# Android-Based Application of Automatic Calibration for Log-Normal Path Loss Model

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*Abstract*—**The presented implementation of the automatic calibration procedure for log-normal path loss model is a mobile application developed for Android-based devices. The procedure is used to increase the accuracy of RSS based lateration technique which uses log-normal signal propagation model to distance estimation within indoor areas. The application shows steps of automated calibration including user proximity detection, log-normal path loss parameter calculation based on internal sensor data and estimated distance calculation using calibrated parameters. The signal which is used for localization is the signal of Bluetooth Low Energy beacons allocated within the indoor area.**

**The automatic calibration procedure is a part of RSS based lateration technique which is used for indoor localization. The purpose of RSS based lateration is to determine an approximate radius by RSS values for each reference point. This problem corresponds to determining the distance between transmitter and receiver using a signal propagation model. Log-normal path loss signal propagation model has certain parameters that can be determined empirically via calibration phase. The developed mobile application implements automated calibration procedure which is used to avoid prior RSS measuring and measurement processing. The procedure opens the possibility to calibrate the model parameters during the 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 is performed to middle beacon proximity zone because there is no sense to do this within the radius of 0.5 meters. The parameter values of near zone path loss equation are prior known and are used for middle zone parameter calibration.**

**The automatic calibration procedure uses internal sensor data provided by mobile phone. If the user goes into near proximity zone the mobile application can detect user proximity. The measured RSS level of our beacons at the distance 0.5 m is 45dBm. We assume that the user moves on the tangent to the border of near proximity zone only, because we can't correctly determine the direction of user moving regarding the beacon (Fig. 1). Thus we can estimate initial user position and begin to count the steps and estimate new distance value. After the distance estimation we can calculate parameters of log-normal path loss model automatically.**

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

**The developed mobile application uses automatic calibration procedure implementation for log-normal path loss model and two-dimensional signal propagation model. The application 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.**

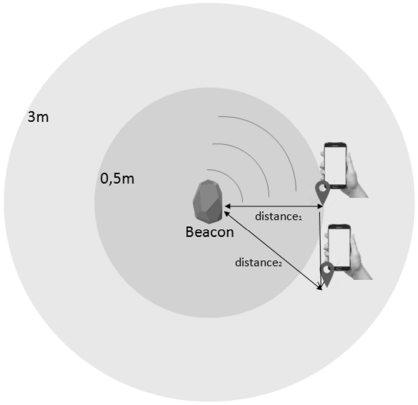


Fig. 1. General Architecture of Mobile Tourist Guide