Mobility survey based on intelligent technologies (MOBIFIT)

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1 ABSTRACT

The main objective of MobiFit is to develop a method for collecting mobility data of people based on tracking their changes of location by GPS-Technology and to develop a method of data processing and analysing for the collected mobility data with the goal to achieve results comparable to traditional, survey-based mobility studies. The mobility survey will be based on a data collection via GPS to improve the knowledge on modal choice, purpose of trips, trip length as well as its changes in time. This should result in more accurate mobility data (often incomplete statistical registration of data by test persons etc.), availability of a dynamical data collection, as well as a reduction of time efforts of the test persons.

2 PROJECT OVERVIEW

2.1 Initial situation/Motive

Mobility needs will underlie fundamental changes as regards its quantitative, spatial and time related patterns in the future. The mobility in the modern society will be influenced by fundamental trends caused by changes to a more flexible lifestyle as regards the organization of work and spare time, ageing society, emerging information technologies as well as increasing mobility needs. Furthermore mobility patterns in the future will be influenced by a changing spatial, economical, societal and environmental framework. These changes will induce new demands and challenges for the future transport policy. Therefore, reliable data for the future needs are necessary for decision making in transport policy. Knowledge of mobility patterns in the society are fundamental, e.g. data on which transport modes are favoured by the population and knowledge on motives for modal choice.

Current mobility surveys are mainly executed by paper-pencil surveys and telephone interviews. These methods are static and in particular time and work intensive for the test persons.

2.2 Aim of the Project

The main goal of MOBIFIT is to develop and test methodologies and technological applications to achieve basic mobility data in passenger transport assisted by intelligent technologies (tracking changes of location via GPS-Technology).

Thereby it will be possible to provide a broad knowledge on mobility in passenger transport to detect trends and future demands in time,

- with significantly reduced efforts for test persons (interaction needs), and
- more realistic results achieved compared to traditional paper-pencil surveys as well as
- to solve the often incomplete statistical registration of mainly short trips. Corrections of the collected data may then be carried out by weighting these system immanent errors derived from paper-pencil surveys.

Furthermore the results will make a contribution secure and improve mobility needs and options with innovative mobility tools or new forms of mobility from an organizational point of view.

At the end of the research project MOBIFIT, concrete results of three kind of mobility surveys will be presented for comparison:

- Mobility behaviour of the population surveyed by Technology and additional validation of the surveyed mobility

- Mobility behaviour of the population surveyed by Technology and in parallel by a “conventional” survey method
- Mobility behaviour of the population surveyed by a “conventional” survey method only, without using Technology

Furthermore, the survey area is divided in urban and rural cases.

3 TECHNOLOGICAL POSSIBILITIES FOR UPCOMING MOBILITY SURVEYS

The goal of this research project is to obtain adequate and current data bases on the mobility behavior of individuals by means of a dynamically applicable collection and analysis technology in future. The so recoverable, improved, more accurate and dynamic mobility data provide a basis for improved planning, particularly in the areas of transport and spatial planning. The project brings new dimensions for transport planning using state of the art technologies and methods.

For implementation major carrier technologies such as GPS are needed. The first pilot applications of so-called "new technologies" to collect personal mobility data have been made only since 2002, mainly because of technological developments. These are technologies in order to determine the spatial position of the subjects at a given time. This position is defined by corresponding receivers in frequency (e.g. every second). From the spatial and temporal sequence of data points it is possible to obtain conclusions about movements of the person.

Because of the distribution and availability in Europe mainly Navstar GPS is used. Currently, commercially available GPS receivers, supply position information with an accuracy of ± 5 m or better. GPS signals, as opposed to GSM or other technologies, receive worldwide coverage.

Basically we have to differentiate between passive and active data collection methods. The term "passive tracking" summarizes survey methods, in which during the survey and recording of the trips no active intervention by the subject is necessary. The effort for test persons is limited to carry and maintain the survey equipment. In contrast, the "active tracking" requests additional information from subjects during the collecting and recording the trip such as trip purpose and mode choice. This considerable additional work requires special cooperation from the test persons. This leads to higher costs due to more complex devices, data transfer and data volume but also to savings in staff and in data analysing.

Almost all recent GPS-based mobility tracking surveys are a combination of GPS-tracking and interview method, as certain characteristics (such as trip purpose) are difficult or impossible to be collected without additional information from the subjects. These additional surveys will be carried out before and / or after the GPS survey. Different survey methods are used: telephone, in person, and recently more often through the Internet (risk of distortion).

3.1 Advantages and disadvantages of data collection by means of (interactive) GPS devices

The potential advantages of those survey methods are manifold:

- By means of GPS
  - source
  - target and
  - Route Information
- are accurately recorded without any need for interaction of the subject.
- Trips which the subject would forget in conventional surveys are also recorded (completeness).
- Beginning and ending times and
- Trip duration and trip lengths are also recorded automatically.
- GPS data can be combined with GIS data and information collected in advance (homes, workplaces, etc.) to verify the recorded data (map-matching).
- By means of active collection methods additional information such as trip purposes or vehicle types can be collected.

- The quality of data recording is thus substantially improved with significantly less effort for the test persons.

In contrast there are also disadvantages:

- Position inaccuracies of GPS and random errors caused by problems in satellite orbits, receivers, signal disturbances or reflections (especially in buildings).
- The raw data collected with passive GPS receivers is not directly usable for analysis. For further processing of the data more or less sophisticated software solutions are necessary, depending on the desired accuracy of results.
- It is difficult to collect informations about the transport mode, about trip purposes or for example about the occupancy of vehicles.
- It is not possible to collect data such as travel expenses or the personal situation of the subjects.
- Significant costs and expenses for post-processing of the data (post-processing) are to be expected.
- Another problem is the possible duration of the collection, which is limited by battery life and storage capacities of the devices.
- Risk of faulty handling of the devices by the test subjects, such as forgetting the devices, not power on, not charging, etc.

4 PROJECT COURSE

Until now the following project targets could be achieved.

4.1 State of the Art research:

- Weaknesses of traditional survey methods
- Requirements for future data collection methods and mobility data
- Analysis of past, technology-based survey methods
- Technological options for future collection methods (Positioning / GPS)
    - Passive vs. active collection methods
    - Issues regarding the involvement of the test persons

4.2 Preparation of the GPS data collection Showcase:

- Definition of the survey approach and necessary survey contents
- Selection of survey technology, with an extensive set of test runs on various GPS data loggers
- A Partner for the GPS technology was found
- Survey organisation was planned
- Survey guidelines were created
- Surveyors were selected and trained

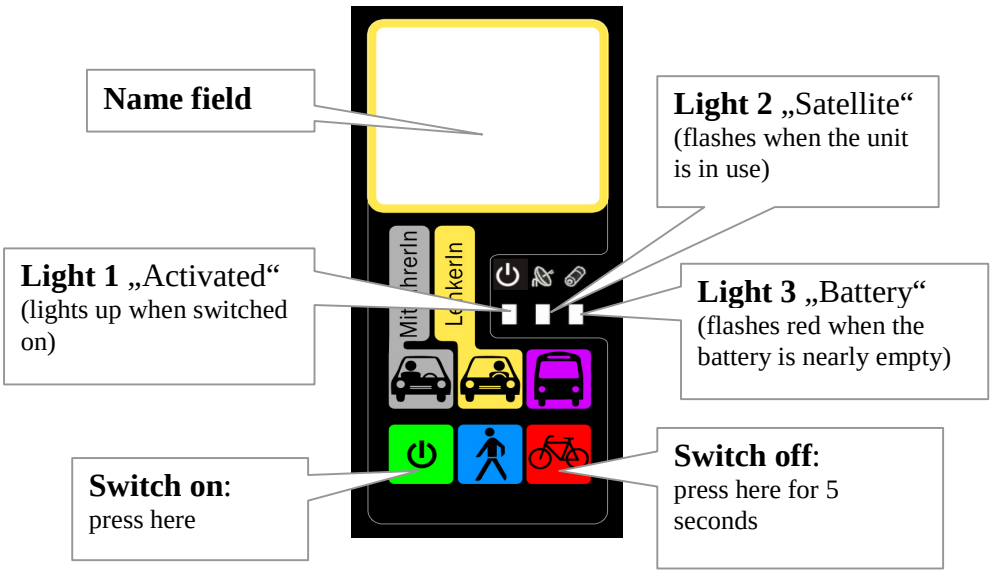

Figure 4.1: Used GPS Data Logger

4.3 GPS data collection Showcase

- Implementation of the first phase survey in the region of Tulln an der Donau in Nov / Dec 2009 with 53 test subjects
- Adaptation of the survey concept and improvement the data collection procedures
- Implementation of the second phase survey in the city of Graz in Jan / Feb 2010 with 81 test subjects

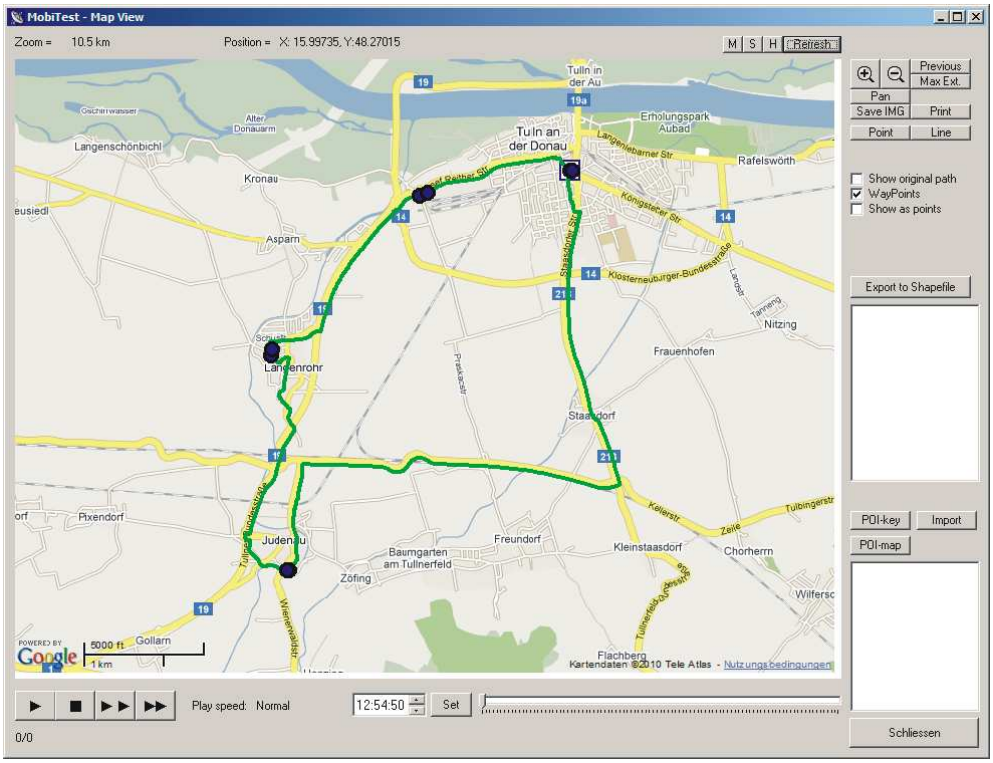

Figure 4.2: Collected GPS data of a subject

5 CONCLUSION AND LESSONS LEARNED

- As regards analysis of the recorded GPS data yet no appropriate procedures could be developed. This is currently being solved by developing a simplified semi-automated data analysis approach in cooperation with the manufacturer of the GPS devices. A standard software for the analysis of the recorded GPS data is not currently on the market.

- The technology has been partly overestimated. The quality of the GPS position data is already very good but not optimal for use in mobility surveys.
- The GPS records show partly outliers, which mainly due to lack of signal quality.
- Well thought-out hardware and software solutions for this problem can be found on the market barely.
- There is less information from the literature on specific survey methods, response and refusal rates, data analysis and expectable data quality.
- The applied survey method (in this variant) is partly time consuming and relatively expensive.
- For a broad-based GPS survey, it is necessary to develop a simplified procedure. But the project "MobiFit“ is testing a mobility survey based on intelligent technologies as a whole and therefore will gain important informations for future use.
- The participants of the test case consistently indicate that their effort for participating in the GPS based survey method is very low and that they clearly prefer this over a paper survey.

Therefore it remains to solve the task, how best to combine and apply traditional and new survey technologies in future, broader mobility surveys to benefit best of different survey methods, particularly those of technology assisted surveys, with regard to contents and economic issues.

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