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The development of a cognitive indoor route planning algorithm: which aspects to include?

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Abstract:

Wayfinding in the indoor environment is challenging and people often get lost indoors. Navigation systems guide people in these environments, however, the existing systems are not well adapted to their users. The focus of our research is on the route planning aspect of navigation systems. By adapting the routes that people are guided along in the environment, our goal is to substantially improve the wayfinding experience for the users of those systems. Guiding people along routes that adhere better to their cognitive processes could ease the wayfinder in the indoor environment.

To select the aspects that should be implemented in a routing algorithm that calculates such routes, a mixed method approach was applied. In this approach, the results of an exploratory focus group and a complementary online survey were combined. To validate these results, a real-life experiment is being developed at the time of writing.

Our first study, the exploratory focus group, comprised academic researchers and experts with different background (i.e. Psychology, Geography and Architectural Design). The discussions were guided by a rotating wheel according to the GPS-method which was developed by the Flanders District of Creativity. These discussions provided a broad overview of the elements to be regarded when studying wayfinding. Moreover, results indicate that route complexity has to be considered at different levels: local level (i.e. at decision points) and global level (i.e. legibility of the building). Based on the results of the focus group, multiple situations with specific local characteristics likely inducing confusion and discomfort (e.g. specific intersections, different stair cases, different door types) were selected to elaborate more deeply in the complementary online survey. In this survey, videos of these situations were shown to the participants, as if they were navigating through the building. They were asked to rank their comfort and confusion level about the recorded situation on a 5-point Likert-scale. The results show that visibility, visual clutter and geometric simplicity are of substantial importance when evaluating comfort and confusion levels, and thus the complexity of indoor navigation situations.

Since body-movement and the real-world perceptions, which have a substantial impact on information processing and spatial decision making [1], are excluded in these well-controlled lab environments of the previous studies, a real-life experiment will be executed to validate previous findings. The developed study design is in line with the experiment design of previous wayfinding studies [2], [3]. Eye tracking data of participants guided through different complex buildings along different paths (i.e. shortest path and fewest turn path) will be recorded. Performance measures (e.g. duration, stops, errors), eye tracking measures (e.g. fixation number, fixating duration) and annotations of the accompanying researcher, which are all measures indicating complexity and cognitive load, will be compared across the different paths and its decision points. This analysis will allow us to determine complex routes and to identify the environmental characteristics increasing the perceived complexity. Moreover, it will lead to an understanding how and in which occasions people make wayfinding errors.

In a subsequent phase of our research project, these results will be incorporated in a cognitively-sounding route planning algorithm which could be a valuable improvement of indoor navigation support. Focus will be on the theoretical interpretation of the underlying spatial concepts. Adjusting the route planning support of indoor navigation systems to human wayfinding behavior could be a substantial contribution in this area.

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