Review of Indoor Localization Methods and Workflow Analysis to Support Indoor Navigation

Based on a security intervention and a device maintenance use case we validate the most applicable indoor localization methods. We also elaborate and analysise the overall workflow that it takes to support indoor navigation. Finally, we suggest inertial dead reckoning for continuous path tracking fused with RFID tags for location fixes and path correction.

Situation

As the population grows constructions get bigger and more complex. Finding locations is at times difficult and time consuming. Outdoors, with the use of global navigation satellite systems (GNSS) such as GPS on a mobile device, finding the shortest path from one's current location to a sought destination has become easy. Although many businesses would profit, there is no comprehensive solution for indoor localization and navigation.

Objectives

This thesis investigates various methods to build such a system for the particular use cases of security intervention and device maintenance staff. In detail we focus on analyzing the overall workflow that it takes to support indoor navigation using a smart-phone. This includes a review on state-of-the-art indoor localization methods, floor plan pre-processing, finding shortest path as well as communicating directions. Detailed explanations and suggestions relating a later implementation shall support project acquisition and help to illustrate proposals of solutions.

Lukas Baumann
lubaum@gmx.net

Review

In specific, we review tag, light, acoustics, CCTV and ambient pressure based indoor localization methods. Further, we review motion tracking with dead reckoning from data of inertial sensors as well as electromagnetic field based localization methods such as WiFi fingerprinting and trilateration. Based on a literature review of over two hundred papers, theses, technical reports as well as the web, we identify possible approaches and applicable solutions. With this collected knowledge, we elaborate and analyze the overall workflow that it takes to develop an indoor navigation application.

Results

In order to provide sufficient user experience, we suggest the fusion of inertial dead reckoning with RFID tags. RFID tags provide location fixes and the smart-phone built-in inertial sensors continuous location tracking. In terms of workflow analysis, we explain and discuss every major aspect relevant to design and development. Major is the procedure to translate floor plans on paper into vectorized map representations. We also cover applicable routing algorithms to find the shortest path as well as communicating directions to users. On top, we introduce available libraries and useful software. Finally, we are pleased to lay a solid foundation for successful developments of indoor localization and navigation systems.
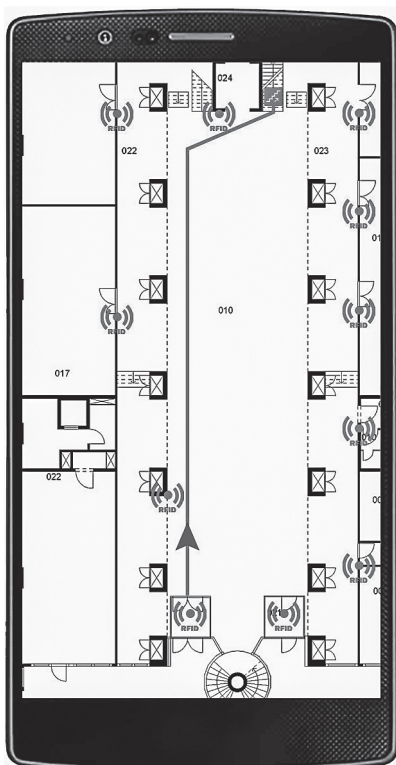

Illustration of dead reckoning fused with RFID tags to ensure continuous and precise location tracking.