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SMART USAGE OF CONTEXT INFORMATION FOR THE ANALYSIS, DESIGN, AND GENERATION OF POWER-AWARE POLICIES FOR MOBILE SENSING APPS

Doctoral seminar

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STRUCTURE

INTRODUCTION

BACKGROUND

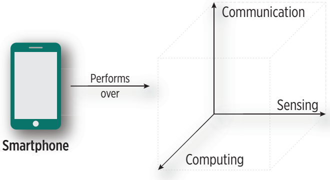

Figure: The advances in the communication, computing and sensing dimensions of mobile devices contribute to their acceptance by society.

Background

- → Dude, tons of advances
- → Context-awareness for everyone
- → New ways to interact, new ways to see the cyber-world
- → Mobility awareness is cool.
- → Nevertheless, using sensors has an impact on energy resources of mobile devices.
- → Battery has not evolved at the same pace than other components.

PROBLEM STATEMENT

PROBLEM STATEMENT

→ The understanding of mobility is possible at different spatial-temporal scales:

Fine-grain mobility patterns identification

→ They refer to the transportation mode employed by user when moving between stay points.

→ Given a set of values $\mathcal{V} = \{v_{acc\ 1}, v_{acc\ 2}, \ldots, v_{acc\ n}\}$ obtained from accelerometer in the time interval $[t_1, t_2]$, identify fine-grain mobility information:

$$\text{FineGrainMobilityIdentifier}(\mathcal{V}) \to p_S \in \{\text{static, walking, biking, vehicle}\}$$

with each $v_{acc\ i} \in \mathcal{V}$ composed as $\langle acc_x, acc_y, acc_z, t\rangle$.

Coarse-grain mobility patterns identification

→ They refer to motion at a large spatial scale related to user visiting stay points.

→ Given a set of values $\mathcal{V} = \{v_{gps\ 1}, v_{gps\ 2}, \ldots, v_{gps\ n}\}$ obtained from GPS location provider in time interval $[t_1, t_2]$, identify coarse-grain mobility information:

$$\text{CoarseGrainMobilityIdentifier}(\mathcal{V}) \to p_S \in \{\text{new stay point, arrival, departure}\}$$

with each $v_{gps\ i} \in \mathcal{V}$ composed associated $\langle lat, lon, t\rangle$.

HYPOTHESIS

Hypothesis

→ The energy consumption of continuous and extended location tracking could be reduced by means of a cognitive dynamic system that learns an expanded spatial-time model from mobility events detected from sensors data and that employs such model in a cognitive controller for dynamically adapting GPS sampling rate through sampling policies tailored to current mobility state.

OBJECTIVES

OBJECTIVES

Main objective

→ To reduce the energy consumption of mobile sensing apps, which perform continuous sensor sampling, through self-adapting power-aware policies generated from context information obtained from sensors data.

Particular objectives

→ To detect mobility patterns from context information obtained from an inertial sensor (accelerometer) and location provider (GPS).

→ To generate an accurate representation of detected patterns for summarizing user mobility.

→ To dynamically adapt GPS sampling rate by means of a cognitive controller that employs the learned mobility representation and accuracy requirements for implementing power-aware sampling policies.

→ To ease the development of mobile sensing applications that require user location tracking, i.e., LBSs and MBSs, isolating the complexity of sensors access and the associated efficient energy management.

CONTRIBUTIONS

Contributions

- → An on-device mobility patterns detector that works with streams of raw data collected by smartphone's sensors (GPS and accelerometer).
- → An on-device mobility analyzer that incrementally builds a model of user mobility from the detected mobility patterns.
- → A cognitive controller inspired on CDSs that, based on the mobility information learned, dynamically adapts GPS sampling rate through power-aware policies.
- → A middleware with the previous modules embedded for easing the development of LBSs and MBSs for the Android mobile platform.

METHODOLOGY

RESEARCH BACKGROUND

Steps

1. Revision of state of the art power-aware sensing techniques.
2. Formal definition and selection of mobility patterns to be identified.
3. Research on algorithms for detecting mobility patterns.
4. Design of the Mobility Events Detector.
5. Design of adaptive policies for energy efficient usage of sensors.
6. Design of the Cognitive Controller.
7. Development of a middleware involving the Mobility Events Detector and the Cognitive Controller for the Android platform.
8. Experimentation in terms of spatial-time accuracy and energy efficiency.

RESEARCH BACKGROUND

Schedule

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