Spontaneous and Privacy-friendly Mobile Indoor Routing and Navigation

Peter Ruppel and Florian Gschwandtner

Mobile and Distributed Systems Group
Institute for Computer Science
Ludwig-Maximilians-Universität, Munich, Germany

{peter.ruppel | florian.gschwandtner}@ifi.lmu.de

Indoor navigation systems guide users through buildings and premises by taking into account the current position of the user and a destination such as a room, office or shop. In addition to the simple displaying of positions on a map such systems comprise e.g. the calculation of shortest possible paths and navigation instructions in the building. Depending on the environment and the requirements of the navigation application a navigation instruction itself can basically be realized both on mobile devices and on stationary components that are installed in a building such as public displays, speakers, illuminated markers or digital signposts. Present mobile devices possess adequate displays and computing power to run navigation applications directly on the device. Together with existing and upcoming software platforms for purchasing, installing and maintaining the application it is easy to offer mobile indoor navigation applications for the mass-market. However, in many environments such as airports, hospitals or university campuses a spontaneous and also anonymous navigation is hard to achieve because many systems that have been proposed so far require the integration of a radio-based positioning system and access to other organization-specific systems. This results in a lot of things a user has to deal with before the navigation system can be used. Furthermore network-based or terminal-assisted positioning systems raise a lot of issues with respect to the location privacy of the user as such systems technically allow a constant tracking of the user. We propose a mobile indoor navigation system that allows spontaneous navigation and that guarantees location privacy for the user. A pre-compiled compact representation for all the routes and navigation instructions in a building is the basis for an application that uses the built-in camera on the mobile device to derive the current position in the building from barcodes which are distributed all over the building. The approach allows to navigate through a building with thousands of rooms and requires only little data on the device. A navigation instruction can be derived efficiently in $O(1)$ on the device and the only infrastructure that is required are the barcodes which can be easily printed and installed at walls or already existing signs in the building. This work also identifies and discusses seven different properties among which indoor navigation systems can be classified: the mobility, the degree of personalization, the instruction granularity, the positioning system, the location privacy, the route calculation process and dynamic behavior.