CO-127

DEFINING PSYCHOLOGICAL ROUTE QUALITIES TO ENHANCE PEDESTRIAN ROUTE PLANNING

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ABSTRACT

Route planning systems (web-based or mobile) have strongly influenced the process of pre-planning ways in everyday life. Beside route planning systems for car navigation, the rapid development of mobile services supported the emergence of solutions for pedestrians in the last years. However, in existing systems the flexibility of pedestrians to identify the optimal route between a point A and a point B is limited because of a small set of path selection criteria. Further user-specific requirements are usually not taken into account. The following paper explores how psychological route qualities (e.g. attractiveness, safety, convenience) can be defined to enhance route planning. A field test was conducted to collect route criteria influencing the psychological route qualities. Special attention was paid to a gender-sensitive research approach. From the results a data model was developed, that allows the consideration of these criteria in a routing algorithm.

Keywords: pedestrian navigation, gender-sensitive research, route planning systems, routing engine

1 INTRODUCTION

Walking, driving a car, riding a bicycle or using public transport – increasing mobility asks for adapted applications which support humans in their daily travel and wayfinding tasks. E.g. electronic time table information and other services for public transport have been developed in the last years. Especially online route planning systems allow pedestrians to preplan their trips. They became popular tools in the last years. Routes in current route planning systems are usually calculated based on geometrical features (e.g. street type, distance optimization). However, a review on previous literature shows that humans are not only interested in the shortest and fastest route, but have individual preferences in route choice (Golledge 1997). Route planning and path selection are two main characteristics of human wayfinding. Several researches have been done on supporting pedestrians in route planning (e.g. Hochmair 2007, Millonig & Schechtner 2005, Papinski et al. 2009). However, most studies concentrated on theoretical approaches and findings were rarely tested and implemented in practice. First examples of considering personal interests in route planning can be found sporadically with the possibility to display points of interest on the route or the exclusion of specific path types (for example no stairs, etc.).

FEMroute – the project in which context this paper is written – aims at advancing the degree of personalization of such systems in order to support humans with different contexts of use in their mobility needs. We hereby concentrate on two main issues: 1) Collecting and analyzing route criteria which result in psychological route qualities (attractiveness, safety, convenience). 2) Using a gender-sensitive research approach to ensure, that different mobility needs caused by differences in mobility behavior are considered. Therefore, a field test is obtained to collect route criteria connected to the above mentioned route qualities. The collected route criteria are then used to enhance the free geo database OpenStreetMap (e.g. implementation of specific tags). In combination with a routing engine, this data can be used to create target-oriented routes and route descriptions based on these criteria.

This paper is organized as follows: The second section describes the objectives of the project in more detail. The third section explains the methodology used in the project. Finally, a short conclusion and outlook are given.

2 BACKGROUND AND OBJECTIVES

2.1 Route Qualities for Pedestrians

In their paper on route qualities for pedestrians, Millonig and Schechtner (2005) identified three interdependent dimensions of route qualities: 1) physical quality (e.g. distance, acclivity), 2) psychological quality (e.g. attractiveness, safety), and 3) mental quality (e.g. number and complexity of decision points).

When analyzing current route planning systems on the market, it shows that they mainly focus on the physical dimension, especially distance. Detailed route selection possibilities can be found in public transport solutions, e.g. some timetable queries offer selection possibilities regarding accessibility of vehicles and public transportation stops (no stairs, no escalators etc.). Additionally, walking speed and

connections to other modes of transport can be stated (time, number of transfers, maximum length of footways).

The relevance of the mental quality on the route choice can be confirmed by research results that show that pedestrians prefer longer, but less complex routes over shorter, but more complex routes ("least decision load" strategy) (Wiener et al. 2004). Some existing route planners support this preference by suggesting a number of possible routes with varying complexity.

The psychological quality is determined by the structure and appearance of an environment, which influences if a pedestrian feels comfortable crossing an area or not, e.g. attractiveness, safety and availability of facilities (Millonig 2006). The psychological quality of routes and areas is an important issue in urban planning. However, it is not clear yet, which concrete route criteria influence the psychological quality of pedestrian routes and how to use them in route planning. Therefore, FEMroute tries to investigate the route criteria determining the psychological quality in terms of attractiveness, convenience and safety.

2.2 Gender-Sensitive Research Approach

So far the designers of mobility supporting systems (e.g. routing planning or navigation systems) haven't used more than fancy packaging and design to reach out to female customers (e.g. Garmin Pink Nüvi). The underlying software solutions usually remained unchanged. Therefore, FEMroute aimed at identifying and integrating female-specific factors in mobility supporting systems. However, after a phase of studying existing research in route choice and mobility behaviour, it proved to be more useful to focus on the aspect of "gender" in the sense of social roles and identities instead on the biological sex (Self & Golledge 2000). Even though studies in Austria and Germany show sex-related differences in mobility behaviour (e.g. women make more, but shorter trips with more complex travel patterns, use public transport more often, make more serve-passenger trips, etc.), many of these differences disappear, when socioeconomic aspects (e.g. employment status, household structure) are taken into account (Nobis & Lenz 2004; Knoll 2008). Part-time employed men in multiperson households for example have very similar travel patterns to women, which implies, that the division of household duties and child care is the influencing factor on differences in mobility patterns, rather than the biological sex (Nobis & Lenz 2004). As an example: Regardless the biological sex, a person heading straight home after work might prefer the fastest route, while a person picking up his/her child from day-care might want to add safety and convenience aspects to the route choice.

Therefore, to ensure that different needs caused by differences in mobility behavior are considered, a gender-sensitive research approach is used. From a gender perspective, qualitative research methods are recommended, which incorporate direct involvement of potential users (Rommes 2006). Hence, the project follows a user-centered design methodology which means that users with different ages, employment status and family obligations are part of the development process from collecting user needs and requirements to evaluating the suggested routing model. The method design including all questionnaires was developed in consultation with trained gender experts.

3 METHODOLOGY

3.1 Field Test Methodology

Aim of the field test was to explore which route criteria test persons associate with the psychological route qualities attractiveness, convenience and safety. A field test with 20 test persons was designed to collect route impressions. The test persons separately walked along a pre-defined route in Vienna accompanied by an instructor. At every decision point, the test persons answered closed and open questions about their perception of the area they just walked through with regard to the route qualities. Additionally they were asked, how they would like to continue their way and why they would prefer one sub-route over the other.

The selection of test persons was based on the preliminary literature review, which showed that navigation behavior is influenced by age, cultural background, gender, and cognitive abilities (e.g. Millonig 2005). Patterns of mobility can be observed depending on the type of household, division of labor and employment status (Nobis & Lenz 2004). We therefore chose a sex-balanced, homogeneous group of test persons, with a special focus on representing people with different employment status and family obligations.

3.2 Field Test Results

The test persons mentioned a wide range of criteria, which were then categorized. For example, "attractiveness" divides into buildings, infrastructure, nature, streets/paths, courts and surroundings. These categories are further defined by sub-categories e.g. "nature" breaks down into the sub-categories parks, water surfaces (rivers, lakes, etc.) and green areas. The next step was to calculate the frequencies of how

often the different sub-categories were mentioned, e.g. for “attractiveness” the criterion “surroundings” (ambiance, bustle, etc.) was mentioned most often by the test persons. Regarding “convenience” the subcategory “footpath width” was the most frequently mentioned criterion. *Table 1* shows the criteria which were mentioned the most for each route quality. Positive and negative mentions of the criteria are combined.

Table 1: Most frequently mentioned criteria for each route quality.

Attractiveness (positive and negative)

	Number of Mentions
Ambience	126
Buildings	76
Automobile traffic	60
Shops	47
Bustle	47
Footpath width	41
Street type (alley, side street, main road)	36
Ambient noise	35
Green areas	34
Parks	30

Convenience (positive and negative)

	Number of Mentions
Footpath width	175
Surface	111
Automobile traffic	61
Barriers (parking cars, planters, …)	40
Ambience	39
Acclivity	33
Pedestrian crossings	25

Safety in daylight (safe and unsafe)

	Number of Mentions
Automobile traffic	40
Bustle	13
Barriers (parking cars, planters, …)	12
Footpath width	11
Surface	10

In the further course of the project, a data model was built based on these criteria and categories. In order to obtain user feedback on the results and on different contexts of use, also a focus group discussion was organized.

3.3 Developing a Data Model

For developing a data model that can be used by a routing engine, the weighted criteria (frequency of mentioned terms) from the field test were utilized. As the routing engine is based on the free geo database OpenStreetMap (OSM, www.openstreetmap.org), the criteria had to be adapted to the current existing data model in OSM. Some criteria, e.g. “attractiveness of facades” or “footpath width”, were not yet available in the existing OSM data model. Therefore new tags were developed, which were marked as FEMroute tags, to ensure the tags wouldn’t be deleted, even though they are not part of the official OSM tagging scheme yet. The new tags will have to be discussed within the community; especially tags like “ambiance”, which are hard to map objectively.

The developed data model can now serve as input for a routing engine. We collected the above mentioned criteria for two test areas in Salzburg and Vienna and created test routes in order to evaluate the developed data model.

4 CONCLUSION AND FUTURE PLANS

In this project a field test was conducted to identify route criteria that influence the psychological route quality. From the broad range of collected criteria a weighted data model was developed. An exemplary implementation of a routing engine using this model has been developed. The next step is to evaluate the FEMroute approach on different test routes in the cities of Salzburg and Vienna. 40 test persons representing different stages of life and employment (students, business people, parents, etc.) are going to be part of the test. They will walk along an attractive, a convenient and a safe path and then express whether they agree with the assigned route quality or not. The test users also have to fill out a questionnaire on their personal background and how they currently plan their routes. The results of the evaluation will help us to estimate the usefulness of the suggested routing model.

We expect that the results of this project bring us closer to the vision of a new generation of mobility supporting systems for pedestrians. However, non-network based and context-specific criteria such as feelings concerning safety or ambiance are difficult for consideration in a routing algorithm because of the need to quantify them in geodata. Research in this field still remains to be conducted, especially on how subjective criteria, such as emotions, can be mapped in geodata.

ACKNOWLEDGEMENT

The FEMroute project is funded by the Austrian Ministry for Transport, Innovation and Technology (BMVIT) within the structural research program FEMtech fFORTE.

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