Bachelorarbeitsbeschreibung

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1 Student

Name:
Matr.-Nr.:
Geb.-Datum:
Adresse:
Studiengang:
Fachsemester:
Betreuer:
Beginn:
Ende:

2 Thesis

2.1 Working Title

Selection Techniques for Positioning Systems

2.2 Summary

In recent years, a new class of applications has arisen. These applications are called *Location-based Services* (LBS) and have in common, that they use information about the users current whereabouts to adapt their delivered service. An example for such services is an application that automatically displays information about special offers of nearby stores on the display of the user's mobile device.

While the user is outdoors, the most widely used source for location information is the satellite-based *Global Positioning System* (GPS) [5]. GPS offers an accuracy of up to few meters under optimal conditions. If the conditions worsen though, the accuracy of GPS rapidly decreases. Finally, for example inside buildings or when there is no direct line of sight between the receiver and at least three GPS satellites, no position estimation is possible any more with GPS.

In these – in reality quite frequent – cases, other systems can be to estimate the user's location. Among these, the position estimation with *802.11* and *fingerprinting* has emerged as one of the more promising solutions (e.g [2], [4]).

Estimating a position with fingerprinting is a two-step approach. In a first so-called *training phase*, data is collected at pre-defined reference positions. This *fingerprint* shall reflect the unique properties of the signal space at the position it was collected and is stored in a database for later reference. In the second or *position determination phase*, the user's mobile device again collects measurements which then are compared to all the fingerprints in the database. Subsequently, the position of the fingerprint that offers the best match is returned.

Finally, in situations where neither GPS nor training data for the users current whereabout is available, still more simple solutions like proximity- or angulation-based approaches can likely be used to at least roughly estimate a users position (e.g., Skyhook Wireless [1], PlaceLab [7]).

All the just introduced approaches have both advantages and disadvantages. Sometimes they are not available, sometimes the accuracy is degraded or maybe another system could deliver better results. But as each of these approaches offers the possibility to at least roughly estimate the positioning error (e.g., Dearman et al. [3], Krishnakumar et al. [6]) and also the availability or absence of each system can be verified with little effort, we are seeking for an algorithmic approach to automatically select the positioning system most suitable to estimate the position of a mobile user in his current environment.

2.2.1 The Thesis

Subject of this thesis is the conceptual design, the implementation and the verification of a system that, depending on available context information as expected positioning error, system availability and e.g., user preferences, situation specifically selects the most appropriate positioning system to estimate the position of the mobile user.

The first part of the thesis shall consist of an analysis of current positioning systems. Here the candidate shall analyse available quality metrics for the single approaches and create a functional mapping to rate each system on a situation-specific basis.

Subsequently, the algorithmic approach developed by the candidate shall be implemented and integrated into the suite of 802.11-related tools that is used at the "Lehrstuhl für Praktische Informatik IV".

Finally, an evaluation and performance analysis of the system shall be made to demonstrate the effectiveness of the developed approach. Therefore, data from the already existing testbed as also data from new testbeds shall be used.

Literatur

[1] Skyhook wireless. `http://www.skyhookwireless.com/`.

[2] P. Bahl and V. N. Padmanabhan. RADAR: An In-Building RF-based User Location and Tracking System. In *Proceedings of the 19th Annual Joint Conference of the IEEE Computer and Communications Societies*, 2000.

[3] D. Dearman, A. Varshavsky, E. de Lara, and K. N. Truong. An exploration of location error estimation. In *Procedings of the Nineth Interational Conference on Ubiquitous Computing*, 2007.

[4] A. Haeberlen, E. Flannery, A. M. Ladd, A. Rudys, D. S. Wallach, and L. E. Kavraki. Practical Robust Localization over Large-Scale 802.11 Wireless Networks. In *Proceedings of the Tenth ACM International Conference on Mobile Computing and Networking*, 2004.

[5] E. Kaplan and C. Hegarty, editors. *Understanding GPS: Principles and Applications*. Artech House Incorporated, second edition, December 2005.

[6] A. S. Krishnakumar and P. Krishnan. On the accuracy of signal strength-based estimation techniques. In *Proceedings of the 24th Annual Joint Conference of the IEEE Computer and Communications Societies*, 2005.

[7] A. LaMarca, Y. Chawathe, S. Consolvo, J. Hightower, I. Smith, J. Scott, T. Sohn, J. Howard, J. Hughes, F. Potter, J. Tabert, P. Powledge, G. Borriello, and B. Schilit. Place Lab: Device Positioning Using Radio Beacons in the Wild. In *Proceedings of the Third International Conference on Pervasive Computing*, 2005.