Precise Indoor Location - Without initialization

A Motion Tracking Solution for Indoor Location Using Smartphones

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OVERVIEW

Precise indoor location (PIL) enables a smartphone to track people indoors in real time, based on the analysis of gait patterns. The system relies on data provided by inertial and position sensors commonly found on smartphones (i.e. accelerometer, gyroscope, magnetometer) to estimate displacements from a known position. Also, information from environmental sources, such as RF signals, magnetic fluctuations or floor plan data, is used to initialize and refine the system.

Calculated positions are then displayed on an Android application, either within a blank canvas, a custom map or a Google Maps widget (Figure 1).
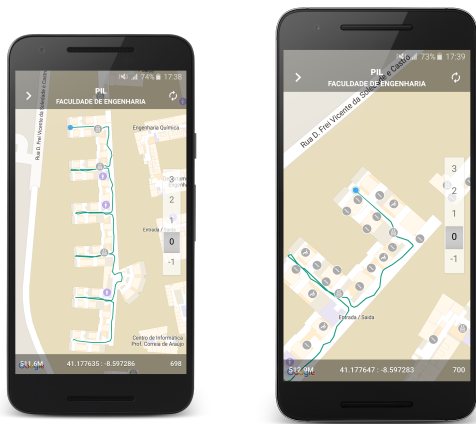

Figure 1: Screenshots of a route traced with PIL's algorithms inside a building available on Google Maps.

TECHNOLOGY

Using a proprietary sensor fusion algorithm, the system precisely calculates movement and orientation variations in real time. This is performed with an innovative dead reckoning approach, employing filtering techniques based on cyclic human walking patterns. As a result, the user's location is estimated based on displacements from a last known position, all of this while the smartphone is being carried in one of several use cases (i.e. texting and calling positions or in the pocket). Additionally, whenever a barometer sensor is available, floor change detection is possible by comparing pressure variations with a predefined floor height.

Since these algorithms are iterative and rely on previous calculations' accuracy, they are subject to cumulative errors. Therefore, the system probes for available RF signals and magnetic fluctuation patterns, using the outcome to generate initial position estimates and to calibrate the motion tracking algorithms over time. Moreover, matching the displacements history with floor plan data can be used to incrementally match routes within the map, further improving positioning efficiency.

After all these data are gathered and evaluated, a position is determined and translated to custom map coordinates or a latitude and longitude pair.

REQUIREMENTS

This version of PIL was designed to run on an Android smartphone equipped with an inertial measurement unit and Wifi capabilities. Scanning the region of interest in advance is required to generate appropriate fingerprints, while access to floor plan data is needed to improve algorithms performance and to display the positioning outcome.