Guiding People Along More Intuitive Indoor Paths

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Abstract Route planning algorithms in indoor navigation systems are currently limited to shortest path algorithms or derivatives. The development of a cognitive route planning algorithm, providing cognitive more comfortable paths to navigators, could improve these systems. The first phase of the development of such an algorithm entails the identification of relevant path characteristics of the indoor environment. Therefore, a user study is enrolled: an in-depth discussion with a focus group of experts is followed by an international online survey.

Keywords Indoor navigation · Route planning algorithm · Cognition

1 Background

As long as people need to decide where to go and how to reach a destination, navigation will remain one of the fundamental problems in human cognition, wayfinding and geospatial research. Wayfinding is the goal-directed part of navigation based on decision making and planning, and influenced by both personal and environmental factors (Montello 2005). The improvement of indoor navigation systems could ease the wayfinding task in the indoor environment.

Route planning is a key element of navigation guidance applications as it aims at computing an optimal route between a starting and a destination point (Montello 2005). Route planning algorithms in existing (indoor) navigation applications are limited to the shortest or fastest path (Vanclooster et al. 2014a). However, studies have proven that people do not always prefer the shortest or fastest route to reach

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their destination (Golledge 1999). More intuitive and easier-to-follow routes reduce the risk of getting lost, require a smaller wayfinding effort, guide in recalling routes and are overall perceived as more comfortable (Vanclooster et al. 2014a).

This research focuses on developing a cognitive route planning algorithm to support indoor navigation systems. The development of such an algorithm will improve indoor navigation systems by guiding people along cognitive more comfortable paths. Since these paths are in line with the user's mental structure and thus adhere better to natural human wayfinding behaviour, the cognitive load for the wayfinder will be reduced to the minimum (Vanclooster et al. 2013).

2 Research Question

Until now, little research has been devoted to the definition of indoor path characteristics that differentiate a more intuitive path from the common indoor shortest or fastest path. In order to create this cognitive indoor routing algorithm, it is crucial to understand the determining characteristics of path selection and to interpret how wayfinders make route choices in indoor environments. In other words, this research wants to focus on identifying the path characteristics people use during indoor wayfinding. The outcome of this research provides essential insights into users' natural route planning behaviour in indoor environments.

3 Approach

To determine path characteristics of cognitive routes in indoor environments, a research design was developed in line with previous studies about outdoor navigation, route choice criteria and their accompanying path characteristics (such as intersection complexity, visibility, turning points) (e.g. Dalton 2003; Golledge 1995; Hillier and Iida 2005; Hochmair 2005). Furthermore, the research design was based on existing research on indoor wayfinding behaviour (Hölscher et al. 2006), usability engineering and user-centred design (UCD) (e.g. Haklay and Nivala 2010; Nielsen 1994; van Elzakker and Wealands 2007).

To obtain a well-founded and coherent selection of relevant cognitive path characteristics and to incorporate the definition of the user requirements into the design process, a focus group and an online survey are employed.

The focus group is composed of diverse academic researchers and experts experienced with indoor environments, navigation and human behaviour studies. This focus group helps to define and formulate, through multiple discussions, possible cognitive path characteristics in indoor environments. Hereafter, the results of the focus group discussions are scrutinised through an online survey, in which a large group and diverse range of participants can be reached.

In the online survey, different routes in various indoor environments are recorded and displayed to the participants. Subsequently, in a questionnaire participants are asked to answer questions about these routes, their characteristics and preferences.

Integrating the results of the focus group and the online survey leads to a coherent selection of relevant cognitive path characteristics and provides complementary information on the main path characteristics in the indoor environment. Through this combination of qualitative and quantitative research, the path characteristics that differentiate a more intuitive path from the currently used indoor shortest or fastest paths (e.g. Kwan and Lee 2005; Thill et al. 2011) are defined.

4 Outcome

In general, the results of this research will provide essential knowledge on which characteristics are determinative in human path selection in indoor environments and how humans interpret these path characteristics. It will not only provide information on how to make navigation aid more comfortable, but it will also contribute to the overall understanding of indoor wayfinding and navigation.

5 Further Work

The obtained path characteristics will be incorporated in the cognitive route planning algorithm. The development of such an algorithm requires a theoretical conceptualisation of the underlying spatial concepts of each of those path characteristics, which have to model the users' perception on these path characteristics. The underlying indoor spatial model has to be taken into account in this process, as this determines the structure of the algorithm and could influence the results and accuracy of the algorithmic implementation (Vanclooster et al. 2014b).

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