Diplomarbeitsbeschreibung

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1 Diploma Thesis

1.1 Working Title

Wireless LAN-based Indoor Location Systems: A Fingerprinting Approach that utilizes Different Transmission Power Levels

1.2 Summary

Recently, various indoor location systems based on Wireless LAN have been proposed (e.g., [2], [1], [6]). 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-based 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 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 by investigating the signal strength [4]. The error introduced by the wireless 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 in two stages: 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. The database is then 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 its communication range and matches this samples 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.

As shown in [2], the aforementioned Wireless LAN-based indoor location systems work well in various indoor conditions and provide location accuracy up to a few meters. However, a large number of access points is required to accurately locate a mobile device.

Nowadays, access points are able to transmit packets with different power levels. For instance, the D-Link DWL-G700AP AirPlusG access point supports

four different power levels. This fact can be used to virtually create four fingerprint databases for each access point. By collecting additional information from an access point by using different transmission levels at each measurement point we believe the number of required access points can be decreased while the accuracy keeps unchanged.

1.3 The Thesis

Subject of this thesis is an implementation and evaluation of an fingerprinting algorithm that uses different transmission power levels. In a first step, the recording tools that have already been implemented at Praktische Informatik IV to store signal strength sample have to be extended, so that different power levels are supported. The difficulty here is that the power levels of the access points have to be remotely adjusted.

The second task is to create a testbed, where the recording tools can be used to record the signal strength samples at different measurement points. The idea behind this is that reproducible conditions improve and simplify the analysis of positioning algorithms. The result of this task should be a trace file that contains signal strength measurements at various points.

In a next step, a fingerprinting algorithm that utilizes different transmission power levels should be conceived. A probabilistic approach should be considered, because this class of algorithms usually outperforms deterministic approaches (see [5]). Further, this algorithm should be implemented using the Loceva framework (*Loceva – A Location Evaluation Framework* developed at Praktische Informatik IV [3]). The trace file produced in step two should be used as input to compare the performance of this algorithm with existing approaches resulting in a deep and thorough analysis.

Literatur

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[5] M. Youssef and A. Agrawala. On the Optimality of WLAN Location Determination Systems. In *Communication Networks and Distributed Systems Modeling and Simulation Conference*, January 2004.

[6] 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.