

Ubee.in – An Indoor Location solution for mobile devices

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ABSTRACT

Ubee.in indoor location technology is a software-only solution for mobile devices with an average accuracy of 1 to 5 meters and floor detection for multi-storey buildings. The technology is based on two major techniques: Radio Signal Fingerprinting (Wi-Fi and Bluetooth) and Inertial Navigation based on accelerometer, gyroscope, and magnetometer. The solution is currently deployed in more than 25 shopping malls in Brazil and registers more than 100 thousand users' locations per day.

Categories and Subject Descriptors

K.8.m [Personal Computing]: Miscellaneous

General Terms

Algorithms

Keywords

Wi-Fi based location; Bluetooth based location; Inertial Navigation.

1. INTRODUCTION

Ubee.in indoor location technology was developed to address the need for orientation inside large venues, such as Shopping Malls and Airports. Aiming to create a scalable, low cost, and accurate solution, the technology was created by a fusion of various indoor location techniques.

2. RADIO SIGNAL FINGERPRINTING

The radio signal fingerprinting technique is based on a data collection phase, where a specialized user goes through the venue to map the radio signals. The minimal infrastructure required is at least 3 Wi-Fi Access Points or Bluetooth Beacons, reachable from the mobile device.

The user that is mapping the venue goes to strategic points and registers a new location point (fingerprint) on the calibration app (available at: <http://bit.ly/1eEUZT8>). When a point is registered, the mobile device scans and sends all radio signals to a remote server, called fingerprint server. The process is fast and easy, a venue with 200 stores is mapped in approximately 4 hours by one person.

After this process, all data are processed and the location is available to the new venue. The mobile device sends to our

server radio signals information that is processed to estimate user's location based on the strategic points that were stored in the calibration phase. Our server works with automatic calibration algorithms that refresh the strategic points database as users send new data.

The technique is highly reliable. The accuracy is point-based and is related to the fingerprint density, and to the Wi-Fi and Bluetooth infrastructure. The maximum accuracy reached only with Wi-Fi was about 2 meters, and when included Bluetooth it was about 0.5m.

3. INERTIAL NAVIGATION

The Inertial Navigation technique does not need previous calibration and is based on three algorithms:

- Step detection: detects, counts, and classifies user's steps. The step categories are: walking, running, and vertical transitioning.
- Step length estimation: estimates the displacement of each step and updates the user location in real time.
- Vertical transitional points: detects vertical transitional points by a constant monitoring of the vertical displacement. The vertical transitional points have three different types: elevator, escalators, and stairs.

The technique has a lower reliability, since the sensors have a high rate of error accumulation. The accuracy is also point-based and reaches a 0.5-meter level (step level).

4. MERGED SOLUTION

The Dead Reckoning has a greater accuracy, but a lower reliability as the sensors accumulate errors rapidly. The vertical transitional points are used to reset those errors, but they are scarce in the majority of indoor venues. To solve the problem of error accumulation, the Radio Signal Fingerprinting technique is used, as it is vastly available and reliable, resetting the Dead Reckoning sensors and bringing reliability to the extremely accurate solution.

5. ACKNOWLEDGEMENTS

Our thanks to IPSN organization and Microsoft for the invitation.