Indoor Navigation on Wheels (and Without) using Smartphones

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ABSTRACT

While indoor navigation is challenging for pedestrians, it is even more so for persons bound to a wheelchair. Additionally, the necessary WiFi infrastructure for fine grained RF fingerprinting-based indoor positioning is often unavailable. We propose a system completely contained in current smartphones, that allows people, wheelchair bound and others, to find their way in an unfamiliar environment.

Building on top of previous work, where we designed and implemented a system based on step detection and path matching, we extend the system for use on wheelchairs, where a self-contained smartphone based step detection mechanism is unavailable.

We detect movements by analyzing the optical flow encoded in the motion vectors of a live H.263 video stream recorded from the smartphone's video camera. As the phone makes use of specialized hardware for motion estimation, this process happens in real time and is very efficient.

While previously the user was only guided along a single path, we now extend this for the case when a user departs from the initial route, either voluntarily or because she is lost. For this, we make use of Markov Processes, where we model each distinct position as a state and vary the transition between these states based on the current bearing of the user.

Combining these approaches, we show the potential of smartphone based indoor navigation, allowing an accuracy of better than 5m after a change of direction, independent of the length of the overall path.

KEYWORDS: Indoor Navigation, Pedestrian Navigation, Wheelchair Navigation, Map Matching