Discover Barrier-free Accessible Locations with the Location Navigator

Konrad Abicht*[1], Simeon Ackermann[2] and Michael Martin[3]

Abstract: We present the current version of the Location Navigator, which supports users by finding locations in Leipzig, that can be accessed without barriers. Besides this current version of the prototype we present additionally experiences regarding its engineering process and the previously performed conversion of Open Data provided by the registered association Behindertenverband Leipzig e.V. (BVL). Our vision of the underlying data is an inter-commune data network, in order to support persons with special needs and, furthermore, to apply developments such as the Location Navigator to other municipalities. For this purpose, RDF will be used for the representation and linking of data in the future. Besides the presentation of the Location Navigator, we sketch some approaches we evaluated during the creation of the respective data model.

Keywords: open data; people with disabilities; locations; data management

1 Introduction

As people with disabilities are able to plan and shape their daily lives outside their home, they often need special information. In Germany many public locations are not fully accessible[4]. If people are visiting i.e. a foreign city, they need to inform themselves about the availability of wheelchair suitable toilets and corresponding address information. Therefore they have to obtain manually detailed and approved information about those public locations. The BVL provides a static website, based on the relational database Microsoft Access (RDB), which contains a wide range of information about locations in Leipzig but without any search and filter function.

[1] *Corresponding author. Address: Leipzig University, Institute of Computer Science, AKSW Group, Augustusplatz 10, 04109 Leipzig, Germany abicht@informatik.uni-leipzig.de

[2] Hochschule für Technik, Wirtschaft und Kultur Leipzig (HTWK) - University of Applied Sciences, Gustav-Freytag-Str. 42A, 04277 Leipzig, s.ackermann@mail.de

[3] Leipzig University, Institute of Computer Science, AKSW Group, Augustusplatz 10, 04109 Leipzig, Germany martin@informatik.uni-leipzig.de

[4] Regarding to statements of the Behindertenverband Leipzig e.V. (BVL) and their experience and observations of the last 20 years.

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In 2016 we[5] started a cooperation[6] with the Behindertenverband Leipzig e.V.[7] (BVL) as part of the LEDS project[8]. The BVL is a non-profit organization which cares about issues of people with disabilities. Founded in 1990, the BVL is attendee in several councils, provides consulting and educates people about disabilities. Besides that, the BVL maintains a database, which contains information about locations in Leipzig and their degree of accessibility.

At the beginning of the project, our major goal addresses the publication of the data using a respective open license, to gain more attraction to a broader community. Hence, not only disabled people can benefit from the data. The data can also be of interest, for example, for governmental departments and companies. At a later stage, we developed the Location Navigator to give insights about the dataset and to showcase how the dataset can be used exemplary.

In this document we present our work, which includes the enrichment of the CSV export of the accessibility data as well as the development of the Location Navigator. As a next development step, we will convert the current version of the dataset to RDF (including the deployment in an open accessible triple store), to enrich the data with respective semantics and to lower the barrier by reusing the data in further use cases. With the best of our knowledge, currently are no suitable RDF vocabularies available, which makes it necessary to develop a new one. Despite being future work, we want to discuss our thoughts in more detail, to outline our motivation. The new vocabulary could be set on top of an ontology, describing general features of a buildings. Such an ontology could be the *3D building ontology* developed by M. Goetz and A. Zipf [GZ11], which offers possibilities of representing inner aspects of buildings. It describes parts of the building to enable i.e. indoor navigation and it also provides general information, such as types of building doors or how buildings parts are connected. On top, we will build an ontology with more detailed information about accessibility features.

In the following section we present related projects. Afterwards in section 3 the data model and the underlying management process is sketched. In section 4 we give a brief presentation of the developed prototype. Finally, we conclude our work in section 5 and give some insights about future steps towards achieving our goals.

2 Related work

In this section, we compare the Location Navigator with further web applications, dealing with information about the accessibility of buildings and public places.

[5] Members of the Leipzig University and Lecos GmbH

[6] `http://www.leds-projekt.de/de/aktuelles/2016/zusammenarbeit-mit-behindertenverband.html`

[7] `http://www.le-online.de/infos.htm`

[8] `http://www.leds-projekt.de/de/linked-enterprise-data-services.html`

Wheelmap[9], published by the *Sozialhelden*[10], is an online map service for searching, finding and marking places accessible by wheel-chaired people. Stored data is crowdsourced [DWW14], which means that everbody can add information about accessible or non-accessible locations. We received feedback from the BVL, that Wheelmap contains contrary information, compared with data from the BVL (provided data is not verified). Furthermore, Wheelmap provides only three states about the accessibility: (a) fully accessible, (b) partial accessible and (c) not accessible. In comparison, the Location Navigator provides exclusively data, that was verified by experts. Additionally, data about locations collected by the BVL is much more detailed.

The Czech project *Maps without barriers*[11] is similar to Wheelmap, but it provides more information about a location, i.e. the number of stairs or the width of narrowed passages. According to the page[12], data is collected and verified manually. The underlying data is about places all over the Czech republic and is published using the Open Database License (ODbL)[13]. The publication of the accessibility of locations is organized similarly to Wheelmap using the states (a) accessible, (b) partly accessible or (c) inaccessible. The Location Navigator present more detailed information about locations and provide features to filter fine-granularly, However, *Maps without barriers* is not limited to locations of only one commune.

The Great British Public Toilet Map[14] [BK12] publishes detailed information about toilets, i.e. the gender attribute. Underlying data is provided as open data and is restricted to a limited geographical area (Greater London). Besides the publication of public toilets, one superior goal of this project was to demonstrate the usefulness of open data itself. Additionally, the data is aggregated with meta information such as its data sources and credibility, which is presented to the user as well. This web services acts as a public participation and campaigning site. Despite the usage of some WIA-ARIA tags[15], the presentation of the web service could be improved in order to support people far better, that are visual impaired or blind.

The *Open Street Map*[16] [HW08] project (OSM) provide geo-related content, acquired and contributed by the crowd. After users select a place or building, OSM present information about the selection organized as tags resp. key-value pairs. For some locations accessibility information are included (i.e. *wheelchair: true*[17]). We assume, that this means the location is at least partly accessible for wheelchairs.

[9] https://wheelmap.org/map
[10] http://sozialhelden.de
[11] https://mapybezbarier.cz/en
[12] http://web.mapybezbarier.cz/en/about-project/
[13] https://opendatacommons.org/licenses/odbl/1.0/
[14] https://greatbritishpublictoiletmap.rca.ac.uk/
[15] e.g. aria-label
[16] https://www.openstreetmap.org
[17] e.g. Leipzig Opera: https://www.openstreetmap.org/way/18920139#map=19/51.34052/12.38151

3 Data generation, transformation, publication and architecture

Category	Entrance	Lift	Toilet
Education / Culture	151	59	61
Services	6	0	0
Catering trade	58	18	13
Health / Social	117	57	38
Public Administration	71	43	31
Organizations	19	11	2
Traffic	3	0	0

Tab. 1: Number of locations per category which provide full wheelchair support for entrance, lift or toilet.

In this section we present the data model and related processes. For each location a number of measures are available to describe its accessibility. Before presenting the model, general information about the locations will be shown. In Table 1 basic statistic about contained locations are listed. The BVL collected data of about 1700 public and private locations from different categories like education (e.g. schools) or public administration (e.g. city hall). Some measure are represented using hierarchical values, for instance: availability of toilets can be either

- no toilet available, or
- toilet available, and
  - *partly* accessible by wheelchairs, or
  - *fully* accessible by wheelchairs

We re-used the hierarchy in the prototype to implement a filter functionality, described in the next section.

The initial model, developed by the BVL, was inspired by the public specifications DIN 18024 [DIN98] (outdated) and 18040 [DIN10]. Data items are collected using paper forms and to keep the effort low, the number of measures are limited. All measures are either numbers or boolean values.

Figure 1 illustrates the data generation, transformation and consumption process and additionally some thoughts about future work.

The original database structure is not self-explanatory (e.g. column IDs like A10 or B24) and partially inconsistent (i.e. integrated HTML code as described in the project blog[18]).

[18] http://www.leds-projekt.de/de/aktuelles/2016/Die-Ueberfuehrung-des-BVL-Online-Stadtfuehrers-ins-CSV-Datenformat.html

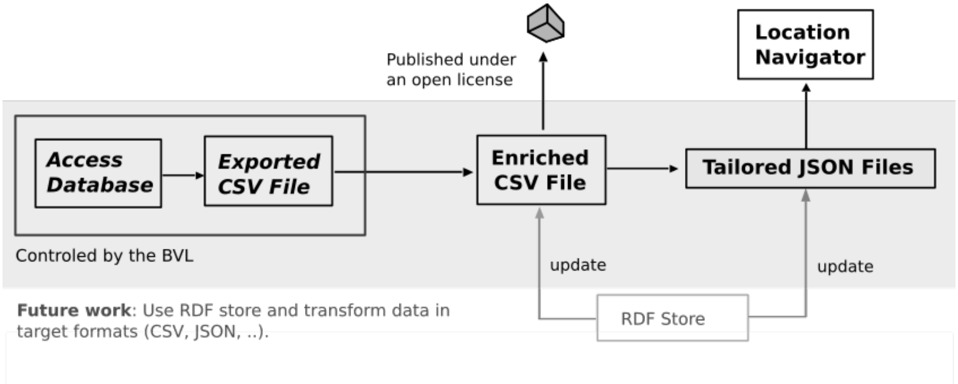

Fig. 1: Illustration of the data process (Generation, Transformation, Publication and Consumption)

To improve the quality of the database export (CSV) we scripted a use case specific converter[19], which is enriching the geo-related data items with geo-coordinates (WGS84). The resulting CSV file is published using the data license Germany[20]. The resulting CSV file was converted to JSON to prepare processing in the Location Navigator.

4 The Location Navigator

The Location Navigator is made available over the Website of the BVL[21] (cf. Figure 2). Besides functional requirements of the web service we focused additionally on the usage by people with impaired vision (screenreader support). To reach that goal we took care about the WAI-ARIA specification [Di16] and integrated further best practices such as:

- Usage of colors which are good to read (even outdoor).
- Using simple texts and short sentences without any technical terms.
- Complement texts with meaningful icons to support its understanding.
- Avoid nested menus or complex navigation structures.

Further requirements were taken into account to support mobile usage, such as (a) mobile client design and (b) localization of the user used to filter locations in the near.

[19] https://github.com/AKSW/transform-bvl-pages-to-csv-file
[20] https://github.com/AKSW/transform-bvl-pages-to-csv-file
[21] https://behindertenverband-leipzig.de/gebaeude-navigator

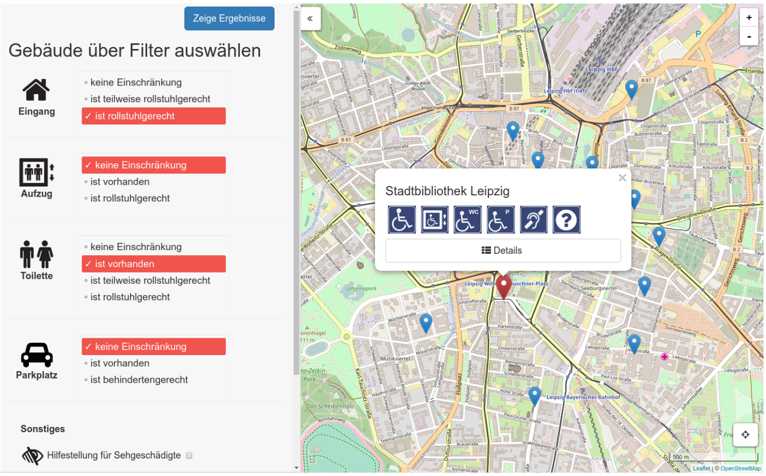

Fig. 2: Screenshot of the searchbar and the map (German version)

4.1 Version history

We implemented the Location Navigator three times. In the following, we sketch some insights about development history.

The first version[22] started as a proof of concept (POC) project, realized by a group of students from Leipzig University. Implemented with JavaScript and the front-end framework React[23], it provides major functionalities for filtering, selection and presentation of location information. Because of violating basic design principles, which would have prevented a long-term maintenance, we decided to re-implement that POC.

To prepare this reimplementation[24], we researched for a suitable architecture and best practices with React. As a result, we decided to use JavaScript with React-Redux[25] and stateless functional components. Furthermore, processed geo-coordinates were represented as RDF (managed entirely in JavaScript with JS-library *rdfstore-js*[26]), instead of processing a CSV file as in the first version. The resulting web application fulfilled most of the requirements but caused massive performance lacks while querying the In-Memory RDF Store using SPARQL. Furthermore the applied Redux data flow and the usage of functional programmed components slowed down the development and required an intermediate skill set.

[22] `http://pcai042.informatik.uni-leipzig.de/~spe16/`
[23] `https://facebook.github.io/react/`
[24] `https://github.com/AKSW/building-navigator/projects/1`
[25] `http://redux.js.org/`
[26] `https://github.com/antoniogarrote/rdfstore-js`

The current version[27] is implemented fully object oriented using React as described in the following subsection.

4.2 Architecture

After removing Redux, we decided to use an architecture based on the unidirectional dataflow concept and to develop three main components: (1) global stores, providing various settings (i.e. UI settings) and data, (2) the front-end components for rendering HTML output and (3) a controller unit. As illustrated in figure 3 the Location Navigator controller passes the data from the stores to the respective components. Each component can call events by using a method from the parent class, which passes the event to the EventHandler. The EventHandler decides to whom store the event will trigger an action. After completion the Location Navigator class gets the new data and passes it to the components.

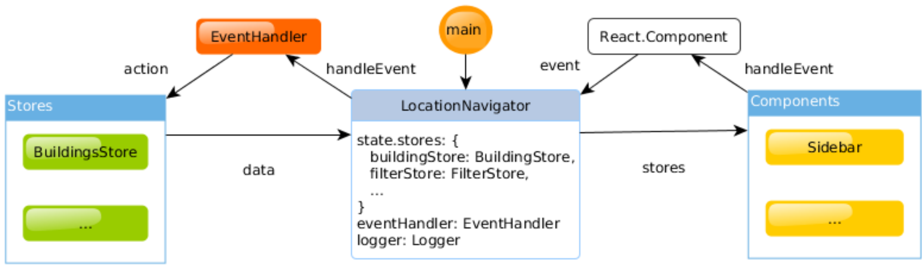

Fig. 3: Architecture (Stores, LocationNavigator controller and Components), event handling and data passing

Finally, we used JavaScript with React as front-end framework and a development stack with Node.js, NPM and further NPM packages as well as Webpack and built a docker container for deployment[28]. Bootstrap[29] is used due to its extended collection of CSS styles and the low entry point for web users.

4.2.1 Filtering Locations

One important feature, depicted in figure 4 integrated in the Location Navigator, is the filter component, whereas a filter is basically a requirement (i.e. a toilet, which needs to be fully accessible for wheelchairs). As mentioned before, some filters are designed with hierarchical values. While using requirements for locations as filters more restricted values are being

[27] `https://github.com/AKSW/building-navigator/projects/2`
[28] `https://hub.docker.com/r/k00ni/docker-nodejs-environment/`
[29] `https://getbootstrap.com/`

included in less included values (i.e. every toilet, that is “fully accessible for wheelchaired people” have to be found if a filter is set to “partially accessible for wheelchair users”).

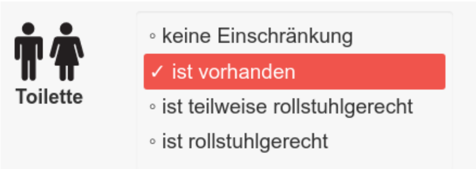

Fig. 4: Example view of a filter (German version)

A subsection of those filters can be set on the welcome screen (depicted at Figure 5) of the Location Navigator, which are acting as pre-set filters providing information about the type of disability.

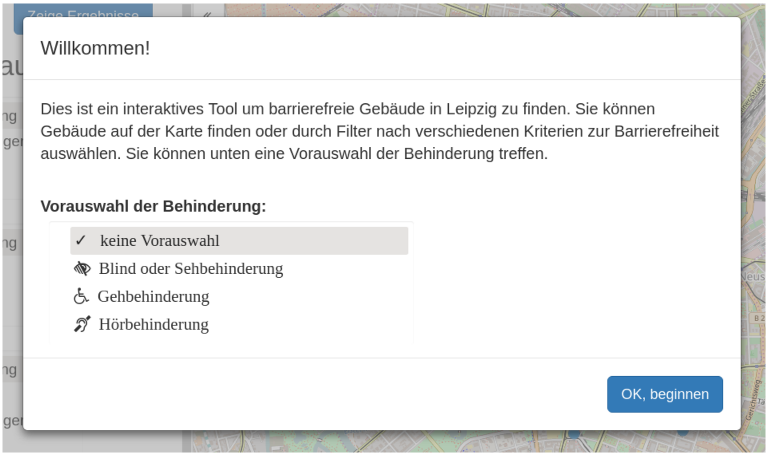

Fig. 5: View of the welcome screen (German version)

5 Conclusion and future work

We presented our intermediate project results we developed in cooperation with the Behindertenverband Leipzig e.V. (BVL). The enriched and published CSV file is suitable as a basis for the conversion to further file formats and thus for further processing within the Location Navigator. Using the described architectural design enables us to integrate the web service into other infrastructures and to adapt further data sources easily. Currently, we represent underlying data item as CSV and RDF (geo-coordinates). To enable the re-usage of all data from the BVL as part of other use cases, we prepare currently the conversion of the whole dataset to RDF and its respective publication as Linked Open Data. To realize the conversion, we will re-use existing ontologies such as (a) *the 3D building* *ontology* for general descriptions of buildings and (b) *the vocabulary for (L)OD description of wheelchair accessibility*[30]. This ontology (b) provides properties, such as the elevator door width. The open publication of such data as RDF could as well be of interest for enterprises, i.e. (interactive) information provider in the tourism or real estate domain. Travel, reservation and real estate portals could consume, enrich and publish accessibility features in combination with their own information resources (i.e. entrance fully accessible by wheelchairs of a specific hotel or museum. Appropriate (international) service companies would demand regional data, which is modelled using well known vocabularies in order to integrate the data cost-effective. Hence, we refer the reader to the paper [Ch09], in which the authors outline how to enrich travel information systems using web services and RDF.

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