A Context Aware Evaluation Tool for Individual Mobility

Mathias Trefzger, Waldemar Titov, Christine Keller, Felix Böhm and Thomas Schlegel
Institute of Ubiquitous Mobility Systems
Karlsruhe University of Applied Sciences
e-mail: iums@hs-karlsruhe.de

Keywords: Individual Mobility, Context Awareness, Application

The evaluation of people's mobility is crucial for understanding traffic in general. Information on which routes people take, what transport modalities they use and how long it takes them to reach their destination is usually gathered in time-consuming surveys using so called mobile diaries, which often must be filled out by hand and therefore mostly in hindsight of a route. Typical problems of this method are that the author has to rely on correct statements of the respondents. However, usually people forget to record all of their trips and routes and when they then try to complete the survey afterwards, it is hard to remember the exact mobility procedure of a given day.

However, often study participants do not track their mobility and fill out the surveys later the day, some in the end of the week or even worse shortly before handing in their surveys. As well know, remembering the exact details about the experienced mobility at a certain day, does not lead to reliable data and thus often falsifies the overall study results.

Additionally, respondents round their information subjectively. For example, it is to be observed that in evaluations from MiD (Mobilität in Deutschland/mobility in Germany) accumulations of 5-kilometer and 5-minute intervals occur (Schelewsky et al., 2014). This leads to inaccuracies in the collected data, which limits data validity. Another problem is that the digitalization of the costly gained Information for easier further analysis is a time-consuming act.

In this paper, we present a project that is designed to eliminate some of the above-mentioned limitations of the prevailing survey method. Particularly we introduce an android application for mobile devices that is able to automatically recognize the type of movement of its carrier using sensors and that records information about the track. The data acquisition is based on existing and time proven methods like the Mobilitätspanel, which is a standardized questionnaire for accessing travelers mobility designed and conducted by the German ministry of traffic and infrastructure (BMVI, 2019).

In particular, the app captures factors like start time, the chosen mode of transport, the transfer time, the time of arrival and finally, yet importantly, the purpose of the route. The App asks the user to state their mode of transport after each stage of their way. Simultaneously the modes are identified automatically using the Google Awareness Api. This makes it possible to verify the provided data from the users. The App uses Google Maps and the coordinates of the location are tracked multiple times a minute.

Over the years numerous GPS-Trackers were published. Some of them also specifically are used to research mobility behavior. For example Schelewsky et al. (2014) concentrated themselves in 2014 on collecting the data, that is also collected with questionnaires and evaluating the data. Another

example is the App Itinerum by the Concordia University that is used to carry out mobility studies. What differentiates our App from the Apps mentioned above is the possibility to track additional context information. The App queries the current weather and links the Information to the recorded routes. The App also checks the audio jack, and records, if headphones are connected. That enables to verify multiple hypotheses like:

- When it's sunny people are more likely to ride to work by bike
- People listen to their headphones while riding train rather than while riding bike

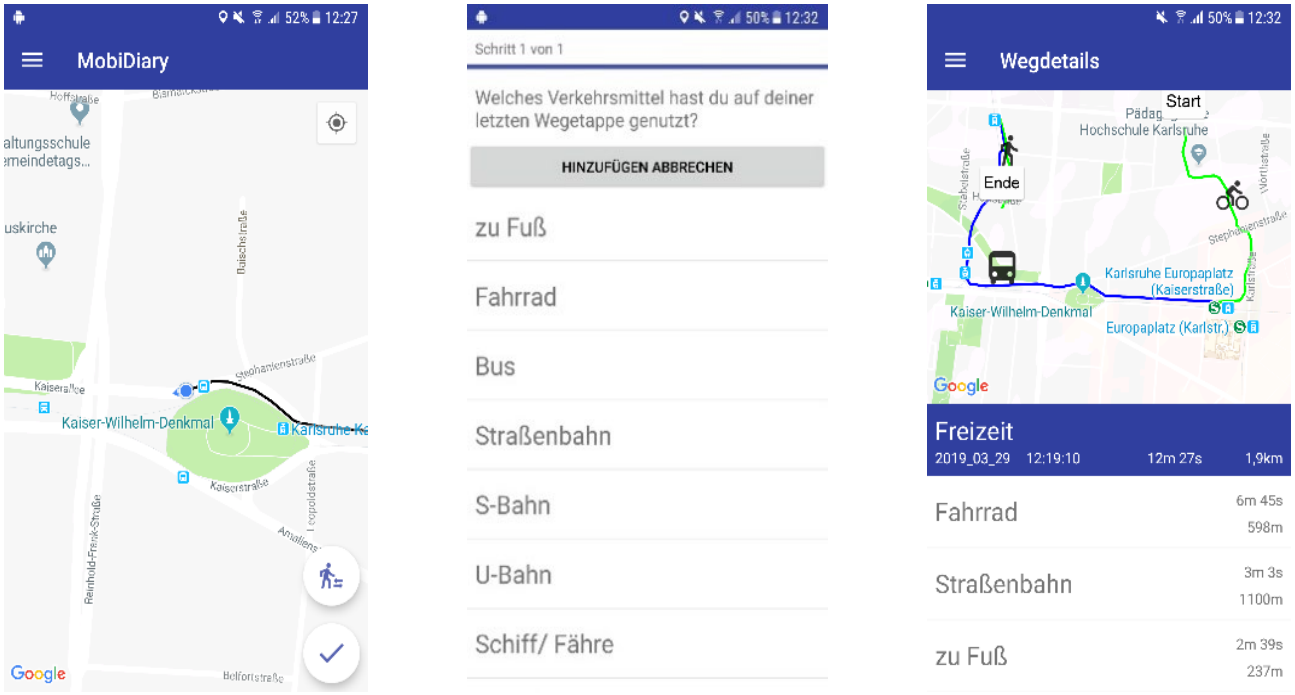

Fig. 1. App Interface while recording a track. *Left:* Started route tracking. *Middle:* Choosing the used traffic mode for every route sequence. *Right:* Visualization of the recorded track.

Furthermore, the App enables the users to add a description of the situations in which a transport change decision was made. This information can be used to validate the specifications on the purpose of the route given by the app users. If for example a user indicated that the route purpose is free time when being located in a university building, the given information might be wrong.

To record a track, the user has to actively start the recording of the track. After finishing tracks, they can be easily sent/exported as JSON-file via the typical sending options like mail, cloud services etc. Fig. 1 visualizes the proceeding of recording a mobility track. With this method, we save the intermediate step of digitalizing the data with the traditional surveys and can directly start with the data analysis.

We evaluated the App in a field study in which 38 student subjects participated. They used the app to record their mobility behavior over two weeks in October 2018. In this time span, they uploaded about 1.800.000 rows of data. This data collection allows us to answer multiple questions:

- When are people on the move?

- Which transport modes do people use?
- How long are people mobile on average and in total?
- How many transport modes do people use daily and which modes are used together for one route?

Analyzing the data we were able to get a good impression on the typically mobility behavior of the students. Fig. 2 shows that the mobile behavior of the students has a direct correlation with their timetable from university. The lecture blocks have a duration of 90 minutes, starting at 8.00, 9.50, 11.30, 14.00, 15.40 and 17.20.

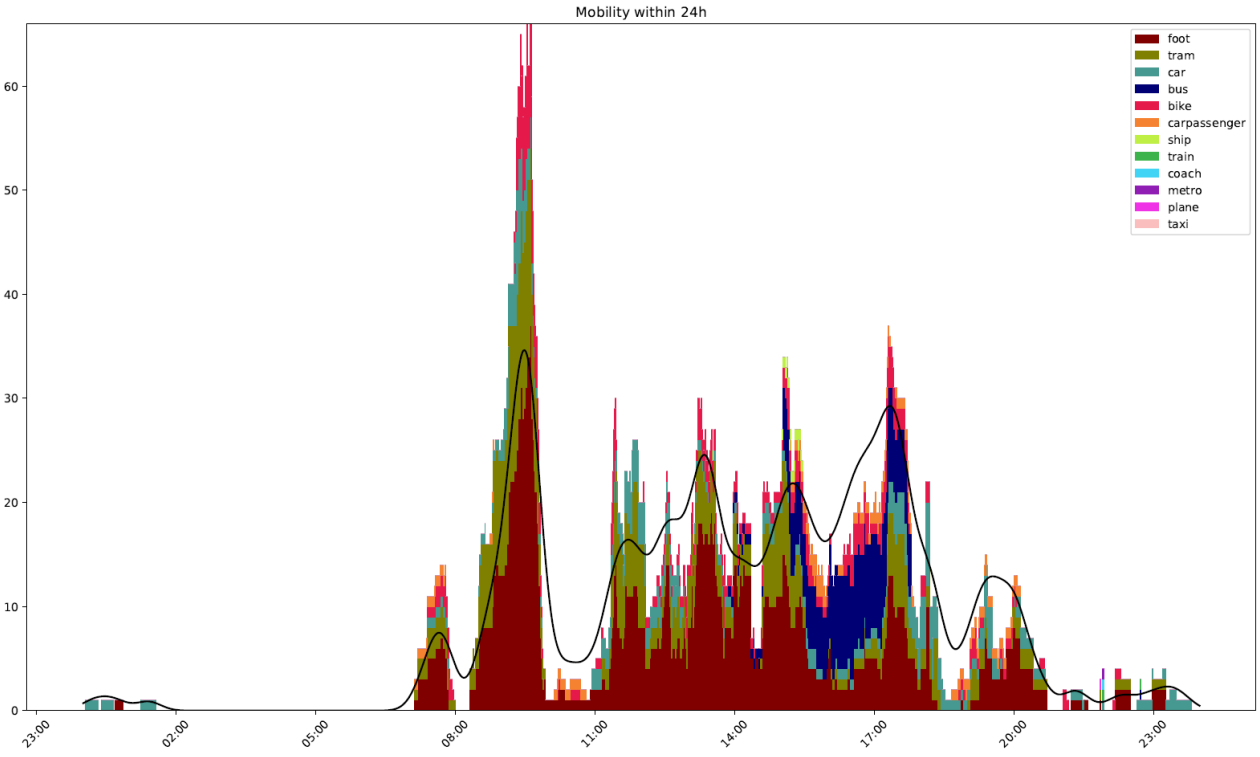

Fig. 2. Mobile behavior of the students in the field study.

One can see that the mobility drops off during the lectures and then again, peaks at about 15-30 minutes before lectures start. Additionally, you can get an overview about the used transport mode and their distribution: The average usage duration of the transport modes were 15 minutes for tram, 11 minutes by foot, 12 by bike, 56 with the bus and car about 21 minutes (Fig. 3).

The students covered a total distance of 3100 km using the tram, 1200 km by bus, 250 km as car driver, 500 km as car passenger, 200 km by bike and 200 km by foot (Fig. 4). The way purpose was to 34,1% education, 28% free time, 12,2% times shopping, 11,3% way home, 11,1% other executions, 2% picking somebody up and 1,7% work.

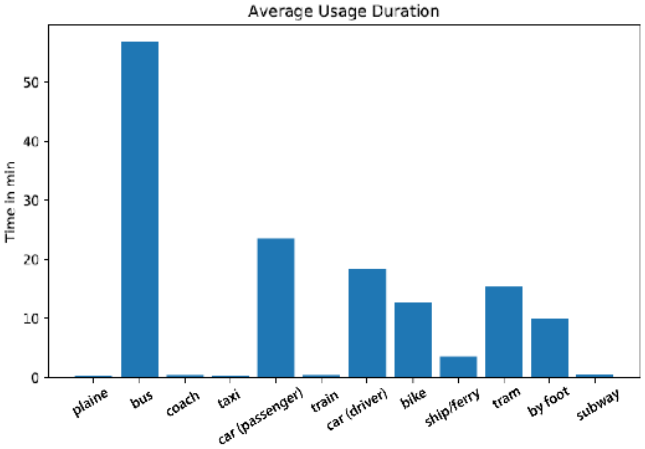

Fig. 3: Average usage Duration.

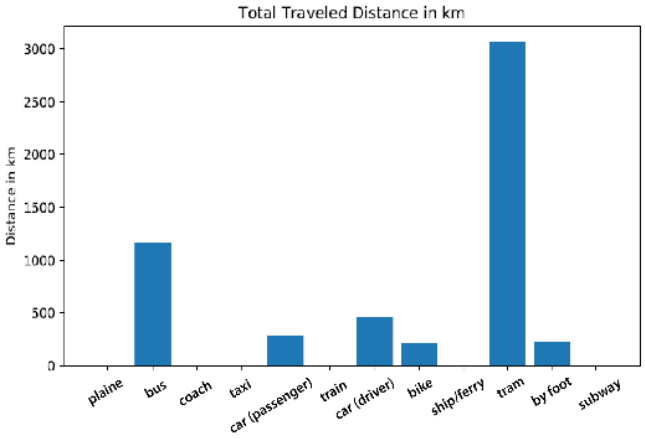

Fig. 4: Total traveled distance.

Out of our evaluation study, we draw the conclusion that the App facilitates and speeds up the procedure of collecting information about the routes of road users. Additionally the acquisition of context-based information enables us to evaluate more scenarios than it would be possible using only traditional surveys. The problem, that subjects falsify the outcome of a study due to round ups and obliviousness is also eliminated with the app. Nonetheless, the app still has a big potential in including new features. For example, we also want to add a functionality that identifies if the user arrived to their destination and then actively asks the user to enter the purpose of the route.

This work was conducted within the scope of the research project “SmartMMI – model- and context-based mobility information on smart public displays and mobile devices in public transport” and was funded by the German Federal Ministry of Transport and Digital Infrastructure as part of the mFund initiative (Funding ID: 19F2042A).

References

Schelewsky, M., Bock, B., Jonuschat, H. and Stephan, K. (2014). Das elektronische Wegetagebuch: Chancen und Herausforderungen einer automatisierten Wegeerfassung intermodaler Wege. Available at https://www.researchgate.net/publication/259897501_Das_elektronische_Wegetagebuch_Chancen_und_Herausforderungen_einer_automatisierten_Wegeerfassung_intermodaler_Wege [07.06.2019].

BMVI (2019). Article regarding the inquiry of mobility data by the German ministry of traffic and infrastructure. Available at https://www.bmvi.de/SharedDocs/DE/Artikel/G/deutsches-mobilitaetspanel.html [07.06.2019]