Sensor Data Management: New Applications and New Challenges

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Sensors...what does Merriam-Webster has to say about them?

- a device that
  - responds to a **physical stimulus** (as heat, light, sound, pressure, magnetism, or a particular motion) and
  - transmits a resulting impulse (as for measurement or operating a control)
Sensors...what does Merriam-Webster has to say about them?

- **Etymology**
  - from latin "sentire" or "to perceive"
- "perceive"
  - "to attain awareness or understanding of…"
  - "aware" implies vigilance in observing or alertness in drawing inferences from what one experiences
  - "understanding" is the power to make experience intelligible by applying *concepts and categories*
..did you notice something?

- ...there is a big gap between the first meaning (device, measurement) and the second (awareness, understanding)
- ..and that gap (or the infrastructure needed to bridge that gap) is what sensor data management is about..

![Diagram showing the relationship between sensors, knowledge, awareness, understanding, control, and SDM (sensing data management).]
Sensing applications?

..obviously, there are (increasingly) many of these applications,
Sensing applications?

- Obviously, there are (increasingly) many of these applications, which require...
  - Some form of intelligence (awareness, understanding)...
  - Embedded (device, measurement) in the (physical, commercial, or cyber) environment in an ambient manner
Ambient Applications

- Human centered
- Location/context sensitive
- Media-rich (not only images and video! how about haptics?)
- Sensor-based
Ambient Media Applications

http://ame.asu.edu/
Ambient Media Intelligence

- It is an area of increasing interest:
  - International Conference on Ambient Media and Systems (Ambi-Sys)
  - Workshop on Ambient Intelligence, Media, and Sensing (AIMS)
  - ACM Multimedia tracks (3 out of 4)
    - Multimedia Networking and Systems
    - End-systems and Applications
    - Human Centered Multimedia
Examples: Ambi-sys 2008

- Enriching Music with Synchronized Lyrics, Images and Colored Lights
- Improving Dialogue Systems in a Home Automation Environment
- A vision-based hybrid method for facial expression recognition
- A Model for Ontology-Based Scene Description for Context-Aware Driver Assistance Systems
- Deconstructing Ambient Intelligence into Ambient Narratives: The Intelligent Shop Window
- Assisting Elders via Dynamic Multi-tasks Planning - A Markov Decision Processes based Approach
- TaPuMa: Tangible Public Map for Information Acquirement through the Things We Carry
Examples: Ambi-sys 2008 (cont.)

- Active Manipulation of Users in Haptic-Enabled Virtual Environments
- Interaction with Volumetric Medical Data: experiencing the Wiimote
- The Development of Wireless Sensor System for Pressure and Temperature Signals Monitoring
- Cooperative Caching Techniques for Continuous Media in Wireless Home Networks
- Emergency Response Simulation Using Wireless Sensor Networks
- A Semiotic Multi-Agent System for Intelligent Building Control
How far are we from Ambient Media and Systems?

- Sensors are there...
- ...networks are there (low-power short range wPANs for location sensitive applications)...
- ...some catchy bodyNet and personal area networking applications are there...
- ..but, unfortunately, we are not quite there..
  - Decentralized, Autonomous, and Networkwide Service Delivery and Multimedia Workflow Processing (DANS)
How far are we from Ambient Media and Systems?

- Sensors are there...
- ...networks are there (low-power short range wPANs for location sensitive applications)...
- ..some catchy bodyNet and personal area networking (PAN) applications are there...
How far are we from Ambient Media and Systems?

- but, unfortunately, we are not quite there...
- why not?
  - no design tools......no design principles,...no standards.....did you say plug-and-play?
How far are we from Ambient Media and Systems?

- but, unfortunately, we are not quite there...
- why not?
  - loosely coupled, adaptive and evolvable system design is not yet that well understood....
How far are we from Ambient Media and Systems?

- ..but, unfortunately, we are not quite there...
- why not?
  - what about privacy implications?....

http://techblog.dallasnews.com/
How far are we from Ambient Media and Systems?

- ..but, unfortunately, we are not quite there...
- why not?
  - how about interfacing between different ambient systems?....
..what is missing?

- ...there is a big gap between the first meaning (device, measurement) and the second (awareness, understanding)
- ..and that gap (or the infrastructure needed to bridge that gap) is what sensor data management is all about..