Conference Poster

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Ain’t short sweet, when walking down that street?

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1. Extended abstract

Navigating users on the shortest possible path could lead to a suboptimal user experience in many use cases. Therefore, several car navigation systems present the fastest route in addition to the shortest route. But even beyond that, Zhu and Levinson (2015) argued that there are more aspects that should be considered to better fulfill users’ needs. By logging and analyzing GPS data from drivers, they revealed that whenever shortest paths are taken they match the shortest time path. But also these fastest routes are only taken in 34% of all cases. An approach to generate more elaborate routes is, for instance, followed by Krisp and Keler (2015), who take the drivers’ fear of complicated crossings into account. In the research field of pedestrian navigation, similar efforts have been made to provide better routes to users of navigation systems. Millonig and Schechtner (2007) review studies, showing that individuals may prefer safe, simple and non-exhaustive routes. Quercia et al. (2014) generated more beautiful, quiet and happy routes by the use of a crowd sourced approach. Their evaluation revealed that the shortest route was rated worst.

With this showcase we want to demonstrate a navigation system that is capable to adapt routes to various user preferences. Furthermore, we want to demonstrate that a simple weighting of different path entities can lead to routes that better fit users’ preferences than the shortest possible path.

To assist people in complex indoor and outdoor environments we set up a graph-based navigation system. We modeled the campus of our university containing many different connected buildings with long similar floors. Routes from an office to a lecture hall are often up to one kilometer, leading to several alternative paths a person could take.
Nodes and edges were tagged with information like “outdoor”, “revolving door” or “elevator”. Thus, by using weight factors for differently tagged nodes and edges, paths found by an A* algorithm can be influenced. Pursuing this approach, it would also be possible to enrich the tag set with information like complexity, beautifulness. To learn optimal weights and to investigate if such weights for our tag set can lead to routes that are more similar to the routes taken by pedestrians, we interviewed people that are familiar with the environment at the university. By this, we collected a dataset of 221 routes favored by users. Similar to the results of Zhu and Levinson (2015), only 5% of these routes matched exactly the shortest path. With a CMA-ES optimization (see Ostermeier et al., 1994) we learned weight factors leading to paths that were more similar to the users’ routes than the shortest paths. 80% of the data was used for training so we could evaluate the results with the remaining 20%. To rate similarity between routes, we used a distance metric that was reduced by a constant unit whenever the calculated route had more nodes or longer edges with a certain tag than the paths favored by users. The routes that were generated with the resulting (local) minimum turned out to be significantly more similar to the remaining 20% of our collected user routes than the shortest possible routes (Wilcoxon test, \( p < 0.01 \)). Results showed that the routes calculated with the optimized weights had significantly fewer hallway doors and revolving doors than the shortest routes (Wilcoxon test with Bonferroni correction, \( n = 19 \), corrected \( \alpha = 0.0026 \)). Furthermore, the optimized routes had significantly fewer ways in outdoor areas and through lecture halls, fewer small stairs and ramps within one level, but more ways in indoor areas. In the showcase we want to demonstrate our navigation system and discuss the approach, its effects and possible methods to evaluate its generalizability.

References