Developments in Sensor Technology

A Journey with SWAN

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My background

- High-performance distributed computing
  - Cluster computing, grids, clouds, eScience
- Mobile computing
  - Distributed smartphones
- Distributed sensing
  - SWAN framework
Journey Plan

- Illustrate technological developments hand-in-hand with SWAN framework
  - Sensing with smartphones + external sensors
  - Wearables
  - Beacons
  - Phone-to-phone
  - Live open data
  - Internet of Things
Sensing with smartphones

- accelerometer + heart rate → optimal step frequency
SWAN framework

- Started as: sensing with smartphones
  - Sensing With Android Nodes
- Middleware between apps and sensors
  - Supports 20+ sensors
  - Easy plug-in for third party sensors
- Real-time feedback
  - Processing on the phone
- Domain-specific language
SWAN-Song

- Where is the sensor?
- What processing?
- Which sensor?

self@light:lux{MAX,1000ms}

“Let me know if the battery drops more than 25% within 1h with the screen turned off.”

screen:on {ALL, 1h} == false && (battery:level {MAX, 1h} - battery:level {MIN, 1h}) > 25
Wearables

- Can run SWAN expressions on the watch
  - E.g., using hearth rate monitor
- Sometimes reduces energy consumption (compared to sending all data to the phone)
Beacons

- Indoor positioning
  - Project with Alkmaar library
- Hogeschool van Amsterdam: Oosterpark project
  - Motivational messages
Phone to Phone

- Direct communication between nearby phones
  - Using BlueTooth or WifiDirect
  - Share sensors
- Useful for social aspects
Using real-time open data

- Combine hardware sensors with live open data on the internet ("software sensors")
  - Weather, parking, traffic, …
  - E.g., catch-the-bus
Example

- Advise bikers using GPS + real-time rain predictions
Current work: integrating Internet-of-Things

LoRa nodes → IoT gateway → Internet → Cloud

LoRa nodes

IoT gateway

Internet

Cloud
LoRaWAN

- Long-range, outdoor, low power, low cost
- Several Dutch initiatives
  - KPN, Thingsnetwork
- Many use cases
  - Prorail, Schiphol, smart cities …
LoRaWAN testbed Alkmaar

- Use cases
  - Sound monitoring
  - Air quality
  - Logistics

- Example
  - Find quiet walking route from A to B
Challenge: where to store and process which data?

- **Phone:**
  - ☑️ Real-time feedback
  - ☹️ Limited compute power, storage, battery

- **Cloud:**
  - ☑️ High capacity
  - ☹️ Higher communication delay

- Best solution depends on application and update frequency of sensors
  - ☑️ SWAN allow flexibility to choose
What lies ahead

Sensing With All Nodes
The Team

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