Semi-Automatic Self-Calibrating Indoor Localization Android-based Mobile Application

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***Abstract*—The presented application is the implementation of the semi-automatic calibration procedure of the log-distance path loss model. The mobile application is developed for Android-based devices and implements the algorithm of the semi-automatic calibration procedure which is used to increase the accuracy of RSS based multilateration technique. The application uses log-distance signal propagation model to estimate the distance to Bluetooth Low Energy beacons within indoor areas. The distances estimated by the signal propagation model are used to provide the user's localization area. The application takes into account the beacon's zone of proximity and internal sensor data. The proposed procedure processes smartphone's orientation, beacon signal obstructions caused by user's body and moving people bodies.**

The purpose of RSS-based multilateration is to determine the distance between transmitter and receiver using a signal propagation model. The usage of log-distance path loss signal propagation model requires accurate path-loss exponent value definition. Thus the path-loss exponent can be determined empirically via offline calibration phase. The proposed semi-automatic calibration procedure allows to avoid the prior RSS measuring and measurement processing. The procedure opens the possibility to calibrate the model parameters during the online localization phase.

The mobile application uses BLE beacons allocated within some room to locate a user with his/her mobile phone. Each beacon has proximity zones where measured RSS level has certain range of values. In order to take into account proximity zones we propose to use two-dimensional path loss model. The model includes near (0.5 m) and middle (3 m) proximity zones of the beacon.

The automatic calibration procedure starts if the user goes into near proximity zone. At this moment the mobile application detects user location at the distance 0.5 m from the beacon which corresponds to RSS level of 45dBm. The significant assumption is that the user moves on the tangent to the border of near proximity zone only (Fig. 1). The mobile application detects steps during user movement and estimates new distance value. It is possible after the distance estimation to calculate the path-loss exponent.

Also the presented semi-automatic calibration procedure has several steps: the initialization of parameters for near proximity zone determination; if the user enters the near proximity zone, then his/her location is estimated as at the border of this zone; determine smartphone orientation; calculate the distance via smartphone sensors by direct moving; if the distance is 1 meter, measure RSS level; calibrate the path loss model.

The developed mobile application uses semi-automatic calibration procedure implementation for log-distance path loss model, processes BLE signals, shows user's proximity zone allocation, counts his/her steps and shows new parameter values and estimated distances to the beacons. This demo application uses known BLE beacons and is sensitive to built-in smartphone sensor errors. Moreover the situations when the signal is affected by user's body and moving people are processed.

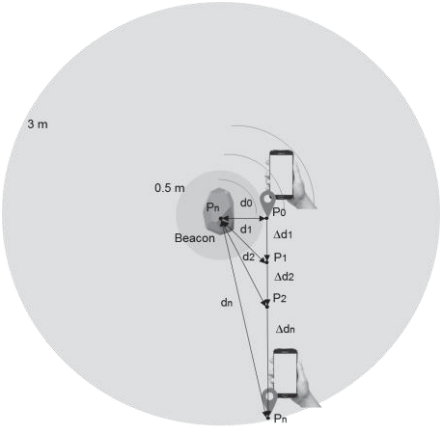

Fig. 1. RSS measurements for BLE beacon semi-automatic calibration