Demo: Indoor Geolocation on Multi-Sensor Smartphones

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ABSTRACT

In this demo, we present an efficient hybrid indoor positioning solution that uses multi-sensory location-oriented observations, including WiFi, accelerometer, gyroscope and digital compass data, that are widely available on Android smartphones[1]. Our system mainly comprises three building blocks, namely the *WiFi Fingerprinting*, the *Inertial Measurement Unit (IMU) Positioning* and the *Location Fusion* components.

The *WiFi Fingerprinting* module relies on existing WiFi infrastructure and exploits Received Signal Strength (RSS) values from neighboring Access Points (AP) to infer the unknown user location. Specifically, it utilizes a number of RSS fingerprints collected a priori to build the so-called radiomap. Subsequently, the WiFi-based location is estimated with a state-of-the-art algorithm that exploits the currently measured fingerprint and fingerprints in the radiomap [1].

The *IMU Positioning* module performs multi-dimensional (i.e., 3-axis accelerometer, gyroscope and digital compass) motion sensor fusion for calculating the user orientation in real-time and implements an in-house pedometer algorithm for pedestrian trajectory tracking. An interesting feature in our implementation is the use of raw magnetic data to detect magnetic anomalies, which are common inside buildings, e.g. due to power cables, electrical appliances or metal surfaces, in order to refine orientation. Moreover, a map-matching submodule performs error correction in order to handle inaccurate IMU location estimates (e.g., showing a user passing through a wall or moving into a restricted area).

Finally, the WiFi-based and IMU-based location estimates and associated uncertainties are provided as inputs to the *Location Fusion* module that implements the hybridization scheme by means of a particle filter. Thus, our prototype system delivers a smooth final location estimate that is consistent with the actual travelled path; see Fig. 1.

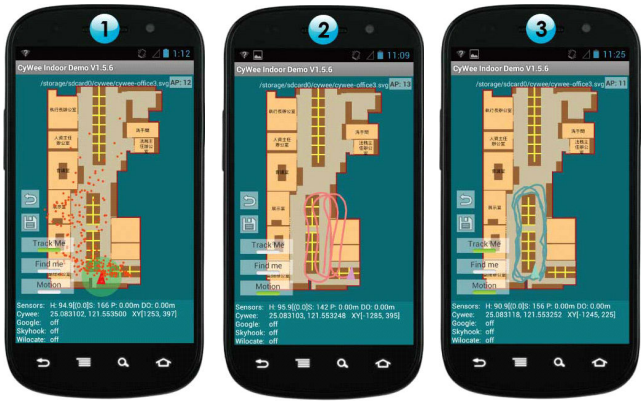

Figure 1: Indoor localization using solely WiFi (left), solely IMU (middle) and location fusion (right) while a user walks several times along a rectangular path in a typical office environment.

We will demonstrate the real-time positioning capabilities of our hybrid system by allowing attendees to carry an Android smartphone running our tracking application and viewing their current location on a floorplan map, while walking around the demo area. In this interactive scenario, the participants will be able to appreciate the potential of our indoor geolocation system, which is reliable and attains a localization error below 3 meters through the integration and optimization of diverse technologies, while our software may run on any commercial Android smartphone.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous

Keywords

Indoor positioning, WiFi, Signal strength, Android, Sensors

1. REFERENCES

[1] C. Laoudias et al., "Localization Using Radial Basis Function Networks and Signal Strength Fingerprints in WLAN," in *IEEE GLOBECOM*, 2009, pp. 1–6.

[1] An early version of our prototype system was recently evaluated in a conference venue and the demo video is available at: `http://youtu.be/DyvQLSuIOOI`

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