Indoor Navigation with Maximum Likelihood Classification of Wi-Fi Fingerprints

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There are many applications for indoor navigation, from navigating hospitals, airports and shopping malls, to mining and disaster response. Despite intensive research, the problem of developing an accurate indoor navigation system remains largely unsolved. GPS is widely used for outdoor navigation, but its signals are attenuated and useless indoors. Augmented GPS, ultrasound, and inertial navigation systems have been proposed but require specialized sensors and remain impractical. The solution presented in this project does not require any special hardware. Implemented as an Android app on an ordinary smart phone or tablet, it makes use of commonly available Wi-Fi networks. The system comprises a calibration stage and a navigation stage. In the calibration stage, the system creates a Wi-Fi fingerprint for each room of a building, where the received signal power of multiple signals are collected over time and space and stored as multivariate Gaussian distributions. During the navigation stage, the system determines its position by matching Wi-Fi signal strengths to the fingerprints. The key ideas of the system are its use of maximum-likelihood classification for the fingerprint matching and its use of Bayes' Theorem to take the building topology into account. For testing and evaluation, two test sites were selected: a suburban home and a shopping mall. Experiments were performed to measure the system performance during calibration, location determination, and navigation. The system outperformed two other algorithms that were tested. It could determine its position in only a few seconds, yielding the correct location 97.5% of the time in the home and 100% of the time in the mall. Because of its speed and ease of use, it is ideal for navigating malls and public buildings.

Awards Won:

Second Award of $2,000