Precise Indoor Location

A Motion Tracking Solution for Indoor Location Using Smartphones

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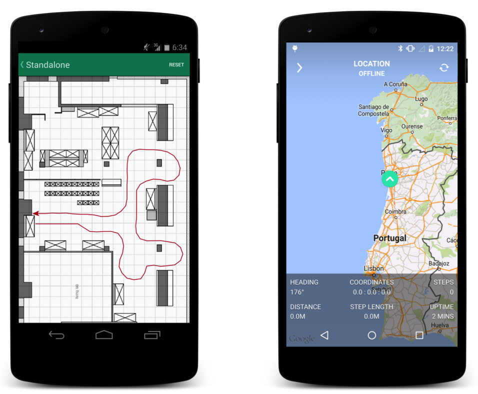
ABSTRACT

Precise indoor location enables the smartphone to track the indoor location of people in real time, based on the analysis of gait patterns. The system relies on information provided by inertial and position sensors commonly found on smartphones (i.e. accelerometer, gyroscope, magnetometer), which are evaluated to track the relative position of people walking inside buildings.

When available, information from additional sources, such as RF signals or floor plan data, can be used to refine the system.

The calculated user position is then displayed on an Android application, either on a blank canvas, a custom map or a Google Maps widget.



(a) Custom local map (Android 4.4.4) (b) Using Google Maps (Android 5.0.2)

Figure 1: Application screenshots.

1. TECHNOLOGY

Using a proprietary sensor fusion algorithm, the system calculates very precise movement and orientation variations, providing users position and heading in real time. This is performed with an innovative dead reckoning approach that employs filtering techniques based on the cyclic human walking patterns. Steps detection, direction of movement and stride length estimation allow the system to precisely infer users location based on displacements from a last known position. All of this is performed in real time, while the user carries the smartphone in several predefined everyday use cases (i.e. texting and calling positions or inside their pocket).

Whenever a barometer sensor is available, floor change detection is also possible by comparing pressure variations to a predefined floor height.

Moreover, since these algorithms are iterative and depend on previous calculations, they are subject to cumulative errors. Therefore, the system probes for available RF signals, such as Bluetooth or WiFi, and uses the outcome to correct said errors and calibrate the motion tracking algorithms. Additionally, using floor plan data, the system can exclude position sets that cannot be possible according to the building's structure.

After all this data are gathered and evaluated, the algorithms merge them in the best possible position which is then translated to custom map coordinates or a latitude and longitude pair.

2. REQUIREMENTS

Due to the modular nature of this system, for a basic version to work, no requirements are necessary apart from an Android application installed on a smartphone with an inertial measurement unit.

Providing floor plan data to the system, such as the architectural blueprint, and an initial coordinate will greatly increase the precision of the algorithms.