

Precise Indoor Location

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. When available, information from environmental sources, such as RF signals, magnetic fluctuations or floor plan data, can be used to 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.

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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 inside their pocket). Additionally, whenever a barometer sensor is available, floor change detection is also 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 correct said errors and calibrate the motion tracking algorithms. Moreover, matching the position history with floor plan data further helps eliminate erroneous calculations.

As an initial position is not always available, displacements history and environmental measurements are used to incrementally match the route with the map, in order to determine the user's current location.

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

Due to the modular nature of this system, for a basic version to work there are no requirements 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. Probing the area of interest in advance can create an alternative to the initial position requirement, although in a less than optimal scenario.