Signal Space Based Navigation

Tech ID: 34561 / UC Case 2014-329-0

ABSTRACT

Researchers at the University of California, Davis have developed a navigation system that constructs a sensing map from wireless signal observations and pedestrian deadreckoning (PDR) data to enable accurate indoor navigation without relying on traditional geographic localization maps.

FULL DESCRIPTION

This technology introduces a signal space based navigation apparatus and method that leverages wireless signal clusters, such as WiFi signals, and PDR displacement vectors obtained via crowd-sourced data from mobile user devices. Unlike conventional systems that depend on pre-existing localization maps linking geographic locations, this navigation system builds a topological sensing map that represents locations as clusters of wireless signals connected by mobility information. It detects turns using low-power accelerometers to collect more frequent wireless observations at these locations, improving both accuracy and energy efficiency. The system further uses density-based clustering (e.g., DBSCAN) and fuses PDR traces to establish relative positions between clusters, facilitating route planning and navigation guidance through a user interface.

APPLICATIONS

- Indoor navigation solutions for shopping malls, airports, hospitals, and large public venues.
- Enhanced location-aware services in environments with limited GPS accessibility.
- Mobile applications providing crowd-sourced navigation data for retail and facility management.
- Assistive technologies for visually impaired users in indoor public spaces.
- Enterprise asset tracking and workforce navigation in industrial and commercial buildings.

FEATURES/BENEFITS

- Removes the need for prior geographic knowledge or localization maps.
- Compatible with existing mobile devices.
- Constructs autonomous, non-intrusive maps using crowd-sourced wireless and PDR data.
- Increases energy efficiency by activating higher sensor sampling rates only during detected turns with always-on accelerometers.
- Mitigates PDR drift and signal fluctuation errors through clustering and trace fusion.
- Refines wireless clusters adaptively over time to enhance sensing map accuracy.
- Enables indoor navigation with segmented path instructions generated at turns.
- Resolves signal fluctuation and PDR drift challenges in mobile device navigation.
- Reduces energy consumption via adaptive, turn-based sensor sampling.
- Overcomes complexity in mapping sensor data to physical layouts.
- Simplifies indoor map building by removing the need for manual annotation or user intervention.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,733,088	08/15/2017	2014-329
Patent Cooperation Treaty	Published Application	WO 2015/065375	05/07/2015	2014-329

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OTHER INFORMATION

KEYWORDS

accelerometer, clustering, crowd-sourcing, deadreckoning, indoor navigation, pedestrian navigation, sensing map, turn detection, WiFi clusters, wireless signal

CATEGORIZED AS

- **Communications**
  - Wireless
- **Computer**
  - Software
- **Sensors & Instrumentation**
  - Position sensors

RELATED CASES

2014-329-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Individual Identity Verified Through Device-Free, WiFi Based Framework
- Sensor-Assisted Facial Authentication System For Smartphones
- Energy Efficient Trigger Word Detection via Accelerometer Data

▶ Adversarial Resilient Malware Detector Based on Randomization

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