Accurate Multi-Sensor Localization on Android Devices

Christos Laoudias
KIOS Research Center
University of Cyprus
laoudias@ucy.ac.cy

George Larkou
Dept. of Computer Science
University of Cyprus
glarko01@cs.ucy.ac.cy

Chin-Lung Li
Cywee Corporation Ltd
Taipei, Taiwan
chinlung@cywee.com

Yu-Kuen Tsai
Cywee Corporation Ltd
Taipei, Taiwan
YKTsai@cywee.com

Demetrios Zeinalipour-Yazti
Dept. of Computer Science
University of Cyprus
dzeina@cs.ucy.ac.cy

Christos G. Panayiotou
KIOS Research Center
University of Cyprus
christosp@ucy.ac.cy

ABSTRACT

In our indoor localization approach we employ a multitude of location-dependent data that are readily available on modern sensor-rich Android smartphones[1]. In particular, we exploit WiFi Received Signal Strength (RSS) observations and combine them with Inertial Measurement Unit (IMU) readings, i.e. accelerometer, gyroscope and magnetometer, to deliver accurate location information on top of digital floorplan maps within the user-carried device. The system follows a modular architecture, where the key components include the *WiFi Fingerprinting*, the *IMU Positioning* and the *Location Fusion* modules [1].

The *WiFi Fingerprinting* module relies on RSS values from the surrounding Access Points (AP) and is based on a machine learning algorithm, developed in-house, to determine location. Moreover, by leveraging orientation data we mitigate the effect of the user body, in case some AP signals are blocked.

The *IMU Positioning* module computes the user orientation in real-time and implements a custom Pedestrian Dead Reckoning (PDR) algorithm for accurate trajectory tracking. The orientation readings are refined by incorporating raw magnetic data to account for magnetic disturbances inside buildings, due to power cables, electrical appliances or metal surfaces.

Finally, the *Location Fusion* module processes the WiFi and IMU locations, as well as their associated uncertainties, by means of a particle filter. Moreover, a map-matching submodule handles and corrects any inaccurate locations after filtering, e.g., a user crossing a wall or moving into a non accessible area. Thus, our system delivers a fine grain final location that accurately reflects the travelled path; see Fig. 1 taken from [1].

The system is a software-based solution that may run on any commercial Android smartphone for the provision of indoor geolocation information in real-time. It is efficient and reliable, while it attains meter level localization accuracy through the integration and optimization of diverse technologies. For the deployment only the floorplan digital map of the venue is required, while additional APs can be quickly deployed by our team to provide adequate WiFi coverage, if necessary.

Figure 1: Indoor localization using solely WiFi (left), solely IMU (middle) and location fusion (right) while a user walks several times along a rectangular path in a typical office environment.

[1]A demo video of the prototype system inside a conference hall is available at: `http://youtu.be/DyvQLSuI0OI`

1. REFERENCES

[1] C.-L. Li, et al. Indoor geolocation on multi-sensor smartphones. In *MobiSys*, pages 503–504, 2013.