Mobile App for Public Transport: A Usability and User Experience Perspective

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Abstract. The fast progress of smart devices and applications in the mobility sector open up a huge potential for mobility services that allow for an individualization of mobility patterns. In combination with an increasing infrastructure of public transport and diverse means of transportation, novel mobility concepts represent a promising solution to societal changes and mobility needs. However, the increasing functionality and multitude of options add to the complexity of using those services. The research is embedded into an interdisciplinary project – Mobility Broker – in which the central platform for planning and booking a journey using different public means of transport is developed. Different from other approaches, users are integrated in all stages of technical development. The paper reports on an empirical study in which the usability of the first prototype of the smart phone application was tested. Findings show that interface design and visual ergonomics are quite mature at this stage. Implications of findings are discussed and future research lines are explicated.

Keywords: Mobility services · Smart apps · Intermodal mobility · Usability · Interface design

1 Introduction

Mobility is a topic as old as mankind. Be it for leisure or business, people need to travel. Recent ICT developments promise to offer potent and ubiquitous mobility services [1]. Travel services delivered by small screen devices are highly developed [2], thus, travel and mobile services can be retrieved at any time, at any place, with travel information being wirelessly delivered, continuously updated, context-adaptive, and even targeted to user profiles [3]. Different people use different means of travel. Also, they use different methods to plan their journey, which reflect and affect the preferred means of transportation [4]. There are numerous services that help to find routes and offers for travelling by public transport, such as airplane, train, or bus or by individual transport by car. All means of transportation have certain limits and are more useful for certain distances. Except for long range travelling, for which the airplane stays unrivaled, the private car seems to be the most flexible and comfortable means of travel. In combination with an increasing infrastructure of public transport and diverse means of transportation, novel mobility concepts represent a promising solution to societal

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changes and mobility needs [5]. Until now, it is rather cumbersome to plan a journey using a combination of different public transport services, let alone to book all parts of a so called mixed-mode journey, as it involves the consultation of numerous websites that offer planning and/or booking of one specific service only. This is where the project Mobility Broker comes into play [6].

The project aims at providing a central platform for both, planning and booking of a journey including all kinds of public means of transport, as well as semi public individual traffic, such as car sharing or e-bike rental. Barriers that result from the complexity of combining the results of several search engines and of using a variety of payment services could be overcome with such a service. Hopefully, this will contribute to an increased use of public transport compared to the use of private cars. The interdisciplinary project is lead by the local public transport provider, teaming up with IT service providers and research institutes from different disciplines to gain a holistic understanding. Both, a website offering mixed-mode routing and booking, and a smart phone application with a similar functional range are developed. As such, Mobility Broker is implemented resting on a well-designed server back end – current fundamental research regards the necessary system architecture to develop a single point of contact for travelers (see [7]). As a strong focus on end users' requirements regarding the front-end is a major aspect of the project, in all stages of technical development, feedback of potential users is integrated into future prototype variants.

2 Methodology

The evaluation of an initial prototype consisted of three parts. The first part referred to mobility requirements, which were assessed prior to the evaluation of the prototype. Then, participants were asked to interact with the prototype, carrying out typical tasks in the context of city mobility. Finally, participants were requested to evaluate the ease of navigation and the suitability of the interface design. Figure 1 pictures the schematic procedure of the approach.

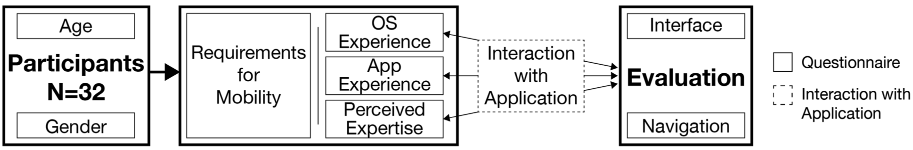

Fig. 1. Design of empirical approach.

2.1 Procedure and Experimental Design

Participants were asked to solve prototypic tasks by interacting with the application. For comparison reasons, each participant was given the same testing scenario in the same order. Figure 2 shows snapshots from the application screen, when tasks were solved. After participants had completed the tasks, they assessed the perceived ease of navigation and the perceived interface quality, each addressing different aspects (see next sections).

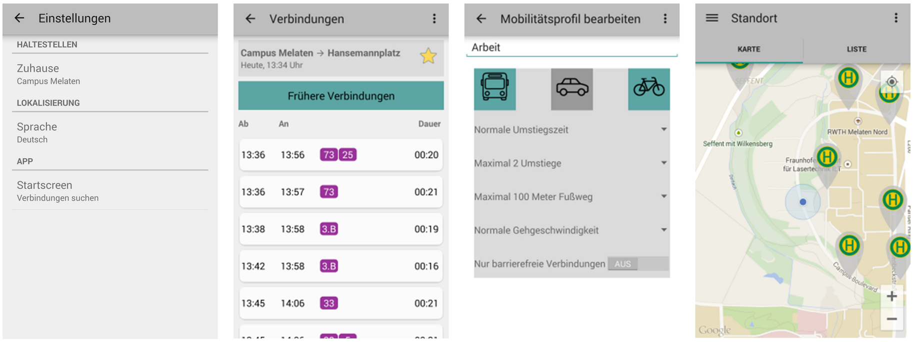

Fig. 2. Left: menu to select "Zuhause" (Home; Task 1). Center left: saving of a connection as a favorite (Task 2). Center right: menu to create a new mobility profile (Task 3). Right: map to find the closest bus stop near the current location (Task 4).

2.2 Measuring of Perceived Ease of Navigation

The perceived ease of navigation through the app's menu structure was evaluated through questions regarding the participants' perceived (dis)orientation when navigating through the menu [8]. Each one of four statements (Table 1) had to be (dis)-agreed to on a five-point Likert-scale. The items included "I knew where I was currently located in the menu", "I knew where to go next", "I did not feel lost in the menu" as well as "I knew how to reach a specific function".

Table 1. Items to evaluate interface quality.

	Items (1 = fully disagree; 5 = fully agree)
Use of colors	"The choice of colors is appealing to me." "In my opinion, the application is too colorful." (*) "The colors change too often." (*) "The choice of colors is adhered to consequently."
Relation of textual and graphical elements	"Overall, the application seems to be graphically overloaded." "In my opinion, the relation between text and graphical elements is well-balanced." "Overall, the application is too heavy on the text."
Visual ergonomics	"In general, the contrast between the elements/objects and the background is too low." (*) "I am able to identify all objects without difficulties." "Very often, the typing is too small." (*) "I can read all texts without difficulties." "I can identify some of the elements on the interface with difficulties only." (*)

2.3 Measuring of Perceived Interface Quality

To evaluate different facets of interface design, items were developed for "Use of colors", "Relation between textual and graphical elements" and "Visual ergonomics". The Likert scaling used for each item ranged from 1 = "I fully disagree" to 5 = "I fully agree". Scores of negatively formulated items were inversed (marked by (*) in Table 1). Items were summed up to a global score for "Use of colors" and "Visual ergonomics", all others were evaluated individually. All items are given in Table 1.

2.4 Participants

32 participants took part in the user test (50 % women). 18 were students and 16 (self-) employed. The average age was M = 29.6 years (SD = 8.6) on a range from 20 to 58 years. Participants were screened with respect to their mobility habits, their familiarity with mobility apps and their technical expertise.

Mobility Habits: 29 out of 32 users reported to go by foot on a daily basis. All participants used bus and car several times a week or even daily. A small group (N = 8) indicated to use the bicycle daily. 26 participants used trains more than monthly. Most of the participants (N = 27) reported to have used bike rental ever and 21 never used car sharing. 50 % of participants indicated not to have used ridesharing so far.

Experience with Mobility Applications: All participants were highly accustomed to international (Google Maps), nationwide (DB Navigator, Öffi, BlaBlaCar, qixxit, Pendel Panda, DriveNow, Mitfahrgelegenheit, moovel, allryder) and regional (ASEAG mobil, AVV connect, VRR App) trip assistant applications. Especially the DB Navigator was well known (78 %), but also Google Maps (78 %) and the local bus company's app - ASEAG mobil (56 %).

Technical Expertise: All participants had technical experience using smart small screen devices (26 out of 32 participants used the Android operating system that was also used in the experiment). Also, participants' self-reported technical self-confidence [9] yielded high scores. On a scale from 0 to 100 (very low to very high technical self-confidence), the participants reached 81.7 (SD = 14.4) on average. However, a gender effect was found: Women estimated their own technical self-confidence lower (M = 74.7, SD = 16.8) than men (M = 88.8, SD = 6.1, t = 3.1, $p < .05$).

3 Results

Data are assessed descriptively. We report on the perceived ease of navigation, followed by an outline of outcomes on the perceived interface quality.

3.1 Evaluation of Perceived Ease of Navigation

The acceptance of smart applications depends on a high usability. When looking at the perceived orientation in the menu, findings show promising results. Participants largely agreed to know where they were situated within the menu while solving the tasks (M = 4.4, SD = 0.9). When asked about the menu structure, on average, users stated to know where to go next (M = 3.8, SD = 1.2). They did not feel lost in the menu (M = 3.7, SD = 1.2). Furthermore, participants reported to know how to find specific functions (M = 3.4, SD = 1.2) (see Fig. 3, left).

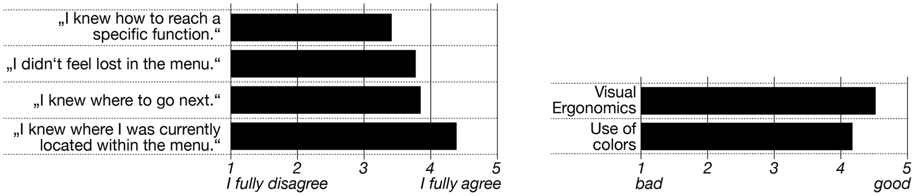

Fig. 3. Left: perceived quality of navigation. Right: perceived quality of visual ergonomics.

3.2 Evaluation of Perceived Interface Quality

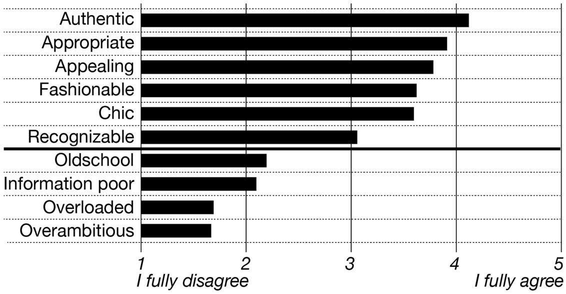

Fig. 4. Rating of the interface design with adjectives.

On average, ratings show a high satisfaction with the given design. Visual ergonomics was rated with 4.5 out of 5 points maximum (SD = 0.5). Also the use of colors reached satisfying scores (M = 4.2, SD = 0.5) (see Fig. 3, right). When focusing on the relation between textual and graphical elements, ratings reveal a positive perception. On average, the relation was judged with M = 4.2 (SD = 1.0), neither too much text (M = 1.7, SD = 0.8), nor too much graphics was used (M = 1.7, SD = 0.8). As many applications profit from an "appealing" overall design, participants were asked to describe the design with adjectives by rating the appropriateness of each adjective to the design, using a Likert scale (1 = "I fully disagree." to 5 = "I fully agree."). Figure 4 shows that adjectives associated with negative properties ("old school", "information poor", "overloaded", "over ambitiously colorful") had a much lower score than positive adjectives, such as "authentic", "appropriate" or "appealing". It is important to notice that the adjective "recognizable had the lowest score of all positive adjectives.

4 Discussion and Future Work

This paper reports on the usability of a novel mobility app that provides a central platform to plan and book a journey using all kinds of public and semi public means of transport. In order to understand the usability in an early stage of development, ease of navigation and overall appearance of the visual design have been assessed, regarding interface quality, visual ergonomic, and the balance between textual and graphical elements. Results show that the current visual design and the perceived ease of interacting with the application receive a positive feedback by participants. However, in this research design a comparably small, quite educated, and technology affine group was examined. At this stage of research, the group is adequate in order to get insights from a benchmark approach. As travelers will be increasingly characterized by diversity, including less educated and less healthy users as well senior travelers, less familiarized with the usage of small screen devices in general and electronic mobility services in particular, we will have to replicate the findings in a broader user group. It will be of vital importance to collect data about navigation performance (effectiveness and efficiency). It is planned to assess the fit of the interface for persons with visual problems or otherwise physically impaired persons, to include their special needs in the development process [10]. Future research will address the role of navigation aids specifically designed for the use in cities [11], in order to enhance the overall experience with usage of electronic mobility services delivered by smart devices [12]. So far, the usability of the application was only tested in a static, quiet and thus, unrealistic experimental setting. A critical test of the real-world suitability will be carried out in the next six months. Participants will use the application during travelling and the usability of context sensitive information will be under study. Another question regards the social acceptance of using connected mobility services. Recent studies show that users are quite clairaudient regarding privacy [13] and safety issues [14] when using smart mobility services. A sensitive trade-off between mobility and travel assistance on the one hand and the disliked possibility to be tracked and monitored on the other hand has to be addressed.

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References

1. Camacho, T.D., Foth, M., Rakotonirainy, A.: Pervasive technology and public transport: opportunities beyond telematics. Pervasive Comput. **12**(1), 18–25 (2013)
2. Emmanouilidis, C., Koutsiamanis, R.-A., Tasidou, A.: Mobile guides: taxanomy of architecture, context awareness, technologies and applications. J. Netw. Comput. Appl. **35**(1), 103–125 (2013)
3. Beul-Leusmann, S., Samsel, C., Wiederhold, M., Krempels, K.-H., Jakobs, E.-M., Ziefle, M.: Usability evaluation of mobile passenger information systems. In: Marcus, A. (ed.) DUXU 2014, Part I. LNCS, vol. 8517, pp. 217–228. Springer, Heidelberg (2014)
4. Zaunbrecher, B., Beul-Leusmann, S., Ziefle, M.: Laypeople's perspectives on electromobility: a focus group study. In: Giaffreda, R., Cagáňová, D., Li, Y., Riggio, R., Voisard, A. (eds.) Internet of Things. IoT Infrastructures. LNICST, vol. 151, pp. 144–149. Springer, Heidelberg (2014)
5. Ziefle, M., Wilkowska, W.: What makes people change their preferences in public transportation – opinions in different user groups. In: Giaffreda, R., Cagáňová, D., Li, Y., Riggio, R., Voisard, A. (eds.) Internet of Things. IoT Infrastructures. LNICST, vol. 151, pp. 137–143. Springer, Heidelberg (2014)
6. Beutel, M., Gokay, S., Kluth, W., Krempels, K.-H., Samsel, C., Terwelp, C.: Product oriented integration of heterogeneous mobility services. In: 17th ITSC, pp. 1529–1534 (2014)

7. Beutel, M., Gökay, S., Kluth, W., Krempels, K.-H., Samsel, C., Terwelp, C., Wiederhold, M.: Heterogeneous Travel Information Exchange (2015, unpublished)
8. Ziefle, M., Bay, S.: How to overcome disorientation in mobile phone menus: a comparison of two different types of navigation aids. Hum.-Comput. Interact. **21**(4), 393–433 (2006)
9. Beyer, G.: Kontrollüberzeugung im Umgang mit Technik. Rep. Psychol. **9**, 648–693 (1999)
10. Karim, N.A., Nwagboso, C.: Assistive technologies in public transport: meeting the needs of elderly and disabled passengers. In: ICICT, p. 69. IEEE Press, New York (2004)
11. Lyons, G.: The role of information in decision-making with regard to travel. Intell. Trans. Syst. **153**(2), 199–212 (2006)
12. Foth, M., Schroeter, R.: Enhancing the experience of public transport users with urban screens and mobile applications. In: 14th International Academic MindTrek Conference, pp. 33–40. ACM, New York (2010)
13. Schmidt, T., Philipsen, R., Ziefle, M.: From V2X to Control2Trust - why trust and control are major attributes in Vehicle2X technologies. In: Tryfonas, T., Askoxylakis, I. (eds.) HAS 2015. LNCS, vol. 9190, pp. 570–581. Springer, Heidelberg (2015)
14. van Heek, J., Arning, K., Ziefle, M.: Safety and privacy perceptions in public spaces: an empirical study on user requirements for city mobility. In: Giaffreda, R., Cagáňová, D., Li, Y., Riggio, R., Voisard, A. (eds.) Internet of Things. IoT Infrastructures. LNICST, vol. 151, pp. 97–103. Springer, Heidelberg (2014)