

Incorporating directional signs into indoor navigation systems

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Abstract:

Recent years have witnessed the rapid development of navigation systems. They gradually become the default way of navigating in our daily life. Despite benefiting from their convenience, we may be negatively influenced by them (Parush et al. 2007). Current navigation systems usually draw too much of users' attention to the mobile devices, which leads to users' lacking interaction with the environment. It is often the case that people easily forget travelled route and get lost without navigation systems (Reilly et al. 2008). Empirical study shows that by dividing attention, navigation systems impair users' spatial memory, and thus impact their navigation skills (Gardony et al. 2013). Since a higher engagement with the environment can improve users' spatial knowledge acquisition without decreasing efficiency (Brügger et al. 2017), navigation systems should incorporate important environmental features.

As objects of visual, cognitive or structural importance (Sorrows & Hirtle 1999), landmarks have been extensively studied, and considered as an important environmental feature to be incorporated into navigation systems (Nuhn & Timpf 2018, Richter 2017, Duckham et al. 2010, Raubal & Winter 2002). They serve as references to provide users with more natural and pleasant navigating experience (Richter & Winter 2014). However, most of landmark-related studies are in outdoor environment. Although researchers have attempted to classify and assess indoor landmarks (Ohm 2014, Viaene 2014), it is still very difficult to determine suitable ones. As a subset of semantic indoor landmarks, existing navigational aids (e.g. signs and floor plans) are designed to assist navigation. Among them, signs are most preferred by users (Wang et al. 2017). Being the signs that give necessary information to route users to possible destinations, directional signs contribute most to wayfinding (Gibson 2009). With route information explicitly presented by them, they are relevant environmental features to be incorporated into indoor navigation systems.

In this study, we therefore propose to incorporate directional signs into indoor navigation systems, in order to guide users' attention back to the environment, to facilitate their spatial learning and improve their spatial knowledge acquisition.

We incorporated directional signs into a proof-of-concept indoor navigation system. First, we integrated directional signs and their semantics into a graph-based model. A directional sign was modelled as a node. Each destination on the sign was linked with the sign by an edge. In order to differentiate it from the normal edge, it was marked as semantic edge. Thus, the semantics of the sign was modelled directly into the graph, instead of being stored as attributes in a previous version of our study (Wang & Gartner 2018). Then, a top-K shortest path algorithm was employed to find candidate routes (Yen 1971). In the end, the route with the largest coverage of semantic edges was suggested to the user. The users would then be explicitly guided to follow the directional signs in the environment.

In the next step, we will evaluate the efficiency and effectiveness of the proposed navigation system by an empirical study with human subjects. Within the experiment, we will also investigate on whether this kind of guidance can succeed in drawing users' attention back to the environment and support their spatial knowledge acquisition.

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