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Tilejunction: Wi-Fi Indoor Localisation Based on Junction of Signal Tiles

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Background

Location-based services have attracted much attention in recent years due to their potential social and commercial value. The quality of such services largely depends on the localisation accuracy of the mobile devices involved. Many types of sensor signal have been explored for indoor localisation, such as Wi-Fi, magnetic field, FM, RFID and sound. Wi-Fi fingerprinting has emerged as particularly promising because it is easy to deploy and requires no extra sensor infrastructure beyond an existing Wi-Fi network. However, due to the statistical fluctuation of signal strengths, there is uncertainty or noise in Wi-Fi signal measurement in both the fingerprint and target RSSI collections. Therefore, the matching algorithm in the on-line phase may result in a disperse set of neighbours far apart in the physical space.

Technology Overview

This system provides a novel, efficient and highly accurate localisation scheme termed Tilejunction. Using only the first two moments of the measured signal, Tilejunction maps the target RSSI of each AP to a convex hull termed "tile", in which the target is likely to be found. Using a linear programming (LP) formulation, the target can then be located within the junction of the tiles. The computational efficiency of Tilejunction is further improved by using an information-theoretic measure to retain only APs whose signals effectively distinguish the reference points. It also partitions the site into multiple clusters to substantially cut the search space in the LP optimisation. We have implemented Tilejunction. Our extensive experimental results show that Tilejunction significantly outperforms recent approaches, providing significantly lower localisation error.

Market Analysis

The market for indoor positioning systems (IPS) is currently growing rapidly due to the ubiquity of mobile devices. The main utility of IPS technology lies in the development of location-aware mobile computing such as targeted advertising, social networking and indoor navigation. As traditional global positioning systems are unable to penetrate to indoor spaces, new methodologies to locate and track the users of mobile devices indoors have been developed using radio waves, magnetic fields, acoustic signals and Wi-Fi. Wi-Fi-based technologies seem to be gaining significant traction due to their low cost and ability to utilise already existing infrastructure. Many

large technology companies, such as Apple and Google, have already made large investments in either acquiring IPS technology companies or developing IPS technology in-house. [1]

Benefits

- Improved stability and accuracy from signal fluctuation.
- Cost and time saving for recalibration.
- System builds upon existing Wi-Fi infrastructure.
- Diversified application for indoor positioning.

Applications

- Tracing for hospital medical equipment
- Tracking objects in warehouses
- Navigation in retail/shopping malls
- Customer traffic analysis

Patents

- US Patent no.: 9,913,092
- China Patent Pending: 201580029474.1
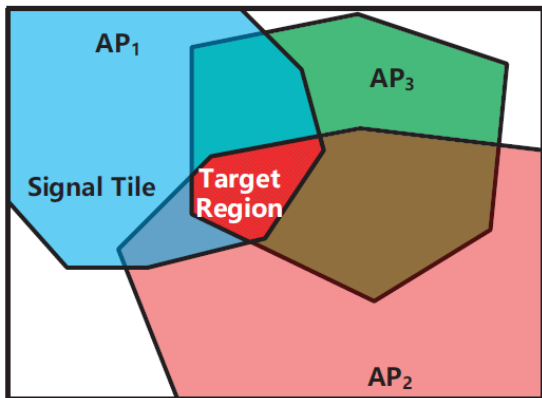
Figures

Fig. 1.   Illustration of signal tile intersection. The overlapped (red) area denotes the target potential area.
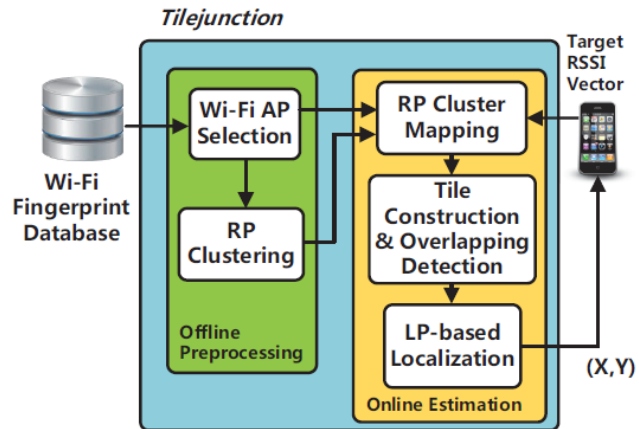

Fig. 2.   An overview of Tilejunction localization system.

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[1] Inventor Evaluation Report – Invention Evaluator Analysis of Tilejunction: Wi-Fi Indoor Localization Based on Junction of Signal Tiles (TTC.PA.0772) (inventionevaluator.com, 2015).