Microsoft Research Asia
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Participatory Sensing and Computation: Concepts and Practices

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Smart X

- Smart object
  - Smart pen, smart cup, smart table, ...

- Smart space
  - Smart home, smart car, smart meeting room, ...

- Smart planet
  - Smart campus, smart street, smart city, ...
What changes

- From small scale to large scale
- From simple to complex
- From individual to community
Challenges of smart planet

- How to sense the large-scale real world information
- How to recognize the complex semantics
Cloud computing?

- mostly focus on using the resource in the cloud side

- the sensing capability of the client side is not well utilized
Solution

 Participatory sensing and computation
- an approach to leverage mass participation and crowd power in data collection and manual interpretation, to form collective intelligence, and to solve social issues from public health to environment monitoring.

- Hybrid intelligence: Human intelligence + Machine intelligence
Related projects

- **Common Sense (UC Berkeley)**

- **Locating in Fingerprint Space (Tsinghua)**
**reCAPTCHA (CMU)**

The words above come from scanned books. By typing them, you help to digitize old texts.

**Google Flu Trends estimate**

![Google Flu Trends graph](image)
Research topics

- Inspiring mechanism
- Data quality
- Heterogeneous data management
- Collaboration mechanism
- Offline-online interaction
Practice: smart campus

Building a smart campus for supporting human social interactions based on participatory sensing and computation
System architecture

Server architecture

The client architecture on smartphone
Application 1: *I-Sensing*

- every user can publish his sensing requests and accomplish others’ sensing tasks by using the sensors in their smart phones
Application 2: *Where2Study*
- aims to help users find a suitable place to study and locate his/her friends based on Wi-Fi positioning technology
Application 3: *Areaware*

- search and visualize tempo-spatial context in a campus based on GPS trajectories

Query examples:

- *CS students usually go to which cafeteria for lunch*
- *EE fresh students usually go to which classroom for study*
- *where is the most possible to meet a business school student around 19:00*
Query input

Lunch place distribution

Trajectory visualization of different grades

Grade 1

Grade 2

Grade 3

Grade 4

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Application 4: *Opportunistic Trading*

- Build a virtual flea market service that works in opportunistic networks to facilitate communications between buyers and sellers of goods in the campus, e.g., second-hand books, coupons, unused movie tickets...
- Everyone can participate in the game of “carry-meet-exchange”
- Link online and opportunistic communities for broker selection
People are involved in online communities and opportunistic communities, and they often switch their roles among them in their daily life.
• Two kinds of components: *online components* (in *blue*) and *opportunistic components* (in *green*).

1. Publish a request and match in *online* circle

   ![Diagram](image_url)

   **Request publication**

   **Broker selection**

   **Task allocation**

Advantages of heterogeneous social communities:

1. **Willingness**: Online social ties are often willing to contribute.

2. **Selection of popular brokers from online community** and allocate the task online, in comparison with encounter-based selection.

3. **Notify** the publisher online/offline and **terminate** the task online.

4. Brokers obtain the task once in an online environment

5. **D**

6. Notify the publisher once matched

**User**

**Opportunistic community**

**Mobility**

**Notification**
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