BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF INFORMATION TECHNOLOGY

Excel@FIT 2025
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Trip Planner for South Moravian Region with Walking Integration

Jan Kvapil*

Abstract

The primary focus of this work is developing a web application that provides advanced route planning features, focusing on combining walking and public transport sections for route planning and giving the user greater freedom in constructing their journey, while utilising GTFS data of the IDS JMK transportation system and OpenStreetMap data. An open-source routing engine, OpenTripPlanner 2, is used to facilitate routing. With the application, users can define points of the journey in four different ways, they can define time spent at each point of the journey, as well as the type of transportation between each point of the journey.

*xkvapi19@stud.fit.vut.cz, Faculty of Information Technology, Brno University of Technology

1. Introduction

Many users of public transport nowadays use various journey planners, with IDOS.cz[1], Mapy.cz[2] and Google Maps[3] being commonly used applications for this purpose[4].

However, these solutions often fall short of users' expectations. Some services offer low levels of customisation, usually lacking any way to add intermediate points to the journey. Other services lock certain route planning features behind paywalls. This often leads to users needing to combine multiple applications to plan a complex journey with walking and public transport-utilising sections.

The primary purpose of this work is to create a new web application that offers users freedom in designing their journey and setting up the journey parameters. In the new application, users will be able to define up to five intermediate points for their journey, including the time spent at each point and the mode that will be used for routing between the two points. They will be able to set their walking speed, the highest number of transfers between points, and filter out public transport modes they do not wish to use.

[1] https://idos.cz/
[2] https://mapy.cz/
[3] https://www.google.com/maps/
[4] Based on a survey done as part of the thesis, 33 respondents.

While the devised solution is designed with the IDS JMK GTFS data in mind, it can be used anywhere with a GTFS data feed and OpenStreetMap data available, albeit with slight modifications.

2. The Trip Planner

The trip planner is implemented as a single-page web application. Based on prior research and a user survey, several sought-after features came to light.

- Creation of complex journeys.
- Variation in way to set journey points.
- Ability to define breaks while planning.
- Clickable stops with timetables.
- Show details about the journey.
- Ability to reverse the direction.
- Ability to set routing preferences.

2.1 Architecture

The architecture and used technologies can be found in Figure 1. React is used on the frontend, while Python is used on the backend. React allows for the application to be implemented as a single-page web application (SPA). Python offers access to libraries such as Pandas that allow for efficient processing of the GTFS dataset. Nominatim, a tool to search OSM data, is used for geocoding. The GTFS data used by the application is sourced from data.brno.cz under the CC BY 4.0 license (GTFS data used in Figure 6 is

sourced from pid.cz under the same license), while the mapping data is © OpenStreetMap contributors and available under the Open Database License (ODbL).

2.2 Routing

The user is able to select the location for their journey in four ways:

- right-clicking in the map
- activating selection mode (button with a marker in the input form) and left-clicking in the map
- selecting from a dropdown of stops [5]
- inputting an original string that is geocoded

Routing is performed using OpenTripPlanner 2. It is built using Java and utilises RAPTOR [1] and A* [2] algorithms. It requires GTFS and OSM data for routing. User input is handled on the frontend and is only sent to the backend when a routing request is sent. Public transport sections and walking sections are routed individually and joined together. This approach allows for creating connected but independent sections (Figure 2).

The user can set routing settings and preferences. These settings are included in the communication with the backend, and they modify the query sent to the router. The user can also define breaks in the input form. These breaks are added post-routing.

2.3 Displaying of Information

The journey is displayed to the user in two different ways. The map, which is a visually dominant element of the application, and the itinerary. The application layout is slightly different on mobile, with the itinerary displaying the legs horizontally rather than vertically (Figure 3). The router returns the polylines describing the journey based on the GTFS dataset. Lissy API[6], created by Ing. Juraj Lazúr [3], is used to make the polylines more accurate. The itinerary shows information about the journey, including both individual legs and total time.

Additionally, departures from stops (Figure 5) are displayed for every stop with at least one departure in the next 3 hours. This feature is implemented by processing the GTFS dataset files.

2.4 Re-routing

To offer the user even more freedom in constructing their journey, the user can perform re-routing (Figure 4). Re-routing works on the same basis as routing, with only the legs following the rerouted leg being recalculated. The user can find the next or previous connection, or move walking legs by 10 minutes into the future or the past. This feature can be especially convenient if a delay occurs or if the user arrives at a stop too early.

[5] Retrieved from the GTFS dataset.

[6] https://github.com/Jorgen98/Lissy/

3. Usage in Other Regions

The application was developed with the South Moravian Region in mind. However, due to its nature of working with standardised data, it can be run in areas with public GTFS feeds with little alteration to the source code. Modifying bounding boxes and geocoding suffixes is the main alteration needed to be made to the source code. The backend and the router need to be run with the relevant GTFS and OSM data to ensure correct routing, stop dropdown menu creation, and the displaying of departures from stops. Once these alterations are made, the application is ready to be deployed outside the South Moravian Region. An example of it running in Prague, Czech Republic can be seen in Figure 6.

4. Conclusion

I created a trip planner that allows combining walking and public transport and introduces numerous ways for users to customise their journeys and routing preferences. While the application is ready for deployment, there is still room for new features. User testing uncovered features and areas where the app could be improved, such as integrating biking functionality into the application or adding route searching by specifying the arrival time rather than the departure time. These features will be worked on in the future.

Acknowledgements

I would like to thank my supervisor, Ing. Jiří Hynek, Ph.D., for his help, support and feedback during the making of this work.

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