RAPS: rate-adaptive positioning systems for energy efficient localization on smartphones
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Introduction: “Trade-off position accuracy for energy”

Problem
• Many emerging smartphone applications require position information to provide location-based or context aware services.
• GPS is preferred over GSM/WiFi based methods, but GPS is extremely power hungry.
• Fixed interval periodic duty cycling will not solve the problem; it may have significant error without significant energy benefits.

Goal
• Reduce the amount of energy spent by the positioning system while still providing sufficiently accurate position information.
• Trade-off position accuracy for reduced energy.

Main Idea
• An energy-efficient positioning system that adaptively duty-cycle GPS only as often as necessary to achieve required accuracy based on user mobility and environment.

Periodic duty-cycling is not good enough

Observations and Challenges: “GPS is less accurate in urban areas”

GPS is less accurate in urban areas
Cell-tower and RSS data cannot reliably measure user movement, but can detect GPS unavailability.

Design and Evaluation: “Use cheaper sensors to rate-adaptively duty cycle GPS”

RAPS Components
- Determine when and when not to turn on GPS efficiently using the cheaper sensors available on a smartphone
  • Movement Detection
    - Use duty-cycled accelerometer with on/off detection algorithm to efficiently measure the activity ratio of the user.
  • Velocity Estimation
    - Use space-time history of the past user movements along with their associated activity ratio to estimate current user velocity.
  • Unavailability Detection
    - Use cell-tower-RSS blacklisting to detect GPS unavailability (e.g. indoors) and avoid turning on GPS in these places.
  • Position Synchronization
    - Utilize Bluetooth-based position synchronization to communicate and reduce position uncertainty among neighboring devices.

Evaluation Results – 3.87times longer lifetime!!

RAPS reduced energy consumption by 48% over fixed duty-cycles with comparable accuracy also.

Cell-tower-RSS blacklisting contributed 59% of the total lifetime increase

Bluetooth synchronization has potential benefits

GPS trace plot for experiment