How Far Can Public Transport Take You?

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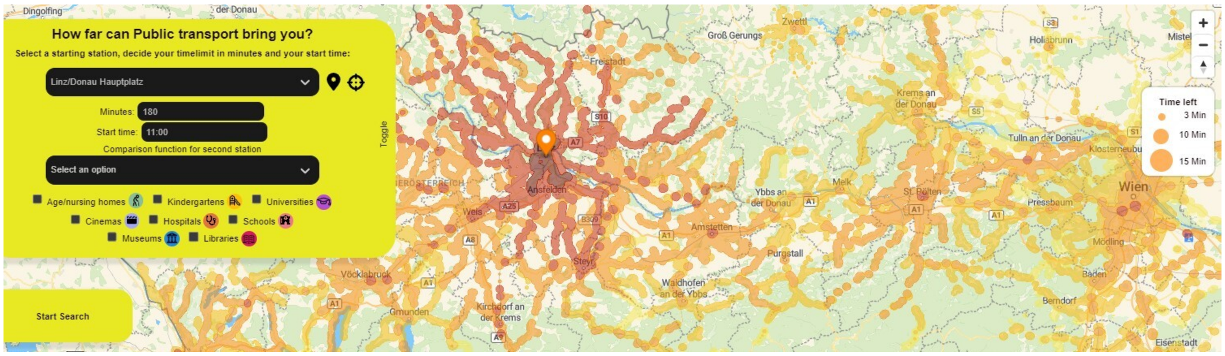

Figure 1: The web application allows users to determine how well connected a location in Austria is through public transport. Users can specify a starting point, a start time, and a maximum travel time to get an overview of reachable areas. Additionally, users can show important public institutions—like hospitals, schools, or pharmacies—on the map to easily see whether they are within a reasonable distance.

Abstract

Sustainable mobility is crucial in our current era. Our proposed interactive web application provides a user-friendly way to evaluate public transport networks and analyze how well-connected a user-defined location is. The current implementation comprises data from all Austrian public transport systems but can be extended with data from any provider. We made the code available on github: github.com/jku-vds-lab/publictransport. The tool can be tested in the deployed version: publictransport.jku-vds-lab.at.

1 Introduction

The domain of transport network analysis has seen numerous tools and methods aimed at augmenting the understanding and utility of public transport systems [5, 8, 9]. However, many existing solutions fall short due to a lack of comprehensive functionality, insufficient data, or inaccurate representation of real-world conditions [6, 7]. We propose a web application that addresses these limitations, offering a robust tool that ensures accurate and consistent public transport data. (see Fig. 1). By centralizing information from various Austrian transport providers and states, it lays the groundwork for nationwide consistent policy-making and informed public decisions.

Incorporating a user-centered design, our tool leverages transit data to create a comprehensive and interactive visualization of public transport coverage. Key features like a comparative analysis of accessibility and using start time as an input parameter enhance user experience and provide valuable insights for stakeholders. This makes the tool also particularly useful for data governance tasks like decision-making. These aspects bring a proper level of real-life applicability to transport network analysis, offering valuable benefits to commuters, urban planners, and policymakers.

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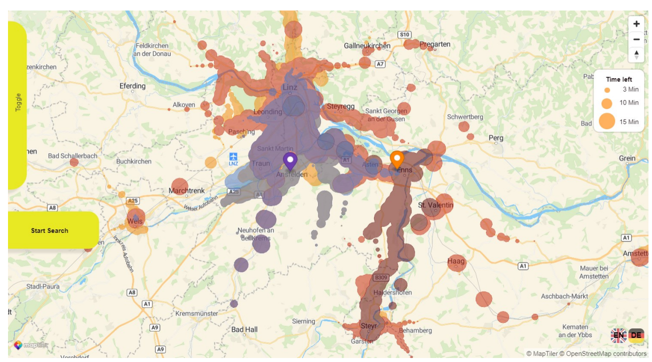

Figure 2: Users can compare the coverage of two start stations. The second station is only encoded with one color to make the visualization easier to understand.

2 Design and Implementation

The application uses the Svelte [3] JavaScript framework. In addition, Python-based FastAPI [1] and Uvicorn [4]—an ASGI server—power the back-end operations. We preprocessed and integrated data procured from multiple providers to facilitate a nationwide application.

In the front-end, users can select travel details (e.g., departure station, travel duration, and start time) in the settings bar. This information is relayed to the back-end, where it is processed to determine reachable areas. The query's result is visually represented on an interactive map using colored areas. The color varies with regard to how many transit changes are needed to reach a particular station (i.e., lighter colors indicate that more transitions are needed). The tool also incorporates several unique features to enhance its utility

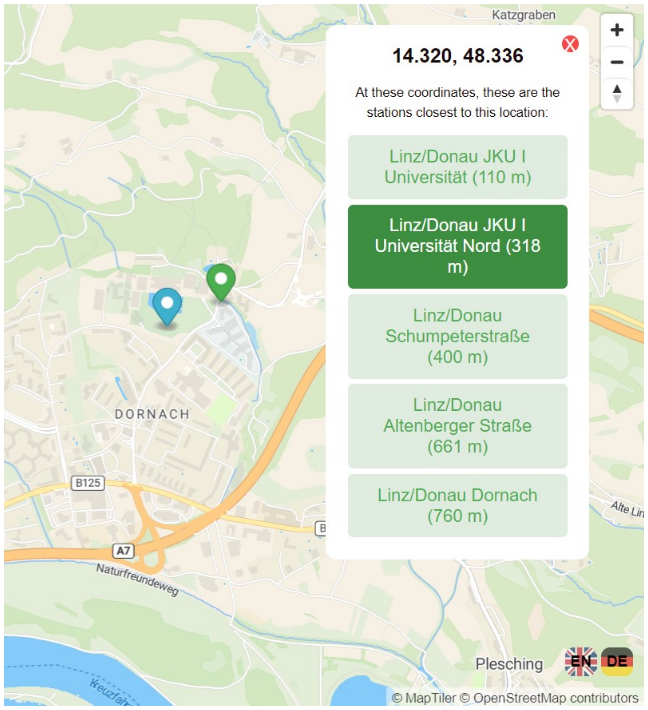

Figure 3: The user-selected location on the map is denoted by a blue marker, while a green marker dynamically indicates the station currently hovered by a user.

for various user and data governance tasks. These include multi-lingual support, an explanatory tutorial, a feature to compare two different starting points simultaneously (Fig. 2), and the functionality to choose between the five nearest public transport stations when a point on the map is selected (Fig. 3).

The tool can overlay the map with markers indicating public facilities such as schools, hospitals, and libraries to determine which ones are within the reachable areas. This feature offers users a more nuanced understanding of the availability of these facilities, adding an extra layer of usefulness to the application.

We conducted a pilot study to test the tool's performance and applicability. The three participants, domain experts in data visualization, were presented with a series of tasks based on varying scenarios. One such scenario was: "You live near the stop 'Enns Bahnhof'. Your best friend lives near the stop 'Ansfelden Steinaltstraße'. It is 17:45, and there is an event at 18:45 at the Hauptplatz in Linz. Will you both make it there in time?" (Fig. 2 shows the desired result). These scenarios required them to leverage the tool's functionalities to make informed decisions about travel routes and timings. The responses gathered through a post-study questionnaire emphasized the tool's intuitive capabilities in solving these tasks as shown in Fig. 4.

3 Limitations

The development of this application posed several challenges. Handling and processing a vast volume of public transport data [2], accounting for 71,371 stations and more than 20 million visits. The inclusion of 'start time' as a variable further compounded the complexity, as it necessitated a dynamic computation of distances between stations, thereby diminishing the efficiency of pre-computed graphs. Despite implementing various optimization techniques, we still encounter multiple minutes long loading times when choosing a time frame over two hours.

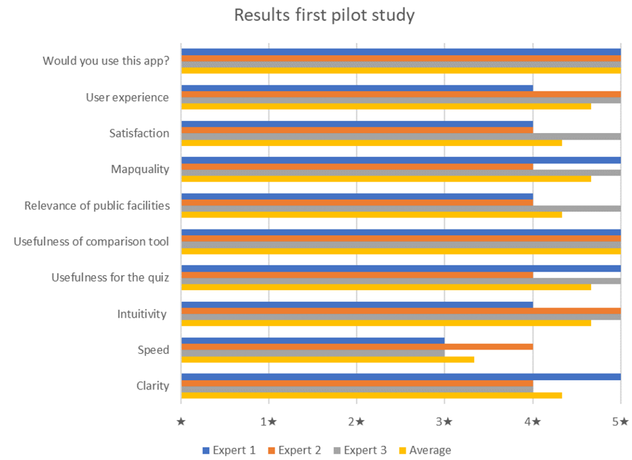

Figure 4: Results from the post-study questionnaires.

4 Conclusion

The application constitutes a significant stride towards a user-centered, data-driven evaluation of public transport accessibility. It opens avenues for further research and provides a supporting tool for decision-making. Future improvements should focus on efficiency enhancement for large-scale data handling, potentially broadening the application's utility to more extensive transport networks and bridging the gap between raw transit data and public understanding.

Acknowledgments

This work was partly funded by the Austrian Science Fund under grant number FWF DFH 23–N.

References

[1] FastAPI. Accessed on 2023-02-24.
[2] MVO - Datenbereitstellungsplattform. Accessed on 2023-07-25.
[3] Svelte • Cybernetically enhanced web apps. Accessed on 2023-02-24.
[4] Uvicorn. Accessed on 2023-02-24.
[5] L. Bertolini, F. le Clercq, and L. Kapoen. Sustainable accessibility: a conceptual framework to integrate transport and land use plan-making. Two test-applications in the Netherlands and a reflection on the way forward. *Transport Policy*, 12(3):207–220, May 2005. doi: 10.1016/j.tranpol.2005.01.006
[6] M. Gidam, R. Kalasek, and F. Pühringer. *GTFS in ÖV-Erreichbarkeitsanalysen*. Wichmann Verlag, DE, July 2020.
[7] C. Truden, M. J. Kollingbaum, C. Reiter, and S. E. Schasché. A GIS-based analysis of reachability aspects in rural public transportation. *Case Studies on Transport Policy*, 10(3):1827–1840, Sept. 2022. doi: 10.1016/j.cstp.2022.07.012
[8] S. Wehrmeyer. Vienna – Mapnificent – Dynamic Public Transport Travel Time Maps.
[9] W. Zeng, C.-W. Fu, S. M. Arisona, A. Erath, and H. Qu. Visualizing Mobility of Public Transportation System. *IEEE Transactions on Visualization and Computer Graphics*, 20(12):1833–1842, Dec. 2014. Conference Name: IEEE Transactions on Visualization and Computer Graphics. doi: 10.1109/TVCG.2014.2346893