A Platform for the Evaluation of Fingerprint Positioning Algorithms on Android Smartphones

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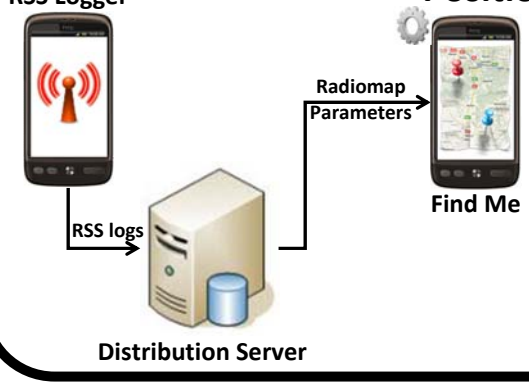
Goals and Contributions

- Build an open Android smartphone platform for positioning and tracking inside buildings
- Integrate two efficient positioning algorithms, RBF[1] and SNAP[2], developed in-house
- Evaluate the performance of several fingerprint-based positioning algorithms in terms of:
  - **Execution Time:** Measure the average time required in practice to perform positioning on smartphones
  - **Positioning Accuracy:** Calculate the mean positioning error pertaining to a test dataset
  - **Power Consumption:** Investigate the actual battery depletion during positioning with the PowerTutor[3] utility

Positioning System Architecture



Mobile-based Network-assisted architecture

- **Low communication overhead:** Avoids uploading the observed RSS fingerprint to the positioning server for estimating location.
- **User privacy & security:** location is estimated by the user and not by the positioning server.

Positioning scenario

1. A User enters an indoor environment, featuring WiFi APs.
2. His smartphone obtains the RSS radiomap and parameters from the local distribution server in a single communication round.
3. The client positions itself independently using only local knowledge and without revealing its personal state.

RSS Logger Application

Features

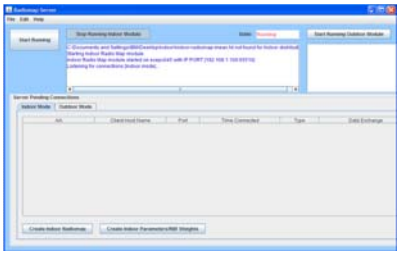
- Developed around the Android RSS API for scanning and collecting measurements
- User defined number of samples and sampling interval
- RSS data stored locally in a log file with (Lat,Lon) from GPS [**outdoors**] or (X,Y) by clicking on floorplan map [**indoors**]
- User can contribute the log files to the system for building and updating the radiomap

Find Me Application

Features

- Connects to the server for downloading the radiomap and algorithm parameters
- User selects any of the available algorithms
- Dual operation mode
- **Online:** Location is plotted on Google Maps [**outdoors**] or the floorplan map [**indoors**]
- **Offline:** Loads an external file with test RSS fingerprints to assess the performance of different algorithms

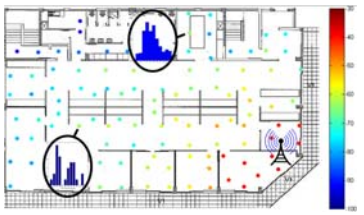
Radiomap Distribution Server



Features

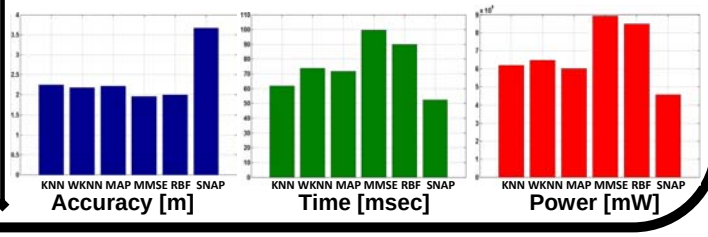
- Constructs and distributes the radiomap and algorithm parameters to the clients
- Parses all RSS log files and merges them in a single radiomap that contains the mean RSS value fingerprint per location
- Selects and fine-tunes algorithm-specific parameters iteratively by using validation RSS data

Experimental Evaluation @ KIOS Center



Measurement Setup

- 560m^2, 9 WiFi APs
- 105 reference locations
- **Train Data:** 105 reference locations, 4200 fingerprints (40 per location)
- **Test Data:** 96 locations, 1920 fingerprints (20 per location)



[1] C. Laoudias, P. Kemppi, C. Panayiotou, "Localization using RBF Networks and Signal Strength Fingerprints in WLAN", IEEE GLOBECOM, 2009, pp. 1-6.
[2] C. Laoudias, M. P. Michaelides, C. G. Panayiotou, "Fault Tolerant Fingerprint-based Positioning", IEEE ICC, 2011, pp. 1-5.
[3] PowerTutor: A Power Monitor for Android-based mobile platforms, http://powertutor.org

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