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Participatory Sensing and Computation: Concepts and Practices

Zhiwen Yu
School of Computer Science
Northwestern Polytechnical University
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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

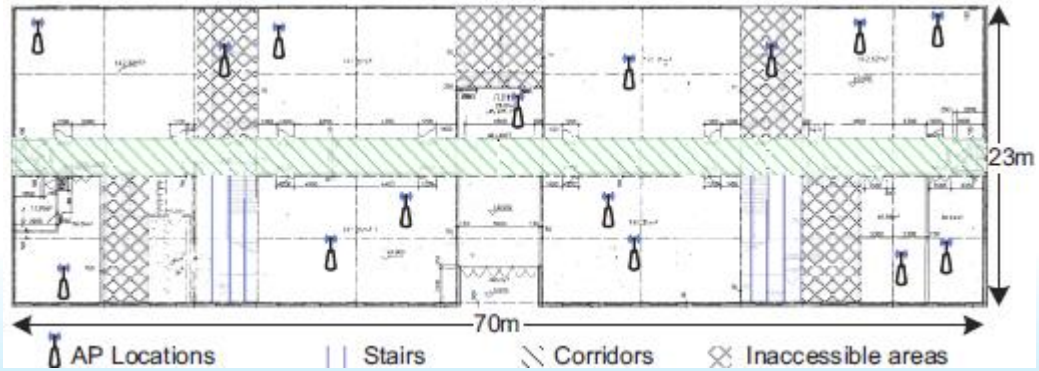
- an approach to leverage mass participation and crowd power in data collection and manual interpretation, to form collective intelligence, and to solve social issues from public health to environment monitoring.

- Hybrid intelligence: Human intelligence + Machine intelligence

Related projects

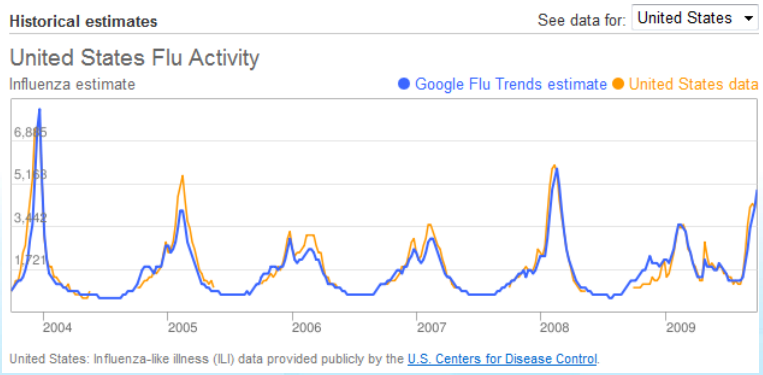
- Common Sense (UC Berkeley)

- Locating in Fingerprint Space (Tsinghua)



- reCAPTCHA (CMU)

- Google Flu Trends estimate

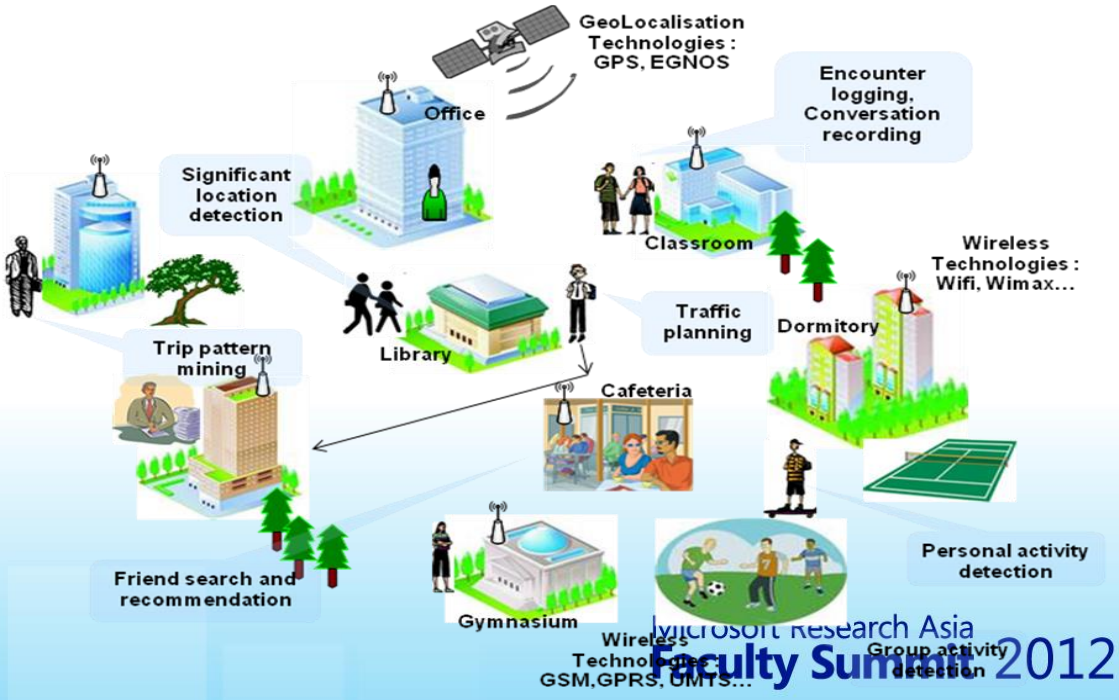


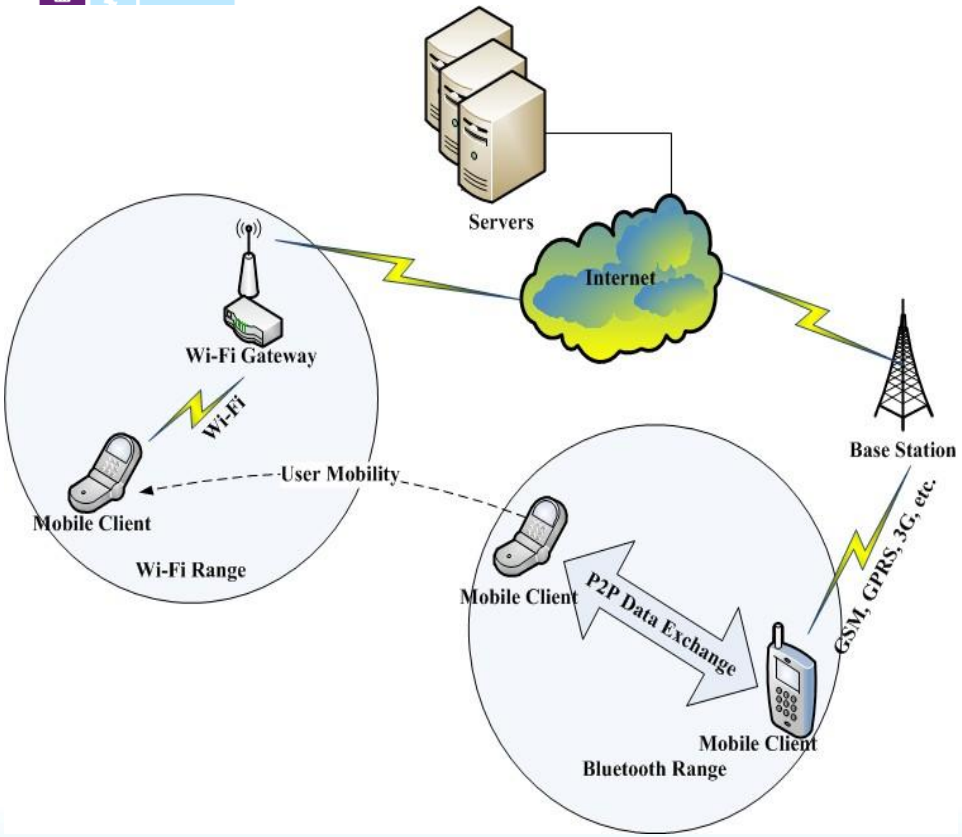
Research topics

- Inspiring mechanism
- Data quality
- Heterogeneous data management
- Collaboration mechanism
- Offline-online interaction

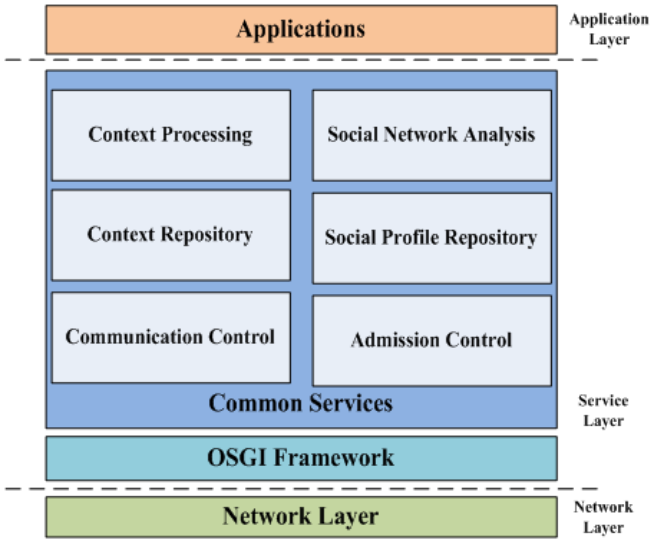
Practice: smart campus

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

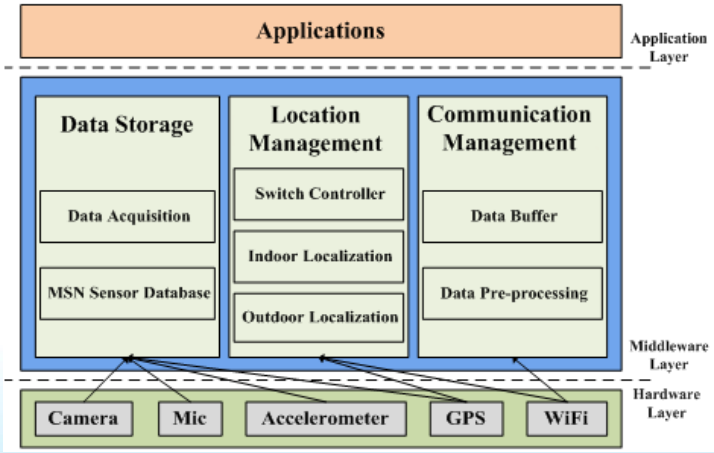




System architecture



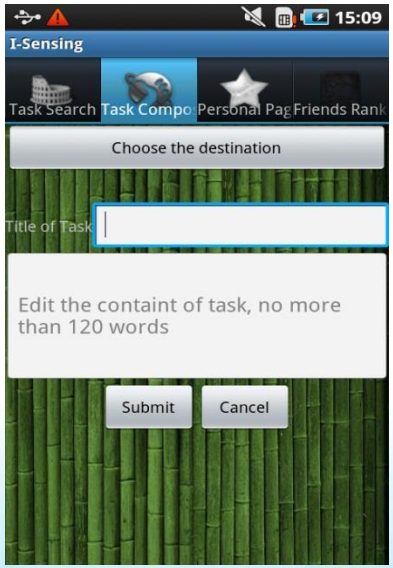
Server architecture



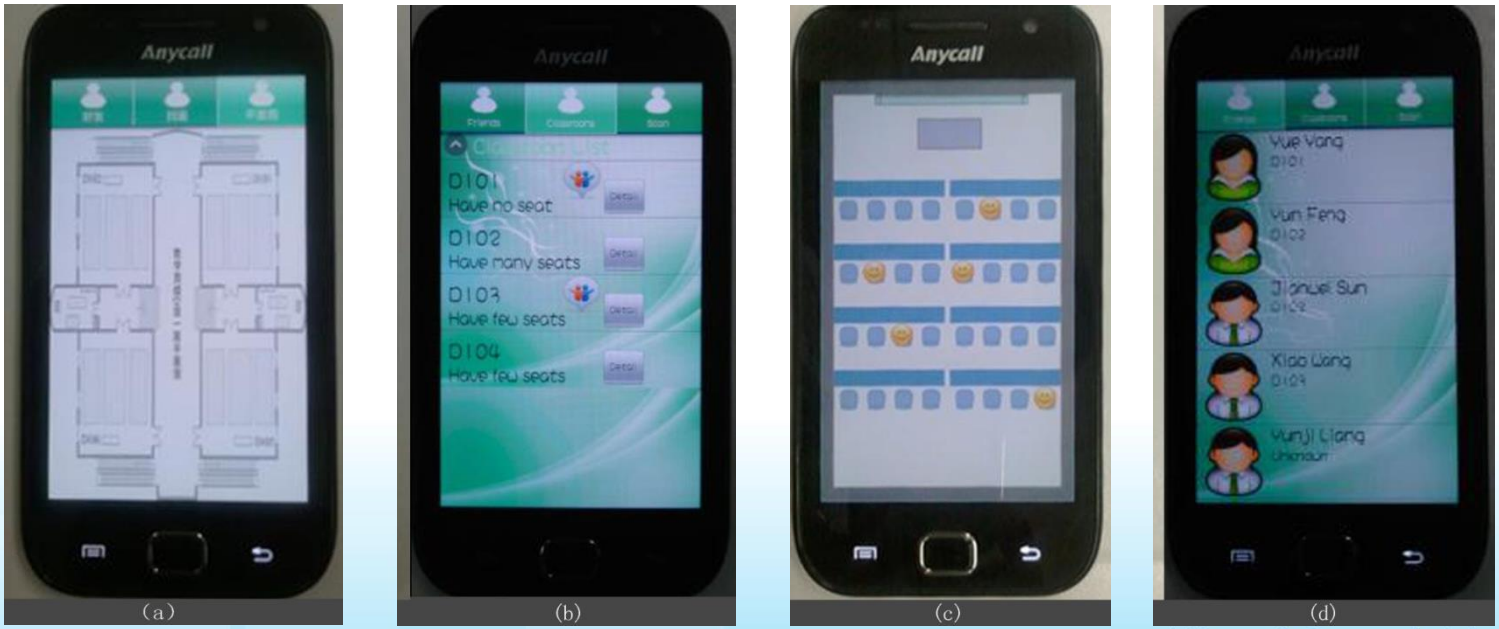
The client architecture on smartphone

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

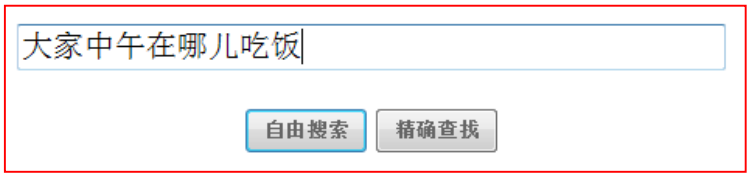


- Application 3: *Areaware*
  - search and visualize tempo-spatial context in a campus based on GPS trajectories

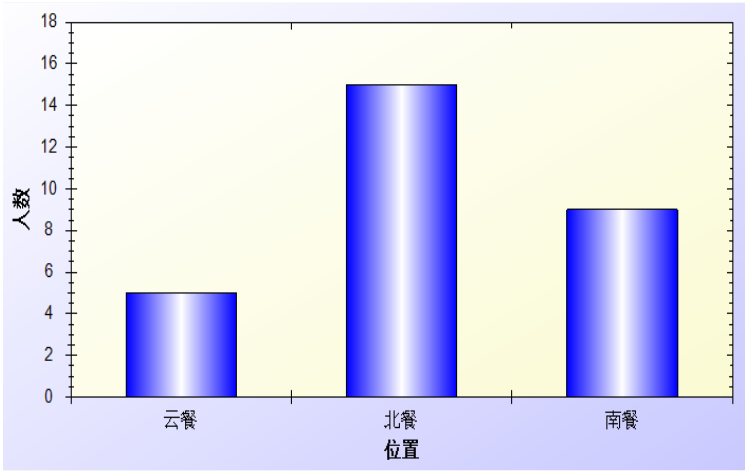
Query examples:

- *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*

Areaware

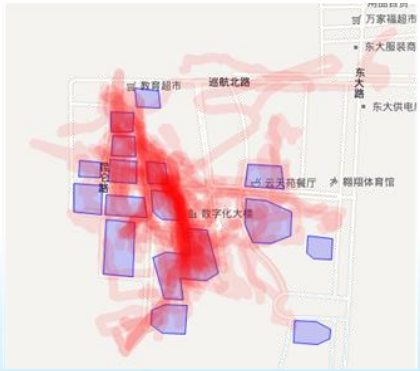


Query input



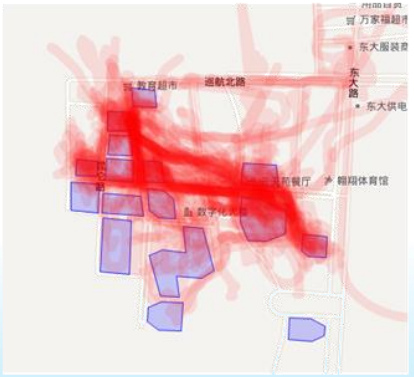
Lunch place distribution

Grade 1



Grade 2

Grade 3



Grade 4

Trajectory visualization of different grades

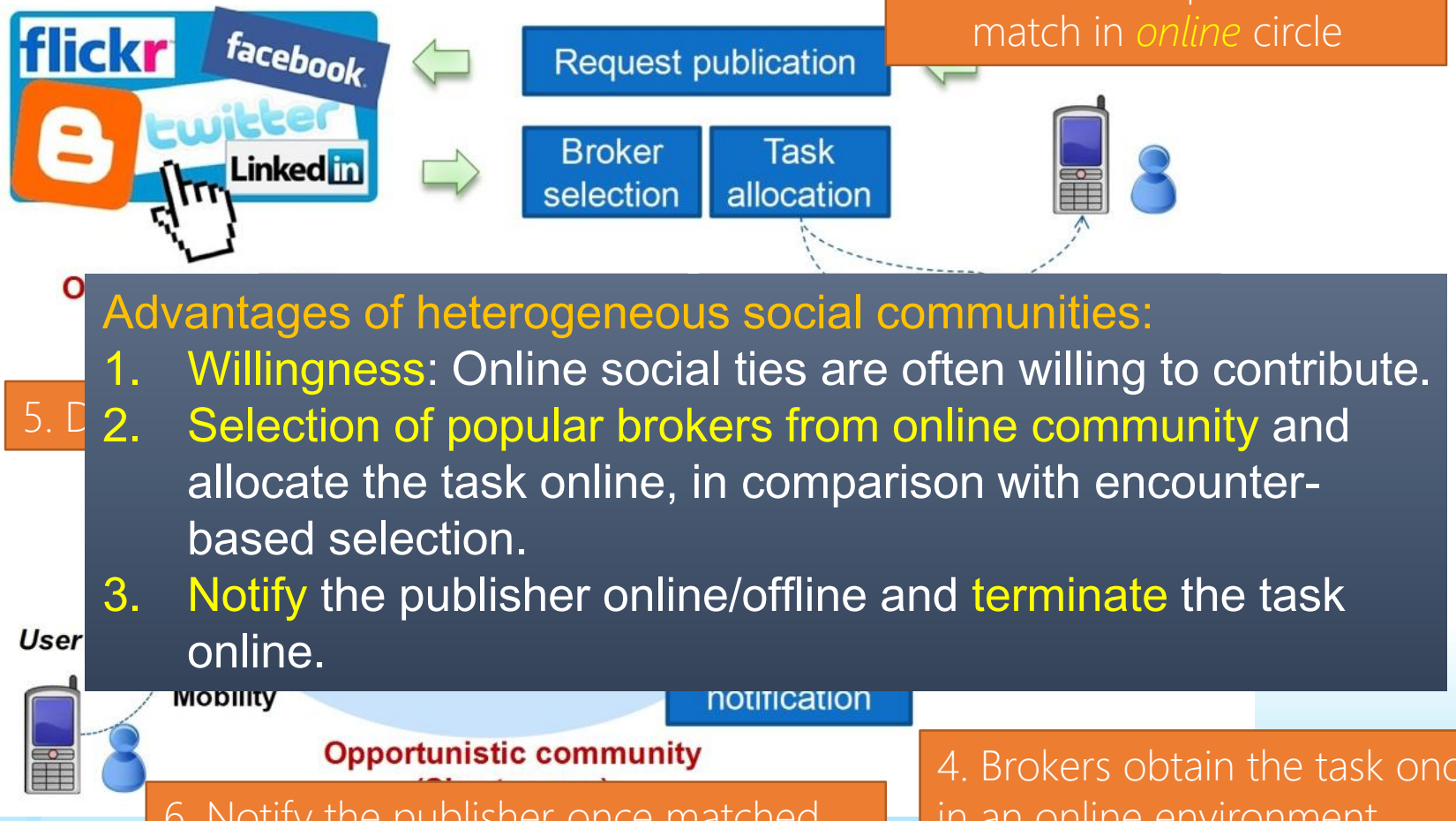
- Application 4: *Opportunistic Trading*
  - Build a virtual flea market service that works in opportunistic networks to facilitate communications between buyers and sellers of goods in the campus, e.g., second-hand books, coupons, unused movie tickets…
  - Everyone can participate in the game of "carry-meet-exchange"
  - 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.

Online Communities

Offline, Opportunistic Communities

• Two kinds of components: *online components (in blue)* and *opportunistic components (in green).*



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Thank you!

Prof. Dr. Zhiwen YU
zhiwenyu@nwpu.edu.cn

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