Classifying and Using Motion in Organic Indoor Positioning

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ABSTRACT

The capacity of a mobile device to know where it is has become a feature used by many applications. Current devices continuously estimate their location, allowing users to "check in", find nearby friends and interests, and determine how to get to their destinations. While underlying satellite-, cell-, and WiFi-based positioning systems can return an accurate and meaningful position in many cases, extending them to work energy-efficiently, particularly indoors, remains an open problem. In this work, we analyze the use of motion detection to turn off or duty-cycle the (usually very energy-hungry) sensor used for positioning. Previous work on motion classification has assumed either continuous or relatively long periods of sensor sampling, in particular, from an accelerometer. Unfortunately, this level of input is not practical for everyday use because of its also high battery consumption. After studying what sampling rates are feasible, we compare six methods for motion classification, two of which have not been used before for this purpose. We find that simple statistical methods that are typically used are not sufficiently robust with respect to different kinds of movement and different users, because the thresholds between movement and non-movement are too tight. In contrast we find that two more sophisticated models, one based on Page-Hinkley statistics, and the other inspired from the Discrete Fourier Transform, provide a clearer differentiation between the two states, with the former presenting an energy efficiency similar to the simpler methods. Through a WiFi geolocation system that relies on motion detection, we show how the choice of the underlying classifier can have a significant impact on user-perceived performance.

KEYWORDS: Motion detection, Page-Hinkley statistics, discrete Fourier transform, energy efficiency, geolocation, crowd-sourcing.