A Mobile Information System for Improved Navigation in Public Transport

User Centered Design, Development, Evaluation and e-Business Scenarios of a Mobile Roadmap Application

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Abstract: End-user friendly interface design is of tremendous importance for the success of mobile applications which are of increasing interest in the e-Business area. In this paper, we present an empirical evaluation of a mobile information system for improving navigation of public transport. High air pollution and respiratory dust, along with other threats to environmental conditions in urban areas, make the use of public transport system less and less a matter of choice. The central hypothesis of this study is that useful, useable and accessible navigation contributes towards making public transport systems more attractive.

1 INTRODUCTION

Public transport is crucial to the liveability of any urban area. Millions of journeys are made on trains, trams and buses every day. However the social, economic and environmental benefits extend beyond those who use it regularly. The advantages of public transport include social, economic and most of all environmental issues (e.g. air pollution, respiratory dust etc.) which is definitely a big issue (Nel, 2005). Consequently, it is commonly accepted, that the environmental impact of increasing transport volumes can be significantly reduced by environmentally-friendly public transport systems (Kroon and Schoebel, 2012). In order to reach such goals, public transport systems must be made much more attractive to the end-user. A highly important issue is to make navigability not only attractive, but useful and usable (Ziefle et al., 2012).

In this paper we introduce a novel end-user friendly mobile roadmap application and discuss challenges, design, development and evaluation of the mobile user-interface and propose a revenue model for the app. Section 2 introduces our app in detail and in Section 3 we report on its empirical evaluation. Section 4 discusses revenue e-Business models and Section 5 concludes this article.

Worldwide sales of mobile devices totaled 440.5 million units in the third quarter of 2011, up 5.6 percent from the same period last year, according to Gartner.Smartphone sales to end users reached 115 million units in the third quarter of 2011, up 42 percent from the third quarter of 2010 and accounted 26 percent of all mobile phone sales. In the third quarter of 2011, Android OS accounted 52.5% of worldwide smartphone sales to end users (compared to 25.3% a year earlier) whereas Symbian accounted 16.9% (36.3% a year earlier), iOS accounted 15.0% (16.6 a year earlier) and Research In Motion accounted 11.0% (15.4% a year earlier) according to Gartner (Gartner, 2011). The majority of smartphones are tailored toward the business-to-consumer (B2C) market, the predominant input technique for mobile devices is the multi-touch concept (Wang and Ren, 2009).

Moreover, a press release from IDC in September 2011 stated: By 2015, more U.S. Internet users will access the Internet through mobile devices than through PCs or other wireless devices. As smartphones begin to outsell simpler feature phones, and as tablet sales explode, the number of mobile Internet users will grow by a compound annual

growth rate of 16.6% between 2010 and 2015.

2 ANDROID BASED MOBILE ROADMAP APPLICATION

A user employs the roadmap application for tasks such as requesting the current timetable and buying tickets: Table 1 lists the use case for buying a ticket.

In designing the user interface we followed standard usability engineering methods (Holzinger, 2005).

The user interface of the application has been improved iteratively. In the following we discuss the most notable steps in designing the user interface. We started with a Spinner layout and improved this design incrementally. This new view also (in case of a successful route request) automatically adds the entered entry into a list, which automatically suggests this location or station when the first letters are entered (Figure 1).

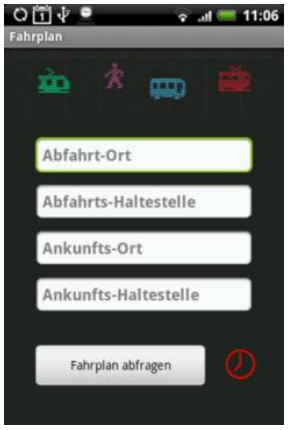


Figure 1: Auto-complete view.

A further step in improving the user interface was the redesign of the results page (see Figure 2).

Compared to the original version of the results page, this view is much easier to understand, it also gives

information about the number of stops, the duration of the trip, the departure and arrival time plus the types of transportation used for this route. Regarding the result page outlined in Figure 2, the trip would consist of a short sidewalk, a train- and a tram trip.

3 EMPIRICAL EVALUATION

To evaluate the usability of the roadmap application

Table 1: Use case buying a ticket.

Name	Buy a Train Ticket
Actor	User
Requirements	• Internet access available • Departure and destination location are valid • Name for the ticket
Inputs	• Desired departure and destination information • Number of persons, desired time • A name • Selection of class (1st or 2nd)
Outputs	• Confirmation message from to the service
Story	1. User selects to buy a train ticket (Menu –Buy train ticket) 2. User enters desired information 3. User sends request 4. User receives confirmation message 5. User has to answer to this message to receive a valid ticket

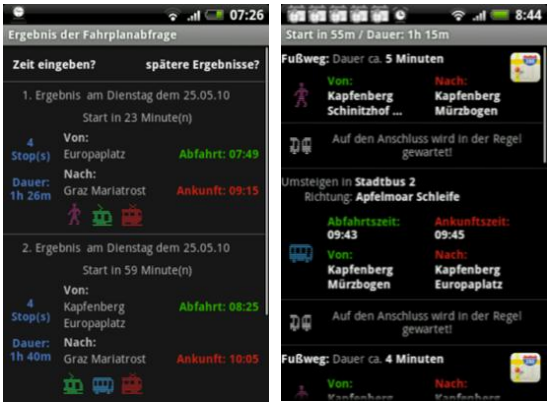


Figure 2: Results pages.

the System Usability Scale (SUS) was performed (Brooke et al., 1996). This is a simple and short, 10 question based survey, which asks the users about their general feelings about the application (complex, cumbersome, easy to use etc.). The SUS test can also be used to review systems, webpages and mobile systems, see e.g. (Holzinger et al., 2011). The user questionnaire consists of 10 questions, where odd-numbered items worded positively and even-numbered items worded negatively. The questions are as follows:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a

technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

The test was performed with 20 randomly selected people from the campus of Graz University of Technology. The average user age was 25 years (min: 19; max: 32); 6 female, 14 male; Figure 4 illustrates the results obtained from our survey.

The results gained from the survey show that the roadmap application has an above average usability rating. An average rating has been abstracted from over 500 studies, where the average SUS score has been 68 (Measuring Usability, 2010). The value representative for comparing it to other applications or usability studies is 80.75, which is definitely above average. From the perspective of an observer, most of the users felt very confident with the system. Also positive credit was gained for this project and this work.

Some users directly downloaded the application to their phone to start using it on a regular basis. Considering the download statistics, it is notable that the number of users is growing constantly (17.421 by September 2011, see Figure 3).

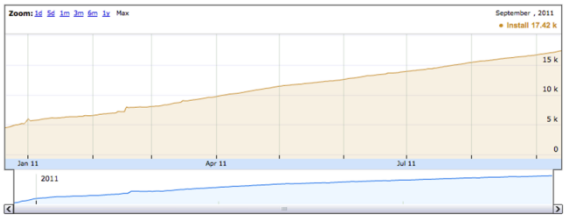


Figure 3: Continuous growth of the number of users.

4 e-BUSINESS SCENARIOS

In building up a business case around our app we differentiate between three different models of revenue creation. Further, to increase the awareness level of the availability of such an application, social media may be used as a low-cost facility for distribution.

Free App with Advertisements: Advertising is a controlled form used by an identified sponsor to deliver messages (text-based, image-based, etc.) to consumer, in an effort to influence and persuade them to take some action (buy, try, talk about, etc.) in relation to the sponsor's products and/or services (Brenner et al., 2008).

Mobile advertising therefore makes use of mobile devices. Instead printing or presenting advertisements on large screens, mobile phone users (users of PDAs, smartphones, handhelds or tablet PCs) are used as potential customers. Advertisements are presented within applications or on websites, which directly address desired end-users. Mobile advertising is an important factor and makes use of both, the advertising and the software business. As mentioned in (Information Gatekeepers Inc., 2007), mobile advertising presents a unique opportunity to directly interact with customers.

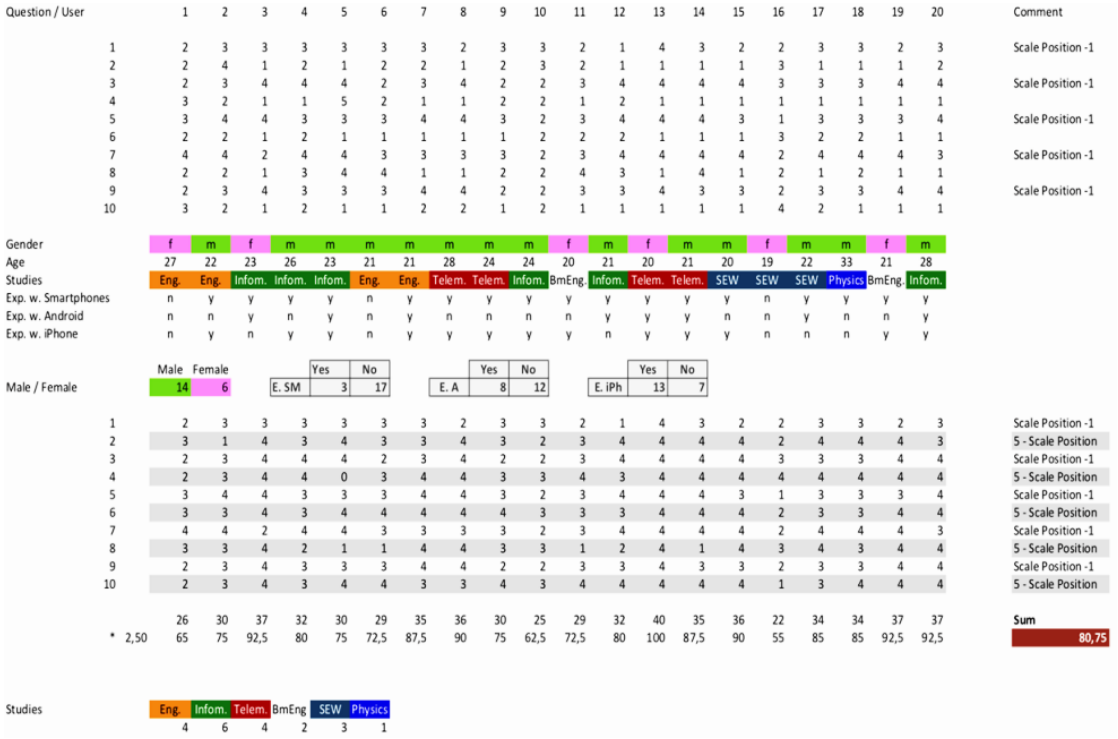
One example is Google Ad Mob (Mobile Advertising, Ad Mob, 2010). Google provides developers with an API, which allows easy access to millions of merchants which can select, where, how and which customers (age, country, gender) the advertising is meant for. This can also be used to strengthen the customer loyalty (i.e. cross selling by local vendors). Local customer retention has been analysed in more detail in (Bulander, 2007) and context sensitive marketing strategies are discussed in (Bulander et al., 2005).

Making services monetarily free could be highly beneficial for government sectors, educational institutions, and non-profit organizations (Gangadharan et al., 2010). The implications of free services are discussed in (Gangadharan et al., 2010).

Non-free App: In addition to the free app (that comes with advertisements), an advanced version of the app can be provided. Besides of further improvements and convenience functions, this app comes with no advertisements. However, the user needs to buy this app instead of downloading it for free.

Royalty Fee: As our app allows one for buying tickets on the fly, this offers another opportunity for revenue generation. Today there are various ways for electronic payment. For example, micro payments can be executed via credit card, mobile phone bill or Paypal.
Whenever a ticket is purchased, the user is charged with a small fee. Compared to the ticket price, this royalty fee is almost negligible, but for a bigger number of users, the generated revenue may be considerable.

Most notably, the three strategies discussed above can be combined as they do not exclude each other: The app can be offered for free and for the



Question / User	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Comment
1	2	3	3	3	3	3	3	2	3	3	2	1	4	3	2	2	3	3	2	3	Scale Position -1
2	2	4	1	2	1	2	2	1	2	3	2	1	1	1	1	3	1	1	1	2	
3	2	3	4	4	4	2	3	4	2	2	3	4	4	4	4	3	3	3	4	4	Scale Position -1
4	3	2	1	1	5	2	1	1	2	2	1	2	1	1	1	1	1	1	1	1	
5	3	4	4	3	3	3	4	4	3	2	3	4	4	4	3	1	3	3	3	4	Scale Position -1
6	2	2	1	2	1	1	1	1	1	2	2	2	1	1	1	3	2	2	1	1	
7	4	4	2	4	4	3	3	3	2	3	4	4	4	4	4	2	4	4	4	3	Scale Position -1
8	2	2	1	3	4	4	1	1	2	2	4	3	1	4	1	2	1	2	1	1	
9	2	3	4	3	3	3	4	4	2	2	3	3	4	3	3	2	3	3	4	4	Scale Position -1
10	3	2	1	2	1	1	2	2	1	2	1	1	1	1	1	4	2	1	1	1	

Gender	f	m	f	m	m	m	m	m	m	m	f	m	f	m	m	f	m	m	f	m
Age	27	22	23	26	23	21	21	28	24	24	20	21	20	21	20	19	22	33	21	28
Studies	Eng.	Eng.	Infom.	Infom.	Infom.	Eng.	Eng.	Telem.	Telem.	Infom.	BmEng.	Infom.	Telem.	Telem.	SEW	SEW	SEW	Physics	BmEng.	Infom.
Exp. w. Smartphones	n	y	y	y	y	n	y	y	y	y	y	y	y	y	y	n	y	y	y	y
Exp. w. Android	n	n	y	n	y	n	y	n	n	n	n	y	y	y	n	n	y	n	n	y
Exp. w. iPhone	n	y	n	y	y	n	y	y	y	y	y	n	y	y	y	n	n	n	y	y

	Male	Female
Male / Female	14	6

	Yes	No
E. SM	3	17

	Yes	No
E. A	8	12

	Yes	No
E. iPh	13	7

1	2	3	3	3	3	3	3	2	3	3	2	1	4	3	2	2	3	3	2	3	Scale Position -1
2	3	1	4	3	4	3	3	4	3	2	3	4	4	4	4	2	4	4	4	3	5 - Scale Position
3	2	3	4	4	4	2	3	4	2	2	3	4	4	4	4	3	3	3	4	4	Scale Position -1
4	2	3	4	4	0	3	4	4	3	3	4	3	4	4	4	4	4	4	4	4	5 - Scale Position
5	3	4	4	3	3	3	4	4	3	2	3	4	4	4	3	1	3	3	3	4	Scale Position -1
6	3	3	4	3	4	4	4	4	4	3	3	4	4	4	4	2	3	3	4	4	5 - Scale Position
7	4	4	2	4	4	3	3	3	3	2	3	4	4	4	4	2	4	4	4	3	Scale Position -1
8	3	3	4	2	1	1	4	4	3	3	1	2	4	1	4	3	4	3	4	4	5 - Scale Position
9	2	3	4	3	3	3	4	4	2	2	3	3	4	3	3	2	3	3	4	4	Scale Position -1
10	2	3	4	3	4	4	3	3	4	3	4	4	4	4	4	1	3	4	4	4	5 - Scale Position

	26	30	37	32	30	29	35	36	30	25	29	32	40	35	36	22	34	34	37	37	Sum
* 2,50	65	75	92,5	80	75	72,5	87,5	90	75	62,5	72,5	80	100	87,5	90	55	85	85	92,5	92,5	80,75

Studies	Eng.	Infom.	Telem.	BmEng	SEW	Physics
	4	6	4	2	3	1

Figure 4: The Evaluation results.

enhanced version without advertisements it is liable to pay some fee. Further, a royalty fee when buying a ticket can be charged to the user for both models. Thus we can achieve a kind of diversification in the strategy of generating revenues and thus reduce the overall risk in generating adequate revenues. This is particularly important for Small and Medium-sized Enterprises (SMEs).

In general, it seems to be a widely accepted notion that play an important economic and social role and often contribute to innovation. But at the present situation the development and operation of a service to be used with mobile and wireless terminals (mobile service) is not bearable for most of them due to technical reasons and the market structure. The authors of (Decker et al., 2006) discuss the SME specific obstacles in m-business.

Although there are various benefits to B2B e-commerce, there are also inhibitors to its deployment. The authors of (Teo et al., 2006) empirically investigate the inhibitors for deploying Web-based B2B e-commerce applications in organizations and the authors of (Stuckenberg et al., 2011) discuss Software as a Service (SaaS) and its implication on revenue streams.

5 CONCLUSIONS

In this paper we have introduced a novel mobile application for improving the navigation on public transport. We point out some challenges in for mobile e-business applications including developments in mobile operating systems, mobile application development and end-user friendly user-interface design. We introduce some of the core features of our app and outline the (iterative) design of the user interface for the mobile application. We report on an empirical evaluation (system usability scale test) and conclude that the app has an above average usability rating (approximately a score of 81 compared to the average score of 68). This claim is further supported by the fact that the number of users is continuously growing. Mobile applications, such as roadmap applications are a great possibility to make public transport systems more attractive for customers, thereby helping to protect our environment.

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