Bachelor-Abschlussarbeitsbeschreibung

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1 Thesis

1.1 Working Title

An indoor location system based on Wireless LAN and digital compasses

1.2 Summary

Recently, various Wireless LAN-based indoor location systems have been proposed (e.g. [2], [1], [4]). These systems utilize the network infrastructure that has been built for communication purposes to determine the position of the object in question. Basically, Wireless LAN indoor location systems work as follows: access points periodically transmit beacons and every mobile device that receives beacons from at least two access points is able to estimate its position. Due to the effects caused by the physical characteristics of the wireless channel, it is not possible to accurately estimate the distance between a mobile device and an access point [3]. The error introduced by the Wireless LAN channel prohibits the use of lateration algorithms.

The so-called *fingerprinting* technique is applied by many Wireless LAN-based indoor location systems to cope with the drawbacks of the channel. Fingerprinting approaches work as two-stage algorithms: in the training phase a database that stores the physical coordinates and radio fingerprints of the measurement points is created. A radio fingerprint comprises the signal strength values of access points in communication range at a particular position. This database is used in the online phase to compute the position of mobile devices. If a mobile device wants to know its position it collects the signal strength values of the access points in communication range and matches this sample with the data stored in the database. If no direct match can be found the nearest fingerprint is selected and based on the selected fingerprint the position is derived.

However, there is a strong dependence between user orientation and signal strength [2]. For most Wireless LAN-based indoor location systems it is practically impossible to infer the user's orientation during the online phase. Furthermore, Bahl et al. [2] demonstrated that the performance of a location system can be improved if orientation is no issue. They emulated the case where the signal used for the fingerprint is not obstructed by the user's body. Unfortunately, they do not provide a deep and comprehensive analysis of these matters.

1.2.1 Working Packages

Subject of this thesis is the conceptual design, the implementation and the evaluation of an indoor location system based on Wireless LAN and digital compasses. In a first step, a simple Wireless LAN-based indoor location system has to be implemented (e.g., the one described in [2]). The main focus in this implementation shall be the functionality of creating databases of fingerprints. In a second step, digital compasses shall be integrated, so that the databases additionally contain the user's orientation. These databases will later be used to evaluate and test the location system.

The third task is to create an idealized environment where different positioning algorithms can be tested and evaluated. The idea behind this testbed is that stable and reproducible conditions improve and simplify the analysis of positioning algorithms. The databases created in step one shall be used as one basic component for this purpose. A testbed for positioning algorithms is already available (at the "Lehrstuhl für Praktische Informatik IV") and should be extended to support digital compasses. This framework is called *Loceva*.

The next step is to conceive novel positioning algorithms that benefit from utilizing digital compasses. These algorithms have to be integrated into the extended *Loceva* framework, so that a deep analysis can be provided. Finally, the most promising positioning algorithm should be integrated in a ready-to-use indoor location system as a proof of concept.

Literatur

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[2] P. Bahl and V. N. Padmanabhan. Radar: An in-building rf-based user location and tracking system. In *In Proceedings of IEEE Infocom*, volume 2, pages 775–784, Tel Aviv, March 2000. IEEE.

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[4] M. Youssef and A. Agrawala. The horus wlan location determination system. In *Proceedings of the 3rd international conference on Mobile Systems, Applications, and Services (Mobisys)*, pages 205–218, 2005.