Poster: Evaluating Energy Consumption of Sensing Algorithms - Solely via Models?

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Automatic detection of significant places is an important concept in many emerging context-aware applications. Providing such detection energy-efficiently poses a crucial challenge on mobile devices with limited battery capacity [1]. Several solutions have been proposed to address the problem, but no comparison between them has yet been published running on mobile devices, making it hard for researchers and developers to provide suitable trade-off solutions between accuracy and energy efficiency in an informed manner. To close this gap, we investigate the impact of four common types of energy efficiency strategies on a fingerprint-based algorithm for place sensing based on WiFi measurements, namely SensLoc [2]. Using experimental prototypes on the Android platform, we show that in empirical evaluation only one of the strategies, namely sample rate management, affects the energy usage in a positive manner. The three other investigated strategies show either no effect or use more energy than the baseline implementation. This results stands in contrast to the conclusion of previous simulation based results [2]. Based on our experimental results, we question the viability of purely model-based validation of energy efficiency.

For our evaluation we implemented the SensLoc algorithm [2], including the following energy efficiency strategies: **Sample Rate Management (SRM)** trades accuracy for energy-efficiency by lowering the WiFi scanning rate. **Sensor Replacement (SR)** replaces a power hungry sensor with a more efficient one; for SensLoc we replace WiFi scanning with accelerometer-based motion detection, which exploits that devices do not change place, when stationary. **Distribution** offloads the computations of the SensLoc algorithm to a remote server over GSM / WiFi. **Code Optimized** requires the optimization of code with regards to Android performance guidelines in order to lower CPU and memory usage.

As the total power consumption is what matters to the end users, we use a holistic measurement approach, i.e. measuring power consumption using the battery information available from the operating system as this makes it possible to perform the tests in every day

conditions of end users. The smartphone used for testing was a HTC Desire with a 1400 mAh battery. The phone was jail broken using Unrevoked in order to access battery information on the operating system level. Table 1 lists the experimental results w.r.t. measured battery drain per hour, and the respective percentual change compared to the baseline algorithm. The results indicate that power consumption is reduced neither via distribution (due to communication overheads) nor via sensor replacement (due to software overheads [3]), and that optimizing code has only an insignificant impact. Solely the sample rate management strategy shows a positive impact, reducing consumption by up to 14%, at the price, however, of reducing accuracy, as evaluated in prior work [2].

Table 1 - Change in power consumption for different energy saving strategies, when used with the SensLoc algorithm.

SensLoc + Strategy	Power per 1h [mAh]	Change
Distributed SRM-0.1 Hz	31.3	+6%
SR Accelerometer	31.3	+6%
SRM-0.1 Hz (Baseline)	29.5	-
Code Optimized	29.3	-0%
SRM-0.05 Hz	28.4	-4%
SRM-0.033 Hz	26.0	-12%
SRM-0.025 Hz	25.3	-14%

These results differ from prior simulation-based results [2] and therefore question the validity of simple model-based validation. Therefore, we recommend that systems are either evaluated through empirical measurements on mobile devices or that more advanced power models are developed, e.g., taking into account dynamic effects [1].

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