Using Open Accessibility Data for Accessible Travelling

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Abstract. This paper summarizes the research of using open accessibility data for accessible travelling. With the aim of addressing the gap between users' special needs and complex accessibility barriers in real world, we proposed a personalized accessible travelling framework based on open accessibility data for people with mobility impairments. This research mainly investigates the use of Linked Open Data to establish a public linked open accessibility repository integrated from heterogeneous data types, such as sensor data, transport data, building data as well as geographic data. Based on this repository and user preference data, we proposed accessible travelling framework to address the travelling problems faced for people with mobility impairment.

Keywords: Open Accessibility Data, Accessible Routing, Decision Support, Linked Data

1. INTRODUCTION

According to the Family Resource Survey 2010/11, mobility disability is listed as one of the top three impairments in UK. Travelling is challenging for people with mobility difficulties due to the discordance between the users' expectation and their actual travel experience [8]. They are mainly faced with three types of problems, namely pre-trip planning, on-trip assistance and after-trip feedback. Pre-trip route planning includes the Level-of-Service (LOS) of public transportation patterns, Points of Interests (POIs) and some complex situations on the road or street, such as road works, flooding, slope and potholes. On-trip assistance means that users seek help or accessibility related information of the surrounding area based on their special needs and real-time location. After-trip is basically for users to review, evaluate or even improve the data quality based on their travelling experience. In this research, we proposed a personalized accessible travelling framework for people with mobility impairments. This framework is applying the Open Data and Linked Data principle to address the challenges of accessible travelling, which includes five models, namely the data model, user preference model, route planning model, assistance model and evaluation model.

2. BACKGROUND

Accessible route planning for people with disabilities is one of the main research areas for improving urban accessibility. One important challenge is the personalization and user modelling due to the complex preferences of people with disabilities. Beale, L. et al. [1] emphasized that the type of wheelchair strongly influenced which barriers hindered access. Carmien, S. et al. [3] proposed the Mobility-for-All project and presented the socio-technical architecture for supporting those with cognitive disabilities and other people with special needs, such as elderly or non-native speakers. Völkel, T. et al. [12] proposed the approach using equally weighted and normalized criteria based on predefined user group profiles and user's rating. However, there is no algorithm for reducing malicious rating.

Another significant challenge to plan routes for people with disabilities is the lack of accessibility related data. There are several projects proposed to apply crowdsourcing or citizen sensing approach to collect these accessibility data. Holone, H. et al. [6] presented the project called Our-Way to combine accessibility maps and route planning for people with mobility problems based on crowdsourcing. Steinfeld, A. et al. [11] also proposed the citizen sensing approach to collect related data to improve public transportation. Cardonha, C. et al. [2] proposed a prototype to build the Accessibility Maps based on citizen sensing. Accessibility barriers identification and measurement is another challenge. MAGUS project [1] proposed a comprehensive LOS model for wheelchair us-

ers based on questionnaires, interviews, observations and physical measurement. The measurement of barriers uses Digital Elevation Models (DEMs), and 10 barriers are identified, such as road surface, drop kerbs, steps, and deep gutters. U-Access [10] proposed a simplified models of both level-of-service and users. Based on these projects and a previous literature review [4], some common problems and challenges could be summarised as the lack of accessibility data, crowd sourced accessibility data not shared across different applications as well as the identification or measurement for accessibility barriers. Therefore, in order to address these challenges, we proposed a personalized accessible travelling framework for people with mobility impairments based on Open Accessibility Data by applying Open Data and Linked Data principles.
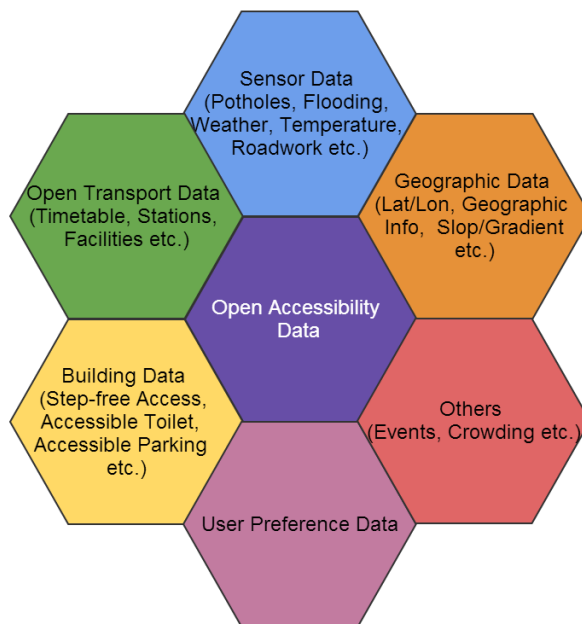
3. RESEARCH MOTIVATION

Figure 1: Domains of Open Accessibility Data

Open accessibility data is the data related to the accessibility that improves accessibility experience, such as step-free access, accessible toilets, or accessible parking. Accessibility data also refers to the data that benefits people with special needs, such as baby change facilities, carrying large luggage or travelling with a baby pushchair. Figure 1 describes the domains of open accessibility data, which includes heterogeneous data resources, such as the sensor data (potholes, flooding and roadwork), open transport data (public transport timetable, station facilities), building data (accessible facilities, step-free access, accessible parking), user preference data (user modelling data), geographic data (latitude/longitude) and some other data (crowding or events). For the usage of open accessibility data, Li, Y. et al. [7] presented the project RailGB using open accessibility data to help people with special needs. Prandi, C. [9] presented the implementation of accessibility and smart data for accessible route planning. Based on the lessons learn from the survey of open accessibility data in UK [5], the motivation of this research is to address the accessibility data creation and sharing barriers of several crowdsourcing applications by integrating heterogeneous accessibility related resources into a public linked open data repository. The main goal of this research is to help people with mobility difficulties to make optimized decisions for their accessible travelling based on the linked open accessibility repository and user preference data.

4. RESEARCH QUESTIONS

According to the statement in previous sections, several research questions should be discussed. First of all, accessible travelling includes the accessibility measurement of POIs and Paths between POIs. Therefore, what kind of data should be annotated as open accessibility data for

describing both the accessibility measurement of POIs and Paths? In current research, we have extracted the open accessibility data from several open systems or applications. There are some existing data schemas for these datasets and there is no standard for specific attributes due to the differences between different applications. The second question is how to conduct a standard guideline for annotating accessibility metadata to describe the accessibility level or barriers identification of target places or facilities as well as paths between different POIs. Crowdsourcing is not enough for obtaining open accessibility data due to the data quality. The government published accessibility data is more accurate but high dimensions. The third question is that what kinds of accessibility data does the user need (the assertion of the accessibility status or detail information about accessible facilities)? Figure 2 demonstrates the accessible travelling framework based on open accessibility data. Another research question is how to evaluate the algorithms applied in route planning model based on user's preference and open accessibility data? The last research question is how this Linked Open Data based framework would benefit people with mobile difficulties for their accessible travelling? All these questions should be answered in the following research.
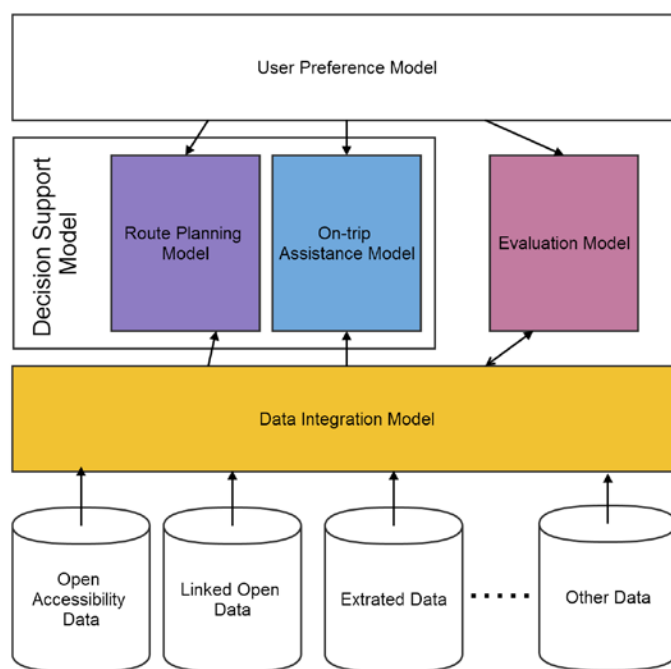

Figure 2: Accessible Travelling Framework

5. RELEVANCE IN ICCHP CONTEXT

The ICCHP conference is a highly regarded international conference focused on the use of computer to help people with special needs. This is an early stage research of improving route planning for people with mobility difficulties. This research aims to investigate the use of Linked Open Data for accessible travelling, and proposes the accessible traveling framework and optimized algorithms of decision supporting system for enhancing assistive travelling. The young researcher consortium provides a great opportunity for me to share and discuss the questions of open accessibility data, accessibility measurement and user personalization as well as future research with other participants. The feedback from other researchers and experts would be very important and helpful for the next stage of my research.

6. NEXT STEP

In our current stage, we have integrated open accessibility data into linked data and the next step of this research is to determine the accessibility measurement metrics for designing the decision supporting algorithms based on the linked open accessibility data repository. As a result, this

research would not only enrich the open accessibility data, but also contributes a novel way to the research of addressing the accessibility data problems with the Linked Data principles, and thereby contribute to the research of accessible route planning for people with mobility difficulties.

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BIOGRAPHY

Chaohai Ding is a PhD candidate and Research Fellow at the Web and Internet Science Group, School of Electronics and Computer Science, University of Southampton. He received his MSc of Web Technology (Distinction) at the University of Southampton. His main research is to investigate the use of Linked Open Data for accessibility, especially for enhancing the travelling experience. He is also interested in the area of decision support system, machine learning, and natural language processing as well as intelligent agent. He is a member of ECS Accessibility Team and currently working on Semantic Multimedia Project.