Sensor Network Applications: From Technology Drivers to Scenarios and Systems

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Presentation Outlook

❖ Motivation
  ■ Technological Advances
  ■ Applications Demands
❖ Application Overview and Classification
  ■ Application Requirements
  ■ Application Domains
❖ The Road Ahead - Challenges
Motivation

Enabling Technologies

Moore's Law

- Disk capacity: 2000x
- CPU speed: 200x
- Available RAM: 110x
- Wireless transfer speed: 11x
- Battery energy density: 2x
Enabling Technologies: Wireless Communication

Sensor Network Applications

Enabling Technology: Digitizing media

Your personal entertainment center
Enabling Technology: Digitizing the world

- embedding IT in objects of every day use

IO-Brush, H. Ishii 2004
Mirror TV, Philips

Technology vs Application Drivers

content and services

enabling

Setting requirements

devices and infrastructure
CRUISE achievements in the domain of Applications and Applications Scenarios:

- The framework of defining an application scenario
- In total twelve main scenarios were defined in according to the proposed framework
- This input served as context for focused comparisons of different technologies in the work of the research clusters
- A set of scenarios were described in a form which can be inputs for simulations and testbed studies
- The compatibility of HHA and scenarios was checked for all the CRUISE main application scenario and three e-SENSE representative scenarios.
- Research challenges related to Application scenarios in general and for HHA were identified.
- A set of common simulation parameters were identified.
Categorization of the application areas

Classification by purpose
- As a research instrument ("macroscope")
  - Habitat Monitoring
  - Environment Monitoring
- As a diagnostics system
  - Monitoring of body functions
- As a surveillance system
  - Home monitoring
  - Military exploration

Classification by sector
- Industry
- Retail
- Agriculture
- Medicine, Health Care
- Military
- Arts

Applications and Scenarios
- Forest Fire Detection
- Flood Detection
- Monitoring Biodiversity
- Habitat Monitoring
- Smart Homes
- Target Tracking
- Environmental Protection
- Warehouse Tracking
- Structural Integrity Monitoring
Petrel Monitoring

- Goal: ecological model for breeding preferences of the “Leach’s Storm Petrel”
  - Nest occupancy
  - Climate conditions of occupied / empty caves
  - Environmental conditions during the breeding period
- “decent” observation
  - Reduction of the “observer effect”
- Challenges
  - Calibration, casing

Cane Toad observation

- Sensornet for the observation of the spreading of Cane Toads
  - Recognition and differentiation by analyzing the quacking
- Challenges
  - High data rates, complex calculations
Summary of Application Demands / Challenges

- **Power efficiency**
  - High durability
- **Restricted resources**
  - Memory, processor, communication bandwidth
- **Robustness, reliability**
  - Node failure
  - Communication errors
- **Autonomy**
  - Without human intervention
  - Self-configurability
- **Further**
  - Costs, calibration, scalability, ...
Summary of Research Issues

Technical Issues
- Architecture, topology, transmission, mobility
- Data Fusion and Aggregation, meaningful interpretation
- Security

Organisational Issues
- Deployment, De/Installation, Environmental Issues

Economic Issues
- Business Models

Legal Issues
- Ownership, right to use data, privacy, …

Societal Issues
- New forms of digital divide

What does the future bring ...

Research perspective
- Better algorithms, architectures and systems
- Extended view to a sensor network: actors, mobile nodes, …

User perspective
- What is missing in order to make sensor networks applicable for everyday usage?

Business perspective
- Killer applications?
- Can you make money with sensor networks?
Obstacles on the way ...

- Programming is complicating
  - Restricted resources and power
  - Dynamic distributed system
  - Node failures
  - Broken connections
  - ...
- Installation in the real world is difficult
  - "in the lab it worked without problems using 10 nodes but on the glacier with 200 nodes it does not"
  - Sensor network debugger?

Thank you!

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