Design, Human Factors

Keywords
Linked open data, accessible travelling, decision support system.

1. INTRODUCTION
According to the statistics report of United Nations, there are nearly 650 million people with disabilities (PwD) in the world and more than 11 million PwD in UK. One of major challenges faced by most PwD in their daily activities is accessible travelling, such as the outdoor or indoor accessible way finding, unfamiliar areas exploration, and journey planning. The development of current Web Technologies empowers the digital inclusion and brings much more opportunities for PwD to fetch some accessibility information of physical places or the area they want to explore. However, it still costs money and time consuming for PwD to find such accessibility information based on their capabilities and preferences. Therefore, this research investigates the use of Linked Data principles and Decision Support System (DSS) for enhanced accessible travelling decision support and proposes the conceptual model as well as the reference architecture of Linked Data-driven decision support system for accessible travelling. The rest of this paper presents the research motivation and questions, proposed solutions as well as a brief conclusion of the current research stage and its envisioned contribution.

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2. PROBLEMS AND MOTIVATION
There are many related research projects proposed to improve accessible travelling for PwD, such as U-Access[9], OurWay[6], Accessibility Maps[3] and [8]. According to the review of related projects and work, there have been some problems identified [4]. One of major problems is the lack of accessibility information for physical places and objects on the Web. Due to the complex conditions of travelling, the discordance between the expectation of PwD and actual situation of transport patterns or facilities could bring significant challenges [7]. Another major problem is that although there are accessibility related datasets available, the data from each project or system is isolated and difficulty to reuse due to various data formats or schema. There is also the urgent need for the better accessibility data integration approach as well as algorithms to provide optimized decision support based on their capability and preference to address these problems. Therefore, the motivation of this research is to address information barriers faced by PwD with following objectives:

- Publishing, integrating and interlinking the distributed open accessibility datasets into the Linked Data.
- Optimizing decision support algorithms based on the generated Linked Data and users' capabilities;
- The model of Linked Data-driven Decision Support System for accessible travelling.

3. PROPOSED SOLUTIONS
In recent years, the revolution of the Web proposes the principles of data sharing, which is known as the Semantic Web instead of document sharing in the traditional Web [2]. As the core data layer, Linked Data demonstrates the advanced characteristics for knowledge sharing, namely human and machine readable, well-structured, standard format, and domain specified. The Linked Data principles [1] proposed by Tim-Berners Lee specifies how all the published datasets could be linked and referenced by other datasets. DSS is the computer based solution system used for decision support and addressing problems, such as management, operation, and planning. There are many common goals shared by the Semantic Web and DSS. However, DSS is much more domain-specific than Semantic Web.

Therefore, this research investigates the use of Linked Data principles and DSS for enhanced accessible travelling decision support. In Figure 1, it demonstrates the reference architecture that implements the conceptual model of Linked Data-driven DSS for accessible travelling. This architecture mainly consists of two major models for this research, namely the data integration model and the decision support model for accessible travelling.

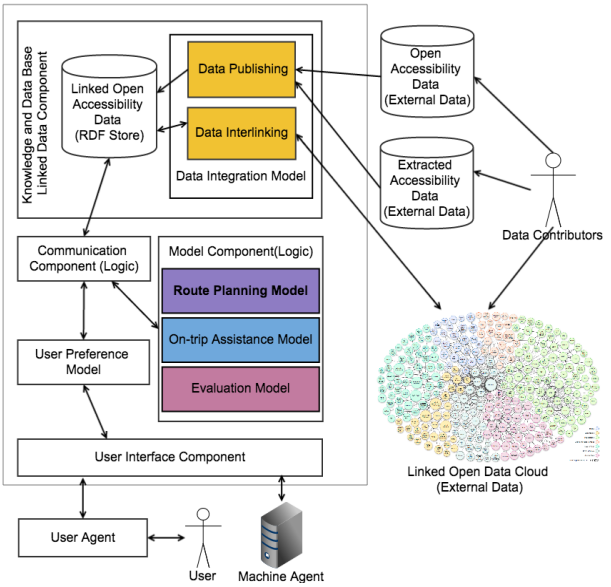

Figure 1: Reference Architecture of Linked Data-driven DSS for Accessible Travelling

3.1 Data Integration Model

The early stage of this research involves applying the Linked Data principles to publish and interlink the open accessibility data integrated from heterogeneous data sources as the Linked Data. There are heterogeneous accessibility data available on the Web and three primary types are: open data, extracted data and linked data. The data processing phase extracts these raw data or fetches the open accessibility data through APIs from different systems. Due to the fact that some data entities fetched are presenting the same object in the real world, there are some data issues, such as data duplication or some data with uncompleted properties. The proposed ontology-based entity matching approach [5] has been applied to interlink these datasets as well as link to other resources on the Linked Data Cloud, such as LinkedGeoData. In the current stage, the experiments of this model have been finished and the SPARQL endpoints of the generated Linked Datasets published for public usage. As a consequence, the main task for this model is to demonstrate the data integration method to achieve well-structured accessibility data to provide the knowledge base for the decision support model.

3.2 Decision Support Model

The decision support model is based on the Linked Data generated by the data integration model. The aim of this model is to provide optimized accessible travelling decisions support for users based on users' capabilities. Algorithm optimization is widely used in decision support systems for speeding up the progress of decision making or improving the accuracy of solutions provided. According to the literature review of current decision support system algorithms, the performance of methods or algorithms is dependent on various factors, such as the nature of the task, complexity of the data structure or scheme, and the scale range of knowledge base. Therefore, the research of this model would mainly explore the decision support algorithms and how these algorithms would be optimized to make effective decision support for accessible travelling based on the accessibility information in the Linked Data and users' capabilities.

4. CONCLUSION

In this paper, we present the research investigating the use of Linked Data principles for enhanced accessible travelling decision support as well as the reference architecture based on proposed model to address information barriers faced by PwD for accessible travelling. In the current stage, we have fetched open accessibility data from several systems and finished the experiments of the data integration model, which includes the approaches for accessibility data integration, entity matching algorithms, data publishing and interlinking. The next step is to investigate the DSS algorithms optimization of decision support system for accessible journey planning. As a result, this research could not only improve accessibility information for the physical places and objects on the Web, it could also address the problem of data isolation by applying Linked Data principles to integrate heterogeneous accessibility data. Moreover, the proposed model and optimization algorithms could provide the reference for other researchers to look into the research of optimized accessible way-finding system based on the Linked Data and DSS.

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6. REFERENCES

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