Design and Implementation of WiFi Indoor Localization based on Gaussian Mixture Model and Particle Filter

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ABSTRACT

Scene analysis based WiFi localization is one of valuable indoor localization methods. However, the practical problems of the method in mobile phones are the amount of WiFi observation data and the calculations for location estimation.

To solve these problems, we propose an observation data modeling method based on Gaussian Mixture Model (GMM) and a location estimation method based on Particle Filter (PF). First the distribution of RSSI is converted into GMM for each access point (AP). Mean and Covariance of each Gaussian distribution are estimated by using EM algorithm. The number of the Gaussian distribution is adjusted according to the number and variance of the observed positions. Based on each AP's GMM and current observed WiFi data, the current location is estimated by using PF in real-time. The amount of calculation is adjustable by setting up the number of particles.

We implemented the proposed method as an Android library. The library consists of the following components: 1. WiFi observation: floor-map capturing via camera and WiFi observation by tapping the current location on the floor-map. 2: Automatic modeling: observed WiFi data is converted into GMM. 3: Real-time localization: current location is returned as a coordinate of the floor-map.

We conducted several experiments to evaluate performance of the proposed method. At first, we compared the amount of raw observation data and GMM in which we found out that the amount of GMM data is 5% of raw data. We then tested the accuracy of location estimation and found out that the occurrence that the estimation error is smaller than 10m is 88%.

In this paper we propose a practical indoor localization method using GMM and PF. We also developed an indoor localization library for Android based on the proposal method. The library will be available within days.

KEYWORDS: WiFi Localization, Gaussian Mixture Model, Particle Filter, Smartphone Library, Scene Analysis