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Smartphone based travel diary collection: experiences from a field trial in Stockholm

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Abstract

Currently, there is a great need for new methods to collect travel data. Traditional methods have considerable drawbacks and, at the same time, the models used to analyse the transport system require more and more detailed and high-quality data. An alternative method that stands out as very promising is to capture raw data from devices that can use any positioning technology (e.g., GPS, WiFi positioning, GSM, etc.), followed by transforming the raw data into meaningful travel data. Since most smartphones are equipped with various sensors that can be used to determine the location of the smartphone, and since smartphones are integrated in the daily life of most people, they provide an unprecedented opportunity for large-scale travel data collection. This method has a great potential to solve the problems related to the estimation of distance/travel time, geographic coding of departure/destination locations and forgotten trips and it will also provide a more detailed and extensive data set.
In a recently completed research project the feasibility of replacing or complementing the traditional travel diary, with a suite of tools that make use of smartphone collected travel data has been evaluated. The advantages and disadvantages of the traditional method and the proposed method were studied. For a fair comparison, both methods have been tested in the same city, at the same time, and with the same respondents. To achieve the objectives of the project, MEILI, a system that consists of a smartphone application for capturing the movement of users and a web application for allowing the users to annotate their movement, has been deployed. The recruitment of respondents is a critical phase for traditional travel diaries and, as expected, this was the case also for the smartphone based method. A lesson learnt was that it is important to simplify the registration process as much as possible. In total 2142 trips were collected and annotated by 171 users. 51 of the users annotated trips covering more than a week. The experiences from the field trial shows that a smartphone based travel diary collection is a very useful complement to traditional travel diary collection methods since it appeals to a different age group and collects more detailed travel data for a longer period. The main findings of the paper are that smartphone based data collection is feasible, that the algorithms to save battery work well and that trips of the same respondent vary considerably depending on day of the week.

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1. Background

Implementing sustainable transport solutions, reducing transport emissions and energy consumption, and achieving a modal shift away from the conventional private car, are the main goals for many major metropolitan areas in the world. To achieve these goals, it is crucial to understand the individual travel decision-making behaviour and implement the correct urban and transport intervention policy measures. The success of a transportation policy itself depends on an accurate description and prediction of aggregate flows, as well as the disaggregate travel behaviour of individuals.

Currently, there is a great need of new methods for collecting travel data. Traditional methods used to collect travel data have considerable drawbacks and, at the same time, the models used to analyse the transport system require more and more detailed and high-quality data. One of the main barriers of collecting accurate and detailed disaggregate travel data is the limitation of the method used to follow the travellers' choices through space and time.

An alternative method that stands out as very promising is to capture raw data from devices that can use any positioning technology (e.g., GPS, WiFi positioning, GSM, etc.), followed by transforming the raw data into meaningful travel data. Since most smartphones are equipped with various sensors that can be used to determine the location of the smartphone, and since smartphones are integrated in the daily life of most people, they provide an unprecedented opportunity for large-scale travel data collection. This method has a great potential to solve problems related to the estimation of distance/travel time, geographic coding of departure/destination locations and forgotten trips (see e.g. Wolf et al., 2004; NCHRP, 2014). It will also provide a more detailed and extensive data set, something that is essential for the next generation of transport models.

However, at the same time, this technology is not without problems (see e.g. Anderson et al., 2009; Cottrill et al., 2013; NCHRP, 2014). Given the limitation of GPS related to the infrastructure and the built environment, there will always be situations and areas where GPS will fail to record locations. Furthermore, applications using this technology are often collecting GPS traces, together with accelerometer readings, which have to be further processed to derive the needed entities, i.e., trips and trip legs, and their attributes, i.e. transport modes, trip destination and trip purpose. Although positioning technology can be used to directly record accurate time and geographic information of travel (see e.g. Gong and Chen, 2012; Feng and Timmermans, 2014; Rasouli, 2014), the participants still needs to be heavily involved by providing/verifying the entities and their attributes. To collect information that cannot be derived from GPS data alone, various prompted recall methods may be used, including paper-based (e.g. Bachu et al., 2010), mobile-phone based (e.g. Ohmori et al., 2005), and web-based (e.g. Bourbonnais and Morency, 2013). Recently there have been attempts to make the whole process either semi-automatic or manually completed on respondents' mobile phone unit (see e.g. Abdulazim et al., 2013; Cottrill et al., 2013; Greaves et al., 2014). With a customised travel diary app, which performs a similar tracking function and that can be downloaded onto a smartphone/mobile device, it is expected that the financial burden and the need to consciously carry an extra device can be reduced or removed. Several challenges remain, however, such as the issue of battery consumption and the location detection accuracy. Whilst some of these problems may be reduced in the near future due to the improvements in battery technology, better algorithms to infer trip purpose and mode are still required. For an overview of the applicability and reliability of travel inference methods, see Prelipcean et al., 2017.

In a recently completed research project the feasibility of replacing or complementing the traditional travel diary, with a suite of tools that make use of smartphone collected travel data has been studied. The aim of the research project was to study if an application installed on a smartphone equipped with GPS can be used as a replacement or supplement to a traditional travel diary and to understand the benefits, challenges and feasibility of using a smartphone application to collect one week of travellers' travel data. A set of measurements of travel behaviour was defined for both methods - smartphone and traditional travel diary - within the project. Their advantages, disadvantages and accuracy in measurement were compared. The methods were implemented in the same city, at the same time and with the same respondents using both methods to make the results as comparable as possible. The purpose of this paper is to present the lessons learned from a field trial that took place in Stockholm in 2015. The